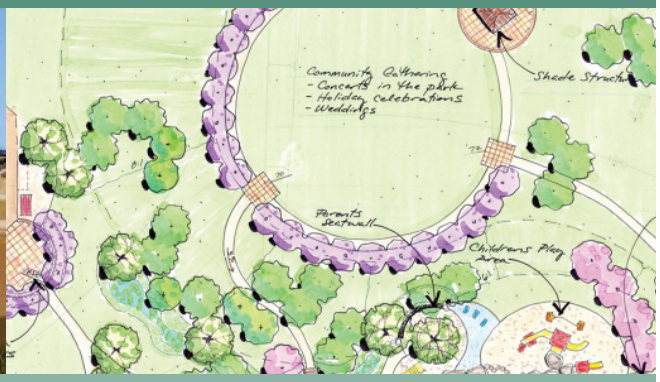
VOLUME V

Technical Appendices

Draft Environmental Impact Report

TR 060922
CUP No. 04-075
Oak Tree Permit No. 04-075

Skyline Ranch Project



County Project No. 04-075
State Clearinghouse No. 2004101090

County of Los Angeles
Department of Regional Planning
Impact Analysis Section
320 West Temple Street
Los Angeles, California 90012-3225

July 2009

VOLUME V

Technical Appendices
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Skyline Ranch Project

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PCR

TABLE OF CONTENTS

VOLUME I

Page

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1

2.0 PROJECT DESCRIPTION 2-1

3.0 CUMULATIVE IMPACT ANALYSIS METHODOLOGY 3-1

4.0 ENVIRONMENTAL IMPACT ANALYSIS 4-1

A. Geotechnical Resources 4.A-1
B. Hydrology and Water Quality 4.B-1
C. Biological Resources 4.C-1
D. Cultural and Paleontological Resources 4.D-1
E. Visual Qualities 4.E-1
F. Traffic/Access 4.F-1
G. Noise 4.G-1
H. Air Quality 4.H-1
I. Water Resources 4.I-1
J. Wastewater Disposal 4.J-1
K. Solid Waste Disposal 4.K-1
L. Law Enforcement Services 4.L-1
M. Fire Services and Hazards 4.M-1
N. Education 4.N-1
O. Libraries 4.O-1
P. Parks 4.P-1
Q. Land Use 4.Q-1
R. Population, Housing and Employment 4.R-1
S. Global Climate Change 4.S-1

5.0 ALTERNATIVES 5-1

A. Introduction 5-1
B. No Project/No Development Alternative 5-8
C. Reasonably Foreseeable On-Site Development Alternative 5-16
D. Reduced Project A: 800-Residential Lot Alternative 5-30
E. Reduced Project B: 935-Residential Lot Alternative 5-45
F. Comparison of Alternatives and Identification of the Environmentally Superior Alternative 5-58

TABLE OF CONTENTS (CONTINUED)

Page

6.0 OTHER CEQA CONSIDERATIONS 6-1

7.0 LIST OF EIR PREPARERS AND ORGANIZATIONS AND PERSONS CONSULTED 7-1

8.0 REFERENCES 8-1

APPENDICES

VOLUME I

APPENDIX A: NOTICE OF PREPARATION, INITIAL STUDY, AND COMMENT LETTERS; SCOPING MEETING MATERIALS

VOLUME II

APPENDIX B: GEOTECHNICAL REPORTS

VOLUME III

APPENDIX C: HYDROLOGY AND WATER QUALITY TECHNICAL REPORTS

C-1 Hydrology/SUSMP Report
C-2 Flood Plain Analysis
C-3 Water Quality Technical Report
C-4 LID Standards Ordinance Exemption Determination

VOLUME IV

APPENDIX D: BIOLOGICAL RESOURCES TECHNICAL REPORTS

D-1 Biological Resources Assessment
D-2 Conceptual Habitat Mitigation and Monitoring Plan for Impacts to Areas within the Jurisdiction of the U. S. Army Corps of Engineers and the California Department of Fish and Game
D-3 On-Site Jurisdictional Delineation
D-4 Off-Site Jurisdictional Delineation

TABLE OF CONTENTS (CONTINUED)

APPENDIX E: CULTURAL AND PALEONTOLOGICAL RESOURCES REPORTS
E-1 Cultural and Paleontological Resources Assessment
E-2 Addendum Report for Off-Site Storm Drain and Channel

APPENDIX F: TRAFFIC IMPACT ANALYSIS

APPENDIX G: NOISE MODELING WORKSHEETS AND NOISE BARRIER LOCATIONS

VOLUME V

APPENDIX H: AIR QUALITY TECHNICAL APPENDIX
H-1 Project Construction Emissions
H-2 SCAQMD Rule 403
H-3 Project Operation Emissions

APPENDIX I: WATER RESOURCES
I-1 Water Resources Technical Report
I-2 Water Supply Assessment
I-3 Santa Clarita Water Division Correspondence

APPENDIX J: SEWER AREA STUDY REPORT

APPENDIX K: GLOBAL CLIMATE CHANGE
K-1 Construction Greenhouse Gas Emissions
K-2 Operational Greenhouse Gas Emissions
K-3 Greenhouse Gas Reference Material

Appendix H: Air Quality Technical Appendix

Skyline Ranch

Draft Environmental Impact Report
Appendix H

Air Quality Assessment Files

Provided by PCR Services Corporation

May 2009

- H-1 Project Construction Emissions
- H-2 SCAQMD Rule 403 (Fugitive Dust) Control Requirements
- H-3 Project Operation Emissions

Appendix H-1

- Construction Emissions Schedule and Inventory

Note: Dates used in these analyses represent the earliest estimated start date and are based on the best information available at the time the study was initiated. The results of these analyses represent the "worst-case" scenario and are conservative, since emission factors and profiles typically improve with time.

- Regional Construction Emissions
  - URBEMIS2007 Output Files
  - Daily Emissions Summary (All Projects)
- Rock Crushing Emissions
- Scalar (CO & NOx) Calculation Sheet
- Local Construction Emissions
  - Contour Plots (Industrial Source Complex)
    - PM_{10} Maximum 24-hr Construction: Site Preparation – Unmitigated & Mitigated
    - $PM_{2.5}$ Maximum 24-hr Construction: Site Preparation – Unmitigated & Mitigated
    - Scalar (CO & NOx) Maximum 1-hr Construction: Site Preparation
    - Scalar (CO & NOx) Maximum 8-hr Construction: Site Preparation
    - Health Risk Assessment Diesel PM_{10} Maximum Annual Construction
- Diesel Particulate Matter (DPM) Health Risk Assessment Summary (HRA

Skyline Ranch
Construction Emissions
(lbs/day)

		Year	2008			2009											
Pollutant	On/Off Site	Month	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
CO	Localized		439.1	439.1	439.1	408.8	408.8	408.8	408.8	408.8	408.8	408.8	408.8	408.8	20.8	20.8	20.8
	Regional		463.3	463.3	463.3	431.4	431.4	431.4	431.4	431.4	431.4	431.4	431.4	431.4	29.1	29.1	43.3
NOx	Localized		988.8	988.8	988.8	940.8	940.8	940.8	940.8	940.8	940.8	940.8	940.8	940.8	40.3	40.3	40.3
	Regional		1004.8	1004.8	1004.8	955.9	955.9	955.9	955.9	955.9	955.9	955.9	955.9	955.9	54.5	54.5	80.6
PM10	Localized		4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	4799.7	2.5	2.5	2.5
	Regional		4841.1	4841.1	4841.1	4839.1	4839.1	4839.1	4839.1	4839.1	4839.1	4839.1	4839.1	4839.1	3.2	3.2	5.0
PM2.5	Localized		1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	1002.4	2.3	2.3	2.3
	Regional		1040.3	1040.3	1040.3	1038.5	1038.5	1038.5	1038.5	1038.5	1038.5	1038.5	1038.5	1038.5	2.9	2.9	4.5
ROG	Localized		103.9	103.9	103.9	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	5.5	5.5	5.5
	Regional		105.7	105.7	105.7	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	6.7	6.7	11.7
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		Year	2010											
Pollutant	On/Off Site	Month	1	2	3	4	5	6	7	8	9	10	11	12
CO	Localized		20.1	20.1	20.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.1
	Regional		41.3	41.3	41.3	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	280.9
NOx	Localized		38.2	38.2	38.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.8
	Regional		75.6	75.6	75.6	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	140.5
PM10	Localized		2.4	2.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1
	Regional		4.7	4.7	4.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	8.7
PM2.5	Localized		2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
	Regional		4.3	4.3	4.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.2
ROG	Localized		5.2	5.2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6
	Regional		11.1	11.1	11.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	32.4
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3

		Year	2011											
Pollutant	On/Off Site	Month	1	2	3	4	5	6	7	8	9	11	11	12
CO	Localized		38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	277.5	277.5	277.5
	Regional		262.8	262.8	262.8	262.8	262.8	262.8	262.8	262.8	262.8	551.0	551.0	551.0
NOx	Localized		65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	639.0	639.0	639.0
	Regional		129.9	129.9	129.9	129.9	129.9	129.9	129.9	129.9	129.9	769.5	769.5	769.5
PM10	Localized		3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	2096.3	2096.3	2096.3
	Regional		8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	2129.9	2129.9	2129.9
PM2.5	Localized		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	437.8	437.8	437.8
	Regional		6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	467.8	467.8	467.8
ROG	Localized		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	69.0	69.0	69.0
	Regional		30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	100.1	100.1	100.1
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4

Skyline Ranch
Construction Emissions
(lbs/day)

		Year	2012											
Pollutant	On/Off Site	Month	1	2	3	4	5	6	7	8	9	10	11	12
CO	Localized		259.9	259.9	259.9	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2
	Regional		515.7	515.7	515.7	266.7	266.7	266.7	266.7	256.1	256.1	256.1	245.8	245.8
NOx	Localized		598.6	598.6	598.6	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
	Regional		718.9	718.9	718.9	153.7	153.7	153.7	153.7	135.3	135.3	135.3	119.7	119.7
PM10	Localized		2096.3	2096.3	2096.3	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	Regional		2127.7	2127.7	2127.7	9.7	9.7	9.7	9.7	8.9	8.9	8.9	7.7	7.7
PM2.5	Localized		437.8	437.8	437.8	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
	Regional		465.7	465.7	465.7	8.1	8.1	8.1	8.1	7.3	7.3	7.3	6.2	6.2
ROG	Localized		65.8	65.8	65.8	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
	Regional		95.2	95.2	95.2	33.8	33.8	33.8	33.8	32.0	32.0	32.0	29.2	29.2
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

		Year	2013											
Pollutant	On/Off Site	Month	1	2	3	4	5	6	7	8	9	10	11	12
CO	Localized		35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8
	Regional		229.6	229.6	229.6	229.6	229.6	229.6	229.6	229.6	229.6	229.6	229.6	229.6
NOx	Localized		57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8	57.8
	Regional		109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
PM10	Localized		3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
	Regional		7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
PM2.5	Localized		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Regional		5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
ROG	Localized		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
	Regional		27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

		Year	2014											
Pollutant	On/Off Site	Month	1	2	3	4	5	6	7	8	9	10	11	12
CO	Localized		34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7
	Regional		215.1	215.1	215.1	215.1	215.1	215.1	215.1	215.1	215.1	215.1	215.1	215.1
NOx	Localized		54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
	Regional		100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2
PM10	Localized		2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
	Regional		6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
PM2.5	Localized		2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Regional		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ROG	Localized		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
	Regional		26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Skyline Ranch
Construction Emissions
(lbs/day)

		Year	2015											
Pollutant	**On/Off Site**	**Month**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO	Localized		33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6
	Regional		201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3	201.3
NOx	Localized		50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Regional		90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8
PM10	Localized		2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	Regional		6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
PM2.5	Localized		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Regional		4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
ROG	Localized		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
	Regional		25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

		Year	2016												Max
Pollutant	**On/Off Site**	**Month**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**(lbs/day)**
CO	Localized		32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	439.1
	Regional		189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	189.3	463.3
NOx	Localized		46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	988.8
	Regional		82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	1004.8
PM10	Localized		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4799.7
	Regional		5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	4841.1
PM2.5	Localized		2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1002.4
	Regional		4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	1040.3
ROG	Localized		10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	103.9
	Regional		24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	105.7
SO2	Localized		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Regional		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.0

Urbemis 2007 Version 9.2.0

Detail Report for Summer Construction Mitigated Emissions (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Construction\Revised 090507\Construction (090507).urb9

Project Name: Skyline Ranch - Construction

Project Location: Los Angeles County

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Summer Pounds Per Day, Mitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
Time Slice 10/1/2008-12/31/2008 Number Active Days: 66	**105.71**	**1,004.84**	463.30	0.03	4,799.89	**41.21**	4,841.10	1,002.43	**37.91**	1,040.34	85,265.53
Mass Grading 10/01/2008-09/30/2009	104.53	989.88	457.14	0.02	4,799.83	40.53	4,840.36	1,002.41	37.28	1,039.69	83,550.48
Mass Grading 10/01/2008-12/31/2016	1.18	14.97	6.16	0.02	0.06	0.68	0.73	0.02	0.62	0.64	1,715.05
Time Slice 1/1/2009-9/30/2009 Number Active Days: 195	101.49	955.88	431.36	0.03	4,799.89	39.20	4,839.09	1,002.43	36.06	1,038.49	85,264.63
Mass Grading 10/01/2008-09/30/2009	100.38	941.80	425.68	0.02	4,799.83	38.59	4,838.42	1,002.41	35.50	1,037.91	83,549.59
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Time Slice 10/1/2009-11/30/2009 Number Active Days: 43	6.67	54.50	29.09	0.02	0.07	3.13	3.20	0.02	2.88	2.90	5,240.00
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Trenching 10/01/2009-03/31/2010	5.56	40.43	23.41	0.00	0.01	2.52	2.53	0.00	2.32	2.32	3,524.95
Time Slice 12/1/2009-12/31/2009 Number Active Days: 23	11.66	80.64	43.33	0.03	0.12	4.89	5.02	0.04	4.50	4.54	7,866.24
Asphalt 12/01/2009-03/31/2010	4.99	26.13	14.24	0.01	0.05	1.76	1.82	0.02	1.62	1.64	2,626.24
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Trenching 10/01/2009-03/31/2010	5.56	40.43	23.41	0.00	0.01	2.52	2.53	0.00	2.32	2.32	3,524.95
Time Slice 1/1/2010-3/31/2010 Number Active Days: 64	11.05	75.61	41.33	0.03	0.12	4.58	4.71	0.04	4.22	4.26	7,866.08
Asphalt 12/01/2009-03/31/2010	4.78	24.44	13.64	0.01	0.05	1.67	1.73	0.02	1.54	1.56	2,626.17
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Trenching 10/01/2009-03/31/2010	5.24	38.32	22.51	0.00	0.01	2.36	2.38	0.00	2.17	2.18	3,524.86
Time Slice 4/1/2010-11/30/2010 Number Active Days: 174	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Time Slice 12/1/2010-12/31/2010 Number Active Days: 23	32.37	140.46	280.90	0.34	1.43	7.27	8.70	0.51	6.64	7.15	39,282.43
Building 12/01/2010-12/31/2016	20.74	127.58	275.19	0.32	1.37	6.72	8.10	0.49	6.14	6.63	37,506.98
Coating 12/01/2010-12/31/2016	10.59	0.03	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.41
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Time Slice 1/3/2011-9/30/2011 Number Active Days: 195	30.72	129.90	262.83	0.34	1.43	6.75	8.18	0.51	6.16	6.66	39,277.72
Building 12/01/2010-12/31/2016	19.17	118.27	257.65	0.32	1.37	6.26	7.63	0.49	5.71	6.20	37,502.27
Coating 12/01/2010-12/31/2016	10.59	0.03	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.40
Mass Grading 10/01/2008-12/31/2016	0.95	11.60	4.68	0.02	0.06	0.48	0.54	0.02	0.44	0.46	1,715.05

Skyline Ranch - Construction
URBEMIS Output (Unmitigated)

Time Slice 10/3/2011-12/30/2011 Number Active Days: 65	100.08	769.53	**550.98**	**0.35**	2,097.79	32.14	2,129.93	438.32	29.51	467.83	**103,062.33**
Building 12/01/2010-12/31/2016	19.17	118.27	257.65	0.32	1.37	6.26	7.63	0.49	5.71	6.20	37,502.27
Coating 12/01/2010-12/31/2016	10.59	0.03	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.40
Mass Grading 10/01/2008-12/31/2016	0.95	11.60	4.68	0.02	0.06	0.48	0.54	0.02	0.44	0.46	1,715.05
Mass Grading 10/01/2011-03/31/2012	69.36	639.63	288.15	0.01	2,096.36	25.39	2,121.75	437.81	23.36	461.17	63,784.62
Time Slice 1/2/2012-3/30/2012 Number Active Days: 65	95.24	718.88	515.67	**0.35**	2,097.79	29.86	2,127.65	438.32	27.42	465.74	103,058.11
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Mass Grading 10/01/2011-03/31/2012	66.07	599.16	269.82	0.01	2,096.36	23.64	2,120.00	437.81	21.74	459.56	63,784.39
Time Slice 4/2/2012-4/30/2012 Number Active Days: 21	29.17	119.72	245.85	0.34	1.43	6.22	7.65	0.51	5.67	6.18	39,273.73
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 5/1/2012-7/31/2012 Number Active Days: 66	33.84	153.74	266.68	0.34	1.45	8.30	9.74	0.51	7.58	8.10	42,798.48
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Trenching 05/01/2012-07/31/2012	4.66	34.02	20.83	0.00	0.01	2.08	2.09	0.00	1.91	1.91	3,524.75
Time Slice 8/1/2012-10/31/2012 Number Active Days: 66	32.04	135.26	256.08	0.34	1.46	7.45	8.91	0.52	6.80	7.32	40,976.84
Asphalt 08/01/2012-10/31/2012	2.86	15.54	10.23	0.01	0.02	1.23	1.25	0.01	1.13	1.14	1,703.11
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 11/1/2012-12/31/2012 Number Active Days: 43	29.17	119.72	245.85	0.34	1.43	6.22	7.65	0.51	5.67	6.18	39,273.73
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 1/1/2013-12/31/2013 Number Active Days: 261	27.78	109.85	229.61	0.34	1.43	5.64	7.08	0.51	5.14	5.65	39,271.01
Building 12/01/2010-12/31/2016	16.40	100.64	225.46	0.32	1.37	5.27	6.65	0.49	4.80	5.29	37,495.59
Coating 12/01/2010-12/31/2016	10.59	0.02	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.38
Mass Grading 10/01/2008-12/31/2016	0.79	9.18	3.72	0.02	0.06	0.37	0.42	0.02	0.34	0.36	1,715.05
Time Slice 1/1/2014-12/31/2014 Number Active Days: 261	26.41	100.22	215.06	0.34	1.43	5.13	6.57	0.51	4.67	5.18	39,268.71
Building 12/01/2010-12/31/2016	15.11	92.13	211.38	0.32	1.37	4.82	6.19	0.49	4.38	4.87	37,493.29
Coating 12/01/2010-12/31/2016	10.59	0.02	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.37
Mass Grading 10/01/2008-12/31/2016	0.71	8.06	3.27	0.02	0.06	0.32	0.37	0.02	0.29	0.31	1,715.05
Time Slice 1/1/2015-12/31/2015 Number Active Days: 261	25.13	90.81	201.33	0.34	1.43	4.66	6.09	0.51	4.23	4.74	39,266.96
Building 12/01/2010-12/31/2016	13.91	83.75	198.09	0.32	1.37	4.39	5.76	0.49	3.98	4.47	37,491.54
Coating 12/01/2010-12/31/2016	10.59	0.02	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.37
Mass Grading 10/01/2008-12/31/2016	0.64	7.04	2.87	0.02	0.06	0.27	0.33	0.02	0.25	0.27	1,715.05
Time Slice 1/1/2016-12/30/2016 Number Active Days: 261	23.96	82.83	189.33	0.34	1.43	4.34	5.77	0.51	3.94	4.44	39,264.48
Building 12/01/2010-12/31/2016	12.79	76.58	186.43	0.32	1.37	4.10	5.48	0.49	3.72	4.21	37,489.07
Coating 12/01/2010-12/31/2016	10.59	0.02	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.36
Mass Grading 10/01/2008-12/31/2016	0.58	6.23	2.55	0.02	0.06	0.23	0.29	0.02	0.21	0.23	1,715.05

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Mass Grading 10/1/2008 - 9/30/2009 - Phase 1 Grading
For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:
PM10: 55% PM25: 55%
The following mitigation measures apply to Phase: Mass Grading 10/1/2011 - 3/31/2012 - Phase 2 Grading
For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:
PM10: 55% PM25: 55%

Phase Assumptions

Phase: Mass Grading 10/1/2008 - 12/31/2016 - Additional Truck Trips (Concrete/Haul/Deliveries)
Total Acres Disturbed: 423.33
Maximum Daily Acreage Disturbed: 105.83
Fugitive Dust Level of Detail: Default
0 lbs per acre-day
On Road Truck Travel (VMT): 404.64
Off-Road Equipment:

Phase: Mass Grading 10/1/2008 - 9/30/2009 - Phase 1 Grading
Total Acres Disturbed: 514.39
Maximum Daily Acreage Disturbed: 51.4
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 67573 cubic yards/day; Offsite Cut/Fill: 0 cubic yards/day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
5 Graders (174 hp) operating at a 0.61 load factor for 10 hours per day
10 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 10 hours per day
8 Other Material Handling Equipment (191 hp) operating at a 0.59 load factor for 10 hours per day
8 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 10 hours per day
24 Scrapers (313 hp) operating at a 0.72 load factor for 10 hours per day
3 Water Trucks (189 hp) operating at a 0.5 load factor for 10 hours per day

Phase: Mass Grading 10/1/2011 - 3/31/2012 - Phase 2 Grading
Total Acres Disturbed: 122
Maximum Daily Acreage Disturbed: 31
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 28788 cubic yards/day; Offsite Cut/Fill: 0 cubic yards/day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
4 Graders (174 hp) operating at a 0.61 load factor for 10 hours per day
5 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 10 hours per day
4 Other Material Handling Equipment (191 hp) operating at a 0.59 load factor for 10 hours per day
6 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 10 hours per day
20 Scrapers (313 hp) operating at a 0.72 load factor for 10 hours per day
3 Water Trucks (189 hp) operating at a 0.5 load factor for 10 hours per day

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Phase: Trenching 10/1/2009 - 3/31/2010 - Phase 1 Infrastructure Improvements
Off-Road Equipment:
3 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day
2 Trenchers (63 hp) operating at a 0.75 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Trenching 5/1/2012 - 7/31/2012 - Phase 2 Infrastructure Improvements
Off-Road Equipment:
3 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day
2 Trenchers (63 hp) operating at a 0.75 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Paving 12/1/2009 - 3/31/2010 - Phase 1 Paving
Acres to be Paved: 51.4
Off-Road Equipment:
2 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

Phase: Paving 8/1/2012 - 10/31/2012 - Phase 2 Paving
Acres to be Paved: 12.2
Off-Road Equipment:
2 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

Phase: Building Construction 12/1/2010 - 12/31/2016 - Building Construction
Off-Road Equipment:
1 Aerial Lifts (60 hp) operating at a 0.46 load factor for 8 hours per day
1 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Generator Sets (49 hp) operating at a 0.74 load factor for 8 hours per day
1 Other Equipment (190 hp) operating at a 0.62 load factor for 8 hours per day
2 Rough Terrain Forklifts (93 hp) operating at a 0.6 load factor for 8 hours per day
2 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day
1 Skid Steer Loaders (44 hp) operating at a 0.55 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Phase: Architectural Coating 12/1/2010 - 12/31/2016 - Architectural Coatings
Rule: Residential Interior Coatings begins 1/1/2005 ends 6/30/2008 specifies a VOC of 100
Rule: Residential Interior Coatings begins 7/1/2008 ends 12/31/2040 specifies a VOC of 50
Rule: Residential Exterior Coatings begins 1/1/2005 ends 6/30/2008 specifies a VOC of 250
Rule: Residential Exterior Coatings begins 7/1/2008 ends 12/31/2040 specifies a VOC of 100
Rule: Nonresidential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250
Rule: Nonresidential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Skyline Ranch - Construction
URBEMIS Output (Mitigated)

Urbemis 2007 Version 9.2.0

Detail Report for Summer Construction Mitigated Emissions (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Construction\Revised 090507\Construction (090507) - Mitigated.urb9

Project Name: Skyline Ranch - Construction

Project Location: Los Angeles County

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Summer Pounds Per Day, Mitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
Time Slice 10/1/2008-12/31/2008 Number Active Days: 66	**105.71**	**1,004.84**	463.30	0.03	4,397.58	**41.21**	4,438.78	918.41	**37.91**	956.32	85,265.53
Mass Grading 10/01/2008-09/30/2009	104.53	989.88	457.14	0.02	4,397.52	40.53	4,438.05	918.39	37.28	955.68	83,550.48
Mass Grading 10/01/2008-12/31/2016	1.18	14.97	6.16	0.02	0.06	0.68	0.73	0.02	0.62	0.64	1,715.05
Time Slice 1/1/2009-9/30/2009 Number Active Days: 195	101.49	955.88	431.36	0.03	4,397.58	39.20	4,436.78	918.41	36.06	954.47	85,264.63
Mass Grading 10/01/2008-09/30/2009	100.38	941.80	425.68	0.02	4,397.52	38.59	4,436.11	918.39	35.50	953.89	83,549.59
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Time Slice 10/1/2009-11/30/2009 Number Active Days: 43	6.67	54.50	29.09	0.02	0.07	3.13	3.20	0.02	2.88	2.90	5,240.00
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Trenching 10/01/2009-03/31/2010	5.56	40.43	23.41	0.00	0.01	2.52	2.53	0.00	2.32	2.32	3,524.95
Time Slice 12/1/2009-12/31/2009 Number Active Days: 23	11.66	80.64	43.33	0.03	0.12	4.89	5.02	0.04	4.50	4.54	7,866.24
Asphalt 12/01/2009-03/31/2010	4.99	26.13	14.24	0.01	0.05	1.76	1.82	0.02	1.62	1.64	2,626.24
Mass Grading 10/01/2008-12/31/2016	1.11	14.08	5.68	0.02	0.06	0.61	0.67	0.02	0.56	0.58	1,715.05
Trenching 10/01/2009-03/31/2010	5.56	40.43	23.41	0.00	0.01	2.52	2.53	0.00	2.32	2.32	3,524.95
Time Slice 1/1/2010-3/31/2010 Number Active Days: 64	11.05	75.61	41.33	0.03	0.12	4.58	4.71	0.04	4.22	4.26	7,866.08
Asphalt 12/01/2009-03/31/2010	4.78	24.44	13.64	0.01	0.05	1.67	1.73	0.02	1.54	1.56	2,626.17
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Trenching 10/01/2009-03/31/2010	5.24	38.32	22.51	0.00	0.01	2.36	2.38	0.00	2.17	2.18	3,524.86
Time Slice 4/1/2010-11/30/2010 Number Active Days: 174	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Time Slice 12/1/2010-12/31/2010 Number Active Days: 23	32.37	140.46	280.90	0.34	1.43	7.27	8.70	0.51	6.64	7.15	39,282.43
Building 12/01/2010-12/31/2016	20.74	127.58	275.19	0.32	1.37	6.72	8.10	0.49	6.14	6.63	37,506.98
Coating 12/01/2010-12/31/2016	10.59	0.03	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.41
Mass Grading 10/01/2008-12/31/2016	1.03	12.85	5.18	0.02	0.06	0.55	0.60	0.02	0.50	0.52	1,715.05
Time Slice 1/3/2011-9/30/2011 Number Active Days: 195	30.72	129.90	262.83	0.34	1.43	6.75	8.18	0.51	6.16	6.66	39,277.72
Building 12/01/2010-12/31/2016	19.17	118.27	257.65	0.32	1.37	6.26	7.63	0.49	5.71	6.20	37,502.27
Coating 12/01/2010-12/31/2016	10.59	0.03	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.40
Mass Grading 10/01/2008-12/31/2016	0.95	11.60	4.68	0.02	0.06	0.48	0.54	0.02	0.44	0.46	1,715.05

Skyline Ranch - Construction
URBEMIS Output (Mitigated)

Time Slice 10/3/2011-12/30/2011 Number Active Days: 65	100.08	769.53	**550.98**	**0.35**	2,097.79	32.14	2,129.93	438.32	29.51	467.83	**103,062.33**
Building 12/01/2010-12/31/2016	19.17	118.27	257.65	0.32	1.37	6.26	7.63	0.49	5.71	6.20	37,502.27
Coating 12/01/2010-12/31/2016	10.59	0.03	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.40
Mass Grading 10/01/2008-12/31/2016	0.95	11.60	4.68	0.02	0.06	0.48	0.54	0.02	0.44	0.46	1,715.05
Mass Grading 10/01/2011-03/31/2012	69.36	639.63	288.15	0.01	2,096.36	25.39	2,121.75	437.81	23.36	461.17	63,784.62
Time Slice 1/2/2012-3/30/2012 Number Active Days: 65	95.24	718.88	515.67	**0.35**	2,097.79	29.86	2,127.65	438.32	27.42	465.74	103,058.11
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Mass Grading 10/01/2011-03/31/2012	66.07	599.16	269.82	0.01	2,096.36	23.64	2,120.00	437.81	21.74	459.56	63,784.39
Time Slice 4/2/2012-4/30/2012 Number Active Days: 21	29.17	119.72	245.85	0.34	1.43	6.22	7.65	0.51	5.67	6.18	39,273.73
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 5/1/2012-7/31/2012 Number Active Days: 66	33.84	153.74	266.68	0.34	1.45	8.30	9.74	0.51	7.58	8.10	42,798.48
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Trenching 05/01/2012-07/31/2012	4.66	34.02	20.83	0.00	0.01	2.08	2.09	0.00	1.91	1.91	3,524.75
Time Slice 8/1/2012-10/31/2012 Number Active Days: 66	32.04	135.26	256.08	0.34	1.46	7.45	8.91	0.52	6.80	7.32	40,976.84
Asphalt 08/01/2012-10/31/2012	2.86	15.54	10.23	0.01	0.02	1.23	1.25	0.01	1.13	1.14	1,703.11
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 11/1/2012-12/31/2012 Number Active Days: 43	29.17	119.72	245.85	0.34	1.43	6.22	7.65	0.51	5.67	6.18	39,273.73
Building 12/01/2010-12/31/2016	17.71	109.32	241.19	0.32	1.37	5.80	7.17	0.49	5.28	5.77	37,498.29
Coating 12/01/2010-12/31/2016	10.59	0.03	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.39
Mass Grading 10/01/2008-12/31/2016	0.87	10.37	4.19	0.02	0.06	0.42	0.48	0.02	0.39	0.41	1,715.05
Time Slice 1/1/2013-12/31/2013 Number Active Days: 261	27.78	109.85	229.61	0.34	1.43	5.64	7.08	0.51	5.14	5.65	39,271.01
Building 12/01/2010-12/31/2016	16.40	100.64	225.46	0.32	1.37	5.27	6.65	0.49	4.80	5.29	37,495.59
Coating 12/01/2010-12/31/2016	10.59	0.02	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.38
Mass Grading 10/01/2008-12/31/2016	0.79	9.18	3.72	0.02	0.06	0.37	0.42	0.02	0.34	0.36	1,715.05
Time Slice 1/1/2014-12/31/2014 Number Active Days: 261	26.41	100.22	215.06	0.34	1.43	5.13	6.57	0.51	4.67	5.18	39,268.71
Building 12/01/2010-12/31/2016	15.11	92.13	211.38	0.32	1.37	4.82	6.19	0.49	4.38	4.87	37,493.29
Coating 12/01/2010-12/31/2016	10.59	0.02	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.37
Mass Grading 10/01/2008-12/31/2016	0.71	8.06	3.27	0.02	0.06	0.32	0.37	0.02	0.29	0.31	1,715.05
Time Slice 1/1/2015-12/31/2015 Number Active Days: 261	25.13	90.81	201.33	0.34	1.43	4.66	6.09	0.51	4.23	4.74	39,266.96
Building 12/01/2010-12/31/2016	13.91	83.75	198.09	0.32	1.37	4.39	5.76	0.49	3.98	4.47	37,491.54
Coating 12/01/2010-12/31/2016	10.59	0.02	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.37
Mass Grading 10/01/2008-12/31/2016	0.64	7.04	2.87	0.02	0.06	0.27	0.33	0.02	0.25	0.27	1,715.05
Time Slice 1/1/2016-12/30/2016 Number Active Days: 261	23.96	82.83	189.33	0.34	1.43	4.34	5.77	0.51	3.94	4.44	39,264.48
Building 12/01/2010-12/31/2016	12.79	76.58	186.43	0.32	1.37	4.10	5.48	0.49	3.72	4.21	37,489.07
Coating 12/01/2010-12/31/2016	10.59	0.02	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.36
Mass Grading 10/01/2008-12/31/2016	0.58	6.23	2.55	0.02	0.06	0.23	0.29	0.02	0.21	0.23	1,715.05

Construction Related Mitigation Measures

The following mitigation measures apply to Phase: Mass Grading 10/1/2008 - 9/30/2009 - Phase 1 Grading
For Soil Stablizing Measures, the Water exposed surfaces 3x daily watering mitigation reduces emissions by:
PM10: 61% PM25: 61%
The following mitigation measures apply to Phase: Mass Grading 10/1/2011 - 3/31/2012 - Phase 2 Grading
For Soil Stablizing Measures, the Water exposed surfaces 2x daily watering mitigation reduces emissions by:
PM10: 55% PM25: 55%

Phase Assumptions

Phase: Mass Grading 10/1/2008 - 9/30/2009 - Phase 1 Grading
Total Acres Disturbed: 514.39
Maximum Daily Acreage Disturbed: 51.4
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 67573 cubic yards/day; Offsite Cut/Fill: 0 cubic yards/day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
5 Graders (174 hp) operating at a 0.61 load factor for 10 hours per day
10 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 10 hours per day
8 Other Material Handling Equipment (191 hp) operating at a 0.59 load factor for 10 hours per day
8 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 10 hours per day
24 Scrapers (313 hp) operating at a 0.72 load factor for 10 hours per day
3 Water Trucks (189 hp) operating at a 0.5 load factor for 10 hours per day

Phase: Mass Grading 10/1/2008 - 12/31/2016 - Additional Truck Trips (Concrete/Haul/Deliveries)
Total Acres Disturbed: 423.33
Maximum Daily Acreage Disturbed: 105.83
Fugitive Dust Level of Detail: Default
0 lbs per acre-day
On Road Truck Travel (VMT): 404.64
Off-Road Equipment:

Phase: Mass Grading 10/1/2011 - 3/31/2012 - Phase 2 Grading
Total Acres Disturbed: 122
Maximum Daily Acreage Disturbed: 31
Fugitive Dust Level of Detail: Low
Onsite Cut/Fill: 28788 cubic yards/day; Offsite Cut/Fill: 0 cubic yards/day
On Road Truck Travel (VMT): 0
Off-Road Equipment:
4 Graders (174 hp) operating at a 0.61 load factor for 10 hours per day
5 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 10 hours per day
4 Other Material Handling Equipment (191 hp) operating at a 0.59 load factor for 10 hours per day
6 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 10 hours per day
20 Scrapers (313 hp) operating at a 0.72 load factor for 10 hours per day
3 Water Trucks (189 hp) operating at a 0.5 load factor for 10 hours per day

Phase: Trenching 10/1/2009 - 3/31/2010 - Phase 1 Infrastructure Improvements
Off-Road Equipment:
3 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day
2 Trenchers (63 hp) operating at a 0.75 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

9/7/2007 05:52:53 PM

Phase: Trenching 5/1/2012 - 7/31/2012 - Phase 2 Infrastructure Improvements
Off-Road Equipment:
3 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 8 hours per day
2 Trenchers (63 hp) operating at a 0.75 load factor for 8 hours per day
1 Water Trucks (189 hp) operating at a 0.5 load factor for 8 hours per day

Phase: Paving 12/1/2009 - 3/31/2010 - Phase 1 Paving
Acres to be Paved: 51.4
Off-Road Equipment:
2 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

Phase: Paving 8/1/2012 - 10/31/2012 - Phase 2 Paving
Acres to be Paved: 12.2
Off-Road Equipment:
2 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Paving Equipment (104 hp) operating at a 0.53 load factor for 8 hours per day
2 Rollers (95 hp) operating at a 0.56 load factor for 6 hours per day

Phase: Building Construction 12/1/2010 - 12/31/2016 - Building Construction
Off-Road Equipment:
1 Aerial Lifts (60 hp) operating at a 0.46 load factor for 8 hours per day
1 Cement and Mortar Mixers (10 hp) operating at a 0.56 load factor for 8 hours per day
2 Generator Sets (49 hp) operating at a 0.74 load factor for 8 hours per day
1 Other Equipment (190 hp) operating at a 0.62 load factor for 8 hours per day
2 Rough Terrain Forklifts (93 hp) operating at a 0.6 load factor for 8 hours per day
2 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 8 hours per day
2 Rubber Tired Loaders (164 hp) operating at a 0.54 load factor for 8 hours per day
1 Skid Steer Loaders (44 hp) operating at a 0.55 load factor for 8 hours per day
2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 7 hours per day

Phase: Architectural Coating 12/1/2010 - 12/31/2016 - Architectural Coatings
Rule: Residential Interior Coatings begins 1/1/2005 ends 6/30/2008 specifies a VOC of 100
Rule: Residential Interior Coatings begins 7/1/2008 ends 12/31/2040 specifies a VOC of 50
Rule: Residential Exterior Coatings begins 1/1/2005 ends 6/30/2008 specifies a VOC of 250
Rule: Residential Exterior Coatings begins 7/1/2008 ends 12/31/2040 specifies a VOC of 100
Rule: Nonresidential Interior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250
Rule: Nonresidential Exterior Coatings begins 1/1/2005 ends 12/31/2040 specifies a VOC of 250

Rock Crushing Emission Calculations[1]

	PM10	PM2.5
Dry Primary Crushing EF (lbs/ton)	0.017	0.005
Tertiary Crushing EF (lbs/ton)	0.112	0.035
Rock Crushing Throughput (CY/day)	300	300
Material Density (tons/CY)[2]	1.3	1.3
Rock Crushing Throughput (ton/day)	390	390
Rock Crushing Emissions (lbs/day)	50.31	15.6
Rock Crushing Control Efficiency (%)[3]	99%	99%
Screening + Rock Crushing Emissions (lbs/day) - Controlled	0.50	0.16

[1]Mojave Desert Air Quality Management District Emissions Inventory Guidance - Mineral Handling and Processing Industries, April 2000

[2]http://www.ciwmb.ca.gov/leatraining/resources/cdi/tools/calculations.htm (Gravel or Crushed Stone)

[3]SCAQMD Rule 2100 requires dust collection equipment to have a minimum particulate matter control efficiency of 99%

Skyline Ranch - Pardee
CO and NOx Scalar
ISC Input and Output Values

		Residential		School		Hotel
	Maximum	West	South	Leona Cox Community School	Santa Clarita Little People Daycare	Travelodge
Scalar Emissions						
Emission Rate grams/sec (10 hr day)	1.00	1.00	1.00	1.00	1.00	1.00
Concentrations (ug/m^3)						
1-hr	40.02	23.68	11.26	15.39	8.22	6.06
8-hr	7.40	5.91	4.96	5.62	2.49	2.86

		Residential		School		Hotel
	Maximum	West	South	Leona Cox Community School	Santa Clarita Little People Daycare	Travelodge
Site Grading Activities						
NOx						
1-hr Concentration (ug/m^3)	499	295	140	192	103	76
1-hr Concentration (ppm)	0.03	0.02	0.01	0.01	0.01	0.00
CO						
1-hr Concentration (ug/m^3)	222	131	62	85	46	34
1-hr Concentration (ppm)	**0.19**	**0.11**	**0.05**	**0.07**	**0.04**	**0.03**
8-hr Concentration (ug/m3)	41	33	27	31	14	16
8-hr Concentration (ppm)	**0.04**	**0.03**	**0.02**	**0.03**	**0.01**	**0.01**

		Residential		School		Hotel
	Maximum	West	South	Leona Cox Community School	Santa Clarita Little People Daycare	Travelodge
Construction Activities						
NOx						
1-hr Concentration (ug/m^3)	511	28	24	27	12	14
1-hr Concentration (ppm)	0.03	0.00	0.00	0.00	0.00	0.00
CO						
1-hr Concentration (ug/m^3)	227	17	14	16	7	8
1-hr Concentration (ppm)	**0.20**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
8-hr Concentration (ug/m3)	0	0	0	0	0	0
8-hr Concentration (ppm)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Emissions - Site Grading	NOx	CO
lbs/day	**989**	**439**
grams/day	449006	199306
grams/sec (10 hr day)	12.47	5.54

Emissions - Construction	NOx	CO
lbs/day	**69**	**40**
grams/day	31326	18160
grams/sec (10 hr day)	0.87	0.50

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 24-hr Max PM10 Site Preparation Phase (Unmitigated)	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:18,898 0 0.5 km	
	MAX: **170.33125 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 24-hr Max PM10 Site Preparation Phase (Mitigated)	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:18,898 0 0.5 km	
	MAX: **156.17671 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 24-hr Max PM2.5 Site Preparation Phase (Unmitigated)	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:18,898 0 0.5 km	
	MAX: **36.56652 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 24-hr Max PM2.5 Site Preparation Phase (Mitigated)	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:18,898 0 0.5 km	
	MAX: **33.61113 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 1-hr Max Scalar Exhaust Only	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:18,898 0 0.5 km	
	MAX: **40.01599 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

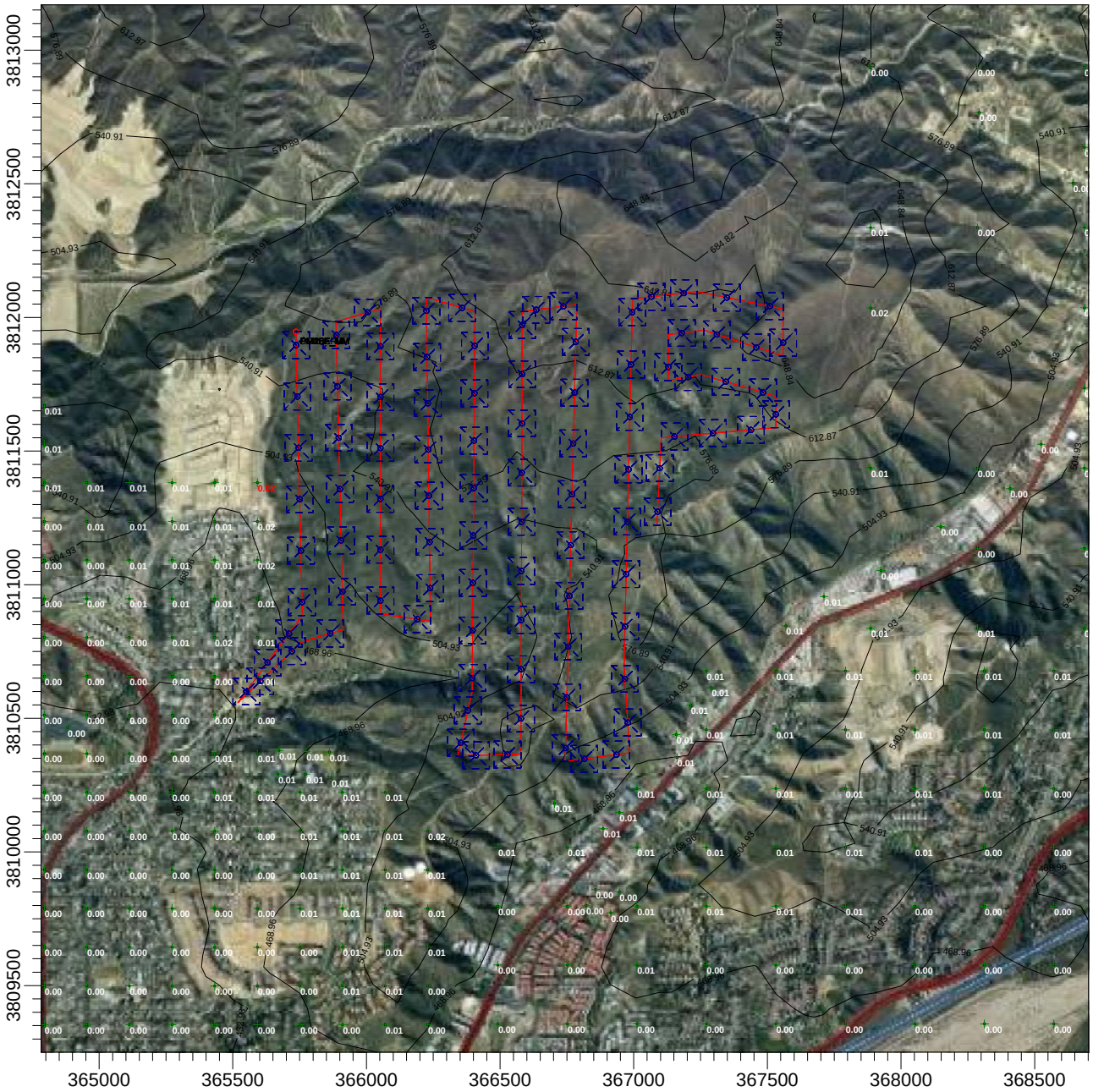
PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis

COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch 8-hr Max Scalar Exhaust Only	**9**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:28,347 0 1 km	
	MAX: **7.7427 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

PROJECT TITLE:

Skyline Ranch
Localized Construction Emissions Analysis



COMMENTS:	SOURCES:	COMPANY NAME:	
Skyline Ranch Annual Max Diesel PM Exhaust Only	**10**		
	RECEPTORS: **263**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:23,918 0 0.5 km	
	MAX: **0.02383 ug/m^3**	DATE: **5/26/2009**	PROJECT NO.:

Skyline Ranch - Pardee
Diesel Particulate Matter Health Risk Assessment
Calculations

Scalar Calculation

URF Basis (years)	70.00	
Project Duration (months)	840.00	Skyline Ranch Construction Emissions Spreadsheet
Project Duration (years)	70.00	
Work Week (days)	5.00	
Yearly Scalar	1.00	(Project Duration) / (URF Basis)
Work Week Scalar (5 day)	0.71	(5 days) / (7 days)
Scalar (5-day work week)	0.71	(Yearly Scalar) x (Work Week Scalar)

	Residential			**School Receptor**		**Hotel Receptor**
	North-West	**West**	**South**	**Little People Daycare**	**Leona Cox Community School**	**Travelodge**
Maximum Off-Site Concentration[1] (ug/m^3)	0.0189	0.0238	0.0141	0.0065	0.0019	0.0072
Diesel Particulate URF[2] (ug/m^3)$^{-1}$	3.00E-04	3.00E-04	3.00E-04	3.00E-04	3.00E-04	3.00E-04
Carcinogenic Risk[3] (ug/m^3)$^{-1}$	**4.05E-06**	**5.10E-06**	**3.02E-06**	**1.39E-06**	**4.03E-07**	**1.54E-06**
SCAQMD Cancer Risk Threshold:	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05	1.00E-05
Impact:	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Appendix H-2

- SCAQMD Rule 403 (Fugitive Dust) Control Requirements

(Adopted May 7, 1976) (Amended November 6, 1992)
(Amended July 9, 1993) (Amended February 14, 1997)
(Amended December 11, 1998)(Amended April 2, 2004)
(Amended June 3, 2005)

RULE 403. FUGITIVE DUST

(a) Purpose

The purpose of this Rule is to reduce the amount of particulate matter entrained in the ambient air as a result of anthropogenic (man-made) fugitive dust sources by requiring actions to prevent, reduce or mitigate fugitive dust emissions.

(b) Applicability

The provisions of this Rule shall apply to any activity or man-made condition capable of generating fugitive dust.

(c) Definitions

(1) ACTIVE OPERATIONS means any source capable of generating fugitive dust, including, but not limited to, earth-moving activities, construction/demolition activities, disturbed surface area, or heavy- and light-duty vehicular movement.

(2) AGGREGATE-RELATED PLANTS are defined as facilities that produce and / or mix sand and gravel and crushed stone.

(3) AGRICULTURAL HANDBOOK means the region-specific guidance document that has been approved by the Governing Board or hereafter approved by the Executive Officer and the U.S. EPA. For the South Coast Air Basin, the Board-approved region-specific guidance document is the Rule 403 Agricultural Handbook dated December 1998. For the Coachella Valley, the Board-approved region-specific guidance document is the Rule 403 Coachella Valley Agricultural Handbook dated April 2, 2004.

(4) ANEMOMETERS are devices used to measure wind speed and direction in accordance with the performance standards, and maintenance and calibration criteria as contained in the most recent Rule 403 Implementation Handbook.

(5) BEST AVAILABLE CONTROL MEASURES means fugitive dust control actions that are set forth in Table 1 of this Rule.

(6) BULK MATERIAL is sand, gravel, soil, aggregate material less than two inches in length or diameter, and other organic or inorganic particulate matter.

(7) CEMENT MANUFACTURING FACILITY is any facility that has a cement kiln at the facility.

(8) CHEMICAL STABILIZERS are any non-toxic chemical dust suppressant which must not be used if prohibited for use by the Regional Water Quality Control Boards, the California Air Resources Board, the U.S. Environmental Protection Agency (U.S. EPA), or any applicable law, rule or regulation. The chemical stabilizers shall meet any specifications, criteria, or tests required by any federal, state, or local water agency. Unless otherwise indicated, the use of a non-toxic chemical stabilizer shall be of sufficient concentration and application frequency to maintain a stabilized surface.

(9) COMMERCIAL POULTRY RANCH means any building, structure, enclosure, or premises where more than 100 fowl are kept or maintained for the primary purpose of producing eggs or meat for sale or other distribution.

(10) CONFINED ANIMAL FACILITY means a source or group of sources of air pollution at an agricultural source for the raising of 3,360 or more fowl or 50 or more animals, including but not limited to, any structure, building, installation, farm, corral, coop, feed storage area, milking parlor, or system for the collection, storage, or distribution of solid and liquid manure; if domesticated animals, including horses, sheep, goats, swine, beef cattle, rabbits, chickens, turkeys, or ducks are corralled, penned, or otherwise caused to remain in restricted areas for commercial agricultural purposes and feeding is by means other than grazing.

(11) CONSTRUCTION/DEMOLITION ACTIVITIES means any on-site mechanical activities conducted in preparation of, or related to, the building, alteration, rehabilitation, demolition or improvement of property, including, but not limited to the following activities: grading, excavation, loading, crushing, cutting, planing, shaping or ground breaking.

(12) CONTRACTOR means any person who has a contractual arrangement to conduct an active operation for another person.

(13) DAIRY FARM is an operation on a property, or set of properties that are contiguous or separated only by a public right-of-way, that raises cows or

produces milk from cows for the purpose of making a profit or for a livelihood. Heifer and calf farms are dairy farms.

(14) DISTURBED SURFACE AREA means a portion of the earth's surface which has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed natural soil condition, thereby increasing the potential for emission of fugitive dust. This definition excludes those areas which have:

(A) been restored to a natural state, such that the vegetative ground cover and soil characteristics are similar to adjacent or nearby natural conditions;

(B) been paved or otherwise covered by a permanent structure; or

(C) sustained a vegetative ground cover of at least 70 percent of the native cover for a particular area for at least 30 days.

(15) DUST SUPPRESSANTS are water, hygroscopic materials, or non-toxic chemical stabilizers used as a treatment material to reduce fugitive dust emissions.

(16) EARTH-MOVING ACTIVITIES means the use of any equipment for any activity where soil is being moved or uncovered, and shall include, but not be limited to the following: grading, earth cutting and filling operations, loading or unloading of dirt or bulk materials, adding to or removing from open storage piles of bulk materials, landfill operations, weed abatement through disking, and soil mulching.

(17) DUST CONTROL SUPERVISOR means a person with the authority to expeditiously employ sufficient dust mitigation measures to ensure compliance with all Rule 403 requirements at an active operation.

(18) FUGITIVE DUST means any solid particulate matter that becomes airborne, other than that emitted from an exhaust stack, directly or indirectly as a result of the activities of any person.

(19) HIGH WIND CONDITIONS means that instantaneous wind speeds exceed 25 miles per hour.

(20) INACTIVE DISTURBED SURFACE AREA means any disturbed surface area upon which active operations have not occurred or are not expected to occur for a period of 20 consecutive days.

(21) LARGE OPERATIONS means any active operations on property which contains 50 or more acres of disturbed surface area; or any earth-moving operation with a daily earth-moving or throughput volume of 3,850 cubic

meters (5,000 cubic yards) or more three times during the most recent 365-day period.

(22) OPEN STORAGE PILE is any accumulation of bulk material, which is not fully enclosed, covered or chemically stabilized, and which attains a height of three feet or more and a total surface area of 150 or more square feet.

(23) PARTICULATE MATTER means any material, except uncombined water, which exists in a finely divided form as a liquid or solid at standard conditions.

(24) PAVED ROAD means a public or private improved street, highway, alley, public way, or easement that is covered by typical roadway materials, but excluding access roadways that connect a facility with a public paved roadway and are not open to through traffic. Public paved roads are those open to public access and that are owned by any federal, state, county, municipal or any other governmental or quasi-governmental agencies. Private paved roads are any paved roads not defined as public.

(25) PM_{10} means particulate matter with an aerodynamic diameter smaller than or equal to 10 microns as measured by the applicable State and Federal reference test methods.

(26) PROPERTY LINE means the boundaries of an area in which either a person causing the emission or a person allowing the emission has the legal use or possession of the property. Where such property is divided into one or more sub-tenancies, the property line(s) shall refer to the boundaries dividing the areas of all sub-tenancies.

(27) RULE 403 IMPLEMENTATION HANDBOOK means a guidance document that has been approved by the Governing Board on April 2, 2004 or hereafter approved by the Executive Officer and the U.S. EPA.

(28) SERVICE ROADS are paved or unpaved roads that are used by one or more public agencies for inspection or maintenance of infrastructure and which are not typically used for construction-related activity.

(29) SIMULTANEOUS SAMPLING means the operation of two PM_{10} samplers in such a manner that one sampler is started within five minutes of the other, and each sampler is operated for a consecutive period which must be not less than 290 minutes and not more than 310 minutes.

(30) SOUTH COAST AIR BASIN means the non-desert portions of Los Angeles, Riverside, and San Bernardino counties and all of Orange

County as defined in California Code of Regulations, Title 17, Section 60104. The area is bounded on the west by the Pacific Ocean, on the north and east by the San Gabriel, San Bernardino, and San Jacinto Mountains, and on the south by the San Diego county line.

(31) STABILIZED SURFACE means any previously disturbed surface area or open storage pile which, through the application of dust suppressants, shows visual or other evidence of surface crusting and is resistant to wind-driven fugitive dust and is demonstrated to be stabilized. Stabilization can be demonstrated by one or more of the applicable test methods contained in the Rule 403 Implementation Handbook.

(32) TRACK-OUT means any bulk material that adheres to and agglomerates on the exterior surface of motor vehicles, haul trucks, and equipment (including tires) that have been released onto a paved road and can be removed by a vacuum sweeper or a broom sweeper under normal operating conditions.

(33) TYPICAL ROADWAY MATERIALS means concrete, asphaltic concrete, recycled asphalt, asphalt, or any other material of equivalent performance as determined by the Executive Officer, and the U.S. EPA.

(34) UNPAVED ROADS means any unsealed or unpaved roads, equipment paths, or travel ways that are not covered by typical roadway materials. Public unpaved roads are any unpaved roadway owned by federal, state, county, municipal or other governmental or quasi-governmental agencies. Private unpaved roads are all other unpaved roadways not defined as public.

(35) VISIBLE ROADWAY DUST means any sand, soil, dirt, or other solid particulate matter which is visible upon paved road surfaces and which can be removed by a vacuum sweeper or a broom sweeper under normal operating conditions.

(36) WIND-DRIVEN FUGITIVE DUST means visible emissions from any disturbed surface area which is generated by wind action alone.

(37) WIND GUST is the maximum instantaneous wind speed as measured by an anemometer.

(d) Requirements

(1) No person shall cause or allow the emissions of fugitive dust from any active operation, open storage pile, or disturbed surface area such that:

(A) the dust remains visible in the atmosphere beyond the property line of the emission source; or

(B) the dust emission exceeds 20 percent opacity (as determined by the appropriate test method included in the Rule 403 Implementation Handbook), if the dust emission is the result of movement of a motorized vehicle.

(2) No person shall conduct active operations without utilizing the applicable best available control measures included in Table 1 of this Rule to minimize fugitive dust emissions from each fugitive dust source type within the active operation.

(3) No person shall cause or allow PM_{10} levels to exceed 50 micrograms per cubic meter when determined, by simultaneous sampling, as the difference between upwind and downwind samples collected on high-volume particulate matter samplers or other U.S. EPA-approved equivalent method for PM_{10} monitoring. If sampling is conducted, samplers shall be:

(A) Operated, maintained, and calibrated in accordance with 40 Code of Federal Regulations (CFR), Part 50, Appendix J, or appropriate U.S. EPA-published documents for U.S. EPA-approved equivalent method(s) for PM_{10}.

(B) Reasonably placed upwind and downwind of key activity areas and as close to the property line as feasible, such that other sources of fugitive dust between the sampler and the property line are minimized.

(4) No person shall allow track-out to extend 25 feet or more in cumulative length from the point of origin from an active operation. Notwithstanding the preceding, all track-out from an active operation shall be removed at the conclusion of each workday or evening shift.

(5) No person shall conduct an active operation with a disturbed surface area of five or more acres, or with a daily import or export of 100 cubic yards or more of bulk material without utilizing at least one of the measures listed in subparagraphs (d)(5)(A) through (d)(5)(E) at each vehicle egress from the site to a paved public road.

(A) Install a pad consisting of washed gravel (minimum-size: one inch) maintained in a clean condition to a depth of at least six inches and extending at least 30 feet wide and at least 50 feet long.

(B) Pave the surface extending at least 100 feet and at least 20 feet wide.

(C) Utilize a wheel shaker/wheel spreading device consisting of raised dividers (rails, pipe, or grates) at least 24 feet long and 10 feet wide to remove bulk material from tires and vehicle undercarriages before vehicles exit the site.

(D) Install and utilize a wheel washing system to remove bulk material from tires and vehicle undercarriages before vehicles exit the site.

(E) Any other control measures approved by the Executive Officer and the U.S. EPA as equivalent to the actions specified in subparagraphs (d)(5)(A) through (d)(5)(D).

(6) Beginning January 1, 2006, any person who operates or authorizes the operation of a confined animal facility subject to this Rule shall implement the applicable conservation management practices specified in Table 4 of this Rule.

(e) Additional Requirements for Large Operations

(1) Any person who conducts or authorizes the conducting of a large operation subject to this Rule shall implement the applicable actions specified in Table 2 of this Rule at all times and shall implement the applicable actions specified in Table 3 of this Rule when the applicable performance standards can not be met through use of Table 2 actions; and shall:

(A) submit a fully executed Large Operation Notification (Form 403 N) to the Executive Officer within 7 days of qualifying as a large operation;

(B) include, as part of the notification, the name(s), address(es), and phone number(s) of the person(s) responsible for the submittal, and a description of the operation(s), including a map depicting the location of the site;

(C) maintain daily records to document the specific dust control actions taken, maintain such records for a period of not less than three years; and make such records available to the Executive Officer upon request;

(D) install and maintain project signage with project contact signage that meets the minimum standards of the Rule 403 Implementation Handbook, prior to initiating any earthmoving activities;

(E) identify a dust control supervisor that:

(i) is employed by or contracted with the property owner or developer;

(ii) is on the site or available on-site within 30 minutes during working hours;

(iii) has the authority to expeditiously employ sufficient dust mitigation measures to ensure compliance with all Rule requirements;

(iv) has completed the AQMD Fugitive Dust Control Class and has been issued a valid Certificate of Completion for the class; and

(F) notify the Executive Officer in writing within 30 days after the site no longer qualifies as a large operation as defined by paragraph (c)(18).

(2) Any Large Operation Notification submitted to the Executive Officer or AQMD-approved dust control plan shall be valid for a period of one year from the date of written acceptance by the Executive Officer. Any Large Operation Notification accepted pursuant to paragraph (e)(1), excluding those submitted by aggregate-related plants and cement manufacturing facilities must be resubmitted annually by the person who conducts or authorizes the conducting of a large operation, at least 30 days prior to the expiration date, or the submittal shall no longer be valid as of the expiration date. If all fugitive dust sources and corresponding control measures or special circumstances remain identical to those identified in the previously accepted submittal or in an AQMD-approved dust control plan, the resubmittal may be a simple statement of no-change (Form 403NC).

(f) Compliance Schedule

The newly amended provisions of this Rule shall become effective upon adoption. Pursuant to subdivision (e), any existing site that qualifies as a large operation will have 60 days from the date of Rule adoption to comply with the notification and recordkeeping requirements for large operations. Any Large Operation

Notification or AQMD-approved dust control plan which has been accepted prior to the date of adoption of these amendments shall remain in effect and the Large Operation Notification or AQMD-approved dust control plan annual resubmittal date shall be one year from adoption of this Rule amendment.

(g) Exemptions

(1) The provisions of this Rule shall not apply to:

(A) Dairy farms.

(B) Confined animal facilities provided that the combined disturbed surface area within one continuous property line is one acre or less.

(C) Agricultural vegetative crop operations provided that the combined disturbed surface area within one continuous property line and not separated by a paved public road is 10 acres or less.

(D) Agricultural vegetative crop operations within the South Coast Air Basin, whose combined disturbed surface area includes more than 10 acres provided that the person responsible for such operations:

(i) voluntarily implements the conservation management practices contained in the Rule 403 Agricultural Handbook;

(ii) completes and maintains the self-monitoring form documenting sufficient conservation management practices, as described in the Rule 403 Agricultural Handbook; and

(iii) makes the completed self-monitoring form available to the Executive Officer upon request.

(E) Agricultural vegetative crop operations outside the South Coast Air Basin whose combined disturbed surface area includes more than 10 acres provided that the person responsible for such operations:

(i) voluntarily implements the conservation management practices contained in the Rule 403 Coachella Valley Agricultural Handbook; and

(ii) completes and maintains the self-monitoring form documenting sufficient conservation management practices, as described in the Rule 403 Coachella Valley Agricultural Handbook; and

(iii) makes the completed self-monitoring form available to the Executive Officer upon request.

(F) Active operations conducted during emergency life-threatening situations, or in conjunction with any officially declared disaster or state of emergency.

(G) Active operations conducted by essential service utilities to provide electricity, natural gas, telephone, water and sewer during periods of service outages and emergency disruptions.

(H) Any contractor subsequent to the time the contract ends, provided that such contractor implemented the required control measures during the contractual period.

(I) Any grading contractor, for a phase of active operations, subsequent to the contractual completion of that phase of earth-moving activities, provided that the required control measures have been implemented during the entire phase of earth-moving activities, through and including five days after the final grading inspection.

(J) Weed abatement operations ordered by a county agricultural commissioner or any state, county, or municipal fire department, provided that:

(i) mowing, cutting or other similar process is used which maintains weed stubble at least three inches above the soil; and

(ii) any discing or similar operation which cuts into and disturbs the soil, where watering is used prior to initiation of these activities, and a determination is made by the agency issuing the weed abatement order that, due to fire hazard conditions, rocks, or other physical obstructions, it is not practical to meet the conditions specified in clause (g)(1)(H)(i). The provisions this clause shall not exempt the owner of any property from stabilizing, in accordance with paragraph (d)(2), disturbed surface areas which have been created as a result of the weed abatement actions.

(K) sandblasting operations.

(2) The provisions of paragraphs (d)(1) and (d)(3) shall not apply:

(A) When wind gusts exceed 25 miles per hour, provided that:

(i) The required Table 3 contingency measures in this Rule are implemented for each applicable fugitive dust source type, and;

(ii) records are maintained in accordance with subparagraph (e)(1)(C).

(B) To unpaved roads, provided such roads:

(i) are used solely for the maintenance of wind-generating equipment; or

(ii) are unpaved public alleys as defined in Rule 1186; or

(iii) are service roads that meet all of the following criteria:

(a) are less than 50 feet in width at all points along the road;

(b) are within 25 feet of the property line; and

(c) have a traffic volume less than 20 vehicle-trips per day.

(C) To any active operation, open storage pile, or disturbed surface area for which necessary fugitive dust preventive or mitigative actions are in conflict with the federal Endangered Species Act, as determined in writing by the State or federal agency responsible for making such determinations.

(3) The provisions of (d)(2) shall not apply to any aggregate-related plant or cement manufacturing facility that implements the applicable actions specified in Table 2 of this Rule at all times and shall implement the applicable actions specified in Table 3 of this Rule when the applicable performance standards of paragraphs (d)(1) and (d)(3) can not be met through use of Table 2 actions.

(4) The provisions of paragraphs (d)(1), (d)(2), and (d)(3) shall not apply to:

(A) Blasting operations which have been permitted by the California Division of Industrial Safety; and

(B) Motion picture, television, and video production activities when dust emissions are required for visual effects. In order to obtain this exemption, the Executive Officer must receive notification in writing at least 72 hours in advance of any such activity and no nuisance results from such activity.

(5) The provisions of paragraph (d)(3) shall not apply if the dust control actions, as specified in Table 2, are implemented on a routine basis for

each applicable fugitive dust source type. To qualify for this exemption, a person must maintain records in accordance with subparagraph (e)(1)(C).

(6) The provisions of paragraph (d)(4) shall not apply to earth coverings of public paved roadways where such coverings are approved by a local government agency for the protection of the roadway, and where such coverings are used as roadway crossings for haul vehicles provided that such roadway is closed to through traffic and visible roadway dust is removed within one day following the cessation of activities.

(7) The provisions of subdivision (e) shall not apply to:

(A) officially-designated public parks and recreational areas, including national parks, national monuments, national forests, state parks, state recreational areas, and county regional parks.

(B) any large operation which is required to submit a dust control plan to any city or county government which has adopted a District-approved dust control ordinance.

(C) any large operation subject to Rule 1158, which has an approved dust control plan pursuant to Rule 1158, provided that all sources of fugitive dust are included in the Rule 1158 plan.

(8) The provisions of subparagraph (e)(1)(A) through (e)(1)(C) shall not apply to any large operation with an AQMD-approved fugitive dust control plan provided that there is no change to the sources and controls as identified in the AQMD-approved fugitive dust control plan.

(h) Fees

Any person conducting active operations for which the Executive Officer conducts upwind/downwind monitoring for PM_{10} pursuant to paragraph (d)(3) shall be assessed applicable Ambient Air Analysis Fees pursuant to Rule 304.1. Applicable fees shall be waived for any facility which is exempted from paragraph (d)(3) or meets the requirements of paragraph (d)(3).

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure	Guidance
Backfilling	01-1 Stabilize backfill material when not actively handling; and 01-2 Stabilize backfill material during handling; and 01-3 Stabilize soil at completion of activity.	✓ Mix backfill soil with water prior to moving ✓ Dedicate water truck or high capacity hose to backfilling equipment ✓ Empty loader bucket slowly so that no dust plumes are generated ✓ Minimize drop height from loader bucket
Clearing and grubbing	02-1 Maintain stability of soil through pre-watering of site prior to clearing and grubbing; and 02-2 Stabilize soil during clearing and grubbing activities; and 02-3 Stabilize soil immediately after clearing and grubbing activities.	✓ Maintain live perennial vegetation where possible ✓ Apply water in sufficient quantity to prevent generation of dust plumes
Clearing forms	03-1 Use water spray to clear forms; or 03-2 Use sweeping and water spray to clear forms; or 03-3 Use vacuum system to clear forms.	✓ Use of high pressure air to clear forms may cause exceedance of Rule requirements
Crushing	04-1 Stabilize surface soils prior to operation of support equipment; and 04-2 Stabilize material after crushing.	✓ Follow permit conditions for crushing equipment ✓ Pre-water material prior to loading into crusher ✓ Monitor crusher emissions opacity ✓ Apply water to crushed material to prevent dust plumes

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure	Guidance
Cut and fill	05-1 Pre-water soils prior to cut and fill activities; and 05-2 Stabilize soil during and after cut and fill activities.	✓ For large sites, pre-water with sprinklers or water trucks and allow time for penetration ✓ Use water trucks/pulls to water soils to depth of cut prior to subsequent cuts
Demolition – mechanical/manual	06-1 Stabilize wind erodible surfaces to reduce dust; and 06-2 Stabilize surface soil where support equipment and vehicles will operate; and 06-3 Stabilize loose soil and demolition debris; and 06-4 Comply with AQMD Rule 1403.	✓ Apply water in sufficient quantities to prevent the generation of visible dust plumes
Disturbed soil	07-1 Stabilize disturbed soil throughout the construction site; and 07-2 Stabilize disturbed soil between structures	✓ Limit vehicular traffic and disturbances on soils where possible ✓ If interior block walls are planned, install as early as possible ✓ Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes
Earth-moving activities	08-1 Pre-apply water to depth of proposed cuts; and 08-2 Re-apply water as necessary to maintain soils in a damp condition and to ensure that visible emissions do not exceed 100 feet in any direction; and 08-3 Stabilize soils once earth-moving activities are complete.	✓ Grade each project phase separately, timed to coincide with construction phase ✓ Upwind fencing can prevent material movement on site ✓ Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure	Guidance
Importing/exporting of bulk materials	09-1 Stabilize material while loading to reduce fugitive dust emissions; and 09-2 Maintain at least six inches of freeboard on haul vehicles; and 09-3 Stabilize material while transporting to reduce fugitive dust emissions; and 09-4 Stabilize material while unloading to reduce fugitive dust emissions; and 09-5 Comply with Vehicle Code Section 23114.	✓ Use tarps or other suitable enclosures on haul trucks ✓ Check belly-dump truck seals regularly and remove any trapped rocks to prevent spillage ✓ Comply with track-out prevention/mitigation requirements ✓ Provide water while loading and unloading to reduce visible dust plumes
Landscaping	10-1 Stabilize soils, materials, slopes	✓ Apply water to materials to stabilize ✓ Maintain materials in a crusted condition ✓ Maintain effective cover over materials ✓ Stabilize sloping surfaces using soil binders until vegetation or ground cover can effectively stabilize the slopes ✓ Hydroseed prior to rain season
Road shoulder maintenance	11-1 Apply water to unpaved shoulders prior to clearing; and 11-2 Apply chemical dust suppressants and/or washed gravel to maintain a stabilized surface after completing road shoulder maintenance.	✓ Installation of curbing and/or paving of road shoulders can reduce recurring maintenance costs ✓ Use of chemical dust suppressants can inhibit vegetation growth and reduce future road shoulder maintenance costs

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure	Guidance
Screening	12-1 Pre-water material prior to screening; and 12-2 Limit fugitive dust emissions to opacity and plume length standards; and 12-3 Stabilize material immediately after screening.	✓ Dedicate water truck or high capacity hose to screening operation ✓ Drop material through the screen slowly and minimize drop height ✓ Install wind barrier with a porosity of no more than 50% upwind of screen to the height of the drop point
Staging areas	13-1 Stabilize staging areas during use; and 13-2 Stabilize staging area soils at project completion.	✓ Limit size of staging area ✓ Limit vehicle speeds to 15 miles per hour ✓ Limit number and size of staging area entrances/exists
Stockpiles/ Bulk Material Handling	14-1 Stabilize stockpiled materials. 14-2 Stockpiles within 100 yards of off-site occupied buildings must not be greater than eight feet in height; or must have a road bladed to the top to allow water truck access or must have an operational water irrigation system that is capable of complete stockpile coverage.	✓ Add or remove material from the downwind portion of the storage pile ✓ Maintain storage piles to avoid steep sides or faces

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure	Guidance
Traffic areas for construction activities	15-1 Stabilize all off-road traffic and parking areas; and 15-2 Stabilize all haul routes; and 15-3 Direct construction traffic over established haul routes.	✓ Apply gravel/paving to all haul routes as soon as possible to all future roadway areas ✓ Barriers can be used to ensure vehicles are only used on established parking areas/haul routes
Trenching	16-1 Stabilize surface soils where trencher or excavator and support equipment will operate; and 16-2 Stabilize soils at the completion of trenching activities.	✓ Pre-watering of soils prior to trenching is an effective preventive measure. For deep trenching activities, pre-trench to 18 inches soak soils via the pre-trench and resuming trenching ✓ Washing mud and soils from equipment at the conclusion of trenching activities can prevent crusting and drying of soil on equipment
Truck loading	17-1 Pre-water material prior to loading; and 17-2 Ensure that freeboard exceeds six inches (CVC 23114)	✓ Empty loader bucket such that no visible dust plumes are created ✓ Ensure that the loader bucket is close to the truck to minimize drop height while loading
Turf Overseeding	18-1 Apply sufficient water immediately prior to conducting turf vacuuming activities to meet opacity and plume length standards; and 18-2 Cover haul vehicles prior to exiting the site.	✓ Haul waste material immediately off-site

TABLE 1
BEST AVAILABLE CONTROL MEASURES
(Applicable to All Construction Activity Sources)

Source Category	Control Measure		Guidance
Unpaved roads/parking lots	19-1	Stabilize soils to meet the applicable performance standards; and	✓ Restricting vehicular access to established unpaved travel paths and parking lots can reduce stabilization requirements
	19-2	Limit vehicular travel to established unpaved roads (haul routes) and unpaved parking lots.	
Vacant land	20-1	In instances where vacant lots are 0.10 acre or larger and have a cumulative area of 500 square feet or more that are driven over and/or used by motor vehicles and/or off-road vehicles, prevent motor vehicle and/or off-road vehicle trespassing, parking and/or access by installing barriers, curbs, fences, gates, posts, signs, shrubs, trees or other effective control measures.	

Table 2
DUST CONTROL MEASURES FOR LARGE OPERATIONS

FUGITIVE DUST SOURCE CATEGORY	CONTROL ACTIONS	
Earth-moving (except construction cutting and filling areas, and mining operations)	(1a)	Maintain soil moisture content at a minimum of 12 percent, as determined by ASTM method D-2216, or other equivalent method approved by the Executive Officer, the California Air Resources Board, and the U.S. EPA. Two soil moisture evaluations must be conducted during the first three hours of active operations during a calendar day, and two such evaluations each subsequent four-hour period of active operations; OR
	(1a-1)	For any earth-moving which is more than 100 feet from all property lines, conduct watering as necessary to prevent visible dust emissions from exceeding 100 feet in length in any direction.
Earth-moving: Construction fill areas:	(1b)	Maintain soil moisture content at a minimum of 12 percent, as determined by ASTM method D-2216, or other equivalent method approved by the Executive Officer, the California Air Resources Board, and the U.S. EPA. For areas which have an optimum moisture content for compaction of less than 12 percent, as determined by ASTM Method 1557 or other equivalent method approved by the Executive Officer and the California Air Resources Board and the U.S. EPA, complete the compaction process as expeditiously as possible after achieving at least 70 percent of the optimum soil moisture content. Two soil moisture evaluations must be conducted during the first three hours of active operations during a calendar day, and two such evaluations during each subsequent four-hour period of active operations.

Table 2 (Continued)

FUGITIVE DUST SOURCE CATEGORY	CONTROL ACTIONS	
Earth-moving: Construction cut areas and mining operations:	(1c)	Conduct watering as necessary to prevent visible emissions from extending more than 100 feet beyond the active cut or mining area unless the area is inaccessible to watering vehicles due to slope conditions or other safety factors.
Disturbed surface areas (except completed grading areas)	(2a/b)	Apply dust suppression in sufficient quantity and frequency to maintain a stabilized surface. Any areas which cannot be stabilized, as evidenced by wind driven fugitive dust must have an application of water at least twice per day to at least 80 percent of the unstabilized area.
Disturbed surface areas: Completed grading areas	(2c)	Apply chemical stabilizers within five working days of grading completion; OR
	(2d)	Take actions (3a) or (3c) specified for inactive disturbed surface areas.
Inactive disturbed surface areas	(3a)	Apply water to at least 80 percent of all inactive disturbed surface areas on a daily basis when there is evidence of wind driven fugitive dust, excluding any areas which are inaccessible to watering vehicles due to excessive slope or other safety conditions; OR
	(3b)	Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface; OR
	(3c)	Establish a vegetative ground cover within 21 days after active operations have ceased. Ground cover must be of sufficient density to expose less than 30 percent of unstabilized ground within 90 days of planting, and at all times thereafter; OR
	(3d)	Utilize any combination of control actions (3a), (3b), and (3c) such that, in total, these actions apply to all inactive disturbed surface areas.

Table 2 (Continued)

FUGITIVE DUST SOURCE CATEGORY	CONTROL ACTIONS	
Unpaved Roads	(4a)	Water all roads used for any vehicular traffic at least once per every two hours of active operations [3 times per normal 8 hour work day]; OR
	(4b)	Water all roads used for any vehicular traffic once daily and restrict vehicle speeds to 15 miles per hour; OR
	(4c)	Apply a chemical stabilizer to all unpaved road surfaces in sufficient quantity and frequency to maintain a stabilized surface.
Open storage piles	(5a)	Apply chemical stabilizers; OR
	(5b)	Apply water to at least 80 percent of the surface area of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust; OR
	(5c)	Install temporary coverings; OR
	(5d)	Install a three-sided enclosure with walls with no more than 50 percent porosity which extend, at a minimum, to the top of the pile. This option may only be used at aggregate-related plants or at cement manufacturing facilities.
All Categories	(6a)	Any other control measures approved by the Executive Officer and the U.S. EPA as equivalent to the methods specified in Table 2 may be used.

TABLE 3
CONTINGENCY CONTROL MEASURES FOR LARGE OPERATIONS

FUGITIVE DUST SOURCE CATEGORY	CONTROL MEASURES
Earth-moving	(1A) Cease all active operations; OR (2A) Apply water to soil not more than 15 minutes prior to moving such soil.
Disturbed surface areas	(0B) On the last day of active operations prior to a weekend, holiday, or any other period when active operations will not occur for not more than four consecutive days: apply water with a mixture of chemical stabilizer diluted to not less than 1/20 of the concentration required to maintain a stabilized surface for a period of six months; OR (1B) Apply chemical stabilizers prior to wind event; OR (2B) Apply water to all unstabilized disturbed areas 3 times per day. If there is any evidence of wind driven fugitive dust, watering frequency is increased to a minimum of four times per day; OR (3B) Take the actions specified in Table 2, Item (3c); OR (4B) Utilize any combination of control actions (1B), (2B), and (3B) such that, in total, these actions apply to all disturbed surface areas.
Unpaved roads	(1C) Apply chemical stabilizers prior to wind event; OR (2C) Apply water twice per hour during active operation; OR (3C) Stop all vehicular traffic.
Open storage piles	(1D) Apply water twice per hour; OR (2D) Install temporary coverings.
Paved road track-out	(1E) Cover all haul vehicles; OR (2E) Comply with the vehicle freeboard requirements of Section 23114 of the California Vehicle Code for both public and private roads.
All Categories	(1F) Any other control measures approved by the Executive Officer and the U.S. EPA as equivalent to the methods specified in Table 3 may be used.

Table 4
(Conservation Management Practices for Confined Animal Facilities)

SOURCE CATEGORY	CONSERVATION MANAGEMENT PRACTICES
Manure Handling **(Only applicable to Commercial Poultry Ranches)**	(1a) Cover manure prior to removing material off-site; AND (1b) Spread the manure before 11:00 AM and when wind conditions are less than 25 miles per hour; AND (1c) Utilize coning and drying manure management by removing manure at laying hen houses at least twice per year and maintain a base of no less than 6 inches of dry manure after clean out; or in lieu of complying with conservation management practice (1c), comply with conservation management practice (1d). (1d) Utilize frequent manure removal by removing the manure from laying hen houses at least every seven days and immediately thin bed dry the material.
Feedstock Handling	(2a) Utilize a sock or boot on the feed truck auger when filling feed storage bins.
Disturbed Surfaces	(3a) Maintain at least 70 percent vegetative cover on vacant portions of the facility; OR (3b) Utilize conservation tillage practices to manage the amount, orientation and distribution of crop and other plant residues on the soil surface year-round, while growing crops (if applicable) in narrow slots or tilled strips; OR (3c) Apply dust suppressants in sufficient concentrations and frequencies to maintain a stabilized surface.
Unpaved Roads	(4a) Restrict access to private unpaved roads either through signage or physical access restrictions and control vehicular speeds to no more than 15 miles per hour through worker notifications, signage, or any other necessary means; OR (4b) Cover frequently traveled unpaved roads with low silt content material (i.e., asphalt, concrete, recycled road base, or gravel to a minimum depth of four inches); OR (4c) Treat unpaved roads with water, mulch, chemical dust suppressants or other cover to maintain a stabilized surface.
Equipment Parking Areas	(5a) Apply dust suppressants in sufficient quantity and frequency to maintain a stabilized surface; OR (5b) Apply material with low silt content (i.e., asphalt, concrete, recycled road base, or gravel to a depth of four inches).

Appendix H-3

- Operation Emissions Inventory
  - Regional Operation Emissions
    - Regional Emission Summary Sheets
    - URBEMIS2007 Output Files
      - Summer Scenario
      - Winter Scenario
  - Local Operation Emissions
    - Intersection Selection Analysis Sheet
    - One-hour CO Summary Sheets
    - Eight-hour CO Summary Sheets
    - CALINE4 Output Files
    - EMFAC2007 Emission Rates

Skyline Ranch (Year 2011 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Net Mobile	16	16	125	0	21	4
Net Area	8	2	14	0	2	2
Net Stationary	0	15	3	2	1	1
Total Net	25	32	142	2	24	7
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**(30)**	**(23)**	**(408)**	**(148)**	**(126)**	**(48)**
Significant?	**No**	**No**	**No**	**No**	**No**	**No**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	Total Electricity Usage (MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	30.0	5,627	168,795	0.462	0.092	0.005	0.532	0.018	0.055	372.061	0.003	0.002
Total Project			**4,730,295**	**12.960**	**2.59**	**0.13**	**14.90**	**0.52**	**1.56**	**10,426.61**	**0.09**	**0.05**
Net Emissions From Electricity Usage					**2.59**	**0.13**	**14.90**	**0.52**	**1.56**	**10426.61**	**0.09**	**0.05**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2011 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.09	1.14	0.70	0.00	0.00	0.00	1,417.50
Hearth - No Summer Emissions							
Landscape	0.49	0.06	4.43	0.00	0.01	0.01	7.77
Consumer Products	1.54						
Architectural Coatings	2.08						
TOTALS (lbs/day, unmitigated)	4.20	1.20	5.13	0.00	0.01	0.01	1,425.27

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	2.43	2.95	30.42	0.03	5.01	0.98	3,135.77
Elementary school	13.42	9.45	94.77	0.10	16.10	3.13	10,010.12
City park	0.12	0.00	0.01	0.00	0.00	0.00	1.27

TOTALS (lbs/day, unmitigated)	15.97	12.40	125.20	0.13	21.11	4.11	13,147.16

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2011 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	10.00	9.57	dwelling units	30.00	287.10	2,900.51
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					1,254.73	12,218.71

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.6	0.8	99.0	0.2
Light Truck < 3750 lbs	7.3	2.7	94.6	2.7
Light Truck 3751-5750 lbs	23.0	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.6	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.5	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	64.3	35.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2011 Summer Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2011 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.09	1.14	0.70	0.00	0.00	0.00	1,417.50
Hearth	4.70	0.43	13.05	0.04	2.02	1.95	570.86
Landscaping - No Winter Emissions							
Consumer Products	1.54						
Architectural Coatings	2.08						
TOTALS (lbs/day, unmitigated)	8.41	1.57	13.75	0.04	2.02	1.95	1,988.36

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	2.47	3.70	27.09	0.03	5.01	0.98	2,722.76
Elementary school	9.82	11.86	84.53	0.08	16.10	3.13	8,683.47
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	12.33	15.56	111.63	0.11	21.11	4.11	11,407.33

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2011 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	10.00	9.57	dwelling units	30.00	287.10	2,900.51
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					1,254.73	12,218.71

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.6	0.8	99.0	0.2
Light Truck < 3750 lbs	7.3	2.7	94.6	2.7
Light Truck 3751-5750 lbs	23.0	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.6	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.5	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	64.3	35.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2011 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2012 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	31	39	323	0	58	11
Area	56	9	112	0	17	16
Stationary	0	19	3	2	1	1
Total Project	**87**	**67**	**438**	**3**	**76**	**28**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**32**	**12**	**(112)**	**(147)**	**(74)**	**(27)**
Significant?	**Yes**	**Yes**	**No**	**No**	**No**	**No**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	(MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	252.0	5,627	1,417,878	3.885	0.777	0.039	4.467	0.155	0.466	3125.314	0.026	0.014
Total Project			**5,979,378**	**16.382**	**3.28**	**0.16**	**18.84**	**0.66**	**1.97**	**13,179.86**	**0.11**	**0.06**
Net Emissions From Electricity Usage					**3.28**	**0.16**	**18.84**	**0.66**	**1.97**	**13179.86**	**0.11**	**0.06**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	3.28	0.16	18.84	0.66	1.97
Total Net Emissions (lbs/day)	**3.28**	**0.16**	**18.84**	**0.66**	**1.97**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2012 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.44	5.78	2.67	0.00	0.01	0.01	7,336.02
Hearth - No Summer Emissions							
Landscape	2.28	0.17	14.34	0.00	0.04	0.04	23.68
Consumer Products	12.93						
Architectural Coatings	2.88						
TOTALS (lbs/day, unmitigated)	18.53	5.95	17.01	0.00	0.05	0.05	7,359.70

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	18.72	22.65	235.34	0.26	42.10	8.20	26,343.38
Elementary school	12.48	8.65	87.24	0.10	16.09	3.13	10,011.29
City park	0.11	0.00	0.01	0.00	0.00	0.00	1.27

TOTALS (lbs/day, unmitigated)	31.31	31.30	322.59	0.36	58.19	11.33	36,355.94

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2012 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	84.00	9.57	dwelling units	252.00	2,411.64	24,364.32
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					3,379.27	33,682.52

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.5	0.6	99.2	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.0	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.7	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.5	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	60.7	39.3	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2012 Summer Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2012 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.44	5.78	2.67	0.00	0.01	0.01	7,336.02
Hearth	39.51	3.59	109.60	0.31	17.00	16.37	4,795.22
Landscaping - No Winter Emissions							
Consumer Products	12.93						
Architectural Coatings	2.88						
TOTALS (lbs/day, unmitigated)	55.76	9.37	112.27	0.31	17.01	16.38	12,131.24

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	18.97	28.43	209.06	0.22	42.10	8.20	22,862.32
Elementary school	9.06	10.85	77.62	0.08	16.09	3.13	8,680.12
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	28.07	39.28	286.69	0.30	58.19	11.33	31,543.54

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2012 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	84.00	9.57	dwelling units	252.00	2,411.64	24,364.32
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					3,379.27	33,682.52

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.5	0.6	99.2	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.0	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.7	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.5	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	60.7	39.3	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2012 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2013 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	45	60	491	1	95	19
Area	103	17	211	1	32	31
Stationary	0	23	4	2	1	1
Total Project	**148**	**100**	**705**	**4**	**128**	**50**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**93**	**45**	**155**	**(146)**	**(22)**	**(5)**
Significant?	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	(MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	474.0	5,627	2,666,961	7.307	1.461	0.073	8.403	0.292	0.877	5878.567	0.049	0.027
Total Project			**7,228,461**	**19.804**	**3.96**	**0.20**	**22.78**	**0.79**	**2.38**	**15,933.11**	**0.13**	**0.07**
Net Emissions From Electricity Usage					**3.96**	**0.20**	**22.78**	**0.79**	**2.38**	**15933.11**	**0.13**	**0.07**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	3.96	0.20	22.78	0.79	2.38
Total Net Emissions (lbs/day)	**3.96**	**0.20**	**22.78**	**0.79**	**2.38**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2013 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.80	10.41	4.64	0.00	0.02	0.02	13,254.54
Hearth - No Summer Emissions							
Landscape	4.07	0.28	24.25	0.00	0.07	0.07	39.59
Consumer Products	24.32						
Architectural Coatings	3.68						
TOTALS (lbs/day, unmitigated)	32.87	10.69	28.89	0.00	0.09	0.09	13,294.13

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	32.80	40.09	409.94	0.50	79.19	15.42	49,696.39
Elementary school	11.80	8.14	80.76	0.10	16.09	3.13	10,041.05
City park	0.11	0.00	0.01	0.00	0.00	0.00	1.27

TOTALS (lbs/day, unmitigated)	44.71	48.23	490.71	0.60	95.28	18.55	59,738.71

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2013 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	158.00	9.57	dwelling units	474.00	4,536.18	45,828.12
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					5,503.81	55,146.32

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.3	0.4	99.4	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.1	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.7	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	53.6	46.4	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2013 Summer Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2013 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	0.80	10.41	4.64	0.00	0.02	0.02	13,254.54
Hearth	74.31	6.75	206.15	0.58	31.97	30.78	9,019.58
Landscaping - No Winter Emissions							
Consumer Products	24.32						
Architectural Coatings	3.68						
TOTALS (lbs/day, unmitigated)	103.11	17.16	210.79	0.58	31.99	30.80	22,274.12

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	33.03	50.18	363.50	0.41	79.19	15.42	43,139.13
Elementary school	8.49	10.19	71.72	0.08	16.09	3.13	8,707.94
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	41.56	60.37	435.23	0.49	95.28	18.55	51,848.17

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2013 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	158.00	9.57	dwelling units	474.00	4,536.18	45,828.12
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					5,503.81	55,146.32

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.3	0.4	99.4	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.1	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.7	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.6	0.0	81.2	18.8
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	53.6	46.4	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2013 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2014 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	57	77	641	1	131	26
Area	149	25	307	1	47	45
Stationary	0	27	5	3	1	1
Total Project	**207**	**129**	**952**	**4**	**179**	**71**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**152**	**74**	**402**	**(146)**	**29**	**16**
Significant?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	Total Electricity Usage (MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	690.0	5,627	3,882,285	10.636	2.127	0.106	12.232	0.425	1.276	8557.407	0.071	0.039
Total Project			**8,443,785**	**23.134**	**4.63**	**0.23**	**26.60**	**0.93**	**2.78**	**18,611.95**	**0.16**	**0.09**
Net Emissions From Electricity Usage					**4.63**	**0.23**	**26.60**	**0.93**	**2.78**	**18611.95**	**0.16**	**0.09**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	4.63	0.23	26.60	0.93	2.78
Total Net Emissions (lbs/day)	**4.63**	**0.23**	**26.60**	**0.93**	**2.78**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2014 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.15	14.92	6.56	0.00	0.03	0.03	19,013.10
Hearth - No Summer Emissions							
Landscape	5.81	0.39	33.89	0.00	0.09	0.09	55.07
Consumer Products	35.40						
Architectural Coatings	4.46						
TOTALS (lbs/day, unmitigated)	46.82	15.31	40.45	0.00	0.12	0.12	19,068.17

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	45.66	54.11	564.77	0.72	115.34	22.52	72,403.58
Elementary school	11.35	7.55	76.44	0.10	16.10	3.14	10,049.53
City park	0.10	0.00	0.01	0.00	0.00	0.00	1.27

TOTALS (lbs/day, unmitigated)	57.11	61.66	641.22	0.82	131.44	25.66	82,454.38

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2014 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	230.00	9.57	dwelling units	690.00	6,603.30	66,711.82
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					7,570.93	76,030.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.1	0.4	99.4	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.1	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.8	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	50.0	50.0	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2014 Summer Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2014 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.15	14.92	6.56	0.00	0.03	0.03	19,013.10
Hearth	108.17	9.82	300.09	0.85	46.55	44.81	13,129.76
Landscaping - No Winter Emissions							
Consumer Products	35.40						
Architectural Coatings	4.46						
TOTALS (lbs/day, unmitigated)	149.18	24.74	306.65	0.85	46.58	44.84	32,142.86

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	46.09	67.85	500.78	0.59	115.34	22.52	62,848.01
Elementary school	8.18	9.46	67.87	0.08	16.10	3.14	8,715.00
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	54.31	77.31	568.66	0.67	131.44	25.66	71,564.11

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2014 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	230.00	9.57	dwelling units	690.00	6,603.30	66,711.82
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					7,570.93	76,030.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	51.1	0.4	99.4	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.1	0.4	99.6	0.0
Med Truck 5751-8500 lbs	10.8	0.9	99.1	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.8	50.0	50.0	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2014 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2015 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	65	90	744	1	170	33
Area	199	33	411	1	62	60
Stationary	0	31	5	3	1	1
Total Project	**265**	**154**	**1160**	**5**	**234**	**94**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**210**	**99**	**610**	**(145)**	**84**	**39**
Significant?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	Total Electricity Usage (MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	924.0	5,627	5,198,886	14.244	2.849	0.142	16.380	0.570	1.709	11459.484	0.095	0.053
Total Project			**9,760,386**	**26.741**	**5.35**	**0.27**	**30.75**	**1.07**	**3.21**	**21,514.03**	**0.18**	**0.10**
Net Emissions From Electricity Usage					**5.35**	**0.27**	**30.75**	**1.07**	**3.21**	**21514.03**	**0.18**	**0.10**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	5.35	0.27	30.75	1.07	3.21
Total Net Emissions (lbs/day)	**5.35**	**0.27**	**30.75**	**1.07**	**3.21**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2015 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.53	19.81	8.64	0.00	0.04	0.04	25,251.54
Hearth - No Summer Emissions							
Landscape	7.70	0.51	44.34	0.00	0.12	0.12	71.85
Consumer Products	47.40						
Architectural Coatings	5.31						
TOTALS (lbs/day, unmitigated)	61.94	20.32	52.98	0.00	0.16	0.16	25,323.39

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	54.66	65.11	675.56	0.97	154.38	30.09	96,903.53
Elementary school	10.44	6.78	68.21	0.10	16.09	3.13	10,043.89
City park	0.10	0.00	0.01	0.00	0.00	0.00	1.27

TOTALS (lbs/day, unmitigated)	65.20	71.89	743.78	1.07	170.47	33.22	106,948.69

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2015 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	308.00	9.57	dwelling units	924.00	8,842.68	89,335.82
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					9,810.31	98,654.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.2	99.6	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.8	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.9	48.3	51.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2015 Summer Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2015 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.53	19.81	8.64	0.00	0.04	0.04	25,251.54
Hearth	144.85	13.16	401.87	1.13	62.33	60.01	17,582.46
Landscaping - No Winter Emissions							
Consumer Products	47.40						
Architectural Coatings	5.31						
TOTALS (lbs/day, unmitigated)	199.09	32.97	410.51	1.13	62.37	60.05	42,834.00

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	54.99	81.51	595.83	0.79	154.38	30.09	84,067.19
Elementary school	7.43	8.49	60.24	0.08	16.09	3.13	8,705.16
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	62.46	90.00	656.08	0.87	170.47	33.22	92,773.45

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2015 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	308.00	9.57	dwelling units	924.00	8,842.68	89,335.82
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					9,810.31	98,654.02

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.2	99.6	0.2
Light Truck < 3750 lbs	7.3	1.4	95.9	2.7
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.8	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.9	48.3	51.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2015 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2016 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	71	97	818	1	201	39
Area	238	39	491	1	75	72
Stationary	0	34	6	4	1	1
Total Project	**310**	**171**	**1315**	**6**	**277**	**112**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**255**	**116**	**765**	**(144)**	**127**	**57**
Significant?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	Total Electricity Usage (MWh\Day)	CO 0.2	ROC 0.01	NOx 1.15	PM10 0.04	SOx 0.12	CO2 804.54	CH4 0.0067	NO2 0.0037
					Emission Factors (lbs/MWh) [b]							
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	1106.0	5,627	6,222,909	17.049	3.410	0.170	19.606	0.682	2.046	13716.655	0.114	0.063
Total Project			**10,784,409**	**29.546**	**5.91**	**0.30**	**33.98**	**1.18**	**3.55**	**23,771.20**	**0.20**	**0.11**
Net Emissions From Electricity Usage					**5.91**	**0.30**	**33.98**	**1.18**	**3.55**	**23771.20**	**0.20**	**0.11**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	5.91	0.30	33.98	1.18	3.55
Total Net Emissions (lbs/day)	**5.91**	**0.30**	**33.98**	**1.18**	**3.55**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.82	23.61	10.26	0.00	0.05	0.04	30,103.66
Hearth - No Summer Emissions							
Landscape	9.17	0.60	52.46	0.00	0.14	0.14	84.89
Consumer Products	56.74						
Architectural Coatings	5.97						
TOTALS (lbs/day, unmitigated)	73.70	24.21	62.72	0.00	0.19	0.18	30,188.55

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2

Single family housing	61.33	71.51	754.51	1.16	184.79	36.01	116,055.36
Elementary school	9.90	6.22	63.64	0.10	16.09	3.13	10,049.50
City park	0.09	0.00	0.01	0.00	0.00	0.00	1.27
TOTALS (lbs/day, unmitigated)	71.32	77.73	818.16	1.26	200.88	39.14	126,106.13

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2016 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	368.67	9.57	dwelling units	1,106.00	10,584.42	106,932.27
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					11,552.05	116,250.47

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.2	99.6	0.2
Light Truck < 3750 lbs	7.2	0.0	98.6	1.4
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.9	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0

Motorcycle	2.9	48.3	51.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2016 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	1.82	23.61	10.26	0.00	0.05	0.04	30,103.66
Hearth	173.38	15.75	481.02	1.35	74.61	71.83	21,045.68
Landscaping - No Winter Emissions							
Consumer Products	56.74						
Architectural Coatings	5.97						
TOTALS (lbs/day, unmitigated)	237.91	39.36	491.28	1.35	74.66	71.87	51,149.34

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	61.53	89.51	664.05	0.94	184.79	36.01	100,639.15
Elementary school	7.01	7.79	56.08	0.08	16.09	3.13	8,706.28
City park	0.04	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	68.58	97.30	720.14	1.02	200.88	39.14	109,346.53

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2016 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	368.67	9.57	dwelling units	1,106.00	10,584.42	106,932.27
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					11,552.05	116,250.47

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.2	99.6	0.2
Light Truck < 3750 lbs	7.2	0.0	98.6	1.4
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.9	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.9	48.3	51.7	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2016 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

Skyline Ranch (Year 2017 Operations)

Regional Emission Calculations (lbs/day)

	VOC	NOx	CO	SO2	PM10	PM2.5
Project						
Mobile	75	101	861	1	228	44
Area	273	45	564	2	86	83
Stationary	0	37	6	4	1	1
Total Project	**348**	**183**	**1431**	**7**	**315**	**128**
SCAQMD Significance Threshold	55	55	550	150	150	55
Difference	**293**	**128**	**881**	**(143)**	**165**	**73**
Significant?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**

Electricity Usage

Land Use	1,000 Sqft	Electricity Usage Rate [a] (kWh\sq.ft\yr)	Total Electricity Usage (KWh\year)	Total Electricity Usage (MWh\Day)	CO	ROC	NOx	PM10	SOx	CO2	CH4	NO2
					Emission Factors (lbs/MWh) [b]							
					0.2	0.01	1.15	0.04	0.12	804.54	0.0067	0.0037
Project												
Elementary School	750.0	5.9	4,425,000	12.123	2.425	0.121	13.942	0.485	1.455	9753.670	0.081	0.045
Miscellaneous	13.0	10.5	136,500	0.374	0.075	0.004	0.430	0.015	0.045	300.876	0.003	0.001
Residential (DU)	1270.0	5,627	7,145,655	19.577	3.915	0.196	22.514	0.783	2.349	15750.590	0.131	0.072
Total Project			**11,707,155**	**32.074**	**6.42**	**0.32**	**36.89**	**1.28**	**3.85**	**25,805.14**	**0.22**	**0.12**
Net Emissions From Electricity Usage					**6.42**	**0.32**	**36.89**	**1.28**	**3.85**	**25805.14**	**0.22**	**0.12**

Summary of Stationary Emissions

	CO	ROC	NOx	PM10	SOx
Total Existing Emissions (lbs/day)	0.00	0.00	0.00	0.00	0.00
Total Project Emissions (lbs/day)	6.42	0.32	36.89	1.28	3.85
Total Net Emissions (lbs/day)	**6.42**	**0.32**	**36.89**	**1.28**	**3.85**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[b] Emission Factors from Table A9-11-B, CEQA Air Quality Handbook, SCAQMD, 1993.

[c] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

[d] Emission Factors from URBEMIS2002 Version 8.7 (US EPA 1995)

[e] The emission factors for NOx in lbs per million cuft of natural gas are 100 for nonresidential uses and 94 for residential uses.

URBEMIS2007 Output File:
2017 Summer Operational

Urbemis 2007 Version 9.2.0

Combined Summer Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	2.09	27.04	11.72	0.00	0.05	0.05	34,475.90
Hearth - No Summer Emissions							
Landscape	10.49	0.68	59.78	0.00	0.16	0.16	96.65
Consumer Products	65.15						
Architectural Coatings	6.56						
TOTALS (lbs/day, unmitigated)	84.29	27.72	71.50	0.00	0.21	0.21	34,572.55

URBEMIS2007 Output File:
2017 Summer Operational

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Summer Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	65.11	75.12	801.65	1.33	212.08	41.26	133,244.12
Elementary school	9.32	5.69	58.87	0.10	16.09	3.12	10,047.96
City park	0.09	0.00	0.01	0.00	0.00	0.00	1.27
TOTALS (lbs/day, unmitigated)	74.52	80.81	860.53	1.43	228.17	44.38	143,293.35

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2017 Temperature (F): 85 Season: Summer

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	423.33	9.57	dwelling units	1,270.00	12,153.90	122,788.42
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					13,121.53	132,106.62

URBEMIS2007 Output File:
2017 Summer Operational

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.0	100.0	0.0
Light Truck < 3750 lbs	7.2	0.0	98.6	1.4
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.9	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.9	44.8	55.2	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

URBEMIS2007 Output File:
2017 Winter Operational

Urbemis 2007 Version 9.2.0

Combined Winter Emissions Reports (Pounds/Day)

File Name: V:\AQNOISE DIVISION\Active Projects\Skyline Ranch\Operations\URBEMIS 9.2 runs\Revised Grading(9_5_07)\2017\URBEMIS.urb9

Project Name: Skyline Ranch Revised 9.2

Project Location: South Coast AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Area Source Unmitigated Detail Report:

AREA SOURCE EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOx	CO	SO2	PM10	PM2.5	CO2
Natural Gas	2.09	27.04	11.72	0.00	0.05	0.05	34,475.90
Hearth	199.09	18.08	552.35	1.56	85.67	82.48	24,166.37
Landscaping - No Winter Emissions							
Consumer Products	65.15						
Architectural Coatings	6.56						
TOTALS (lbs/day, unmitigated)	272.89	45.12	564.07	1.56	85.72	82.53	58,642.27

Area Source Changes to Defaults

Percent residential using natural gas changed from 78% to 100%

Operational Unmitigated Detail Report:

OPERATIONAL EMISSION ESTIMATES Winter Pounds Per Day, Unmitigated

Source	ROG	NOX	CO	SO2	PM10	PM25	CO2
Single family housing	65.16	94.07	704.07	1.08	212.08	41.26	115,497.24
Elementary school	6.55	7.13	51.76	0.08	16.09	3.12	8,701.35
City park	0.03	0.00	0.01	0.00	0.00	0.00	1.10

TOTALS (lbs/day, unmitigated)	71.74	101.20	755.84	1.16	228.17	44.38	124,199.69

Operational Settings:

Does not include correction for passby trips

Does not include double counting adjustment for internal trips

Analysis Year: 2017 Temperature (F): 60 Season: Winter

Emfac: Version : Emfac2007 V2.3 Nov 1 2006

Summary of Land Uses

Land Use Type	Acreage	Trip Rate	Unit Type	No. Units	Total Trips	Total VMT
Single family housing	423.33	9.57	dwelling units	1,270.00	12,153.90	122,788.42
Elementary school		1.29	students	750.00	967.50	9,317.02
City park		0.01	acres	13.00	0.13	1.18
					13,121.53	132,106.62

Vehicle Fleet Mix

Vehicle Type	Percent Type	Non-Catalyst	Catalyst	Diesel
Light Auto	50.9	0.0	100.0	0.0
Light Truck < 3750 lbs	7.2	0.0	98.6	1.4
Light Truck 3751-5750 lbs	23.2	0.0	100.0	0.0
Med Truck 5751-8500 lbs	10.9	0.0	100.0	0.0
Lite-Heavy Truck 8501-10,000 lbs	1.7	0.0	82.4	17.6
Lite-Heavy Truck 10,001-14,000 lbs	0.5	0.0	60.0	40.0
Med-Heavy Truck 14,001-33,000 lbs	0.9	0.0	22.2	77.8
Heavy-Heavy Truck 33,001-60,000 lbs	0.6	0.0	0.0	100.0
Other Bus	0.1	0.0	0.0	100.0
Urban Bus	0.1	0.0	0.0	100.0
Motorcycle	2.9	44.8	55.2	0.0
School Bus	0.1	0.0	0.0	100.0
Motor Home	0.9	0.0	88.9	11.1

URBEMIS2007 Output File:
2017 Winter Operational

Travel Conditions

	Residential			Commercial		
	Home-Work	Home-Shop	Home-Other	Commute	Non-Work	Customer
Urban Trip Length (miles)	12.7	7.0	9.5	13.3	7.4	8.9
Rural Trip Length (miles)	17.6	12.1	14.9	15.4	9.6	12.6
Trip speeds (mph)	30.0	30.0	30.0	30.0	30.0	30.0
% of Trips - Residential	32.9	18.0	49.1			
% of Trips - Commercial (by land use)						
Elementary school				20.0	10.0	70.0
City park				5.0	2.5	92.5

#	Intersection	Peak Hour	Future No Project V/C or Delay	Future No Project LOS	Future With Project V/C or Delay	Future With Project LOS	Increase in V/C	Significant Project Impact	V/C Increase%	LOS >= C?	Analyze?
148	SB-14 NB Ramps & Via Princessa	AM	0.58	A	0.6	B	0.020	NO	3.4%	No	No
148	SB-14 NB Ramps & Via Princessa	PM	0.90	D	1	E	0.100	YES	11.1%	Yes	Yes
149	SR-14 SB Ramps & Via Princessa	AM	0.52	A	0.53	A	0.010	NO	1.9%	No	No
149	SR-14 SB Ramps & Via Princessa	PM	0.64	E	0.72	C	0.080	YES	12.5%	Yes	Yes
153	Sand Canyon Road and Soledad Canyon Road	AM	0.72	C	0.73	C	0.010	YES	1.4%	Yes	No
153	Sand Canyon Road and Soledad Canyon Road	PM	0.82	D	0.83	D	0.010	YES	1.2%	Yes	No
170	Sierra Highway and Via Princessa	AM	0.77	C	0.79	C	0.020	YES	2.6%	Yes	Yes
170	Sierra Highway and Via Princessa	PM	0.79	C	0.81	D	0.020	YES	2.5%	Yes	Yes
171	Whites Canyon Road and Via Princessa	AM	0.76	C	0.74	C	-0.020	NO	-2.6%	Yes	No
171	Whites Canyon Road and Via Princessa	PM	0.80	C	0.76	C	-0.040	NO	-5.0%	Yes	No
172	Whites Canyon Road and Soledad Canyon Road	AM	1.19	F	1.22	F	0.030	YES	2.5%	Yes	Yes
172	Whites Canyon Road and Soledad Canyon Road	PM	1.19	F	1.26	F	0.070	YES	5.9%	Yes	Yes
173	Santa Catarina/GVR and Plum Canyon Road	AM	0.74	C	0.75	C	0.010	YES	1.4%	Yes	No
173	Santa Catarina/GVR and Plum Canyon Road	PM	0.60	A	0.62	B	0.020	NO	3.3%	No	No
174	Bouquet Canyon Road and Plum Canyon Road	AM	1.10	F	1.1	F	0.000	YES	0.0%	Yes	No
174	Bouquet Canyon Road and Plum Canyon Road	PM	1.27	F	1.34	F	0.070	YES	5.5%	Yes	Yes
176	Sierra Highway and Soledad Canyon Road	AM	1.13	F	1.13	E	0.000	YES	0.0%	Yes	No
176	Sierra Highway and Soledad Canyon Road	PM	1.20	F	1.36	F	0.160	YES	13.3%	Yes	Yes
178	Sierra Highway and SR-14 NB Off Ramp	AM	0.49	A	0.65	B	0.160	NO	32.7%	No	No
178	Sierra Highway and SR-14 NB Off Ramp	PM	0.79	C	0.87	D	0.080	YES	10.1%	Yes	Yes
191	Sierra Highway and Sand Canyon Road	AM	0.59	A	0.6	A	0.010	NO	1.7%	No	No
191	Sierra Highway and Sand Canyon Road	PM	0.69	B	0.69	B	0.000	NO	0.0%	No	No
202	Sierra Highway and Skyline Ranch Road	AM	na	na	0.84	D	0.840	YES	839900.0%	Yes	Yes
202	Sierra Highway and Skyline Ranch Road	PM	na	na	0.71	C	0.710	YES	709900.0%	Yes	Yes
334	Maribel Way and Plum Canyon Road	AM	0.49	A	0.5	A	0.010	NO	2.0%	No	No
334	Maribel Way and Plum Canyon Road	PM	0.49	A	0.51	A	0.020	NO	4.1%	No	No
335	Heller Circle (North) and Plum Canyon Road	AM	0.55	A	0.57	A	0.020	NO	3.6%	No	No
335	Heller Circle (North) and Plum Canyon Road	PM	0.55	A	0.58	A	0.030	NO	5.5%	No	No
336	La Madrid and Plum Canyon Road	AM	0.56	A	0.58	A	0.020	NO	3.6%	No	No
336	La Madrid and Plum Canyon Road	PM	0.77	C	0.78	C	0.010	YES	1.3%	Yes	No

Skyline Ranch

CALINE4 Modeling Results and Estimated Local 1-Hour Carbon Monoxide Concentrations (ppm)

Projected Background 1-Hour CO Concentrations (ppm) [a]

Monitoring Station: Santa Clarita

Year	1-Hr Concentration
2017	5.1

Intersection and Receptor Locations	Future Without Project		Future With Project		
	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Exceedance of Significance Threshold [d]
Bouquet Canyon Road and Plum Canyon Road					
NE	1.1	6.2	1.1	6.2	NO
SE	1.4	6.5	1.4	6.5	NO
SW	1.5	6.6	1.5	6.6	NO
NW	1.1	6.2	1.1	6.2	NO
Bouquet Canyon Road and Plum Canyon Road					
NE	1.1	6.2	1.1	6.2	NO
SE	1.1	6.2	1.1	6.2	NO
SW	1.2	6.3	1.3	6.4	NO
NW	1.0	6.1	1.0	6.1	NO
Sierra Highway and Via Princessa					
NE	1.4	6.5	1.5	6.6	NO
SE	1.6	6.7	1.7	6.8	NO
SW	1.7	6.8	1.7	6.8	NO
NW	1.6	6.7	1.6	6.7	NO
Sierra Highway and Via Princessa					
NE	2.0	7.1	2.2	7.3	NO
SE	2.0	7.1	2.0	7.1	NO
SW	2.1	7.2	2.1	7.2	NO
NW	1.8	6.9	2.0	7.1	NO
SR-14 NB Ramps and Via Princessa					
NE	0.7	5.8	0.7	5.8	NO
SE	0.6	5.7	0.5	5.6	NO
SW	0.5	5.6	0.5	5.6	NO
NW	0.6	5.7	0.6	5.7	NO
SR-14 NB Ramps and Via Princessa					
NE	1.3	6.4	1.3	6.4	NO
SE	1.2	6.3	1.2	6.3	NO
SW	1.2	6.3	1.2	6.3	NO
NW	1.4	6.5	1.3	6.4	NO
SR-14 SB Ramps and Via Princessa					
NE	1.4	6.5	1.4	6.5	NO
SE	1.1	6.2	1.3	6.4	NO
SW	1.3	6.4	1.3	6.4	NO
NW	1.6	6.7	1.5	6.6	NO
SR-14 SB Ramps and Via Princessa					
NE	0.9	6.0	0.9	6.0	NO
SE	0.9	6.0	0.9	6.0	NO
SW	0.8	5.9	0.7	5.8	NO
NW	1.0	6.1	1.0	6.1	NO
Whites Canyon Road and Soledad Canyon Road					
NE	1.6	6.7	1.5	6.6	NO
SE	1.1	6.2	1.1	6.2	NO
SW	1.2	6.3	1.2	6.3	NO
NW	1.6	6.7	1.6	6.7	NO
Whites Canyon Road and Soledad Canyon Road					
NE	1.6	6.7	1.5	6.6	NO
SE	1.8	6.9	1.8	6.9	NO
SW	1.5	6.6	1.4	6.5	NO
NW	1.5	6.6	1.3	6.4	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The 1-hour traffic contribution (ppm) is determined by inputing total traffic volumes into the CALINE4 model.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 1-hour CO concentrations is 20 ppm.

Skyline Ranch

CALINE4 Modeling Results and Estimated Local 8-Hour Carbon Monoxide Concentrations (ppm)

Projected Background 8-Hour CO Concentrations (ppm) [a]	
Monitoring Station: Santa Clarita	Average Persistence Factor = 0.70
Year 2017 — 8-Hr Concentration 2.6	

Intersection and Receptor Locations	Future Without Project: Traffic CO Contribution [b]	Future Without Project: Estimated Local CO Concentration [c]	Future With Project: Traffic CO Contribution [b]	Future With Project: Estimated Local CO Concentration [c]	Future With Project: Exceedance of Significance Threshold [d]
Bouquet Canyon Road and Plum Canyon Road					
NE	0.8	3.4	0.8	3.4	NO
SE	1.0	3.6	1.0	3.6	NO
SW	1.1	3.7	1.1	3.7	NO
NW	0.8	3.4	0.8	3.4	NO
Bouquet Canyon Road and Plum Canyon Road					
NE	0.8	3.4	0.8	3.4	NO
SE	0.8	3.4	0.8	3.4	NO
SW	0.8	3.4	0.9	3.5	NO
NW	0.7	3.3	0.7	3.3	NO
Sierra Highway and Via Princessa					
NE	1.0	3.6	1.1	3.7	NO
SE	1.1	3.7	1.2	3.8	NO
SW	1.2	3.8	1.2	3.8	NO
NW	1.1	3.7	1.1	3.7	NO
Sierra Highway and Via Princessa					
NE	1.4	4.0	1.5	4.1	NO
SE	1.4	4.0	1.4	4.0	NO
SW	1.5	4.1	1.5	4.1	NO
NW	1.3	3.9	1.4	4.0	NO
SR-14 NB Ramps and Via Princessa					
NE	0.5	3.1	0.5	3.1	NO
SE	0.4	3.0	0.4	3.0	NO
SW	0.4	3.0	0.4	3.0	NO
NW	0.4	3.0	0.4	3.0	NO
SR-14 NB Ramps and Via Princessa					
NE	0.9	3.5	0.9	3.5	NO
SE	0.8	3.4	0.8	3.4	NO
SW	0.8	3.4	0.8	3.4	NO
NW	1.0	3.6	0.9	3.5	NO
SR-14 SB Ramps and Via Princessa					
NE	1.0	3.6	1.0	3.6	NO
SE	0.8	3.4	0.9	3.5	NO
SW	0.9	3.5	0.9	3.5	NO
NW	1.1	3.7	1.1	3.7	NO
SR-14 SB Ramps and Via Princessa					
NE	0.6	3.2	0.6	3.2	NO
SE	0.6	3.2	0.6	3.2	NO
SW	0.6	3.2	0.5	3.1	NO
NW	0.7	3.3	0.7	3.3	NO
Whites Canyon Road and Soledad Canyon Road					
NE	1.1	3.7	1.1	3.7	NO
SE	0.8	3.4	0.8	3.4	NO
SW	0.8	3.4	0.8	3.4	NO
NW	1.1	3.7	1.1	3.7	NO
Whites Canyon Road and Soledad Canyon Road					
NE	1.1	3.7	1.1	3.7	NO
SE	1.3	3.9	1.3	3.9	NO
SW	1.1	3.7	1.0	3.6	NO
NW	1.1	3.7	0.9	3.5	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The persistence factor is calculated as recommended in Table B.15 in the Transportation Project-Level Carbon Monoxide Protocol (Institute of Transportation Studi Davis, Revised 1997). This is a generalized persistence factor likely to provide a conservative estimate in most situations.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 8-hour CO concentrations is 9 ppm.

Skyline Ranch

CALINE4 Modeling Results and Estimated Local 1-Hour Carbon Monoxide Concentrations (ppm)

Projected Background 1-Hour CO Concentrations (ppm) [a]

Monitoring Station: Santa Clarita

Year	1-Hr Concentration
2017	5.1

Intersection and Receptor Locations	Future Without Project		Future With Project		
	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Exceedance of Significance Threshold [d]
Sierra Highway and Skyline Ranch Road					
NE	0.5	5.6	0.5	5.6	NO
SE	0.5	5.6	0.7	5.8	NO
SW	0.7	5.8	0.8	5.9	NO
NW	0.7	5.8	0.4	5.5	NO
Sierra Highway and Skyline Ranch Road					
NE	0.7	5.8	0.5	5.6	NO
SE	0.7	5.8	0.7	5.8	NO
SW	0.5	5.6	0.8	5.9	NO
NW	0.5	5.6	0.4	5.5	NO
Sierra Highway and Soledad Canyon Road					
NE	1.4	6.5	1.6	6.7	NO
SE	1.6	6.7	1.7	6.8	NO
SW	1.9	7.0	2.2	7.3	NO
NW	2.2	7.3	2.4	7.5	NO
Sierra Highway and Soledad Canyon Road					
NE	1.4	6.5	1.9	7.0	NO
SE	1.8	6.9	2.2	7.3	NO
SW	2.0	7.1	2.2	7.3	NO
NW	2.0	7.1	2.0	7.1	NO
Sierra Highway and SR-14 NB Off-Ramps					
NE	0.4	5.5	0.5	5.6	NO
SE	0.5	5.6	0.5	5.6	NO
SW	0.7	5.8	0.8	5.9	NO
NW	0.8	5.9	0.5	5.6	NO
Sierra Highway and SR-14 NB Off-Ramps					
NE	0.7	5.8	0.7	5.8	NO
SE	0.7	5.8	0.8	5.9	NO
SW	0.8	5.9	0.6	5.7	NO
NW	0.8	5.9	0.7	5.8	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The 1-hour traffic contribution (ppm) is determined by inputing total traffic volumes into the CALINE4 model.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 1-hour CO concentrations is 20 ppm.

Skyline Ranch

CALINE4 Modeling Results and Estimated Local 8-Hour Carbon Monoxide Concentrations (ppm)

Projected Background 8-Hour CO Concentrations (ppm) [a]	
Monitoring Station: Santa Clarita	Average Persistence Factor = 0.70
Year: 2017 — 8-Hr Concentration: 2.6	

Intersection and Receptor Locations	Future Without Project		Future With Project		
	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Traffic CO Contribution [b]	Estimated Local CO Concentration [c]	Exceedance of Significance Threshold [d]
Sierra Highway and Skyline Ranch Road					
NE	0.4	3.0	0.4	3.0	NO
SE	0.4	3.0	0.5	3.1	NO
SW	0.5	3.1	0.6	3.2	NO
NW	0.5	3.1	0.6	3.2	NO
Sierra Highway and Skyline Ranch Road					
NE	0.5	3.1	0.4	3.0	NO
SE	0.5	3.1	0.5	3.1	NO
SW	0.4	3.0	0.6	3.2	NO
NW	0.4	3.0	0.6	3.2	NO
Sierra Highway and Soledad Canyon Road					
NE	1.0	3.6	1.1	3.7	NO
SE	1.1	3.7	1.2	3.8	NO
SW	1.3	3.9	1.5	4.1	NO
NW	1.5	4.1	1.7	4.3	NO
Sierra Highway and Soledad Canyon Road					
NE	1.0	3.6	1.3	3.9	NO
SE	1.3	3.9	1.5	4.1	NO
SW	1.4	4.0	1.5	4.1	NO
NW	1.4	4.0	1.4	4.0	NO
Sierra Highway and SR-14 NB Off-Ramps					
NE	0.3	2.9	0.4	3.0	NO
SE	0.4	3.0	0.4	3.0	NO
SW	0.5	3.1	0.6	3.2	NO
NW	0.6	3.2	0.4	3.0	NO
Sierra Highway and SR-14 NB Off-Ramps					
NE	0.5	3.1	0.5	3.1	NO
SE	0.5	3.1	0.6	3.2	NO
SW	0.6	3.2	0.4	3.0	NO
NW	0.6	3.2	0.5	3.1	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The persistence factor is calculated as recommended in Table B.15 in the Transportation Project-Level Carbon Monoxide Protocol (Institute of Transportation Studies, UC Davis, Revised 1997). This is a generalized persistence factor likely to provide a conservative estimate in most situations.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 8-hour CO concentrations is 9 ppm.

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: 1SR-14 SB RAMPS AND VIA PRINCESSA AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	0	1.8	.0	35.0
B. NA	0	500	0	0	AG	0	3.4	.0	33.0
C. ND	0	0	0	-500	AG	0	2.2	.0	33.0
D. NE	0	-500	0	-1500	AG	0	1.8	.0	35.0
E. SF	0	1500	0	500	AG	910	1.8	.0	35.0
F. SA	0	500	0	0	AG	880	3.7	.0	33.0
G. SD	0	0	0	-500	AG	1670	3.7	.0	33.0
H. SE	0	-500	0	-1500	AG	1670	1.8	.0	35.0
I. WF	1500	23	500	23	AG	1510	1.8	.0	50.0
J. WA	500	23	0	23	AG	910	2.5	.0	33.0
K. WD	0	23	-500	23	AG	1790	2.0	.0	33.0
L. WE	-500	23	-1500	23	AG	1790	1.8	.0	50.0
M. EF	-1500	-15	-500	-15	AG	1510	1.8	.0	65.0
N. EA	-500	-15	0	-15	AG	1510	2.5	.0	45.0
O. ED	0	-15	500	-15	AG	470	1.9	.0	45.0
P. EE	500	-15	1500	-15	AG	470	1.8	.0	65.0
Q. NL	0	-1900	0	-1800	AG	0	3.4	.0	33.0
R. SL	0	0	0	500	AG	30	3.4	.0	33.0
S. WL	0	0	500	15	AG	600	2.6	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	2.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	1.4	.0	.0	.0	.0	.0	.2	.9	.0
2. SE3	276.	1.1	.0	.0	.0	.0	.0	.0	.4	.0
3. SW3	5.	1.3	.0	.0	.0	.0	.0	.6	.3	.0
4. NW3	176.	1.6	.0	.0	.0	.0	.0	.2	.9	.0
5. NE7	186.	.9	.0	.0	.0	.0	.0	.0	.6	.0
6. SE7	278.	.9	.0	.0	.0	.0	.0	.0	.3	.0
7. SW7	79.	.7	.0	.0	.0	.0	.0	.0	.3	.0
8. NW7	174.	1.0	.0	.0	.0	.0	.0	.0	.6	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.2	.0	.4	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: 1SR-14 SB RAMPS AND VIA PRINCESSA AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	0	1.8	.0	35.0
B. NA	0	500	0	0	AG	0	3.4	.0	33.0
C. ND	0	0	0	-500	AG	0	2.2	.0	33.0
D. NE	0	-500	0	-1500	AG	0	1.8	.0	35.0
E. SF	0	1500	0	500	AG	900	1.8	.0	35.0
F. SA	0	500	0	0	AG	860	3.7	.0	33.0
G. SD	0	0	0	-500	AG	1650	3.7	.0	33.0
H. SE	0	-500	0	-1500	AG	1650	1.8	.0	35.0
I. WF	1500	23	500	23	AG	1500	1.8	.0	50.0
J. WA	500	23	0	23	AG	880	2.4	.0	33.0
K. WD	0	23	-500	23	AG	1740	2.0	.0	33.0
L. WE	-500	23	-1500	23	AG	1740	1.8	.0	50.0
M. EF	-1500	-15	-500	-15	AG	1470	1.8	.0	65.0
N. EA	-500	-15	0	-15	AG	1470	2.5	.0	45.0
O. ED	0	-15	500	-15	AG	480	1.9	.0	45.0
P. EE	500	-15	1500	-15	AG	480	1.8	.0	65.0
Q. NL	0	-1900	0	-1800	AG	0	3.4	.0	33.0
R. SL	0	0	0	500	AG	40	3.4	.0	33.0
S. WL	0	0	500	15	AG	620	2.6	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	2.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	1.4	.0	.0	.0	.0	.0	.2	.9	.0
2. SE3	185.	1.3	.0	.0	.0	.0	.0	.0	1.2	.0
3. SW3	5.	1.3	.0	.0	.0	.0	.0	.5	.3	.0
4. NW3	176.	1.5	.0	.0	.0	.0	.0	.2	.9	.0
5. NE7	186.	.9	.0	.0	.0	.0	.0	.0	.6	.0
6. SE7	278.	.9	.0	.0	.0	.0	.0	.0	.3	.0
7. SW7	79.	.7	.0	.0	.0	.0	.0	.0	.3	.0
8. NW7	174.	1.0	.0	.0	.0	.0	.0	.0	.6	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: 1SR-14 SB RAMPS AND VIA PRINCESSA PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	0	1.8	.0	35.0
B. NA	0	500	0	0	AG	0	3.7	.0	33.0
C. ND	0	0	0	-500	AG	0	3.5	.0	33.0
D. NE	0	-500	0	-1500	AG	0	1.8	.0	35.0
E. SF	0	1500	0	500	AG	410	1.8	.0	35.0
F. SA	0	500	0	0	AG	380	3.7	.0	33.0
G. SD	0	0	0	-500	AG	840	3.7	.0	33.0
H. SE	0	-500	0	-1500	AG	840	1.8	.0	35.0
I. WF	1500	23	500	23	AG	1250	1.8	.0	50.0
J. WA	500	23	0	23	AG	900	2.5	.0	33.0
K. WD	0	23	-500	23	AG	1280	1.9	.0	33.0
L. WE	-500	23	-1500	23	AG	1280	1.8	.0	50.0
M. EF	-1500	-15	-500	-15	AG	1720	1.8	.0	65.0
N. EA	-500	-15	0	-15	AG	1720	2.6	.0	45.0
O. ED	0	-15	500	-15	AG	1260	1.9	.0	45.0
P. EE	500	-15	1500	-15	AG	1260	1.8	.0	65.0
Q. NL	0	-1900	0	-1800	AG	0	3.7	.0	33.0
R. SL	0	0	0	500	AG	30	3.7	.0	33.0
S. WL	0	0	500	15	AG	350	2.4	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	2.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	.9	.0	.0	.0	.0	.0	.0	.5	.0
2. SE3	276.	.9	.0	.0	.0	.0	.0	.0	.2	.0
3. SW3	5.	.8	.0	.0	.0	.0	.0	.3	.2	.0
4. NW3	176.	1.0	.0	.0	.0	.0	.0	.0	.5	.0
5. NE7	263.	.6	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	278.	.7	.0	.0	.0	.0	.0	.0	.2	.0
7. SW7	82.	.6	.0	.0	.0	.0	.0	.0	.2	.0
8. NW7	174.	.7	.0	.0	.0	.0	.0	.0	.4	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.1	.0	.5	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.2	.0	.1	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
8. NW7	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: 1SR-14 SB RAMPS AND VIA PRINCESSA PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	0	1.8	.0	35.0
B. NA	0	500	0	0	AG	0	3.7	.0	33.0
C. ND	0	0	0	-500	AG	0	3.5	.0	33.0
D. NE	0	-500	0	-1500	AG	0	1.8	.0	35.0
E. SF	0	1500	0	500	AG	390	1.8	.0	35.0
F. SA	0	500	0	0	AG	360	3.7	.0	33.0
G. SD	0	0	0	-500	AG	820	3.7	.0	33.0
H. SE	0	-500	0	-1500	AG	820	1.8	.0	35.0
I. WF	1500	23	500	23	AG	1330	1.8	.0	50.0
J. WA	500	23	0	23	AG	970	2.5	.0	33.0
K. WD	0	23	-500	23	AG	1330	2.0	.0	33.0
L. WE	-500	23	-1500	23	AG	1330	1.8	.0	50.0
M. EF	-1500	-15	-500	-15	AG	1620	1.8	.0	65.0
N. EA	-500	-15	0	-15	AG	1620	2.5	.0	45.0
O. ED	0	-15	500	-15	AG	1190	1.9	.0	45.0
P. EE	500	-15	1500	-15	AG	1190	1.8	.0	65.0
Q. NL	0	-1900	0	-1800	AG	0	3.7	.0	33.0
R. SL	0	0	0	500	AG	30	3.7	.0	33.0
S. WL	0	0	500	15	AG	360	2.4	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	2.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	.9	.0	.0	.0	.0	.0	.0	.5	.0
2. SE3	276.	.9	.0	.0	.0	.0	.0	.0	.2	.0
3. SW3	83.	.7	.0	.0	.0	.0	.0	.0	.2	.0
4. NW3	176.	1.0	.0	.0	.0	.0	.0	.0	.5	.0
5. NE7	186.	.6	.0	.0	.0	.0	.0	.0	.4	.0
6. SE7	278.	.7	.0	.0	.0	.0	.0	.0	.2	.0
7. SW7	82.	.6	.0	.0	.0	.0	.0	.0	.2	.0
8. NW7	174.	.6	.0	.0	.0	.0	.0	.0	.4	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.1	.0	.4	.0	.0	.0	.0	.0	.0
3. SW3	.1	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0
4. NW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
8. NW7	.0	.0	.1	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: BOUQUET CANYON ROAD AND PLUM CANYON ROAD AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	980	1.8	.0	50.0
B. NA	23	-500	23	0	AG	970	2.6	.0	45.0
C. ND	23	0	23	500	AG	630	1.9	.0	33.0
D. NE	23	500	23	1500	AG	630	1.8	.0	50.0
E. SF	-23	1500	-23	500	AG	1250	1.8	.0	50.0
F. SA	-23	500	-23	0	AG	760	2.6	.0	45.0
G. SD	-23	0	-23	-500	AG	1610	2.1	.0	33.0
H. SE	-23	-500	-23	-1500	AG	1610	1.8	.0	50.0
I. WF	1500	15	500	15	AG	1160	1.8	.0	35.0
J. WA	500	15	0	15	AG	350	3.2	.0	33.0
K. WD	0	15	-500	15	AG	40	2.1	.0	33.0
L. WE	-500	15	-1500	15	AG	40	1.8	.0	35.0
M. EF	-1500	-15	-500	-15	AG	110	1.8	.0	35.0
N. EA	-500	-15	0	-15	AG	100	3.2	.0	33.0
O. ED	0	-15	500	-15	AG	1220	3.7	.0	33.0
P. EE	500	-15	1500	-15	AG	1220	1.8	.0	35.0
Q. NL	0	0	15	-500	AG	10	2.5	.0	33.0
R. SL	0	0	-15	500	AG	490	2.7	.0	33.0
S. WL	0	0	500	15	AG	810	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.2	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	33	6.0
2. SE3	48	-33	6.0
3. SW3	-48	-33	6.0
4. NW3	-48	33	6.0
5. NE7	61	46	6.0
6. SE7	61	-46	6.0
7. SW7	-61	-46	6.0
8. NW7	-61	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	185.	1.1	.0	.4	.0	.0	.0	.0	.0	.1
2. SE3	83.	1.4	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	85.	1.5	.0	.0	.0	.0	.0	.0	.2	.0
4. NW3	96.	1.1	.0	.0	.0	.0	.0	.1	.0	.0
5. NE7	187.	.8	.0	.3	.0	.0	.0	.0	.0	.1
6. SE7	80.	.8	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	82.	1.1	.0	.0	.0	.0	.0	.0	.2	.0
8. NW7	98.	.9	.0	.0	.0	.0	.0	.1	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.2	.0
2. SE3	.0	.0	.0	.0	.0	.0	.9	.0	.0	.0	.3	.0
3. SW3	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.2	.0
4. NW3	.0	.2	.0	.0	.0	.0	.3	.0	.0	.0	.3	.0
5. NE7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.1	.0
6. SE7	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0	.2	.0
7. SW7	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0	.2	.0
8. NW7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.3	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: BOUQUET CANYON ROAD AND PLUM CANYON ROAD AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	970	1.8	.0	50.0
B. NA	23	-500	23	0	AG	960	2.6	.0	45.0
C. ND	23	0	23	500	AG	640	1.9	.0	33.0
D. NE	23	500	23	1500	AG	640	1.8	.0	50.0
E. SF	-23	1500	-23	500	AG	1240	1.8	.0	50.0
F. SA	-23	500	-23	0	AG	750	2.6	.0	45.0
G. SD	-23	0	-23	-500	AG	1650	2.1	.0	33.0
H. SE	-23	-500	-23	-1500	AG	1650	1.8	.0	50.0
I. WF	1500	15	500	15	AG	1210	1.8	.0	35.0
J. WA	500	15	0	15	AG	360	3.0	.0	33.0
K. WD	0	15	-500	15	AG	40	2.0	.0	33.0
L. WE	-500	15	-1500	15	AG	40	1.8	.0	35.0
M. EF	-1500	-15	-500	-15	AG	120	1.8	.0	35.0
N. EA	-500	-15	0	-15	AG	110	3.0	.0	33.0
O. ED	0	-15	500	-15	AG	1210	3.7	.0	33.0
P. EE	500	-15	1500	-15	AG	1210	1.8	.0	35.0
Q. NL	0	0	15	-500	AG	10	2.6	.0	33.0
R. SL	0	0	-15	500	AG	490	2.7	.0	33.0
S. WL	0	0	500	15	AG	850	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.0	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	33	6.0
2. SE3	48	-33	6.0
3. SW3	-48	-33	6.0
4. NW3	-48	33	6.0
5. NE7	61	46	6.0
6. SE7	61	-46	6.0
7. SW7	-61	-46	6.0
8. NW7	-61	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	185.	1.1	.0	.4	.0	.0	.0	.0	.0	.2
2. SE3	83.	1.4	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	85.	1.5	.0	.0	.0	.0	.0	.0	.2	.0
4. NW3	96.	1.1	.0	.0	.0	.0	.0	.1	.0	.0
5. NE7	187.	.8	.0	.3	.0	.0	.0	.0	.0	.1
6. SE7	80.	.8	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	82.	1.1	.0	.0	.0	.0	.0	.0	.2	.0
8. NW7	98.	.9	.0	.0	.0	.0	.0	.1	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.2	.0
2. SE3	.0	.0	.0	.0	.0	.0	.9	.0	.0	.0	.3	.0
3. SW3	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.3	.0
4. NW3	.0	.2	.0	.0	.0	.0	.3	.0	.0	.0	.3	.0
5. NE7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.1	.0
6. SE7	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0	.2	.0
7. SW7	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0	.2	.0
8. NW7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.3	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: BOUQUET CANYON ROAD AND PLUM CANYON ROAD PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1380	1.8	.0	50.0
B. NA	23	-500	23	0	AG	1320	2.6	.0	45.0
C. ND	23	0	23	500	AG	1110	2.0	.0	33.0
D. NE	23	500	23	1500	AG	1110	1.8	.0	50.0
E. SF	-23	1500	-23	500	AG	700	1.8	.0	50.0
F. SA	-23	500	-23	0	AG	470	2.5	.0	45.0
G. SD	-23	0	-23	-500	AG	1120	2.0	.0	33.0
H. SE	-23	-500	-23	-1500	AG	1120	1.8	.0	50.0
I. WF	1500	15	500	15	AG	1090	1.8	.0	35.0
J. WA	500	15	0	15	AG	460	3.2	.0	33.0
K. WD	0	15	-500	15	AG	90	2.1	.0	33.0
L. WE	-500	15	-1500	15	AG	90	1.8	.0	35.0
M. EF	-1500	-15	-500	-15	AG	50	1.8	.0	35.0
N. EA	-500	-15	0	-15	AG	40	3.2	.0	33.0
O. ED	0	-15	500	-15	AG	900	3.7	.0	33.0
P. EE	500	-15	1500	-15	AG	900	1.8	.0	35.0
Q. NL	0	0	15	-500	AG	60	2.5	.0	33.0
R. SL	0	0	-15	500	AG	230	2.5	.0	33.0
S. WL	0	0	500	15	AG	630	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.2	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	33	6.0
2. SE3	48	-33	6.0
3. SW3	-48	-33	6.0
4. NW3	-48	33	6.0
5. NE7	61	46	6.0
6. SE7	61	-46	6.0
7. SW7	-61	-46	6.0
8. NW7	-61	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	185.	1.1	.0	.5	.0	.0	.0	.0	.0	.1
2. SE3	83.	1.1	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	85.	1.2	.0	.1	.0	.0	.0	.0	.1	.0
4. NW3	95.	1.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	187.	.8	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	353.	.7	.0	.0	.2	.0	.0	.0	.0	.0
7. SW7	82.	1.0	.0	.1	.0	.0	.0	.0	.1	.0
8. NW7	98.	.8	.0	.0	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.1	.0
2. SE3	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.2	.0
3. SW3	.0	.0	.0	.0	.0	.0	.6	.0	.0	.0	.2	.0
4. NW3	.0	.3	.0	.0	.0	.0	.2	.0	.0	.0	.3	.0
5. NE7	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.1	.0
6. SE7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.1	.0
7. SW7	.0	.0	.0	.0	.0	.0	.4	.0	.0	.0	.2	.0
8. NW7	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.2	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: BOUQUET CANYON ROAD AND PLUM CANYON ROAD PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1390	1.8	.0	50.0
B. NA	23	-500	23	0	AG	1330	2.6	.0	45.0
C. ND	23	0	23	500	AG	1100	2.0	.0	33.0
D. NE	23	500	23	1500	AG	1100	1.8	.0	50.0
E. SF	-23	1500	-23	500	AG	700	1.8	.0	50.0
F. SA	-23	500	-23	0	AG	460	2.5	.0	45.0
G. SD	-23	0	-23	-500	AG	1130	2.0	.0	33.0
H. SE	-23	-500	-23	-1500	AG	1130	1.8	.0	50.0
I. WF	1500	15	500	15	AG	1120	1.8	.0	35.0
J. WA	500	15	0	15	AG	470	3.2	.0	33.0
K. WD	0	15	-500	15	AG	90	2.1	.0	33.0
L. WE	-500	15	-1500	15	AG	90	1.8	.0	35.0
M. EF	-1500	-15	-500	-15	AG	50	1.8	.0	35.0
N. EA	-500	-15	0	-15	AG	40	3.2	.0	33.0
O. ED	0	-15	500	-15	AG	940	3.7	.0	33.0
P. EE	500	-15	1500	-15	AG	940	1.8	.0	35.0
Q. NL	0	0	15	-500	AG	60	2.5	.0	33.0
R. SL	0	0	-15	500	AG	240	2.5	.0	33.0
S. WL	0	0	500	15	AG	650	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.2	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	33	6.0
2. SE3	48	-33	6.0
3. SW3	-48	-33	6.0
4. NW3	-48	33	6.0
5. NE7	61	46	6.0
6. SE7	61	-46	6.0
7. SW7	-61	-46	6.0
8. NW7	-61	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	185.	1.1	.0	.5	.0	.0	.0	.0	.0	.1
2. SE3	83.	1.1	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	85.	1.3	.0	.1	.0	.0	.0	.0	.1	.0
4. NW3	95.	1.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	187.	.9	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	353.	.7	.0	.0	.2	.0	.0	.0	.0	.0
7. SW7	82.	1.0	.0	.1	.0	.0	.0	.0	.1	.0
8. NW7	98.	.8	.0	.0	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.1	.0
2. SE3	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.2	.0
3. SW3	.0	.0	.0	.0	.0	.0	.6	.0	.0	.0	.2	.0
4. NW3	.0	.3	.0	.0	.0	.0	.2	.0	.0	.0	.3	.0
5. NE7	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.1	.0
6. SE7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.1	.0
7. SW7	.0	.0	.0	.0	.0	.0	.4	.0	.0	.0	.2	.0
8. NW7	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.2	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND VIA PRINCESSA AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	750	1.8	.0	65.0
B. NA	0	500	0	0	AG	410	2.9	.0	75.0
C. ND	0	0	0	-500	AG	630	2.0	.0	45.0
D. NE	0	-500	0	-1500	AG	630	1.8	.0	65.0
E. SF	0	1500	0	500	AG	1740	1.8	.0	65.0
F. SA	0	500	0	0	AG	1400	2.9	.0	75.0
G. SD	0	0	0	-500	AG	1650	2.2	.0	45.0
H. SE	0	-500	0	-1500	AG	1650	1.8	.0	65.0
I. WF	1500	23	500	23	AG	1570	1.8	.0	65.0
J. WA	500	23	0	23	AG	1270	2.7	.0	75.0
K. WD	0	23	-500	23	AG	2050	2.1	.0	45.0
L. WE	-500	23	-1500	23	AG	2050	1.8	.0	65.0
M. EF	-1500	-15	-500	-15	AG	1510	1.8	.0	50.0
N. EA	-500	-15	0	-15	AG	1350	2.7	.0	60.0
O. ED	0	-15	500	-15	AG	1240	2.0	.0	33.0
P. EE	500	-15	1500	-15	AG	1240	1.8	.0	50.0
Q. NL	0	-1900	0	-1800	AG	340	2.9	.0	33.0
R. SL	0	0	0	500	AG	340	2.9	.0	33.0
S. WL	0	0	500	15	AG	300	2.7	.0	33.0
T. EL	0	-1900	0	-1800	AG	160	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	182.	1.4	.0	.0	.2	.0	.0	.1	.5	.1
2. SE3	358.	1.6	.0	.2	.0	.0	.2	.5	.2	.0
3. SW3	2.	1.7	.0	.2	.0	.0	.2	.5	.2	.0
4. NW3	178.	1.6	.0	.0	.2	.0	.0	.1	.5	.1
5. NE7	263.	1.1	.0	.0	.0	.0	.0	.2	.0	.0
6. SE7	357.	1.1	.0	.1	.0	.0	.1	.4	.0	.0
7. SW7	3.	1.2	.0	.1	.0	.0	.1	.4	.0	.0
8. NW7	175.	1.3	.0	.0	.2	.0	.0	.2	.4	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.1	.0	.0	.2	.0	.0
3. SW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.2	.0	.0
4. NW3	.0	.0	.3	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.4	.0	.1	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0
7. SW7	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND VIA PRINCESSA AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	770	1.8	.0	65.0
B. NA	0	500	0	0	AG	430	2.8	.0	75.0
C. ND	0	0	0	-500	AG	660	2.0	.0	45.0
D. NE	0	-500	0	-1500	AG	660	1.8	.0	65.0
E. SF	0	1500	0	500	AG	1830	1.8	.0	65.0
F. SA	0	500	0	0	AG	1540	2.9	.0	75.0
G. SD	0	0	0	-500	AG	1690	2.2	.0	45.0
H. SE	0	-500	0	-1500	AG	1690	1.8	.0	65.0
I. WF	1500	23	500	23	AG	1530	1.8	.0	65.0
J. WA	500	23	0	23	AG	1210	2.7	.0	75.0
K. WD	0	23	-500	23	AG	2100	2.2	.0	45.0
L. WE	-500	23	-1500	23	AG	2100	1.8	.0	65.0
M. EF	-1500	-15	-500	-15	AG	1460	1.8	.0	50.0
N. EA	-500	-15	0	-15	AG	1290	2.8	.0	60.0
O. ED	0	-15	500	-15	AG	1140	2.1	.0	33.0
P. EE	500	-15	1500	-15	AG	1140	1.8	.0	50.0
Q. NL	0	-1900	0	-1800	AG	340	2.8	.0	33.0
R. SL	0	0	0	500	AG	290	2.8	.0	33.0
S. WL	0	0	500	15	AG	320	2.7	.0	33.0
T. EL	0	-1900	0	-1800	AG	170	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	182.	1.5	.0	.0	.2	.0	.0	.1	.5	.2
2. SE3	358.	1.7	.0	.2	.0	.0	.2	.5	.2	.0
3. SW3	2.	1.7	.0	.2	.0	.0	.2	.5	.2	.0
4. NW3	178.	1.6	.0	.0	.2	.0	.0	.1	.5	.2
5. NE7	263.	1.1	.0	.0	.0	.0	.0	.2	.0	.0
6. SE7	357.	1.2	.0	.1	.0	.0	.2	.5	.0	.0
7. SW7	3.	1.2	.0	.1	.0	.0	.2	.5	.0	.0
8. NW7	175.	1.3	.0	.0	.2	.0	.0	.2	.4	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.1	.0	.0	.1	.0	.0
3. SW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.1	.0	.0
4. NW3	.0	.0	.3	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.4	.0	.1	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0
7. SW7	.0	.0	.1	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND VIA PRINCESSA PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	1720	1.8	.0	65.0
B. NA	0	500	0	0	AG	1020	2.7	.0	75.0
C. ND	0	0	0	-500	AG	1280	2.0	.0	45.0
D. NE	0	-500	0	-1500	AG	1280	1.8	.0	65.0
E. SF	0	1500	0	500	AG	1840	1.8	.0	65.0
F. SA	0	500	0	0	AG	1560	2.8	.0	75.0
G. SD	0	0	0	-500	AG	920	2.0	.0	45.0
H. SE	0	-500	0	-1500	AG	920	1.8	.0	65.0
I. WF	1500	23	500	23	AG	1410	1.8	.0	65.0
J. WA	500	23	0	23	AG	1280	2.9	.0	75.0
K. WD	0	23	-500	23	AG	2730	3.2	.0	45.0
L. WE	-500	23	-1500	23	AG	2730	1.8	.0	65.0
M. EF	-1500	-15	-500	-15	AG	1800	1.8	.0	50.0
N. EA	-500	-15	0	-15	AG	1410	3.0	.0	60.0
O. ED	0	-15	500	-15	AG	1840	3.2	.0	33.0
P. EE	500	-15	1500	-15	AG	1840	1.8	.0	50.0
Q. NL	0	-1900	0	-1800	AG	700	2.8	.0	33.0
R. SL	0	0	0	500	AG	280	2.7	.0	33.0
S. WL	0	0	500	15	AG	130	2.8	.0	33.0
T. EL	0	-1900	0	-1800	AG	390	2.8	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	264.	2.0	.0	.1	.0	.0	.0	.2	.0	.0
2. SE3	358.	2.0	.2	.3	.2	.0	.2	.5	.1	.0
3. SW3	2.	2.1	.2	.3	.2	.0	.2	.5	.1	.0
4. NW3	178.	1.8	.0	.0	.4	.1	.0	.1	.3	.0
5. NE7	262.	1.5	.0	.1	.0	.0	.0	.2	.0	.0
6. SE7	357.	1.5	.1	.3	.0	.0	.2	.4	.0	.0
7. SW7	3.	1.6	.1	.3	.0	.0	.2	.4	.0	.0
8. NW7	175.	1.5	.0	.1	.3	.0	.0	.2	.2	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	1.2	.0	.1	.2	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.1	.0	.0
3. SW3	.0	.0	.3	.0	.0	.2	.0	.0	.0	.1	.0	.0
4. NW3	.0	.0	.5	.0	.0	.2	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.7	.0	.1	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
7. SW7	.0	.0	.3	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.4	.0	.0	.2	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND VIA PRINCESSA PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	1500	0	500	AG	1840	1.8	.0	65.0
B. NA	0	500	0	0	AG	1030	2.7	.0	75.0
C. ND	0	0	0	-500	AG	1270	2.0	.0	45.0
D. NE	0	-500	0	-1500	AG	1270	1.8	.0	65.0
E. SF	0	1500	0	500	AG	1840	1.8	.0	65.0
F. SA	0	500	0	0	AG	1540	2.7	.0	75.0
G. SD	0	0	0	-500	AG	900	2.0	.0	45.0
H. SE	0	-500	0	-1500	AG	900	1.8	.0	65.0
I. WF	1500	23	500	23	AG	1440	1.8	.0	65.0
J. WA	500	23	0	23	AG	1310	2.9	.0	75.0
K. WD	0	23	-500	23	AG	2850	3.5	.0	45.0
L. WE	-500	23	-1500	23	AG	2850	1.8	.0	65.0
M. EF	-1500	-15	-500	-15	AG	1620	1.8	.0	50.0
N. EA	-500	-15	0	-15	AG	1250	2.9	.0	60.0
O. ED	0	-15	500	-15	AG	1720	3.4	.0	33.0
P. EE	500	-15	1500	-15	AG	1720	1.8	.0	50.0
Q. NL	0	-1900	0	-1800	AG	810	2.8	.0	33.0
R. SL	0	0	0	500	AG	300	2.7	.0	33.0
S. WL	0	0	500	15	AG	130	2.9	.0	33.0
T. EL	0	-1900	0	-1800	AG	370	2.9	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	264.	2.2	.0	.1	.0	.0	.0	.2	.0	.0
2. SE3	358.	2.0	.2	.3	.2	.0	.2	.5	.1	.0
3. SW3	2.	2.1	.2	.3	.2	.0	.2	.5	.1	.0
4. NW3	264.	2.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	262.	1.6	.0	.1	.0	.0	.0	.2	.0	.0
6. SE7	357.	1.5	.2	.3	.0	.0	.2	.4	.0	.0
7. SW7	3.	1.6	.2	.3	.0	.0	.2	.4	.0	.0
8. NW7	175.	1.5	.0	.1	.3	.0	.0	.2	.2	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	1.4	.0	.1	.1	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.1	.0	.0
3. SW3	.0	.0	.3	.0	.0	.2	.0	.0	.0	.1	.0	.0
4. NW3	.0	.0	1.5	.1	.1	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.9	.0	.1	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
7. SW7	.0	.0	.3	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.5	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SR-14 NB RAMPS AND VIA PRINCESSA AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	-1500	0	-500	AG	540	1.8	.0	35.0
B. NA	0	-500	0	0	AG	300	3.7	.0	33.0
C. ND	0	0	0	500	AG	390	3.4	.0	33.0
D. NE	0	500	0	1500	AG	390	1.8	.0	35.0
E. SF	0	-1500	0	-500	AG	0	1.8	.0	35.0
F. SA	0	-500	0	0	AG	0	3.4	.0	33.0
G. SD	0	0	0	500	AG	0	2.2	.0	33.0
H. SE	0	500	0	1500	AG	0	1.8	.0	35.0
I. WF	1500	15	500	15	AG	1390	1.8	.0	65.0
J. WA	500	15	0	15	AG	1390	2.5	.0	45.0
K. WD	0	15	-500	15	AG	1520	1.9	.0	45.0
L. WE	-500	15	-1500	15	AG	1520	1.8	.0	65.0
M. EF	-1500	-23	-500	-23	AG	480	1.8	.0	50.0
N. EA	-500	-23	0	-23	AG	200	2.3	.0	33.0
O. ED	0	-23	500	-23	AG	500	1.9	.0	33.0
P. EE	500	-23	1500	-23	AG	500	1.8	.0	50.0
Q. NL	0	0	0	-500	AG	240	3.4	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	3.4	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
T. EL	0	0	-500	-15	AG	280	2.4	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	.7	.0	.2	.0	.0	.0	.0	.0	.0
2. SE3	356.	.6	.0	.0	.3	.0	.0	.0	.0	.0
3. SW3	83.	.5	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	96.	.6	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	186.	.5	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	277.	.4	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	81.	.4	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	97.	.5	.0	.0	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0
4. NW3	.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.2	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SR-14 NB RAMPS AND VIA PRINCESSA AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	-1500	0	-500	AG	540	1.8	.0	35.0
B. NA	0	-500	0	0	AG	300	3.7	.0	33.0
C. ND	0	0	0	500	AG	380	3.2	.0	33.0
D. NE	0	500	0	1500	AG	380	1.8	.0	35.0
E. SF	0	-1500	0	-500	AG	0	1.8	.0	35.0
F. SA	0	-500	0	0	AG	0	3.4	.0	33.0
G. SD	0	0	0	500	AG	0	2.2	.0	33.0
H. SE	0	500	0	1500	AG	0	1.8	.0	35.0
I. WF	1500	15	500	15	AG	1370	1.8	.0	65.0
J. WA	500	15	0	15	AG	1370	2.5	.0	45.0
K. WD	0	15	-500	15	AG	1500	1.9	.0	45.0
L. WE	-500	15	-1500	15	AG	1500	1.8	.0	65.0
M. EF	-1500	-23	-500	-23	AG	480	1.8	.0	50.0
N. EA	-500	-23	0	-23	AG	210	2.3	.0	33.0
O. ED	0	-23	500	-23	AG	510	1.9	.0	33.0
P. EE	500	-23	1500	-23	AG	510	1.8	.0	50.0
Q. NL	0	0	0	-500	AG	240	3.4	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	3.4	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
T. EL	0	0	-500	-15	AG	270	2.4	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	.7	.0	.2	.0	.0	.0	.0	.0	.0
2. SE3	276.	.5	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	83.	.5	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	96.	.6	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	186.	.5	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	277.	.4	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	81.	.4	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	97.	.5	.0	.0	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0
2. SE3	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0
4. NW3	.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.2	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.1	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0
8. NW7	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SR-14 NB RAMPS AND VIA PRINCESSA PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	-1500	0	-500	AG	1390	1.8	.0	35.0
B. NA	0	-500	0	0	AG	650	3.7	.0	33.0
C. ND	0	0	0	500	AG	680	2.7	.0	33.0
D. NE	0	500	0	1500	AG	680	1.8	.0	35.0
E. SF	0	-1500	0	-500	AG	0	1.8	.0	35.0
F. SA	0	-500	0	0	AG	0	2.9	.0	33.0
G. SD	0	0	0	500	AG	0	2.0	.0	33.0
H. SE	0	500	0	1500	AG	0	1.8	.0	35.0
I. WF	1500	15	500	15	AG	620	1.8	.0	65.0
J. WA	500	15	0	15	AG	620	2.7	.0	45.0
K. WD	0	15	-500	15	AG	1250	2.0	.0	45.0
L. WE	-500	15	-1500	15	AG	1250	1.8	.0	65.0
M. EF	-1500	-23	-500	-23	AG	1250	1.8	.0	50.0
N. EA	-500	-23	0	-23	AG	680	2.7	.0	33.0
O. ED	0	-23	500	-23	AG	1330	2.1	.0	33.0
P. EE	500	-23	1500	-23	AG	1330	1.8	.0	50.0
Q. NL	0	0	0	-500	AG	740	3.7	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.9	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	570	2.9	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	1.3	.0	.4	.0	.0	.0	.0	.0	.0
2. SE3	185.	1.2	.0	.5	.0	.0	.0	.0	.0	.0
3. SW3	175.	1.2	.0	.5	.0	.0	.0	.0	.0	.0
4. NW3	176.	1.4	.0	.4	.0	.0	.0	.0	.0	.0
5. NE7	186.	.8	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	277.	.8	.0	.1	.0	.0	.0	.0	.0	.0
7. SW7	84.	.7	.0	.1	.0	.0	.0	.0	.0	.0
8. NW7	174.	.9	.0	.3	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.6	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.6	.0	.0	.0
4. NW3	.0	.0	.1	.0	.0	.0	.0	.0	.5	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.2	.0	.0	.2	.0	.0	.1
7. SW7	.0	.0	.0	.0	.0	.0	.2	.0	.2	.0	.0	.0
8. NW7	.0	.0	.1	.0	.0	.0	.0	.0	.3	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SR-14 NB RAMPS AND VIA PRINCESSA PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	0	-1500	0	-500	AG	1460	1.8	.0	35.0
B. NA	0	-500	0	0	AG	640	3.4	.0	33.0
C. ND	0	0	0	500	AG	630	2.2	.0	33.0
D. NE	0	500	0	1500	AG	630	1.8	.0	35.0
E. SF	0	-1500	0	-500	AG	0	1.8	.0	35.0
F. SA	0	-500	0	0	AG	0	2.9	.0	33.0
G. SD	0	0	0	500	AG	0	2.0	.0	33.0
H. SE	0	500	0	1500	AG	0	1.8	.0	35.0
I. WF	1500	15	500	15	AG	630	1.8	.0	65.0
J. WA	500	15	0	15	AG	630	2.7	.0	45.0
K. WD	0	15	-500	15	AG	1340	2.0	.0	45.0
L. WE	-500	15	-1500	15	AG	1340	1.8	.0	65.0
M. EF	-1500	-23	-500	-23	AG	1180	1.8	.0	50.0
N. EA	-500	-23	0	-23	AG	660	2.7	.0	33.0
O. ED	0	-23	500	-23	AG	1300	2.1	.0	33.0
P. EE	500	-23	1500	-23	AG	1300	1.8	.0	50.0
Q. NL	0	0	0	-500	AG	820	3.7	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.9	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	520	2.9	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	18	48	6.0
2. SE3	18	-48	6.0
3. SW3	-18	-48	6.0
4. NW3	-18	48	6.0
5. NE7	31	61	6.0
6. SE7	31	-61	6.0
7. SW7	-31	-61	6.0
8. NW7	-31	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	184.	1.3	.0	.4	.0	.0	.0	.0	.0	.0
2. SE3	185.	1.2	.0	.5	.0	.0	.0	.0	.0	.0
3. SW3	175.	1.2	.0	.5	.0	.0	.0	.0	.0	.0
4. NW3	176.	1.3	.0	.4	.0	.0	.0	.0	.0	.0
5. NE7	186.	.8	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	277.	.8	.0	.1	.0	.0	.0	.0	.0	.0
7. SW7	84.	.7	.0	.1	.0	.0	.0	.0	.0	.0
8. NW7	174.	.9	.0	.3	.0	.0	.0	.0	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0
4. NW3	.0	.0	.1	.0	.0	.0	.0	.0	.5	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.4	.0	.0	.0
6. SE7	.0	.0	.0	.1	.0	.2	.0	.0	.2	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.2	.0	.2	.0	.0	.0
8. NW7	.0	.0	.1	.0	.0	.0	.0	.0	.4	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: WHITES CANYON ROAD AND SOLEDAD CANYON AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	30	-1500	30	-500	AG	1150	1.8	.0	50.0
B. NA	30	-500	30	0	AG	790	2.9	.0	60.0
C. ND	30	0	30	500	AG	1170	2.2	.0	33.0
D. NE	30	500	30	1500	AG	1170	1.8	.0	50.0
E. SF	-30	1500	-30	500	AG	1860	1.8	.0	50.0
F. SA	-30	500	-30	0	AG	1310	2.9	.0	60.0
G. SD	-30	0	-30	-500	AG	1760	3.3	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1760	1.8	.0	50.0
I. WF	1500	38	500	38	AG	2200	1.8	.0	50.0
J. WA	500	38	0	38	AG	1790	2.8	.0	60.0
K. WD	0	38	-500	38	AG	2110	3.0	.0	33.0
L. WE	-500	38	-1500	38	AG	2110	1.8	.0	50.0
M. EF	-1500	-30	-500	-30	AG	1390	1.8	.0	65.0
N. EA	-500	-30	0	-30	AG	1240	2.7	.0	75.0
O. ED	0	-30	500	-30	AG	1560	2.0	.0	45.0
P. EE	500	-30	1500	-30	AG	1560	1.8	.0	65.0
Q. NL	0	0	23	-500	AG	360	2.9	.0	33.0
R. SL	0	0	-23	500	AG	550	2.9	.0	33.0
S. WL	0	0	500	30	AG	410	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	150	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	63	6.0
2. SE3	55	-63	6.0
3. SW3	-55	-63	6.0
4. NW3	-55	63	6.0
5. NE7	68	76	6.0
6. SE7	68	-76	6.0
7. SW7	-68	-76	6.0
8. NW7	-68	76	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	264.	1.6	.0	.0	.2	.0	.0	.1	.0	.0
2. SE3	352.	1.1	.0	.1	.3	.0	.1	.1	.0	.0
3. SW3	81.	1.2	.0	.0	.0	.0	.0	.0	.3	.0
4. NW3	174.	1.6	.1	.0	.0	.0	.0	.2	.7	.0
5. NE7	257.	1.1	.0	.0	.1	.0	.0	.1	.0	.0
6. SE7	348.	.9	.0	.0	.2	.0	.0	.2	.0	.0
7. SW7	75.	1.0	.0	.0	.0	.0	.0	.0	.3	.0
8. NW7	168.	1.2	.0	.1	.0	.0	.0	.1	.5	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.7	.0	.1	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
3. SW3	.1	.1	.0	.0	.0	.1	.3	.0	.0	.0	.0	.0
4. NW3	.0	.0	.4	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.5	.0	.0	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.1	.0	.0	.1	.0	.0
7. SW7	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
8. NW7	.0	.0	.3	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: WHITES CANYON ROAD AND SOLEDAD CANYON AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	30	-1500	30	-500	AG	1100	1.8	.0	50.0
B. NA	30	-500	30	0	AG	750	2.9	.0	60.0
C. ND	30	0	30	500	AG	1060	2.1	.0	33.0
D. NE	30	500	30	1500	AG	1060	1.8	.0	50.0
E. SF	-30	1500	-30	500	AG	1770	1.8	.0	50.0
F. SA	-30	500	-30	0	AG	1330	2.9	.0	60.0
G. SD	-30	0	-30	-500	AG	1830	3.4	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1830	1.8	.0	50.0
I. WF	1500	38	500	38	AG	2130	1.8	.0	50.0
J. WA	500	38	0	38	AG	1650	2.8	.0	60.0
K. WD	0	38	-500	38	AG	2070	2.9	.0	33.0
L. WE	-500	38	-1500	38	AG	2070	1.8	.0	50.0
M. EF	-1500	-30	-500	-30	AG	1370	1.8	.0	65.0
N. EA	-500	-30	0	-30	AG	1210	2.7	.0	75.0
O. ED	0	-30	500	-30	AG	1410	2.0	.0	45.0
P. EE	500	-30	1500	-30	AG	1410	1.8	.0	65.0
Q. NL	0	0	23	-500	AG	350	2.9	.0	33.0
R. SL	0	0	-23	500	AG	440	2.9	.0	33.0
S. WL	0	0	500	30	AG	480	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	160	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	63	6.0
2. SE3	55	-63	6.0
3. SW3	-55	-63	6.0
4. NW3	-55	63	6.0
5. NE7	68	76	6.0
6. SE7	68	-76	6.0
7. SW7	-68	-76	6.0
8. NW7	-68	76	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	264.	1.5	.0	.0	.1	.0	.0	.1	.0	.0
2. SE3	352.	1.1	.0	.1	.3	.0	.1	.1	.0	.0
3. SW3	81.	1.2	.0	.0	.0	.0	.0	.0	.4	.0
4. NW3	174.	1.6	.1	.0	.0	.0	.0	.2	.7	.0
5. NE7	258.	1.1	.0	.0	.1	.0	.0	.1	.0	.0
6. SE7	278.	.9	.0	.1	.0	.0	.0	.0	.2	.0
7. SW7	75.	1.0	.0	.0	.0	.0	.0	.0	.3	.0
8. NW7	168.	1.2	.0	.1	.0	.0	.0	.1	.5	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.7	.0	.1	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
3. SW3	.1	.0	.0	.0	.0	.1	.3	.0	.0	.0	.0	.0
4. NW3	.0	.0	.4	.0	.0	.1	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.5	.0	.0	.1	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.2	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
8. NW7	.0	.0	.3	.0	.0	.1	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: WHITES CANYON ROAD AND SOLEDAD CANYON PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	30	-1500	30	-500	AG	1730	1.8	.0	50.0
B. NA	30	-500	30	0	AG	1250	3.0	.0	60.0
C. ND	30	0	30	500	AG	2140	3.7	.0	33.0
D. NE	30	500	30	1500	AG	2140	1.8	.0	50.0
E. SF	-30	1500	-30	500	AG	1460	1.8	.0	50.0
F. SA	-30	500	-30	0	AG	810	3.0	.0	60.0
G. SD	-30	0	-30	-500	AG	1500	3.4	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1500	1.8	.0	50.0
I. WF	1500	38	500	38	AG	1990	1.8	.0	50.0
J. WA	500	38	0	38	AG	1550	2.7	.0	60.0
K. WD	0	38	-500	38	AG	1580	2.2	.0	33.0
L. WE	-500	38	-1500	38	AG	1580	1.8	.0	50.0
M. EF	-1500	-30	-500	-30	AG	2520	1.8	.0	65.0
N. EA	-500	-30	0	-30	AG	2030	2.7	.0	75.0
O. ED	0	-30	500	-30	AG	2480	2.2	.0	45.0
P. EE	500	-30	1500	-30	AG	2480	1.8	.0	65.0
Q. NL	0	0	23	-500	AG	480	3.0	.0	33.0
R. SL	0	0	-23	500	AG	650	3.0	.0	33.0
S. WL	0	0	500	30	AG	440	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	490	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	63	6.0
2. SE3	55	-63	6.0
3. SW3	-55	-63	6.0
4. NW3	-55	63	6.0
5. NE7	68	76	6.0
6. SE7	68	-76	6.0
7. SW7	-68	-76	6.0
8. NW7	-68	76	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	262.	1.6	.0	.0	.5	.0	.0	.0	.0	.0
2. SE3	354.	1.8	.0	.2	.9	.0	.1	.0	.0	.0
3. SW3	83.	1.5	.0	.1	.0	.0	.0	.0	.3	.0
4. NW3	173.	1.5	.1	.0	.0	.0	.0	.1	.6	.0
5. NE7	256.	1.3	.0	.0	.4	.0	.0	.0	.0	.0
6. SE7	348.	1.4	.0	.1	.6	.0	.0	.1	.0	.0
7. SW7	75.	1.2	.0	.1	.0	.0	.0	.0	.2	.0
8. NW7	168.	1.2	.0	.2	.0	.0	.0	.0	.4	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.4	.0	.2	.1	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0
3. SW3	.2	.0	.0	.0	.0	.2	.6	.0	.0	.0	.0	.0
4. NW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.3	.0	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.1	.0	.0
7. SW7	.0	.2	.0	.0	.0	.1	.4	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.2	.0	.0	.1	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: WHITES CANYON ROAD AND SOLEDAD CANYON PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= 15.6 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	30	-1500	30	-500	AG	1830	1.8	.0	50.0
B. NA	30	-500	30	0	AG	1410	3.2	.0	60.0
C. ND	30	0	30	500	AG	2110	3.6	.0	33.0
D. NE	30	500	30	1500	AG	2110	1.8	.0	50.0
E. SF	-30	1500	-30	500	AG	1260	1.8	.0	50.0
F. SA	-30	500	-30	0	AG	750	2.9	.0	60.0
G. SD	-30	0	-30	-500	AG	1360	2.8	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1360	1.8	.0	50.0
I. WF	1500	38	500	38	AG	1820	1.8	.0	50.0
J. WA	500	38	0	38	AG	1380	2.7	.0	60.0
K. WD	0	38	-500	38	AG	1540	2.2	.0	33.0
L. WE	-500	38	-1500	38	AG	1540	1.8	.0	50.0
M. EF	-1500	-30	-500	-30	AG	2500	1.8	.0	65.0
N. EA	-500	-30	0	-30	AG	1980	2.7	.0	75.0
O. ED	0	-30	500	-30	AG	2400	2.2	.0	45.0
P. EE	500	-30	1500	-30	AG	2400	1.8	.0	65.0
Q. NL	0	0	23	-500	AG	420	2.9	.0	33.0
R. SL	0	0	-23	500	AG	510	3.0	.0	33.0
S. WL	0	0	500	30	AG	440	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	520	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	63	6.0
2. SE3	55	-63	6.0
3. SW3	-55	-63	6.0
4. NW3	-55	63	6.0
5. NE7	68	76	6.0
6. SE7	68	-76	6.0
7. SW7	-68	-76	6.0
8. NW7	-68	76	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	262.	1.5	.0	.0	.5	.0	.0	.0	.0	.0
2. SE3	354.	1.8	.0	.2	.9	.0	.1	.0	.0	.0
3. SW3	83.	1.4	.0	.2	.0	.0	.0	.0	.2	.0
4. NW3	172.	1.3	.1	.1	.0	.0	.0	.1	.5	.0
5. NE7	256.	1.2	.0	.0	.4	.0	.0	.0	.0	.0
6. SE7	348.	1.3	.0	.1	.6	.0	.0	.1	.0	.0
7. SW7	75.	1.1	.0	.1	.0	.0	.0	.0	.2	.0
8. NW7	168.	1.1	.0	.2	.0	.0	.0	.0	.3	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.4	.0	.2	.1	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0
3. SW3	.1	.0	.0	.0	.0	.2	.5	.0	.0	.0	.0	.0
4. NW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.3	.0	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.2	.0	.0	.1	.0	.0
7. SW7	.0	.1	.0	.0	.0	.1	.4	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SKYLINE RANCH ROAD AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U=	.5 M/S	Z0=	100. CM	ALT=	0. (FT)
BRG=	WORST CASE	VD=	.0 CM/S		
CLAS=	7 (G)	VS=	.0 CM/S		
MIXH=	1000. M	AMB=	.0 PPM		
SIGTH=	5. DEGREES	TEMP=	.5 DEGREE (C)		

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	15	-1500	15	-500	AG	820	1.6	.0	50.0
B. NA	15	-500	15	0	AG	820	2.3	.0	33.0
C. ND	15	0	15	500	AG	820	1.8	.0	33.0
D. NE	15	500	15	1500	AG	820	1.6	.0	50.0
E. SF	-15	1500	-15	500	AG	1610	1.6	.0	50.0
F. SA	-15	500	-15	0	AG	1610	2.8	.0	33.0
G. SD	-15	0	-15	-500	AG	1610	1.9	.0	33.0
H. SE	-15	-500	-15	-1500	AG	1610	1.6	.0	50.0
I. WF	0	1800	0	1900	AG	0	1.6	.0	35.0
J. WA	0	1800	0	1900	AG	0	3.7	.0	33.0
K. WD	0	1800	0	1900	AG	0	3.7	.0	33.0
L. WE	0	1800	0	1900	AG	0	1.6	.0	35.0
M. EF	0	1800	0	1900	AG	0	1.6	.0	35.0
N. EA	0	1800	0	1900	AG	0	3.7	.0	33.0
O. ED	0	1800	0	1900	AG	0	3.7	.0	33.0
P. EE	0	1800	0	1900	AG	0	1.6	.0	35.0
Q. NL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	3.7	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	3.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	40	25	6.0
2. SE3	40	-25	6.0
3. SW3	-40	-25	6.0
4. NW3	-40	25	6.0
5. NE7	53	38	6.0
6. SE7	53	-38	6.0
7. SW7	-53	-38	6.0
8. NW7	-53	38	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	352.	.5	.0	.0	.2	.0	.0	.2	.0	.0
2. SE3	353.	.5	.0	.0	.2	.0	.0	.2	.0	.0
3. SW3	6.	.7	.0	.0	.0	.0	.0	.5	.0	.0
4. NW3	6.	.7	.0	.0	.0	.0	.0	.5	.0	.0
5. NE7	349.	.4	.0	.0	.1	.0	.0	.2	.0	.0
6. SE7	351.	.4	.0	.0	.1	.0	.0	.2	.0	.0
7. SW7	7.	.5	.0	.0	.0	.0	.0	.4	.0	.0
8. NW7	7.	.5	.0	.0	.0	.0	.0	.3	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SKYLINE RANCH ROAD AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U=	.5 M/S	Z0=	100. CM	ALT=	0. (FT)
BRG=	WORST CASE	VD=	.0 CM/S		
CLAS=	7 (G)	VS=	.0 CM/S		
MIXH=	1000. M	AMB=	.0 PPM		
SIGTH=	5. DEGREES	TEMP=	.5 DEGREE (C)		

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1060	1.6	.0	50.0
B. NA	23	-500	23	0	AG	720	2.3	.0	45.0
C. ND	23	0	23	500	AG	870	1.8	.0	33.0
D. NE	23	500	23	1500	AG	870	1.6	.0	50.0
E. SF	-23	1500	-23	500	AG	1610	1.6	.0	50.0
F. SA	-23	500	-23	0	AG	1610	2.4	.0	45.0
G. SD	-23	0	-23	-500	AG	2010	2.0	.0	33.0
H. SE	-23	-500	-23	-1500	AG	2010	1.6	.0	50.0
I. WF	0	1800	0	1900	AG	0	1.6	.0	35.0
J. WA	0	1800	0	1900	AG	0	3.5	.0	33.0
K. WD	0	1800	0	1900	AG	410	3.7	.0	33.0
L. WE	0	1800	0	1900	AG	410	1.6	.0	35.0
M. EF	-1500	-8	-500	-8	AG	620	1.6	.0	35.0
N. EA	-500	-8	0	-8	AG	470	3.7	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.2	.0	33.0
P. EE	0	1800	0	1900	AG	0	1.6	.0	35.0
Q. NL	0	0	15	-500	AG	340	2.3	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	3.5	.0	33.0
T. EL	0	0	-500	-8	AG	150	3.5	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	25	6.0
2. SE3	48	-25	6.0
3. SW3	-48	-25	6.0
4. NW3	-48	25	6.0
5. NE7	61	38	6.0
6. SE7	61	-38	6.0
7. SW7	-61	-38	6.0
8. NW7	-61	38	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	264.	.5	.0	.0	.0	.0	.0	.1	.0	.0
2. SE3	274.	.7	.0	.0	.0	.0	.0	.0	.1	.0
3. SW3	5.	.9	.0	.0	.0	.0	.0	.6	.0	.0
4. NW3	172.	.8	.0	.0	.0	.0	.0	.0	.5	.0
5. NE7	262.	.4	.0	.0	.0	.0	.0	.1	.0	.0
6. SE7	276.	.5	.0	.0	.0	.0	.0	.0	.1	.0
7. SW7	6.	.6	.0	.0	.0	.0	.0	.3	.0	.0
8. NW7	173.	.6	.0	.0	.0	.0	.0	.0	.3	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SKYLINE RANCH ROAD PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	15	-1500	15	-500	AG	1480	1.6	.0	50.0
B. NA	15	-500	15	0	AG	1480	2.7	.0	33.0
C. ND	15	0	15	500	AG	1480	1.8	.0	33.0
D. NE	15	500	15	1500	AG	1480	1.6	.0	50.0
E. SF	-15	1500	-15	500	AG	970	1.6	.0	50.0
F. SA	-15	500	-15	0	AG	970	2.4	.0	33.0
G. SD	-15	0	-15	-500	AG	970	1.8	.0	33.0
H. SE	-15	-500	-15	-1500	AG	970	1.6	.0	50.0
I. WF	0	1800	0	1900	AG	0	1.6	.0	35.0
J. WA	0	1800	0	1900	AG	0	3.7	.0	33.0
K. WD	0	1800	0	1900	AG	0	3.7	.0	33.0
L. WE	0	1800	0	1900	AG	0	1.6	.0	35.0
M. EF	0	1800	0	1900	AG	0	1.6	.0	35.0
N. EA	0	1800	0	1900	AG	0	3.7	.0	33.0
O. ED	0	1800	0	1900	AG	0	3.7	.0	33.0
P. EE	0	1800	0	1900	AG	0	1.6	.0	35.0
Q. NL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	3.7	.0	33.0
T. EL	0	-1900	0	-1800	AG	0	3.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	40	25	6.0
2. SE3	40	-25	6.0
3. SW3	-40	-25	6.0
4. NW3	-40	25	6.0
5. NE7	53	38	6.0
6. SE7	53	-38	6.0
7. SW7	-53	-38	6.0
8. NW7	-53	38	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	186.	.7	.0	.5	.0	.0	.0	.0	.0	.0
2. SE3	186.	.7	.0	.5	.0	.0	.0	.0	.0	.0
3. SW3	5.	.5	.0	.0	.0	.1	.0	.3	.0	.0
4. NW3	6.	.5	.0	.0	.0	.1	.0	.3	.0	.0
5. NE7	187.	.5	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	187.	.5	.0	.3	.0	.0	.0	.0	.0	.0
7. SW7	6.	.4	.0	.0	.0	.1	.0	.2	.0	.0
8. NW7	173.	.4	.0	.1	.0	.0	.0	.0	.2	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SKYLINE RANCH ROAD PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1850	1.6	.0	50.0
B. NA	23	-500	23	0	AG	1400	2.4	.0	45.0
C. ND	23	0	23	500	AG	1500	1.9	.0	33.0
D. NE	23	500	23	1500	AG	1500	1.6	.0	50.0
E. SF	-23	1500	-23	500	AG	1030	1.6	.0	50.0
F. SA	-23	500	-23	0	AG	1030	2.3	.0	45.0
G. SD	-23	0	-23	-500	AG	1310	1.8	.0	33.0
H. SE	-23	-500	-23	-1500	AG	1310	1.6	.0	50.0
I. WF	0	1800	0	1900	AG	0	1.6	.0	35.0
J. WA	0	1800	0	1900	AG	0	3.7	.0	33.0
K. WD	0	1800	0	1900	AG	600	3.7	.0	33.0
L. WE	0	1800	0	1900	AG	600	1.6	.0	35.0
M. EF	-1500	-8	-500	-8	AG	530	1.6	.0	35.0
N. EA	-500	-8	0	-8	AG	430	3.7	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.7	.0	33.0
P. EE	0	1800	0	1900	AG	0	1.6	.0	35.0
Q. NL	0	0	15	-500	AG	450	2.4	.0	33.0
R. SL	0	-1900	0	-1800	AG	0	2.3	.0	33.0
S. WL	0	-1900	0	-1800	AG	0	3.7	.0	33.0
T. EL	0	0	-500	-8	AG	100	3.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	48	25	6.0
2. SE3	48	-25	6.0
3. SW3	-48	-25	6.0
4. NW3	-48	25	6.0
5. NE7	61	38	6.0
6. SE7	61	-38	6.0
7. SW7	-61	-38	6.0
8. NW7	-61	38	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	185.	.8	.0	.5	.0	.0	.0	.0	.0	.1
2. SE3	186.	.8	.0	.5	.0	.0	.0	.0	.0	.1
3. SW3	5.	.7	.0	.0	.0	.1	.0	.4	.0	.0
4. NW3	172.	.7	.0	.1	.0	.0	.0	.0	.3	.0
5. NE7	187.	.6	.0	.3	.0	.0	.0	.0	.0	.0
6. SE7	187.	.5	.0	.3	.0	.0	.0	.0	.0	.1
7. SW7	6.	.5	.0	.0	.0	.1	.0	.2	.0	.0
8. NW7	170.	.6	.0	.1	.0	.0	.0	.0	.2	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SOLEDAD CANYON ROAD AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	8	-1500	8	-500	AG	1190	1.6	.0	50.0
B. NA	8	-500	8	0	AG	700	2.9	.0	60.0
C. ND	8	0	8	500	AG	1140	2.3	.0	33.0
D. NE	8	500	8	1500	AG	1140	1.6	.0	50.0
E. SF	-8	1500	-8	500	AG	1580	1.6	.0	50.0
F. SA	-8	500	-8	0	AG	1480	3.3	.0	45.0
G. SD	-8	0	-8	-500	AG	1720	3.6	.0	33.0
H. SE	-8	-500	-8	-1500	AG	1720	1.6	.0	50.0
I. WF	1500	15	500	15	AG	1680	1.6	.0	65.0
J. WA	500	15	0	15	AG	1400	2.6	.0	75.0
K. WD	0	15	-500	15	AG	2510	2.0	.0	45.0
L. WE	-500	15	-1500	15	AG	2510	1.6	.0	65.0
M. EF	-1500	-23	-500	-23	AG	2270	1.6	.0	50.0
N. EA	-500	-23	0	-23	AG	1750	2.7	.0	60.0
O. ED	0	-23	500	-23	AG	1350	2.0	.0	33.0
P. EE	500	-23	1500	-23	AG	1350	1.6	.0	50.0
Q. NL	0	0	8	-500	AG	490	2.9	.0	33.0
R. SL	0	0	-8	500	AG	100	2.9	.0	33.0
S. WL	0	0	500	0	AG	280	2.6	.0	33.0
T. EL	0	0	-500	-15	AG	520	2.6	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	25	48	6.0
2. SE3	25	-48	6.0
3. SW3	-25	-48	6.0
4. NW3	-25	48	6.0
5. NE7	38	61	6.0
6. SE7	38	-61	6.0
7. SW7	-38	-61	6.0
8. NW7	-38	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	262.	1.4	.0	.0	.2	.0	.0	.3	.0	.0
2. SE3	275.	1.6	.0	.0	.0	.0	.0	.0	.3	.0
3. SW3	5.	1.9	.0	.0	.2	.0	.0	.7	.3	.0
4. NW3	176.	2.2	.0	.2	.0	.0	.0	.3	.9	.0
5. NE7	259.	1.1	.0	.0	.1	.0	.0	.2	.0	.0
6. SE7	277.	1.3	.0	.1	.0	.0	.0	.0	.3	.0
7. SW7	6.	1.3	.0	.0	.2	.0	.0	.5	.0	.0
8. NW7	172.	1.5	.0	.2	.0	.0	.0	.0	.6	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.5	.0	.1	.2	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.2	.0	.6	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.3	.0	.0	.2	.0	.0	.2	.0	.0	.0
5. NE7	.0	.0	.4	.0	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.1	.2	.0	.5	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.1	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SOLEDAD CANYON ROAD AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	8	-1500	8	-500	AG	1310	1.6	.0	50.0
B. NA	8	-500	8	0	AG	840	2.8	.0	60.0
C. ND	8	0	8	500	AG	1340	2.4	.0	33.0
D. NE	8	500	8	1500	AG	1340	1.6	.0	50.0
E. SF	-8	1500	-8	500	AG	1940	1.6	.0	50.0
F. SA	-8	500	-8	0	AG	1740	3.4	.0	45.0
G. SD	-8	0	-8	-500	AG	1950	3.5	.0	33.0
H. SE	-8	-500	-8	-1500	AG	1950	1.6	.0	50.0
I. WF	1500	15	500	15	AG	1710	1.6	.0	65.0
J. WA	500	15	0	15	AG	1430	2.7	.0	75.0
K. WD	0	15	-500	15	AG	2440	2.3	.0	45.0
L. WE	-500	15	-1500	15	AG	2440	1.6	.0	65.0
M. EF	-1500	-23	-500	-23	AG	2140	1.6	.0	50.0
N. EA	-500	-23	0	-23	AG	1630	2.8	.0	60.0
O. ED	0	-23	500	-23	AG	1370	2.0	.0	33.0
P. EE	500	-23	1500	-23	AG	1370	1.6	.0	50.0
Q. NL	0	0	8	-500	AG	470	2.8	.0	33.0
R. SL	0	0	-8	500	AG	200	2.8	.0	33.0
S. WL	0	0	500	0	AG	280	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	510	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	25	48	6.0
2. SE3	25	-48	6.0
3. SW3	-25	-48	6.0
4. NW3	-25	48	6.0
5. NE7	38	61	6.0
6. SE7	38	-61	6.0
7. SW7	-38	-61	6.0
8. NW7	-38	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	262.	1.6	.0	.0	.2	.0	.0	.3	.0	.0
2. SE3	355.	1.7	.0	.0	.5	.0	.0	.6	.0	.0
3. SW3	5.	2.2	.0	.0	.3	.0	.0	.8	.4	.0
4. NW3	176.	2.4	.0	.3	.0	.0	.0	.4	1.0	.0
5. NE7	259.	1.2	.0	.0	.2	.0	.0	.3	.0	.0
6. SE7	278.	1.4	.0	.1	.0	.0	.0	.0	.3	.0
7. SW7	6.	1.5	.0	.0	.2	.0	.0	.6	.0	.0
8. NW7	172.	1.5	.0	.2	.0	.0	.0	.0	.7	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.6	.0	.0	.2	.0	.0	.0	.0	.0	.0
2. SE3	.0	.2	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0
3. SW3	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.3	.0	.0	.2	.0	.0	.2	.0	.0	.0
5. NE7	.0	.0	.4	.0	.0	.2	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.2	.1	.0	.5	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.1	.0	.0	.1	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SOLEDAD CANYON ROAD PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	8	-1500	8	-500	AG	1280	1.6	.0	50.0
B. NA	8	-500	8	0	AG	840	2.9	.0	60.0
C. ND	8	0	8	500	AG	1480	2.7	.0	33.0
D. NE	8	500	8	1500	AG	1480	1.6	.0	50.0
E. SF	-8	1500	-8	500	AG	1660	1.6	.0	50.0
F. SA	-8	500	-8	0	AG	1330	3.0	.0	45.0
G. SD	-8	0	-8	-500	AG	1520	3.2	.0	33.0
H. SE	-8	-500	-8	-1500	AG	1520	1.6	.0	50.0
I. WF	1500	15	500	15	AG	1290	1.6	.0	65.0
J. WA	500	15	0	15	AG	1010	2.6	.0	75.0
K. WD	0	15	-500	15	AG	1900	1.9	.0	45.0
L. WE	-500	15	-1500	15	AG	1900	1.6	.0	65.0
M. EF	-1500	-23	-500	-23	AG	2610	1.6	.0	50.0
N. EA	-500	-23	0	-23	AG	1880	2.8	.0	60.0
O. ED	0	-23	500	-23	AG	1940	2.7	.0	33.0
P. EE	500	-23	1500	-23	AG	1940	1.6	.0	50.0
Q. NL	0	0	8	-500	AG	440	2.9	.0	33.0
R. SL	0	0	-8	500	AG	330	2.9	.0	33.0
S. WL	0	0	500	0	AG	280	2.6	.0	33.0
T. EL	0	0	-500	-15	AG	730	2.7	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	25	48	6.0
2. SE3	25	-48	6.0
3. SW3	-25	-48	6.0
4. NW3	-25	48	6.0
5. NE7	38	61	6.0
6. SE7	38	-61	6.0
7. SW7	-38	-61	6.0
8. NW7	-38	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	261.	1.4	.0	.0	.3	.0	.0	.2	.0	.0
2. SE3	355.	1.8	.0	.0	.6	.0	.0	.4	.0	.0
3. SW3	5.	2.0	.0	.0	.3	.0	.0	.6	.3	.0
4. NW3	176.	2.0	.0	.3	.0	.0	.0	.2	.7	.0
5. NE7	259.	1.1	.0	.0	.2	.0	.0	.2	.0	.0
6. SE7	353.	1.3	.0	.1	.4	.0	.0	.3	.0	.0
7. SW7	6.	1.4	.0	.0	.2	.0	.0	.5	.0	.0
8. NW7	173.	1.3	.0	.2	.0	.0	.0	.0	.5	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.4	.0	.0	.2	.0	.0	.0	.0	.0	.1
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.1	.0	.0
3. SW3	.0	.0	.1	.0	.0	.3	.0	.0	.0	.1	.0	.0
4. NW3	.0	.0	.2	.0	.0	.2	.0	.0	.2	.0	.0	.0
5. NE7	.0	.0	.3	.0	.0	.2	.0	.0	.0	.0	.0	.1
6. SE7	.0	.0	.0	.0	.0	.0	.2	.0	.0	.1	.0	.0
7. SW7	.0	.0	.1	.0	.0	.3	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.2	.0	.0	.2	.0	.0	.1	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SOLEDAD CANYON ROAD PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	8	-1500	8	-500	AG	1360	1.6	.0	50.0
B. NA	8	-500	8	0	AG	920	2.8	.0	60.0
C. ND	8	0	8	500	AG	1750	3.3	.0	33.0
D. NE	8	500	8	1500	AG	1750	1.6	.0	50.0
E. SF	-8	1500	-8	500	AG	1930	1.6	.0	50.0
F. SA	-8	500	-8	0	AG	1470	3.2	.0	45.0
G. SD	-8	0	-8	-500	AG	1670	2.8	.0	33.0
H. SE	-8	-500	-8	-1500	AG	1670	1.6	.0	50.0
I. WF	1500	15	500	15	AG	1340	1.6	.0	65.0
J. WA	500	15	0	15	AG	1070	2.7	.0	75.0
K. WD	0	15	-500	15	AG	1790	2.0	.0	45.0
L. WE	-500	15	-1500	15	AG	1790	1.6	.0	65.0
M. EF	-1500	-23	-500	-23	AG	2550	1.6	.0	50.0
N. EA	-500	-23	0	-23	AG	1810	2.8	.0	60.0
O. ED	0	-23	500	-23	AG	1970	2.9	.0	33.0
P. EE	500	-23	1500	-23	AG	1970	1.6	.0	50.0
Q. NL	0	0	8	-500	AG	440	2.8	.0	33.0
R. SL	0	0	-8	500	AG	460	3.2	.0	33.0
S. WL	0	0	500	0	AG	270	2.7	.0	33.0
T. EL	0	0	-500	-15	AG	740	2.8	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	25	48	6.0
2. SE3	25	-48	6.0
3. SW3	-25	-48	6.0
4. NW3	-25	48	6.0
5. NE7	38	61	6.0
6. SE7	38	-61	6.0
7. SW7	-38	-61	6.0
8. NW7	-38	61	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	354.	1.9	.0	.0	1.1	.0	.0	.4	.0	.0
2. SE3	355.	2.2	.0	.1	.8	.0	.0	.5	.0	.0
3. SW3	5.	2.2	.0	.0	.4	.0	.0	.6	.3	.0
4. NW3	176.	2.0	.0	.3	.0	.0	.0	.3	.7	.0
5. NE7	259.	1.2	.0	.0	.3	.0	.0	.2	.0	.0
6. SE7	353.	1.6	.0	.1	.6	.0	.0	.3	.0	.0
7. SW7	6.	1.6	.0	.0	.3	.0	.0	.5	.0	.0
8. NW7	173.	1.3	.0	.2	.0	.0	.0	.0	.5	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.3	.0	.0	.2	.0	.0
3. SW3	.0	.0	.1	.0	.0	.3	.0	.0	.0	.2	.0	.0
4. NW3	.0	.0	.2	.0	.0	.2	.0	.0	.2	.0	.0	.0
5. NE7	.0	.0	.3	.0	.0	.2	.0	.0	.0	.0	.0	.1
6. SE7	.0	.1	.0	.0	.0	.0	.3	.0	.0	.1	.0	.0
7. SW7	.0	.0	.1	.0	.0	.3	.0	.0	.0	.1	.0	.0
8. NW7	.0	.0	.2	.0	.0	.2	.0	.0	.1	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS AM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	450	2.0	.0	65.0
B. NA	23	-500	23	0	AG	390	2.5	.0	60.0
C. ND	23	0	23	500	AG	770	2.0	.0	45.0
D. NE	23	500	23	1500	AG	770	2.0	.0	65.0
E. SF	-30	1500	-30	500	AG	1470	2.0	.0	50.0
F. SA	-30	500	-30	0	AG	1470	2.7	.0	45.0
G. SD	-30	0	-30	-500	AG	1850	2.2	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1850	2.0	.0	50.0
I. WF	0	1800	0	1900	AG	760	2.0	.0	35.0
J. WA	0	1800	0	1900	AG	380	3.3	.0	33.0
K. WD	0	15	-500	15	AG	80	2.3	.0	33.0
L. WE	-500	15	-1500	15	AG	80	2.0	.0	35.0
M. EF	-1500	-15	-500	-15	AG	20	2.0	.0	35.0
N. EA	-500	-15	0	-15	AG	10	3.3	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.3	.0	33.0
P. EE	0	1800	0	1900	AG	0	2.0	.0	35.0
Q. NL	0	0	8	-500	AG	60	2.5	.0	33.0
R. SL	0	0	-23	500	AG	0	2.5	.0	33.0
S. WL	0	0	500	15	AG	380	3.6	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	33	6.0
2. SE3	55	-33	6.0
3. SW3	-55	-33	6.0
4. NW3	-55	33	6.0
5. NE7	68	46	6.0
6. SE7	68	-46	6.0
7. SW7	-68	-46	6.0
8. NW7	-68	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	186.	.4	.0	.1	.0	.0	.0	.0	.0	.2
2. SE3	353.	.5	.0	.0	.2	.0	.1	.0	.0	.0
3. SW3	5.	.7	.0	.0	.0	.0	.0	.5	.0	.0
4. NW3	5.	.8	.0	.0	.0	.0	.0	.6	.0	.0
5. NE7	187.	.4	.0	.0	.0	.0	.0	.0	.0	.2
6. SE7	352.	.4	.0	.0	.1	.0	.1	.0	.0	.0
7. SW7	6.	.5	.0	.0	.0	.0	.0	.3	.0	.0
8. NW7	6.	.5	.0	.0	.0	.0	.1	.3	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS AM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	38	-1500	38	-500	AG	480	2.0	.0	65.0
B. NA	38	-500	38	0	AG	420	2.5	.0	60.0
C. ND	38	0	38	500	AG	880	2.0	.0	45.0
D. NE	38	500	38	1500	AG	880	2.0	.0	65.0
E. SF	-38	1500	-38	500	AG	1610	2.0	.0	50.0
F. SA	-38	500	-38	0	AG	1610	2.7	.0	45.0
G. SD	-38	0	-38	-500	AG	1940	2.3	.0	33.0
H. SE	-38	-500	-38	-1500	AG	1940	2.0	.0	50.0
I. WF	1500	38	500	38	AG	790	2.0	.0	35.0
J. WA	500	38	0	38	AG	460	3.3	.0	33.0
K. WD	0	38	-500	38	AG	80	2.3	.0	33.0
L. WE	-500	38	-1500	38	AG	80	2.0	.0	35.0
M. EF	-1500	-38	-500	-38	AG	20	2.0	.0	65.0
N. EA	-500	-38	0	-38	AG	10	3.3	.0	75.0
O. ED	0	-38	500	-38	AG	0	2.3	.0	45.0
P. EE	500	-38	1500	-38	AG	0	2.0	.0	35.0
Q. NL	23	-500	0	0	AG	60	2.5	.0	33.0
R. SL	-23	500	0	0	AG	0	2.5	.0	33.0
S. WL	500	0	0	0	AG	330	3.5	.0	33.0
T. EL	-500	-23	0	0	AG	10	3.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	70	70	6.0
2. SE3	70	-70	6.0
3. SW3	-70	-70	6.0
4. NW3	-70	70	6.0
5. NE7	83	83	6.0
6. SE7	83	-83	6.0
7. SW7	-83	-83	6.0
8. NW7	-83	83	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	187.	.5	.0	.1	.0	.0	.0	.0	.0	.2
2. SE3	353.	.5	.0	.0	.2	.0	.1	.0	.0	.0
3. SW3	6.	.6	.0	.0	.0	.0	.0	.4	.0	.0
4. NW3	169.	.5	.0	.0	.0	.0	.0	.0	.4	.0
5. NE7	188.	.4	.0	.1	.0	.0	.0	.0	.0	.2
6. SE7	352.	.4	.0	.0	.2	.0	.1	.0	.0	.0
7. SW7	7.	.5	.0	.0	.0	.0	.0	.3	.0	.0
8. NW7	101.	.4	.0	.0	.0	.0	.0	.2	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS PM NP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1180	2.0	.0	65.0
B. NA	23	-500	23	0	AG	1110	2.5	.0	60.0
C. ND	23	0	23	500	AG	1710	2.1	.0	45.0
D. NE	23	500	23	1500	AG	1710	2.0	.0	65.0
E. SF	-30	1500	-30	500	AG	1420	2.0	.0	50.0
F. SA	-30	500	-30	0	AG	1420	2.7	.0	45.0
G. SD	-30	0	-30	-500	AG	1930	2.3	.0	33.0
H. SE	-30	-500	-30	-1500	AG	1930	2.0	.0	50.0
I. WF	0	1800	0	1900	AG	1080	2.0	.0	35.0
J. WA	0	1800	0	1900	AG	600	3.4	.0	33.0
K. WD	0	15	-500	15	AG	90	2.2	.0	33.0
L. WE	-500	15	-1500	15	AG	90	2.0	.0	35.0
M. EF	-1500	-15	-500	-15	AG	50	2.0	.0	35.0
N. EA	-500	-15	0	-15	AG	40	3.3	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.2	.0	33.0
P. EE	0	1800	0	1900	AG	0	2.0	.0	35.0
Q. NL	0	0	8	-500	AG	70	2.5	.0	33.0
R. SL	0	0	-23	500	AG	0	2.5	.0	33.0
S. WL	0	0	500	15	AG	480	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	10	3.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	33	6.0
2. SE3	55	-33	6.0
3. SW3	-55	-33	6.0
4. NW3	-55	33	6.0
5. NE7	68	46	6.0
6. SE7	68	-46	6.0
7. SW7	-68	-46	6.0
8. NW7	-68	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	186.	.7	.0	.3	.0	.0	.0	.0	.0	.2
2. SE3	353.	.7	.0	.0	.4	.0	.1	.0	.0	.0
3. SW3	5.	.8	.0	.0	.0	.2	.0	.5	.0	.0
4. NW3	173.	.8	.1	.0	.0	.0	.0	.0	.5	.0
5. NE7	187.	.6	.0	.2	.0	.0	.0	.0	.0	.2
6. SE7	353.	.6	.0	.0	.2	.0	.1	.0	.0	.0
7. SW7	7.	.6	.0	.0	.0	.1	.0	.3	.0	.0
8. NW7	173.	.6	.1	.0	.0	.0	.0	.0	.3	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS PM WP
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	38	-1500	38	-500	AG	1170	2.0	.0	65.0
B. NA	38	-500	38	0	AG	1100	2.5	.0	60.0
C. ND	38	0	38	500	AG	1770	2.1	.0	45.0
D. NE	38	500	38	1500	AG	1770	2.0	.0	65.0
E. SF	-38	1500	-38	500	AG	1530	2.0	.0	50.0
F. SA	-38	500	-38	0	AG	1530	2.7	.0	45.0
G. SD	-38	0	-38	-500	AG	1940	2.3	.0	33.0
H. SE	-38	-500	-38	-1500	AG	1940	2.0	.0	50.0
I. WF	1500	38	500	38	AG	1050	2.0	.0	35.0
J. WA	500	38	0	38	AG	670	3.4	.0	33.0
K. WD	0	38	-500	38	AG	90	2.3	.0	33.0
L. WE	-500	38	-1500	38	AG	90	2.0	.0	35.0
M. EF	-1500	-38	-500	-38	AG	50	2.0	.0	65.0
N. EA	-500	-38	0	-38	AG	40	3.3	.0	75.0
O. ED	0	-38	500	-38	AG	0	2.3	.0	45.0
P. EE	500	-38	1500	-38	AG	0	2.0	.0	35.0
Q. NL	0	0	23	-500	AG	70	2.5	.0	33.0
R. SL	0	0	-23	500	AG	0	2.5	.0	33.0
S. WL	0	0	500	23	AG	380	3.6	.0	33.0
T. EL	0	0	-500	-23	AG	10	3.3	.0	33.0

III. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	70	70	6.0
2. SE3	70	-70	6.0
3. SW3	-70	-70	6.0
4. NW3	-70	70	6.0
5. NE7	83	83	6.0
6. SE7	83	-83	6.0
7. SW7	-83	-83	6.0
8. NW7	-83	83	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	187.	.7	.0	.3	.0	.0	.0	.0	.0	.2
2. SE3	353.	.8	.0	.1	.4	.0	.1	.0	.0	.0
3. SW3	6.	.6	.0	.0	.0	.1	.0	.4	.0	.0
4. NW3	97.	.7	.0	.0	.0	.0	.0	.2	.0	.0
5. NE7	188.	.6	.0	.2	.0	.0	.0	.0	.0	.2
6. SE7	352.	.6	.0	.0	.3	.0	.1	.0	.0	.0
7. SW7	8.	.5	.0	.0	.0	.1	.0	.3	.0	.0
8. NW7	99.	.5	.0	.0	.0	.0	.0	.2	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS AM NO PROJECT
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	458	2.0	.0	65.0
B. NA	23	-500	23	0	AG	383	2.6	.0	60.0
C. ND	23	0	23	500	AG	825	2.1	.0	45.0
D. NE	23	500	23	1500	AG	825	2.0	.0	65.0
E. SF	-30	1500	-30	500	AG	1903	2.0	.0	50.0
F. SA	-30	500	-30	0	AG	1903	2.8	.0	45.0
G. SD	-30	0	-30	-500	AG	2009	2.4	.0	33.0
H. SE	-30	-500	-30	-1500	AG	2009	2.0	.0	50.0
I. WF	0	1800	0	1900	AG	560	2.0	.0	35.0
J. WA	0	1800	0	1900	AG	456	3.7	.0	33.0
K. WD	0	15	-500	15	AG	98	2.6	.0	33.0
L. WE	-500	15	-1500	15	AG	98	2.0	.0	35.0
M. EF	-1500	-15	-500	-15	AG	11	2.0	.0	35.0
N. EA	-500	-15	0	-15	AG	10	3.7	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.6	.0	33.0
P. EE	0	1800	0	1900	AG	0	2.0	.0	35.0
Q. NL	0	0	8	-500	AG	75	2.6	.0	33.0
R. SL	0	0	-23	500	AG	0	2.6	.0	33.0
S. WL	0	0	500	15	AG	104	3.7	.0	33.0
T. EL	0	0	-500	-15	AG	1	3.7	.0	33.0

I. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	33	6.0
2. SE3	55	-33	6.0
3. SW3	-55	-33	6.0
4. NW3	-55	33	6.0
5. NE7	68	46	6.0
6. SE7	68	-46	6.0
7. SW7	-68	-46	6.0
8. NW7	-68	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	353.	.5	.0	.0	.2	.0	.2	.0	.0	.0
2. SE3	352.	.5	.0	.0	.2	.0	.1	.1	.0	.0
3. SW3	5.	.9	.0	.0	.0	.0	.0	.7	.0	.0
4. NW3	5.	1.0	.0	.0	.0	.1	.1	.8	.0	.0
5. NE7	352.	.4	.0	.0	.1	.0	.2	.0	.0	.0
6. SE7	352.	.4	.0	.0	.1	.0	.2	.0	.0	.0
7. SW7	6.	.6	.0	.0	.0	.0	.0	.4	.0	.0
8. NW7	6.	.6	.0	.0	.0	.0	.1	.4	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS AM WITH PROJECT
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	38	-1500	38	-500	AG	624	2.0	.0	65.0
B. NA	38	-500	38	0	AG	549	2.6	.0	60.0
C. ND	38	0	38	500	AG	1304	2.1	.0	45.0
D. NE	38	500	38	1500	AG	1304	2.0	.0	65.0
E. SF	-38	1500	-38	500	AG	2457	2.0	.0	50.0
F. SA	-38	500	-38	0	AG	2457	3.1	.0	45.0
G. SD	-38	0	-38	-500	AG	2548	2.4	.0	33.0
H. SE	-38	-500	-38	-1500	AG	2548	2.0	.0	50.0
I. WF	1500	38	500	38	AG	871	2.0	.0	35.0
J. WA	500	38	0	38	AG	767	3.9	.0	33.0
K. WD	0	38	-500	38	AG	113	2.5	.0	33.0
L. WE	-500	38	-1500	38	AG	113	2.0	.0	35.0
M. EF	-1500	-38	-500	-38	AG	13	2.0	.0	65.0
N. EA	-500	-38	0	-38	AG	10	3.7	.0	75.0
O. ED	0	-38	500	-38	AG	0	2.5	.0	45.0
P. EE	500	-38	1500	-38	AG	0	2.0	.0	35.0
Q. NL	23	-500	0	0	AG	75	2.6	.0	33.0
R. SL	-23	500	0	0	AG	0	2.6	.0	33.0
S. WL	500	0	0	0	AG	104	3.7	.0	33.0
T. EL	-500	-23	0	0	AG	3	3.7	.0	33.0

I. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	70	70	6.0
2. SE3	70	-70	6.0
3. SW3	-70	-70	6.0
4. NW3	-70	70	6.0
5. NE7	83	83	6.0
6. SE7	83	-83	6.0
7. SW7	-83	-83	6.0
8. NW7	-83	83	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	187.	.6	.0	.2	.0	.0	.0	.0	.0	.2
2. SE3	353.	.7	.0	.0	.3	.0	.2	.0	.0	.0
3. SW3	6.	.9	.0	.0	.0	.1	.0	.7	.0	.0
4. NW3	7.	.9	.0	.0	.0	.1	.0	.7	.0	.0
5. NE7	188.	.5	.0	.1	.0	.0	.0	.0	.0	.2
6. SE7	350.	.6	.0	.0	.2	.0	.2	.0	.0	.0
7. SW7	8.	.7	.0	.0	.0	.1	.0	.5	.0	.0
8. NW7	99.	.7	.0	.0	.0	.0	.0	.3	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS PM NO PROJECT
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	23	-1500	23	-500	AG	1375	2.0	.0	65.0
B. NA	23	-500	23	0	AG	1293	2.9	.0	60.0
C. ND	23	0	23	500	AG	2274	2.3	.0	45.0
D. NE	23	500	23	1500	AG	2274	2.0	.0	65.0
E. SF	-30	1500	-30	500	AG	1397	2.0	.0	50.0
F. SA	-30	500	-30	0	AG	1397	3.0	.0	45.0
G. SD	-30	0	-30	-500	AG	2146	2.9	.0	33.0
H. SE	-30	-500	-30	-1500	AG	2146	2.0	.0	50.0
I. WF	0	1800	0	1900	AG	1686	2.0	.0	35.0
J. WA	0	1800	0	1900	AG	984	3.7	.0	33.0
K. WD	0	15	-500	15	AG	109	2.3	.0	33.0
L. WE	-500	15	-1500	15	AG	109	2.0	.0	35.0
M. EF	-1500	-15	-500	-15	AG	71	2.0	.0	35.0
N. EA	-500	-15	0	-15	AG	56	3.3	.0	33.0
O. ED	0	1800	0	1900	AG	0	2.3	.0	33.0
P. EE	0	1800	0	1900	AG	0	2.0	.0	35.0
Q. NL	0	0	8	-500	AG	82	2.8	.0	33.0
R. SL	0	0	-23	500	AG	0	2.8	.0	33.0
S. WL	0	0	500	15	AG	702	3.9	.0	33.0
T. EL	0	0	-500	-15	AG	15	3.3	.0	33.0

I. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	55	33	6.0
2. SE3	55	-33	6.0
3. SW3	-55	-33	6.0
4. NW3	-55	33	6.0
5. NE7	68	46	6.0
6. SE7	68	-46	6.0
7. SW7	-68	-46	6.0
8. NW7	-68	46	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	186.	.9	.0	.5	.0	.0	.0	.0	.0	.2
2. SE3	353.	1.0	.0	.0	.5	.0	.1	.0	.0	.0
3. SW3	174.	.9	.1	.0	.0	.0	.0	.0	.7	.0
4. NW3	172.	1.1	.0	.1	.0	.0	.0	.0	.7	.0
5. NE7	188.	.7	.0	.3	.0	.0	.0	.0	.0	.2
6. SE7	353.	.7	.0	.0	.3	.0	.1	.0	.0	.0
7. SW7	7.	.7	.0	.0	.0	.2	.0	.4	.0	.0
8. NW7	172.	.7	.1	.0	.0	.0	.0	.0	.5	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
2. SE3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
3. SW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
4. NW3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
5. NE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
6. SE7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
7. SW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

CALINE4: CALIFORNIA LINE SOURCE DISPERSION MODEL
JUNE 1989 VERSION
PAGE 1

JOB: SIERRA HIGHWAY AND SR-14 NB OFF-RAMPS PM WITH PROJECT
RUN: (WORST CASE ANGLE)
POLLUTANT: Carbon Monoxide

I. SITE VARIABLES

U= .5 M/S Z0= 100. CM ALT= 0. (FT)
BRG= WORST CASE VD= .0 CM/S
CLAS= 7 (G) VS= .0 CM/S
MIXH= 1000. M AMB= .0 PPM
SIGTH= 5. DEGREES TEMP= .5 DEGREE (C)

II. LINK VARIABLES

LINK DESCRIPTION	LINK COORDINATES (FT) X1	Y1	X2	Y2	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)
A. NF	38	-1500	38	-500	AG	1860	2.0	.0	65.0
B. NA	38	-500	38	0	AG	1778	2.9	.0	60.0
C. ND	38	0	38	500	AG	3221	2.8	.0	45.0
D. NE	38	500	38	1500	AG	3221	2.0	.0	65.0
E. SF	-38	1500	-38	500	AG	1857	2.0	.0	50.0
F. SA	-38	500	-38	0	AG	1857	3.1	.0	45.0
G. SD	-38	0	-38	-500	AG	2622	2.8	.0	33.0
H. SE	-38	-500	-38	-1500	AG	2622	2.0	.0	50.0
I. WF	1500	38	500	38	AG	2157	2.0	.0	35.0
J. WA	500	38	0	38	AG	1428	3.9	.0	33.0
K. WD	0	38	-500	38	AG	120	2.3	.0	33.0
L. WE	-500	38	-1500	38	AG	120	2.0	.0	35.0
M. EF	-1500	-38	-500	-38	AG	89	2.0	.0	65.0
N. EA	-500	-38	0	-38	AG	56	3.3	.0	75.0
O. ED	0	-38	500	-38	AG	0	2.3	.0	45.0
P. EE	500	-38	1500	-38	AG	0	2.0	.0	35.0
Q. NL	0	0	23	-500	AG	82	2.8	.0	33.0
R. SL	0	0	-23	500	AG	0	2.8	.0	33.0
S. WL	0	0	500	23	AG	729	3.9	.0	33.0
T. EL	0	0	-500	-23	AG	33	3.3	.0	33.0

I. RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. NE3	70	70	6.0
2. SE3	70	-70	6.0
3. SW3	-70	-70	6.0
4. NW3	-70	70	6.0
5. NE7	83	83	6.0
6. SE7	83	-83	6.0
7. SW7	-83	-83	6.0
8. NW7	-83	83	6.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE)

RECEPTOR	BRG (DEG)	PRED CONC (PPM)	CONC/LINK (PPM) A	B	C	D	E	F	G	H
1. NE3	187.	1.2	.0	.5	.0	.0	.0	.0	.0	.2
2. SE3	353.	1.5	.0	.2	.8	.0	.2	.0	.0	.0
3. SW3	51.	.9	.0	.0	.2	.0	.0	.0	.4	.0
4. NW3	97.	1.2	.0	.0	.2	.0	.0	.3	.0	.0
5. NE7	188.	1.0	.0	.4	.0	.0	.0	.0	.0	.2
6. SE7	352.	1.1	.0	.0	.6	.0	.2	.0	.0	.0
7. SW7	51.	.8	.0	.0	.2	.0	.0	.0	.3	.0
8. NW7	99.	1.0	.0	.0	.2	.0	.0	.2	.0	.0

IV. MODEL RESULTS (WORST CASE WIND ANGLE) (CONT.)

RECEPTOR	CONC/LINK (PPM) I	J	K	L	M	N	O	P	Q	R	S	T
1. NE3	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2. SE3	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
3. SW3	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
4. NW3	.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
5. NE7	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
6. SE7	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
7. SW7	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
8. NW7	.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0

Title : Los Angeles County Avg January 15 CYrs 2007 to 2020 Default Title
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/03/26 10:45:39
Scen Year: 2017 -- All model years in the range 1973 to 2017 selected
Season : Winter
Area : Los Angeles

****

Year: 2017 -- Model Years 1973 to 2017 Inclusive -- Winter
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile)

Pollutant Name: Carbon Monoxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
3	2.162	3.671	5.747	11.805	24.653	26.443	3.695
4	2.107	3.568	5.611	11.805	24.653	26.443	3.619
5	2.054	3.471	5.484	11.805	24.653	26.443	3.547
6	2.004	3.377	5.217	10.889	22.502	25.472	3.405
7	1.956	3.289	4.973	10.047	20.586	24.579	3.274
8	1.910	3.205	4.749	9.272	18.878	23.758	3.151
9	1.866	3.124	4.543	8.559	17.351	23.002	3.036
10	1.823	3.048	4.354	7.905	15.985	22.306	2.929
11	1.783	2.975	4.180	7.305	14.760	21.667	2.830
12	1.744	2.905	4.019	6.756	13.661	21.079	2.736
13	1.706	2.838	3.870	6.256	12.673	20.540	2.649
14	1.670	2.774	3.732	5.802	11.784	20.047	2.567
15	1.636	2.712	3.604	5.391	10.983	19.595	2.491
16	1.602	2.653	3.485	5.022	10.260	19.183	2.419
17	1.570	2.597	3.374	4.692	9.606	18.809	2.352
18	1.539	2.542	3.271	4.401	9.015	18.470	2.290
19	1.509	2.490	3.174	4.138	8.480	18.165	2.231
20	1.480	2.440	3.084	3.971	7.995	17.893	2.179
21	1.452	2.392	3.000	3.817	7.555	17.651	2.130
22	1.425	2.345	2.920	3.673	7.156	17.440	2.083
23	1.399	2.300	2.846	3.539	6.794	17.257	2.039
24	1.373	2.257	2.776	3.415	6.465	17.103	1.997
25	1.349	2.216	2.711	3.300	6.166	16.976	1.957
26	1.325	2.176	2.649	3.193	5.894	16.877	1.918
27	1.302	2.137	2.591	3.093	5.647	16.805	1.882
28	1.280	2.100	2.537	3.001	5.423	16.761	1.847
29	1.259	2.064	2.486	2.915	5.220	16.743	1.814
30	1.238	2.030	2.437	2.836	5.036	16.753	1.783
31	1.218	1.996	2.392	2.763	4.869	16.791	1.753
32	1.199	1.964	2.349	2.695	4.719	16.857	1.725
33	1.180	1.933	2.309	2.633	4.584	16.952	1.698
34	1.162	1.903	2.271	2.576	4.464	17.078	1.672
35	1.144	1.874	2.236	2.523	4.356	17.235	1.648
36	1.127	1.847	2.203	2.476	4.260	17.425	1.625
37	1.110	1.820	2.172	2.433	4.177	17.649	1.604
38	1.094	1.794	2.143	2.394	4.104	17.909	1.583
39	1.079	1.770	2.117	2.360	4.042	18.207	1.564
40	1.064	1.746	2.092	2.330	3.990	18.546	1.546

Appendix I: Water Resources

I-1

WATER RESOURCES TECHNICAL REPORT

Water Resources Technical Report for the

Skyline Ranch Project/ VTTM No. 060922

July 2009

CH2MHILL
610 Anacapa Street
Santa Barbara, CA 93101

and

ENTRIX, Inc.
201 N. Calle Cesar Chavez, Suite 203
Santa Barbara, CA 93103

Contents

Section Page

Contents ..... **i**

Acronyms and Abbreviations ..... **iii**

Introduction and Background **1-1**
1.1 Santa Clarita Valley Water Supply Background 1-2
1.1.1 Water Agencies 1-2
1.1.2 Water Supply 1-4
1.2 Contents of this Technical Report 1-6

Current Water Supply Information **2-1**
2.1 Local Supplies 2-1
2.1.1 Groundwater 2-1
2.1.2 Recycled Water 2-6
2.2 Imported Supplies and Banking 2-8
2.2.1 Semitropic Groundwater Banking Projects 2-8
2.2.2 SWP Table A Supply and the CLWA Supplemental Water Project (41,000 Acre-foot Table A Transfer) 2-9
2.2.3 Rosedale-Rio Bravo Water Storage District Groundwater Storage, Banking, Exchange, Extraction and Conjunctive Use Program 2-16
2.2.4 Water Acquisition from the Buena Vista Water Storage District and Rosedale-Rio Bravo Water Storage District Water Banking and Recovery Program 2-17
2.2.5 CLWA and Ventura County Flexible Storage Account 2-18
2.2.6 Nickel Water 2-19
2.2.7 Newhall Land- Semitropic Water Storage District Banking 2-19
2.3 Facilities 2-19
2.3.1 Treatment 2-19
2.3.2 Conveyance 2-20
2.4 Plans and Reports 2-21
2.4.1 NCWD Water Supply Assessment 2-21
2.4.2 Santa Clarita Valley Water Reports 2-22
2.4.3 2005 Urban Water Management Plan 2-25
2.4.4 Monterey Agreement and the SWP Delivery Reliability Report 2-33
2.4.5 Potential Climate Change Effects on Water Resources 2-37
2.5 Delta-Related Planning Activities 2-44
2.5.1 SWP and/or CVP Operations Projects 2-44
2.5.2 CALFED Bay Delta Program 2-44
2.5.3 Environmental Water Account 2-45
2.5.4 South Delta Improvements Program 2-45
2.5.5 Delta Levee Emergency Planning 2-46
2.5.6 Delta Vision 2-47

2.5.7 Bay Delta Conservation Plan....2-47
2.5.8 CALFED Ecosystem Restoration Program Conservation Strategy....2-48
2.5.9 Delta Risk Management Strategy....2-48
2.6 Santa Clarita River TMDLs....2-49
2.6.1 Chlorides....2-49
2.6.2 Nitrogen....2-51

References and Personal Communications....3-1

Tables

1 Saugus and Valencia WRP Wastewater Collection and Capacity....2-7
2 Current and Projected Demand and Availability of Recycled Water....2-8
3 Summary of 2007 Water Supplies and Uses (acre-feet)....2-23
4 Municipal Water Supply Utilization by the Local Purveyors....2-24
5 Projected Water Demands in the CLWA Service Area....2-26
6 Summary of Current and Planned Water Supplies and Banking Programs....2-27
7 Projected Average/Normal Year Supplies and Demands....2-29
8 Projected Single-Dry Year Supplies and Demands....2-30
9 Projected Multiple-Dry Year Supplies and Demands....2-31
10 Average and Dry Period SWP A Deliveries from the Delta under Current Conditions....2-37
11 Average and Dry Period SWP A Deliveries from the Delta under Future Conditions....2-38
12 Potential Effects of Climate Change on California's Water Resources and Expected Consequences....2-40
13 Regulatory Timeline for Chloride....2-50

Figures

1 CLWA and Local Purveyors Service Area....1-3
2 Santa Clara River Valley East Groundwater Subbasin....2-2
3 Alluvium and Saugus Formation....2-3
4 Historical Annual Total Demand in the CLWA Service Area....2-26

Attachments

A California Water Impact Network v. CLWA, Case No. BS 098724
B Sierra Club, et al. v. City of Santa Clarita, et al., Case No. BS 194771

Acronyms and Abbreviations

af	acre-feet
afy	acre-feet per year
BA	Biological Assessment
BDCP	Bay Delta Conservation Plan
BMP	Best Management Practices
BO	Biological Opinion
BVWSD	Buena Vista Water Storage District
CCWA	Central Coast Water Agency
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
CLWA	Castaic Lake Water Agency
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
CWIN	California Water Impact Network
DEIR	Draft Environmental Impact Report
Delta	Sacramento-San Joaquin River Delta
DRMS	Delta Risk Management Strategy
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EOP	Emergency Operations Plan
ERP	Ecosystem Restoration Program
ESA	Federal Endangered Species Act
ESWFP	Earl Schmidt Water Filtration Plant
EWA	Environmental Water Account
GWMP	Groundwater Management Plan
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
KCWA	Kern County Water Agency
LACSD	Sanitation Districts of Los Angeles County
LACWWD #36	Los Angeles County Waterworks District #36
LARWQCB	Los Angeles Regional Water Quality Control Board

mgd	million gallons per day
MOU	Memorandum of Understanding
NCCPA	State Natural Community Conservation Planning Act
NCWD	Newhall County Water District
NOAA	National Oceanic and Atmosphere Administration
OCAP	Operating Criteria and Plan
OMR	Old and Middle River
PCL	Planning and Conservation League
POD	Pelagic Organism Decline
RRBWSD	Rosedale-Rio Bravo Water Storage District
RVWTP	Rio Vista Water Treatment Plant
SCOPE	Santa Clarita Organization for Planning the Environment
SCVWP	Santa Clarita Valley Water Purveyors
SCVWR	Santa Clarita Valley Water Report
SCWD	Santa Clarita Water Division of CLWA
SDIP	South Delta Improvements Program
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TMDL	Total Maximum Daily Loads
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UWCD	United Water Conservation District
UWMP	Urban Water Management Plan
VWC	Valencia Water Company
WRMWSD	Wheeler Ridge-Maricopa Water Storage District
WRP	water reclamations plant

SECTION 1

Introduction and Background

This Water Resources Technical Report for the Skyline Ranch Project/Vesting Tentative Tract Map No. 060922 (Project) provides detailed information regarding the Santa Clarita Valley's water supply and the reliability of that supply. Water for this Project is expected to be provided by Castaic Lake Water Agency's (CLWA) Santa Clarita Water Division (SCWD), one of four local water purveyors in the Santa Clarita Valley. The local and imported regional water supplies are cooperatively managed by those four water purveyors and CLWA, the regional wholesale water agency.

Water supply planning and management in the Santa Clarita Valley is a dynamic process with ongoing activities to secure additional supplies, improve existing supply reliability, improve water quality, upgrade infrastructure, and plan for future conditions. While not directly tied to the Skyline Ranch development, these activities have produced studies, plans, and water management and facilities upgrades that pertain to the existing environmental conditions with regard to water supply availability and reliability. These studies, plans and water management upgrades include:

- Completion of steps towards cleanup of perchlorate contamination of several groundwater wells in the Santa Clarita Valley;
- Completion of steps towards expanded use of recycled water in the Santa Clarita Valley;
- Completion of the Groundwater Management Plan in compliance with AB 3030;
- Completion of groundwater banking agreements with Semitropic Water Storage District;
- Completion of a revised CLWA Supplemental Water Project Transfer of 41,000 Acre-Feet of State Water Project (SWP) Table A Amount Final EIR, and continued implementation of the 41,000 acre-foot water transfer from Kern County Water Agency and its member unit in Kern County, the Wheeler Ridge-Maricopa Water Storage District (WRMWSD);[1]
- Completion of long-term groundwater banking arrangements with Rosedale-Rio Bravo Water Storage District;
- Completion of an imported water augmentation agreement with the Buena Vista Water Storage District and the Rosedale-Rio Bravo Water Storage District;
- Completion of water quality and capacity improvements to the Earl Schmidt Water Treatment Plant and planned expansion of the Rio Vista Water Treatment Plant;
- Planning and construction of treated water supply pipelines;

[1] The environmental documentation for the 41,000 AF water transfer is not complete, however, and is discussed in more detail in Section 2.2.2.

- Completion of the Newhall County Water District's Water Supply Assessment Report;
- Completion of annual updates of the Santa Clarita Valley Water Report; and
- Completion of the 2005 Urban Water Management Plan.

Other relevant actions include:

- Completion of the California Department of Water Resources' (DWR's) technical memorandum describing progress made in incorporating climate change into existing water resources planning and management tools and methodologies; and
- Completion of the 2007 SWP Delivery Reliability Report.

This Technical Report provides a summary of each of these activities, their current status and the anticipated effects on the local and regional water supply. In addition, local and regional water supply uncertainty is discussed herein.

1.1 Santa Clarita Valley Water Supply Background

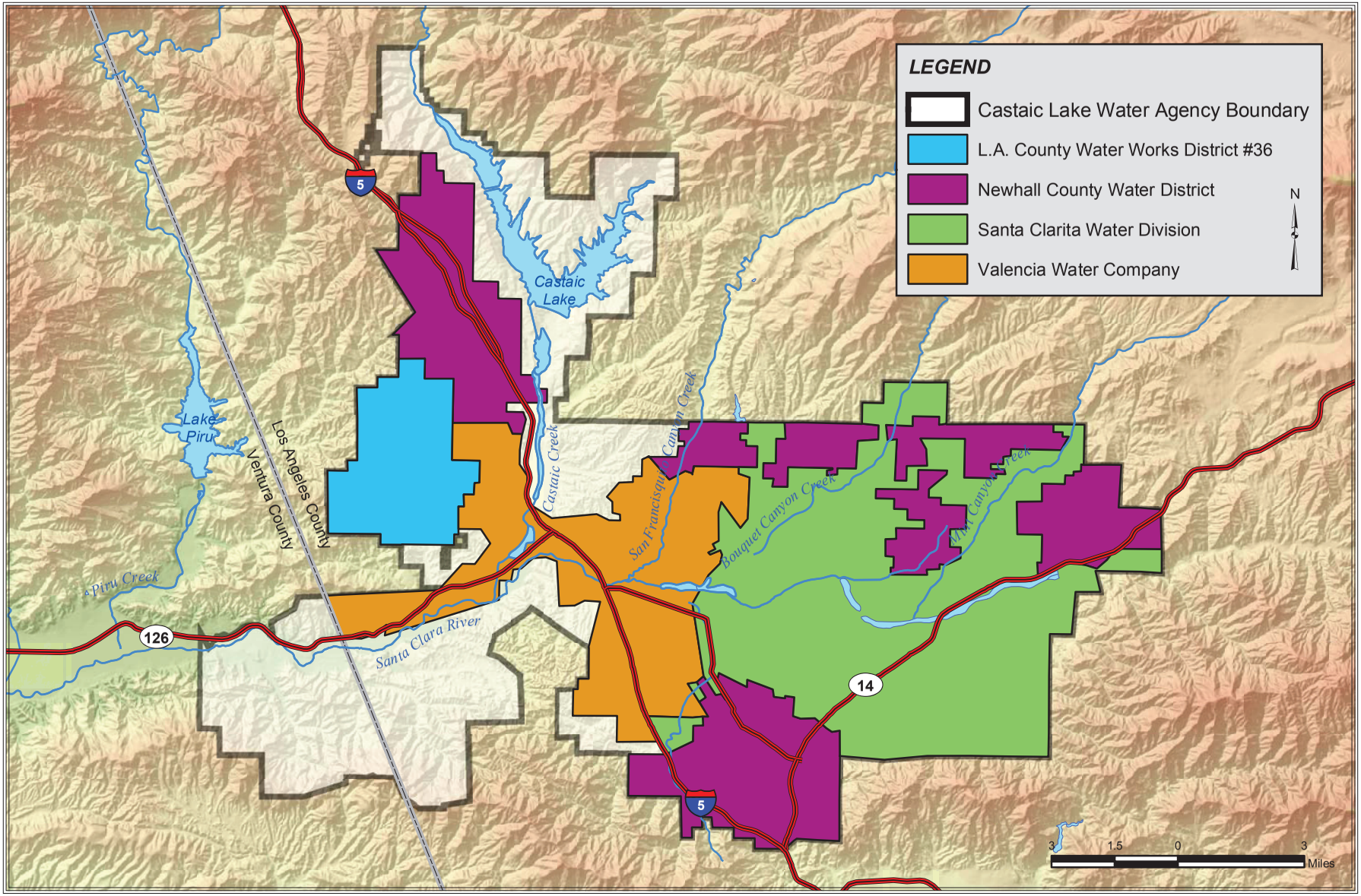
1.1.1 Water Agencies

One wholesale water agency (CLWA) and four retail water purveyors provide water service to most residents of the Santa Clarita Valley. The four retail purveyors are CLWA SCWD, Newhall County Water District (NCWD), Los Angeles County Waterworks District #36 (LACWWD #36), and the Valencia Water Company (VWC); these four purveyors are collectively referred to as the Local Purveyors. The service area for CLWA and the Local Purveyors is shown on Figure 1.

CLWA SCWD's service area includes portions of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Canyon Country, Newhall, and Saugus. CLWA SCWD supplies water from local groundwater and imported water from CLWA. CLWA SCWD delivered approximately 31,400 af of water in 2007 and has approximately 27,900 connections (SCVWP 2008).

NCWD provides potable water to more than 30,000 people in an area of more than 34 square miles in the Santa Clarita Valley. NCWD's service area is composed of four separate water service areas (Newhall, Castaic, Pinetree, and Tesoro), and includes portions of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Newhall, Canyon Country, Saugus, and Castaic. NCWD supplies water from local groundwater and imported water from CLWA. NCWD delivered approximately 12,000 af of water in 2007 and has approximately 9,500 connections (SCVWP 2008).

LACWWD #36's service area includes the Hasley Canyon area in the unincorporated community of Val Verde. During most years, the District obtains its water supply from CLWA. LACWWD #36 delivered approximately 1,400 af of water in 2007 and has approximately 1,400 connections (SCVWP 2008).



Source: SCVWP 2006

FIGURE 1
CLWA and Local Purveyors Service Area

VWC's service area includes a portion of the City of Santa Clarita and unincorporated portions of Los Angeles County in the communities of Castaic, Stevenson Ranch, and Valencia. VWC supplies water from local groundwater, imported water from CLWA, and recycled water. VWC delivered approximately 32,800 af of water in 2007 and has approximately 29,400 connections (SCVWP 2008).

CLWA is a public water agency that was formed for the purpose of contracting with DWR to provide a supplemental supply of imported water from the SWP to the Local Purveyors in the Santa Clarita Valley. CLWA (acting as the regional wholesale water agency) serves an area of 195 square miles in Los Angeles and Ventura counties. CLWA, as a SWP contractor (public agencies that hold SWP Water Supply Contracts with DWR are collectively referred to as "SWP contractors" or "contractors"), holds a water supply contract with DWR with a Table A Amount[2] of 95,200 af. [3]

1.1.2 Water Supply

There are two main water supplies for the Santa Clarita Valley—local supplies and imported supplies. Local supplies consist of groundwater and recycled water, and imported supplies consist of, for example, SWP water, and SWP-related supplies such as groundwater banking programs. In 2007, the imported supplies were augmented by acquisition of additional supplemental water from the Buena Vista Water Storage District (BVWSD) and the Rosedale-Rio Bravo Water Storage District (RRBWSD). Additional information on these supplies is provided in Section 2. Background information on the SWP is provided below.

Imported water is provided to the CLWA service area via the SWP. The SWP is a complex system of reservoirs, dams, power plants, pumping plants, canals, and aqueducts for the storage and delivery of water authorized by an act of the California State Legislature in 1959. The SWP includes 28 storage facilities, reservoirs and lakes; 20 pumping plants; six pumping-generating plants and hydroelectric power plants; and approximately 660 miles of aqueducts and pipelines. The primary water source for the SWP is the drainage of the Feather River, a tributary of the Sacramento River. Runoff released from Oroville Dam in Butte County flows down natural channels to the Sacramento-San Joaquin River Delta (Delta), where a portion of the water is pumped through the North Bay Aqueduct to Napa and Solano counties. In the southern Delta, water is pumped from the Clifton Court Forebay by the Harvey O. Banks Delta Pumping Plant into the 444-mile-long, Governor Edmund G. Brown California Aqueduct (California Aqueduct). The California Aqueduct conveys water to the primarily agricultural users in the San Joaquin Valley and the primarily urban regions of the San Francisco Bay Area, the Central Coast, and southern California. Water intended for use in southern California is conveyed through the West Branch to Castaic Lake and through the East Branch to Lake Perris, which are referred to as terminal reservoirs for the SWP.

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[2] Table A Amount (formerly referred to as "entitlement") is named for the "Table A" in each SWP contractor's Water Supply Contract. It contains an annual buildup in Table A Amounts of SWP water, from the first year of the Water Supply Contract through a specific year, based on growth projections made before the Water Supply Contract was executed. CLWA has augmented its Table A Amount through the acquisition of contract rights from the Devil's Den Water District (in 1991) and from the acquisition of contract rights from the Kern County Water Agency via the WRMWSD (in 1999). The total of all SWP contractors' maximum Table A Amounts is currently about 4.17 million af.

[3] More detail is provided in Section 2.2.2 regarding the legal challenges related to the transfer of 41,000 af of Table A Amount from Kern County Water Agency and its member unit in Kern County, the WRMWSD to CLWA.

The original plan for the SWP included constructing additional water storage facilities as contractor demands increased, however, essentially no new construction of additional SWP storage facilities has occurred since the initial SWP facilities were completed. Although future construction or other actions can improve the quantity and reliability of SWP supplies, these actions entail their own environmental reviews, potential litigation delays, and multi-year construction period; therefore, it is likely to take many years before any additional storage and/or conveyance facilities that improve SWP reliability are operational.

DWR is the state agency charged with the statutory responsibility to build, manage, and operate the SWP. In 1960, DWR began executing individual Water Supply Contracts with public agencies throughout the State of California to finance and construct SWP facilities to deliver water to each public agency. CLWA is one of 29 SWP contractors and provides imported water supplies via the SWP to the CLWA service area.

Each Water Supply Contract identifies a Table A Amount, which is the annual maximum amount of water that DWR is contracted to deliver under Table A of the contract, if available for delivery, to each SWP contractor on an annual basis. DWR has historically delivered less water to the contractors than the Table A Amounts, in part, because the Table A Amounts were predicated on the state's obligation to build out the SWP so as to deliver 4.23 million af to the contractors and because many contractors have historically not requested delivery of their full Table A Amount. However, the SWP infrastructure has not been completed, and DWR cannot deliver the full Table A Amounts (currently at 4.173 million af) to the contractors in most years due to lack of storage facilities and other constraints. Overall reliable water supply is determined biannually by DWR through a process which includes public review and comment.[4] Thus, the Table A Amounts do not guarantee that each contractor will receive the maximum amount of water granted to it in its Water Supply Contract; the Table A Amounts instead provide the basis for proportional allocation of available water among contractors.

Each contractor annually submits a request to DWR for water delivery in the following year, in any amount up to the contractor's Table A Amount. The Water Supply Contracts provide that in a year when DWR is unable to deliver total contractor requests, deliveries to all contractors will be reduced in proportion to Table A Amounts so that total deliveries equal total available supply for that year. While SWP contractors currently hold Table A Amounts totaling approximately 4.173 million af, the amount of water actually requested by contractors is less than that due to a number of contractors whose demands have not yet increased to their full Table A Amount. Even at these lower current demands, however, the SWP cannot meet all water delivery requests in some years, particularly in dry years, due to operational, hydrologic, and environmental constraints.

[4] DWR publishes every two years a reliability report that contains data concerning the reliability of current and projected SWP deliveries. This reliability data is generated from CalSim II, DWR's computer simulation model of SWP operations. As discussed in more detail in this Technical Report, DWR released its Draft 2007 SWP Delivery Reliability Report on January 28, 2008, the period for public comments on the draft report ended on March 13, 2008, and DWR released the final 2007 SWP Delivery Reliability Report in August of 2008.

As stated above, CLWA's contractual "right" to imported water via the SWP (i.e., its Table A Amount) is 95,200 af.

1.2 Contents of this Technical Report

This Technical Report contains the following sections in addition to this Introduction:

- Section 2, Current Water Supply Information. This section provides a discussion of water supplies including water supply availability, quality, and reliability, as well as a discussion of local water supply infrastructure. In addition, this section summarizes the studies, plans, and reports relevant to water supplies in the Santa Clarita Valley. A discussion of global climate change as it relates to water resources is also included, as well as a discussion of Delta-related planning activities.
- Section 3, References. This section provides a list of references cited in this Technical Report.

SECTION 2

Current Water Supply Information

As stated above, this section provides a discussion of water supplies including water supply availability, quality, and reliability, as well as a discussion of local water supply infrastructure. In addition, this section summarizes the studies, plans, and reports relevant to water supplies in the Santa Clarita Valley. A discussion of global climate change as it relates to water resources is also included, as well as a discussion of Delta-related planning activities. The documents and reports summarized below are publicly available from SCWD, CLWA, or DWR.

2.1 Local Supplies

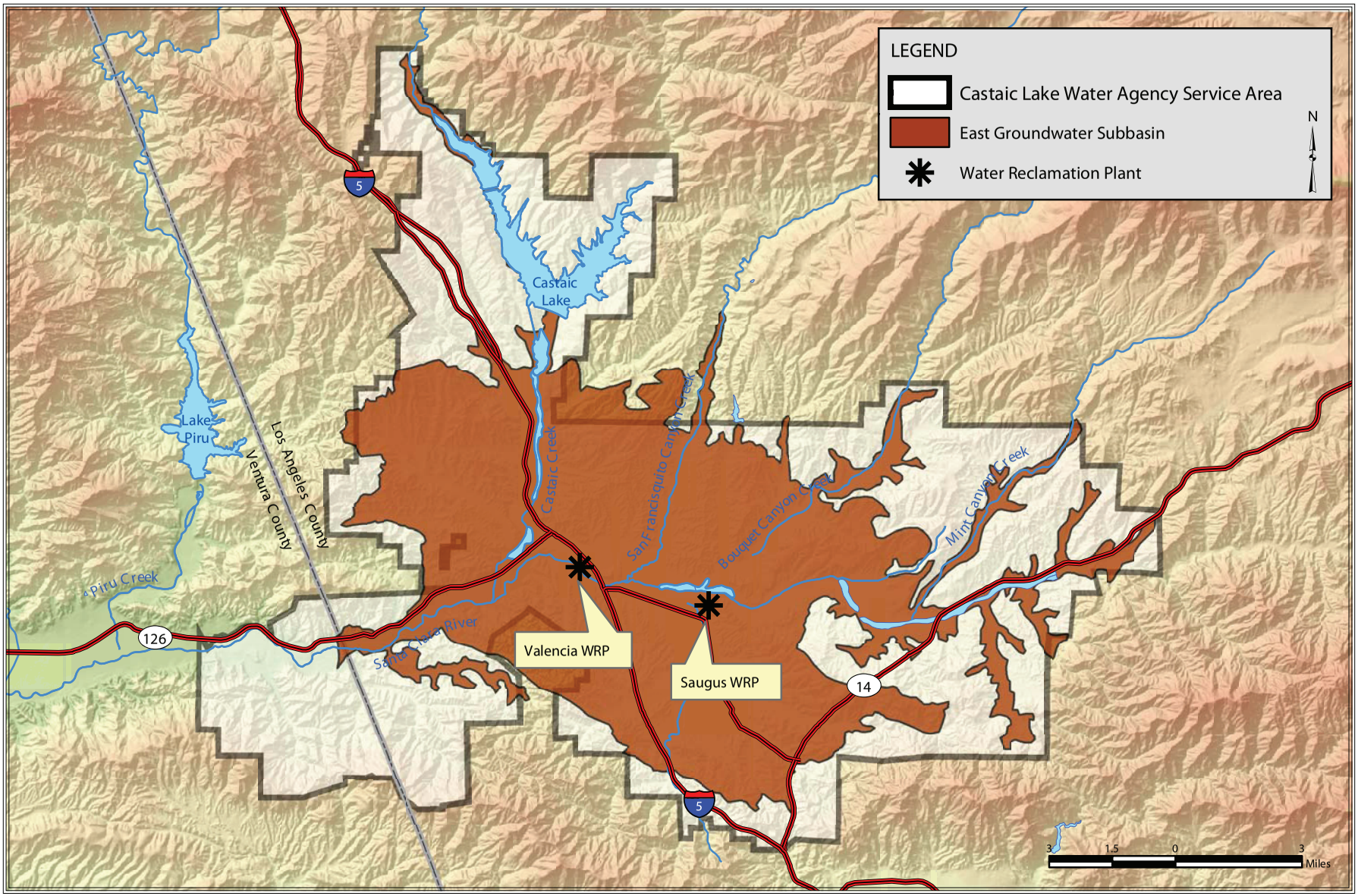
Water derived from local sources includes groundwater pumped from the Santa Clara River Valley Groundwater Basin in the Santa Clarita Valley or from recycled water following treatment and disinfectant at local wastewater treatment plants. Current information about these local sources is provided below.

2.1.1 Groundwater

The East Subbasin of the Santa Clara River Valley Groundwater Basin (Basin) is the sole source of groundwater for urban use in the Santa Clarita Valley. Two aquifers in this Basin are used for domestic and agricultural supply – the Alluvial and Saugus Formation aquifers. The East Subbasin and the location of the Alluvial and Saugus Formation aquifers are shown on Figures 2 and 3.

Groundwater Management Plan

The groundwater component of overall water supply in the Valley is managed based on a groundwater operating plan developed over the last 20 years to meet water requirements (municipal, agricultural, small domestic) while maintaining the Basin in a sustainable condition (i.e., no long-term depletion of groundwater or interrelated surface water). This operating plan also addresses groundwater contamination issues in the Basin. The groundwater operating plan is based on the concept that pumping can vary from year to year to allow increased groundwater use in dry periods and increased recharge during wet periods and to collectively assure that the groundwater basin is adequately replenished through various wet/dry cycles. As formalized in the Groundwater Management Plan (GWMP), the operating yield concept has been quantified as ranges of annual pumping volumes.



Source: SCVWP 2006

FIGURE 2
SANTA CLARA RIVER VALLEY EAST GROUNDWATER SUBBASIN
SKYLINE RANCH PROJECT

CH2MHILL

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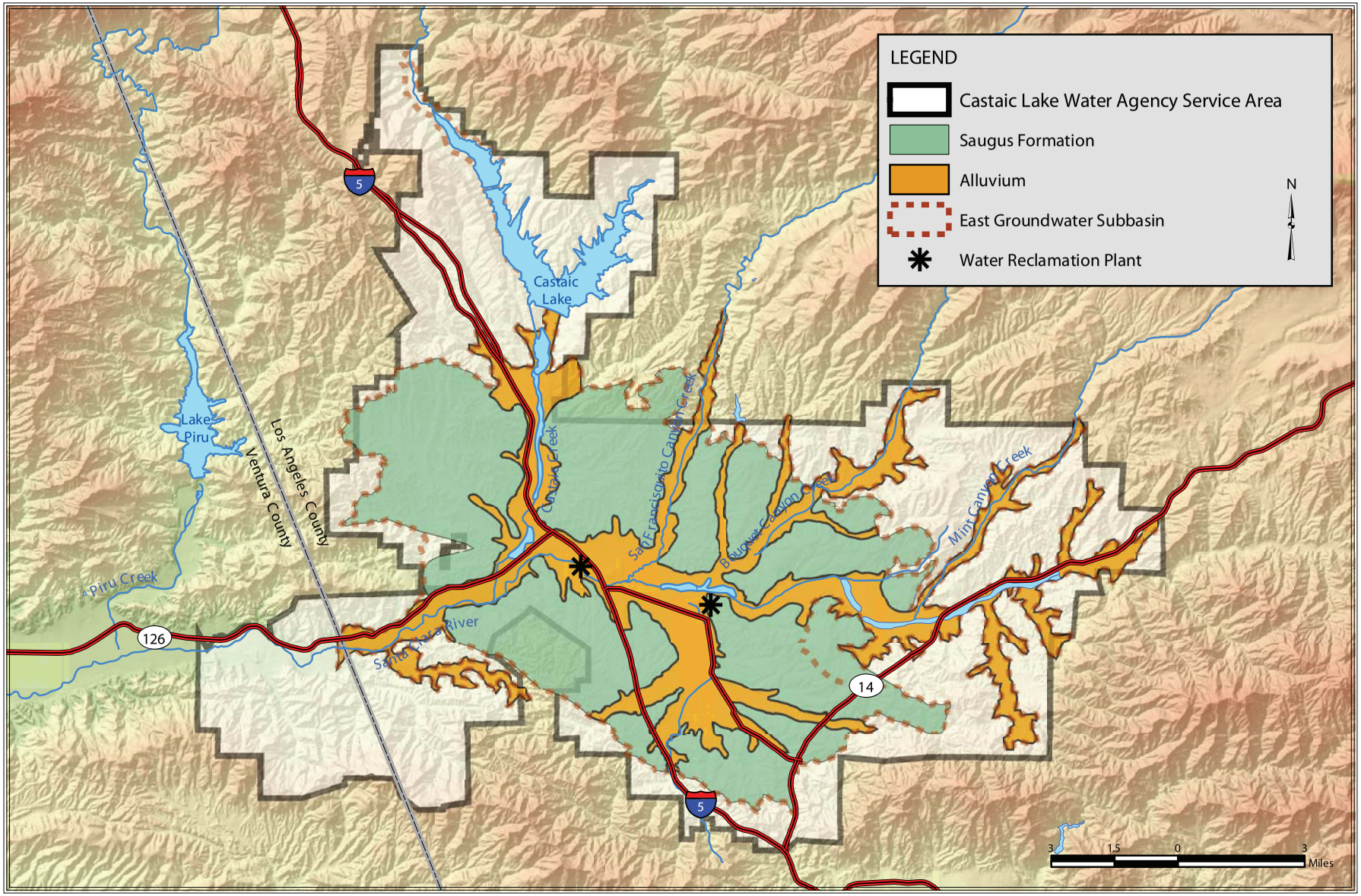

Source: SCVWP 2006

FIGURE 3
ALLUVIUM AND SAUGUS FORMATION
SKYLINE RANCH PROJECT

CH2MHILL

ES082006006SAC figure_3.ai 10-18-06 sbm

CLWA and the Local Purveyors adopted the regional GWMP in December 2003 (CLWA 2003c). This Plan satisfies all applicable requirements (including those outlined in Assembly Bill [AB] 134 [Water Code Sections 12944.7 and 31633; CLWA Law Sections 15.1 and 16.1] and AB 3030 [Water Code Sections 10750 *et seq.*]). The GWMP outlines four specific management goals for the East Subbasin (CLWA 2003c):

1. Development of integrated surface water, groundwater, and recycled water supplies to meet existing and projected demands for municipal, agricultural, and other water supply;
2. Assessment of groundwater basin conditions to determine a range of operational yield values that will make use of local groundwater conjunctively with SWP and recycled water to avoid groundwater overdraft;
3. Preservation of groundwater quality, including active characterization and resolution of any groundwater contamination problems; and,
4. Preservation of interrelated surface water resources, which includes managing groundwater to not adversely impact surface and groundwater discharges or quality to downstream basin(s).

Following adoption of the GWMP in 2003, two formal reports were produced under a Memorandum of Understanding between CLWA, the Local Purveyors, and United Water Conservation District (UWCD).[5] The first report, dated April 2004, documents the construction and calibration of the groundwater flow model for the Santa Clarita Valley. The second report, dated August 2005, presents the modeling analysis of the Local Purveyors' groundwater operating plan. The primary conclusion of the modeling analysis is that the groundwater operating plan is sustainable because it will not cause detrimental short- or long-term effects to the groundwater and surface water resources in the Valley.[6]

Development and adoption of the regional GWMP provides assurances regarding groundwater use and protection of that use through the four management goals listed above.

Alluvial Aquifer

The groundwater operating plan includes pumping from the Alluvial Aquifer in the range of 30,000 to 40,000 afy in average/normal years, and slightly reduced pumping (30,000 to 35,000 afy) in dry years (CLWA 2005a). Current data indicate that the Alluvial Aquifer remains in good operating condition and can continue to support groundwater pumping in the range stated above without adverse results (e.g., long-term water level decline or degradation of groundwater quality; CLWA 2005a).

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[5] UWCD manages surface water and groundwater resources in seven groundwater basins, all located in Ventura County, downstream of the East Subbasin of the Santa Clara River Valley Groundwater Basin (Basin), and is a partner in cooperative management efforts to accomplish the objectives (goals) for the Basin, particularly as they relate to preservation of surface water resources that flow through the respective basins.

[6] From "Analysis of Groundwater Basin Yield, Upper Santa Clara River Basin, Eastern Subbasin, Los Angeles County, California," prepared by CH2M HILL and Luhdorff and Scalmanini Consulting Engineers, August 2005.

As described in the Plan, implementation of the specific management goals for the Alluvial Aquifer system would result in the preservation of the groundwater levels and quality that is consistent with the last 30 years of use of that resource. While some specific changes in groundwater levels have been observed over the last 20 years, there has been no chronic decline in groundwater level or aquifer storage. Management actions to reduce water surface fluctuations, sustain aquifer recharge and avoid storage overdraft will accomplish the basin objectives while continuing to use local groundwater to meet part of the existing and anticipated water requirements of the Santa Clarita Valley.

In 2002, as part of ongoing monitoring of wells for perchlorate contamination, perchlorate was detected in one well in the Alluvial Aquifer located near the former Whittaker-Bermite facility. The detected concentration was slightly below the Notification Level for perchlorate (6 µg/L), and the well has been inactivated for municipal water supply since the detection of perchlorate. In early 2005, perchlorate was detected in a second well in the Alluvial Aquifer. Following the installation of wellhead treatment (in the fall of 2005), the second well was returned to water supply service. All other wells in the Alluvial Aquifer operated by the Local Purveyors continue to be used for municipal water supply service; those wells near the Whittaker-Bermite property are routinely sampled and perchlorate has not been detected. The ongoing inactivation of the one Alluvial well due to perchlorate contamination does not limit the ability to produce groundwater from the Alluvium in accordance with the groundwater operating plan in the 2005 Urban Water Management Plan (2005 UWMP) (SCVWP 2007). Also see the discussion in the Water Supply Assessment completed for the Project provided in Appendix I-2. Additional discussion on perchlorate is provided below.

Saugus Formation

The groundwater operating plan includes pumping from the Saugus Formation in the range of 7,500 to 15,000 afy in average/normal years; it also includes planned dry-year pumping from the Saugus Formation of 21,000 to 35,000 afy for one to three consecutive dry years (SCVWP 2007). Such short-term pumping can be recharged during subsequent wet/normal years to allow groundwater levels and storage to recover, as it has in historical periods.

Implementation of the specific management goals for the Saugus Formation aquifer would also result in the preservation of the groundwater levels and quality. However, pumping rates from the Saugus Formation aquifer may be intermittently higher than the historic pumping rates during periods of low SWP supply or other emergency conditions. Such increases in pumping rate would withdraw a small portion of the total aquifer storage and successfully contribute to local water supplies while still meeting the management objective. Water stored in the Saugus Formation would be expected to recover via a reduction in pumping during wet or normal conditions.

In 1997, ammonium perchlorate was discovered in four Saugus Formation wells in the vicinity of the former Whittaker-Bermite facility. All four of those impacted wells remain out of active supply service. All other wells in the Saugus Formation owned and operated by the Local Purveyors are available for municipal water supply service. As part of regular operation, those wells are sampled on a routine basis. Despite the inactivated wells, the Local Purveyors still have sufficient pumping capacity in other wells to meet the planned normal range of Saugus pumping in the 2005 UWMP (also see the discussion in the Water

Supply Assessment completed for the Project provided in Appendix I-2) (SCVWP 2007). Additional discussion on perchlorate is provided immediately below.

Ammonium Perchlorate Contamination

As discussed above, ammonium perchlorate, originating at the former Whittaker-Bermite propellant production facility, has been a water quality concern in groundwater basins of the Santa Clarita Valley since it was first detected in four wells in the Saugus Formation in 1997. In November 2002, perchlorate was detected in one Alluvial well (Stadium well) near the Whittaker-Bermite site, and in early 2005, perchlorate was detected in a second Alluvial well. All six wells were removed from active water service, and one of the Alluvial wells has been returned to active water supply service with the operation of wellhead perchlorate removal technology approved for operation by California Department of Health Services (SCVWP 2006). In addition, based on zone-specific monitoring, very low levels of perchlorate contamination (i.e., approximately 2 parts per billion) were detected in well NC-13 (personal communication, S. Cole 2007). However, this level is well below the action level and the well remains in operation (personal communication, S. Cole 2007).

In November 2000, CLWA and the Local Purveyors filed a suit against the then current and former owners of the Whittaker-Bermite site. The suit seeks to have the defendants cover all costs of response, contaminant removal, remedial actions, and any liabilities or damages caused by the contamination. In 2003, the parties reached an interim settlement and funding agreement, which expired in January 2005. The parties have since reached a settlement, which was approved by the court in July of 2007 (personal communication, J. Ford 2008). The parties to the lawsuit also jointly developed a plan to pump and treat contaminated water from some of the impacted wells to stop the movement of the plume.

CLWA and the affected Local Purveyors have undertaken a comprehensive groundwater containment, treatment, and restoration project to address perchlorate contamination (CLWA 2005c). The project will intercept the perchlorate plume in the Saugus Formation groundwater. Contaminated water will be pumped from intercepting wells to the new treatment facility where the chemical will be removed and the treated water used as part of the Santa Clarita Valley drinking water supply (SCVWP 2006 and CLWA 2005c). Construction began in November of 2007 and treatment is anticipated to commence in August of 2009 (personal communication, J. Ford 2009).

2.1.2 Recycled Water

As water demands in the Santa Clarita Valley increase in the future, recycled water will be an important factor in improving water supply reliability. The Sanitation Districts of Los Angeles County (LACSD) own and operate two water reclamations plants (WRP) in the CLWA service area, the Saugus WRP and the Valencia WRP; and is the main supplier of wastewater for recycling in the CLWA service area. Distribution of this recycled water is the responsibility of CLWA.

The Saugus WRP, located in District No. 26, was completed in 1962 and has undergone two expansions since that time. Its current design capacity is approximately 6.5 million gallons per day (mgd). Use of tertiary treated water from this plant for water recycling is permitted under the Los Angeles Regional Water Quality Control Board (LARWQCB) Order No. 87-49. Currently, only water from the Valencia WRP is used for recycled purposes, although

CLWA is proposing to use the Saugus WRP to treat water for Phase II of its recycled water system, which is undergoing environmental review.

The Valencia WRP was completed in 1967. After three subsequent expansions, its current capacity is 21.6 mgd. Use of recycled water from this plant is permitted under LARWQCB Order No. 87-48. In July 1996, CLWA entered into an agreement with LACSD to purchase up to 1,700 acre-feet per year (afy) of recycled water from the Valencia WRP. In 2002, CLWA constructed facilities needed to utilize this supply and began recycled water deliveries in 2003.

The Saugus and Valencia WRP's together have a design capacity of 28.1 mgd. To accommodate future growth in the Santa Clarita Valley and meet LARWQCB standards, LACSD is expanding the Valencia WRP. The Phase I expansion was completed in 2002. Phase 2 is expected to be completed in 2010 and would expand the capacity by an additional 6 mgd. There are no current plans to expand the Saugus WRP. With completion of the Phase II expansion at the Valencia WRP, total combined capacity at the WRPs would be 34.1 mgd (38,200 afy). Table 1 provides the existing and projected future wastewater capacity for the Saugus and Valencia WRPs.

TABLE 1
Saugus and Valencia WRP Wastewater Collection and Capacity

	Capacity (af)						
Type of Wastewater	**2002**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Wastewater Collected and Treated in the Service Area	20,542	31,500	38,200	38,200	38,200	38,200	38,200
Quantity that Meets Recycled Water Standards	20,542	31,500	38,200	38,200	38,200	38,200	38,200

Source: CLWA 2005a.

Use of recycled water by CLWA is constrained by water rights holders downstream of the Saugus and Valencia WTPs. According to Section 1211 of the California Water Code, downstream water rights holders are protected if the source of return flow is "native water." Native water is water that, under natural conditions, would contribute to a given stream or other body of water. The use of "foreign water," such as imported SWP water, by downstream water rights holders is not protected under the Water Code. Groundwater pumped from and used in the Valley is considered "native water" while imported SWP water is considered "foreign water." Therefore, only the percentage of foreign water discharged from the WRPs can be diverted for recycling purposes. While CLWA has been approved to use 1,700 afy of recycled water, it may only do so if the amount of foreign water to be discharged from the WRP's meets or exceeds this amount.

Table 2 provides the current and projected future demand and availability of recycled water, as described in the 2005 UWMP. In 2005, foreign water comprised 64 percent of the Valley's potable water supply, while the remaining 36 percent consisted of native water. Future (2030) projected potable water demand was expected to be met with 65 percent foreign and 35 percent native water. This means that projected recycled water availability would be 65 percent of generated wastewater. As shown in Table 2, the demand for, and availability of, recycled water is expected to increase beyond CLWA's currently approved

use of 1,700 afy. CLWA is preparing to implement Phase II of its recycled water system, which would generate up to 1,740 additional acre-feet of recycled water[7].

TABLE 2
Current and Projected Demand and Availability of Recycled Water

	Native Water Demand (afy)	Foreign Water Demand (afy) (1)	Recycled Water Demand (afy)	Potable Water Demand Total (afy)	Waste-water Flow (afy)	Foreign Water Percentage of Potable Water Demand	Foreign Water Portion of Wastewater (afy)
2005 (2)	25,500	46,100	800	71,600	31,500	64%	20,100
2030 Projected	39,700	72,800	17,391	112,500	38,200	65%	24,830

Source: CLWA 2005a.
Notes: (1) Foreign water includes SWP water, water transfers, and desalination. (2) 2005 values were developed prior to the availability of 2005 use data, and therefore, are projected values.

As described in the 2005 UWMP, Berry Petroleum, another potential recycled water supplier, is considering treating the produced water from the Placerita Oilfield and making it available for CLWA to purchase. This recycled water source would be available on a short-term basis only because it is a by-product of oil extraction. The use of these supplemental recycled water sources for irrigation and to meet non-potable demand would allow CLWA to more efficiently use and distribute its potable water, increasing the reliability of water supplies in the Santa Clarita Valley.

Recycled water service was initiated in July 2003. As stated, CLWA is permitted to deliver up to 1,700 afy of recycled water. Future plans would allow the delivery of up to 17,400 afy (an additional 15,700 af; CLWA certified its Recycled Water Master Plan EIR in March of 2007). The amount of recycled water used for irrigation purposes, at a golf course and in roadway median strips, was approximately 470 af in 2007 (SCVWP 2008).

In addition, wastewater generated from development within the Newhall Ranch Specific Plan area will be treated by the proposed Newhall Ranch Water Reclamation Plant, which will use reverse osmosis/membrane technology to treat the effluent (personal communication, J. Ford 2008). The recycled water will be reused within the Specific Plan area for non-potable uses and the estimated available recycled water amount is approximately 5,400 afy at the time of full project build-out (personal communication, J. Ford 2008).

2.2 Imported Supplies and Banking

2.2.1 Semitropic Groundwater Banking Projects

In 2002 and 2004, CLWA entered into agreements with the Semitropic Water Storage District (Semitropic) to store a portion of CLWA's available Table A Amount under Semitropic's groundwater banking program (CLWA 2002 and 2003a). In 2002, CLWA stored an available

[7] Ford, Jeff, Water Resources Planner, Castaic Lake Water Agency, 2009.

portion of its Table A Amount (24,000 af), and in 2004, CLWA stored 32,522 af of available 2003 Table A Amount. Under the terms of both storage agreements, water can be stored for up to 10 years and 90 percent of the amount stored by CLWA, or 50,870 af, is recoverable through 2013 to meet demands in the CLWA service area. Water not recovered by CLWA after 2013 will be forfeited. CLWA anticipates using the stored water for a dry-year supply (CLWA 2005a).

The Negative Declaration prepared by CLWA for the 2002 Groundwater Banking Project was challenged in *California Water Network v. Castaic Lake Water Agency* (Ventura County Superior Court Case Number CIV 215327), which held in favor of CLWA. The decision was appealed. All issues regarding the 2002 banking program with Semitropic were conclusively resolved in favor of CLWA in June 2006. No legal challenges were filed to CLWA's approval of the second Groundwater Banking Project or its related Negative Declaration.

Implementation of groundwater banking agreements with Semitropic does not change the long-term, year-by-year water supply available for use in the Santa Clarita Valley. However, implementation of these agreements does improve the reliability of supplies for use within the CLWA service area because water stored in Semitropic could be used to augment dry-year supplies sometime in the future.

2.2.2 SWP Table A Supply and the CLWA Supplemental Water Project (41,000 Acre-foot Table A Transfer)

As stated, CLWA's contractual "right" to imported water via the SWP (i.e., its Table A Amount) is 95,200 af. Climatic conditions and other factors can significantly alter the availability of SWP water in any year, and DWR makes annual allocations of SWP water based on that year's hydrologic conditions and other factors. Refer to the discussion in Section 1.1.2 above, as well as that in Sections 2.4.3 and 2.4.4 below, for additional discussion on SWP delivery reliability.

The principal component of the CLWA Supplemental Water Project is the execution of an agreement for the transfer of 41,000 af of SWP Table A Amount and the associated conveyance and delivery terms from Kern County Water Agency (KCWA) to CLWA. In 1999, CLWA entered into such a contract with KCWA and its member unit, the WRMWSD. DWR concurred with this arrangement and modified CLWA's Water Supply Contract to conform to the agreement.

This transfer of contract rights to the SWP from KCWA to CLWA was completed in accordance with the "Monterey Amendments." These amendments to the Water Supply Contracts for the SWP are based on a statement of principles that were incorporated into an omnibus revision of the long-term contracts between DWR and most of the contractors.

Prior to the enactment of the Monterey Amendments and in compliance with an agreement among the SWP contractors and DWR, the Central Coast Water Agency (CCWA), one of the SWP contractors, acted as the lead agency for the preparation of a program EIR, which was used to support the Monterey Amendments (the "Monterey Agreement Program EIR"). Each of the other affected SWP contractors and DWR later adopted the Monterey Agreement Program EIR. These actions were challenged in court by the Planning and Conservation League, Citizens Planning Association, and Plumas County.

In the absence of a restraint from the courts, DWR modified the Water Supply Contracts and implemented the various components of the Monterey Agreement. At this point, the omnibus revision of the long-term contracts became known as the Monterey Amendments.

CLWA later prepared and certified a Supplemental Water Project EIR to evaluate the agreement with KCWA, including the 41,000 af transfer. As a project contained within the Monterey Agreement Program EIR, the Supplemental Water Project EIR was tiered off of the Monterey Agreement Program EIR.

After CLWA's certification of the Supplemental Water Project EIR, the Monterey Agreement Program EIR was decertified by the Court of Appeal in *Planning and Conservation League v. Dept. of Water Resources* (2000) 83 Cal.App.4th 892 (*PCL*). The Court of Appeal in *PCL* held that DWR should have been the lead agency for the Monterey Agreement Program EIR, instead of CCWA, and required DWR to prepare and certify its own EIR for the Monterey Agreement. The Court also held that the Monterey Agreement Program EIR was insufficient because it failed to analyze the impact of implementing a provision in the existing (pre-Monterey Amendments) Water Supply Contracts concerning the allocation of water among the contractors in the event of a permanent water shortage (Article 18(b))[8] as part of the no-project alternative. The Court in *PCL* did not invalidate the Monterey Agreement or enjoin the resulting implementing transfer contracts. Instead, the Court directed the trial court to consider whether the Monterey Agreement should remain in place pending DWR's preparation of a new EIR under Public Resources Section 21168.9 and to retain jurisdiction pending certification of the new EIR.

Because it was tiered from a now decertified Monterey Agreement Program EIR, the Court of Appeal decertified CLWA's Supplemental Water Project EIR in *Friends of the Santa Clara River v. Castaic Lake Water Agency* (2002) 95 Cal.App.4th 1373 (*Friends)*. The Court expressly found that all other contentions concerning the legal adequacy of the Supplemental Water Project EIR were without merit. "If the PCL/tiering problem had not arisen, we would have affirmed the judgment." *Friends*, *supra*, at 1387.

Similarly, the Court of Appeal in *Friends* did not enjoin the Supplemental Water Project or its 41,000 af transfer. It instead ordered the trial court to consider whether the contract authorizing the 41,000 af transfer should remain in place pending CLWA's preparation of a new EIR that is not tiered from the now decertified Monterey Agreement Program EIR under Public Resources Code Section 21168. Accordingly, the Court did not issue any ruling affecting CLWA's ability to continue to use and rely on the 41,000 af, leaving it to the trial court to determine whether to enjoin CLWA's use of the water pending its completion of a new EIR. *Friends*, *supra*, at 1388.

[8] Article 18 is a provision in the water supply contracts that addresses how water will be allocated amongst the contractors in the event of water supply shortages. Article 18(b), *Permanent Shortage; Reduction of Entitlements* was deleted with the Monterey Amendments. Article 18(b) provided that, in the event that DWR was unable to construct sufficient additional conservation facilities to prevent a reduction in the minimum SWP yield, or if for any other reason there was a reduction in the minimum SWP yield, which threatened a permanent shortage in the supply of SWP water to be made available to the contractors, the annual entitlements and the maximum annual entitlements of all contractors, except to the extent such entitlements may reflect established rights under the area of origin statutes, would be reduced by amendment of Table A of the contracts, proportionately by DWR to the extent necessary so that the sum of the revised maximum annual entitlements of all contractors would then equal such reduced minimum SWP yield.

In September 2002, on remand to the Los Angeles County Superior Court, the *Friends* petitioners applied under Public Resources Section 21168.9 to enjoin CLWA from continuing to use and rely on water from the 41,000 af transfer. The trial court rejected that request.

In December 2003, the Court of Appeal affirmed the trial court's ruling and refused to enjoin CLWA from continuing to use and rely on water from the 41,000 af transfer pending completion of a new EIR. The *Friends* petitioners were permitted to renew their application based upon evidence of the actual use of such additional water for purposes it considers improper.

Meanwhile, before the trial court in *Friends* acted on remand, the parties to the *PCL* litigation entered into a settlement agreement, which was later approved by the Sacramento County Superior Court. The settlement agreement provides that the SWP will continue to be administered and operated in accord with both the Monterey Amendments and the terms of the settlement agreement.

The settlement agreement did not invalidate or vacate the Monterey Amendments or any water transfer effected under them, including the CLWA-KCWA transfer. The settlement agreement recognized the pending litigation on the 41,000 af transfer and the parties to the settlement agreement agreed that the litigation should remain in the Los Angeles County Superior Court. The water transfer was effected and permanent under the settlement agreement.

The Supplemental Water Project EIR having been decertified, CLWA prepared and circulated a new Draft Supplemental Water Project EIR, which did not tier off the Monterey Agreement Program EIR. CLWA held two separate public hearings concerning the new Draft Supplemental Water Project EIR, and received and responded to public comments. CLWA certified the new Supplemental Water Project EIR on December 22, 2004, and lodged the certified EIR with the Los Angeles Superior Court as part of its return to the trial court's writ of mandate in *Friends*. Thereafter, the *Friends* petitioners voluntarily dismissed the *Friends* action in February 2005.

Two legal challenges to CLWA's new Supplemental Water Project EIR were filed in January 2005 in the Ventura County Superior Court (*Planning and Conservation League v. CLWA* and *California Water Impact Network v. CLWA*). These challenges were consolidated and transferred to the Los Angeles Superior Court (*California Water Impact Network v. CLWA*, Case No. BS 098724) (*CWIN*). The Los Angeles County Superior Court issued its statement of decision on May 22, 2007 (a copy of the decision is provided in Attachment A of this Technical Report). In July 2007, Petitioners filed a Partial Notice of Appeal and CLWA subsequently filed a Notice of Cross Appeal.

In *CWIN*, the trial court upheld the validity and finality of the 41,000 afy transfer. The statement of decision states: "Under contract and validation law, the Kern water transfer contract, entered into in 1999, is valid, has been approved by DWR, and [CLWA] has paid Wheeler Ridge for it. Neither the parties nor DWR can terminate the Kern transfer contract. Nothing in CEQA permits a public agency to void a contract." (*CWIN*, *supra*, at 13).

The court found that DWR's new Monterey Agreement Program EIR may affect the Kern water transfer. "DWR conceivably could conclude that these transfers have significant environmental impacts. As a consequence, DWR might have to impose feasible mitigation

measures, adopt alternatives, or make a finding of infeasibility and adopt a statement of overriding considerations." (*Id.*) But DWR cannot invalidate the 41,000 AF transfer. "Though the court cannot conclude that the Kern water transfer would have occurred without the Monterey Amendments, it can conclude that the transfer will remain in effect even if the Monterey Amendments are not approved or otherwise are mitigated under CEQA. The Court already has indicated that the Kern water transfer is final." (*CWIN, supra,* at 19).

In discussing the impact of the *PCL* decision, the court indicated that nothing in *PCL* requires CLWA to wait for DWR's Monterey Agreement Program EIR. "Under lead agency law, [CLWA] may act as lead agency and prepare an EIR for the Kern water transfer. The Kern water transfer is a project separate in time from the Monterey Amendments, now Monterey Plus." (*CWIN, supra,* at 16).

The court held that the new Supplemental Water Project EIR was properly prepared, except for one defect – it failed to show the analytic route as to how and why three possible water delivery scenarios are relevant and would occur.

The court identified that the new Supplemental Water Project EIR considered the impacts of the project based on three water delivery scenarios: pre-Monterey Amendments without Article 18 cutbacks, pre-Monterey Amendments with Article 18 cutbacks, and post-Monterey Amendments. The court criticized the EIR for assuming the three possible water delivery scenarios without any discussion of why or how they would occur. The court indicated that the new Supplemental Water Project EIR stated only: "Since the Monterey Amendments change the way in which SWP water is allocated among contractors, the 2004 EIR provides three separate analyses of the project's impacts to water supply." The court found the new Supplemental Water Project EIR deficient because it did not explain that the three water delivery scenarios are possible outcomes of challenges to the Monterey Amendments, and did not explain how the challenges could cause these allocations to occur. This one defect in the new Supplemental Water Project EIR does not relate to the environmental conclusions reached in the EIR.

The petition for writ of mandate in *CWIN* was therefore granted in part and requires CLWA to set aside its approval of the new Supplemental Water Project EIR and comply with CEQA addressing the analytic route of the three water allocations. However, the decision clearly states that: "[CLWA] is not directed to set aside the Kern water transfer." (*CWIN, supra,* at 30). Therefore, the judgment was entered in favor of the Petitioners solely on the issue identified.

Other court actions have addressed water planning issues and uncertainty including issues in the Santa Clarita Valley and the CLWA Supplemental Water Project specifically. For example, the Court of Appeal in *California Oak Foundation v. City of Santa Clarita* (2005) 144 Cal.App.4th 1219 struck down the City of Santa Clarita's certification of an EIR for the Gate-King industrial project because it did not address the legal uncertainties surrounding the 41,000 af transfer. The City's EIR included no discussion of the uncertainty regarding the 41,000 af transfer other than brief references in the appendices and responses to comments. The Court of Appeal found this to be an inadequate analysis because it failed to inform the public of the litigation uncertainties surrounding the transfer.

The Court of Appeal's ruling in *California Oak* did not prohibit reliance on the CLWA Supplemental Water Project, including the 41,000 af transfer. The Court criticized the City's reasoning for relying on the CLWA-imported water supply (including the 41,000 af Table A transfer), but it did not bar the City or any other agency from relying on the transfer for planning purposes.

Instead, the Court of Appeal held that the EIR must include either: (1) an analysis of why it is appropriate to rely on the 41,000 af transfer; or in the alternative (2) an analysis of how the demand for water would be met without the 41,000 af entitlement. The Court held that it was still up to the City to determine whether reliance on the 41,000 af is reasonable.

Accordingly, under *California Oak*, so long as the agency has analyzed the uncertainties surrounding this water supply, it is within the agency's province to decide whether to rely on the transfer for planning purposes.

The Los Angeles County Superior Court issued a statement of decision in *Santa Clarita Oak Conservancy, et al. v. City of Santa Clarita*, Aug. 15, 2007, Case No. BS 084677 (*Gate-King*), which upheld the City's Return to a Writ of Mandate and Final Additional Analysis to the Gate-King project EIR. The court found that the City was not legally precluded from relying on the 41,000 af transfer for planning purposes pending completion of the litigation surrounding the Monterey Agreement and DWR's new Monterey Agreement Program EIR. The court found also that the City analyzed adequately the uncertainties surrounding the 41,000 af transfer and provided a reasoned analysis based on substantial evidence as to why it was appropriate to rely on that transfer. Lastly, the court found that the Final Additional Analysis was not required to identify supplies to replace the 41,000 af in light of the California Supreme Court's decision in *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412 (*Vineyard*).[9] "Here, it was *not* impossible to confidently determine that the 41,000 afy would continue to be available based on the record before the City." (*Gate-King*, *supra*, at p. 13).

The Court of Appeal in *Santa Clarita Organization for Planning the Environment v. County of Los Angeles* (2007) 157 Cal.App.4th 149 (*West Creek*) found the County's analysis of water supply adequate in its recertified EIR for Newhall Land and Farming's West Creek project, which relied on the 41,000 afy transfer. The court further held that it can be confidently determined that the 41,000 afy transfer will be available such that no analysis of possible alternative replacement sources of water is needed under the California Supreme Court's analysis in *Vineyard.*

[9] In *Vineyard*, the California Supreme Court considered the sufficiency of the water supply analysis contained in an EIR prepared for a development project. The EIR's water supply analysis identified near-term supplies sufficient to serve the first phase of the project, and potential long-term water supplies for the later phases. Project opponents alleged various deficiencies in the analysis of water supplies and claimed that the EIR failed to demonstrate with sufficient certainty that water would be available for the project.

The Court concluded that a water supply analysis need not establish certainty or provide guarantees of available long-term supply; however, the Court determined that the EIR failed to adequately analyze long-term water supply and the environmental effects of potential sources for long-term provision of water. The Court emphasized that certainty is not required for long-term supplies, but nevertheless required the EIR to include some discussion of possible replacement water sources when it is not possible to confidently determine that anticipated future water sources will be available, and to disclose the significant foreseeable environmental effects of those sources, as well as mitigation measures to minimize adverse impacts.

Despite the litigation uncertainties surrounding the 41,000 af transfer since its inception, the transfer was completed in 1999 and the water has been continuously delivered to CLWA. CLWA has paid approximately $47 million for the additional Table A Amount based on the transfer. The monies have been delivered. The sales price was financed by tax-exempt bonds. DWR recognized the transfer as permanent under the Monterey Agreement by entering into Amendment No. 18 to CLWA's agreement, which increases its Table A Amount by 41,000 af. The water supplies have consistently been allocated to CLWA based on that entitlement ever since.

A future adverse judgment related to the 41,000 af transfer, or to the Monterey Agreement, or imposed mitigation measures affecting the 41,000 af transfer could affect CLWA SCWD's ability to use water from the 41,000 af transfer and adversely affect CLWA SCWD's water supplies over the long term (creating potential uncertainty relative to this water supply). However, it is not reasonable to believe that pending litigation or a future court decision is likely to unwind executed and completed agreements with respect to the permanent transfer of SWP water amounts, including the 41,000 af transfer.

A summary of legal decisions, relevant environmental documentation, and other circumstances that support the appropriateness of relying upon the 41,000 af transfer for planning purposes, including the Project, is provided below:

1. The Monterey Agreement and resulting implementing transfer amendments remain in full force and effect, and no court has questioned the validity of the Monterey Agreement or the resulting implementing contracts.
2. The 41,000 af transfer was completed in 1999 and DWR has allocated and annually delivered water in accordance with the completed transfer. A price was set, the money was paid (financed by tax-exempt bonds), DWR amended CLWA's contract to include the additional entitlement, and the water has been continuously allocated and annually delivered to CLWA since 2000.
3. The Court of Appeal in *Friends* refused to enjoin the reasonable use of water from the CLWA Supplemental Water Project, including the 41,000 af transfer.
4. The existing SWP Water Supply Contract (including the 41,000 af transfer amendment) remains in full force and effect, and no court has ever questioned the validity of the contract or enjoined use of this portion of CLWA's Table A Amount.
5. Nothing in the Monterey Amendments settlement agreement precludes reliance on the 41,000 af transfer.
6. The Monterey Amendments settlement agreement expressly authorizes the operation of the SWP in accordance with the Monterey Amendments, which authorize the 41,000 af transfer.
7. Nothing in the Monterey Amendments settlement agreement precluded CLWA from preparing and certifying its new Supplemental Water Project EIR for the 41,000 af transfer, as instructed by the Court of Appeal in *Friends*.

8. DWR is preparing a new Monterey Agreement Program EIR, which will analyze all of the water transfers that were facilitated by the Monterey Amendments;[10] this does not preclude CLWA from preparing and certifying its own EIR for the 41,000 af transfer, as instructed by *Friends*. In *CWIN,* the Superior Court held that CLWA does not need to wait for DWR's new Monterey Agreement Program EIR, CLWA can prepare its own environmental analysis, and the 41,000 af water transfer is "a project separate in time from the Monterey Amendments." (*CWIN, supra,* at 16).

9. The 1999 CLWA Supplemental Water Project EIR for the 41,000 af transfer was decertified solely because it tiered from a later-decertified Monterey Agreement Program EIR. CLWA certified the new Supplemental Water Project EIR, including the 41,000 af Table A Amount transfer, without tiering from the Monterey Agreement EIR. CLWA's new 2004 Supplemental Water Project EIR corrected the sole defect identified by the Court of Appeal (i.e., tiering off the Monterey Agreement Program EIR).

10. The Superior Court in *CWIN* held that CLWA may act as the lead agency for the Kern water transfer and that the new Supplemental Water Project EIR was properly prepared except for one defect (described above). As also stated above, the defect did not relate to the environmental conclusions reached in the environmental document. The decision clearly states that: "[CLWA] is not directed to set aside the Kern water transfer." (*CWIN, supra,* at 30).

11. In connection with its preparation of a new Monterey Agreement Program EIR, DWR may impose mitigation measures for the 41,000 af transfer or may adopt alternatives to the 41,000 af transfer, which may impact the Kern water transfer. But, the Superior Court in *CWIN* held that DWR cannot invalidate the Kern water transfer. Moreover, close cooperation between DWR and CLWA on the preparation of the new Supplemental Water Project EIR reduced, but does not eliminate, the prospect that DWR will impose additional alternatives or mitigation measures in its Monterey Agreement Program EIR.

12. The Los Angeles County Superior Court decision in CWIN upheld the validity and finality of the 41,000 afy transfer.

13. The Court of Appeal in an unpublished decision upheld the City of Santa Clarita's EIR for Newhall Land and Farming's Riverpark project and found that the City properly relied on the 41,000 af water transfer for planning purposes and that substantial evidence supports reliance on the 41,000 af water transfer. (*Sierra Club, et al. v. City of Santa Clarita, et al.*, Jan. 29, 2008, Case No. B194771). "We conclude that the facts stated in the EIR, including the executed agreements effecting the transfer, the implementation of those agreements and delivery of water for several years, and the absence of any court order vacating the approval of those agreements, constitute substantial evidence supporting the EIR's conclusion [that the 41,000 af would continue to be available despite the pending Monterey Agreement environmental review and litigation challenges]." (*Sierra Club, supra,* at 34) The opinion is provided at Attachment B of this Technical Report.

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[10] DWR released the Draft Environmental Impact Report for the Monterey Amendment to the State Water Project Contracts, including the Kern Water Bank Transfer and Associated Actions as Part of a Settlement Agreement (Monterey Plus) in October of 2007.

14. The Los Angeles County Superior Court issued a statement of decision in *Santa Clarita Oak Conservancy, et al. v. City of Santa Clarita*, Aug. 15, 2007, Case No. BS 084677 (*Gate-King*), which upheld the City's Return to a Writ of Mandate and Final Additional Analysis to the Gate-King project EIR. The court found that the City was not legally precluded from relying on the 41,000 af transfer for planning purposes pending completion of the litigation surrounding the Monterey Agreement and DWR's new Monterey Agreement Program EIR. The court found also that the City analyzed adequately the uncertainties surrounding the 41,000 af transfer and provided a reasoned analysis based on substantial evidence as to why it was appropriate to rely on that transfer. Lastly, the court found that the Final Additional Analysis was not required to identify supplies to replace the 41,000 af in light of the California Supreme Court's decision in *Vineyard*. "Here, it was *not* impossible to confidently determine that the 41,000 afy would continue to be available based on the record before the City." (*Gate-King*, *supra*, at p. 13) On May 13, 2009, the Second District Court of Appeal issued an unpublished opinion affirming the judgment and also affirming the judgment of the Los Angeles County Superior Court on a related case, California Water Impact Network v. Newhall County Water District, Case No. BS098727 (holding that NCWD's reliance on the City's recertified EIR, Final Additional Analysis, and CEQA Findings was adequate to support its adoption of a resolution to annex the Gate-King site into NCWD's service area).

15. In *West Creek*, Santa Clarita Organization for Planning the Environment (SCOPE) challenged the water supply analysis in the County's recertified EIR for the West Creek project, a proposed mixed residential and commercial development in the Santa Clarita Valley. Specifically, SCOPE opposed the City's reliance on the 41,000 af water transfer. The court considered whether the California Supreme Court's decision in *Vineyard* compelled the City to consider replacement water sources for the 41,000 af water transfer because the current source of water could be uncertain in the future. The court concluded that the record contained "substantial evidence demonstrating a reasonable likelihood that water from the Kern-Castaic transfer will be available for the project's near- and long-term needs," (*West Creek, supra,* 157 Cal.App.4th at 162), and analysis of potential replacement sources is not required. "Suffice it to say, however the Monterey Agreement litigation is eventually decided, the Kern-Castaic transfer will likely not be affected. Per principle four [of *Vineyard*] we can confidently determine that the water will be available." (*Id.* at 162–63)

2.2.3 Rosedale-Rio Bravo Water Storage District Groundwater Storage, Banking, Exchange, Extraction and Conjunctive Use Program

In an effort to enhance water supply reliability over the long-term, CLWA has entered into a water banking agreement with the RRBWSD. The EIR evaluating the potential environmental effects of this agreement was certified and the agreement was approved by CLWA in fall 2005.

Under the RRBWSD Groundwater Storage, Banking, Exchange, Extraction and Conjunctive Use Program (RRBWSD Storage and Recovery Program), CLWA may store up to 20,000 afy of its total SWP Table A Amount for later withdrawal and delivery to the CLWA service area in a future year or years when demand in the CLWA service area is greater than supply

(i.e., in drier years; CLWA 2005b). Additional yearly storage capacity may be provided from time to time as determined by RRBWSD, however, the maximum amount of stored water that CLWA will have in the RRBWSD Storage and Recovery Program at any time is 100,000 af. Over the life of the project (through 2035), CLWA will be able to store a total of 200,000 af in the RRBWSD Storage and Recovery Program (CLWA 2005b). Under the RRBWSD Storage and Recovery Program, CLWA banked 20,000 af in 2005 and 20,000 af in 2006 (personal communication, J. Ford 2007). The banked excess 2005 and 2006 SWP Table A water, augmented by water acquired through the Buena Vista/Rosedale-Rio Bravo Water Acquisition Agreement (discussed below) represent a total of 57,600 af of recoverable water for drought water supply from the Rosedale-Rio Bravo Banking and Exchange Program (SCVWP 2007). An additional 8,200 af was also banked in the Rosedale-Rio Bravo Banking and Exchange Program bringing the recoverable total to approximately 64,900 af[11] (personal communication, J. Ford 2007).

Under the RRBWSD Storage and Recovery Program, CLWA may elect to deliver to RRBWSD its excess Table A Amount or other SWP supplies available to CLWA. RRBWSD would use this water in lieu of pumping groundwater for irrigation or would directly recharge it to the underlying groundwater basin in recharge/percolation ponds. Upon request, RRBWSD would return CLWA's previously stored SWP water in one or more years, by either (1) requesting that an equivalent amount of RRBWSD's SWP water be delivered to CLWA (exchange); or (2) by pumping the water from its groundwater basin (pumpback) to the Cross Valley Canal into the California Aqueduct, at which time the water would commingle with the SWP water in the California Aqueduct and would be conveyed to CLWA. The water RRBWSD returns to CLWA would be delivered through the California Aqueduct to CLWA on a space-available basis within the capacity of SWP facilities. CLWA will be able to request the withdrawal of 20,000 afy plus any additional and available extraction capacity as determined by RRBWSD.

This is a long-term banking and exchange project that will extend through 2035. The RRBWSD Storage and Recovery Program improves the reliability of CLWA's existing single or multiple dry-year supplies.

2.2.4 Water Acquisition from the Buena Vista Water Storage District and Rosedale-Rio Bravo Water Storage District Water Banking and Recovery Program

CLWA has a water acquisition agreement with the BVWSD and the RRBWSD, referred to as the BVWSD/RRBWSD Water Acquisition Project. The Final EIR was certified and the project was approved on October 25, 2006.

In November 2006, a complaint and petition for writ of mandate seeking to set aside CLWA's certification of its EIR for the BVWSD/RRBWSD Water Acquisition Project was filed by California Water Impact Network in the Los Angeles County Superior Court (LASC Case No. BS106546). The complaint/petition was later amended to add Friends of the Santa Clara River (Friends) as a plaintiff/petitioner. In November 2007, the trial court filed its Statement of Decision finding that in certifying the EIR and approving the project, CLWA

[11] The recoverable amounts account for contractual losses of 11 percent as appropriate.

proceeded in a manner required by law, and that its actions were supported by substantial evidence. Judgment was entered in favor of CLWA in December 2007. On April 20, 2009, the Second District Court of Appeal issued an unpublished opinion affirming the Judgment denying the mandate petition (Case No. B205622).

Through the BVWSD/RRBWSD Water Acquisition Project, CLWA has rights to purchase 11,000 af annually from BVWSD/RRBWSD during the term of CLWA's SWP Contract (2035), with an option to extend to a later date. The purchased water associated with the BVWSD/RRBWSD Water Acquisition Project originates from local and other supplies available to BVWSD and RRBWSD that are recharged and banked in their groundwater basins (CLWA 2006b). These supplies include Kern River wet year water and other acquired waters that may become available (CLWA 2006b). Should delivery of the entire amount of water not be required in a given year, CLWA would have the option to store the water in any groundwater storage or banking program to which it has access. CLWA is entitled to 22,000 af of water that was stored in the Rosedale Rio-Bravo Water Banking and Exchange Program on CLWA's behalf (discussed above) (SCVWP 2007).

The BVWSD/RRBWSD Water Acquisition Project was an action by CLWA to augment its water supply to meet the water demands of its service area, and its service area as it may be extended through annexation, through the purchase, or transfer, of water from the BVWSD/RRBWSD Program (CLWA 2006b). Due to uncertainty surrounding the ability of the SWP to maintain current pumping levels in the Delta, as a result of litigation concerning the impact of SWP operations on endangered species (refer to the discussion below), CLWA advised in mid- and late-2007 that it would be deferring temporarily consideration of requests to annex property into its service area. Instead, in the near-term, CLWA is reserving the 11,000 afy, which is not affected by the pending litigation and actions in the Delta, for current and future demand within the existing CLWA service area, including the proposed Project addressed in this EIR, which is already within CLWA's service area and is unaffected by CLWA's temporary policy on annexations. This deferral also applies to other developers who may approach CLWA in the near future regarding proposed annexations to CLWA's service area. The deferral does not affect water service to Santa Clarita Valley retail purveyor customers in CLWA's wholesale service area.

Under certain hydrologic and operational conditions, an additional 9,000 af could be purchased from year to year when water may be available (CLWA 2006b). This additional water would only be available periodically, and while it would increase the water supply reliability for the CLWA service area, it would not support new development.

2.2.5 CLWA and Ventura County Flexible Storage Account

Flexible storage is storage available to SWP contractors that share in repayment of the costs of terminal reservoirs (Castaic and Perris lakes). These contractors may withdraw water from their share of flexible storage, in addition to any other SWP supplies available to the contractor. The contractor must replace any water it withdraws from flexible storage within five years.

CLWA may withdraw up to 4,684 af of water from Castaic Lake as flexible storage (CLWA 2005a). CLWA manages this storage by keeping the account full in normal and wet years and then withdrawing that stored amount (or a portion of it) to deliver during dry periods.

The account is refilled during the next year that adequate SWP supplies are available to CLWA to do so.

In addition, CLWA has negotiated with Ventura County water agencies to obtain the use of their Flexible Storage Account. As part of this agreement, CLWA has access to another 1,376 af of storage in Castaic Lake on a year-to-year basis for ten years, beginning in 2006 (CLWA 2005a).

2.2.6 Nickel Water

1,607 afy of Nickel Water has been secured by the Newhall Ranch Specific Plan project applicant under contract with Nickel Family LLC in Kern County (Los Angeles County 2003). The water is not a part of the SWP supplies and is 100 percent reliable on a year-to-year basis and not subject to dry year conditions (Los Angeles County 2003). Once all of the required contracts between the owners of the water or any agency that would transport, treat or deliver the water to the Santa Clarita Valley have been executed, this water would be delivered through the KCWA to the SWP and, from there, DWR would use SWP facilities to deliver the water to CLWA whose filtration plants would treat the water and whose distribution system would deliver the water to the CLWA service area (personal communication, J. Ford 2008).

2.2.7 Newhall Land- Semitropic Water Storage District Banking

The Newhall Ranch Specific Plan project applicant has entered into an agreement to reserve and purchase water storage capacity of up to 55,000 af in the Semitropic Water Storage District Groundwater Banking Project (Los Angeles County 2003). Sources of water that could be stored include, but are not limited to, the Nickel Water. The stored water could be extracted in dry years in amounts up to 4,950 afy (Los Angeles County 2003). As of December 31, 2007, there is 18,828 af of water stored in the Semitropic Groundwater Storage Bank by The Newhall Land and Farming Company for the Newhall Ranch Specific Plan. Newhall Ranch is located within the CLWA service area. Delivery of stored water from the Newhall Land Semitropic Groundwater Bank requires further agreements between CLWA and Newhall Land.

2.3 Facilities

2.3.1 Treatment

CLWA filters and disinfects SWP water at its two treatment plants prior to its distribution to Local Purveyors. CLWA has constructed upgrades to the Earl Schmidt Water Filtration Plant and plans to expand the Rio Vista Water Treatment Plant (expected completion in 2011). The following section summarizes these actions.

The Earl Schmidt Water Filtration Plant (ESWFP) is one of two potable water treatment plants in the CLWA service area. The ESWFP is located near Castaic Junction, south of Lake Hughes Road and adjacent to Castaic Lake. It receives untreated SWP water from Castaic Lake and treats that water to meet applicable potable water quality standards.

CLWA evaluated designs and potential environmental impacts of the upgrade and expansion of the ESWFP in 2003. These process modifications were designed to achieve

compliance with current and proposed water quality regulations (CLWA 2003b). The capacity modifications to the ESWFP increased the firm treatment capacity of this facility to 56 mgd (CLWA 2003b). These capacity modifications had the additional benefits of providing: (1) a greater degree of redundancy in treatment capabilities in the event of an emergency; (2) additional peak throughput capacity to meet existing summer peaking needs; and (3) capacity to serve future growth. The 56 mgd plant has been functioning with its new processing system and added capacity since the spring of 2005.

CLWA is also planning the expansion of the Rio Vista Water Treatment Plant (RVWTP) (CLWA 2006a). The plans call for the expansion of this facility from 30 mgd to 60 mgd. The capacity modifications would have the same benefits as described for the ESWFP above. The CLWA Board of Directors approved the project and certified the Rio Vista Water Treatment Plant Expansion Final EIR on August 23, 2006. Construction is underway and expected to be completed in the spring of 2011 (personal communication, J. Ford 2009).

Expansion of treatment capacity enhances the ability of regional water agencies to meet the peak demands of water users. Without these expansions water purveyors may be forced to increase the pumping capacity of groundwater wells to meet peak demands because of limited peaking capacity to treat imported water supplies. Treatment plant expansions do enhance the reliability of the delivery of water to users but do not add to the reliability of overall water supply in the Valley.

2.3.2 Conveyance

CLWA provides treated water to the Local Purveyors via a network of pipelines. Completion and operation of the new facilities described below does not influence the amount of water available to support new development in the CLWA service area, but does support the delivery of the available water for use to existing and future development. Facilities upgrades in the CLWA service area contribute to meeting peak period daily demands and provide redundancy to cope with unanticipated outages and emergencies.

Pitchess Pipeline Extension

The Pitchess Pipeline Extension project is an approximately 4,300-foot-long, 24-inch lateral pipeline extension that extends the existing pipeline from just east of Interstate 5 to the intersection of the Old Road and Sedona Way. The Pitchess Pipeline carries treated imported water to the northwestern portion of CLWA's service area to supplement existing groundwater supplies distributed by the Local Purveyors. The Pitchess Pipeline was completed in fall of 2005.

Honby Pipeline

The Honby Pipeline Project is the construction of a 9,500-foot, 60-inch buried steel water pipeline to replace the existing 33-inch Honby pipeline, in a new alignment. Construction will occur in two stages. The first phase will include construction of a 2,500-foot pipeline segment that will connect the 84-inch treated water pipeline that leads from the RVWTP to the existing Honby Pipeline. The second phase will consist of the construction of the remaining 6,400-foot segment of the pipeline. This segment will continue from the end of the 2,500-foot segment to the new Sand Canyon pump station. Construction is expected to

be complete by spring 2010. This pipeline will transport water that is already part of CLWA's supply.

Sand Canyon Pipeline

CLWA recently completed the construction of the Sand Canyon Pipeline and pump station, and a related storage reservoir. The 48-inch, approximately 30,000-foot-long water pipeline originates near the intersection of Furnivall Avenue and Santa Clara Street where the new Sand Canyon pump station is located. The pipeline travels southeast from the new pump station and terminates at the new storage reservoir which was constructed west of Rolling Hills Avenue and Warmuth Road. The new pump station will provide the lift to transport water to the 7-million-gallon storage reservoir and ensure that adequate pressure is available throughout the project's service zone.

2.4 Plans and Reports

2.4.1 NCWD Water Supply Assessment

Because the Skyline Ranch project is located both within NCWD's and CLWA SCWD's service area, a brief discussion of the NCWD Water Supply Assessment report is provided here.

In late 2004, NCWD prepared an assessment of regional water supplies to assist the agency in determining if currently available and reasonably foreseeable water sources will be sufficient to meet existing and anticipated future water demands (NCWD 2004). This assessment characterized the local and imported water supplies available to NCWD, the reliability of those water supplies and the projected water demands for the Santa Clarita Valley, and those within the NCWD service area. The assessment followed the guidelines in the California Water Code Sections 10910-10912 for approach, required information, and the criteria for determining supply sufficient for a water supply assessment.

NCWD evaluated various methods of predicting future water demands. The various methods included regional projections of per capita use estimates, extrapolation of historic water connections to new water connections, and econometric approaches using planned land use. The extrapolation of historic water connection method (with consideration of the results of the other methods) was used in the report.

It was determined that the total annual demand within the NCWD service area at build-out of the approved land use (at an indeterminate date) would be 29,150 af. Water connections are expected to increase to 14,550 by 2025. Water demand in the NCWD service area (with anticipated conservation measures) is expected to increase to 17,400 afy by 2025.

NCWD reviewed the status of each of the local and imported water supplies, their constraints, reliability, and augmentation possibilities. Based on those analyses sufficient water supplies appeared to be available to meet anticipated demand through 2025. This determination included normal, multiple dry, and single dry year conditions along with the use of local groundwater, imported, banked, and recycled supplies.

2.4.2 Santa Clarita Valley Water Reports

Water management agencies in the Santa Clarita Valley have prepared the annual *Santa Clarita Valley Water Report* (SCVWR) since 1998. The 2007 report provides the current information about water supplies (including the local groundwater resources, SWP and other imported water supplies, water conservation and recycled water) and demands. The 2007 edition reviews the sufficiency and reliability of current supplies in the context of existing demand and provides a short-term outlook of the supply-demand relationship for 2008.

As described in the 2007 SCVWR, the total water demand in the Santa Clarita Valley in 2007 was approximately 92,300 af. Approximately 84 percent (77,500 af) of this demand was delivered for municipal use and the remainder (14,800 af) was for agricultural and other (miscellaneous) uses. Total demand in 2007 was about one percent higher than in 2006 with the difference being attributable to the increase of about 800 municipal service connections, and a less than typical use of water for agricultural irrigation after a return to normal in 2006 following the extremely wet conditions of 2005. Water requirements in 2007 remained consistent with projections in the 2005 UWMP.

The total water demands in 2007 were met by a combination of about 46,500 af from local groundwater resources, about 45,300 af of SWP water and other imported water, and about 470 af of recycled water. Groundwater supplies were used to meet about 31,700 af for municipal demand and 14,800 af for agricultural and other uses. Groundwater supplies from the Alluvial Aquifer produced approximately 38,800 af and about 7,700 af were pumped from the underlying, deeper Saugus Formation. Alluvial Aquifer pumping represented about a 4,300 af decrease from 2006 while pumping from the Saugus Formation was about 400 af higher than in 2006. Neither pumping volume resulted in any overall change in ongoing groundwater conditions (water levels, water quality, etc.) in either aquifer system. Imported water deliveries to the Local Purveyors increased by about 4,700 af from the volume delivered in 2006. Table 3 provides a summary of the water uses and supplies in the Santa Clarita Valley in 2007.

CLWA's final allocation of Table A from the SWP for 2007 was 60 percent, or 57,120 af. The total available imported water supply in 2007 was 72,336 af, composed of the 57,120 af of Table A supply, 11,000 af purchased from Buena Vista/Rosedale Rio Bravo, and 4,216 af of 2006 carryover delivered in early 2007. CLWA deliveries were 45,332 af to the Purveyors, 8,200 af to the RRBWSD Storage and Recovery Program (described above), and 6,071 af to Devil's Den Ranch.

The SCVWR also provided a review of the status of the water resources available for use in the Santa Clarita Valley and applicable water management plans. Management plans for the Alluvial Aquifer anticipate withdrawals in the range of 30,000 to 40,000 afy in average/normal years, and 30,000 to 35,000 afy in dry years. Pumping from the Alluvial Aquifer was approximately 38,800 af in 2007, which is within the operating plan range for the Alluvium. On a long-term basis, the Alluvium shows no signs of water level-related overdraft, i.e., no trend toward decreasing water levels and storage. Consequently, pumping from the Alluvium has been and continues to be sustainable, well within the operational yield of that aquifer on a long-term average basis, and also within the operating yield in almost every individual year.

TABLE 3
Summary of 2007 Water Supplies and Uses (acre-feet)

Municipal		
State Water Project and Other Imported	—	45,332
Groundwater (Total)	—	31,690
Alluvial Aquifer	25,632	—
Saugus Formation	6,058	—
Recycled Water	—	470
Subtotal	**—**	**77,492**
Agriculture/Miscellaneous		
State Water Project and Other Imported	**—**	**—**
Groundwater (Total)	**—**	14,768
Alluvial Aquifer	13,141	**—**
Saugus Formation	1,627	**—**
Subtotal	**—**	**14,768**
Total	**—**	**92,260**

Source: SCVWP 2008.

While there have been historical fluctuations in groundwater level and quality, typically associated with variations in precipitation and streamflow, there has been no long-term trend toward groundwater quality degradation; groundwater produced from the Alluvial Aquifer remains a viable municipal and agricultural water supply.

The Alluvial Aquifer wells near the Whittaker-Bermite property are routinely sampled and perchlorate has not been detected. The inactivation of Alluvial wells due to perchlorate contamination (described above) does not limit the Purveyors' ability to produce groundwater from the Alluvial Aquifer in accordance with the groundwater operating plan. All other Alluvial wells operated by the Purveyors continue to be used for municipal water supply service.

Management plans for the Saugus Formation aquifer anticipate withdrawals in the range of 7,500 to 15,000 afy in average/normal years and 21,000 to 35,000 afy for one to three consecutive dry years. These management plans describe that such short-term pumping can be recharged during subsequent wet/normal years to allow groundwater levels and storage to recover, as it has in historical periods.

Total pumping from the Saugus Formation was about 7,700 af in 2007. On average, pumping from the Saugus Formation has been about 6,800 afy since 1980. The pumping rates remain well within, and generally at the lower end of the range of operational yield of the Saugus Formation. Based on available data, there is no evidence of any historic or recent trend toward permanent water level or storage decline.

Ammonium perchlorate contamination from the Whittaker-Bermite facility continued to force the closure of four wells in the Saugus Formation (described above). Despite the inactivated Saugus wells, the Purveyors still have sufficient pumping capacity in other wells to meet the planned normal range of Saugus pumping.

The 2007 SCVWR also provides up-to-date information on historical and current water deliveries by water source type. This information is provided in Table 4. Water demands and supplies fluctuate from year to year in response to climatic conditions. For example, while the long-term urbanization of the Santa Clarita Valley has resulted in a long-term increase in demand for urban uses, demand in 2005 was less than in 2004, principally as a result of a lengthy rainy season.

TABLE 4
Municipal Water Supply Utilization by the Local Purveyors

Year	Imported Water[1]	Alluvial Aquifer	Saugus Formation	Recycled Water	Total Municipal
1980	1,125	16,625	4,569	0	22,319
1981	5,816	14,056	4,950	0	24,822
1982	9,659	8,684	3,569	0	21,912
1983	9,185	8,803	3,398	0	21,386
1984	10,996	12,581	3,809	0	27,386
1985	11,823	12,519	4,140	0	28,482
1986	13,759	12,418	4,975	0	31,152
1987	16,285	12,630	4,962	0	33,877
1988	19,033	12,197	6,404	0	37,634
1989	21,618	13,978	7,217	0	42,813
1990	21,613	13,151	8,302	0	43,066
1991	7,968	17,408	14,417	0	39,793
1992	13,911	16,897	10,458	0	41,266
1993	13,393	19,808	10,151	0	43,352
1994	14,389	20,068	11,531	0	45,988
1995	16,996	20,590	8,087	0	45,673
1996	18,093	24,681	7,373	0	50,147
1997	22,148	25,273	6,752	0	54,173
1998	20,254	23,898	4,706	0	48,858
1999	27,282	27,240	2,728	0	57,250
2000	32,579	25,216	3,193	0	60,988
2001	35,369	22,055	3,267	0	60,691
2002	41,768	22,097	4,360	0	68,225
2003	44,419	19,397	3,581	50	67,447

TABLE 4
Municipal Water Supply Utilization by the Local Purveyors

Year	Imported Water[1]	Alluvial Aquifer	Saugus Formation	Recycled Water	Total Municipal
2004	47,205	18,970	5,701	420	72,296
2005	38,034	26,368	5,948	418	70,768
2006	40,646	27,189	5,872	419	74,126
2007	45,332	25,632	6,058	470	77,492

Source: SCVWP 2008.

1 Reflects State Water Project through 2006; includes imported water from State Water Project and Buena Vista WSD Agreement beginning in 2007.

2.4.3 2005 Urban Water Management Plan

In 2005, the water management agencies in the Santa Clarita Valley prepared and approved the 2005 UWMP.[12,13] The approved 2005 UWMP provides a framework to guide long-term planning and management actions by the regional water agencies. It also provides a broad perspective on a number of water supply issues to the public and provides information regarding:

- The potential sources of supply and their reasonable probable yield;
- The probable demand, given a reasonable set of assumptions about regional growth and implementation of good water management practices; and
- An assessment of how the supply will be able to meet demand in the next 20 years.

The 2005 UWMP contains a description of the historic and current water use and a description of the methodology used to project future demands within CLWA's service area. Water use was divided into applicable land use categories (residential, industrial, institutional, landscape, agricultural, and other). Existing land use data and approved new water connection information were compiled from each of the Local Purveyors. Future projections of demand were based on information in the "One Valley One Vision" report, a

12 The California Legislature enacted the Urban Water Management Planning Act in 1983. This act has been implemented through Water Code Sections 10610 - 10656. The Act states that every urban water supplier that provides water to 3,000 or more customers, or that provides over 3,000 acre-feet of water annually, should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry years. The Act describes the contents of the Urban Water Management Plans as well as how urban water suppliers should adopt and implement the plans.

13 In February 2006, the California Water Impact Network and Friends of the Santa Clara River ("petitioners") filed a lawsuit challenging the adequacy of the 2005 UWMP on multiple grounds, *California Water Impact Network v. Castaic Lake Water Agency* (Los Angeles County Superior Court). Petitioners' main arguments were that the 2005 UWMP overstated the reliability of both groundwater and surface water supplies, failed to provide an adequate discussion of perchlorate contamination, failed to adequately address the reliability of the 1999 SWP Table A permanent transfer of 41,000 afy from KCWA and its member unit (WRMWSD) to CLWA, relied on a flawed model for predicting SWP deliveries, failed to address the effect of global warming and regulatory water quality controls on water deliveries from the SWP, and failed to identify the impact of private wells on the Santa Clarita River watershed. On August 3, 2007, the trial court issued a Statement of Decision in favor of CLWA and its retail agencies on all issues raised by Petitioners and finding the 2005 UWMP legally adequate. On August 22, 2007, Judgment was entered in favor of CLWA and the purveyors. On October 19, 2007, the Petitioners appealed this Judgment to the Second District Court of Appeal. That appeal is pending. In the meantime, the 2005 UWMP must be assumed legally adequate, unless and until it is set aside by a court of competent jurisdiction. (Wat. Code § 10651; *Barthelemy v. Chino Basin Water Dist.* (1995) 38 Cal. App.4th 1607, 1609 [agency actions are presumed to comply with applicable law, until proof is presented to the contrary].) That has not occurred.

joint planning effort by the City of Santa Clarita and the County of Los Angeles. This information was then compared to historical trends for new water service connections and customer use factors considering climatic and water conservation effects. Historic water demands are shown in Figure 4, and projected future water demands are provided in Table 5.

FIGURE 4
Historical Annual Total Demand in the CLWA Service Area
Source: CLWA 2005a.

TABLE 5
Projected Water Demands in the CLWA Service Area

Purveyor	Demand (af) 2005	2010	2015	2020	2025	2030	Annual Increase
CLWA's SCWD	30,400	35,000	39,100	43,100	47,100	51,100	2.1%
LACWWD #36	1,300	1,600	1,800	2,000	2,000	2,800	3.1%
NCWD	11,800	14,400	16,000	17,700	19,300	21,000	2.4%
VWC	30,200	35,100	40,200	43,700	50,600	54,400	2.4%
Total Purveyor	**73,700**	**86,100**	**97,100**	**106,500**	**119,400**	**129,300**	**2.2%**
Agricultural/ Private Uses	15,600	13,950	12,300	10,650	9,000	9,000	--
Total (w/o conservation)	**89,300**	**100,050**	**109,400**	**117,150**	**128,400**	**138,300**	**--**
Conservation[1]	(7,370)	(8,610)	(9,710)	(10,650)	(11,940)	(12,930)	--
Total w/conservation	**81,930**	**91,440**	**99,690**	**106,500**	**116,460**	**125,370**	**1.3%**

Source: CLWA 2005a.
1 Assumes 10 percent reduction on urban portion of demand resulting from conservation best management practices.

The 2005 UWMP also contains a description of existing and reasonably anticipated water resources available to CLWA and the Local Purveyors. These descriptions include the various sources of water, the amount of water that would be expected to be available under normal years and during periods of single year and multiple year droughts.

Table 6 provides the existing and anticipated water supplies for use within the CLWA service area, and the associated assumptions and caveats, as were described in the 2005 UWMP. Subsequent to the completion of the 2005 UWMP, as discussed in Section 2.2.3 above, the Rosedale-Rio Bravo project was approved, an agreement finalized, and water has been banked pursuant to the agreement. In addition, it should be noted that since the 2005 UWMP was completed, the BVWSD/RRBWSD Water Acquisition project EIR was certified, the agreement completed, and the project EIR was legally challenged and CLWA received a favorable decision (refer to the discussion above). Also, the information presented in Footnote 7 (excerpted from the 2005 UWMP) with regard to water demand for the annexations is no longer current because CLWA is deferring temporarily consideration of annexation requests. These notations have been added to Table 6 to qualify the information otherwise excerpted from the 2005 UWMP due to the passage of time.

TABLE 6
Summary of Current and Planned Water Supplies and Banking Programs[1]

Water Supply Sources	Supply (af)					
	2005	2010	2015	2020	2025	2030
Existing Supplies						
Wholesale (Imported)	***70,380***	***73,660***	***75,560***	***76,080***	***77,980***	***77,980***
SWP Table A Supply [2]	65,700	67,600	69,500	71,400	73,300	73,300
Flexible Storage Account (CLWA) [3]	4,680	4,680	4,680	4,680	4,680	4,680
Flexible Storage Account (Ventura County) [3, 4]	0	1,380	1,380	0	0	0
Local Supplies						
Groundwater	*40,000*	*46,000*	*46,000*	*46,000*	*46,000*	*46,000*
Alluvial Aquifer	35,000	35,000	35,000	35,000	35,000	35,000
Saugus Formation	5,000	11,000	11,000	11,000	11,000	11,000
Recycled Water	1,700	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	**112,080**	**121,360**	**123,260**	**123,780**	**125,680**	**125,680**
Existing Banking Programs[3]						
Semitropic Water Bank[5]	50,870	50,870	0	0	0	0
Total Existing Banking Programs	**50,870**	**50,870**	**0**	**0**	**0**	**0**
Planned Supplies						
Local Supplies						
Groundwater	*0*	*10,000*	*10,000*	*20,000*	*20,000*	*20,000*
Restored wells (Saugus Form.)	0	10,000	10,000	10,000	10,000	10,000
New wells (Saugus Formation)	0	0	0	10,000	10,000	10,000
Recycled water[6]	0	0	1,600	6,300	11,000	15,700
Transfers						
Buena Vista-Rosedale[7*]	0	11,000	11,000	11,000	11,000	11,000
Total Planned Supplies	**0**	**21,000**	**22,600**	**37,300**	**42,000**	**46,700**

TABLE 6
Summary of Current and Planned Water Supplies and Banking Programs[1]

Water Supply Sources	Supply (af)					
	2005	2010	2015	2020	2025	2030
Planned Banking Programs[3]						
Rosedale-Rio Bravo**	0	20,000	20,000	20,000	20,000	20,000
Additional Planned Banking	0	0	20,000	20,000	20,000	20,000
Total Planned Banking Programs	**0**	**20,000**	**40,000**	**40,000**	**40,000**	**40,000**

Source: CLWA 2005a; Table 3-1.
1 The values shown under "Existing Supplies" and "Planned Supplies" are supplies projected to be available in average/normal years. The values shown under "Existing Banking Programs" and "Planned Banking Programs" are either total amounts currently in storage, or the maximum capacity of program withdrawals.
2 SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available, taken from Table 6-5 of DWR's "Excerpts from Working Draft of 2005 SWP Delivery Reliability Report" (May 2005).
3 Supplies shown are total amounts that can be withdrawn and would typically be used only during dry years.
4 Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).
5 Supplies shown are the total amount currently in storage and would typically be used only during dry years. Once the current storage amount is withdrawn, this supply would no longer be available and in any event, is not available after 2013.
6 Recycled water supplies based on projections provided in Chapter 4, Recycled Water.
7 CLWA is in the process of acquiring this supply, primarily to meet the potential demands of future annexations to the CLWA service area. This acquisition is consistent with CLWA's annexation policy under which it will not approve potential annexations unless additional water supplies are acquired. Currently proposed annexations have a demand for about 4,000 afy of this supply which, if approved, would leave the remaining 7,000 afy available for potential future annexations. Unless and until any such annexations are actually approved, this supply will be available to meet demands within the existing CLWA service area.
* While this project was planned at the time of the completion of the 2005 UWMP, since the 2005 UWMP was completed, the project EIR has been certified and CLWA has completed agreements for the transfer. It is also noted that since the completion of the 2005 UWMP, the information presented in Footnote 7 (excerpted from the 2005 UWMP) with regard to water demand for the annexations is no longer current because CLWA is deferring temporarily consideration of annexation requests. In addition, the project EIR was legally challenged and CLWA received a favorable decision.
** While this project was planned at the time of the completion of the 2005 UWMP, CLWA has completed its evaluation and has signed an agreement to implement this project. CLWA has banked water in accordance with the agreement since 2005.

Table 6 above provides the overall existing and anticipated water supplies and banking programs for use within the CLWA service area as described in the 2005 UWMP while Table 7 through Table 9 below provide a summary of the projected supplies for certain hydrologic years, i.e., average/normal year and dry years, and also provide projected demands, as described in the 2005 UWMP.

Table 7 below, excerpted from CLWA's 2005 UWMP, summarizes the projected average/normal year supplies and demands as shown in the 2005 UWMP, and includes the associated assumptions and notes, as described in the 2005 UWMP. As described in Footnote 1 of Table 7, for example, SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available (71 percent [or 67,600 af] in 2010 and 77 percent [or 73,300 af] in 2025/2030), taken from Table 6-5 of DWR's "Excerpts from Working Draft of 2005 State Water Project Delivery Reliability Report "(May 2005).

Table 8 and Table 9 below, also excerpted from CLWA's 2005 UWMP, summarize the projected single-dry and multi-dry year supplies and demands as shown in the 2005 UWMP, and include the associated assumptions and notes, as described in the 2005 UWMP.

The updates related to the Rosedale-Rio Bravo project, the Buena Vista/Rosedale-Rio Bravo project, and annexations identified above for Table 6 are applicable to Tables 7, 8 and 9.

TABLE 7
Projected Average/Normal Year Supplies and Demands

Water Supply Sources	Supply (af) 2010	2015	2020	2025	2030
Existing Supplies					
Wholesale (Imported)	***67,600***	***69,500***	***71,400***	***73,300***	***73,300***
SWP Table A Supply [1]	67,600	69,500	71,400	73,300	73,300
Flexible Storage Account (CLWA) [2]	0	0	0	0	0
Flexible Storage Account (Ventura County) [2]	0	0	0	0	0
Local Supplies					
Groundwater	*46,000*	*46,000*	*46,000*	*46,000*	*46,000*
Alluvial Aquifer	35,000	35,000	35,000	35,000	35,000
Saugus Formation	11,000	11,000	11,000	11,000	11,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	**115,300**	**117,200**	**119,100**	**121,000**	**121,000**
Existing Banking Programs					
Semitropic Water Bank [2]	0	0	0	0	0
Total Existing Banking Programs	0	0	0	0	0
Planned Supplies					
Local Supplies					
Groundwater	*0*	*0*	*0*	*0*	*0*
Restored Wells (Saugus Formation) [2]	0	0	0	0	0
New Wells (Saugus Formation) [2]	0	0	0	0	0
Recycled Water [3]	0	1,600	6,300	11,000	15,700
Transfers					
Buena Vista-Rosedale [4]	11,000	11,000	11,000	11,000	11,000
Total Planned Supplies	**11,000**	**12,600**	**17,300**	**22,000**	**26,700**
Planned Banking Programs					
Rosedale-Rio Bravo [2]	0	0	0	0	0
Additional Planned Banking [2]	0	0	0	0	0
Total Planned Banking Programs	0	0	0	0	0
Total Existing and Planned Supplies and Banking	**126,300**	**129,800**	**136,400**	**143,000**	**147,700**
Total Estimated Demand (w/o conservation) [5]	**100,050**	**109,400**	**117,150**	**128,400**	**138,300**
Conservation [6]	**(8,600)**	**(9,700)**	**(10,700)**	**(11,900)**	**(12,900)**
Total Adjusted Demand	**91,450**	**99,700**	**106,450**	**116,500**	**125,400**

Source: CLWA 2005a; Table 6-2.

1 SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available (71% in 2010 and 77% in 2025/2030), taken from Table 6-5 of DWR's "Excerpts from Working Draft of 2005 State Water Project Delivery Reliability Report " (May 2005).

2 Not needed during average/normal years.

3 Recycled water supplies based on projections provided in Chapter 4, Recycled Water.

4 CLWA is in the process of acquiring this supply, primarily to meet the potential demands of future annexations to the CLWA service area. This acquisition is consistent with CLWA's annexation policy under which it will not approve potential annexations unless additional water supplies are acquired. Currently proposed annexations have a demand for about 4,000 afy of this supply which, if approved, would leave the remaining 7,000 afy available for potential future annexations. Unless and until any such annexations are actually approved, this supply will be available to meet demands within the existing CLWA service area.

5 Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area will be added if and when such annexations are approved. Currently proposed annexations have a demand for about 4,000 afy and, given supplies CLWA is in the process of acquiring, potential future annexations with demands up to an additional 7,000 afy could eventually be approved (see Footnote 4).

6 Assumes 10 percent reduction on urban portion of total demand resulting from conservation best management practices, as discussed in Chapter 7.

TABLE 8
Projected Single-Dry Year Supplies and Demands

	Supply (af)				
Water Supply Sources	**2010**	**2015**	**2020**	**2025**	**2030**
Existing Supplies					
Wholesale (Imported)	***9,860***	***9,860***	***8,480***	***9,480***	***9,480***
SWP Table A Supply [1]	3,800	3,800	3,800	4,800	4,800
Flexible Storage Account (CLWA)	4,680	4,680	4,680	4,680	4,680
Flexible Storage Account (Ventura County) [2]	1,380	1,380	0	0	0
Local Supplies					
Groundwater	*47,500*	*47,500*	*47,500*	*47,500*	*47,500*
Alluvial Aquifer	32,500	32,500	32,500	32,500	32,500
Saugus Formation	15,000	15,000	15,000	15,000	15,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	59,060	59,060	57,680	58,680	58,680
Existing Banking Programs					
Semitropic Water Bank [3]	17,000	0	0	0	0
Total Existing Banking Programs	**17,000**	**0**	**0**	**0**	**0**
Planned Supplies					
Local Supplies					
Groundwater	*10,000*	*10,000*	*20,000*	*20,000*	*20,000*
Restored Wells (Saugus Formation)	10,000	10,000	10,000	10,000	10,000
New Wells (Saugus Formation)	0	0	10,000	10,000	10,000
Recycled Water [4]	0	1,600	6,300	11,000	15,700
Transfers					
Buena Vista-Rosedale [5]	11,000	11,000	11,000	11,000	11,000
Total Planned Supplies	**21,000**	**22,600**	**37,300**	**42,000**	**46,700**
Planned Banking Programs					
Rosedale-Rio Bravo [6]	20,000	20,000	20,000	20,000	20,000
Additional Planned Banking [7]	0	20,000	20,000	20,000	20,000
Total Planned Banking Programs	**20,000**	**40,000**	**40,000**	**40,000**	**40,000**
Total Existing and Planned Supplies and Banking	**117,060**	**121,660**	**134,980**	**140,680**	**145,380**
Total Estimated Demand (w/o conservation) [8, 9]	**110,100**	**120,300**	**128,900**	**141,200**	**152,100**
Conservation [10]	**(9,500)**	**(10,700)**	**(11,700)**	**(13,100)**	**(14,200)**
Total Adjusted Demand	**100,600**	**109,600**	**117,200**	**128,100**	**137,900**

Source: CLWA 2005a; Table 6-3.

1 SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of single dry deliveries projected to be available for the worst case single dry year of 1977 (4% in 2010 and 5% in 2025/2030), taken from Table 6-5 of DWR's "Excerpts from Working Draft of 2005 State Water Project Delivery Reliability Report " (May 2005).

2 Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).

3 The total amount of water currently in storage is 50,870 af, available through 2013. Withdrawals of up to this amount are potentially available in a dry year, but given possible competition for withdrawal capacity with other Semitropic banking partners in extremely dry years, it is assumed here that about one third of the total amount stored could be withdrawn.

4 Recycled water supplies based on projections provided in Chapter 4, Recycled Water.

5 CLWA is in the process of acquiring this supply, primarily to meet the potential demands of future annexations to the CLWA service area. This acquisition is consistent with CLWA's annexation policy under which it will not approve potential annexations unless additional water supplies are acquired. Currently proposed annexations have a demand for about 4,000 afy of this supply which, if approved, would leave the remaining 7,000 afy available for potential future annexations. Unless and until any such annexations are actually approved, this supply will be available to meet demands within the existing CLWA service area.

6 Rosedale-Rio Bravo Water Banking and Recovery Program online in 2006, based on completing CEQA and subsequent adoption by CLWA Board of Directors.

7 Assumes additional planned banking supplies available by 2014.

8 Assumes increase in total demand of 10 percent during dry years.

9 Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area will be added if and when such annexations are approved. Currently proposed annexations have a demand for about 4,000 afy and, given supplies CLWA is in the process of acquiring, potential future annexations with demands up to an additional 7,000 afy could eventually be approved (see Footnote 5).

10 Assumes 10 percent reduction on urban portion of total normal year demand resulting from conservation best management practices ([urban portion of total normal year demand x 1.10] * 0.10), as discussed in Chapter 7.

TABLE 9
Projected Multiple-Dry Year Supplies and Demands [1]

Water Supply Sources	Supply (af) 2010	2015	2020	2025	2030
Existing Supplies					
Wholesale (Imported)	***32,010***	***32,910***	***32,570***	***32,570***	***32,570***
SWP Table A Supply [2]	30,500	31,400	31,400	31,400	31,400
Flexible Storage Account (CLWA) [3]	1,170	1,170	1,170	1,170	1,170
Flexible Storage Account (Ventura County) [3]	340	340	0	0	0
Local Supplies					
Groundwater	*47,500*	*47,500*	*47,500*	*47,500*	*47,500*
Alluvial Aquifer	32,500	32,500	32,500	32,500	32,500
Saugus Formation [4]	15,000	15,000	15,000	15,000	15,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	**81,210**	**82,110**	**81,770**	**81,770**	**81,770**
Existing Banking Programs					
Semitropic Water Bank [3]	12,700	0	0	0	0
Total Existing Banking Programs	**12,700**	**0**	**0**	**0**	**0**
Planned Supplies					
Local Supplies					
Groundwater	*6,500*	*6,500*	*6,500*	*6,500*	*6,500*
Restored Wells (Saugus Formation) [4]	6,500	6,500	5,000	5,000	5,000
New Wells (Saugus Formation) [4]	0	0	1,500	1,500	1,500
Recycled Water [5]	0	1,600	6,300	11,000	15,700
Transfers					
Buena Vista-Rosedale [6]	11,000	11,000	11,000	11,000	11,000
Total Planned Supplies	**17,500**	**19,100**	**23,800**	**28,500**	**33,200**
Planned Banking Programs					
Rosedale-Rio Bravo [7, 8]	5,000	15,000	15,000	15,000	15,000
Additional Planned Banking [8, 9]	0	5,000	15,000	15,000	15,000
Total Planned Banking Programs	**5,000**	**20,000**	**30,000**	**30,000**	**30,000**
Total Existing and Planned Supplies and Banking	**116,410**	**121,210**	**135,570**	**140,270**	**144,970**
Total Estimated Demand (w/o conservation) [10, 11]	**110,100**	**120,300**	**128,900**	**141,200**	**152,100**
Conservation [12]	**(9,500)**	**(10,700)**	**(11,700)**	**(13,100)**	**(14,200)**
Total Adjusted Demand	**100,600**	**109,600**	**117,200**	**128,100**	**137,900**

Source: CLWA 2005a; Table 6-4.

1 Supplies shown are annual averages over four consecutive dry years (unless otherwise noted).

2 SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of deliveries projected to be available for the worst case four-year drought of 1931-1934 (32% in 2010 and 33% in 2025/2030), taken from Table 6-5 of DWR's "Excerpts from Working Draft of 2005 State Water Project Delivery Reliability Report " (May 2005).

3 Based on total amount of storage available divided by 4 (4-year dry period). Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).

4 Total Saugus pumping is the average annual amount that would be pumped under the groundwater operation plan, as summarized in Table 3-6 ([11,000+15,000+25,000+35,000]/4).

5 Recycled water supplies based on projections provided in Chapter 4, Recycled Water.

6 CLWA is in the process of acquiring this supply, primarily to meet the potential demands of future annexations to the CLWA service area. This acquisition is consistent with CLWA's annexation policy under which it will not approve potential annexations unless additional water supplies are acquired. Currently proposed annexations have a demand for about 4,000 afy of this supply which, if approved, would leave the remaining 7,000 afy available for potential future annexations. Unless and until any such annexations are actually approved, this supply will be available to meet demands within the existing CLWA service area.

7 Rosedale-Rio Bravo Water Banking and Recovery Program online in 2006, assuming CEQA complete and adoption by CLWA Board of Directors.

8 Average dry year period supplies could be up to 20,000 af for each program depending on storage amounts at the beginning of the dry period.

9 Assumes additional planned banking supplies available by 2014.

10 Assumes increase in total demand of 10 percent during dry years.

TABLE 9
Projected Multiple-Dry Year Supplies and Demands [L]

	Supply (af)				
Water Supply Sources	**2010**	**2015**	**2020**	**2025**	**2030**

11 Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area will be added if and when such annexations are approved. Currently proposed annexations have a demand for about 4,000 afy and, given supplies CLWA is in the process of acquiring, potential future annexations with demands up to an additional 7,000 afy could eventually be approved (see Footnote 6).
12 Assumes 10 percent reduction on urban portion of total normal year demand resulting from conservation best management practices ([urban portion of total normal year demand x 1.10] * 0.10), as discussed in Chapter 7.

New information, based primarily upon the 2007 SWP Delivery Reliability Report (described below), has been provided by CLWA, which updates the information provided in the 2005 UWMP shown in the four tables previously described, i.e., Tables 6 through 9. The new information (updated tables) is presented in Section 4.I of this Draft Environmental Impact Report (DEIR). The updated tables also include certain updated information regarding other sources of supply, such as the Nickel Water (discussed above) and the recycled water for Newhall Ranch (also discussed above).

The 2005 UWMP includes an extensive discussion of the investigations, management plans, and control actions to address perchlorate contamination (Chapter 5 describes the water quality of both groundwater and imported water supplies and discusses potential water quality impacts on supply reliability).

Reliability planning and the inherent nature of the delivery reliability of each of the water sources were reviewed in the 2005 UWMP. This discussion includes:

- Characteristics of the local groundwater supplies from the Alluvial and Saugus Formation aquifers;
- The timing and availability of recycled water;
- Supplies from the SWP, provisions of the water supply contract and the anticipated delivery reliability of those supplementary supplies (as described in the 2005 SWP Delivery Reliability Report [DWR 2006b]); and
- Various flexible water supply arrangements (e.g., the flexible storage account with DWR, water banking agreements with Semitropic Water Storage District and the Rosedale-Rio Bravo Water Storage District, and the evaluation of a water supply agreement with the BVWSD and the RRBWSD) established by CLWA to meet water demands in years when local and SWP supplies were insufficient to meet water user demands.

Also included in the 2005 UWMP are descriptions of Water Demand Management Measures and the Best Management Practices implemented by CLWA as a part of water conservation programs to result in quantifiable water savings for the Valley, and a Water Shortage Contingency Plan and a Drought Emergency Water Sharing Agreement that have been prepared by CLWA and the Local Purveyors.

The 2005 UWMP was the subject of a series of public outreach actions, including two public hearings. It was adopted by the water management agencies in the Santa Clarita Valley in late 2005.

2.4.4 Monterey Agreement and the SWP Delivery Reliability Report

During the 1990s, disagreements arose between DWR and the agencies that hold contracts for SWP water (SWP contractors) about how available SWP supplies should be allocated. The SWP contractors and DWR agreed to negotiate a settlement of their differences and develop a new approach to managing SWP resources through a major overhaul of the Water Supply Contracts. After a series of exhaustive negotiating sessions, an agreement was reached in December 1994 in Monterey, California on a set of principles, known as the "Monterey Agreement." The Monterey Agreement principles were implemented through amendments to the Water Supply Contracts between DWR and the SWP contractors, which became known as the "Monterey Amendments." The Monterey Amendments were approved in 1995 and went into effect in August 1996.

A Program EIR analyzing the environmental impacts of the Monterey Amendments (Monterey Agreement EIR) was prepared and certified by CCWA in 1995. As discussed in Section 2.2.2, in late 1995, a lawsuit was filed by the Planning and Conservation League (PCL), Plumas County Water Conservation and Flood Control District (Plumas County), and Citizens Planning Association of Santa Barbara County (collectively referred to as the "plaintiffs") challenging the EIR. The plaintiffs argued that the environmental impact analysis prepared was inadequate because CCWA was not a proper lead agency and the EIR analysis did not reflect the inability of the SWP to deliver full Contract amounts to SWP contractors, even though they held contractual "entitlements" to those supplies. In 2000, the California State Court of Appeal (Third District) found that a new EIR must be prepared.

Discussions to mediate a settlement began in 2001 and were finalized in May 2003. All parties to the litigation have signed the settlement agreement. The settlement agreement calls for DWR to prepare a new EIR pursuant to CEQA, while the Monterey Amendments' provisions remain in operation. Pursuant to the settlement agreement, the parties are preparing a new EIR to evaluate the potential environmental impacts of changes to SWP operations incorporated in the Monterey Amendments and the settlement agreement (as noted above, the Draft Environmental Impact Report was released in October of 2007). The settlement agreement did not change the substance of the Monterey Amendments, but addressed the process by which the new EIR is to be prepared. The settlement agreement also calls for DWR to produce a biennial SWP Delivery Reliability Report.

DWR issued the 2005 SWP Delivery Reliability Report (DWR 2006b) to update information presented in the similar 2002 report (DWR 2003). A draft of the SWP Delivery Reliability Report 2005 underwent extensive public review in late-2005. The information contained in the 2005 report was recommended by DWR for use by SWP contractors in developing their 2005 Urban Water Management Plans.

The 2005 SWP Delivery Reliability Report presented DWR's then current information regarding the annual water delivery reliability of the SWP for existing and future levels of development in the water source areas, assuming historical patterns of precipitation. This report reviewed the general subject of water delivery reliability and discussed how DWR determines delivery reliability for the SWP. A discussion of the analysis tool (the CalSim II computer simulation model), the analyses, and peer review regarding the accuracy of

CalSim II and its suitability for use in this report was included.[14] Finally, estimates of SWP delivery reliability were provided along with examples of how to incorporate this information into local water management plans.

On January 28, 2008, DWR released for public review and comment the Draft 2007 SWP Delivery Reliability Report, and released the final 2007 SWP Delivery Reliability Report in August of 2008 (DWR 2008). The 2007 SWP Delivery Reliability Report updates the 2005 SWP Delivery Reliability Report. Included in the information provided in the 2007 SWP Delivery Reliability Report are descriptions of key planning activities with objectives related to providing a sustainable Delta that may impact future SWP delivery reliability. These include: the Delta Vision process; the Bay Delta Conservation Plan (BDCP); the Delta Risk Management Strategy (DRMS); and the CALFED Ecosystem Restoration Program Conservation Strategy. A discussion of Delta-related planning activities is provided in Section 2.5 below.

The 2007 SWP Delivery Reliability Report also describes three areas of significant uncertainty to SWP delivery reliability: the recent and significant decline in pelagic organisms in the Delta[15] (open-water fish such as striped bass, delta smelt[16] and longfin smelt[17]), climate change and sea level rise, and the vulnerability of Delta levees' to failure (additional discussion of climate change and sea level rise is provided in Section 2.4.5 below

[14] The critical data in the 2002 and 2005 Reports are based upon water delivery predictions using a computer simulation model, CalSim II. Public criticism of this analytical approach has centered on two areas: (1) the ability of CalSim II to simulate "real world" conditions and accurately estimate SWP deliveries; and (2) the inability of the approach to account for future uncertainties such as changes in the climate pattern or levee failure in the Sacramento-San Joaquin Delta due to flooding or an earthquake. While no model is perfect, DWR is satisfied with the degree to which CalSim II simulates actual, real-world operations of the SWP. When professional judgment is used with the knowledge of the limitations of CalSim II and the assumptions used in the studies, CalSim II is a useful tool in assessing the delivery reliability of the SWP. The studies and peer review related to CalSim II are discussed in Chapter 3 and Appendix E of the 2005 Report. The 2007 SWP Delivery Reliability Report, discussed herein, also includes a discussion of CalSim II performance and recent improvements to CalSim II simulations in Chapter 5 of the report.

[15] In late 2004 and early 2005, scientists became concerned about the numbers of many pelagic organisms, including delta smelt, which had been declining sharply since the early 2000s (DWR 2008). Other pelagic fish with very low numbers in the Delta are striped bass, longfin smelt and threadfin shad, and by 2005, the decline was widely recognized as a serious issue and became known as the Pelagic Organism Decline (POD) (DWR 2008). Hypothesized factors contributing individually or in concert to lower pelagic productivity are: 1) toxic effects, 2) exotic species effects, and 3) water project effects (DWR 2008). Studies over the last three years are indicating that all these factors might be contributing to the decline in pelagic fishes, and their relative importance might vary depending upon year, season, and location within the Delta (DWR 2008).

[16] On May 31, 2007, DWR voluntarily shut down the Harvey O. Banks Delta Pumping Plant for 10 days as a preventative measure to protect delta smelt located near the DWR facilities. This action followed the observed entrainment of juvenile smelt between May 25, 2007 and May 31, 2007 at the Harvey O. Banks Delta Pumping Plant facility. DWR resumed limited pumping at the Harvey O. Banks Delta Pumping Plant on June 10, 2007. Pumping was increased beginning on June 17, 2007.

By way of background, in 2007, the SWP modified its operations by use of the adaptive Environmental Water Account (EWA; discussed in section 2.5 herein). From January through mid-May 2007, about 300,000 af of EWA water was used to reduce exports to help protect delta smelt. During this time period, no delta smelt were recorded in the SWP fish salvage operations at the Harvey O. Banks Delta Pumping Plant (the concept of salvage generally refers to the process of using mechanical devices to screen fish that would otherwise be entrained in project facilities such as pumps into holding tanks for transport to other parts of the Delta but, unlike many other fish species in the Delta, delta smelt do not survive the salvage process and, as a result, for delta smelt, the United States Fish and Wildlife Service (USFWS) uses the terms salvage and entrainment essentially interchangeably). In mid-May 2007, exports were reduced again due to the distribution of delta smelt into areas that made them more susceptible to pumping. On May 24, 2007 delta smelt began to appear at the pumping plant in low numbers. These numbers increased, triggering DWR's response of shutting down temporarily the Harvey O. Banks Delta Pumping Plant described above.

[17] The 2007 SWP Delivery Reliability Report notes that longfin smelt is being considered for listing under the California Endangered Species Act (CESA). On February 7, 2008, the California Fish and Game Commission (Commission) designated longfin smelt as a candidate species for listing under CESA. Under CESA, candidate species receive the same legal protection as listed threatened and endangered species. Under state law, take of candidate species (including incidental take by

(footnote continued on next page)

as well as in Section 4.S of this DEIR, and additional discussion related to Delta levees is provided in Section 2.5 below). As stated in the report, the 2007 SWP Delivery Reliability Report is distinguished from earlier SWP Delivery Reliability reports by including estimates of the potential reductions to SWP delivery reliability due to the pelagic organism decline (POD) and future climate changes.

The 2007 SWP Delivery Reliability Report includes CalSim II simulations that were conducted to evaluate current (2007) SWP delivery reliability and incorporate actions to protect the delta smelt as required by the federal court ruling in *Natural Resources Defense Council, et al. v. Kempthorne,* Case No. 1:05-cv-01207-OWW-NEW.[18] As described in

engaging in activities that may result in take) is prohibited unless authorized by the Commission or the California Department of Fish and Game (Department) under specified conditions. On February 17, 2009, DWR adopted a Negative Declaration (ND) for the ongoing SWP operations in the Sacramento-San Joaquin Delta for the protection of the longfin smelt as authorized by the DFG through issuance of a permit for take of longfin smelt under Section 2081 of CESA (California Fish and Game Code Section 2081). The permit issued by DFG allows the incidental take of longfin smelt until it expires on December 31, 2018. The action consists of operation of SWP facilities consistent with certain actions identified in the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion of the Operating Criteria and Plan (OCAP) for the Coordinated Operations of the Central Valley Project and State Water Project. The action includes operation of SWP facilities from December through June to protect adult longfin smelt migration and spawning and larvae and juvenile rearing. The protection of longfin smelt is achieved through operations undertaken during the same period to protect delta smelt, which DWR found are sufficient for the protection of longfin smelt because of adaptive management provisions and the substantial overlap in timing and distribution of these species in the Sacramento-San Joaquin Delta. DFG also imposed additional mitigation measures as part of its Incidental Take Permit. On March 4, 2009, the California Fish and Game found that a threatened listing was warranted for longfin smelt, and its regulatory findings indicated that a variety of factors are affecting the fish and posing a threat to its recovery, including water project operations in the Delta, pollutants, dredging and sand mining operations, and commercial bait fishing for bay shrimp. On June 25, 2009, the Commission formally listed longfin smelt as a threatened species under CESA.

On August 8, 2007, USFWS was petitioned to list only the San Francisco Bay-Delta population of longfin smelt as a Distinct Population Segment (DPS). On May 6, 2008, the USFWS published a 90-day finding that listing might be warranted. On April 9, 2009, the USFWS issued a full 12-month finding that it did not qualify as a DPS. They also announced a new status review of the species through its entire range. On April 8, 2009, the USFWS announced that the Bay-Delta population of longfin smelt does not meet the legal criteria for protection as a species subpopulation under the federal Endangered Species Act. The USFWS simultaneously announced that it is seeking additional information for a broader assessment of the longfin smelt that could lead to future action, although no decision can be made before reviewing any new information.

[18] On May 25, 2007, the United States District Court (Eastern District of California, Fresno Division) in *Natural Resources Defense Council, et al. v. Kempthorne*, Case No. 1:05-cv-01207-OWW-NEW (*Kempthorne*) granted in part the plaintiff's motion for summary judgment and found that the USFWS's 2005 Biological Opinion (BO) on the impacts of the long-term operations of the Central Valley Project (CVP) and the SWP on delta smelt was inadequate. In late June 2007, District Judge Oliver W. Wanger in *Kempthorne* heard and rejected Natural Resources Defense Council's and Earthjustice's motion for a temporary restraining order to curb southbound water shipments at least temporarily due to smelt issues. Judge Wanger ruled that the BO, consequently, must be remanded to the NMFS and the U.S. Bureau of Reclamation for further consultation in accordance with law and that the U.S. Bureau of Reclamation must continue to take no actions during reconsultation that make any irreversible or irretrievable commitment of resources that forecloses the formulation or implementation of reasonable and prudent alternative measures.. On August 31, 2007, the court in Kempthorne issued an oral statement of decision granting a preliminary injunction and remedial order to protect delta smelt until a new delta smelt BO was issued by the USFWS. The decision, finalized on December 14, 2007, set interim operating limits for the joint SWP and CVP operations and required new steps to monitor delta smelt. The Kempthorne requirements were triggered by environmental conditions and the presence of specific delta smelt life stages and were focused on minimizing the negative entrainment effects caused when the combined export pumping of the SWP and the CVP reverses the flow in Old and Middle River (OMR). The decision required the USFWS to complete a new BO by September 15, 2008; however, the USFWS requested and was granted a three-month extension to complete the BO. which was then issued on December 15, 2008 (http://www.fws.gov/sacramento/es/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf). The new BO supersedes the operating parameters and requirements set forth in the interim remedial order, but continues similar parameters and requirements. DWR estimates that water deliveries to cities, farms, and businesses throughout much of the state will be reduced about 20 to 30 percent on average, but that cuts could be even greater under certain hydrologic conditions (DWR News Release, December 15, 2008, Delta Water Exports Could Be Reduced By Up to 50 Percent Under New Federal *(Footnote continued on next page*)
Biological Opinion; DWR Director Snow Responds to Delta Smelt Biological Opinion). DWR, however, has not yet issued formal guidance regarding the effects of this BO on SWP reliability.

Similar to the challenge to the delta smelt BO, a second BO, covering Sacramento River winter-run Chinook, Central Valley spring-run Chinook, and Central Valley steelhead, issued in October 2004 by the NMFS, was challenged in Pacific Coast Federation of Fishermen's Associations/Institute for Fisheries Resources, et al. v. Gutierrez, Case No. 1:06-cv-00245-OWW-GSA. Subsequent to the initiation of this lawsuit, the U.S. Bureau of Reclamation reinitiated consultation on the BO. On April 16, 2008, Judge Wanger issued a summary judgment order in this case invalidating the salmon and steelhead BO, finding it
(footnote continued on next page)

the report, simulations to evaluate future (2027) SWP delivery reliability incorporate the current interim court-ordered operating rules related to delta smelt and a range of possible climate change impacts to hydrology in the Central Valley. The interim operating rules for delta smelt were simulated at a more-restricted level and a less-restricted level for Delta exports to provide a range of estimated water deliveries. Therefore, for 2007, two studies were conducted. For 2027, ten simulations were used to reflect the four assumed scenarios for climate change and the two levels of operating rules. Results of these updated CalSim II simulations are presented in the 2007 SWP Delivery Reliability Report along with results from the 2005 SWP Delivery Reliability Report to help identify and explain impacts to delivery reliability due to actions to protect delta smelt and future climate change.

Since the 2007 SWP Delivery Reliability Report was issued, two Biological Opinions (BO) were released by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for the protection of species listed under the federal Endangered Species Act (refer to Footnote 18 in this section for additional detail). These BOs restrict negative flows on watercourses leading to the SWP and CVP export facilities in the Delta, resulting in restrictions on SWP pumping. This has led to reduced water supplies and increased uncertainty regarding the ability of the SWP to meet its contractual deliveries to CLWA and other SWP contractors. Multiple entities have challenged the scientific basis of these restrictions, however, and some water agencies are developing other means of protecting biological resources in the Delta while providing water supply benefits.

Among the projects that are being developed, but have not yet received approvals and/or permits are the BDCP, the purpose of which is to develop a conservation plan that resolves the conflict between fishery protection under state and federal ESAs and water operations of

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unlawful and inadequate on a number of grounds. Judge Wanger ruled that the BO, consequently, must be remanded to the NMFS and the U.S. Bureau of Reclamation for further consultation in accordance with law (which, as noted above, is already ongoing) and that the U.S. Bureau of Reclamation must continue to take no actions during re-consultation that make any irreversible or irretrievable commitment of resources which forecloses the formulation or implementation of reasonable and prudent alternative measures. On June 4, 2009, NMFS released its BO (http://swr.nmfs.noaa.gov/ocap.htm), which concludes that CVP and SWP operations will jeopardize the covered species and destroy or adversely affect critical habitat. DWR estimates that restrictions included in the BO could reduce Delta exports on average by 300,000 to 500,000 af (News Release, June 4, 2009, DWR Responds to New Biological Opinion to Protect Salmon).

On April 10, 2008, the Pacific Fishery Management Council adopted a closure of commercial and sport Chinook fisheries off California and most of Oregon and allowed only a limited fishery for hatchery coho salmon in response to the collapse of Sacramento River fall Chinook and poor status of coho salmon from Oregon and Washington (http://www.pcouncil.org/newsreleases/PFMC_FINAL_PressRel.pdf). And on May 1, 2008, Secretary of Commerce Carlos M. Gutierrez declared a commercial fishery failure for the West Coast salmon fishery and the National Oceanic and Atmosphere Administration's (NOAA's) Fisheries Service issued regulations to close or severely limit recreational and commercial salmon fishing in the area (http://www.nmfs.noaa.gov/mediacenter/docs/disaster_declaration_2008_FINAL.pdf). Many potential causes of decline have been indicated but the reason for the collapse of the Sacramento fall Chinook stock is not readily apparent (http://www.pcouncil.org/newsreleases/PFMC_FINAL_PressRel.pdf). Potential causes have been suggested and include ocean temperature changes and a resulting lack of upwelling; and a combination of human-caused and natural factors including both marine conditions and freshwater factors such as in-stream water withdrawals, habitat alterations, dam operations, construction, and pollution (http://www.pcouncil.org/newsreleases/PFMC_FINAL_PressRel.pdf; http://swr.nmfs.noaa.gov/news/030308.salmon_decline.final.pdf).

In addition, on April 18, 2007, an Alameda County Superior Court in *Watershed Enforcers v. California Dept. of Water Resources*, Case No. RG06292124, granted the petition for writ of mandate and issued an order to cease and desist from further operation of the Harvey O. Banks Delta Pumping Plant until and unless DWR obtains authorization from the California Department of Fish and Game in compliance with CESA with regard to their incidental take of various species, including the delta smelt, winter-run Chinook salmon and spring-run Chinook salmon. The order was stayed for 60 days to provide DWR with time to comply with the CESA's incidental take authorizing requirements. This court decision has been appealed and the appellate process has been stayed by stipulation of the parties and approval of the Appellate Court with status report from the parties in October, November and December 2008 (personal communication, M. Morrow 2008). In the meantime, DWR is working with the California Department of Fish and Game to obtain a consistency statement or other permit in response to the Superior Court's order (personal communication, M. Morrow 2008).

the SWP, CVP, and Mirant Power facilities in the legal Delta; improvements to the North Bay Aqueduct, which are intended to benefit protected species and improve water quality; the Los Vaqueros Reservoir Expansion Project, which could provide water supplies for environmental water management in the Delta to support fish protection, habitat management and other environmental water needs; and installation of operable gates in key channels in the Delta in order to control flows and thereby provide reduced entrainment of delta smelt and other sensitive aquatic species at the SWP and CVP export pumping facilities. Given the factors described above, however, the SWP supply reliability is uncertain, and is expected to remain below the contractual maximum described in the Table A Amount and somewhat less than or equal to the amount most recently provided by DWR (2007).

DWR has not yet issued a new SWP Delivery Reliability Report based on the new BOs, and other formal estimates of delivery reductions that might occur as a result of the BOs have not been published. Therefore, the information from the 2007 report is considered the best information currently available. It is presented below with the caveat that SWP deliveries are likely to be less in the future than shown here.

The 2007 SWP Delivery Reliability Report includes the information presented in Tables 10 and 11 below, which provide average and dry period estimated deliveries for current conditions (2007) and future conditions (2027), and compares those figures to those in the 2005 SWP Delivery Reliability Report.

TABLE 10
Average and Dry Period SWP Table A Deliveries from the Delta under Current Conditions

	SWP Table A Delivery from the Delta (in percent of maximum Table A[1])					
Study of Current Conditions	**Long-term Average[2]**	**Single dry-year (1977)**	**2-year drought (1976-1977)**	**4-year drought (1931-1934)**	**6-year drought (1987-1992)**	**6-year drought (1929-1934)**
2005 SWP Reliability Report, Study 2005	68%	4%	41%	32%	42%	37%
Update with 2007 Studies[3]	63%	6%	34%	35%	35%	34%

Source: DWR 2008; Table 6-5.
1. Maximum Table A Amount is 4,133 thousand acre-feet/year.
2. 1922-1994 for 2005 SWP Delivery Reliability Report; 1922-2003 for Update with 2007 studies.
3. Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6-3 of the 2007 SWP Delivery Reliability Report.

As stated above, new information, based primarily upon the 2007 SWP Delivery Reliability Report discussed here, has been provided by CLWA and updates the information provided in the 2005 UWMP (discussed above). It is presented in Section 4.I of this DEIR.

2.4.5 Potential Climate Change Effects on Water Resources

On June 1, 2005, Governor Arnold Schwarzenegger issued Executive Order S-3-05 and established greenhouse gas emissions targets for California and required biennial reports on potential climate change effects on several areas, including water resources.

A growing body of evidence indicates that Earth's atmosphere is warming. Earth's climate has exhibited variability and has changed over time. "Climate change" is the shift in the

TABLE 11
Average and Dry Period SWP Table A Deliveries from the Delta under Future Conditions

	SWP Table A Delivery from the Delta (in percent of maximum Table A[1])					
Study of Future Conditions	**Long-term Average[2]**	**Single dry-year (1977)**	**2-year drought (1976-1977)**	**4-year drought (1931-1934)**	**6-year drought (1987-1992)**	**6-year drought (1929-1934)**
2005 SWP Reliability Report, Study 2025	77%	5%	40%	33%	42%	38%
Update with 2027 Studies[3]	66-69%	7%	26-27%	32-37%	33-35%	33-36%

Source: DWR 2008; Table 6-14.
1. Maximum Table A Amount is 4,133 thousand acre-feet/year.
2. 1922-1994 for 2005 SWP Delivery Reliability Report; 1922-2003 for Update with 2027 studies.
3. Range in values reflects four modified scenarios of climate change: annual Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

average weather, or trend, that a region experiences. Thus, climate change cannot be represented by single annual events nor individual anomalies. That is, a single large flood event or particularly hot summer is not an indication of climate change, while a series of floods or warm years that statistically change the average precipitation or temperature over time may indicate climate change.

Although climate science is a relatively new field of inquiry, much has been learned in recent years. Several mechanisms have been identified that have the potential to affect the earth's climate such as solar activity and greenhouse gases. Greenhouse gases are contributed to the atmosphere by both natural and anthropogenic (human) sources.

Scientists believe that human activities are changing the composition of the atmosphere, and that increasing the concentration of greenhouse gases will change the planet's climate; however, they are not sure by how much it will change, at what rate it will change, or what the exact effects will be (http://epa.gov/climatechange/index.html). The U.S. Environmental Protection Agency (USEPA) maintains a website summarizing recent scientific evaluations and current news on the climate change issue including information from the Intergovernmental Panel on Climate Change (IPCC) and the National Oceanic and Atmospheric Administration: http://epa.gov/climatechange/index.html.

Although there is now broad scientific consensus that the earth's atmosphere has warmed over the last century and will likely continue to warm in the future, there is substantial uncertainty as to how this warming will quantitatively affect future water supplies, including how this warming will affect SWP supplies. DWR, as the owner and operator of the SWP and the agency with a statewide perspective and most relevant technical expertise, addressed the need to consider global climate change as part of long-term planning for the management of California's water resources in the Bulletin 160: California Water Plan Update – 2005. The 2005 SWP Delivery Reliability Report also addressed the need to incorporate some of the uncertainties of global warming with regard to planning and operation of the SWP:

> *Until the impacts of climate change on precipitation and runoff patterns in California are better quantified, future weather patterns are usually assumed to be similar to those in the past, especially where there is a significant historical rainfall record.*
>
> *The State Water Project analyses contained in this report are based upon 73 years of historical records (1922-1994) for rainfall and runoff that have been adjusted to reflect the current and future levels of development in the source areas by analyzing land use patterns and projecting future land and water use. These series of data are then used to forecast the amount of water available to the SWP under current and future conditions.*
>
> *The assumption that past rainfall-runoff patterns will be repeated in the future has an inherent uncertainty, especially given the evolving information on the potential effects of global climate change. (DWR 2006b)*

In June 2006, DWR published a Technical Memorandum Report entitled *Progress on Incorporating Climate Change into Planning and Management of California's Water Resources* in response to the Executive Order (DWR 2006a). The Report describes progress made incorporating climate change into existing water resources planning and management tools and methodologies. Some preliminary results on the potential effects of climate change were presented. While the analyses presented used the most current scientific techniques and were reviewed by experts, the study results were preliminary as stated in the Report. The Report incorporated several assumptions, reflected a limited number of climate change scenarios, and did not address the likelihood of each scenario. Policy implications of climate change and recommendations to respond to the future demands for water were identified as beyond the scope of the Report. The Report acknowledged that there are substantial uncertainties regarding the effects of global warming on SWP supplies and suggested additional analysis to reduce this uncertainty.

The Report covered a wide range of topics addressing climate change and its potential impact on California's water resources. These included the following:

- Causes of climate change and potential threat to California's water resources, and measures that could be taken to adapt to or mitigate the effects of climate change.
- Background and approach used for the climate change analyses included and the climate change scenarios used in the Report.
- Potential impacts of the selected climate change scenarios on SWP and Central Valley Project operations. Results presented included changes in reservoir inflows, delivery reliability, and annual average carryover storage. It also discussed the interaction of various regulatory and operational conflicts such as water allocations, flood control, in-stream flow requirements, and water quality requirements. The Report also presented the implications for possible changes to operations that could mitigate the effects of climate change. However, as stated in the Report, these operational changes were left for future work.
- Potential impacts to Delta water quality and water levels, including effects of modified Delta inflows and exports on compliance with water quality standards and the implications of sea level rise.
- Implications of global warming for managing floods.

- Potential increases in crop water use due to global warming, and application of analysis tools to assess changes in estimated net irrigation requirements for crops.

In addition, the Report included directions for further work to incorporate climate change into California's water resources management. This included probability estimates of potential climate change scenarios in order to provide policymakers with both ranges of impacts and the likelihoods associated with those impacts.

Based on the information provided in the Report, Table 12 provides a summary of the potential future effects of global climate change on California's water resources and the consequences of those effects.

TABLE 12
Potential Effects of Climate Change on California's Water Resources and Expected Consequences

Potential Water Resource Impact	Expected Consequence
Reduction of the State's Average Annual Snowpack	Potential loss of 5 million acre-feet or more of average annual water storage in the State's snowpack Increased challenges for reservoir management and balancing the competing concerns of flood protection and water supply
Changes in the Timing, Intensity, Location, Amount, and Variability of Precipitation	Potential increased storm intensity and increased potential for flooding Possible increased potential for droughts
Long-term Changes in Watershed Vegetation and Increased Incidence of Wildfires	Changes in the intensity and timing of runoff Possible increased incidence of flooding and increased sedimentation
Sea Level Rise	Inundation of coastal marshes and estuaries Increased salinity intrusion into the Sacramento-San Joaquin River Delta Increased potential for Delta levee failure Increased potential for salinity intrusion into coastal aquifers (groundwater) Increased potential for flooding near the mouths of rivers due to backwater effects
Increased Water Temperatures	Possible critical effects on listed and endangered aquatic species Increased environmental water demand for temperature control Possible increased problems with foreign invasive species in aquatic ecosystems Potential adverse changes in water quality, including the reduction of dissolved oxygen levels
Changes in Urban and Agricultural Water Demand	Changes in demand patterns and evapotranspiration rates

Source: DWR 2006a.

DWR stated in its California Climate Change Activities update, California's Climate Action Programs (http://www.climatechange.ca.gov/climate_action_team/factsheets/2007-03_CLIMATE_ACTIVITIES_FS.PDF):

> *The Department of Water Resources (DWR) is working to help increase water use efficiency, conservation, and ground and surface water storage facilities to better manage flood risks and maintain a reliable water supply into the future. Changes in precipitation, temperature, sea level and the hydrologic cycle affect the severity of winter storms and our ability to manage water supply during dry periods. By 2050, up to 40 percent of the Sierra snowpack may disappear, resulting in decreased runoff that will impact water supply for urban, agricultural and environmental uses.*

As stated above, the 2007 SWP Delivery Reliability Report is distinguished from earlier SWP Delivery Reliability reports by including estimates of the potential reductions to SWP delivery reliability due to future climate changes. The 2007 SWP Delivery Reliability Report included an evaluation of SWP deliveries under four different future climate change scenarios. The report utilizes the same scenarios that were analyzed in the 2006 Technical Memorandum Report, *Progress on Incorporating Climate Change into Planning and Management of California's Water Resources* discussed above (DWR 2008). As described in the 2007 SWP Delivery Reliability Report, those scenarios assume greenhouse gas emissions for 2050, not at the 2027 level assumed for the Future Conditions in the 2007 SWP Delivery Reliability Report. The 2007 SWP Delivery Reliability Report estimates climate change impacts to SWP deliveries by interpolating between future studies which assume no climate change and studies which assume 2050 emissions (DWR 2008). The four scenarios include pairings of two global climate models ("PCM" and "GFDL") and two greenhouse gas emission scenarios ("A2" and "B1"). The two emissions scenarios selected by DWR include lower (B1) and medium-high (A2) scenarios developed by the IPCC.

All four of the climate change scenarios analyzed in the 2007 SWP Delivery Reliability Report project a general warming trend for California. Two of the four scenarios project modestly drier climates for California, while two project a minor precipitation increase. For each of these scenarios, the inflows into the CALSIM II model were adjusted using perturbation ratios to reflect the climate change future as compared to historical climate. The perturbation ratios are simply modifiers to historical inflows to reflect the effects of climate change.

While the 2027 studies incorporate assumptions about climate change, they do not account for sea level rise or the expected accompanying increase in Delta salinity because the tools to evaluate this impact of climate change have not yet been completed (DWR 2008). Future sea level rise associated with climate change could increase the salinity in the Delta as higher ocean tides push saline water farther inland (DWR 2008). If Delta water quality standards remain the same, SWP pumping could become more restricted, at least under some hydrologic conditions (DWR 2008).

Climate change could also have an effect on the demand for imported water supplies in the SWP contractors' local regions. Increases in temperatures may result in greater local water demands and potential reductions in the availability of local water supplies. However, because the non-climate change scenarios assume nearly maximum Table A demands for every SWP contractor, the SWP demands used in the climate change scenarios could not be increased relative to the non-climate change scenarios. CALSIM II model simulations indicated that SWP deliveries were moderately reduced in the climate change scenarios relative to the non-climate change scenarios due to a reduction in available water supply. While the PCM B1 scenario showed approximately the same amount of Table A deliveries as in the non-climate change scenario, the remaining three climate change scenarios showed a two to three percent decrease in Table A deliveries (as a percentage of total Table A Amount) relative to the non-climate change scenarios.

With the completion of the 2007 SWP Delivery Reliability Report, local water agencies such as CLWA and the Local Purveyors are better able to determine to what extent their supplies will be affected by global climate change. However, it is anticipated that climate change science and the ability to project changes and system responses to climate change will

continue to carry significant uncertainty for some time. As discussed in the 2005 UWMP, Volume 1, Chapter 4 of the California Water Plan, "Preparing for an Uncertain Future," lists some potential impacts of global warming, based on more than a decade of scientific studies on the subject (provided below):

- Global warming may produce hydrologic conditions, variability, and extremes that are different from what current water systems are designed to manage;
- Global warming may occur too rapidly to allow sufficient time and information to permit managers to respond appropriately; and
- Global warming may require special efforts or plans to protect against surprises or uncertainties.

Also discussed in CLWA's 2005 UWMP, should global warming increase over time, it may cause a number of changes that may impact future water supplies, including changes in Sierra snowpack (the source of the SWP's water supply in Lake Oroville), runoff patterns, sea level, rainfall intensity, and statewide water demand. Changes related to groundwater recharge and availability may also occur.

CLWA has incorporated into the water supply planning the updated SWP delivery reliability information presented in the 2007 SWP Delivery Reliability Report which includes the assessment of climate change described above (refer to Section 4.I of the Skyline Ranch DEIR for the updated information provided by CLWA based on the 2007 SWP Delivery Reliability Report). In addition to imported water, CLWA's portfolio includes local supplies including groundwater and recycled supplies. CLWA and the Local Purveyors have commenced the process of updating the groundwater basin yield analysis and intend to analyze to the extent possible the potential climate change impacts on groundwater resources (personal communication, J. Ford 2008). As stated, the 2007 SWP Delivery Reliability Report accounts for anticipated climate change and CLWA has indicated they believe there to be an adequate water supply to meet demands with the updated reliability figures (refer to the complete discussion in Section 4.I of the Skyline Ranch DEIR). The results of the updated groundwater basin yield study will be factored in upon completion, including results from the analyses of additional goals included in that study (i.e., to further assess increased utilization, augmentation and optimal distribution of the basin's yield, and assess groundwater recharge opportunities) along with potential impacts from climate change (personal communication, J. Ford 2008). It is not anticipated that the results from the analysis will identify a substantial adverse change in the hydrology of the local groundwater basin as a result of potential climate change impacts (personal communication, J. Ford 2008). Negative impacts, if any, may tend to be offset by additional yield available as a result of the work related to the aforementioned additional goals included in the study (i.e., to further assess increased utilization, augmentation and optimal distribution of the basin's yield, and assess groundwater recharge opportunities) (personal communication, J. Ford 2008). CLWA and the Local Purveyors will continue to update their water supply planning as needed.

Generally, little work has been done on the effects of climate change on specific groundwater basins, groundwater quality or groundwater recharge characteristics (Kiparsky and Gleick 2003). Changes in rainfall and changes in the timing of the

groundwater recharge season would result in changes in recharge. Warmer temperatures could lead to higher evaporation or shorter rainfall seasons, which could mean that soil deficits would persist for longer time periods, shortening recharge seasons. Warmer, wetter winters would increase the amount of runoff available for groundwater recharge. This additional winter runoff, however, may be occurring at a time when some basins are being recharged at their maximum capacity. Reductions in spring runoff and higher evapotranspiration, on the other hand, could reduce the amount of water available for recharge.

Demand increases may also occur as a result of climate change due to potential increased irrigation demand in a longer growing season and increased urban demand with more heat waves and dry spells (AMWA 2007). As a result, increased drawdown of local groundwater resources to meet increased demand could occur (AMWA 2007). However, the extent to which climate will change and the impact of that change on groundwater are uncertain and dependent on overall water management in the region.

The importance of conservation and maintaining a reliable water supply in the context of climate change is recognized by DWR and water planners. Conservation efforts assist in adapting to reduced or, at best, more varied water supplies.[19] In an assessment of urban water use (Boland 1997, 1998, cited in Kiparsky and Gleick 2003) it has been shown that water conservation measures such as education and modern plumbing standards, etc., can be extremely effective at mitigating the effects of climate change on regional water supplies.

CLWA has enhanced the long-term reliability of the total mix of water supplies currently available to meet the needs of the Santa Clarita Valley, including the Project, through the use, for example, of transfers and groundwater banking programs. In addition, in 2001, CLWA signed a Memorandum of Understanding Regarding Urban Water Conservation in California (MOU). By signing the MOU, CLWA became a member of the California Urban Water Conservation Council (CUWCC) and pledged to implement all cost-effective Best Management Practices (BMPs) for water conservation. CLWA has estimated that conservation measures within the service area can reduce total water demands by about ten percent of the urban portion of total demand. CLWA and the Local Purveyors are also currently working on a long-term program related to conservation, i.e., the Santa Clarita Valley Water Conservation Strategic Plan. Moreover, compliance with the County's Green Building Ordinance and Drought-Tolerant Landscaping Ordinance and mitigation measures related to water conservation including requiring appliances such as showerheads and faucets to comply with efficiency standards, low flush toilets, irrigation systems that prevent the waste of water, emphasizing drought-tolerant vegetation, and informing residential occupants as to the benefits of low-water-using landscaping and sources of additional assistance in such, would be incorporated as part of the Project (refer to Section 4.I of the Skyline Ranch DEIR).

[19] In addition, the less water that is used, the less water that needs to be pumped and treated. According to the California Energy Commission, conserving one af of water reduces greenhouse gas emissions by approximately one metric ton (http://www.climatechange.water.ca.gov/docs/062207ARB.pdf). The Global Warming Solutions Act of 2006 (Health and Safety Code Sections 38500 *et seq*.) requires the California Air Resources Board (CARB) to adopt regulations requiring monitoring and annual reporting of greenhouse gas emissions from the most important sources or categories of sources. By January 1, 2011 CARB must establish greenhouse gas emissions limits and emission reduction measures necessary to achieve the 1990 levels by 2020.

2.5 Delta-Related Planning Activities

A discussion of Delta-related planning activities is provided below.

2.5.1 SWP and/or CVP Operations Projects

There are a variety of ongoing and planned projects related to the operations of the SWP and CVP. As discussed in the 2007 SWP Delivery Reliability Report, in 2004 Reclamation and DWR developed a new Operating Criteria and Plan (OCAP) for the SWP and CVP. This plan documented many aspects of the SWP and CVP through detailed project descriptions; explanations of regulatory and legal requirements; listings of changes in project operations since the last OCAP in 1992; and an analysis of the present and proposed operations using computer simulations (DWR 2008). OCAP provided the project descriptions required for a comprehensive biological assessment of the SWP and CVP. The biological assessment analyzed existing and potential effects of the SWP and CVP operations on listed species and led to Endangered Species Act (ESA) consultation with the USFWS and the National Oceanic and Atmosphere Administration's (NOAA) NMFS to update the BO for delta smelt, winter-run salmon, and other species listed under the ESA.

In 2004, USFWS issued a non-jeopardy BO with regards to impacts on delta smelt caused by revised operations of the CVP and SWP. This opinion was updated in 2005. USFWS concluded that any adverse effects from the CVP and SWP operations would be avoided or minimized by conservation and adaptive management measures included in the OCAP. As described herein, the USFWS's 2005 BO for delta smelt was invalidated. Refer to the discussion above regarding this and the recent invalidation of the salmon BO. DWR and the U.S. Bureau of Reclamation issued biological assessments (BA) on May 16, 2008 on their respective water projects and requested the initiation of formal consultation.

USFWS issued its new BO on December 15, 2008 (USFWS 2008), which includes operating parameters and requirements for SWP and CVP operations. DWR estimates that water deliveries to cities, farms, and businesses throughout much of the state will be reduced about 20 to 30 percent on average, but that cuts could be even greater under certain hydrologic conditions (DWR News Release, December 15, 2008, Delta Water Exports Could Be Reduced By Up to 50 Percent Under New Federal Biological Opinion; DWR Director Snow Responds to Delta Smelt Biological Opinion). DWR, however, has not yet issued formal guidance regarding the effects of this BO on SWP reliability.

On June 4, 2009, NMFS released its BO (NMFS 2009), which concludes that CVP and SWP operations will jeopardize the covered species and destroy or adversely affect critical habitat. DWR estimates that restrictions included in the BO could reduce Delta exports on average by 300,000 to 500,000 af (News Release, June 4, 2009, DWR Responds to New Biological Opinion to Protect Salmon).

2.5.2 CALFED Bay Delta Program

The CALFED Bay Delta Program is an association of agencies and stakeholders whose goal is to develop and implement a long-term plan to address chronic water supply and environmental problems in the Delta and San Francisco Bay. This association has developed a Program Action Plan that provides a framework for the implementation of projects within

the CALFED Program. The major program components are ecosystem restoration; water supply reliability (including water use efficiency, water transfers, watershed management, water storage, and water conveyance); water quality; and levee system integrity. An Environmental Impact Statement (EIS)/EIR was prepared for the CALFED Program in 1999 and was certified in August 2000. Three separate cases concerning the CALFED process were originally filed in Superior Court in Sacramento, Fresno, and Orange counties, and the cases were coordinated for trial proceedings before the Superior Court, Sacramento County. In April 2003, a Sacramento Superior Court upheld the EIR and its certification under CEQA. This judgment was initially reversed, in part, by the Third Appellate Court of California. However, on June 23, 2008 the California Supreme Court issued a decision and concluded that the CALFED Program EIR was not legally defective in any of the areas identified by the Court of Appeal. Therefore, components of the CALFED Program continue to be implemented.

2.5.3 Environmental Water Account

As discussed in the 2007 SWP Delivery Reliability Report, the POD (discussed above) is occurring despite the operation since 2001 of the Environmental Water Account (EWA). This CALFED water management tool was created to provide added protection to at-risk fish species at no uncompensated costs to SWP and CVP water deliveries. The purpose of the EWA is to enable modifying water project operations in the Delta to provide protection for fish while also compensating for any water supply lost to SWP and CVP water users. Under EWA, fish protection is achieved by periodic curtailment of SWP and CVP water diversion from the Delta to water users south of the Delta and later replacing any lost water supply. EWA achieves this through buying water from willing sellers or diverting surplus water when safe for fish, then banking, storing, transferring, and releasing the water as needed to protect fish and compensate water users. In its simplest terms, the EWA is aimed at adding flexibility to the state's water delivery system by providing water at critical times to meet environmental needs without reducing SWP and CVP water deliveries. Funding for the EWA is expected to continue through 2008 (DWR 2008). Without the compensation for the supply effects due to restricted pumping, SWP water supply reliability will be reduced (DWR 2008). The studies in the 2007 SWP Delivery Reliability Report assume no EWA will be in place under the current and future scenarios (DWR 2008). DWR and the U.S. Bureau of Reclamation released the Final EIS/EIR for the EWA in January 2004.

2.5.4 South Delta Improvements Program

The South Delta Improvements Program (SDIP) was included in the CALFED Program. The SDIP consists of two major components: (1) physical and structural improvements in the south Delta; and (2) operational improvements at the SWP's Clifton Court Forebay. The physical and structural improvements consist of the following: (1) construction and operation of permanent operable gates at up to four locations in the south Delta channels to protect fish and meet the water level and, through improved circulation, water quality needs for local irrigation diversions; (2) channel dredging to improve water conveyance; and (3) modification of 24 local agricultural diversions. The operational components consider raising the permitted diversion limit into the SWP Clifton Court Forebay from 6,680 cubic feet per second (cfs) to 8,500 cfs. Some of the CALFED actions, such as the SDIP, may be stalled due to other Delta-related events and litigation. DWR and the U.S. Bureau of Reclamation released the Final EIS/EIR for the SDIP in December 2006.

2.5.5 Delta Levee Emergency Planning

As described in the 2007 SWP Delivery Reliability Report, a potential uncertainty for SWP water conveyance through the Delta is the risk of interruptions in SWP diversions from the Delta due to levee failure. SWP source water enters the Delta through the Sacramento River and is conveyed to the Harvey O. Banks Delta Pumping Plant via Delta channels lined with fragile levees (DWR 2008). There are over 1,600 miles of aging levees in the Delta. The integrity of these levees has been of concern for some time and was brought to the forefront after the failure of the Delta's Jones Tract levee in 2004, and subsequent levee failures and flooding due to hurricane Katrina in New Orleans in 2005. If a levee fails, depending on the location and the size of the adjacent island, the flow of water from nearby channels onto the affected island can draw saline water from Suisun and San Pablo Bays into the central Delta (DWR 2008). In such an incident, SWP pumping at the Harvey O. Banks Delta Pumping Plant may have to be curtailed or ceased for a period to prevent drawing saline water into the south Delta and additional releases from Lake Oroville may be necessary to flush the Delta of the saline water (DWR 2008).

CalSim II studies which reflect risk of levee failure are not included in the 2007 SWP Delivery Reliability Report (DWR 2008). The impact on SWP deliveries due to a single or multiple levee failure is highly dependent on where the levees fail and the Delta conditions at the time (DWR 2008). The effect on SWP deliveries can range from relatively minor to catastrophic for a large earthquake with extensive levee failures, depending on whether the earthquake occurs under dry or wet Delta conditions (DWR 2008).

A growing concern about the long-term viability of the Delta's levee system led to the initiation of the Delta Risk Management Strategy (DRMS) discussed in more detail below (DWR 2008).

As further described in the 2007 SWP Delivery Reliability Report, as part of its efforts to reduce impacts to the SWP should a levee failure occur, DWR has initiated the development of an Emergency Operations Plan (EOP), a plan that will provide procedures for emergency preparedness and incident management typically necessary for a jurisdiction or organization with emergency response roles and responsibilities. While DWR has current general procedures for emergency response, the EOP will ultimately enhance the state's ability to prepare for, respond to, and recover from a Delta levee failure disaster and will provide DWR with a plan focused specifically on a catastrophic levee failure disaster (DWR 2008). The EOP will be a blueprint for coordinating the protection of life and property with its local, state and federal partners in taking the steps necessary to protect the state's water system (DWR 2008).

As discussed in the 2007 SWP Delivery Reliability Report, DWR has completed the first of two phases of engineering design work intended to enhance the state's ability to respond to large-scale levee failures or floods in the Delta. In the first phase, DWR conducted a discovery process to analyze previously developed plans and procedures and to identify current DWR capabilities for response to emergencies and disasters in the Delta. This phase included: developing plans to determine the quantity and gradation of rock needed to repair several levee breaches and block certain river channels to minimize salinity intrusion into the interior of the Delta; securing strategic joint stockpile-transfer facilities; completing design requirements and contracting for the construction of a new belt conveyor system;

and establishing new procurement contracts for rock to be placed at the stockpile-transfer facilities. Through this process, DWR has categorized response actions that can be taken to reduce the impact of a Delta levee failure disaster. The first phase, now complete, has resulted in a DWR report, *Delta Emergency Operations Plan Concept Paper April 2007*. This report can be accessed at http://www.dfm.water.ca.gov/er/.

In the second phase, DWR will engage its partners in local, state, and federal government, and in the private sector, to develop a detailed EOP for responding to levee failure events, stabilizing the system, and facilitating recovery. The EOP will be consistent with, and in compliance with, California's Standardized Emergency Management System and with the National Incident Management System. By developing the EOP, DWR will improve preparedness capabilities for response and recovery (DWR 2008).

2.5.6 Delta Vision

In 2006, by Executive Order S-17-06, the Governor initiated a comprehensive Delta Vision process and appointed a Blue Ribbon Task Force to recommend future actions that will achieve a sustainable Delta. In December of 2007, the Delta Vision Blue Ribbon Task Force submitted to the Governor its first of two required reports, "Our Vision for the California Delta," which included twelve linked recommendations and several proposed near-term actions to protect the Delta ecosystem and the state's water supply. Among the twelve Integrated and Linked Recommendations (http://deltavision.ca.gov/BlueRibbonTaskForce/FinalVision/Vision_2_Page_Summary.pdf) is the recommendation that the goals of conservation, efficiency and sustainable use must drive California water policies. In addition, the recommendations include that a revitalized Delta ecosystem will require reduced diversions, or changes in patterns and timing of those diversions, upstream, within the Delta and exported from the Delta at critical times.

The near-term actions included in the report focus on preparing for disasters in or around the Delta, protecting its ecosystem and water supply system from urban encroachment, and starting work on short-term improvements to both the ecosystem and the water supply system. The complete report is accessible at http://deltavision.ca.gov/BlueRibbonTaskForce/FinalVision/Delta_Vision_Final.pdf). The second and final required report, a Strategic Plan to implement the Delta Vision, is to be completed by the Blue Ribbon Task Force by October of 2008.

2.5.7 Bay Delta Conservation Plan

The purpose of the BDCP is to develop a conservation plan that resolves the conflict between fishery protection under state and federal Endangered Species acts and water operations of the SWP, CVP, and Mirant Power facilities in the legal Delta (DWR 2008). The goal of the BDCP is to develop a plan that satisfies both the conservation and water supply goals of the Planning Agreement signed in October 2006 (DWR 2008).

Among other things, the plan will: provide for conservation and management of at-risk fish species affected by the covered activities; preserve, restore, and conserve aquatic, riparian and associated terrestrial habitats; and provide clear expectations and regulatory assurances for Delta water operations and facilities (CVP, SWP, and Mirant Corporation) (DWR 2008). The steering committee for the BDCP has been actively working since April 2007 to set the

scope and focus of this planning (DWR 2008). The committee initially developed ten options and these options were narrowed to four options for conveyance and opportunities that provide for habitat restoration and enhancement and include: Option 1, Existing Through-Delta Conveyance; Option 2, Improved Through Delta Conveyance; Option 3, Dual Conveyance; and Option 4, Peripheral Aqueduct (DWR 2008).

2.5.8 CALFED Ecosystem Restoration Program Conservation Strategy

The Ecosystem Restoration Program (ERP) implementing agencies are developing a Conservation Strategy to guide ecosystem restoration implementation based on evaluation of past actions, new information, and changing understanding of the ecosystem (DWR 2008). The Conservation Strategy is non-regulatory and based on willing seller participation. The effort has focused on the Delta due to the emphasis placed on the POD and other planning efforts (DWR 2008).

The Conservation Strategy is a biological view of where restoration of important habitat types could occur to restore ecosystem form and processes to the maximum extent (DWR 2008). Areas have been identified in the Conservation Strategy with potential for various kinds of habitat restoration in the Delta-Suisun Marsh based upon existing elevations, habitat, and natural process requirements of pelagic organisms and other native fishes (DWR 2008). Elevation and soil type are the drivers for this preliminary depiction which does not consider the constraints of water conveyance options, infrastructure, or land use patterns and ownership (DWR 2008). The Conservation Strategy is also incorporating information from other Delta-related planning efforts (e.g., Delta Risk Management Strategy [described below], Suisun Marsh Implementation Plan, the ERP End of Stage 1 Assessment, and recovery plans for Federally-listed species) and technical and public input (DWR 2008).

2.5.9 Delta Risk Management Strategy

The 2000 CALFED Record of Decision presented its Preferred Program Alternative describing actions, studies, and conditional decisions to help fix the Delta (DWR 2008). Included in the Stage 1 Implementation of the preferred alternative was the completion of a Delta Risk Management Strategy (DRMS) that would look at sustainability of the Delta and assess major risks to Delta resources from floods, seepage, subsidence, and earthquakes (DWR 2008). DRMS would also evaluate the consequences and develop recommendations to manage the risk (DWR 2008).

In 2005, the Legislature passed and the Governor signed AB 1200 which requires DWR to evaluate the potential impacts on water supply derived from the Delta based on 50-, 100-, and 200-year projections for possible impacts on the Delta due to subsidence, earthquakes, floods, climate change, and combinations of these (DWR 2008). DWR and the California Department of Fish and Game must determine the principal options for the Delta and DWR must then evaluate each option for addressing those impacts for its ability to, among other things, prevent the disruption of water supplies derived from the Delta, improve the water quality of drinking water supplies from the Delta, and maintain Delta water quality for Delta users (DWR 2008). The California Department of Fish and Game is to evaluate and comparatively rate each option for its ability to restore salmon and other fisheries that use the Delta (DWR 2008). A report, *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta*, pursuant to the requirements of AB 1200 was

completed in January of 2008 (the complete report can be found at: http://www.drms.water.ca.gov/docs/AB_1200_latest.pdf). The document reports on progress made to define the risks and options to reduce risks for the Delta as requested by the Legislature. The DRMS Project was developed, in part, to address the provision in AB 1200 and is a major source of scientific and technical information on the Delta and Suisun Marsh levees for other major studies and initiatives including the Delta Vision initiative, the BDCP, and the CALFED End of Stage 1 Assessment (DWR 2008).

2.6 Santa Clarita River TMDLs

As a result of long-term water quality concerns, two Total Maximum Daily Loads (TMDL)[20] were required and completed for chlorides and nitrogen on the Santa Clara River. These TMDLs are described below.

2.6.1 Chlorides

In recent years, elevated concentrations of chloride have been measured in waters of the Santa Clara River watershed. These concentrations are primarily due to various types of loading during beneficial water uses, including agricultural uses (irrigation and leaching); commercial uses; domestic uses; and water treatment (e.g., water softeners) (LACSD 2002). In addition to loading from urban runoff, imported water in certain year types, and the discharge of treated wastewater, naturally occurring chloride concentrations contribute to excessive chloride concentrations in Santa Clarita Valley groundwater (LARWQCB 1999). The identification of excessive chloride concentrations resulted in the addition of several reaches of the Santa Clara River to the Section 303(d) List.

Table 13 provides a timeline summary of the regulatory actions taken to regulate chloride loading within the Santa Clara River.

The revisions to the chloride TMDL adopted in May 2004 required completion of several special studies to characterize the sources, fate, transport, and specific impacts of chloride in the Upper Santa Clara River. The first of these special studies, the Literature Review Evaluation, was completed in September 2005 (Upper Santa Clara River Agricultural Technical Working Group 2005).

In addition, the LACSD has compiled the Santa Clarita Valley Joint Sewerage System Chloride Source Report, a detailed and comprehensive study of the sources of chloride loading in the Santa Clarita Valley (LACSD 2002). That study identified that residential water use, primarily from self-regenerating water softeners, greatly contributes to the chloride loading. Based on the results of that study, the LACSD adopted an ordinance that

[20] The federal Clean Water Act requires states to designate appropriate water uses to be protected and directs states to set water quality criteria based on these uses (United States Environmental Protection Agency [USEPA] 2000). Under section 303(d) of the Clean Water Act, states, territories, and authorized Indian tribes are required to submit lists to the USEPA detailing water bodies for which existing pollution controls are insufficient to attain or maintain water quality standards. After submitting the list of “impaired waters” to the USEPA, states must develop a TMDL plan to limit excess pollution. A TMDL is a number that represents the assimilative capacity of water for a particular pollutant, or the amount of a particular pollutant that the waterbody can receive without impacting its beneficial uses. TMDL plan implementation can be accomplished through revised permit requirements (for point source contaminants) and through implementation of Best Management Practices (USEPA 1999).

TABLE 13
Regulatory Timeline for Chloride

Time	Action
January 1997	LARWQCB adopts a Chloride Policy, which consists of Resolution No. 97-02: Amendment to the California Regional Water Quality Control Plan for the Los Angeles Region, to Incorporate a Policy for Addressing Levels of Chloride in Discharges of Wastewaters.
Fiscal Year 1997/1998	Santa Clara River Reaches 3, 7 and 8 are added to the Section 303(d) List for chloride impairment, and TMDL monitoring commences.
October 2002	LARWQCB amended the 1994 Basin Plan to incorporate a TMDL for chloride for the upper Santa Clara River, establishing the 100 mg/L surface water quality objective for Reaches 7 and 8.
February 2003	The California State Water Resources Control Board (SWRCB) remanded the chloride TMDL back to the LARWQCB to consider sequentially phasing TMDL implementation tasks, extending the interim limits, and reevaluation of the chloride objective itself.
March 2003	LACSD adopts an ordinance that prohibits the installation and use of new self-regenerating water softeners in the Santa Clarita Valley to help lessen the chloride loading in the region.
May 2003	The USEPA is developing chloride TMDLs for Reaches 3, 7 and 8 of the Santa Clara River, in the event that the LARWQCB does not adopt its chloride TMDL by June 2003.
July 2003	The LARWQCB adopted the chloride TMDL in light of the Remand Resolution, and revised the Basin Plan to incorporate the chloride TMDL.
May 2004	The LARWQCB revised and adopted the chloride TMDL. Revisions included incorporation of four major studies into the Implementation Plan, including an evaluation of the appropriate chloride threshold for the reasonable protection of salt-sensitive agriculture.
Late 2004	The SWRCB and the Office of Administrative Law approve the chloride TMDL.
April 2005	The USEPA approved the chloride TMDL.
August 2006	The LARWQCB adopted revisions to the TMDL. The revisions include acceleration of the final TMDL completion date and incorporation of time-certain tasks related to the design and treatment facilities into the Implementation Plan.
May 2007	The SWRCB approved the amendment to the Basin Plan to revise the implementation plan for the chloride TMDL.
November 2007	A Basin Plan Amendment was approved by the LARWQCB which subdivided Reach 4 of the Santa Clara River.

Source: LARWQCB 2006a, 2006b and 2007; SWRCB 2002, 2003 and 2007; LACSD 2002; USEPA 2003.

prohibits the installation and use of new self-regenerating water softeners in the Santa Clarita Valley. This ordinance took effect in March 2003.

LACSD has also led the completion of a collaborative report entitled "Chloride Source Identification/Reduction, Pollution Prevention, and Public Outreach Plan" which identifies chloride sources and strategies for reducing sources. The Report identified the potable water supply as the largest source and self-regenerating water softeners as the second largest source of chloride loading (LARWQCB 2006b).

As described in Table 13, the LARWQCB adopted revisions to the chloride TMDL that would accelerate the final TMDL completion date and incorporate time-certain tasks related to the design and treatment facilities into the Implementation Plan (LARWQCB 2006b).

2.6.2 Nitrogen

The LARWQCB adopted a nutrient TMDL in late 2003 for the upper Santa Clara River that addresses the Section 303(d) List for nitrate plus nitrite impairment (LARWQCB 2003). The TMDL limits nitrate (NO_3), nitrite (NO_2), ammonia (NH_3), and total nitrogen (N). Principal sources of nitrogen to a watershed typically include discharges from water reclamation plants and runoff from agricultural activities. Elevated nitrogen concentrations (ammonia, nitrate, and nitrite) can cause impairments in warm water fish and wildlife habitat, along with contributing to eutrophic effects such as algae growth and low dissolved oxygen.

SECTION 3

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Attachment A

California Water Impact Network v. Castaic Lake Water Agency and Planning and Conservation League v. Castaic Lake Water Agency - Consolidated Cases

ORIGINAL

FILED
LOS ANGELES SUPERIOR COURT
MAY 22 2007 F.D.
JOHN A. CLARKE, CLERK
A. Fajardo
BY A. FAJARDO, DEPUTY

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MAY 18 2007
CIVIL OPERATIONS

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF LOS ANGELES, CENTRAL DISTRICT

PLANNING AND CONSERVATION LEAGUE, Petitioner, vs. CASTAIC LAKE WATER AGENCY, Respondent, CALIFORNIA DEPARTMENT OF WATER RESOURCES, KERN COUNTY WATER AGENCY, WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT, Real Parties in Interest.	CASE NO.: BS 098724 Assigned for All Purposes: Honorable James Chalfant Department 13 (Consolidated Cases) [Transferred from Ventura County Master File No. CIV 231588 (consolidated with Ventura County Case No. CIV 231606)] **~~[PROPOSED]~~ JUDGMENT GRANTING PEREMPTORY WRIT OF MANDATE** Action Filed: January 24, 2005 Action Transferred: August 8, 2005
CALIFORNIA WATER IMPACT NETWORK, Petitioner, vs. CASTAIC LAKE WATER AGENCY, Respondent, CALIFORNIA DEPARTMENT OF WATER RESOURCES, KERN COUNTY WATER AGENCY, WHEELER RIDGE-MARICOPA WATER STORAGE DISTRICT, Real Parties in Interest.	

The above-entitled consolidated matter came on regularly for hearing on March 19, 2007, before the Honorable James C. Chalfant. Petitioner, Planning and Conservation League ("PCL") appeared by and through Antonio Rossman and Roger B. Moore of Rossman & Moore, LLP. Petitioner, California Water Impact Network ("CWIN") appeared by and through Babak Naficy of the Law Offices of Babak Naficy. Respondent, Castaic Lake Water Agency ("Castaic") appeared by and through David D. Boyer of McCormick, Kidman & Behrens, LLP; R. Bruce Tepper of R. Bruce Tepper, ALC; and James G. Moose of Remy, Thomas, Moose and Manley, LLP. Real Party in Interest California Department of Water Resources ("DWR") appeared by and through Deputy Attorney General Marilyn H. Levin, and Deputy Attorney General Deborah A. Wordham. Real Party in Interest Kern County Water Agency ("Kern") appeared by and through Clifford W. Schulz of Kronick, Moskovitz, Tiedmann & Girard, APC. Real Party in Interest Wheeler Ridge-Maricopa Water Storage District ("Wheeler-Ridge") appeared by and through Steven M. Torigiani of the Law Offices of Young Wooldridge, LLP.

At that time the Court heard arguments of counsel and examined key portions of the Administrative Record certified by Castaic and submitted by the parties. After considering the filings of all parties, the oral arguments of counsel, and the records and files in this case, the court took the matter under submission. After further deliberations and further review of applicable legal authorities and key documents in the Administrative Record, the Court prepared a proposed Statement of Decision, which was filed and served by the Court on April 2, 2007. The Court entered its final Statement of Decision (attached hereto as Exhibit "A," and incorporated herein by reference) on May 22, 2007, after reviewing Petitioners' April 17, 2007 objections to the proposed Statement of Decision.

IT IS THEREFORE ORDERED that:

1. The 2004 EIR having been properly prepared in all other respects, Judgment shall be entered in favor of Petitioners in this proceeding solely on the issue of the failure of the EIR to show the analytic route as to how and why the three allocations of pre-Monterey Amendments without Article 18(b) cutbacks, pre-Monterey Amendments with Article 18 (b) cutbacks and post-Monterey Amendments are relevant and would occur.

2. A Peremptory Writ of Mandate shall issue commanding Castaic to set aside its

certification of its 2004 EIR and to comply with CEQA consistent with the Statement of Decision.

3. The Peremptory Writ of Mandate shall not direct Castaic to set aside the Kern Water Transfer, nor shall it limit or control the discretion legally vested in Castaic to determine the appropriate manner to comply with CEQA .

3. The Court retains jurisdiction over this matter by way of return to the Peremptory Writ of Mandate.

DATED: 5/22/07

HONORABLE JAMES CHALFANT
JUDGE OF THE SUPERIOR COURT

Presented by: McCORMICK, KIDMAN & BEHRENS, LLP
Russell G. Behrens,
David D. Boyer

DAVID D. BOYER
Attorneys for Respondent
CASTAIC LAKE WATER AGENCY

California Water Impact Network v. Castaic Lake Water Agency
BS 098724

Statement of Decision on Petition for Writ of Mandate

FILED
LOS ANGELES SUPERIOR COURT
APR 0 2 2007
JOHN A. CLARKE, CLERK
A. Fajardo
EXECUTIVE OFFICER/DEPUTY

Petitioners California Water Impact Network ("CWIN") and Planning and Conservation League ("PCL") petition for writ of mandate under California Environmental Quality Act ("CEQA"). The court has read and considered the moving papers, oppositions, and reply, heard oral argument, and renders the following decision.

A. Statement of the Case

Petitioner CWIN commenced its petition for writ of mandate in Ventura County Superior Court on January 24, 2005. The petition alleges that on December 23, 2004, the Castaic Lake Water Agency ("Castaic"), a public water agency and water wholesaler that treats and delivers water to water retailers in Los Angeles and Ventura Counties, approved the permanent transfer of 41,000 acre feet per year from Real Party in Interest Kern County Water Agency ("Kern") and its member unit in Kern County, Wheeler Ridge-Maricopa Water Storage District ("Wheeler Ridge"), to Castaic (the "Kern water transfer," the "Kern transfer," or the "transfer"). Castaic also purported to certify the Environmental Impact Report ("EIR") for the project (the "2004 EIR" or the "EIR"). Petitioner claims the Kern water transfer "threatens to promote large-scale urban sprawl in Ventura and Los Angeles Counties, while diverting water from important environmental and agricultural uses in Kern County forever." Petitioner alleges that the 2004 EIR is premature, and fails to comply with CEQA.

The petition alleges a cause of action for violation of CEQA in that Real Party in Interest California Department of Water Resources ("DWR"), not Castaic, should have been the lead agency for the 2004 EIR, which does not adequately describe the background on which the project is based, fails to disclose a reliance on an invalid Urban Water Management Plan, fails to adequately describe alternatives to the project, including a "no project" alternative, fails to discuss growth inducement, and inaccurately states the availability of water availability.[1]

On January 24, 2005, PCL filed its own petition for writ of mandate against Castaic in Ventura County Superior Court. The PCL petition alleges a violation by Castaic in recording a Notice of Determination on December 23, 2004, certifying the 2004 EIR and rendering its approval of the Kern water transfer. The petition purports to allege five "causes of action" for violation of CEQA in the 2004 EIR based on Castaic stealing DWR's duty to be the lead agency for the EIR, certification of a defective EIR, approval of inadequate findings, erroneous presentation of the project as already complete, and "prejudicial abuse of discretion."

On June 22, 2005, upon motion by Castaic, the Ventura County Superior Court (the Honorable Frederick H. Bysshe, Jr.) ordered the transfer of both petitions, which had been consolidated, to Los Angeles. On March 27, 2006, the case was reassigned to this court.

On June 27, 2006, the court heard the demurrers of Castaic and Real Party in Interest Kern to the consolidated petitions. The court ruled that the petitions were timely filed and were

[1]On CWIN's oral motion, the petition's second and third causes of action have been dismissed. As a result, CWIN's petition solely concerns Castaic's compliance with CEQA in the 2004 EIR.

EXHIBIT "A"

not barred under the doctrine of *res judicata*. The court noted that the Kern water transfer agreements are valid. While principles of *collateral estoppel* barred Petitioners from re-raising issues resolved by the Second District with respect to the 1999 EIR, this conclusion did not foreclose the petitions and the demurrers were overruled.

On July 16, 2006, the court denied Castaic's motion for a legal determination under principles of *collateral estoppel* and party admission that Castaic is the proper lead agency for preparation of the EIR for the Kern water transfer. However, Petitioners are bound by their concession that Castaic may act as the lead agency at some point for an EIR on the Kern water transfer.

B. Preliminary Issues

1. Standing and Timeliness

Petitioner PCL alleges that it is a non-profit corporation devoted to environmental protection. PCL Pet. at ¶6-7. Some of PCL's members live in the area affected by the Kern water transfer. PCL Pet. at ¶8. Petitioner CWIN alleges that it is a nonprofit public benefit corporation the purpose of which is to protect California's environment. CWIN contends that it is impacted by the Kern water transfer because its members reside in and use the Santa Clara River watershed, which is impaired by the water transfer. CWIN Pet. at ¶9. Thus, Petitioners contend that they are impacted by the project and have standing to raise the issues herein. Respondents do not contest Petitioners' standing. *See* Waste Management of Alameda County, Inc. v. County of Alameda, (2000) 79 Cal.App.4th 1223, 1233-34.

The actions are timely on CEQA issues, each having been filed on January 24, 2005, within 30 days of Castaic's Notice of Determination that the 2004 EIR had been certified, filed in various counties between December 23 and December 27, 2004. *See* Pub. Res. Code §21167(c).

2. The Administrative Record

Castaic has certified the administrative record. Pub. Res. Code §21167.6; LASC 9.24(e). The record was received in evidence at trial.

Castaic and Kern, and DWR separately ask the court to judicially notice various records. Judicial notice is the acceptance by a court without formal proof of the existence of a matter of law or fact that is relevant to an issue in the case. People v. Rowland, (1992) 4 Cal.4th 238, 268, n.6. Certain documents are subject to judicial notice. Ev. Code §451, 452. Even where subject to judicial notice, however, a document must be relevant. Id.

The California Supreme Court decision in Western States Petroleum Assn. v. Superior Court, ("Western States") (1995) 9 Cal.4th 559, 573, n.4, provides that extrinsic evidence is generally not admissible for a traditional mandamus challenging a quasi-legislative agency action. The exclusion of extrinsic evidence in a traditional mandamus action is essentially the exclusion of irrelevant evidence. Extrinsic evidence is generally not admissible for a traditional mandamus challenging a quasi-legislative agency action. Id. Such evidence may be admissible in a narrowly construed exception in which (1) the evidence in question existed before the agency made the decision, and (2) the evidence could not have been presented to the agency in the first instance in the exercise of reasonable diligence. Id. at 578. The purpose of limiting extra-record evidence is that the free use of such evidence would invade the deference to which the legislative

branch is entitled under the constitutional separation of powers. If the courts freely considered extra-record evidence in mandamus cases, the highly deferential substantial evidence standard would be turned into a *de novo* standard where the courts in effect would decide not whether an administrative decision was supported by the evidence before the agency but instead whether it was the wisest and best decision according to the courts. Id. at 572.

Castaic asks the court to judicially notice: (1) the unpublished appellate decision in Friends of the Santa Clara River v. Castaic Lake Water Agency, 2003 Cal.App. Unpub. LEXIS 11239, dated December 1, 2003 ("Friends II"), and (2) the unpublished appellate decision in California Water Network v. Castaic Lake Water Agency, 2006 Cal.App. Unpub. LEXIS 2452, dated March 23, 2003.[2] The existence of these court decisions is subject to judicial notice. Ev. Code §452(d).[3]

DWR asks the court to judicially notice (1) Amendment No. 19 to the Water Supply Contract between it and Castaic dated May 28, 2003, and (2) Notice of Preparation of EIR for the Monterey Amendment dated January 24, 2003. DWR contends that these documents are official acts of a California agency subject to judicial notice under Ev. Code section 452(c) and (d). The Notice of Preparation is an official act of DWR and is judicially noticed. However, Amendment No. 19 is not. Official acts should be limited to regulations, public announcements, and other actions the existence of which is beyond dispute. A well informed person has no way of knowing whether Amendment No. 19 is authentic and valid. Nor is it a court record under section 452(d). DWR's request for judicial notice of Amendment No. 19 is denied.

C. Statement of Facts

1. SWP

In 1951, the Legislature authorized construction of a state water storage and delivery system. Planning & Conservation League v. Department of Water Resources, (2000) 83 Cal.App.4th 892, 898. The Legislature subsequently authorized the State Water Project ("SWP"), a complex system of 28 reservoirs and dams, 26 power and pumping plants, and 600 miles of canals and aqueducts to deliver 4.23 million acre-feet of water annually to Central and Southern California. The primary source for the SWP is the drainage of the Feather River, a tributary of the Sacramento River in Northern California (hereinafter, the "Delta").

DWR is the state agency charged with the statutory responsibility to build, manage, and operate the SWP. Essentially, DWR is the wholesale provider of water to middlemen agencies. In 1961, DWR entered into individual contracts with various agricultural and urban water suppliers in the State, referred to as State Water Contractors. *See* Water Code §12937. There are 29 agencies or districts that currently are State Water Contractors.

The SWP water contracts entitled the contractors to receive an annual amount of SWP

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[2]Castaic also supplied the court with copies of its decisions on demurrer and motion for legal determination in this case, which need not be judicially noticed.

[3]Real Party Wheeler purports to join in Castaic's request for judicial notice. In its ruling on the demurrers, the court informed Wheeler of the futility of a joinder as merely a cheerleading effort. No further discussion of the purported joinder is necessary.

water in exchange for a proportionate share of financing and maintaining the SWP facilities. Each water contract contains provisions for both allocation of the amount of water available each year and costs among the contractors. Each contract identifies a Table A amount, the annual maximum amount of water which DWR agrees to deliver, if available for delivery, to each SWP contractor on an annual basis. Delivery of the Table A amount is not assured, but rather provides the basis for proportional allocation of available water among contractors. The Table A amount is specified as either agricultural or urban (M&I). Each contract also includes Article 40, which permits water transfers between contractors, and Article 41, which requires DWR approval of any transfer subject to reasonable terms and conditions. AR 2356.

Each contractor annually submits a request to DWR for water delivery in the following year, up to the amount in Table A. In a year when DWR is unable to deliver the total of contractor requests, deliveries to all contractors will be reduced. The current Table A totals are 4.17 million acre-feet per year.[4] In fact, given existing facilities and contractor demands, the SWP can only deliver an average of 2.96 million acre-feet per year.

2. <u>The Monterey Agreement</u>

Historically, the delivery of less than Table A totals was not a significant problem because contractor demand was less than the Table A amounts. However, in the late 1980's and early 1990's, a drought led to SWP deliveries in amounts below that requested by contractors. Articles 18(a) and (b) of the SWP water contracts addressed DWR's temporary and permanent inability to deliver the water allocations listed in Table A of the contracts by requiring agricultural contractors to accept a reduction in water first before any remaining reduction was shared by urban contractors. In 1990, agricultural contractors received only half their requested water and none in 1991. Because contractors pay their proportionate share of fixed costs regardless of how much water is delivered, the agricultural contractors were paying for water they were not receiving and they were displeased. As a result, urban and agricultural water contractors clashed over DWR's delivery obligations and the proper interpretation of Article 18. AR 45-46.

In December 1994, five State Water Contractors and and DWR reached agreement on a broad set of fourteen principles (the "Monterey Agreement"). Among other things, the Monterey Agreement changed the allocation between agricultural and urban contractors of entitlements to SWP water. The Monterey Agreement eliminated Article 18 and specified that all SWP water was to be allocated in proportion to Table A amounts. Paragraph 24 of the Monterey Agreement provides for the permanent transfer of 130,000 acre-feet from certain willing agricultural contractors, including KWCA, to urban contractors, as implemented by individual agreement. AR 2515. It also provides that individual contractors may transfer entitlements among themselves beyond the 130,000 acre feet proposed, with DWR expeditiously executing any necessary documents and approving all such contracts. Other provisions of the Monterey Agreement include a revision of water allocations during shortages, eliminating the "agriculture first" provision, and retirement of 45,000 other acre-feet of entitlement by agricultural contractors.

[4]An "acre-foot" is the amount of water that would cover one acre one foot deep.

The Monterey Agreement provides that individual SWP contracts could be amended to conform to it. Over the next two years, 27 of the 29 Water Contractors amended their SWP contracts to implement the principles of the Monterey Agreement (collectively, the "Monterey Amendments").

In 1995, a State Water Contractor, Central Coast Water Authority ("Central"), acted as lead agency and certified a program EIR analyzing the environmental impacts of the Monterey Agreement. This program EIR also addressed Paragraph 24 (Article 53 in the Monterey Amendments) water transfers, including the Kern water transfer. In late 1995, PCL filed a lawsuit in Sacramento Superior Court challenging the program EIR, Planning & Conservation League v. Department of Water Resources, ("PCL").

3. The Kern Water Transfer Agreement

Castaic is a State Water Contractor created by the California Legislature. Its mandate is to purchase and deliver sufficient supplies of water to serve the needs of the Santa Clarita Valley. *See* Swanson v. Marin Municipal Water District, (1976) 56 Cal.App.3d 512, 524 (water district has obligation to augment available water to meet increasing demands). Castaic diverts its SWP water from the West Branch of the California Aqueduct. Castaic is one of the Water Contractors entering into the Monterey Amendments (Amendment 17 to Castaic's SWP contract).

Kern County Water Agency ("KCWA") is a special district formed by the Legislature in 1961. Wheeler Ridge is a special district formed in 1959 to provide supplemental water to agricultural lands in Kern County and is located immediately north and east of Castaic. KCWA has contracts with Wheeler Ridge and other member agencies, for KCWA's SWP water.[5]

In March 1999, Castaic entered into an agreement to purchase from Wheeler Ridge, subject to KCWA's consent, 41,000 acre-feet per year of SWP water (the Kern water transfer). The price for the transfer was $47 million in debt instruments purchased by private investors. The purpose of the transfer is to permit Castaic to serve the water demands of existing users, as well as meet a portion of future water demand from anticipated growth within the Castaic service area. AR 16. The Kern water transfer is the largest transfer under Article 53 of the Monterey Amendments, and it counts towards the 130,000 acre-feet limit. In their transfer agreement, both sides warranted that there was no pending or threatened litigation other than PCL that could affect the 41,000 acre feet SWP entitlement. AR 2562-63.[6]

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[5]In 1998, another KCWA member, Belridge Water Storage District, certified an EIR on the environmental effects of transferring 130,000 acre-feet of SWP water to unidentified purchasers. This EIR was not challenged.

[6]Castaic has been planning since 1987 to increase the supply of water to Santa Clarita Valley. At that time, Los Angeles County General Plan forecast substantial population growth in the Santa Clarita Valley. In 1988, Castaic adopted a Capital Program and Water Plan (the "Capital Program") to address the purchases, construction, and improvements necessary to meet the anticipated water demand. The Capital Program called for the purchase of SWP water from districts willing to sell, including Wheeler Ridge, and the storage of water for later use during drought conditions at Semitropic Groundwater Storage District's ("Semitropic") basins. AR

DWR's approval of the Kern water transfer was required under Articles, 15, 41, and 56 of the SWP contracts. On March 31, 1999, DWR approved the transfer by entering into Amendment 18 of Castaic's SWP contract. Amendment 18 adds Article 53(j), which provides that "in accordance with Article 53(a)" of the Monterey Amendments, Castaic's Table A annual entitlements were increased by 41,000 acre-feet. AR 2545-47. DWR and KCWA, which consented to the transfer of its water, also entered into Amendment 28 to KCWA's SWP contract, an amendment which reduced KCWA's entitlement by 41,000 acre-feet. Based on these amendments, DWR has allocated SWP water to Castaic since 1999 based on a total Table A amount of 95,000 acre-feet -- Castaic's original Table A 54,000 acre-feet plus the 41,000 acre-feet from the Kern water transfer.

On March 29, 1999, Castaic, acting as lead agency, certified an EIR for the Kern water transfer. This 1999 EIR tiered off the 1995 Monterey Amendment program EIR, the Belridge EIR, and Castaic's own 1988 EIR for the Capital Program. In April 1999, Castaic's EIR for the Kern water transfer was challenged in Friends of the Santa Clara River v. Cataic Lake Water Agency, BS056954 ("Friends"). On August 16, 2000, the trial court entered judgment, denying the petition in its entirety.

4. The PCL and Friends Decisions

In September 2000, the Third Appellate District in PCL found that DWR was the only entity with the "statewide perspective and expertise" to serve as lead agency for the Monterey Agreement program EIR. Because "the allocation of water to one part of the state has potential implications for distribution throughout the system," the court recognized DWR's principal responsibility to "facilitate the water transfers allowed under the Monterey Agreement." 83 Cal.App.4th at 907. The use of Central as lead agency for the Monterey Agreement program EIR was inappropriate. Id. at 907.

This lead agency error was not harmless because the EIR also was defective. Perhaps as a consequence of Central's lack of statewide expertise, the EIR failed to properly discuss a "no project" alternative, including the environmental impact of implementing the pre-Monterey Agreement Article 18(b)'s permanent water shortage provision. Id. at 918. This was particularly important because local land use planners rely on the "paper water" entitlements in Table A

41845.

Pursuant to the Capital Program, Castaic permanently acquired 12,700 acre-feet of SWP Table A water in 1991 from Devil's Den Water District, a SWP contractor immediately north of Castaic. This transfer was subject to DWR approval, which per Article 41 of the SWP contracts could not be unreasonably withheld. DWR approved the transfer, noting that the transferred water remained labeled for "agricultural purposes" for purposes of delivery shortages.

Also pursuant to the Capital Program, in 2002 Castaic entered into a groundwater storage or "banking" agreement with Semitropic. This action was challenged under CEQA on the basis that the Monterey Agreement required DWR to conduct an environmental review. The challenge was rejected by the appellate court, which held that DWR had no jurisdiction over Castaic's management of water; DWR merely schedules SWP water delivery to Castaic. Cal. Water Network v. Castaic Lake Water Agency, (2006) 206 Cal.App. Unpub. LEXIS 2452, 9.

rather than real, deliverable water. The question was what impacts were reasonably foreseeable from eliminating Article 18(b)'s solution to permanent water shortage? Id. at 914-15. The PCL court held that the EIR, which lacked simulation models and projections relating to land use planning and demand for water, did not adequately address this issue. Id. at 919. It directed the Sacramento Superior Court to retain jurisdiction over the action until a new EIR was prepared and certified.

Based on the Third District's PCL decision, on January 10, 2002, the Second Appellate District reversed the judgment in Friends and directed the trial court to issue a writ of mandate compelling Castaic to set aside certification of its EIR. Friends, (2002) 95 Cal.App.4th 1373. The reversal was based solely on the fact that Castaic's EIR had been tiered upon the now inadequate Monterey Agreement program EIR. The Second District rejected all of the other challenges to Castaic's EIR, finding them to be without merit. The appellate court noted that Castaic may be able to cure the defect by waiting for DWR to comply with the Third District's directive in PCL by preparing a new program EIR. Castaic could issue a subsequent EIR, a supplement to EIR, or addendum to EIR, tiering upon the new Monterey Agreement EIR.

The Friends appellate decision concluded as follows: "The judgment is reversed. The trial court shall issue a writ of mandate vacating the certification of the EIR, shall retain jurisdiction until Respondent certifies an EIR complying with CEQA consistent with the views expressed in this opinion, and shall consider such orders it deems appropriate under [Pub. Resources Code] section 21168.9."

On October 25, 2002, after remand from the court of appeal, the Friends trial court issued a Peremptory Writ of Mandate and Judgment on Remand, retaining jurisdiction until Castaic certifies an EIR that complies with CEQA and is consistent with the views expressed by the Second District. The trial court did not direct Castaic to set aside its approval of the Kern water transfer and denied the petitioner's request to enjoin Castaic from using any of the 41,000 acre feet of additional water allotted to it by the Kern water transfer. The trial court did state that the injunction request could be renewed upon a showing that the water was actually used for an improper purpose (irreversible new development).

5. Monterey Plus

On June 6, 2003, the Sacramento Superior Court approved a settlement between the parties in PCL. That settlement, known as "Monterey Plus," provides that the Monterey Agreement can proceed on an interim basis. In exchange, DWR agreed, among other things,[7] to prepare a new program EIR for implementation of the Monterey Agreement. This new EIR would include (1) information on water deliveries during the drought and recent historical period, (2) an analysis of a no project alternative, including the environmental impact of Article 18's water shortage provisions, (3) analysis of environmental impacts from changes in SWP operations and deliveries resulting from implementation of the Monterey Agreement, (4) analysis

[7]Some of the other provisions include biennial reports on project reliability, land use restrictions on the Kern Water Bank, new guidelines for permanent water transfers, new procedures for public involvement in contract changes, and funding for watershed restoration and new technical studies. AR 45048-49.

of environmental impacts of seven already completed water transfers from KWCA and member units totaling 70,000 acre-feet (Attachment E), which the parties recognized were "final," and of the Kern water transfer, which the parties acknowledged was being challenged in the pending Friends litigation in Los Angeles Superior Court, and (5) analysis of the environmental impacts from implementation of Monterey Plus. AR 48557-59. With respect to the Kern water transfer, the Monterey Plus parties agreed that "jurisdiction with respect to [Friends] should remain in that court and that nothing in this Settlement Agreement is intended to predispose the remedies or other actions that may occur in that pending litigation." The Monterey Plus did not require DWR to re-approve or disapprove any transfer.

6. The Friends II Decision

The Second District upheld the Friends trial court's decision not to grant injunctive relief for the Kern water transfer on December 1, 2003, in unpublished case no. B164027 ("Friends II"). PCL had filed an *amicus* brief supporting the petitioner in Friends II, pointing out that the Monterey Plus settlement now existed and arguing that the Friends decision required the trial court to rely on the status of PCL litigation, including the new Monterey Agreement program EIR DWR was to prepare, in deciding injunctive relief. The Friends II appellate court stated that PCL was wrong; it merely had suggested, not required, that the trial court could determine and rely on the status of the PCL case in deciding injunctive relief.

7. The 2004 EIR

After Friends, Castaic decided to prepare a revised EIR prior to DWR's preparation of a Monterey Amendment EIR. Castaic was driven by a concern that the Friends petitioner and others would use the decertification of its 1999 EIR to cloud its right to the transferred water, as well as Castaic's duty to its customers to complete the environmental documentation and finalize the Kern water transfer.

In June 2004, Castaic prepared and circulated a draft EIR that tiered only on Castaic's 1988 Capital Program EIR. Castaic concluded that it was the lead agency because it has the principal responsiblility for carrying out and implementing the project. Because the transfer is between neighboring SWP contractors, involving the withdrawal of water from a single branch of the Aqueduct, Castaic concluded that the transfer has no significant impacts on SWP operations or the water diverted from the Delta. *See* AR 13-14.

PCL served comments to the draft EIR on August 16, 2004. These comments criticized the use of Castaic as lead agency, arguing that Castaic's review was "premature" and "likely to operate at cross-purposes with DWR's statewide review." AR 1959. PCL contended that DWR, not Castaic, was required to be the lead agency under the PCL decision. Only DWR's expertise could analyze the changes in the amount of supplies available, the location and timing of deliveries, and changes in the SWP's conveyance and storage facilities for all of the proposed transfers, including the Kern water transfer. AR 1962. CWIN also timely expressed concern about Castaic's lack of authority to act as lead agency, and the potential for conflict with DWR's role. AR 578-580.

DWR, acting as a responsible agency under CEQA, commented on the draft EIR. It stated that the "document adequately and thoroughly discusses the proposed project and its

impacts. The [draft]EIR discusses the effects of the project on the environment and State Water Project (SW) and uses baseline conditions consistent with those being considered for inclusion in [DWR's EIR]. The draft also "adequately discusses the reliability of the SWP, pre- and post-Monterey Amendment conditions, future conditions, and SWP operations." DWR acknowledged that Castaic's EIR uses a model, DWRSIM, to assess the potential impact associated with the Kern transfer and that DWR's EIR will use a newer model, CALSIM II. DWR indicated that the use of a different computer model may cause slight changes in results, which may lead DWR to different conclusions than those made by Castaic in its EIR. Despite this fact, DWR concluded that the draft EIR adequately discusses the reliability of SWP, pre- and post- Monterey Amendments conditions, future conditions, and SWP operations. AR 564-65.

Castaic rejected Petitioners' concerns, and relied on DWR's comments to refute objections that its draft EIR will be inconsistent with the yet to be prepared DWR program EIR. AR 961-4. Castaic adopted findings, a mitigation monitoring program and statement of overriding considerations and certified a final EIR (the 2004 EIR).[8] The 2004 EIR describes Castaic's water program for the future needs of Santa Clarita Valley, the procedural history of the project (including the 1999 EIR), and the fact that the Kern water transfer has been implemented and ongoing since 1999. It uses two separate baselines for the project setting and evaluates environmental impacts of the Kern water transfer on the SWP, Castaic, and Wheeler Ridge. In discussing these impacts, the 2004 EIR considers three SWP scenarios: (a) with the Monterey Agreement, (b) without the Monterey Agreement, and (c) without the Monterey Agreement and with Article 18(b) permanent shortages. The EIR uses the DWRSIM model and concludes no significant direct environmental impacts will occur as a result of the project. There would, however, be indirect growth impacts as a result of water provided by the project.

8. The Petitioners Take Over from the Friends Petitioner

On January 24, 2005, CWIN and PCL filed separate petitions for writ of mandate in Ventura County concerning Castaic's compliance with CEQA in the 2004 EIR, and other issues.

On February 1, 2005, the Friends petitioner dismissed the action with prejudice. On February 7, 2005, the trial court in Friends held a hearing on Castaic's *ex parte* application to vacate the dismissal with prejudice and to discharge the writ of mandate. Castaic argued that, by dismissing, the petitioner was attempting to get the clerk, through ministerial act, to divest the court of its continuing jurisdiction over the 2004 EIR prepared in response to the court's peremptory writ of mandate. Instead, the Friends petitioner was passing the baton to CWIN and PCL for a challenge to the 2004 EIR. The trial court declined to set aside the dismissal, stating that whether the Ventura proceedings were a continuation of the Friends lawsuit was an issue of fact for the Ventura (now this) court.

On March 5, 2005, Castaic petitioned the Second Appellate District for a writ of mandate with respect to the trial court's refusal to vacate the dismissal, arguing that the trial court violated Pub. Resources Code section 21168.9 (stating that the trial court shall maintain jurisdiction over the agency's proceedings until the court has determined that the agency has complied with

[8]On December 30, 2004, Castaic filed its return to the peremptory writ of mandate in Friends.

CEQA) because it had not yet determined that the 2004 EIR complied with CEQA Yet, under CEQA, a trial court that orders preparation of a new EIR must retain jurisdiction for a final determination of the EIR's validity.

On April 14, 2005, the Second Appellate District denied Castaic's petition for "failure to demonstrate that the 'retain jurisdiction' provision of Public Resources Code section 21168.9, subdivision (b), abrogates the entitlement to voluntary dismissal conferred by Code of Civil Procedure section 581, subdivision (b)(1)."[9]

D. CEQA

1. Standard of Review

A party may seek to set aside an agency decision for failure to comply with CEQA by petitioning for either a writ of administrative mandamus (CCP §1094.5) or of traditional mandamus. CCP §1085. A petition for administrative mandamus is appropriate when the party seeks review of a "determination, finding, or decision of a public agency, made as a result of a proceeding in which by law a hearing is required to be given, evidence is required to be taken and discretion in the determination of facts is vested in a public agency, on the grounds of noncompliance with [CEQA]." Pub. Res. Code §21168. This is generally referred to as an "adjudicatory" or "quasi-judicial" decision. Western States Petroleum Assn. v. Superior Court, ("Western States") (1995) 9 Cal.4th 559, 566-67. A petition for traditional mandamus is appropriate in all other actions "to attack, review, set aside, void or annul a determination, finding, or decision of a public agency on the grounds of noncompliance with [CEQA]." Where an agency is exercising a quasi-legislative function, such as by adopting a rule or entering into a contract, it is properly viewed as a petition for traditional mandamus. Id. at 567; Pub. Res. Code §21168.5.

At issue here is a CEQA challenge to a quasi-legislative action recorded by Castaic in a December 23, 2004 Notice of Determination approving the project, certifying the 2004 EIR, and adopting findings, a mitigation monitoring program, and a statement of overriding considerations. This procedural setting, where no administrative hearing was held or required, is governed by traditional mandamus. In determining whether to grant a petition for traditional mandamus in a CEQA case, the court may consider only whether there was a prejudicial abuse of discretion. Public entities abuse their discretion under CEQA if the agency has not proceeded in a manner required by law or if its determination or decision is not supported by substantial evidence. Western States, 9 Cal.4th at 568; Pub. Res. Code §21168.5.[10]

This requires "scrutiny of the alleged defect" depending on whether the claim is predominately "improper procedure or dispute over the facts." Vineyard Area Citizens for

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[9]The Second District later dismissed Castaic's appeal from the Friends dismissal, finding that the voluntary dismissal was not appealable. *See* H.D. Arnaiz, Ltd. v. County of San Joaquin, (2002) 96 Cal.App.4th 1357, 1364-67.

[10]The standard of review for traditional mandamus in a non-CEQA case is governed by an "arbitrary and capricious" standard, not a "prejudicial abuse of discretion" standard. The CEQA standard is the more stringent inquiry. Western States, 9 Cal.4th at 574.

Responsible Growth v. City of Rancho Cordova, ("Vineyard") (2007) 40 Cal.4th 412, 435. Whether Castaic is the proper lead agency is an procedural issue of law for the court. PCL, 83 Cal.App.4th at 905-06. Similarly, as Petitioners argue (Pet. Supp. Resp. Br. at 5), whether Castaic's 2004 EIR failed to provide certain required information and, as a result, presents uncertainties about the finality of the Kern water transfer is failing "to proceed in a manner required by CEQA" and an issue of law. Vineyard, 40 Cal.4th at 435. These issues require "a critical consideration, in a factual context, of legal principles and their underlying values." Harustak v. Wilkins, (2000) 84 Cal.App.4th 208, 212.

On the other hand, whether Castaic abused its discretion in the 2004 EIR's findings must be answered with reference to the evidence in the administrative record. This standard requires deference to the agency's factual and environmental conclusions based on conflicting evidence, but not to issues of law. Laurel Heights Improvement Assn. v. Regents of University of California, ("Laurel Heights") (1988) 47 Cal.3d 376, 393, 409. Argument, speculation, and unsubstantiated opinion or narrative will not suffice.[11] Guidelines, 15384(a), (b). The findings must be supported by "substantial evidence," defined as "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached. CEQA Guidelines §15384(a). The question whether substantial evidence exists is a question of law. *See* California School Employees Association v. DMV, (1988) 203 Cal.App.3d 634, 644.

2. CEQA

The purpose of CEQA (Pub. Res. Code §21000 *et seq.*) is to maintain a quality environment for the people of California both now and in the future. Pub. Res. Code §21000(a). "[T]he overriding purpose of CEQA is to ensure that agencies regulating activities that may affect the quality of the environment give primary consideration to preventing environmental damage." Save Our Peninsula Committee v. Montery County Board of Supervisors, (2001) 87 Cal.App.4th 99, 117. CEQA must be interpreted "so as to afford the fullest, broadest protection to the environment within reasonable scope of the statutory language." Friends of Mammoth v. Board of Supervisors, (1972) 8 Cal.3d 247, 259. Public agencies must regulate both public and private projects so that "major consideration is given to preventing environmental damage, while providing a decent home and satisfying living environment for every Californian." Pub. Res. Code §21000(g).

The Legislature chose to accomplish its environmental goals through public environmental review processes designed to assist agencies in identifying and disclosing both environmental effects and feasible alternatives and mitigations. Pub. Res. Code §21002.

Under CEQA, a "project" is defined as any activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment (1) undertaken directly by any public agency, (2) supported through contracts, grants, subsidies, loans or other public assistance, or (3) involving the issuance of a lease, permit,

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[11]As an aid to carrying out the statute, the State Resources Agency has issued regulations called "Guidelines for the California Environmental Quality Act ("Guidelines"), contained in Code of Regulations, Title 14, Division 6, Chapter 3, beginning at section 15000.

license, certificate, or other entitlement for use by a public agency. Pub. Res. Code §21065. The word "may" in this context means a reasonable possibility. Citizen Action to Serve All Students v. Thornley, (1990) 222 Cal.App.3d 748, 753. "Environment" means the physical conditions which exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise, objects of historic or aesthetic significance. Guidelines, §21060.5.

The "project" is the whole of the action, not simply its constituent parts, which has the potential for resulting in either direct or reasonably foreseeable indirect physical change in the environment. Guidelines §15378. An indirect physical change must be considered if that change is a reasonably foreseeable impact which may be caused by the project. On the other hand, a change that is "speculative or unlikely to occur is not reasonably foreseeable." Guidelines §15064(d)(3). The term "project" may include several discretionary approvals by government agencies; it does not mean each separate government approval. Guidelines §15378(c).

The EIR is the "heart" of CEQA, providing agencies with in-depth review of projects with potentially significant environmental effects. Laurel Heights, 6 Cal.4th at 1123. An EIR describes the project and its environmental setting, identifies the potential environmental impacts of the project, and identifies and analyzes mitigation measures and alternatives that may reduce significant environmental impacts. Id. Using the EIR's objective analysis, agencies "shall mitigate or avoid the significant effects on the environment... whenever it is feasible to do so. Pub. Res. Code §21002.1. The EIR serves to "demonstrate to an apprehensive citizenry that the agency has in fact analyzed and considered the ecological implications of its actions." No Oil, Inc. v. City of Los Angeles, (1974) 13 Cal.3d 68, 86. It is not required to be perfect, merely that it be a good faith effort at full disclosure. Kings County Farm Bureau v. City of hanford, (1990) 221 Cal.App.3d 692, 711-12. A reviewing court passes only on its sufficiency as an informational document and not the correctness of its environmental conclusions. Laurel Heights, 47 Cal.3d at 392. An EIR will be upheld if it suffices as an informational document; mandate will issue only if it fails to include relevant information which precludes informed decision-making and informed public participation.

"Choosing the precise time for CEQA compliance involves a balancing of factors. EIRs... should be prepared as early as feasible in the planning process to enable environmental considerations to influence project program and design and yet late enough to provide meaningful information for environmental assessment." Guidelines, §15004(b). As a general rule, public agencies shall not undertake actions concerning a proposed project that would have a significant adverse effect or limit the choice of alternatives or mitigation measures before completion of CEQA compliance. Guidelines, §15004(b)(2). "[I]n order to achieve the salutary objectives of CEQA the determination of the earliest feasible time to [prepare the CEQA document] is to be made initially by the agency itself, which decision must be respected in the absence of manifest abuse." Mount Sutro Defense Committee v. Regents of University of California, (1978) 77 Cal.App.3d 20, 36, 40.

E. Analysis

CWIN and PCL argue that DWR is required to be the lead agency for the Monterey Amendments project EIR, which will examine all water transfers on a program level. The Kern

water transfer is part of the Monterey Amendments project. Therefore, DWR is the correct lead agency to conduct the environmental review of the Kern water transfer. According to Petitioners, while Castaic may not serve as the lead agency for "first-level" environmental review of the water transfer, it may serve as lead agency for a project level EIR for the Kern water transfer.

1. Validity of the Transfer

At the outset, the court must make clear an issue greatly discussed at hearing. Petitioners contend, and Castaic and Wheeler Ridge strongly dispute, that DWR may "invalidate" the Kern water transfer when it performs the program EIR.

Under contract and validation law, the Kern water transfer contract, entered into in 1999, is valid, has been approved by DWR, and Castaic has paid Wheeler Ridge for it. Neither the parties nor DWR can terminate the Kern transfer contract. Nothing in CEQA permits a public agency to void a contract.

In Kenneth Mebane Rranches v. Superior Court, (1992) 10 Cal.App.4th 276, a flood control district sought to condemn land outside its territory in order to mitigate the environmental impact of a project within its boundaries. The appellate court held that CEQA only requires mitigation of environmental impacts where it is feasible to do so. Where mitigation is infeasible, an agency can always approve a project notwithstanding environmental impacts if it issues a statement of overriding interests. But it cannot take actions that are not legal, and hence infeasible. 10 Cal.App. at 291-92.

Thus, in evaluating the environmental effects of the Monterey Agreement, DWR may impose mitigations that are legal. But it cannot invalidate the Kern transfer. The imposition of illegal mitigations would be infeasible. *See also* Pub. Res. Code §21004 (in mitigating significant environmental impact, agency may only employ powers provided by law).[12]

This does not mean that DWR's Monterey Amendments EIR cannot affect the Kern water transfer. DWR's EIR will consider the environmental impacts of the Kern water transfer in conjunction with the Attachment E transfers which the parties in Monterey Plus agreed were completed and final. DWR conceivably could conclude that these transfers have significant environmental impacts. As a consequence, DWR might have to impose feasible mitigation measures, adopt alternatives, or make a finding of infeasibility and adopt a statement of overriding considerations.[13] If mitigations/alternatives are adopted, they could significantly impact Castaic and Wheeler Ridge. As DWR states, "the contract amendments that effectuated the transfers under the Monterey Amendment[s] do not preclude DWR in its choice of

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[12]The parties disagree on whether the Monterey Amendments are valid and final. That is, they disagree on whether the amendments can be challenged in a reverse validation action separate and apart from CEQA. Resolution of this issue is unnecessary to the court's decision.

[13]At hearing, Petitioners' counsel stated that the parties to Monterey Agreement entered into a joint statement of the possible impacts from the Amendments, citing AR 48628-29. The joint statement at those pages of the record does not discuss possible mitigations; it merely summarizes the terms of Monterey Plus.

alternatives in the Monterey Amendment[s] EIR or mitigation measures that may need to be imposed to reduce significant impacts to less than significant." DWR Br. at 20. DWR gives an example of reducing the amount of SWP water to protect water quality standards for fish in the Delta. Id. at 20. These mitigations could undermine the Kern water transfer.[14] But DWR will not be considering whether the Kern water transfer is valid; it simply does not have the authority to void that transfer. *See* Kenneth Mebane Ranches v. Superior Court, (1994) 10 Cal.App.4th 276, 292.

2. Lead Agency Law

The lead agency under CEQA is the agency that carries out a project or has primary authority for approving a project. Pub. Res. Code 121067; Guidelines §15051; *see* PCL, 83 Cal.App.4th at 904 (DWR, not Central (a State Water Contractor), had principal responsibility for carrying out the Monterey Agreement and should have been lead agency for program EIR). The role and responsibility of the lead agency is "fundamental to the CEQA process as a whole." Guidelines §15050. The identification of the proper lead agency plays a "crucial role" in the division of responsibilities among public agencies reviewing a project. PCL, 83 Cal.App.4th at 903. When determining the appropriate lead agency, the courts look to determine which agency has principal responsibility for the core project activity. Friends of Cuyamaca Valley v. Lake Cuyamaca, (1994) 28 Cal.App.4th 419, 427. The lead agency responsibility is placed upon the agency with power to approve or disapprove the project. Lexington Hills v. State of California, (1988) 200 Cal.App.3d 415, 433. Though one agency has substantial responsibility for a project, it cannot act as lead agency if another agency bears final responsibility. *See* Fullerton Joint Union High School District v. Board of Education, (1982) 32 Cal.3d 779, 795, n.15 (State Board of Education, not county, had final responsibility for school district plan). Where the project is local, such as land use decisions, the agency that has general governmental power over a project is almost always the lead agency. Where two or more agencies are involved in a project, the agency that will carry out the project shall be the lead agency. Guidelines §15051(a).

3. The Impact of the PCL Decision

Petitioners contend that the PCL decision left no doubt that DWR is the appropriate lead agency for a program-level environmental review of the water transfers in the Monterey Agreement, contrasting DWR's statewide expertise with CCWA's "provincial experience." The Monterey Amendments restructure water distribution throughout the state, and the "allocation of water to one part of the state has potential implications for distribution throughout the system." Only DWR has principal responsibility for implementation of the Monterey Amendments. Op. Br. at 11-12; *see* PCL, 83 Cal.App.4th at 904, 908. Since the Kern water transfer is part of the Monterey Amendments, DWR must perform any EIR concerning the Kern water transfer.

Petitioners' argument is a *non-sequitur*. Nothing in PCL requires DWR to perform the environmental review for the Kern water transfer. Certainly, the PCL decision requires that DWR prepare the program EIR for the Monterey Amendments, now Monterey Plus. The

[14]The close cooperation between DWR and Castaic on the 2004 EIR reduces, but does not eliminate, the prospect that DWR will impose alternatives or mitigations.

appellate court's reason for committing this task to DWR is that CEQA requires the lead agency to be the agency with principal responsibility for the project, the project is the environmental review of the Monterey Agreement, and DWR, not CCWA, has principal responsibility for implementing the Monterey Agreement. The decision pointed out that DWR manages the SWP, and has the statewide expertise and perspective to conduct the environmental review of the Monterey Agreement, which statewide project. While CCWA may have had a substantial stake in seeing the Monterey Agreement implemented, it did not have principal responsibility for it. DWR did, and DWR is required to perform the EIR for the Monterey Agreement. 83 Cal.App.4th at 906.

However, the PCL decision does not commit DWR to conduct the EIR for the Kern water transfer, or for any site specific project conducted pursuant to the Monterey Amendments. The PCL decision plainly requires DWR to prepare the program EIR for the Monterey Amendments, and its permanent transfer of 130,000 acre feet of SWP water. But it does not even mention the Kern water transfer, which is a local water transfer of Wheeler Ridge water to a point 60 miles further south in Santa Clarita Valley. The local nature of the project makes Castaic the logical choice to act as lead agency of this transfer, and nothing in PCL requires Castaic to wait for DWR's program EIR. The Kern water transfer is simply a different project from the Monterey Amendments.

Petitioners' concession that at some point Castaic can and should act as the lead agency for the Kern water transfer EIR undermines their argument that PCL committed this task to DWR. The concession shows that Petitioners really are concerned about the timing of this project specific EIR, and not whether it was committed to DWR in the PCL decision. Petitioners contend that Castaic must wait for DWR's Monterey Amendments program EIR and tier off of it for the Kern water transfer EIR. This argument is, as Castaic describes it, that Castaic "jumped the gun" by preparing the 2004 EIR. But the argument implicitly concedes that PCL did not commit the transfer EIR to DWR.

4. The Agency with Principal Responsibility

Even if PCL did not commit environmental review of the Kern water transfer to DWR, Petitioners argue that the Kern water transfer is an integral part of the Monterey Amendments project. This is shown by Monterey Plus, which excludes the Kern water transfer from the list of transfers designated as "final" and recognizes DWR's responsibility to assess its environmental impacts as part of the programmatic review. The Kern water transfer contract itself expressly relies on the Monterey Amendments, using its provisions as authority to accomplish the Kern water transfer. Even Wheeler Ridge's amendment to its SWP contract identifies the outcome of PCL as a factor that could impact the Kern water transfer's effectiveness. All of these facts, Petitioners argue, mean that the transfer is part of the Monterey Amendments environmental review.

Petitioners further argue that the nature of a program EIR supports their position. This purpose "is to document a series of actions so related they can be characterized as one project." Friends, 95 Cal.App.4th at 1377. The Monterey Amendments, including its transfer provisions, qualify as a "series of actions so related that they can be characterized as one project." An integrated review of the entire program may provide occasion for a more exhaustive

consideration of effects and alternatives than would be practical in an EIR on an individual action, ensure consideration of cumulative actions that might be slighted on a case-by-case analysis, avoid duplicative reconsideration of basic policy considerations, and allow the lead agency to consider broad policy alternatives and program-wide mitigation measures at an early time when the agency has greater flexibility to deal with basis problems or cumulative impacts. Id. at 1377. These factors are all borne out by the 2004 EIR, which presents a series of issues (the amount of supplies available to several water agencies, the location and timing of SWP deliveries, and use of SWP conveyance and storage facilities) on which DWR has superior expertise and greater accountability than Castaic. DWR may not delegate to Castaic its responsibility to prepare the environmental review for the Kern water transfer.

Under lead agency law, Castaic may act as lead agency and prepare an EIR for the Kern water transfer. The Kern water transfer is a project separate in time from the Monterey Amendments, now Monterey Plus. The core of the project is a local transfer of water between Castaic and Wheeler Ridge. Castiac alone had the responsibility to determine the water needs of its service area and to obtain the necessary water for those needs. Castaic negotiated and entered into the transfer contract with Wheeler Ridge. Castaic performed the contract by obtaining private investors who paid $47 million to Wheeler Ridge's water, and by taking delivery from DWR. The transfer is valid and cannot be challenged. Thus, Castaic has the general governmental power over the transfer, and is presumptively the lead agency for its own project. Bakman v. Dept. of Transportation, (1979) 99 Cal.App.3d 665, 678-79. Indeed, the environmental review of water transfers is generally performed by a local, not state, agency. County of Amador v. El Dorado County Water Agency, (1999) 76 Cal.App.4th 931 (local agency's analysis of water transfer project); Save Our Carmel River v. Monterey Peninsula Water Management District, (2006) 141 Cal.App.4th 677, 701 (city was lead agency as recipient of water transfer); Friends of the Eel River v. Sonoma County Water Agency, (2003) 108 Cal.Appp.4th 859 (local agency's EIR for plan to increase diversions of water from river); Sierra Club v. West Side Irrigation District, (2005) 128 Cal.App.4th 690 (local agency's environmental review of two projects to transfer water rights).[15]

It is true that DWR has an overall interest in promoting effective water management on a statewide basis. Pursuant to this interest, DWR had the right to approve the Kern water transfer, and it did so. This does not equate to principal responsibility, however. DWR is required by statute to "facilitate" the voluntary transfer of water between local agencies. Water Code §109.

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[15]The Friends court implicitly decided that Castaic may act as lead agency for the Kern water transfer. The Friends court acknowledged that it was required to address all deficiencies in the EIR unless it made a finding of improper lead agency. Pub. Res. Code §21005(c). If Castaic was the improper lead agency for the 1999 EIR, the appellate court was obligated to say so. The Friends court concluded that the 1999 EIR's only deficiency was that it tiered from the defective Monterey Agreement program EIR. Thus, the decision necessarily implied that Castaic was the proper lead agency for the 1999 EIR.

Of course, this case concerns the 2004 EIR, not the 1999 EIR, and the court previously held that Petitioners were not bound by the Friends court's implied determination. But the project is the same, and the implicit appellate determination is entitled to weight.

Per the SWP contracts, DWR's approval of the Kern water transfer could not be unreasonably withheld. Thus, DWR's involvement in the transfer is to facilitate the transfer by approving it and providing the SWP schedule delivery. Moreover, the SWP is intended as a supplement, not the exclusive supply, of water. Water supply decisions must be made by local Water Contractors, who obtain water both from SWP and other sources.[16]

Given that the decision to enter into the Kern water transfer belonged solely to Castaic and Wheeler-Ridge, and that DWR's approval is necessary merely to facilitate the transfer, Casataic had principal responsibility for the transfer.[17]

5. Project Definition

Petitioners contend for the first time in their Supplemental Vineyard Reply and at oral argument that the correct project definition is not the Kern water transfer, but is really the Monterey Amendments, citing the court's earlier ruling on Castaic's motion for legal determination that the key issue is whether the Amendments are a "series of actions (including the Kern water transfer) so related that they should be characterized as a single project." Pet. Supp. Reply at 5.

The correct definition of the project -- whether it is the Monterey Amendments or the Kern water transfer -- is a different issue than whether Castaic can act as lead agency for the project. Although the court did allude to project definition in ruling on the earlier motion, Petitioners never raised this issue in their opening brief or reply. Instead, they raise it for the first time in a reply brief on the application of Vineyard to this case. On appeal, an issue raised without analysis or authority lacks foundation and need not be addressed. City of Arcadia v. State Water Resources Control Board, ("Arcadia") (2006) 135 Cal.App.4th 1392, 1429, 1431. Similarly, an issue raised for the first time in supplemental reply deprives the opposing party of an opportunity to analyzing the issue and defend their position. Petitioners have waived the correct project definition as an issue by not raising it earlier.

Assuming *arguendo* that the issue has not been waived, a project under CEQA includes an activity directly undertaken by a public agency which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment. Pub. Res. Code §21065(a). The "project" must be broadly defined, so as to ensure against avoiding environmental review by "chopping a larger project into little ones" or "piecemealing." Bozung v. Local Agency Formation Commission, (1975) 13 Cal.3d 263, 283-84. The project includes "the whole of an action" that has a potential for resulting in a direct or indirect physical change in the environment. Guidelines §15378. An accurate project description is necessary for an intelligent evaluation of the potential environmental effects of a

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[16]As Wheeler Ridge points out, DWR was not the lead agency for the 1991 Devils Den transfer or any of the Attachment E transfers listed in the Monterey Agreement.

[17]Given that DWR's approval may not be unreasonably withheld, cases holding that a state agency should prepare the EIR where it has final authority to approve a project are simply inapposite. *See* Fullerton v. State Board of Education, (1982) 32 Cal.3d 779, 795, n.15 (State Board of Education had final authority to submit plan to voters for new unified school district).

proposed activity. Mcqueen v. Board of Directors, (1988) 202 cal.App.3d 1136, 1143. The agency must avoid "piecemealing" or splitting a project into two or more segments. Otherwise, the cumulative environmental impacts of each piece may not be fairly analyzed. Burbank-Glendale-Pasadena Airport Authority v Hensler, (1991) 233 Cal.App.3d 577, 592. On the other hand, CEQA was not intended to and cannot reasonably be construed to make a project of every activity of a public agency, regardless of the nature and objective of such activity...." Simi Valley Recreation & Park District v. Local Agency Formation Commission, (1975) 51 Cal.App.3d 648, 663.

In San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus, (1994) 27 Cal.App.4th 713, 731-32, the court held that the project description in an EIR was improperly restricted to a 633 single family residential units, a 40,500 square foot commercial center, and a 14 acre park, failing to include sewer expansion which the EIR acknowledged would be required as part of the development. Although a separate EIR was prepared for the sewer expansion, neither it nor the development project EIR referred to the growth-inducing effects of the two projects considered together. This failure to address cumulative impacts was a separate failure of the development EIR. 27 Cal.App.4h at 733. "[t]he danger of filing separate environmental documents for the same project is that considration of the cumulative impact on the environment of the two halves of the project may not occur. This danger was here realized." Id. at 734 (citation omitted). Because the EIR did not "adequately apprise all interested parties of the true scope of the project for intelligent weighing of the environmental consequences of the project" informed decision-making was precluded, the EIR was inadequate. Id.

The lesson from San Joaquin and other project definition cases is that the project should be defined broadly to ensure a complete analysis of impacts resulting from future expansion or continuation of other phases of the project.

In this case, DWR is the lead agency for the Monterey Amendments program EIR. DWR's description of its project is to improve the management of SWP supplies and operations through the Monterey Amendments. Thus, the Monterey Amendments EIR is broad in scope. The EIR will look at changing the allocation of all SWP water supplies (including deletion of agriculture first shortage provisions), retiring 45,000 acre feet of agricultural water, and establishing more efficient use of SWP facilities. As part of the analysis, it will analyze the potential impacts from permanently transferring 130,000 acre feet of water from agricultural to urban contractors per the Monterey Agreement. This analysis will look at the individual transfers, including the Kern water transfer, as they fit the entire Monterey Amendments. But DWR does not intend to consider each transfer individually; it intends to evaluate the impact of all the Attachment E transfers and the Kern water transfer as a whole. DWR Br. at 17.

Castaic's 2004 EIR project description concerns the impacts of the Kern water transfer alone. Castaic's EIR does look at cumulative impacts of the project with other projects, including the Monterey Amendments, but does not purport to assess the environmental impacts of the Monterey Amendments independent of the Kern water transfer. AR 141-42.

Castaic relies on the independent utility test to argue that the Kern water transfer is a separate project the environmental impact of which may be separately analyzed from the Monterey Amendments. The "independent utility" test has been developed in NEPA cases to determine whether multiple actions are connected so as to require an agency to consider them in

a single environmental review. Wetlands Action Network v. United Sates Army Corps. Engineers, (9th Cir. 2000) 222 F.3d 1105, 1118.[18] Pursuant to the independent utility test, where each of two projects would have taken place with or without the other, each has "independent utility" and the two are not considered so connected that an agency must consider them in a single environmental review. Native Ecosystems Council v. Dombeck, (9th Cir. 2002) 304 F.3d 886, 894. *See also* DelMar Terrace Conservancy, Inc. v. City Council of the City of San Diego, (1992) 10 Cal.App.4th 712 (freeway segment was separate project serving a viable purpose even if long-term, multi-segment plan to expand freeway never occurred, and had independent utility under CEQA).

Castaic argues that it has contemplated the Kern water transfer since 1988, when it included a transfer with Kern in its 1988 Capital Program for the Santa Clarita Valley's future water needs. For economic reasons, Wheeler Ridge, too, sought to transfer its SWP water rights since approximately 1985. Castaic concludes that the Kern water transfer would have occurred with or without the Monterey Amendments. Articles 40 and 41 of the SWP contract permitted transfers between Water Contractors, subject to DWR approval. Article 53, added to the SWP contracts by the Monterey Amendments and concerning the transfer of 130,000 acre-feet, did not "enlarge, restrict, or otherwise impact" Castaic's right to acquire water from Wheeler Ridge under Articles 40 and 41. Instead, it was merely a blanket approval of certain contemplated transfers. Castaic Op. Br. at 21. The Kern water transfer was completed, paid for, and operating since 1999. Nothing about it is tied to the outcome of the Monterey Amendments. Thus, while the transfer is part of a larger scheme (the Monterey Amendments), it is a long-planned site specific project with independent utility from the Monterey Amendments.

The court cannot conclude that the Kern water transfer would have taken place without the Monterey Amendments. True, Castaic has wanted Wheeler Ridge's SWP allocation of water since the late 1980's, and Wheeler Ridge was willing to provide it. Yet, it did not happen until after the Monterey Amendments. The contract between Castaic and Wheeler Ridge states that the transfer was taking place "in accordance with" Article 53 of the Monterey Amendments, and those Amendments change the way SWP water is allocated in California. It does not say that the transfer is being made under Article 41. Petitioners contend, and the court agrees, that only through conjecture can one conclude that Castaic and Wheeler Ridge would have entered into the transfer without the Monterey Amendments, and with Article 18's agriculture first provisions in place.[19]

Though the court cannot conclude that the Kern water transfer would have occurred without the Monterey Amendments, it can conclude that the transfer will remain in effect even if the Monterey Amendments are not approved or otherwise are mitigated under CEQA. The court

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[18]Since CEQA was modeled on the federal NEPA statute, federal decisions on NEPA are persuasive authority on CEQA issues. No Oil, Inc. v. Los Angeles, (1974) 13 Cal.3d 68, 86.

[19]When Petitioners commented on the draft EIR that any pre-Monterey Amendments transfer would be subject to Article 18's agriculture first provisions, Castaic did not say that the Kern transfer would have occurred without the Monterey Amendments. It merely responded that the transfer "could occur" either pre- or post- Monterey Amendments. AR 993.

already has indicated that the Kern water transfer is final. The parties to the transfer stated at hearing that they have no intention of rescinding it even if the Monterey Amendments are mitigated and Article 18's agriculture first provisions are in effect. This position is supported by the fact that the 2004 EIR evaluates the water supply impacts of just such a pre-Monterey Amendment Article 18 scenario. AR 186. As such, it is compelling evidence that the transfer will stand.[20]

Plainly, then, the Kern water transfer is final and will remain in place whatever happens to the Monterey Amendments. As such, the transfer has "independent utility" for purposes of environmental review. It is not so connected to the larger Monterey Amendments that the two must must be considered in a single environmental review. *See* Native Ecosystems Council v. Dombeck, 304 F.3d at 894.

6. EIR Timing

Petitioners' real argument seems to be that, whenever a program EIR is anticipated, the agency preparing an EIR for a specific project must wait for the program EIR.

This is not the law. Nothing in CEQA requires Castaic to wait for DWR's program EIR. Indeed, as a general proposition, the environmental review process should be undertaken early enough in the planning process to impact planning decisions, with the timing committed to the agency's discretion. City of Vernon v. Board of Harbor, (1988) 63 Cal.App.4th 677, 690-91. The Kern water transfer occurred almost eight years ago. It has been paid for and operating for a number of years. Castaic tried to conduct a timely environmental review, but that EIR was set aside in Friends. It is not an abuse of discretion for Castaic to want to complete the environmental review and obtain finality for the transfer without waiting for DWR's program EIR of the Monterey Amendments, now Monterey Plus.

Nor does this decision frustrate the law concerning program EIRs and tiering. The purpose of a program EIR is to document a series of actions so related that they can be characterized as one project. Friends, 95 Cal.App.4th at 1377. If the program EIR is sufficiently comprehensive, the lead agency may dispense with further environmental review for later activities within the program that are adequately covered in the program EIR. Guidelines §15618(c). Thus, the program EIR may be used to focus or simplify later environmental review, or as the basis of a tiered EIR. "Tiering" means the coverage of general matters and environmental effects in an EIR prepared for a policy, plan, program or ordinance, followed by narrower or site-specific EIRs which incorporate by reference the discussion in the prior report. *See* Pub. Resources Code §§ 21068.5, 21093 and Guideline §§ 15152, 15385. Tiering is favored "whenever feasible, as determined by the lead agency." Pub. Resources Code §21093(b). It is required where a prior EIR has been prepared and certified for a program, plan, or ordinance. Pub. Resources Code §21094(a). However, tiering is only required "where a prior environmental report has been prepared and certified for a program." Friends, 95 Cal.App.4th at 1383. It is not required, and in fact is prohibited, where the program EIR has yet to be prepared. Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova, ("Vineyard") (2007) 40 Cal.4th 412

[20]Petitioners think so too, for their principal argument is premised on the 2004 EIR's assumption that the transfer is final for all purposes.

EIR cannot tier off of *future* environmental document).

7. Vineyard

In Vineyard, the Supreme Court addressed a county prepared EIR for a large land use development project known as "Sunrise Douglas." The principal issue was the availability of long-term water supply for the project, and the environmental impacts and mitigation for such supply. The Supreme Court analyzed the various water supply cases and distilled several principles. First, the EIR for a land use project must present sufficient facts to evaluate the pros and cons of supplying the amount of water the project will need, and not simply ignore or assume a water supply solution will be found for a development project. Second, an adequate EIR for a large project must show water supply for the entire project. It is not enough to show available water for early stages. While the agency may tier and defer analysis of certain details of later phases of long-term or complex projects, deferring analysis through tiering is appropriate when the impacts or mitigation measures are not determined by the first-tier approval and are specific to later phases. Third, the future water supplies identified and analyzed must bear a likelihood of actually being available. Finally, where there is some uncertainty about availability, CEQA requires some discussion of possible replacement sources or alternatives, and their environmental consequences.

Of particular use herein, the Supreme Court discussed the EIR's reliance on an anticipated local Water Board's master plan update, which would discuss the availability of long-term water supplies to the area and their environmental impact. The Court held that the county's EIR cannot tier from a *future* environmental document. If the environmental analysis from the Water Board's anticipated master plan update was important to understanding the long-term water supply for Sunrise Douglas, it should have been performed in the Sunrise Douglas EIR even though that might result in subsequent duplication by the Water Board's master plan update. Or, the county could have deferred analysis and approval of Sunrise Douglas until the Water Board's master plan update, then tiered the Sunrise Douglas EIR from the programmatic analysis performed by the Water Board.

The Vineyard decision shows that the timing of Castaic's project specific EIR in relation to DWR's program EIR is up to Castaic. It may either wait for DWR's program EIR and tier off of it, or prepare its own EIR for the Kern water transfer first. If it chooses the latter, Castaic may not tier off an environmental document that does not yet exist. Instead, Castaic must analyze all necessary environmental impacts and mitigations. If analysis of some portion of the Monterey Amendments is important to understanding the environmental impacts of the Kern water transfer, then analysis of that issue must be included in Castaic's EIR. But if Castaic's EIR does so, it is irrelevant that the document duplicates some of what DWR would do, or even that it may be inconsistent with DWR's analysis.[21] As DWR contends, CEQA's goal is to ensure sufficient information; it contains no prohibition against too much information. DWR Br. at 21. The timing of Castaic's EIR for the Kern water transfer is up to Castaic and Castaic alone.

[21] As previously stated, the prospect of inconsistencies between Castaic's EIR and DWR's program EIR is diminished by Castaic's use of DWR modeling, DWR's comments and input into the 2004 EIR, and the general cooperation and coordination between the two agencies.

F. Contents of the 2004 EIR

Apart from the proper lead agency, Petitioners argue that the 2004 EIR is inadequate. Initially, the court believed that Castaic could have real problems on this issue. It is one thing for Castaic to act as lead agency on a water transfer before the program EIR is prepared; Vineyard and other case law say that Castaic may do so. But the EIR must be adequate and complete. Vineyard teaches that if analysis of some portion of the Monterey Amendments is important to understanding the environmental impacts of the Kern water transfer, then that analysis must be included in Castaic's EIR. PCL held that the "no project" alternative was particularly important for the Monterey Amendments, and the public was entitled to know what would happen if the Amendments were not approved and Article 18 was implemented in the event of water shortage. Commentators particularly wanted to know whether imposition of Article 18 might eliminate the "paper water" entitlements in the water contracts, reduce land planning decisions based on that paper water, and ultimately reduce growth and construction of additional SWP facilities. PCL, 83 Cal.App.4th at 892-3.

The court wondered whether Castaic would have the expertise to perform any analysis of the Monterey Amendments or the "no project" alternative that would be required in the 2004 EIR. However, the parties' briefs, and oral argument at hearing, have demonstrated that, with one exception, the 2004 EIR's contents are sufficiently presented. Indeed, Petitioners barely criticize the 2004 EIR's adequacy, except as it impacts the lead agency issue.

1. "Deception"

Petitioners' principal argument about content is that the 2004 EIR is deceptive in failing to make clear that the Kern water transfer is not "final." They contend that the 2004 EIR's project definition treats the Kern water transfer as an immutable *fait accompli* which fails to disclose that the "final status" of the transfer depends on the DWR's forthcoming review. According to Petitioners, the EIR improperly relies on the interim availability of the water to predict that DWR will "leave it in place," a point which the court in California Oak Foundation v. City of Santa Clarita, ("California Oak") (2005) 133 Cal.App.4th 1219, 1238, n.16 had no trouble dispatching, and also improperly states that it would be unnecessary and speculative to consider what the DWR might do to change the transfer (*See* AR 994). Pet. Op. Br. at 19-20. This false assumption that the transfer is immutable may result in land use decision-makers approving projects based on water availability "worth little more than a wish and a prayer." Id. at 20-21.

The court has determined that the transfer is final as a matter of law. Therefore, the EIR is not wrong in saying so. What Petitioners really contend is that the Kern water transfer, though final, can be affected by the DWR's program EIR through mitigations and imposition of alternatives. Yet, the EIR proceeds as if the transfer cannot be altered. As counsel described the issue at hearing, the 2004 EIR "talks about risk, but never directly informed the public about the fact that the transfer may be unwound through the Monterey Amendment EIR process." Thus, the EIR refers to the transfer as of an "*existing* 41,000 " acre feet of SWP Table A water (AR 15, 35) and states that "no permits or *other approvals* would be required other than" certification of the

EIR. AR 16.[22]

The EIR is the method for disclosure of environmental issues. Rural landowners Assn. V City Council, 43 Cal.App.3d 1013, 1020. CEQA's purpose is to compel agencies to make decisions with environmental consequences in mind, but CEQA does not and cannot guarantee that these decisions will always favor environmental concerns. Laurel Heights, 47 Cal.3d at 393. The EIR should provide sufficient analysis to allow decision-makers to make intelligent judgments about environmental consequences. Guidelines §15151. The evaluation of environmental effects need not be exhaustive, but the EIR's sufficiency is reviewed in the light of what is reasonably foreseeable. Id. Perfection is not required, but adequacy, completeness, and a good faith effort at full disclosure is. Id.

In California Oak, the court addressed the proposed development of a 584 acre industrial park project in the Santa Clarita. The City's EIR relied on the Kern water transfer for water supply, and the appellate court held that it did not adequately address the uncertainty in that water delivery. 133 Cal.App.4th at 1236. The City's comments "did little more than dismiss project opponents' concerns about water supply" and the EIR failed to discuss the adequacy and availability of water supply absent the Kern water transfer. Appendix K to the EIR did acknowledge uncertainty in the Kern water transfer, but this was insufficient in part because inforamtion "scattered here and there in EIR appendices" or a report "buried in an appendix" is not a substitute for good faith reasoned analysis. Id. at 1239 (citation omitted). Moreover, Appendix K contained no facts and analysis about the likelihood of deficit or alternative sources of supply, and was misleading about the fact that Castaic had an SWP "entitlement" without explaining that the entitlement consisted in part of "paper water." Id. at 1239-40. Hence the EIR failed as an informational document on water supply issues.

Castaic contends, and the other Respondents agree, that the 2004 EIR fully addresses the uncertainty of what DWR will do. At hearing, they contended that Petitioners really are arguing that the 2004 EIR is misleading because it does not anticipate Petitioners' argument.[23]

The EIR explains that planning for water supply to meet demands requires consideration of reliability of SWP supplies, because historical and statistical analysis show that the full Table A amount will not be available in some years. AR 41. The EIR explains that Castaic's Table A amount is the maximum SWP amount, and the amount of SWP water actually available to it varies from year to year. Id. The EIR acknowledges that DWR's allocations are based on that year's hydrological conditions, the amount of water stored in the SWP system, and contractor requests for water. AR 16. The EIR discusses the Monterey Agreement (AR 46-47), PCL and Monterey Plus. AR 17-18, 47. The EIR cautions land use planners who might rely on the EIR to predict future water supplies, that while Castaic will implement all feasible measures to obtain water "past water deliveries are not a guarantee of future delivery rates." AR 13.

The EIR considers the environmental impact of the project based on water allocation

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[22]At trial, Petitioners' counsel made plain that this issue of deception is distinct from the reliability of water delivery by DWR.

[23]Respondents' contention sounds like an argument that Petitioners failed to exhaust their administrative remedies. However, no failure to exhaust claim was made in their briefs.

scenarios of pre-Monterey Amendments without Article 18 cutbacks, pre-Monterey Amendments with Article 18 cutbacks, and post-Monterey Amendments. AR 56. The EIR argues that the project could have been authorized under Article 41, but instead was implemented under Article 53 of the Monterey Agreement. It adds that DWR is preparing a new EIR for the Monterey Amendment.

Since the Monterey Amendments change the way in which SWP water is allocated among contractors, the 2004 EIR provides three separate analyses of the project's impacts to water supply. AR 186-89. The EIR goes to great lengths to discuss the uncertainties in the Article 18 allocations. AR 187-89. For each scenario, the EIR estimates reliability based on wet, dry, and extended dry year conditions. AR 183-91. The EIR addresses direct impacts to water supply and water quality under the three water allocation scenarios. AR 202-05. It discusses indirect impacts from the growth-inducing effect of the project, and mitigations of these impacts through implementation of existing agency policies. AR 207-224. It discusses the cumulative impact of the project and other projects inside and outside the project area. AR 278-89. Finally, it addresses alternatives to the project, including a no project alternative. AR 293-300.

The EIR clearly demonstrates the variability of SWP deliveries, and covers what could happen as a result of the Monterey Amendments EIR. But Petitioners are correct that the EIR has a hole in it. The EIR does not directly explain that the project may be impacted by the outcome of the Monterey Amendments EIR. Instead, the 2004 EIR assumes there are three possible water delivery scenarios without any discussion of why or how they would occur: "Since the Monterey Amendments change the way in which SWP water is allocated among contractors, the 2004 EIR provides three separate analyses of the project's impacts to water supply." The reader is left to interpret how these allocations could come about, and must conclude on his or her own that they are three possible outcomes of challenges to the Monterey Amendments. Nor does the EIR explain how such challenges could cause these allocations to occur.

An EIR is an informational document which is supposed to provide the reader with the "analytic route the...agency traveled from evidence to action."Citizens of Goleta Valley v. Board of Supervisors, ("Goleta") (1990) 52 Cal.3d 553, 568. This means that the EIR must contain facts and analysis, not just the agency's bare conclusions or opinions. Castaic is not required to predict the outcome of litigation, and may not be able to discuss the likelihood of each of the three allocations. However, it should have at least explained why the three scenarios are relevant and how they would occur.[24] The failure to do so leaves the reader wondering why they are pertinent. Consequently, the 2004 EIR fails to provide the analytic route by which the three alternatives are relevant.

Non-compliance with the disclosure requirements of CEQA may constitute a prejudicial abuse of discretion regardless of whether the agency would have taken the same action had it complied with CEQA. Pub. Res. Code §21005(a). Still, CEQA is subject to the established principle that there is no presumption of prejudicial error. Pub. Res. Code §21005(b). Only if the manner in which the agency failed to follow the law is prejudicial must the decision be set aside. Sierra Club v. State Board of Forestry, (1994) 7 Cal.4th 1215, 1236.

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[24]For example, the court has no idea how a pre-Monterey Amendments without Article 18 cutbacks would occur.

The issue is whether Castaic's failure to supply the analytical route for its consideration of the three allocations is prejudicial. Prejudice depends on whether the failure to include this information makes "any meaningful assessment" of the project's environmental effects impossible, in which case prejudice is presumed. Sierra Club v. State Board of Forestry, (1994) 7 Cal.4th 1215, 1236 (agency approved timber harvesting plans without requiring necessary environmental information in them).[25] Even under this standard, not every CEQA failure is prejudicial. An EIR will be upheld if the error *de minimus* or clerical in nature (Save San Francisco Bay Association v. San Francisco Bay Conservation and Development Commission (1992) 10 Cal.App.4th 908, 935), the EIR analysis is comprehensive, if not perfect, despite the error (Schaeffer Land Trust v. San Jose City Council, (1989) 215 Cal.App.3d 612, 627-28), and information which should have been included to make the EIR accurate nonetheless has no material effect on informed decision-making or informed public participation (Al Larson Boat Shop, Inc. v. Board of Harbor Commissioners, (1993) 18 Cal.App.4th 729, 747-50).

The Vineyard court reiterated that the reviewing court must focus on the nature of the defect, depending on whether the claim is predominantly one of improper procedure or a dispute over facts. Where the agency has employed the correct procedures, greater deference is given to the agency's factual conclusions, which are reviewed for substantial evidence. 40 Cal.4th at 435.

The 2004 EIR's non-compliance concerns its analytic route – why and how the three allocations are pertinent. This is not a fact issue to be supported by substantial evidence. Instead, it is a failure affecting the public's ability to make a "meaningful assessment" of the project's environmental effects. As such, it is prejudicial. *See also* Rural Land Owners Assn. v. Lodi City Council, (1983) 143 Cal.App.3d 1013, 1023 (whenever failure to comply with CEQA results in a subversion of its purposes by omitting information from the environmental review process, the error is prejudicial).[26]

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[25]One appellate court, Resource Defense Fund v. Local Agency Formation Commission, (1987) 191 Cal.App.3d 886, 897-98 has stated that "[f]ailure to comply with CEQA is necessarily prejudicial." This does not appear to be the consensus approach. *See* Dusek v. Anaheim Redevelopment Agency, (1985) 173 Cal.App.3d 1029, 1040-42 ("a minor CEQA sin or two" constituting technical defects where the public had not been misled or defrauded is not enough for prejudice).

[26]Petitioners also argue that the 2004 EIR finesses the non-final nature of the project by jumping the gun and analyzing pre-Monterey Amendments. According to Petitioners, Castaic performed a "mini-programmatic review" at AR 155-06 and App. D (AR 468-550). The charts at AR 184 and 506 show this. According to Petitioners, this is not just factual overlap; this is usurpation of DWR's responsibilities.

DWR correctly points out that Petitioners are complaining about too much information, something that CEQA does not proscribe. Petitioners have no complaint about the content of the mini-program review. To the extent that Castaic performed a task that DWR is obligated to perform, DWR may either use Castaic's analysis or perform a new one. The cooperation of DWR and Castaiac suggests that the overlapping environmental analysis will be consistent. Even if inconsistent, DWR's analysis will control for the Monterey Amendments. There is no

2. Modeling

Petitioners contend that Castaic used an obsolete DWR model, DWRSIM, for making predictions about the amount of SWP water that could be available as a result of the Kern water transfer. DWR has used CALSIM II for modeling SWP deliveries since 2000. While the EIR uses CALSIM II to look at the environmental setting, it only uses DWRSIM to look at environmental impacts. According to Petitioners, Castaic's rationale for doing so -- that DWRSIM should be used for the 1998 environmental setting -- makes no sense. Modeling is for future results, not historical analysis.

Petitioners argue that Castaic's use of an old model prejudicially overstates the reliability of SWP water delivery. App.D, Table 2-2 compares the projected 2020 deliveries based on the two different models. AR 493. The graph shows a discrepancy between the two models, particularly in the 50-70% supply range, and most glaringly in the range of drought conditions. Although the EIR does not quantify these differences, Castaic's responses to public comments presents a table that does. The table shows that the two models can differ by as much as 5000 acre-feet. Pet. Op. Br. at 23. According to Petitioners, this is not the "slight discrepancy" DWR states it is.

When a challenge is brought to studies on which an EIR is based, "the issue is not whether the studies are irrefutable or whether they could have been better. The relevant issue is only whether the studies are sufficient credible to be considered as part of the total evidence that supports the" agency's decision. Laurel Heights, 47 Cal.3d at 409 (lead agency entitled to choose and rely on expert opinion even though others may disagree). Expert testimony constitutes substantial evidence and an agency is entitled to rely on it. Uhler v. City of Encinitas, (1991) 227 Cal.App.3d 795, 805. Even where experts disagree, the agency is entitled to choose one expert's opinion over another. Laurel Heights, 47 Cal.3d at 409. The party challenging the EIR bears the burden of demonstrating that the studies on which the EIR is based "are clearly inadequate or unsupported." State Water Resources Control Board Cases, (2006) 136 Cal.App.4th 674, 795.

CEQA requires Castaic to reasonably inform the reader about the amount of water available. The EIR states that all environmental impacts from the project are driven by the amount of water delivered and the timing of delivery. AR 55. Castaic analyzed the amount of SWP water available for delivery through hydrologic modeling with computer simulations that predict the amount of water available under various hydrologic conditions. To do so, the EIR, like all EIR's had to have an environmental setting for the project. This environmental setting describes the conditions of the project as they exist at the time the Notice of Preparation is published or, if there is none, at the time the environmental analysis is commenced. This setting will normally constitute the baseline physical conditions by which an agency determines whether an impact is significant. Guidelines §15125(a).

The 2004 EIR states that its baseline 1998 environmental setting used DWRSIM, which is a model simulating the operations of the SWP, "because this is the modeling tool that was available during 1998." AR 55. DWR had used DWRSIM in 2000 to conduct a reliability study for another project. The 2004 EIR does use CALSIM II for the current environmental setting of

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usurpation of responsibility.

the project. CALSIM II was available because DWR performed a SWP Delivery Reliability Report in 2003 using CALSIM II as its model. AR 56. Although the modeling tools are different, the criteria used to input into the computer simulation has not changed significantly. Id.

The question raised by Petitioners is why use an older computer simulation model (DWRSIM) for the 1998 baseline when a newer model (CALSIM II) was available? Appendix D of the 2004 EIR, entitled "Technical Data for Hydrologic Analysis," explains that Castaic had to do so because it did not perform any model analysis of its own. Instead, Castaic relied upon DWR's expertise, and its existing model studies. *See* AR 491. DWR used DWRSIM in its 2000 study and CALSIM II in its 2003 study; Castaic relied upon those same studies and same models.

Castaic's reliance on DWR's existing studies and its expertise is an explanation, but the issue becomes whether it is an adequate one.

The answer is in Appendix D, which explains that DWRSIM has a database of monthly runoff based on historic hydrologic data for a 73 year period from 1922-74. DWRSIM takes this data and, depending on the input variables of operating constraints and water contractor demand, estimates the amount of water SWP can deliver each month over that 75 year period. Assuming that hydrologic conditions repeat, the operator can predict the amount of water available under that particular hydrologic condition and with a particular demand and operating condition. AR 491.

Appendix D then shows that DWRSIM and CALSIM II predict similar outcomes, and that the differences in their predictions can be explained. In Figures 2-1 and 2-2 of Appendix D, Castaic compares the two models' prediction of SWP water deliveries at existing demand and at predicted 2020 demand levels. AR 493. The "existing demand" for the DWRSIM model is 1998 demand. The "existing demand" for the CALSIM II model is 2001 estimated demand. The 2001 demand is higher than the 2000 demand. Consistent with reality, the model will only show delivery up to the amount of demand; SWP will not deliver more water than is asked for even if it is available. This difference in demand explains why CALSIM II shows more delivery in wet years than DWRSIM; the lower demand in 1998 limits the amount of delivery.

The difference in demand also explains in part why CALSIM II predicts a higher delivery in extremely dry conditions; 1998's lower demand means more water is left in storage from the preceding year and is available for delivery in a dry year. Appendix D says that the proof is in the pudding: comparison of DWRSIM and CALSIM II in Figure 2-2, for the year 2020 with the same level of demand for each model, shows very close prediction of SWP delivery for both models. AR 492-93.

Castaic concludes that the two models predict "generally comparable" results and their differences are minimal. AR 491, 1003. Castaic argues that, if anything, the slightly higher supplies predicted by the DWRSIM model provide a worst case scenario for purposes of growth inducing impacts; the more water the more developers will grow the Santa Clarita Valley. AR 1003-04, 1009.

Contrary to Petitioners' argument, the use of DWRSIM and not CALSIM II in the 1998 baseline study does not affect the conclusion that the study constitutes substantial evidence. Petitioners do not present expert opinion that the use of DWRSIM results in any error. They merely rely on the differences in Figures 2-1 and 2-2 of Appendix D, and Appendix D explains

the reason for the differences. As Castaic points out, Petitioners cannot point to any environmental significance to the use of DWRSIM and not CALSIM II. Therefore, Petitioners have not met their burden of demonstrating that use of DWRSIM for the 1998 baseline in the 2004 EIR was "clearly inadequate or unsupported."[27]

3. Cumulative Impacts

Petitioners contend that the 2004 EIR attempts to assess the project's impacts on the SWP without discussion why Castaic is competent to do so. As an example, the EIR rejects any significant project impact on the Delta, even though it acknowledges that differences in timing in the use of water for urban (Castaic) rather than agricultural (Wheeler Ridge) purposes would change the timing of deliveries. AR 192. Petitioners argue that the Delta is "in crisis" and there is great potential for conflict between Castaic's and DWR's respective environmental analysis. Pet. Op. Br. at 23-4.

An EIR must contain a cumulative impacts analysis of the project's environmental impact when considered in conjunction with other projects (Guidelines §15130) in order to ensure that "the entire relevant environmental picture" has been adequately considered. Laupheimer v. State of California, (1988) 200 Cal.App.3d 440, 462. A cumulative impact consists of an impact which is created as a result of the combination of the project evaluated in the EIR together with other projects causing related impacts. Guidelines §15130(a)(1). The EIR should not discuss impacts which do not result at least in part from the project being evaluated. Id. The analysis should reflect the severity and likelihood of occurrence of the impact. Guidelines §15130(b). In every case, there should be at least a preliminary search for potential cumulative environmental effects and a preliminary assessment of their significance. Laupheimer, 200 Cal.App.3d at 462-63. The detail required in a cumulative impacts discussion need not be as great as provided for the environmental impacts attributable to the project alone. Guidelines §15130(b). Generally, the EIR should list the projects producing cumulative impacts or provide a summary of projections contained in a prior certified or adopted environmental document which describe the regional conditions contributing to the cumulative impact. Guidelines §15130(b)(1). The 2004 EIR uses the list approach to discuss cumulative impacts of the project's environmental impact when considered in conjunction with other projects. AR 241-289.

Castaic argues that everything that happens with respect to the Kern water transfer happens south of the Delta, and the EIR thoroughly discusses that, including the impact of the timing of deliveries. AR 193-06. Thus, the EIR's conclusion that the project will have no direct

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[27]Castaic does not have statewide expertise on SWP reliability, but its consultants and DWR do. In commenting on Castaic's draft EIR, DWR stated that the differences between CALSIM II and DWRSIM "may cause slight changes in results, which may lead DWR to different conclusions....[in DWR's Monterey Amendments EIR]" AR 564. However, DWR also found that the draft EIR adequately and thoroughly discussed the project and its impacts, including the effects of the project on the environment and the SWP, using appropriate baseline conditions, and had a good discussion of the relationship between the Kern water transfer and Monterey Plus. DWR concluded that the draft EIR a "adequately discusses the reliability of the SWP, pre- and post- Monterey Amendment conditions, and SWP operations." AR 564-65.

significant impact on the SWP or related facilities is fully supported. Castaic contends that Petitioners really are attacking its ability to act as lead agent for a local project if the project has the potential for statewide impact. According to Castaic, this argument goes to the lead agency issue, and is incorrect as a matter of law. Castaic is qualified and required by CEQA to assess impacts that occur outside of its borders in evaluating the Kern water transfer. Citizens of Goleta Valley v. Board of Supervisors, (1990) 52 Cal.3d 553, 573.

The court does not know whether Petitioners really are attacking Castaic's expertise or the adequacy of its assessment of SWP impacts from the Kern transfer. The reason is that Petitioners' arguments are conclusionary and unsupported by analysis, authority, or many facts. Petitioners' obligation was to point out what is wrong with the analysis, or what has been omitted that was required. An issue raised without analysis or authority lacks foundation and need not be addressed. Arcadia, 135 Cal.App.4th at 1429, 1431. The court has no obligation to search the EIR's cumulative analysis section to look for defects. Their general objection requires only a general response that Castaic's cumulative impacts analysis is adequate.

4. The "No Project" Alternative

Petitioners argue that the 2004 EIR fails to address the "no project" alternative, an issue particularly important because it was the principal defect in the PCL Monterey Agreement EIR. As the PCL court stated, a "no project" alternative must discuss "existing conditions" and "what would reasonably be expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services." 83 Cal.App.4th at 912. The Monterey Agreement EIR did not discuss the projections related to land planning, demand for water, and other impacts of reducing entitlements pursuant to Article 18(b). Id. at 919. Petitioners contend that the 2004 EIR does discuss the water supply reliability impacts of invoking Article 18(b), but not the statewide impacts the PCL court found so crucial.

The short answer to Petitioners contention is that 2004 EIR addresses a different project than the Monterey Amendments. The "no project" alternative for any EIR requires a comparison of the impacts of approving the project with the effect of not doing so. Guidelines §15126.6.(e)(1); Mira Mar Mobile Community v. City of Oceanside, (2004) 119 Cal.App.4th 477, 488-89. The only "no project alternative" that Castaic is obligated to consider is the alternative of "no Kern water transfer." Castaic has addressed this alternative by discussing groundwater sources of water and a possible moratorium. AR 291-4. Petitioners do not quibble with this analysis. But Castaic had no obligation to consider "no Monterey Amendments" as a no project alternative.[28] Indeed, it would make no sense to evaluate "no Monterey Amendments" as an alternative to the Kern water transfer.[29]

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[28]Of course, the 2004 EIR is obligated to consider invocation of Article 18(b) as a reasonably foreseeable environmental impact, and the adequacy of it doing so has been discussed.

[29]For a similar reason, Castaic need not analyze alternative uses of the SWP water in a "no project" alternative. CEQA does not require consideration of alternatives that do not meet the project objective; *i.e.*, delivery of water to Castaic's customers. *See* Guidelines §15126.6(c).

5. Post-Hoc Rationalization

Petitioners also suggest that the 2004 EIR is a post-hoc rationalization for "a decision already made." Pet. Op. Br. at 18. Pre-judging environmental decisions in order to accomplish a project is prohibited under CEQA. An agency may not commit to a project before CEQA review is completed because a fundamental purpose of an EIR is to provide decision-makers with information they can use in deciding whether to approve a project. Therefore, post-approval environmental review has been condemned. Laurel Heights, 47 Cal.3d at 394. *See* Residents Ad Hoc Stadium Com. v. Board of Trustees, (1979) 89 Cal.App.4th 274, 285. Of course, an agency contemplating a project may be presumed to favor the project, and CEQA assumes this to be inevitable. Therefore, it builds in procedural protections to insure that the decision-maker does not fail to note the facts and arguments by opponents to the EIR. Id. at 285.

Castaic had completed the transfer and performed under it for several years prior to preparing the 2004 EIR. Plainly, it desires to keep the transfer and not change it. When the 1999 was found deficient, Castaic was required under CEQA to perform a "fresh look" at the transfer's environmental impacts. With the exception of the analytical hole discussed above, it has done so. *See* City of Vernon v. Board of Harbor, (1998) 63 Cal.App.4th 677, 1523 (adequacy of EIR overcomes contention that it was a post-hoc rationalization).

G. Conclusion

Castaic may act as the lead agency for the Kern water transfer. The 2004 EIR was properly prepared except for one defect – it fails to show the analytic route as to how and why the three allocations of pre-Monterey Amendments, pre-Monterey Amendments without Article 18, and post-Monterey Amendments are relevant and would occur. The court offers no opinion on whether this failure must be rectified by addendum (Guidelines §15164), a subsequent EIR, a supplement to EIR, or a new EIR. That determination is Castaic's to make in the first instance.

The Petition for Writ of Mandate is granted in part. A writ shall issue commanding Castaic to set aside its approval of the 2004 EIR and comply with CEQA, either through the preparation of a new EIR or other environmental documentation, such as an addendum, addressing the analytic route of the three water allocations. Castaic is not directed to set aside the Kern water transfer. Judgment shall be entered in favor of Petitioners solely on this issue.

This shall serve as the court's proposed statement of decision in compliance with CRC 232(c). If there are no written objections filed, the statement shall be final. As Respondents have prevailed on all but one issue, Castaic's council is ordered to prepare a writ of mandate and judgment consistent with this decision, and serve it on all other counsel for approval as to form. After 10 days, Castaic may file the proposed writ and judgment with the court, along with a declaration stating the nature and extent of any objections received. An OSC re: judgment shall be set for April 23, 2007.

Dated: April 2, 2007

J. Chalfant

Superior Court Judge
JAMES C. CHALFANT

PROOF OF SERVICE

STATE OF CALIFORNIA)
COUNTY OF ORANGE)

I am employed in the County of Orange, State of California. I am over the age of eighteen (18) years and not a party to the within action; my business address is: 695 Town Center Drive, Suite 400, Costa Mesa, California 92626.

On May 14, 2007, I served the foregoing document described as: **[PROPOSED] JUDGMENT GRANTING PEREMPTORY WRIT OF MANDATE** on the interested parties in this action by placing a true copy thereof enclosed in a sealed envelope addressed to all parties as indicated on the attached mailing list:

SEE ATTACHED LIST

[XX] (BY MAIL) I am "readily familiar" with the firm's practice of collection and processing correspondence by mailing. Under that practice it would be deposited with U.S. postal service on that same day with postage fully prepaid at Costa Mesa, California in the ordinary course of business. I am aware that on motion of the party served, service is presumed invalid if postal cancellation date or postage meter date is more than one day after date of deposit for mailing in affidavit.

[ ] (BY OVERNIGHT MAIL) I caused such document to be delivered by overnight mail to the
offices of the addressee(s).

[ ] (BY PERSONAL DELIVERY) I caused such envelope to be delivered by hand to the offices of the addressee.

[ ] (BY FACSIMILE) I transmitted said document by fax transmission to the fax number(s) indicated

[XX] (BY E-MAIL) I transmitted said document by e-mail transmission to the e-mail addresses indicated

[XX] (STATE) I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on May 14, 2007, at Costa Mesa, California.

Victoria A. Robinson
VICTORIA A. ROBINSON

PROOF OF SERVICE

STATE OF CALIFORNIA)
COUNTY OF ORANGE)

I am employed in the County of Orange, State of California. I am over the age of eighteen (18) years and not a party to the within action; my business address is: 695 Town Center Drive, Suite 400, Costa Mesa, California 92626.

On May 18, 2007, I served the foregoing document described as: **[PROPOSED] JUDGMENT GRANTING PEREMPTORY WRIT OF MANDATE** on the interested parties in this action by placing a true copy thereof enclosed in a sealed envelope addressed to all parties as indicated on the attached mailing list:

SEE ATTACHED LIST

[XX] (BY MAIL) I am "readily familiar" with the firm's practice of collection and processing correspondence by mailing. Under that practice it would be deposited with U.S. postal service on that same day with postage fully prepaid at Costa Mesa, California in the ordinary course of business. I am aware that on motion of the party served, service is presumed invalid if postal cancellation date or postage meter date is more than one day after date of deposit for mailing in affidavit.

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[XX] (BY E-MAIL) I transmitted said document by e-mail transmission to the e-mail addresses indicated

[XX] (STATE) I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on May 18, 2007, at Costa Mesa, California.

Monifa Wilson

MONIFA WILSON

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Los Angeles County Superior Court Case No. BS 098724

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Attachment B

Sierra Club, et al. v. City of Santa Clarita, et al.

Filed 1/29/08 Sierra Club v. City of Santa Clarita CA2/3

NOT TO BE PUBLISHED IN THE OFFICIAL REPORTS

California Rules of Court, rule 8.1115(a), prohibits courts and parties from citing or relying on opinions not certified for publication or ordered published, except as specified by rule 8.1115(b). This opinion has not been certified for publication or ordered published for purposes of rule 8.1115.

IN THE COURT OF APPEAL OF THE STATE OF CALIFORNIA

SECOND APPELLATE DISTRICT

DIVISION THREE

SIERRA CLUB et al., Plaintiffs and Appellants, v. CITY OF SANTA CLARITA et al., Defendants and Respondents; THE NEWHALL LAND AND FARMING COMPANY, Real Party in Interest and Respondent.	B194771 (Los Angeles County Super. Ct. No. BS098722)

APPEAL from a judgment of the Superior Court of Los Angeles County, Dzintra Janavs, Judge. Affirmed.

Law Office of Babak Naficy and Babak Naficy for Plaintiffs and Appellants.

Burke, Williams & Sorenson, Carl K. Newton and Geralyn L. Skapik for Defendants and Respondents.

Paul, Hastings, Janofsky & Walker, Robert I. McCurry and A. Catherine Norian for Real Party in Interest and Respondent.

Sierra Club, Center for Biological Diversity, Friends of the Santa Clara River, and California Water Impact Network (collectively Petitioners) challenge the certification by City of Santa Clarita (city) of an environmental impact report (EIR) and the city's approval of a mixed-use development project known as Riverpark. Petitioners appeal a judgment denying their petition for a writ of mandate and denying relief on their complaint. They challenge the adequacy of the EIR and the city's findings under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.) with respect to impacts on water supply and biological resources, and the city's finding under the Planning and Zoning Law (Gov. Code, § 65000 et seq.) that the project is consistent with the city's general plan.

We conclude that the water supply analysis in the EIR, the analysis of impacts on the holly-leaf cherry and San Diego black-tailed jackrabbit, and the discussion of measures to mitigate the impacts on the western spadefoot toad were adequate, and that the city reasonably concluded that the project is consistent with the city's general plan. We therefore affirm the judgment.

FACTUAL AND PROCEDURAL BACKGROUND

1. *Proposed Project*

The Newhall Land and Farming Company (Newhall) proposed the development of 1,183 residential units, consisting of 439 single-family homes and 744 apartment units, and 40,000 square feet of commercial space, together with trails, a 29-acre park, and open space. The proposed project site is in the central part of the city, north of Soledad Canyon Road and east of Bouquet Canyon Road, and includes a section of the

Santa Clara River running east-west through the site. The total site acreage is 695.4 acres including the river, and 357 acres excluding the river.

The Santa Clara River is the last major unchannelized river in Los Angeles County. The city has designated the Santa Clara River a Significant Ecological Area (SEA). The SEA supports a variety of natural habitats including freshwater marsh, coastal sage scrub, oak woodlands, and riparian woodlands. The 100-year storm limit line determined by the Federal Emergency Management Agency defines the boundaries of the SEA. The proposed project includes 16.9 acres of development within the 100-year storm limit line and therefore within the SEA.

The proposed project site is predominantly undeveloped, but with some disturbed areas including several buildings used for construction purposes and electrical transmission lines. Plant communities on the site include coastal sage scrub, southern riparian scrub, native and non-native grasses and ruderal vegetation, small patches of oak trees, and other native and non-native trees. To the north of the site are undeveloped property, a water treatment facility and administrative offices owned by the Castaic Lake Water Agency, and single-family residential uses. To the south of the site, across the river from the proposed development, are retail commercial uses, the Saugus Speedway, a Metrolink commuter railway station, a mobile home park, and a business park. To the east of the site are undeveloped property and a business park, and to the west are retail commercial uses and open space.

2. *Environmental Review and Project Approval*

The city circulated a draft EIR for the proposed project on March 2, 2004. Focused surveys performed on March 5 and 6, 2004, at the request of the Department of Fish and Game disclosed the presence of western spadefoot toads on the proposed project site. The city circulated a revised biological resources section of the draft EIR discussing the western spadefoot toad on March 24, 2004.

The city's planning commission conducted several public hearings on the proposed project and recommended approval of the project with certain modifications. Newhall modified the proposed project accordingly. Those modifications reduced the number of residential units to 1,123, consisting of 419 single-family homes, 380 condominium units, and 324 apartment units, and reduced the area of commercial space to 16,000 square feet, among other changes.

A final EIR was prepared in December 2004. The city council conducted a public hearing on the proposed project in January 2005, and suggested further modifications. The city council conducted additional public hearings in March and May 2005. The final EIR was revised in May 2005. On May 25, 2005, the city council certified the final EIR, made findings under CEQA and other findings, adopted a statement of overriding considerations, and approved the project. The project approvals included a vesting tentative tract map, general plan amendment, conditional use permit, oak tree permit, and setback and wall height adjustments. The city council approved a zone change on second reading, on June 14, 2005.

The project as approved includes 1,098 residential units, consisting of 439 single-family homes and 657 condominium units, and 16,000 square feet of commercial space, in addition to trails, a 29-acre park, and open space.

3. *Trial Court Proceedings*

Petitioners filed a combined petition for writ of mandate and complaint against the city and its city council in the Ventura County Superior Court in June 2005, challenging the city's certification of the EIR and project approval. The city moved for a change of venue to Los Angeles County Superior Court. The court granted the motion.

The trial court conducted a hearing on the merits in May 2006. The court rejected the Petitioners' contentions in a Decision on Submitted Matter filed on August 14, 2006, and entered a judgment denying the petition for writ of mandate. Petitioners timely appealed the judgment.

CONTENTIONS

Petitioners contend (1) the EIR failed to adequately discuss the uncertainty of the proposed water supplies; (2) due to the uncertainty of the proposed water supplies, the EIR was required to discuss alternative sources and the environmental impact of supplying water from those alternative sources, but failed to do so; (3) the Department of Water Resources rather than the Castaic Lake Water Agency should be the lead agency for environmental review of a water transfer from Kern County; (4) the EIR applied an incorrect legal standard to determine the significance of impacts on the holly leaf cherry; (5) the EIR applied an incorrect legal standard to determine the significance

of impacts on the San Diego black-tailed jackrabbit, and the evidence does not support the city's finding that the impacts on the species will be less than significant; (6) the city failed to consider project revisions or feasible alternatives to reduce the significant impacts on the western spadefoot toad to an insignificant level, and the evidence does not support the city's finding that significant impacts on the species are unavoidable; and (7) the evidence does not support the city's finding that the project is consistent with particular general plan goals and policies.

DISCUSSION

1. *CEQA Requirements*

"CEQA is a comprehensive scheme designed to provide long-term protection to the environment. [Citation.] In enacting CEQA, the Legislature declared its intention that all public agencies responsible for regulating activities affecting the environment give prime consideration to preventing environmental damage when carrying out their duties. [Citations.] CEQA is to be interpreted 'to afford the fullest possible protection to the environment within the reasonable scope of the statutory language.' [Citation.]" (*Mountain Lion Foundation v. Fish & Game Com.* (1997) 16 Cal.4th 105, 112 (*Mountain Lion*).)

An EIR is required for any project that a public agency proposes to carry out or approve that may have a significant effect on the environment. (Pub. Resources Code,

§§ 21100, subd. (a), 21151, subd. (a); Guidelines, § 15064,[1] subd. (a)(1).) An EIR must describe the proposed project and its environmental setting, state the objectives sought to be achieved, identify and analyze the significant effects on the environment, state how those impacts can be mitigated or avoided, and identify and analyze alternatives to the project, among other requirements. (Pub. Resources Code, §§ 21100, subd. (b), 21151; Guidelines, §§ 15124, 15125, 15126.6.) "The purpose of an environmental impact report is to provide public agencies and the public in general with detailed information about the effect which a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project." (Pub. Resources Code, § 21061.)

The lead agency must notify the public of the draft EIR, make the draft EIR and all documents referenced in it available for public review, and respond to comments that raise significant environmental issues. (Pub. Resources Code, §§ 21092, 21091, subds. (a), (d); Guidelines, §§ 15087, 15088.) The agency also must consult with and obtain comments from other agencies affected by the project and respond to their comments. (Pub. Resources Code, §§ 21092.5, 21104, 21153; Guidelines, § 15086.)

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[1] All references to Guidelines are to the CEQA Guidelines (Cal. Code Regs., Tit. 14, § 15000 et seq.) developed by the Office of Planning and Research and adopted by the Resources Agency. (Pub. Resources Code, §§ 21083, 21087.) "[C]ourts should afford great weight to the Guidelines except when a provision is clearly unauthorized or erroneous under CEQA." (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 391, fn. 2 (*Laurel Heights I*).)

The agency must prepare a final EIR including any revisions to the draft EIR, comments received from the public and from other agencies, and responses to comments. (Guidelines, §§ 15089, subd. (a), 15132.)

An agency may not approve a project that will have significant environmental effects if there are feasible alternatives or feasible mitigation measures that would substantially lessen those effects.[2] (Pub. Resources Code, §§ 21002, 21002.1, subd. (b); Guidelines, § 15021, subd. (a)(2); *Mountain Lion, supra*, 16 Cal.4th at p. 134.) An agency may find, however, that particular economic, social, or other considerations make the alternatives and mitigation measures infeasible and that particular project benefits outweigh the adverse environmental effects. (Pub. Resources Code, § 21081, subds. (a)(3), (b); Guidelines, § 15091, subd. (a)(3).) Specifically, an agency cannot approve a project that will have significant environmental effects unless it finds as to each significant effect, based on substantial evidence in the administrative record, that (1) mitigation measures required in or incorporated into the project will avoid or substantially lessen the significant effect; (2) those measures are within the jurisdiction of another public agency and have been adopted, or can and should be adopted, by that agency; or (3) specific economic, legal, social, technological, or other considerations make the mitigation measures or alternatives identified in the EIR infeasible, and

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[2] " 'Feasible' means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors." (Pub. Resources Code, § 21061.1; see also Guidelines, § 15364.)

specific overriding economic, legal, social, technological, or other benefits outweigh the significant environmental effects. (Pub. Resources Code, §§ 21081, 21081.5; Guidelines, § 15091, subds. (a), (b).) A finding that specific overriding project benefits outweigh the significant environmental effects (Pub. Resources Code, § 21081, subd. (b)) is known as a statement of overriding considerations. (Guidelines, § 15093.)

Thus, a public agency is not required to favor environmental protection over other considerations, but it must disclose and carefully consider the environmental consequences of its actions, mitigate or avoid adverse environmental effects if feasible, explain the reasons for its actions, and afford the public and other affected agencies an opportunity to participate meaningfully in the environmental review process. The purpose of these requirements is to ensure that public officials and the public are aware of the environmental consequences of decisions before they are made. (*Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal.3d 553, 564 (*Goleta Valley*).) The EIR process also informs the public of the basis for environmentally significant decisions by public officials and thereby promotes accountability and informed self-government. (*Laurel Heights I, supra*, 47 Cal.3d at p. 392; *Concerned Citizens of Costa Mesa, Inc. v. 32nd Dist. Agricultural Assn.* (1986) 42 Cal.3d 929, 935-936.) Before approving the project, the agency must certify that its decisionmaking body reviewed and considered the information contained in the EIR, that the EIR reflects the agency's independent judgment and analysis, and that the EIR was completed in compliance with CEQA. (Pub. Resources Code, § 21082.1, subd. (c); Guidelines, § 15090.)

"We have repeatedly recognized that the EIR is the 'heart of CEQA.' [Citations.] 'Its purpose is to inform the public and its responsible officials of the environmental consequences of their decisions *before* they are made. Thus, the EIR "protects not only the environment but also informed self-government." [Citations.]' To this end, public participation is an 'essential part of the CEQA process.' [Citations.]" (*Laurel Heights Improvement Assn. v. Regents of University of California* (1993) 6 Cal.4th 1112, 1123 (*Laurel Heights II*).) "The preparation and circulation of an EIR is more than a set of technical hurdles for agencies and developers to overcome. The EIR's function is to ensure that government officials who decide to build or approve a project do so with a full understanding of the environmental consequences and, equally important, that the public is assured those consequences have been taken into account. (*Laurel Heights I, supra*, 47 Cal.3d at pp. 391-392.) For the EIR to serve these goals it must present information in such a manner that the foreseeable impacts of pursuing the project can actually be understood and weighed, and the public must be given an adequate opportunity to comment on that presentation before the decision to go forward is made." (*Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 449-450 (*Vineyard Area Citizens*).)

" 'Significant effect on the environment' means a substantial, or potentially substantial, adverse change in the environment." (Pub. Resources Code, § 21068.) The Guidelines define "significant effect on the environment" in relevant part as "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals,

flora, fauna, ambient noise, and objects of historic or aesthetic significance."[3] (Guidelines, § 15382.)

"Substantial evidence" under CEQA "includes fact, a reasonable assumption predicated upon fact, or expert opinion supported by fact." (Pub. Resources Code, § 21080, subd. (e)(1); see Guidelines, §§ 15384, subd. (b), 15064, subd. (f)(5).) The Guidelines define "substantial evidence" as "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached," and state that this determination must be made "by examining the whole record before the lead agency." (Guidelines, § 15384, subd. (a).) "Substantial evidence is not argument, speculation, unsubstantiated opinion or narrative, evidence that is clearly inaccurate or erroneous, or evidence of social or economic impacts that do not contribute to, or are not caused by, physical impacts on the environment." (Pub. Resources Code, § 21080, subd. (e)(2); accord, *id.* § 21082.2, subd. (c); see also Guidelines, § 15384, subd. (a).)

2. *Standard of Review*

The standard of review of an agency's decision under CEQA is abuse of discretion. Abuse of discretion means the agency failed to proceed in a manner required

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[3] " 'Environment' means the physical conditions which exist within the area which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance. The area involved shall be the area in which significant effects would occur either directly or indirectly as a result of the project. The 'environment' includes both natural and man-made conditions." (Guidelines, § 15360; see also Pub. Resources Code, § 21060.5.)

by law or there was no substantial evidence to support its decision. (Pub. Resources Code, §§ 21168, 21168.5; *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 945.) Whether the agency failed to proceed in a manner required by law is a question of law. A court determines de novo whether the agency complied with CEQA's procedural requirements, " 'scrupulously enforc[ing] all legislatively mandated CEQA requirements' (*Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal.3d 553, 564 [276 Cal.Rptr. 410, 801 P.2d 1161])." (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 435.) The failure to provide information required by CEQA in an EIR is a failure to proceed in a manner required by law. (*Save Our Peninsula Committee v. Monterey County Bd. of Supervisors* (2001) 87 Cal.App.4th 99, 118.) The failure to comply with CEQA's procedural or information disclosure requirements is a prejudicial abuse of discretion if the decision makers or the public is deprived of information necessary to make a meaningful assessment of the environmental impacts. (*Sierra Club v. State Bd. of Forestry* (1994) 7 Cal.4th 1215, 1236-1237; *County of Amador*, *supra*, at p. 946; see Pub. Resources Code, § 21005.)

Findings of fact made by the agency and factual conclusions stated in an EIR are reviewed under the substantial evidence standard. (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 435; *Laurel Heights I*, *supra*, 47 Cal.3d at pp. 392-393, 407.) Under the substantial evidence standard, the court does not determine whether the agency's factual determinations were correct, but only determines whether they were supported by substantial evidence. (*Laurel Heights I*, *supra*, at pp. 392-393.) On appeal, we

independently review the agency's decision under the same standard of review that governs the trial court. (*Vineyard Area Citizens*, *supra*, at p. 427.)

3. *Water Supply*

a. *CEQA Requirements for Water Supply Analysis*

An EIR must identify and analyze the significant environmental impacts that may result from the project. (Pub. Resources Code, § 21100, subds. (a), (b); Guidelines, §§ 15126.2, subd. (a), 15143.) It must include facts and analysis sufficient to allow the decision makers and the public to understand the environmental consequences of the project. (Guidelines, § 15151; *Laurel Heights I*, *supra*, 47 Cal.3d at pp. 404-405; *Napa Citizens for Honest Government v. Napa County Bd. of Supervisors* (2001) 91 Cal.App.4th 342, 356 (*Napa Citizens*).) An EIR for a large, mixed-use development project such as the present project must include an analysis of the reasonably foreseeable environmental impacts of supplying water to the project. (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at pp. 428, 434.) The analysis must include a discussion of the planned and likely sources of water and the impacts of supplying water from those sources. (*Id.* at pp. 428, 432, 434.)

Vineyard Area Citizens involved an EIR prepared for a community plan and a specific plan for a large, mixed-use development project. The EIR stated that the project would rely on both groundwater and surface water for its water supplies. (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 423.) The projected long-term water supplies consisted of an unspecified combination of groundwater and surface water in "conjunctive use." (*Id.* at p. 440.) The EIR stated that a full analysis of the

"conjunctive use" program must await the pending environmental review of a master plan update by the county water agency. (*Id.* at p. 440.) Because the project did not have legal rights to the projected water supplies, a mitigation measure provided that subdivision maps, building permits, and other entitlements would not be granted unless agreements and financing for the water supplies were in place. (*Id.* at p. 424.)

Vineyard Area Citizens discussed several opinions by the Courts of Appeal concerning the sufficiency of an EIR's analysis of water supply (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at pp. 428-430) and derived four principles from those opinions:

"First, CEQA's informational purposes are not satisfied by an EIR that simply ignores or assumes a solution to the problem of supplying water to a proposed land use project. Decision makers must, under the law, be presented with sufficient facts to 'evaluate the pros and cons of supplying the amount of water that the [project] will need.' (*Santiago County Water Dist. v. County of Orange* [(1981)] 118 Cal.App.3d [818,] 829.)

"Second, an adequate environmental impact analysis for a large project, to be built and occupied over a number of years, cannot be limited to the water supply for the first stage or the first few years. While proper tiering of environmental review allows an agency to defer analysis of certain details of later phases of long-term linked or complex projects until those phases are up for approval, CEQA's demand for meaningful information 'is not satisfied by simply stating information will be provided

in the future.' (*Santa Clarita* [*Organization for Planning the Environment v. County of Los Angeles* (2003)] 106 Cal.App.4th [715,] 723.) . . . .

"Third, the future water supplies identified and analyzed must bear a likelihood of actually proving available; speculative sources and unrealistic allocations ('paper water') are insufficient bases for decisionmaking under CEQA. (*Santa Clarita*, *supra*, 106 Cal.App.4th at pp. 720-723.) An EIR for a land use project must address the impacts of *likely* future water sources, and the EIR's discussion must include a reasoned analysis of the circumstances affecting the likelihood of the water's availability. (*California Oak* [*Foundation v. City of Santa Clarita* (2005)] 133 Cal.App.4th [1219,] 1244.)

"Finally, where, despite a full discussion, it is impossible to confidently determine that anticipated future water sources will be available, CEQA requires some discussion of possible replacement sources or alternatives to use of the anticipated water, and of the environmental consequences of those contingencies. (*Napa Citizens*, *supra*, 91 Cal.App.4th at p. 373.)" (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at pp. 430-432.)

Vineyard Area Citizens stated further: "[W]e emphasize that the burden of identifying likely water sources for a project varies with the stage of project approval involved; the necessary degree of confidence involved for approval of a conceptual plan is much lower than for issuance of building permits. The ultimate question under CEQA, moreover, is not whether an EIR establishes a likely source of water, but

whether it adequately addresses the reasonably foreseeable *impacts* of supplying water to the project." (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 434.)

Vineyard Area Citizens concluded that the analysis of near-term groundwater supplies in the EIR was adequate. It stated that the county's conclusion that certain groundwater supplies would be available to the project in the near term was supported by substantial evidence, and rejected the petitioners' argument that competing uses were likely to exhaust those water supplies. (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at pp. 436-437.)[4] It stated further that the county did not fail to proceed in the manner required by law in that the EIR neither improperly deferred analysis of water supplies to future stages of the project nor relied on illusory water supplies. (*Id.* at p. 437.)

Vineyard Area Citizens concluded that the analysis of long-term water supplies in the EIR was inadequate. It stated that the county's conclusion that surface water supplies would satisfy the project's long-term demands was not supported by substantial evidence because the EIR failed to explain inconsistencies in the figures provided on total demand and supply, failed to identify the intended and likely long-term water sources, relied on "vague and unquantified" water supplies (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 440), and failed to identify competing uses. (*Id.* at pp. 439-442.)[5]

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[4] "While much uncertainty remains, then, the record contains substantial evidence demonstrating a reasonable likelihood that a water source the provider plans to use . . . will indeed be available at least in substantial part to supply the Sunrise Douglas project's near-term needs." (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 437.)

[5] "Factual inconsistencies and lack of clarity in the FEIR leave the reader—and the decision makers—without substantial evidence for concluding that sufficient water is, in

It stated further that the county failed to proceed in the manner required by law by deferring environmental review of the conjunctive use program to a future EIR (*id.* at pp. 440-441), failing to properly incorporate information or tier from a prior EIR regarding surface water supplies on which the project relied (*id.* at pp. 442-443), failing to include enforceable mitigation measures for those surface water diversions (*id.* at p. 444), and by relying on a provision precluding further development in lieu of identifying and analyzing the project's intended and likely water sources (*ibid.*) *Vineyard Area Citizens* stated that there was "no plainly stated, coherent analysis of how the supply is to meet the demand." (*Id.* at p. 445.)

b. *Background of the State Water Project*

The State Water Project is a water storage and delivery system operated by the Department of Water Resources. It includes reservoirs, dams, power plants, pumping plants, canals, aqueducts, and other facilities. (See *Planning & Conservation League v. Department of Water Resources* (2000) 83 Cal.App.4th 892, 898-899 (*PCL*).) California voters approved a bond measure in 1960 to fund its construction. (Stats. 1961, p. cxliii; Wat. Code, § 12930 et seq.) Although the system was designed to deliver 4.23 million acre-feet of water annually, for many years it delivered significantly less than that amount. (See *California Oak Foundation v. City of Santa Clarita* (2005) 133 Cal.App.4th 1219, 1227-1228 (*California Oak*); *PCL*, *supra*, at pp. 898-899.)

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fact, likely to be available for the Sunrise Douglas project at full build-out." (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 439.)

The Department of Water Resources is a party to 29 long-term contracts with local water agencies. Under the original contracts, each agency had the right to receive a proportionate share of the 4.23 million acre-feet of water per year that was projected to be supplied by the State Water Project. (See *PCL*, *supra*, 83 Cal.App.4th at p. 899; Wat. Code, § 12937, subd. (b).) The agencies were required to pay for their contractual entitlements of water regardless of whether they actually received the water. (See *PCL*, *supra*, 83 Cal.App.4th at p. 899.) Article 18(a) of the water supply contracts provided that in times of temporary shortage, the agricultural water agencies would receive a reduced allocation. Article 18(b) provided that in times of permanent water shortage, the allocations of all contracting agencies would be reduced proportionately. (See *id.* at pp. 899-900.)

After several years of drought in the late 1980's and early 1990's resulting in disputes between agricultural and urban water agencies, several contracting agencies and the Department of Water Resources entered into an agreement known as the Monterey Agreement. (See *PCL*, *supra*, 83 Cal.App.4th at pp. 897, 901.) The Monterey Agreement is a statement of 14 principles designed to govern revisions to the water supply contracts. It calls for the elimination of the provision requiring agricultural agencies to absorb the first deficiency and provides that in times of shortage, deliveries to all contracting agencies will be reduced in proportion to their entitlements. (See *Friends of the Santa Clara River v. Castaic Lake Water Agency* (2002) 95 Cal.App.4th 1373, 1376 (*Friends*).) The Monterey Agreement also provides for the agricultural agencies to permanently transfer to the urban agencies 130,000

acre-feet of annual water entitlements. (See *id.* at pp. 1376-1377; *PCL*, *supra*, 83 Cal.App.4th at pp. 901-902.) The Monterey Agreement provides for its implementation through amendments to the long-term water supply contracts. (See *PCL*, *supra*, at p. 902.) Table A of those contracts states the amount of each agency's annual water allocation from the State Water Project. The amendments pursuant to the Monterey Agreement are known as the Monterey Amendments.

Pursuant to the Monterey Agreement, the Castaic Lake Water Agency entered into an agreement with the Kern County Water Agency in 1999 for the permanent transfer of 41,000 acre-feet of annual State Water Project water entitlement from the Kern County Water Agency to the Castaic Lake Water Agency (Kern-Castaic transfer). The Department of Water Resources approved the transfer in March 1999, and the long-terms water supply contracts between the two water agencies and the Department of Water Resources were amended accordingly.

The Central Coast Water Agency as lead agency prepared a program EIR for the Monterey Agreement and certified the EIR in October 1995.[6] The Department of Water Resources as a responsible agency also made findings and adopted the EIR. (*PCL*, *supra*, 83 Cal.App.4th at p. 902.) The Sacramento County Superior Court denied a petition for writ of mandate challenging the EIR. In September 2000, the Court of

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[6] A program EIR may be prepared for a series of related actions that can be characterized as one large project. (Guidelines, § 15168, subd. (a).) Subsequent program activities that would cause environmental impacts not analyzed in the program EIR require additional environmental review. (*Id.*, subd. (c).)

Appeal in *PCL* reversed the judgment by the trial court with directions to grant the petition. (*Id.* at pp. 903, 926.) *PCL* held that the Department of Water Resources rather than the Central Coast Water Agency was the proper lead agency, and that the EIR failed to provide a sufficient analysis of the no project alternative. (*Id.* at pp. 907, 916.) *PCL* directed the trial court to vacate the certification of the EIR and make any other order appropriate under Public Resources Code section 21168.9, subdivision (a), but did not direct the court to vacate the project approval, and declined to stay the implementation of the Monterey Agreement. (*PCL*, *supra*, at p. 926 & fn. 16.)

The Castaic Lake Water Agency as lead agency prepared an EIR for the Kern-Castaic transfer in March 1999. It was a project EIR that tiered from three other EIR's, including the Monterey Agreement program EIR.[7] (*Friends*, *supra*, 95 Cal.App.4th at pp. 1379-1380.) The Los Angeles County Superior Court denied a petition for writ of mandate challenging the Castaic Lake Water Agency's EIR. (*Id.* at p. 1381.) The appellate opinion invalidating the Monterey Agreement EIR (*PCL*, *supra*, 83 Cal.App.4th 892) was filed while the appeal in *Friends* was pending. (*Friends*, *supra*, at p. 1382.) In January 2002, the Court of Appeal in *Friends* reversed the

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[7] A project EIR "examines the environmental impacts of a specific development project." (Guidelines, § 15161.) " 'Tiering' or 'tier' means the coverage of general matters and environmental effects in an environmental impact report prepared for a policy, plan, program or ordinance followed by narrower or site-specific environmental impact reports which incorporate by reference the discussion in any prior environmental impact report and which concentrate on the environmental effects which (a) are capable of being mitigated, or (b) were not analyzed as significant effects on the environment in the prior environmental impact report." (Pub. Resources Code, § 21068.5.)

judgment by the trial court with directions to grant the petition. (*Id.* at p. 1388.) *Friends* concluded that the Castaic Lake Water Agency's EIR relied on the analysis of environmental impacts in the Monterey Agreement EIR and that the decertification of the Monterey Agreement EIR precluded reliance on that analysis. (*Id.* at pp. 1384-1387.) *Friends* directed the trial court to vacate the certification of the EIR and make any other order appropriate under Public Resources Code section 21168.9, but did not direct the court to vacate the project approval, and stated that the trial court should determine whether to enjoin the project. (*Friends*, *supra*, at p. 1388.) The trial court entered a judgment on remand in October 2002 vacating the certification of the EIR but not the project approval. The trial court declined the petitioners' request to enjoin the use of water received pursuant to the transfer. The Court of Appeal in an unpublished opinion affirmed the judgment, rejecting the petitioners' challenge to the denial of an injunction (*Friends of the Santa Clara River v. Castaic Lake Water Agency* (Dec. 1, 2003, B164027)).

The parties to the proceeding involving a challenge to the Monterey Agreement EIR (*PCL*, *supra*, 83 Cal.App.4th 892) entered into a settlement agreement in May 2003 specifying certain subjects to be discussed in a new Monterey Agreement EIR to be prepared by the Department of Water Resources. Those subjects included the environmental impacts relating to the transfers of water rights effected pursuant to the Monterey Agreement. The settlement agreement included an Attachment E listing certain transfers other than the Kern-Castaic transfer. The settlement agreement separately identified the Kern-Castaic transfer, and stated that the new Monterey

Agreement EIR would include an analysis of the impacts of both the Attachment E transfers and the Kern-Castaic transfer.

The settlement agreement stated with respect to the Attachment E transfers: "[N]otwithstanding the analysis of the potential impacts of the Attachment E Transfers in the New EIR and without specifically endorsing or opposing those transfers or any prior environmental assessments of them, the Parties recognize that such water transfers are final. Each of the Parties agrees not to, and it shall be a condition to the initial and continuing effectiveness of this Settlement Agreement that Plaintiffs do not, hereafter challenge the effectiveness or validity of such water transfers." It stated with respect to the Kern-Castaic transfer: "[R]egarding the Kern-Castaic Transfer, the Parties recognize that such water transfer is subject to pending litigation in the Los Angeles County Superior Court following remand from the Second District Court of Appeal (*See* Friends of the Santa Clara River v. Castaic Lake Water Agency, 95 Cal.App.4th 1373, 116 Cal.Rptr.2d 54 (2002); *review denied* April 17, 2002). The Parties agree that jurisdiction with respect to that litigation should remain in that court and that nothing in this Settlement Agreement is intended to predispose the remedies or other actions that may occur in that pending litigation."

The settlement agreement included certain proposed amendments to the long-term water service contracts, known as the Attachment A amendments. The settlement agreement stated that the parties would request an order authorizing the operation of the State Water Project on an interim basis in accordance with the Monterey Agreement, the

Attachment A amendments, and other terms of the settlement. The trial court approved the settlement and issued the requested order.

The Castaic Lake Water Agency prepared a second EIR for the Kern-Castaic transfer and certified the EIR in December 2004. The Los Angeles County Superior Court granted a petition for writ of mandate challenging the second EIR for the Kern-Castaic transfer in May 2007 (*Planning and Conservation League v. Castaic Lake Water Agency* (Super. Ct. L.A. County No. BS098724)).[8] The court concluded that although the EIR analyzed the environmental impacts of the project assuming three different State Water Project water allocation scenarios, it failed to adequately explain how those scenarios could result from the pending environmental review of the Monterey Amendments and any challenge to the new Monterey Agreement EIR. The court rejected all other challenges to the EIR. The petitioners, the Castaic Lake Water Agency, and the Kern County Water Agency appealed the judgment. That appeal is currently pending in the Second District Court of Appeal (No. B200673).

c. *Petitioners' Specific Contention*

Petitioners contend the ongoing environmental review of the Monterey Agreement and the possibility that the Department of Water Resources ultimately will exercise its discretion to disapprove or modify the Kern-Castaic transfer render the

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[8] We granted a joint request by the city and Newhall to judicially notice the judgment filed on May 22, 2007, and the statement of decision filed on April 2, 2007, in *Planning and Conservation League v. Castaic Lake Water Agency, supra*, No. BS098724.

transfer uncertain. They argue that the EIR fails to acknowledge that uncertainty. Petitioners cite a statement by the department in *Planning and Conservation League v. Castaic Lake Water Agency, supra*, No. BS098724, that, "[T]he contract amendments that effectuated the transfers under the Monterey Amendment do not preclude DWR in its choice of alternatives in the Monterey Amendment EIR or mitigation measures that may need to be imposed to reduce significant impacts to less than significant. Any contractual agreement to transfer SWP water from one contractor to another is always subject to possible changes or curtailments."[9]

d. *Draft EIR, Response to Comments, and the City's Findings*

The draft EIR here stated that the Castaic Lake Water Agency serves the proposed project area and relies on imported water from the State Water Project. It described the State Water Project and the Monterey Agreement. It stated that the agency's total annual water allocation from the State Water Project is 95,200 acre-feet and that the Kern-Castaic transfer represents 41,000 acre-feet of that amount. It explained that the amounts requested by the contracting agencies from the State Water Project and the amounts actually delivered to the agencies by the State Water Project vary from year to year and can be less than the maximum amounts allocated. It projected that 59.7 percent of the State Water Project water allocation would be available to the city in average years, and that 20 to 39.8 percent would be available in

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[9] We granted Petitioners' request for judicial notice of the Department of Water Resource's opposition brief filed on December 6, 2006, in *Planning and Conservation League v. Castaic Lake Water Agency, supra*, No. BS098724.

dry years. It stated that water transfer agreements made pursuant to the Monterey Agreement "are effective upon execution . . . and, therefore, are considered permanent water reallocations of SWP Table A water."

The draft EIR stated that the agency had completed an EIR for the Kern-Castaic transfer, that the trial court had rejected the petitioners' challenges to the EIR, and that the Court of Appeal had reversed the judgment on the sole ground that the EIR tiered from another EIR (the Monterey Agreement EIR) that had been decertified. It stated that neither the Court of Appeal nor the trial court had ordered the agency to vacate its approval of the transfer agreement pending completion of a new EIR, and that the trial court on remand had allowed the agency to continue to operate under the agreement. It stated that the agency was in the process of preparing a new EIR for the transfer.

The draft EIR stated further that the Court of Appeal had ordered the decertification of the Monterey Agreement EIR on the grounds that the Department of Water Resources should have been the lead agency and that the analysis of the no project alternative was inadequate. It stated that the Court of Appeal had directed the trial court to order the preparation of a new EIR and that neither the Court of Appeal nor the trial court had stayed the implementation of the Monterey Agreement.

The draft EIR stated that the Kern-Castaic transfer could have taken place even without the Monterey Agreement, "under existing SWP water supply contract provisions, subject to appropriate environmental review." It stated that the Kern-Castaic transfer "has been completed, CLWA has paid approximately $47 million for the additional Table A Amount, the monies have been delivered, . . . and DWR has

increased CLWA's SWP maximum Table A Amount to 95,200 AFY because it was a permanent transfer/reallocation of SWP Table A entitlement between SWP contractors." It stated further, "an adverse outcome in the Monterey Agreement litigation is not likely to adversely affect CLWA's water supplies over the long term because CLWA believes that such a result is unlikely to 'unwind' executed and completed agreements with respect to the permanent transfer of SWP Water Amounts."

Thus, the draft EIR characterized the Kern-Castaic transfer as "permanent" and downplayed the likelihood that the "permanent transfer" could be affected by the Monterey Agreement litigation. The draft EIR did not acknowledge the possibility that the environmental review of the Monterey Agreement by the Department of Water Resources could result in the modification of the Kern-Castaic transfer and a reduced allocation to the Castaic Lake Water Agency.

The draft EIR estimated the amounts of groundwater and imported water supplies that would be available in the project area. The estimate of imported water supplies was based on different percentages of the total Table A amount for average years and dry years. The draft EIR also estimated the demand for water and concluded that the supplies would be sufficient to meet the demand.

Several comments to the draft EIR objected to its reliance on the Kern-Castaic transfer and stated that the transfer was uncertain due to pending litigation and the absence of a certified EIR for either the transfer or the Monterey Agreement. The city in a "topical response" to the comments reiterated the discussion in the EIR of the reasons that it considered the transfer reliable "despite potential uncertainty arising from

litigation." The topical response stated, "Because the 41,000 AFY was a permanent water transfer, because DWR includes the 41,000 AFY in calculating CLWA's share of SWP Table A Amount, and because the courts have not prohibited CLWA from using or relying on those additional SWP supplies, the City has determined that it remains appropriate for the Riverpark project to include those water supplies in its water supply and demand analysis, while acknowledging and disclosing the potential uncertainty created by litigation." It stated further that the ongoing environmental review by the Department of Water Resources of the Monterey Agreement, including the Kern-Castaic transfer, did not preclude the city's reliance upon the transfer in these circumstances.

The city's findings under CEQA stated that the project would have no significant impacts on water supply and that no mitigation was required.

e. *The EIR Adequately Analyzed the Uncertainty of the Kern-Castaic Transfer*

We repeat with emphasis, "An EIR for a land use project must address the impacts of likely future water sources, and the EIR's discussion must include a reasoned analysis of the circumstances affecting the likelihood of the water's availability. (*California Oak*, *supra*, 133 Cal.App.4th at p. 1244.)" (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 432.) The sufficiency of an analysis in an EIR is measured by reference to a practical standard that demands neither technical perfection nor full disclosure of all information available on a subject. (*Berkeley Keep Jets Over the Bay Com. v. Board of Port Cmrs.* (2001) 91 Cal.App.4th 1344, 1355; *Al Larson Boat Shop, Inc. v. Board of*

Harbor Commissioners (1993) 18 Cal.App.4th 729, 748.) "The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure." (Guidelines, § 15151.) " 'To facilitate CEQA's informational role, the EIR must contain facts and analysis, not just the agency's bare conclusions or opinions.' [Citations.] An EIR must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (*Laurel Heights I*, *supra*, 47 Cal.3d at pp. 404-405.) The role of a reviewing court is not to determine whether the EIR's conclusions are correct, but only whether they are supported by substantial evidence and sufficient analysis to serve the EIR's informational purposes. (*Id.* at p. 407.)

The absence of relevant information from an EIR does not necessarily constitute a prejudicial abuse of discretion. Rather, a prejudicial abuse of discretion occurs only if the absence of relevant information precludes informed decisionmaking and informed public participation and thereby thwarts the statutory goals of the EIR process. (*Berkeley Keep Jets Over the Bay Com. v. Board of Port Cmrs.*, *supra*, 91 Cal.App.4th at p. 1355.)

The draft EIR and the final EIR, including the responses to comments, explained at length and in detail the reasons for the city's conclusion that water provided by the State Water Project pursuant to the Kern-Castaic transfer would continue to be available to serve the area of the proposed project. The analysis provided was incomplete because it failed to acknowledge the possibility that the environmental review of the Monterey Agreement by the Department of Water Resources could result in the

modification of the transfer and a reduced allocation to the Castaic Lake Water Agency. In our view, the analysis nonetheless was "a reasoned analysis" (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 432) that was adequate in these circumstances. This is true particularly in light of the indications that the Department of Water Resources, Castaic Lake Water Agency, and Kern County Water Agency did not wish to disturb the transfer and the fact that the trial courts and Courts of Appeal in the litigation directly involving the Monterey Agreement and the Kern-Castaic transfer never vacated the approval of either of those projects or enjoined the flow of water. These circumstances do not compel the conclusion that the transfer will be "permanent," but they support our conclusion that the failure to acknowledge the uncertainty of the transfer arising from the department's ongoing environmental review of the Monterey Agreement was not so momentous as to render the analysis provided in the EIR inadequate for its informational purposes.

The water supply analysis here did not rely on inconsistent figures or "vague and unquantified" water supplies (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 440), or fail to provide a complete and coherent analysis of water supply and demand as did the analysis of long-term water supply in *Vineyard Area Citizens*. Moreover, the city did not fail to comply with procedures required by law by, for example, deferring environmental review to a future EIR (*id.* at pp. 440-441), relying on a prior EIR without proper incorporation or tiering (*id.* at pp. 442-443), or relying on a provision precluding further development in lieu of identifying and analyzing the project's intended and likely water sources (*id.* at p. 444).

California Oak, *supra*, 133 Cal.App.4th 1219 is distinguishable. *California Oak* involved a proposed industrial/business park in Santa Clarita. (*Id.* at p. 1224.) The city certified an EIR and approved the project in June 2003. (*Id.* at p. 1225.) The primary dispute on appeal concerned the same 41,000 acre-feet of State Water Project water allocation at issue here. The text of the EIR failed to mention the January 2002 invalidation of the Castaic Lake Water Agency's EIR for the Kern-Castaic transfer and offered no explanation for the city's continued reliance on the transfer (*id.* at p. 1236), and apparently also failed to mention the invalidation of the Monterey Agreement EIR. The city's response to comments was "completely devoid of any direct discussion of the 41,000 AFY" (*id.* at p. 1237) and only referred obliquely to litigation "challenge[s]" (*id.* at pp. 1232-1233). The only mention of the invalidation of the Castaic Lake Water Agency's EIR was in an appendix to the final EIR. (*Id.* at p. 1239.) *California Oak* stated that the issue should be discussed, or at least referenced, in the text of the EIR and that the brief mention of the invalidation in the appendix with no meaningful and forthright discussion was insufficient in any event.[10] (*Ibid.*) Absent a reasoned analysis in the EIR of the uncertainty created by the invalidation of the EIR for the Kern-Castaic transfer, *California Oak* concluded that there was no substantial evidence to support the

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[10] *Vineyard Area Citizens* later endorsed this view, stating, " '[I]nformation "scattered here and there in EIR appendices," or a report "buried in an appendix," is not a substitute for "a good faith reasoned analysis . . . ." ' (*California Oak*, *supra*, 133 Cal.App.4th at p. 1239, quoting *Santa Clarita*, *supra*, 106 Cal.App.4th at pp. 722-723." (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 442.)

conclusion that the water supplies for the project were sufficient. (*Id.* at pp. 1226, 1240.)

Here, in contrast to *California Oak*, *supra*, 133 Cal.App.4th 1219, the EIR contains a reasoned analysis of the circumstances affecting the availability of the 41,000 acre-feet of water allocation. The analysis is supported by facts and discloses pertinent facts, including the invalidation of both the Castaic Lake Water Agency's EIR for the Kern-Castaic transfer and the Department of Water Resource's EIR for the Monterey Agreement. The city's EIR neither relegates that discussion to an appendix to the final EIR nor assumes without analysis that the 41,000 acre-feet of water allocation will be available. In light of that discussion, the EIR's failure to acknowledge the particular uncertainty arising from the Department's ongoing environmental review of the Monterey Agreement stands in stark contrast to the complete failure to offer any reasoned analysis of the circumstances affecting the availability of the transferred water in *California Oak.*

Petitioners also argue that the EIR for the Kern-Castaic transfer should tier from the Monterey Agreement EIR and that absent a proper EIR for the transfer, the present EIR cannot rely on the transfer. The question whether the EIR for the Kern-Castaic transfer complies with CEQA is beyond the scope of this appeal. The EIR for the Kern-Castaic transfer is the subject of a separate mandamus proceeding and a separate appeal (No. B200673). Absent a judgment determining that the EIR for the Kern-Castaic transfer fails to comply with CEQA in the manner asserted, we will not determine in this appeal the merits of a separate proceeding.

Petitioners argue further that due to the uncertainty of the Kern-Castaic transfer, the EIR here was required to discuss alternative sources of water and the environmental impact of supplying water from those alternative sources. *Vineyard Area Citizens* stated, "[W]here, despite a full discussion, it is impossible to confidently determine that anticipated future water sources will be available, CEQA requires some discussion of possible replacement sources or alternatives to use of the anticipated water, and of the environmental consequences of those contingencies. (*Napa Citizens*, *supra*, 91 Cal.App.4th at p. 373.)" (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 432.) "If the uncertainties inherent in long-term land use and water planning make it impossible to confidently identify the future water sources, an EIR may satisfy CEQA if it acknowledges the degree of uncertainty involved, discusses the reasonably foreseeable alternatives—including alternative water sources and the option of curtailing the development if sufficient water is not available for later phases—and discloses the significant foreseeable environmental effects of each alternative, as well as mitigation measures to minimize each adverse impact. ([Pub. Resources Code,] § 21100, subd. (b).)" (*Id.* at p. 434.)

Napa Citizens, *supra*, 91 Cal.App.4th 342, involved a subsequent EIR for an updated specific plan providing for the industrial development of a formerly agricultural area. (*Id.* at pp. 352-353.) The EIR stated that the City of American Canyon supplied water to the project area and would continue to do so in the future. The EIR acknowledged that American Canyon's current water supply would be inadequate in the longer term, but stated that American Canyon was in the process of reaching an

agreement with another municipality that would provide additional water. The EIR assumed that an agreement would be reached and therefore concluded that the project would have no significant impact on long-term water supply. (*Id.* at p. 372.) *Napa Citizens* concluded that the EIR could not rely on the uncertain water supplies without identifying alternative water sources and analyzing the environmental impacts of supplying water from those sources. *Napa Citizens* stated: "Because of the uncertainty surrounding the anticipated sources for water . . . , the FSEIR also cannot simply label the possibility that they will not materialize as 'speculative,' and decline to address it. The County should be informed if other sources exist, and be informed, in at least general terms, of the environmental consequences of tapping such resources. Without either such information or a guarantee that the resources now identified in the FSEIR will be available, the County simply cannot make a meaningful assessment of the potentially significant environmental impacts of the Project. [Citation.]" (*Id.* at pp. 373-374.)

We conclude that whether an EIR can "confidently determine that anticipated future water sources will be available" (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 432; see also *id.* at p. 434) is a question of fact. If the EIR confidently concludes that future water supplies will be sufficient to serve the project, and if that conclusion is supported by reasoned analysis and facts stated in the EIR, the EIR satisfies its informational purposes and a reviewing court must defer to the EIR's conclusion. (See *Laurel Heights*, *supra*, 47 Cal.3d at pp. 404-405, 407.) In those circumstances, the EIR need not evaluate alternative water sources and the environmental impacts of supplying

water from those sources. On the other hand, if the EIR reveals a substantial degree of uncertainty as to the availability of future water supplies, as in *Napa Citizens*, *supra*, 91 Cal.App.4th 342, the EIR must discuss alternative sources of water or alternatives to use of the water and the environmental impacts of those contingencies. (*Vineyard Area Citizens*, *supra*, 40 Cal.4th at p. 432 ["[W]here, despite a full discussion, it is impossible to confidently determine that anticipated future water sources will be available, CEQA requires some discussion of possible replacement sources or alternatives to use of the anticipated water, and of the environmental consequences of those contingencies"].)

After explaining in detail the circumstances affecting the availability of the imported water, the EIR here confidently concluded that water provided by the State Water Project pursuant to the Kern-Castaic transfer would continue to be available to serve the proposed project area despite the pending Monterey Agreement environmental review and litigation challenges. The EIR did not reveal a substantial degree of uncertainty as to the continued availability of the transferred water, unlike the situation in *Napa Citizens*, *supra*, 91 Cal.App.4th 342, where no agreement had been reached to secure the water transfer and no deliveries had occurred. We conclude that the facts stated in the EIR, including the executed agreements effecting the transfer, the implementation of those agreements and delivery of water for several years, and the absence of any court order vacating the approval of the transfer or the Monterey Agreement or staying the implementation of those agreements, constitute substantial evidence supporting the EIR's conclusion. Accordingly, we conclude that the EIR need

not identify alternative water sources or other alternatives to use of the anticipated water.

4. *Holly-Leaf Cherry*

Petitioners contend the EIR applied an incorrect legal standard in determining that the impacts on the holly-leaf cherry would be insignificant. They argue that in evaluating the impact of the proposed elimination of 3.6 acres of the species on the project site, the EIR failed to apply the Guidelines definition of "rare" (Guidelines, § 15380, subd. (b)(2)). We conclude that they have not shown a prejudicial abuse of discretion.

a. *CEQA Requirements*

A project will have a significant effect on the environment if it will cause "a substantial, or potentially substantial, adverse change in the environment." (Pub. Resources Code, § 21068; see also Guidelines, § 15382.) The "environment" means the existing physical conditions in the area of the proposed project, including flora, fauna, and other conditions. (Pub. Resources Code, § 21060.5; Guidelines, § 15360.) "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting." (Guidelines, § 15064, subd. (b).)

An EIR must identify and analyze the significant environmental effects of a project. (Pub. Resources Code, § 21100, subd. (b)(1); Guidelines, § 15126.2.) An

EIR must identify mitigation measures for each significant effect and discuss alternatives to the project that would avoid or substantially lessen the significant effects, and the lead agency must make detailed findings on the infeasibility of any mitigation measures and alternatives rejected as infeasible. (Pub. Resources Code, §§ 21100, subd. (b)(3), (4), 21081, subd. (a)(3); Guidelines, §§ 15126.4, subd. (a)(1)(A), 15126.6, subd. (a), 15091, subd. (a)(3).) If an EIR determines that particular environmental impacts are insignificant, it must "contain a statement briefly indicating the reasons for determining that various effects on the environment of a project are not significant and consequently have not been discussed in detail in the environmental impact report." (Pub. Resources Code, § 21100, subd. (c); see also Guidelines, § 15128.)

Guidelines section 15065 describes certain impacts that necessarily are significant and therefore require the preparation of an EIR and must be analyzed in an EIR. (*Id.* subds. (a), (c).) These are known as mandatory findings of significance. A project necessarily will have a significant effect on the environment if it will "substantially degrade the quality of the environment; substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; substantially reduce the number or *restrict the range of an endangered, rare or threatened species*; or eliminate important examples of the major periods of California history or prehistory." (Guidelines, § 15065, subd. (a)(1), italics added; see *Mountain Lion*, *supra*, 16 Cal.4th at p. 124 [equating "range" with "habitat"]; *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 Cal.App.4th 777, 792 (*Endangered Habitats*).)

Guidelines section 15065 describes impacts that must be considered significant, but "an impact need not satisfy the requirements of a mandatory finding of significance to be considered a significant impact." (*Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 322, 338, fn. 9.)

A species is "rare" under the Guidelines if "[a]lthough not presently threatened with extinction, the species is existing in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment worsens; or [¶] [t]he species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and may be considered 'threatened' as that term is used in the Federal Endangered Species Act."[11] (*Id.*, § 15380, subd. (b)(2).) A species also is "presumed to be endangered, rare or threatened, as it is listed in" federal regulations under the Federal Endangered Species Act and California regulations under the Fish and Game Code. (Guidelines, § 15380, subd. (c).) "A species not included in any listing identified in subdivision (c) shall nevertheless be considered to be endangered, rare or threatened, if the species can be shown to meet the criteria in subdivision (b)." (*Id.*, subd. (d).)

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[11] A species is "endangered" under the Guidelines if "its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, disease, or other factors." (Guidelines, § 15380, subd. (b)(1).)

b. *Draft EIR, Response to Comments, and the City's Findings*

A rare plant survey conducted in the spring of 2003 and attached as an appendix to the draft EIR described "a unique stand of holly-leaf cherry scrub" on the project site. The survey stated, "The stand is dominated by relatively large, mature shrubs of holly-leaf cherry (*Prunus ilicifolia* ssp. *ilicifolia*), 3 to 5 m in height." It stated that although "mainland cherry forest" is ranked "very threatened" by the California Natural Diversity Database, "[t]he canopy cover of the holly-leaf cherry shrubs at this site did not amount to a forest canopy. Holly-leaf cherry scrub, as identified in this survey, is not defined in Holland (1986), and therefore, it has no assigned ranking. However, it should be recognized as a unique and sensitive community at the site."

The draft EIR described the holly-leaf cherry on the project site and stated that the project would result in the direct and permanent loss of 3.6 acres of holly-leaf cherry, which it quantified as approximately 67.9 percent of the holly-leaf cherry on the site. It stated further, "Because holly-leaf cherry scrub on the project site is not known to support special-status plant or wildlife species, and because this plant community is not considered to be sensitive by resource agencies, the loss of 3.6 acres of this habitat type is not considered a significant impact." The draft EIR defined "special-status plant or wildlife species" as "those species considered Rare, Threatened, Endangered, or otherwise sensitive by various state and federal resource agencies," and identified several published listings used as references.

The Department of Fish and Game stated in a comment letter: "The Department considers holly-leafed cherry woodland a declining vegetative community the loss of

which would be considered a significant adverse impact to wildlife habitat. This vegetative community is being systematically eliminated and/or degraded within the Santa Clara River watershed by development. . . . All holly-leafed cherry habitat should be avoided by project alternatives." The comment stated further that even temporary impacts to the plant community involving removal and replanting "will still result in an unacceptable impact to this resource."

The city responded: "The holly-leaf cherry habitat on-site is considered scrub habitat because the canopy cover of this habitat did not amount to a woodland canopy. According to the CDFG's [California Department of Fish and Game] List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Data Base (September 2003 Edition), holly-leaf cherry scrub is not considered a special-status plant community. As stated in Revised Riverpark Draft EIR Section 4.6, Biological Resources, p. 4.6-65, because of the relatively small amount of habitat (3.6 acres) to be lost and because this stand of trees was not considered a sensitive plant community as identified by CDFG, the loss of the 3.6 acres was not considered a significant impact under CEQA."

The city's findings under CEQA stated that the impacts of the proposed project on the holly-leaf cherry would be less than significant.

c. *The EIR Adequately Analyzed the Impacts on the Holly-Leaf Cherry*

The draft EIR described the holly-leaf cherry on the project site and explained the impact of the project on the species. It stated that holly-leaf cherry scrub was not

a designated special status species and was not considered to be sensitive by the resource agencies, and that the loss of 3.6 acres of the species was not a significant impact. The response to the comment explained that the holly-leaf cherry on the project site was in scrub habitat rather than woodland, and therefore was different from the holly-leaf cherry woodland noted by the Department of Fish and Game to be in decline. We conclude that the information provided in the EIR supports the conclusion that the holly-leaf cherry on the project site is not "rare" as defined in Guidelines section 15380(b)(2) because it is not existing in such small numbers that it may become endangered, and that it does not otherwise satisfy the Guidelines definition. The EIR provided information and analysis sufficient to serve the EIR's informational purposes, and Petitioners have shown no abuse of discretion.

5. *San Diego Black-tailed Jackrabbit*

Petitioners contend the EIR failed to apply the correct legal standard to determine the significance of impacts on the San Diego black-tailed jackrabbit, and the evidence does not support the city's finding that the impact on the species will be less than significant. We conclude that they have not shown a prejudicial abuse of discretion.

a. *Draft EIR, Response to Comments, and the City's Findings*

The draft EIR stated that the San Diego black-tailed jackrabbit is designated by California as a species of special concern and is designated by the federal government as a species of concern. It stated that several San Diego black-tailed jackrabbits had been observed on the project site in areas that are subject to natural or manmade disturbances and that the species' habitat on site is considered to be of moderate quality.

It stated: "Where this species occurs within the region, it is common and found in relatively high numbers in some locations (e.g., coastal Orange County and the high desert of northern Los Angeles County). The habitat on the project site for this species is considered of moderate quality. Most individual jackrabbits are expected to disperse to remaining open space areas and the actual number of individual animals that would be lost due to grading and/or construction activities is expected to be low. Because this species is not state or federally listed as Endangered or Threatened, because it is considered relatively abundant in suitable habitat areas within its range, and because the direct loss of individual jackrabbits is expected to be low, it is expected that the regional population would not drop below a self-sustaining level with the implementation of this project. Therefore, the loss of any individual jackrabbits associated with the implementation of this project would not be considered a significant impact."
A biology report in the appendix stated that the species was "relatively common in the project area."

The draft EIR also described the Natural River Management Plan (NRMP), a long-term management plan for projects and activities potentially affecting the Santa Clara River and San Francisquito Creek. It stated that a certified combined EIR and federal environmental impact statement (EIS) for the NRMP had analyzed impacts associated with various proposed infrastructure improvements along the Santa Clara River, including bank stabilization, bridges, utility crossings, and storm drain outlets, and that the United States Army Corps of Engineers, Department of Fish and Game, and California Regional Water Quality Control Board had approved the NRMP. It also

stated that certain proposed infrastructure improvements on the project site (including two bridges, bank stabilization, and outlets) were governed by the NRMP and were subject to mitigation requirements imposed by the NRMP, including the capture of San Diego black-tailed jackrabbits and their relocation "to nearby undisturbed areas with suitable habitat," and the creation or enhancement of habitat for jackrabbits and other species. The draft EIR stated that those mitigation measures had been incorporated into the proposed project.

The draft EIR concluded that although the project impacts to the San Diego black-tailed jackrabbit would be insignificant, cumulative impacts to biological resources, apparently including the San Diego black-tailed jackrabbit, from the proposed project and related projects would be significant due to loss of habitat and increased human activities.

The Department of Fish and Game stated in a written comment: "The DEIR states that the San Diego black-tailed jackrabbit is common where it occurs in the region and abundant in coastal Orange County and the high deserts of Los Angeles County; that displaced individuals of this jackrabbit species will disperse to remaining open space; and that individuals lost i.e. killed by the project is expected to be low. This conclusion is difficult to draw since population estimates were not submitted with the DEIR.

"It is the Department's opinion that the project will result in a cumulative adverse impact to San Diego black-tailed jackrabbit, a California Species of Special Concern. This subspecies is localized within the coastal plains of southern California

including the Santa Clara River Valley. These areas have been and are continuing to be heavily developed and degraded. Jackrabbits do not adapt well to habitat losses and associated disturbances from human proximity. . . . The assumption that displaced jackrabbits will somehow survive by dispersing into remaining degraded open areas of uncertain protected status does not meet the mitigation requirements set forth and described under Section 15021 of CEQA. Insufficient mitigation measure for this subspecies will further assist its decline and may in the future cause more restrictive regulatory measures to protect this resource. The Department recommends a more detailed discussion in the EIR of the project related impacts to San Diego black-tailed jackrabbit with a tangible habitat avoidance and/or preservation element."

The city responded that because the habitat on site is "moderate in quality," "the Riverpark site is not considered to be occupied by a significant population of San Diego black-tailed jackrabbits." The response stated that NRMP mitigation measures had been incorporated into the proposed project with respect to infrastructure improvements governed by the NRMP. It stated that the EIR/EIS for the NRMP had analyzed in detail the impacts on the San Diego black-tailed jackrabbit and had concluded that certain NRMP mitigation measures "requiring capture and relocation of sensitive species including the San Diego black-tailed jackrabbit, and . . . replacement of habitat . . . reduced the impacts to less than significant." The response stated further that some of the infrastructure improvements in the proposed project were less extensive than those contemplated in the NRMP. The response also noted that the draft EIR had

concluded that cumulative impacts due to the loss of habitat were significant and unavoidable.

The city's findings under CEQA stated that the cumulative impacts on biological resources were unavoidable, and the city adopted a statement overriding considerations with respect to that cumulative impact.

b. *The EIR Adequately Analyzed the Impacts on the San Diego Black-tailed Jackrabbit*

The draft EIR explained its conclusion that the project's impacts on the San Diego black-tailed jackrabbit would be insignificant. It stated that the jackrabbit habitat on site was only moderate in quality, that the species is relatively common in other areas within the region, that most individuals of the species are expected disperse to other areas, and that the species is not designated endangered or threatened. The draft EIR also stated that mitigation measures from the NRMP had been incorporated into the project, including the capture and relocation of individual jackrabbits to suitable habitat nearby and the creation or enhancement of habitat for the species. The response to the comment explained further that the jackrabbit population on the site was low.

The statement that the species is relatively common in the region is supported by the statement in the biology report to that effect. The characterization of the habitat on site as only moderate in quality and the statement that individual jackrabbits are likely to disperse to other areas also are supported by substantial evidence, which "includes fact, a reasonable assumption predicated upon fact, or expert opinion supported by fact" (Pub. Resources Code, § 21080, subd. (e)(1)).

We conclude further that the information provided in the EIR supports the conclusion that the San Diego black-tailed jackrabbit is not "rare" as defined in Guidelines section 15380(b)(2) because it is not existing in such small numbers that it may become endangered, and that it does not otherwise satisfy the Guidelines definition. The EIR provided information and analysis sufficient to serve the EIR's informational purposes, and Petitioners have shown no abuse of discretion.

Endangered Habitats, *supra*, 131 Cal.App.4th 777, is distinguishable. The EIR in *Endangered Habitats* stated that an environmental impact was considered significant only if it caused the population of a species to drop below a self-perpetuating level or caused the species to become threatened or endangered. (*Id.* at pp. 792-793.) *Endangered Habitats* concluded that that was an impermissibly lenient standard and that the county failed to proceed in the manner required by law. (*Id.* at p. 793.) Here, in contrast, the statement in the EIR, "it is expected that the regional population would not drop below a self-sustaining level with the implementation of this project" was not the sole reason provided for the conclusion that the project's impacts on the San Diego black-tailed jackrabbit would be insignificant. Rather, the EIR also explained that the impacts would be insignificant because the jackrabbit population on the site was low, the habitat on site was only moderate in quality, and because individual jackrabbits were likely to disperse to other areas.

6. *Western Spadefoot Toad*

Petitioners challenge the EIR's failure to discuss project revisions or alternatives that would reduce the significant impacts on the western spadefoot toad to an

insignificant level. They argue that the proposed mitigation of constructing ponds and relocating the toads is inadequate and the city was required to consider more effective feasible mitigation. We conclude that Petitioners have not shown an abuse of discretion.

a. *Draft EIR, Response to Comments, and the City's Findings*

The city circulated a revised biological resources section of the draft EIR in March 2004 after the discovery of western spadefoot toads on the project site. The western spadefoot toad is designated by California as a species of special concern and by the federal government as a species of concern. The draft EIR estimated that 16 to 20 pairs of breeding western spadefoot toads were present in three seasonal rainpools on the site, all of which were located in areas of proposed development. A biology report in the appendix described the three seasonal rainpools. The draft EIR stated that the potential loss of that population of toads and their eggs would be a significant impact.

The draft EIR recommended several mitigation measures described in the biology report, including the construction of ponds, of a design and location to be approved by the Department of Fish and Game, and the capture and relocation of western spadefoot toads and their eggs to the new ponds. The biology report stated that although very few attempts had been made to relocate western spadefoot toads, there was "a very good possibility of success." The draft EIR concluded nonetheless that the impacts would remain significant despite mitigation: "While mitigation measures can be implemented to create habitat and relocate individuals observed on the project site, these measures are not considered highly effective. It is expected that not all individual

toads would be captured and relocated and that the created habitat might not meet the specific requirements for this species, thus, not supporting the relocated individuals. The loss of those individuals that are not captured and relocated, and those that are not adaptable to the created habitat, would be considered a significant and unavoidable impact."

The Department of Fish and Game stated in a written comment: "The continual loss of western spadefoot habitat within the Santa Clarita Valley, and Southern California as a whole, concerns the Department. The seasonal pools and associated uplands and floodplains habitats associated with the species are often lost with project development. Mitigation measures for this species are often experimental, and not always successful. The recent discovery of western spadefoot on the project site, despite past negative survey results for this species suggests the potential undocumented loss of occupied habitat for this species in the Santa Clarita area. These potential undocumented losses increase the importance of the known populations on the project site. The preservation, avoidance and protection of all existing seasonal pools which support or could support western spadefoot should be accomplished on the project site." The department stated further that if habitat avoidance is not feasible, breeding pools should be created away from areas of human activity and at least 150 feet away from any road or recreational trail.

The city responded that the existing seasonal pools were in disturbed areas and cited a discussion in another EIR stating that the western spadefoot toad " 'is apparently capable of adapting to a variety of artificial habitats in which to breed.' " The response

stated that this "illustrates that the species adapts well to disturbed environments." It also stated: "[W]estern spadefoot toads have no federal or State protected status, but are classified only as California Species of Special Concern and as a federal Species of Concern, which indicates that the species warrants monitoring due to population decline. Therefore, the species is not entitled to legal protection and a project redesign to preserve existing habitat is not required." The Department of Fish and Game later approved a habitat enhancement and relocation plan for the western spadefoot toad on the site.

The city's findings under CEQA stated that the proposed project's impacts on the western spadefoot toad cannot feasibly be mitigated to a level of insignificance and therefore are considered unavoidable, and the city adopted a statement of overriding considerations with respect to those impacts.

b. *The Discussion of Measures to Mitigate the Impacts on the Western Spadefoot Was Adequate*

CEQA does not require the avoidance of all significant environmental impacts or ensure that an approved project will minimize environmental harm. Rather, an adequate EIR that complies with CEQA's procedural requirements and serves its purpose as an informational document, together with appropriate findings by the lead agency, can support an agency's decision to approve the project despite adverse environmental consequences.

An EIR must discuss mitigation measures designed to avoid or reduce each significant impact, but need not discuss project alternatives that would avoid each

significant impact. (*Big Rock Mesas Property Owners Assn. v. Board of Supervisors* (1977) 73 Cal.App.3d 218, 227; see 1 Kostka & Zischke, Practice Under the California Environmental Quality Act (Cont.Ed.Bar 2006) § 15.15, p. 745.) Rather, an EIR must discuss a reasonable range of alternatives to the proposed project as a whole. (*Big Rock Mesas*, *supra*, at p. 227.) The draft EIR discussed several project alternatives, including a no project alternative that would not disturb the existing seasonal rainpools. Petitioners do not challenge the reasonableness of the range of alternatives. We conclude that the discussion of measures to mitigate the significant impacts on the western spadefoot toad was sufficient to serve CEQA's informational purposes and therefore was adequate, that the EIR need not discuss either a project revision or alternative (other than the no project alternative) that would reduce the impacts to the species to an insignificant level, and that Petitioners have shown no abuse of discretion in this regard.

Petitioners challenge the statement in the city's response to comments that "the species is not entitled to legal protection and a project redesign to preserve existing habitat is not required." They argue that the city declined to consider any project revision or alternative to avoid significant impacts to the western spadefoot toad and therefore could not reasonably conclude that the significant impacts to the species are unavoidable. We construe the statement to mean not that the city believed that it had no obligation to avoid or reduce the significant impacts to the western spadefoot toad, if feasible, but that the city understood that it had the discretion to determine that the

benefits of the project outweighed the significant impacts to the species. Petitioners have not shown an abuse of discretion.

7. *Consistency with the General Plan*

Every county and city must adopt a "comprehensive, long-term general plan" for its physical development. (Gov. Code, § 65300.) A general plan must include "a statement of development policies and . . . objectives, principles, standards, and plan proposals." (*Id.*, § 65302.) A general plan embodies fundamental policy decisions (*Goleta Valley*, *supra*, 52 Cal.3d at p. 571) and serves as a "charter for future development" (*Lesher Communications, Inc. v. City of Walnut Creek* (1990) 52 Cal.3d 531, 540). "The policies in a general plan typically reflect a range of competing interests. [Citation.]" (*Federation of Hillside & Canyon Assns. v. City of Los Angeles* (2004) 126 Cal.App.4th 1180, 1194.)

A subdivision must be consistent with applicable general and specific plans. (Gov. Code, §§ 66473.5, 66474.) A subdivision is consistent with an adopted plan only if "the proposed subdivision or land use is compatible with the objectives, policies, general land uses, and programs specified in such a plan." (*Id.*, § 66473.5.)

Consistency does not require full compliance with all general and specific plan policies. Rather, "[o]nce a general plan is in place, it is the province of elected city officials to examine the specifics of a proposed project to determine whether it would be 'in harmony' with the policies stated in the plan. [Citation.]" (*Sequoyah Hills Homeowners Assn. v. City of Oakland* (1993) 23 Cal.App.4th 704, 719 (*Sequoyah Hills*).) A local agency has unique competence to interpret the policies of its own

general plan and weigh competing interests in determining how to apply those policies. (*Save Our Peninsula Committee v. Monterey County Bd. of Supervisors*, *supra*, 87 Cal.App.4th at p. 142; *Sequoyah Hills*, *supra*, at p. 719.) "It is, emphatically, *not* the role of the courts to micromanage these development decisions." (*Sequoyah Hills*, *supra*, at p. 719.)

We review the city's finding that the subdivision is consistent with its general plan under the abuse of discretion standard. (Code Civ. Proc., § 1094.5, subd. (b); *Youngblood v. Board of Supervisors* (1978) 22 Cal.3d 644, 651, fn. 2; *Sequoyah Hills*, *supra*, 23 Cal.App.4th at p. 717.) To prevail on their contention that the project is inconsistent with the general plan, Petitioners must show that there is no substantial evidence to support the city's finding. (Code Civ. Proc., § 1094.5, subd. (b); *Sequoyah Hills*, *supra*, at p. 717.) In other words, Petitioners must show that no reasonable decision maker could conclude that the project is in harmony with the stated policies. (*No Oil, Inc. v. City of Los Angeles* (1987) 196 Cal.App.3d 223, 243.)

The Open Space and Conservation Element of the city's general plan states several goals and policies promoting the protection of natural features, significant ecological resources, and SEA's. The general plan goals cited by Petitioners include: "To preserve the special natural features which define the Santa Clarita planning area and give it its distinct form and identity," and, "To protect significant ecological resources and ecosystems, including, but not limited to, sensitive flora and fauna habitat areas." The general plan policies cited by Petitioners include: "Utilize major environmental features (significant landforms, significant ridgelines, significant

vegetation, ecologically significant areas, other natural resources) as open space within the planning area," "Identify and protect areas of significant ecological value, including, but not limited to, significant ecological habitats . . . and preserve and enhance existing Significant Ecological Areas (SEAs)," and "Preserve to the extent feasible natural riparian habitat and ensure that adequate setback is provided between riparian habitat and surrounding urbanization." Petitioners also cite a Land Use Element policy that "New development must be sensitive to the Significant Ecological Areas (SEAs) through utilization of creative site planning techniques to avoid and minimize disturbance of these and other sensitive areas."

The draft EIR discussed these general plan goals and policies. It stated that the proposed project would preserve the Santa Clara River and much of the significant vegetation on the site, restrict development on the steepest slopes on the site, and mitigate impacts on the portions of the SEA located on the project site, and concluded that the project was consistent with these goals and policies. The draft EIR also discussed numerous other general plan goals and policies and the project's consistency with them. The city in approving the project found that the project would preserve large areas of open space, including the river, and that the project was consistent with the general plan.

Petitioners' argument that the project is inconsistent with the cited general plan goals and policies is based on the presumption that any development incursion within the SEA necessarily would be inconsistent with those goals and policies. The argument largely disregards the city's considerable discretion to determine that the project, on

balance, is in harmony with those goals and policies, and merely expresses Petitioners' contrary point of view. Moreover, Petitioners focus only on particular goals and policies and do not attempt to show, and have not shown, that the project necessarily is inconsistent with the general plan as a whole. We conclude that they have not shown an abuse of discretion.

DISPOSITION

The judgment is affirmed. The city and Newhall are entitled to recover their costs on appeal.

NOT TO BE PUBLISHED IN THE OFFICIAL REPORTS

CROSKEY, J.

WE CONCUR:

KLEIN, P. J.

KITCHING, J.

I-2

WATER SUPPLY ASSESSMENT

SANTA CLARITA WATER DIVISION

REQUIRED WATER SUPPLY ASSESSMENT (WSA) (SB 610)
Water Code § 10910 *et seq.*

TO: (The Lead Agency)
Department of Regional Planning
County of Los Angeles
320 West Temple Street
Los Angeles, CA 90012-3225

(Applicant's Name and Address)
Pardee Homes
26650 The Old Road, Suite 110
Valencia, California 91381

Project Information

Project Title: Skyline Ranch Project / Tract Map No. 060922

- ☒ Residential: No. of dwelling units: 1,270
- ☐ Shopping center or business: No. of employees _____, Sq. ft. of floor space _____
- ☐ Commercial office: No. of employees _____, Sq. ft. of floor space _____
- ☐ Hotel or motel: No. of employees _____, Sq. ft. of floor space _____
- ☐ Industrial, manufacturing, or processing: No. of employees _____, Sq. ft. of floor space _____
- ☐ Mixed use (check and complete all above that apply)
- ☐ Other: _____
- ☐ Number of existing service connections zero.

Water Supply Assessment (WSA) (see supporting documents)

On September 10, 2008 the Board of Directors of the Castaic Lake Water Agency, Santa Clarita Water Division (name of water purveyor) made the following determination regarding the above-described project:

☐ The projected water demand for the project ☒ was ☐ was not included in Santa Clarita Water Division most recently adopted Urban Water Management Plan.

☒ A sufficient water supply **is** available for the project.
The total water supplies available to Santa Clarita Water Division and multiple-dry years with a 20-year projection will meet the projected water demand of the project in addition to the demand of existing and other planned future uses, including, but not limited to, agricultural and manufacturing uses.

☐ A sufficient water supply **is not** available for the project. [Plan for acquiring and developing sufficient water supply attached. Water Code § 10911(a)]

☐ A sufficient water supply **will be** available based on the attached plan (Sec 10911 of the WC)

The foregoing determination is based on the following Water Supply Assessment Information and supporting information in the records of Santa Clarita Water Division (name of water purveyor)

Signature	Title	Date
	Water Resources Planner	September 11, 2008

FINAL

SB 610 WATER SUPPLY ASSESSMENT

FOR THE SKYLINE RANCH PROJECT

September 2008

Prepared By:

SANTA CLARITA WATER DIVISION

Castaic Lake Water Agency

22722 Soledad Canyon Road
Santa Clarita, California 91350
(661) 259-2737

Table of Contents

1.0 INTRODUCTION 3

1.1 Background 3

1.2 Purpose 7

1.3 CLWA's 2005 Urban Water Management Plan 7

1.4 SCWD Policies, Annexation Requirements, Regulatory Approvals and Permits 9

1.5 Information Relied Upon in Preparation of this WSA 9

2.0 EXISTING WATER RESOURCES 11

2.1 Imported Supplies 12

2.1.1 SWP Table A Amount 12

2.1.2 Additional Litigation Effects on Availability of SWP Table A Amount 16

2.1.3 Additional Annual Imported Water Supplies 18

2.1.4 Additional Imported Water Supplies from Banking Programs 18

2.2 Groundwater 19

2.2.1 Water Code §10910(f)(1) 20

2.2.2 Water Code §10910(f)(2) 20

2.2.3 Water Code §10910(f)(3) 21

2.2.4 Water Code §10910(f)(4) 21

2.2.5 Water Code §10910(f)(5) 21

2.2.6 Perchlorate Contamination 22

2.3 Recycled Water 23

3.0 PLANNED WATER RESOURCES 23

3.1 Water Transfers 23

3.2 Additional Banking Programs 23

3.3 Increased Dry-Year Saugus Formation Pumping 24

3.4 Additional Recycled Water 24

3.5 Water Conservation 25

4.0 WATER USE 26

4.1 Historical Water Use 26

4.2 Water Use of Project 28

4.3 Future Water Use 29

5.0 NORMAL, SINGLE-DRY, AND MULTIPLE-DRY YEAR PLANNING 30

5.1 Summary of Existing and Planned Supplies 30

5.2 Normal Water Year 32

5.3 Single-Dry Year **34**
5.4 Multiple-Dry Year **36**
6.0 CONCLUSION **38**

List of Tables

2-1 Average and Dry Period SWP Table A Deliveries from the Delta under Current Conditions
2-2 Average and Dry Period SWP Table A Deliveries from the Delta under Future Conditions
3-1 Future Reliability Enhancement Programs
4-1 Historical Water Use for SCWD
4-2 Historical Water Use for the Santa Clarita Valley Region
4-3 Water Use Estimate for the Project
4-4 Past, Current, and Projected Water Demands for SCWD
4-5 Regional Projected Water Demands
5-1 Summary of Existing and Planned Supplies
5-2 Projected Average/Normal Year Supplies and Demands
5-3 Projected Single-Dry Year Supplies and Demands
5-4 Projected Multiple-Dry Year Supplies and Demands

List of Figures

1-1 Skyline Ranch Project Location
1-2 Purveyor Map

1.0 INTRODUCTION

1.1 Background

Project Location

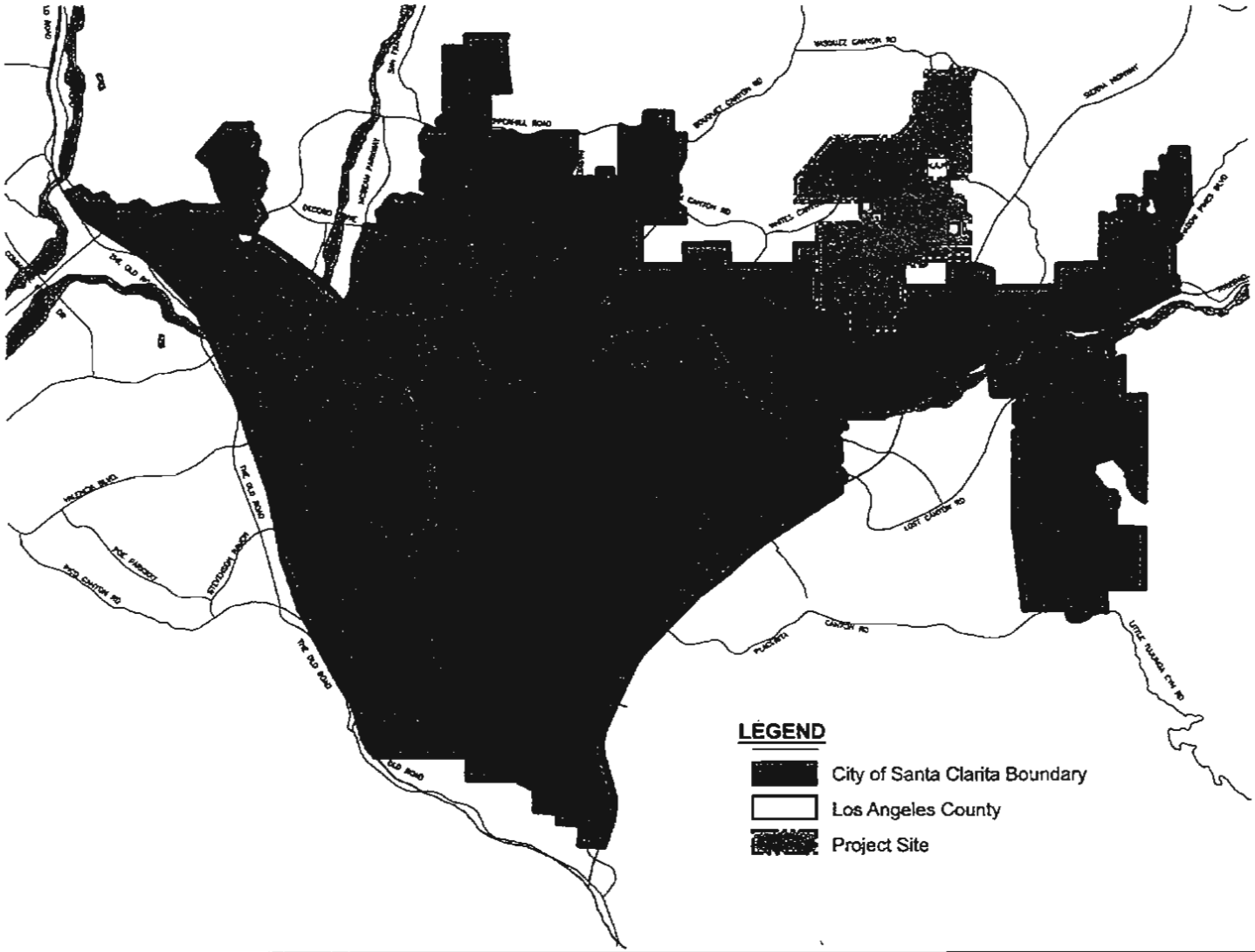
The 2,173-acre Skyline Ranch project (Project) site, Vesting Tentative Tract Map No. 060922, is located in the Santa Clarita Valley, north of Highway 14 (Antelope Valley Freeway) and the City of Santa Clarita, south of Vasquez Canyon Road, between Bouquet Canyon Road and Sierra Highway, in unincorporated Los Angeles County. The Project site includes various undeveloped parcels west of Sierra Highway between the Santa Clara River and Vasquez Canyon. The site is roughly defined by Sierra Highway (Mint Canyon) on the east and southeast, residential communities in Santa Clarita on the south and southwest, Plum Canyon Road on the west, Bouquet Canyon Road to the northwest, and Vasquez Canyon Road to the northeast. Figure 1-1 displays the location of the Project.

Project Description

The Project applicant proposes to develop approximately 620 acres of the site with 1,270 single-family residential lots, pads ranging in size from 5,775 to 7,350 square feet, an approximately 11-acre elementary school site, approximately 10 net acres of fully improved public parkland to be dedicated to the Los Angeles County Department of Parks and Recreation, and approximately 3 net acres of private parkland to be managed by a homeowners' association. Development is proposed for the southern portion of the property, where slopes of 25 percent or less predominate. Nearly three quarters of the site (the northern 1,553 acres) is proposed to remain undeveloped, with approximately 1,378 acres dedicated or designated as natural open space through establishment of the Skyline Ranch Conservation Area (SRCA). The Vesting Tentative Tract Map No. 060922 subdivides the development area of the Project property into 1,324 lots, including 1,270 residential lots (the proposed 1,270 single-family homes are be characterized by a traditional lot orientation at net densities ranging from 3.0 to 4.0 dwelling units per acre on lots with pads ranging in size from 5,775 to 7,350 square feet as stated above). Primary access to the tract is provided by the extension of Whites Canyon Road from Plum Canyon to the southeast through the Project interior, ultimately connecting to Sierra Highway.

Previous Water Supply Assessment

On January 24, 2007, the CLWA Board of Directors approved a Water Supply Assessment (WSA) for the project. Since that time the California Department of Water Resources has issued the 2007 State Water Project Delivery Reliability Report which reflects new areas of uncertainty and is distinguished from earlier reports by including estimates of the potential reductions to SWP delivery reliability due to the pelagic organism decline (POD) and future climate changes. In addition, there are new sources of water and banked water that have been added since the preparation of the 2005 Urban Water Management Plan. In order to have the most current information as part of the environmental review process for the project, the County of Los Angeles has requested a new WSA



Not to Scale

Figure 1-1
Project Location Map

Source: Silkand Engineering & PCR, 2007

SCWD Service and Infrastructure in the Project Area

In September 1999, the Castaic Lake Water Agency (CLWA) acquired the Santa Clarita Water Company, an investor-owned retail water company serving the eastern part of the Santa Clarita Valley. The former Santa Clarita Water Company became CLWA's Santa Clarita Water Division (SCWD), which continues to serve the same approximate area previously served by the Santa Clarita Water Company.

After the purchase, the legislature added Section 15.1 to the CLWA Law (Wat. Cod – App. §103-15.1) to clarify SCWD's ability to provide retail water service. Section 15.1 authorizes SCWD to exercise retail water authority within a specified area. SCWD's service area overlaps with portions of Newhall County Water District's (NCWD) boundaries. Within the overlap area, NCWD has the exclusive authority to provide water service, unless it consents to SCWD providing service. The proposed Project site is located within the overlap area discussed above. NCWD consented to SCWD serving the proposed Project by entering into a Memorandum of Understanding with CLWA on September 19, 2005. Accordingly, SCWD is authorized to serve the proposed Project pursuant to Section 15.1 of CLWA Law, Water Code Section 12944.7,[1] and the Memorandum of Understanding, Figure 1-2 depicts SCWD's and the remaining purveyors' service areas.

SCWD water supply infrastructure is the closest to the proposed Project site and SCWD would have the ability to more readily serve the proposed Project. The proposed Project's water system could ultimately connect to existing 8- and 10-inch pipelines located in Sierra Highway,. There are no existing service water lines on the proposed Project site.

SCWD distributes a combination of imported water from CLWA and groundwater from local wells. SCWD is one of four water purveyors in the Santa Clarita Valley and currently supplies a population of approximately 111,000 with approximately 28,000 service connections.

[1] Water Code Section 12944.7(b) provides in pertinent part that "If the principal act of the public agency restricts the agency to the wholesale distribution of water, the right to sell water directly to consumers may be exercised by the agency only pursuant to a written contract with (1) a wholesaler, if any exists, to which the water would otherwise be sold and (2) a public entity water purveyor, if any exists, serving water at retail within the area in which the consumer is located or a water corporation, if any exists, subject to regulation by the Public Utilities Commission and serving water at retail within the area in which the consumer is located."

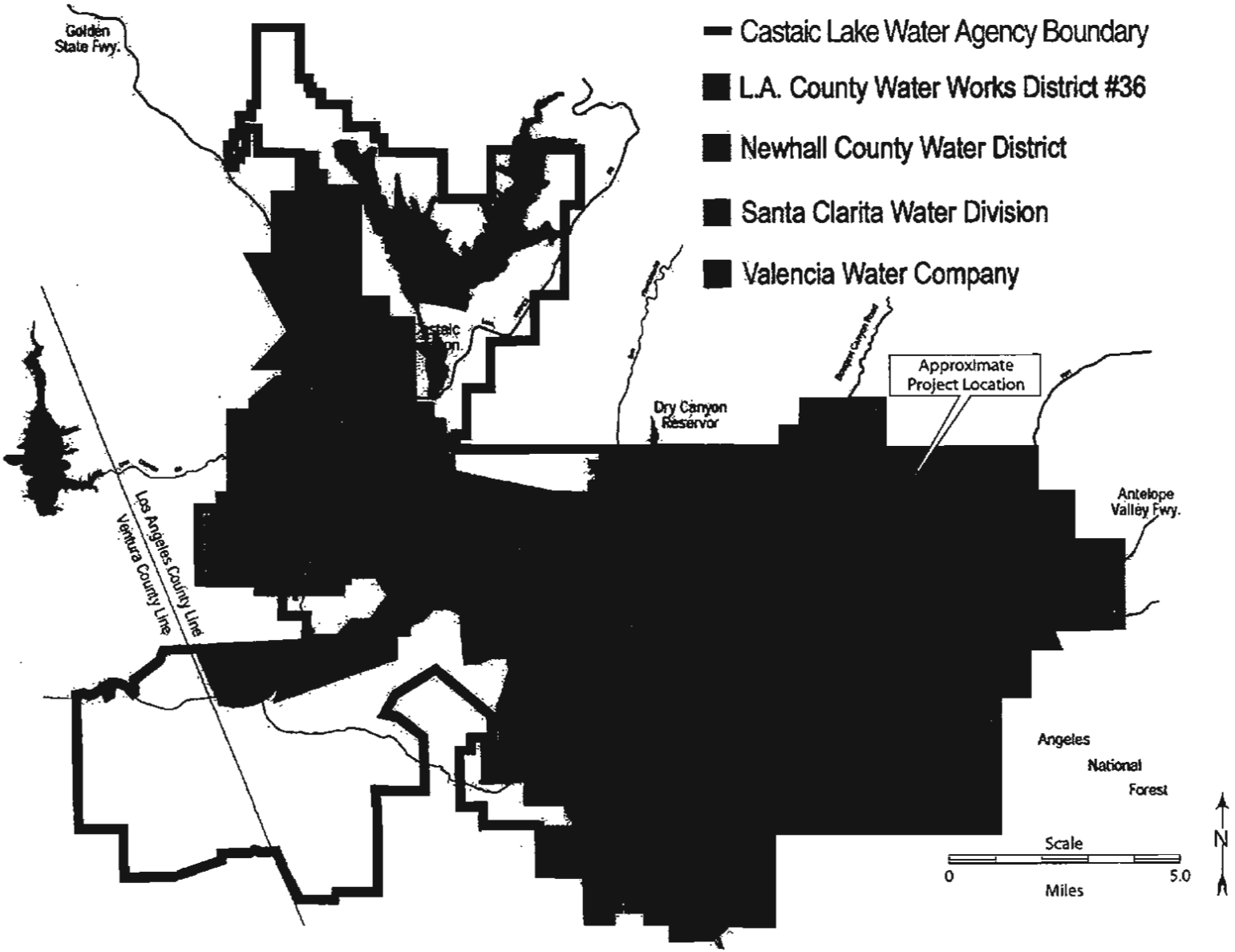


FIGURE 1-2
CLWA AND PURVEYORS' SERVICE AREAS
SKYLINE RANCH PROJECT

Source: Luhdorff & Scalmanini Consulting Engineers
Corrections based on Sikand Engineering 2004

1.2 Purpose

This WSA has been prepared pursuant to the requirements of applicable sections of the California Water Code and California Public Resources Code[2] as amended by Senate Bill 610 (SB 610) (Costa; Chapter 643, Stats. 2001) which became effective January 1, 2002. The legislative purpose of these amendments was to strengthen the process pursuant to which local agencies determine the adequacy of existing and planned future water supplies to meet existing and planned future demands on those water supplies.

Once it is determined that a project is subject to the California Environmental Quality Act (CEQA), SB 610 requires cities and counties to identify any public water system that may supply water for the project and to request that public water systems prepare a specified water supply assessment to be included in any environmental document prepared for the project.[3] The assessment includes, among other information, an identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts.

The purpose of this WSA is to answer the question:

Will the water supplier's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection meet the projected water demand of the proposed Project, in addition to the water supplier's existing and planned future uses, including agricultural and manufacturing uses?[4]

A WSA is required for any "project" that is subject to CEQA[5] and proposes, among other things, residential development of more than 500 dwelling units or a project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.[6] The Skyline Ranch project is a qualifying project under this definition.[7] This WSA will provide information to the County of Los Angeles for its consideration in making a determination as to whether there is a sufficient water supply available to serve the Skyline Ranch project. The WSA must be submitted to the County within 90 days of its request to the public water system.[8] The County of Los Angeles requested this WSA from SCWD on July 10, 2008.

1.3 CLWA's 2005 Urban Water Management Plan

SB 610 provides that if the projected water demand associated with the proposed Project was accounted for in the Urban Water Management Plan (UWMP) adopted by the retail water purveyor, then relevant information from that document may be incorporated into the SB 610 WSA. The 2005 UWMP was adopted by CLWA on November 9, 2005, and properly filed with the California Department of Water Resources (DWR). The 2005 UWMP was a regional

---

[2] SB 610 amended section 21151.9 of the California Public Resources Code, and amended sections 10631, 10656, 10910, 10911, 10912, and 10915 of, repealed section 10913 of, and added and amended section 10657 of, the California Water Code.

[3] Water Code § 10911(b), (c).

[4] Water Code § 10910 (c) (4).

[5] Public Resources Code § 21080.

[6] Water Code § 10912(a)(1),(7). This section also includes other types of development that are defined as a "project" by this section of the code.

[7] Water Code § 10912(a)(1).

[8] Prior to the expiration of the 90-day period, if the public water system intends to request an extension of time to prepare and adopt the WSA, the public water system shall meet with the city or county to request an extension of time, which shall not exceed 30 days, to prepare and adopt the WSA (Water Code § 10910 (g)(2)).

planning effort by CLWA and the Santa Clarita Valley water purveyors that built upon previous documents, specifically the 2000 UWMP, an amendment to the 2000 UWMP, and CLWA's 2003 Groundwater Management Plan - Santa Clara River Valley Groundwater Basin, East Subbasin.[9] The 2005 UWMP includes the following eight major sections:

1. Introduction
2. Water Use
3. Water Resources
4. Recycled Water
5. Water Quality
6. Reliability Planning
7. Demand Management Measures
8. Water Shortage Contingency Planning

The Project's associated water demand was included by SCWD in the water demand projections contained in the 2005 UWMP (see Table 2-3 in the 2005 UWMP) and, therefore, under SB 610 (Water Code section 10910(c)(2)) the development is considered accounted for in the most recently adopted urban water management plan.

In February 2006, the California Water Impact Network and Friends of the Santa Clara River ("petitioners") filed a lawsuit challenging the adequacy of the 2005 UWMP on multiple grounds, *California Water Impact Network v. Castaic Lake Water Agency* (Los Angeles County Superior Court). Petitioners' main arguments were that the 2005 UWMP overstated the reliability of both groundwater and surface water supplies, failed to provide an adequate discussion of perchlorate contamination, failed to adequately address the reliability of the 1999 SWP Table A permanent transfer of 41,000 afy from the Kern County Water Agency (KCWA) and its member unit (Wheeler Ridge-Maricopa Water Storage District) to CLWA, relied on a flawed model for predicting SWP deliveries, failed to address the effect of global warming and regulatory water quality controls on water deliveries from the SWP, and failed to identify the impact of private wells on the Santa Clarita River watershed. On August 3, 2007, the trial court issued a Statement of Decision in favor of CLWA and its retail agencies on all issues raised by Petitioners and finding the 2005 UWMP legally adequate. On August 22, 2007, Judgment was entered in favor of CLWA and the purveyors. On October 19, 2007, the Petitioners appealed this Judgment to the Second District Court of Appeal. That appeal remains pending. In the meantime, the 2005 UWMP must be assumed legally adequate, unless and until it is set aside by a court of competent jurisdiction. (Wat. Code § 10651; *Barthelemy v. Chino Basin Water Dist.* (1995) 38 Cal. App.4th 1607, 1609 [agency actions are presumed to comply with applicable law, until proof is presented to the contrary].) That has not occurred. Therefore, in SCWD's judgment, the 2005 UWMP still provides the best available information regarding water supply and demand projections, except for the effect of the operation changes in the SWP resulting from the decision in *Natural Resources Defense Council, et al. v. Kempthorne*, (discussed in section 2.1.1, infra).

[9] As required by Water Code section 10631, CLWA's 2005 UWMP includes a copy of CLWA's Groundwater Management Plan.

1.4 SCWD Policies, Annexation Requirements, Regulatory Approvals and Permits

SCWD Policies

The Project will be subject to all SCWD policies, rules and regulations that govern development and connection to the SCWD water system. It will be the responsibility of the Project applicant to make appropriate financial and contractual arrangements with SCWD. Following the receipt of the appropriate application, arrangements can be made for the installation of water facilities required to meet the needs of the Project.

Annexation Requirements

As described, the Project is currently within the boundaries of the SCWD and NCWD service areas. The Project site is subject to the aforementioned MOU between the CLWA and NCWD that will permit SCWD to serve the proposed Project. No annexation by SCWD or CLWA is required.

Regulatory Approvals and Permits

The State of California Department of Public Health and the County of Los Angeles will issue permits and regulatory approvals for constructing the necessary improvements to supply and deliver water to the Project.

1.5 Information Relied Upon in Preparation of this WSA

The following list identifies the documentation that has been relied upon in the preparation of this WSA. Copies of the referenced documents are available for review at CLWA by contacting Jeff Ford, (661) 297-1600, and can be obtained upon the payment of the costs of reproduction. These documents are part of SCWD's record of proceedings for the preparation of this WSA:

1. *2005 Urban Water Management Plan*, prepared for Castaic Lake Water Agency, CLWA Santa Clarita Water Division, Newhall County Water District, Valencia Water Company, Los Angeles County Waterworks District No. 36, prepared by Black & Veatch, Nancy Clemm, Kennedy Jenks Consultants, Jeff Lambert, Luhdorff & Scalmanini, Richard Slade and Associates, November 2005. (2005 UWMP)
2. *Analysis of Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California*, prepared in support of the August 2001 Memorandum of Understanding between the Upper Basin Water Purveyors and the United Water Conservation District, prepared by CH2M HILL in cooperation with Luhdorff & Scalmanini, August 2005. (Basin Yield Study, 2005)
3. *Interim Remedial Action Plan,* prepared for CLWA by Kennedy/Jenks Consultants, December 2005.
4. *Santa Clarita Valley Water Report 2005*, prepared for CLWA, Los Angeles County Waterworks District No. 36, Santa Clarita Water Division, Newhall County Water District and Valencia Water Company by Luhdorff and Scalmanini, Consulting Engineers, April 2006. (SCVWR, 2006)
5. *Santa Clarita Valley Water Report 2006*, prepared for CLWA, Los Angeles County Waterworks District No. 36, Santa Clarita Water Division, Newhall County Water District and Valencia Water Company by Luhdorff and Scalmanini, Consulting Engineers, May 2007. (SCVWR, 2007)
6. *Santa Clarita Valley Water Report 2007*, prepared for CLWA, Los Angeles County Waterworks District No. 36, Santa Clarita Water Division, Newhall County Water District and Valencia Water Company by Luhdorff and Scalmanini, Consulting Engineers, April 2008. (SCVWR, 2008)

7. *2001 Update Report: Hydrogeologic Conditions in the Alluvial and Saugus Formation Aquifer Systems*, prepared for Santa Clarita Valley Water Purveyors by Richard C. Slade and Associates, LLC, July 2002. (Slade, 2002)

8. *Revised Draft Additional Analysis to the Newhall Ranch Specific Plan and Water Reclamation Plant Final Environmental Impact Report*, prepared for Los Angeles County Department of Regional Planning, November 2002. (Newhall Ranch, 2002)

9. *CLWA Capital Improvement Program* prepared by Kennedy/Jenks Consultants, 2003.

10. *Water Supply Reliability Plan Draft Report* prepared for CLWA by Kennedy/Jenks Consultants, September 2003.

11. *Memorandum of Understanding Between Castaic Lake Water Agency and Newhall County Water District*, September, 2005.

12. *Memorandum of Understanding Between the Santa Clara River Valley Upper Basin Water Purveyors and United Water Conservation District*, August 2001. (MOU, 2001)

13. *Groundwater Management Plan - Santa Clara River Valley Groundwater Basin, East Subbasin*, prepared for CLWA by Luhdorff & Scalmanini Consulting Engineers, December 2003.

14. *Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration*, prepared for Upper Basin Water Purveyors (CLWA, CLWA Santa Clarita Water Division, Newhall County Water District and Valencia Water Company) by CH2M HILL, April 2004.

15. *Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property, Santa Clarita, California*, prepared for Upper Basin Water Purveyors in Support of the Department of Health Services 97-005 Permit Application by CH2M HILL, December 2004.

16. *Analysis of Near-Term Groundwater Capture Areas for Production Wells Located Near the Whittaker-Bermite Property (Santa Clarita, California)*, prepared for Upper Basin Water Purveyors in support of the amended 2000 UWMP by CH2M HILL, December 21, 2004.

17. *Mitigated Negative Declaration - Groundwater Containment, Treatment and Restoration Project*, CLWA, August 2005.

18. *Water Supply Contract Between the State of California Department of Water Resources and CLWA, 1963 (plus amendments, including the "Monterey Amendment," 1995, and Amendment No. 18, 1999, the transfer of 41,000 acre-feet of entitlement from Kern County Water Agency to CLWA).*

19. *2002 Semitropic Groundwater Storage Program and Point of Delivery Agreement Among the Department of Water Resources of the State of California, CLWA and Kern County Water Agency.*

20. *2002 Draft Recycled Water Master Plan* prepared for CLWA by Kennedy/Jenks Consultants.

21. *Draft Program Environmental Impact Report - Recycled Water Master Plan*, prepared for CLWA by Bon Terra Consulting, November 2006.

22. *Final Program Environmental Impact Report - Recycled Water Master Plan*, prepared for CLWA by Bon Terra Consulting, March 2007.

23. *2003 Semitropic Groundwater Storage Program* prepared for CLWA by Kennedy/Jenks Consultants.

24. *Draft Environmental Impact Report – Supplemental Water Project Transfer of 41,000 acre-feet of State Water Project Table A Amount*, prepared for CLWA by Science Applications International Corporation, June 2004.

25. *Final Environmental Impact Report – Supplemental Water Project Transfer of 41,000 acre-feet of State Water Project Table A Amount*, prepared for CLWA by Science Applications International Corporation, December 2004.

26. *Draft Environmental Impact Report - Rosedale-Rio Bravo Water Storage District (RRBWSD) Water Banking and Exchange Program*, prepared for CLWA by Science Applications International Corporation, August 2005.

27. *Final Environmental Impact Report - Rosedale-Rio Bravo Water Storage District (RRBWSD) Water Banking and Exchange Program,* prepared for CLWA by Science Applications International Corporation, October 2005.

28. *Draft Environmental Impact Report - Castaic Lake Water Agency Water Acquisition from the Buena Vista Water Storage District and Rosedale-Rio Bravo Water Storage District Water Banking and Recovery Program,* prepared for CLWA by Science Applications International Corporation, June 2006.

29. *Final Environmental Impact Report - Castaic Lake Water Agency Water Acquisition from the Buena Vista Water Storage District and Rosedale-Rio Bravo Water Storage District Water Banking and Recovery Program,* prepared for CLWA by Science Applications International Corporation, October 2006.

30. *California Department of Water Resources, California's Groundwater, Bulletin 118, Santa Clara River Valley Groundwater Basin, Santa Clara River Valley East Subbasin,* February, 2004.

31. *California Department of Water Resources, Groundwater Basins in California, Bulletin 118-80,* January 1980. (DWR Bulletin 118-80, 1980)

32. *California Department of Water Resources, The State Water Project Delivery Reliability Report 2002,* May 2003. (DWR Reliability Report, 2003)

33. *California Department of Water Resources, Excerpts from the Working Draft of 2005 State Water Project Delivery Reliability,* May 25, 2005. (DWR Reliability Report Excerpts, 2005)

34. *California Department of Water Resources, The State Water Project Delivery Reliability Report 2005, Final,* April 2006. (DWR Reliability Report, 2006)

35. *California Department of Water Resources, The State Water Project Delivery Reliability Report 2007, Draft,* December 2007. (DWR Reliability Report Draft, 2007)

36. *California Department of Water Resources, The State Water Project Delivery Reliability Report 2007,* August 2008. (DWR Reliability Report, 2007)

37. *2008 Water Master Plan,* 90% draft, (Santa Clarita Water Division of the Castaic Lake Water Agency), Civiltec Engineering, Inc., May 19, 2008.

38. *CLWA Letter to Los Angeles County Department of Regional Planning,* February 2008. (CLWA Letter, February 2008)

39. *CLWA Letter to City of Santa Clarita and Los Angeles County Department of Regional Planning,* June 2007.

40. *Los Angeles County. 2003. Additional CEQA Findings Regarding the Newhall Ranch Final Additional Analysis to the Partially Certified Final EIR for the Newhall Ranch Specific Plan and Water Reclamation Plant.* March. (Los Angeles County 2003)

2.0 EXISTING WATER RESOURCES

Water Code §10910(d) requires the WSA to include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed Project, and a description of the quantities of water received in prior years by the public water system.

The identification of existing water supplies shall be demonstrated by providing information related to the following:

- written contracts or other proof of entitlement to an identified water supply;
- copies of a capital outlay program for financing the delivery of a water supply that has been adopted by the public water system;
- federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply; and,
- any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply.

The current water supply for the Santa Clarita Valley is derived from the following primary sources:

1. Imported State Water Project (SWP) Water
2. Additional Annual Imported Water Supplies
3. Water from Water Banking Programs
4. Groundwater from the Alluvial Aquifer
5. Groundwater from the Saugus Formation

In addition, recycled water is now available through CLWA within its service area, which allows SWP and groundwater supplies to be available for other uses within the SCWD service area.

These sources of water supply can be characterized as 1) *imported supplies*, transported via the SWP and consisting of SWP Table A Amounts, Buena Vista/Rosedale Rio-Bravo Water and additional reliability supplies; and 2) *local supplies*, consisting of groundwater and recycled water. All of these sources are necessary to meet the regional demands identified in the 2005 UWMP.

2.1 Imported Supplies

2.1.1 SWP Table A Amount

Since 1980, local supplies in the Santa Clarita Valley have been supplemented with imported water from the SWP. Imported water obtained from the SWP through CLWA is the largest source of water for municipal use in the Santa Clarita Valley. The SWP contractual Table A Amount, depending on annual allocation, currently meets more than half of local demand. "Table A Amount" refers to the maximum amount of water a SWP contractor may request each year from the SWP. Table A is used in determining each contractor's proportionate share, or allocation, of the total SWP water supply DWR determines to be available each year. Annual water deliveries are dependent upon many factors including operational, hydrologic, and environmental constraints. The Table A Amount is not equivalent to actual deliveries of water in any given year.

The following information responds to specific requirements of Water Code §10910(d) regarding the identification of existing water supply entitlements, water rights and water service contracts relevant to the identified water supply for the proposed Project:

Wholesaler's entitlements to its supplies: CLWA has an annual SWP Table A contract amount of 95,200 acre-feet (af). This Table A Amount is a maximum and does not reflect the actual amount of water available to CLWA from the SWP, which varies from year to year as described above. In an effort to assess the impact of these varying conditions on SWP supply reliability, the Department of Water Resources (DWR) issued its "State Water Project Delivery Reliability Report" in May 2003 (DWR Reliability Report, 2003). The report assisted SWP contractors in assessing the reliability of the SWP component of their overall supplies. DWR subsequently issued its 2005 SWP Delivery Reliability Report. This updated analysis indicated that the SWP, using existing facilities operated under current regulatory and operational constraints, and with all contractors requesting delivery of their full Table A Amounts in most years, could deliver 77 percent of total Table A Amounts on a long-term average basis. The conclusions in CLWA's 2005 UWMP concerning SWP supply reliability are based on the analysis contained in DWR's 2005 SWP Delivery Reliability Report.

DWR released for public review and comment on January 28, 2008, a Draft 2007 SWP Delivery Reliability Report (DWR Reliability Report Draft, 2007) and the final version was released in August 2008. The 2007 SWP Delivery Reliability Report updates the 2005 SWP Delivery Reliability Report. The 2007 SWP Delivery Reliability Report describes three areas of significant uncertainty to SWP delivery reliability: the recent and significant decline in pelagic organisms in the Delta[10] (open-water fish such as striped bass, Delta smelt[11] and longfin smelt[12]), climate change and sea level rise, and the vulnerability of Delta levees' to failure. Its inclusion of new areas of uncertainty distinguishes the 2007 SWP Delivery Reliability Report from earlier reports by including estimates of the potential reductions to SWP delivery reliability due to the pelagic organism decline (POD) and future climate changes.

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[10] In late 2004 and early 2005, scientists became concerned about the numbers of many pelagic organisms, including Delta smelt, which had been declining sharply since the early 2000's (DWR Reliability Report, 2007). Other pelagic fish with very low numbers in the Delta are striped bass, longfin smelt and threadfin shad, and by 2005, the decline was widely recognized as a serious issue and became known as the Pelagic Organism Decline (POD) (DWR Reliability Report, 2007). Hypothesized factors contributing individually or in concert to lower pelagic productivity are: 1) toxic effects, 2) exotic species effects, and 3) water project effects (DWR Reliability Report, 2007). Studies over the last three years are indicating that all these factors might be contributing to the decline in pelagic fishes, and their relative importance might vary depending upon year, season, and location within the Delta (DWR Reliability Report, 2007).

[11] On May 31, 2007, DWR voluntarily shut down the Harvey O. Banks Pumping Plant for 10 days as a preventative measure to protect Delta smelt located near the DWR facilities. This action followed the observed entrainment of juvenile smelt between May 25, 2007 and May 31, 2007 at the Harvey O. Banks Pumping Plant facility. DWR resumed limited pumping at the Harvey O. Banks Pumping Plant on June 10, 2007. Pumping was increased beginning on June 17, 2007.

By way of background, in 2007, the SWP modified its operations by use of the adaptive Environmental Water Account (EWA). From January through mid-May 2007, about 300,000 af of EWA water was used to reduce exports to help protect Delta smelt. During this time period, no Delta smelt were recorded in the SWP fish salvage operations at the Harvey O. Banks Pumping Plant (the concept of salvage generally refers to the process of using mechanical devices to screen fish that would otherwise be entrained in project facilities such as pumps into holding tanks for transport to other parts of the Delta but, unlike many other fish species in the Delta, Delta smelt do not survive the salvage process and, as a result, for Delta smelt, the United States Fish and Wildlife Service (USFWS) uses the terms salvage and entrainment essentially interchangeably). In mid-May 2007, exports were reduced again due to the distribution of Delta smelt into areas that made them more susceptible to pumping. On May 24, 2007 Delta smelt began to appear at the pumping plant in low numbers. These numbers increased, triggering DWR's response of shutting down temporarily the Harvey O. Banks Pumping Plant described above.

[12] The 2007 SWP Delivery Reliability Report notes that the longfin smelt is being considered for listing under the California Endangered Species Act (CESA). On February 7, 2008, the California Fish and Game Commission (Commission) designated longfin smelt as a candidate species for listing under CESA. Under CESA, candidate species receive the same legal protection as listed threatened and endangered species. Under state law, take of candidate species (including incidental take by engaging in activities that may result in take) is prohibited unless authorized by the Commission or the California Department of Fish and Game (Department) under specified conditions. The Department has testified that under certain measures the species will not, in its opinion, become immediately at risk of extinction. Therefore, the Commission adopted emergency regulations allowing state and federal water managers and local water agencies to continue to conduct water pumping operations over the next 180 days (following the aforementioned Commission action in February 2008) under specified terms and conditions. According to the Commission, these regulations will ensure appropriate interim protections for longfin smelt within the area covered by the petition while the Department conducts a 12-month review of the status of the candidate species. The Commission's decision may or may not alter SWP water supply deliveries. The 180 day period may be extended for two 90-day periods. Thus, short-term impacts of listing the species as a candidate species is speculative at this time. If the regulation is extended, operational requirements for December through February may be added by amending the regulation prior to expiration or extension. Potential long-term effects are also speculative; at this time, it is unknown if the Commission will ultimately decide to list longfin smelt. In addition, operational restrictions in place to protect Delta smelt (discussed herein) may be duplicative of restrictions needed to protect longfin smelt.

As described in the report, simulations to evaluate future (2027) SWP delivery reliability incorporate the current interim court-ordered operating rules related to Delta smelt and a range of possible climate change impacts to hydrology in the Central Valley.[13] The interim operating rules for Delta smelt are simulated at a more-restricted level and a less-restricted level for Delta exports to provide a range of estimated water deliveries. Therefore, for 2007, two studies were conducted. For 2027, ten simulations were used to reflect the four assumed scenarios for climate change and the two levels of operating rules.

The 2007 SWP Delivery Reliability Report includes the information presented in Tables 2-1 and 2-2 below, which provide average and dry period estimated deliveries for current conditions (2007) and future conditions (2027), and compares those figures to those in the 2005 SWP Delivery Reliability Report.

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[13] On May 25, 2007, the United States District Court (Eastern District of California, Fresno Division) in *Natural Resources Defense Council, et al. v. Kempthorne*, Case No. 1:05-cv-01207-OWW-NEW (*Kempthorne*) granted in part the plaintiff's motion for summary judgment and found that the USFWS's 2005 Biological Opinion (BO) on the impacts of the long-term operations of the Central Valley Project (CVP) and the SWP on Delta smelt was inadequate. In late June 2007, District Judge Oliver W. Wanger in *Kempthorne* heard and rejected Natural Resources Defense Council's and Earthjustice's motion for a temporary restraining order to curb southbound water shipments at least temporarily due to smelt issues. On August 31, 2007, the court in *Kempthorne* issued an oral statement of decision granting a preliminary injunction and remedial order to protect Delta smelt until a new Delta smelt BO is issued by the USFWS. The decision, finalized on December 14, 2007, sets interim operating limits for the joint SWP and CVP operations and requires new steps to monitor Delta smelt. The *Kempthorne* requirements are triggered by environmental conditions and the presence of specific Delta smelt life stages and are focused on minimizing the negative entrainment effects caused when the combined export pumping of the SWP and the CVP reverses the flow in Old and Middle River (OMR). The decision requires the USFWS to complete a new BO by September 15, 2008. DWR and the U.S. Bureau of Reclamation are currently working with USFWS to prepare the new BO. The new BO will supersede the operating parameters and requirements set forth in the interim remedial order; however, it is likely that some version of the interim operating rules will become permanent because the federal court's ruling will influence the development of the new BO.

A second BO, covering salmon and steelhead, was issued in October 2004 (in 2004 the U.S. Bureau of Reclamation and DWR developed a new 2004 Operating Criteria and Plan [2004 OCAP] for the SWP and CVP) by the National Marine Fisheries Service (NFMS). This second BO was challenged in *Pacific Coast Federation of Fishermen's Associations/Institute for Fisheries Resources, et al. v. Gutierrez*, Case No. 1:06-cv-00245-OWW-GSA. This lawsuit focused on alleged adverse impacts to species and habitat caused by the changes to cold water temperature management (i.e., elimination of Shasta Dam carryover storage requirement and movement of temperature compliance point on the Sacramento River). On April 16, 2008, Judge Wanger issued a summary judgment order invalidating the salmon and steelhead BO, finding it unlawful and inadequate on a variety of grounds.

In addition, on April 18, 2007, an Alameda County Superior Court in *Watershed Enforcers v. California Dept. of Water Resources*, Case No. RG06292124, granted the petition for writ of mandate and issued an order to cease and desist from further operation of the Harvey O. Banks Pumping Plant until and unless DWR obtains authorization from the California Department of Fish and Game in compliance with the California Endangered Species Act (CESA) with regard to their incidental take of various species, including the Delta smelt, winter-run Chinook salmon and spring-run Chinook salmon. The order was stayed for 60 days to provide DWR with time to comply with the CESA's incidental take authorizing requirements. This court decision has been appealed and the appellate process has been stayed by stipulation of the parties and approval of the Appellate Court with status reports from the parties in October, November and December 2008. In the meantime, DWR is working with the California Department of Fish and Game to obtain a consistency statement or other permit in response to the Superior Court's order.

TABLE 2-1
AVERAGE AND DRY PERIOD SWP TABLE A DELIVERIES FROM THE DELTA UNDER CURRENT CONDITIONS

	SWP Table A Delivery from the Delta (in percent of maximum Table A[1])					
Study of Current Conditions	Long-term Average[2]	Single dry-year (1977)	2-year drought (1976-1977)	4-year drought (1931-1934)	6-year drought (1987-1992)	6-year drought (1929-1934)
2005 SWP Reliability Report, Study 2005	68%	4%	41%	32%	42%	37%
Update with 2007 Studies[3]	63%	6%	34%	35%	35%	34%

Source: DWR Reliability Report, 2007; Table 6-5.

1. Maximum Table A Amount is 4,133 thousand acre-feet/year.
2. 1922-1994 for 2005 SWP Delivery Reliability Report; 1922-2003 for Update with 2007 studies.
3. Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6-3 of the 2007 SWP Delivery Reliability Report.

TABLE 2-2
AVERAGE AND DRY PERIOD SWP TABLE A DELIVERIES FROM THE DELTA UNDER FUTURE CONDITIONS

	SWP Table A Delivery from the Delta (in percent of maximum Table A[1])					
Study of Future Conditions	Long-term Average[2]	Single dry-year (1977)	2-year drought (1976-1977)	4-year drought (1931-1934)	6-year drought (1987-1992)	6-year drought (1929-1934)
2005 SWP Reliability Report, Study 2025	77%	5%	40%	33%	42%	38%
Update with 2027 Studies[3]	66-69%	7%	26-27%	32-37%	33-35%	33-36%

Source: DWR Reliability Report, 2007; Table 6-14.

1. Maximum Table A Amount is 4,133 thousand acre-feet/year.
2. 1922-1994 for 2005 SWP Delivery Reliability Report; 1922-2003 for Update with 2027 studies.
3. Range in values reflects four modified scenarios of climate change: annual Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

As shown, under the updated Future Conditions (2027), average SWP delivery amounts may decrease from 8 to 11 percent of maximum Table A amounts as compared to earlier estimates in the 2005 SWP Delivery Reliability Report. This decrease in reliability results in an estimated average delivery of 66 percent to 69 percent (versus 77 percent as identified in the 2005 SWP Delivery Reliability Report).

Applying the 66 percent figure (most conservative of the 66-69 percent range) to CLWA's Table A Amount of 95,200 af, results in approximately 62,800 af expected under average Future Conditions (2027) according to the 2007 SWP Delivery Reliability Report. This is compared to the 77 percent, or 73,300 af, included in the water supply planning in the 2005 UWMP in 2030 in an average year as discussed above.

Based on this new information, CLWA has determined that, while the court-ordered operating rules related to Delta smelt (or a Biological Opinion premised on those operating rules) are in effect, there are sufficient water supplies available for pending and future residential and commercial developments within the CLWA service area for the foreseeable future through 2030 as set forth in the Santa Clarita Valley (SCV) Urban Water Management Plan (CLWA Letter, February 2008; see also Sections 4.3 and 5.1- 5.4, infra.).

2.1.2 Additional Litigation Effects on Availability of SWP Table A Amount

Of CLWA's 95,200 afy annual Table A Amount, 41,000 afy was permanently transferred to CLWA in 1999 by Wheeler Ridge-Maricopa Water Storage District, a member unit of the Kern County Water Agency (Kern-Castaic Transfer). The Transfer was to be accounted for as part of the 130,000 af referenced in Article 53 of the Monterey Amendment to the SWP water supply contracts. The Environmental Impact Report ("EIR") for the Monterey Amendment was certified in 1995, was later challenged and in 2000 was ordered decertified. (*Planning and Conservation League v. Dept. of Water Resources (PCL)* [2000] 83 Cal. App. 4th 892). CLWA's EIR prepared in connection with the 41,000 afy water transfer was challenged in *Friends of the Santa Clara River v. Castaic Lake Water Agency* (Los Angeles County Superior Court, Case Number BS056954) (*Friends Action*). On appeal, the Court of Appeal, Second Appellate District held that since the Kern-Castaic Transfer EIR tiered off the Monterey Amendment EIR that was later decertified by the PCL decision, CLWA would also have to decertify its EIR as well as prepare a revised EIR. (*Friends of the Santa Clara River v. Castaic Lake Water Agency* (*Friends I*) (2002) 95 Cal.App.4th 1373, 1387-1388.) CLWA, however, has never been enjoined from using any water that is part of the Kern-Castaic Transfer.

Under the jurisdiction of the Los Angeles County Superior Court in the *Friends Action*, CLWA prepared and circulated a revised Draft EIR for the Kern-Castaic Transfer, received and responded to public comments regarding the revised Draft EIR, and held two separate public hearings concerning the revised Draft EIR. CLWA approved the revised EIR for the Transfer on December 22, 2004 and lodged the revised EIR with the Los Angeles Superior Court as part of its Return to the Preemptory Writ of Mandate in the *Friends Action*. Thereafter, Friends was dismissed with prejudice (permanently).

In January 2005, two new challenges to CLWA's environmental review for the Transfer were filed in the Ventura County Superior Court by the Planning and Conservation League (PCL) and by the California Water Impact Network (CWIN); and were subsequently transferred to Los Angeles County Superior Court (LASC). These petitioners allege that CLWA may not prepare its EIR for the Kern-Castaic Transfer until DWR certifies an adequate EIR for the Monterey Amendment EIR, a process that began as a result of the litigation and settlement in the *PCL* case (The Monterey Amendment Settlement Agreement).[14]

[14] Pursuant to the Settlement Agreement in the litigation concerning the Monterey Amendment, DWR has prepared a draft EIR for the Monterey Amendment for which the comment period ended on January 14, 2008.

On April 2, 2007, the LASC trial court rejected all of petitioners' arguments and found that CLWA's 2004 EIR for the Kern-Castaic Transfer "was properly prepared except for one defect -- it fails to show the analytical route as to how and why the three allocations of pre-Monterey Amendments, pre-Monterey Amendments without Article 18, and post-Monterey Amendments are relevant and would occur." Importantly, the trial court found that CLWA may act as the lead agency for the Kern-Castaic Transfer EIR. The trial court also found that the Transfer is final and valid, and may not be terminated by the parties or DWR. In addition, the trial court made it clear that CLWA "is not directed to set aside the [Kern-Castaic] water transfer." Nonetheless, because of the one defect identified in the 2004 EIR, the trial court ordered CLWA to prepare new environmental documents addressing the analytical route of the three water allocations. In July 2007, Petitioners filed a Partial Notice of Appeal and CLWA subsequently filed a Notice of Cross Appeal.

Two related cases discuss the Kern-Castaic Transfer. In *California Oak Foundation v. City of Santa Clarita* (2005) 133 Cal.App.4th 1219, the Court of Appeal invalidated an EIR for the Gate-King Project. The water-supply section of the EIR was based in part on an earlier WSA prepared by NCWD. The WSA and the EIR disclosed the existence of the earlier (now dismissed) litigation challenging CLWA's EIR for the 41,000 afy transfer, but did not sufficiently explain how demand for water would be met if the transfer were set aside or why it was appropriate to rely on the transfer despite the litigation. Since the appellate court action, the City of Santa Clarita revised the Gate-King EIR by preparing an Additional Analysis responsive to the court's findings. The City certified the Additional Analysis in 2006 and re-approved the Gate-King Project. In 2007, the Los Angeles County Superior Court found that the revised EIR met the requirements of CEQA, and entered judgment in favor of the City. Specifically, the court found that substantial evidence supported the City's conclusion that the Kern-Castaic Transfer was permanent and that it would continue to exist with or without the Monterey Amendment.

The Court of Appeal in *Santa Clarita Organization for Planning the Environment v. County of Los Angeles* (*SCOPE II*) (2007) 157 Cal.App.4th 149 found the County's analysis of water supply adequate in its recertified EIR for Newhall Land and Farming's West Creek project, which relied on the Kern-Castaic Transfer. The court concluded that the record contained "substantial evidence demonstrating a reasonable likelihood that water from the Kern-Castaic Transfer will be available for the project's near- and long-term needs, and analysis of potential replacement sources is not required. (*SCOPE II, supra,* 157 Cal.App4th at 162) "Suffice it to say, however the Monterey Agreement litigation is eventually decided, the Kern-Castaic transfer will likely not be affected. Per principle four [of Vineyard] we can confidently determine that the water will be available." (Id. at 162–63).[15]

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[15] In *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova (Vineyard)* (2007) 40 Cal. 4th 412, the California Supreme Court considered the sufficiency of the water supply analysis contained in an EIR prepared for a development project. The EIR's water supply analysis identified near-term supplies sufficient to serve the first phase of the project, and potential long-term water supplies for the later phases. Project opponents alleged various deficiencies in the analysis of water supplies and claimed that the EIR failed to demonstrate with sufficient certainty that water would be available for the project.

The Court concluded that a water supply analysis need not establish certainty or provide guarantees of available long-term supply; however, the Court determined that the EIR failed to adequately analyze long-term water supply and the environmental effects of potential sources for long-term provision of water. The Court emphasized that certainty is not required for long-term supplies, but nevertheless required the EIR to include some discussion of possible replacement water sources when it is not possible to confidently determine that anticipated future water sources will be available, and to disclose the significant foreseeable environmental effects of those sources, as well as mitigation measures to minimize adverse impacts.

2.1.3 Additional Annual Imported Water Supplies

The following existing additional water sources are available to meet demands when necessary.

- **Buena Vista/Rosedale-Rio Bravo Water Storage District Water Acquisition (BV/RRB Water Acquistion Project):** CLWA has finalized a Water Acquisition Agreement with the Buena Vista Water Storage District (Buena Vista) and the Rosedale-Rio Bravo Water Storage District (Rosedale-Rio Bravo) in Kern County. Under this Program, Buena Vista's high flow Kern River entitlements (and other acquired waters that may become available) are captured and recharged within Rosedale-Rio Bravo's service area on an ongoing basis. CLWA will receive 11,000 af per year of these supplies annually through either through direct delivery of water to the California Aqueduct via the Cross Valley Canal or by exchange of Buena Vista's and Rosedale-Rio Bravo's SWP supplies.

In November 2006, a complaint and petition for writ of mandate seeking to set aside CLWA's certification of its EIR for the BV/RRB Water Acquisition Project was filed by California Water Impact Network in the Los Angeles County Superior Court (LASC Case No. BS106546.) The complaint/petition was later amended to add Friends of the Santa Clara River (Friends) as a plaintiff/petitioner. In November 2007, the trial court filed its Statement of Decision finding that in certifying the EIR and approving the project, CLWA proceeded in a manner required by law, and that its actions were supported by substantial evidence. Judgment was entered in favor of CLWA in December 2007. Petitioners filed a notice of appeal of the Judgment on January 31, 2008. This appeal is pending. In the meantime, the EIR is presumed to be legally adequate, unless and until it is set aside by a court of competent jurisdiction. (*Barthelemy v. Chino Basin Water Dist.* (1995) 38 Cal. App.4th 1607, 1609 [agency actions are presumed to comply with applicable law, until proof is presented to the contrary].)

- **Nickel Water:** The Newhall Ranch Specific Plan and Water Reclamation Plant Revised Draft Additional Analysis, November 2002 describes an additional source of water that has been acquired by the Newhall Ranch Specific Plan applicant for use. The Newhall Ranch Specific Plan applicant has secured 1,607 af of water under contract with Nickel Family LLC in Kern County. This water is 100 percent reliable on a year-to-year basis, and not subject to the annual fluctuations that can occur to the SWP in dry year conditions. (Newhall Ranch, 2002)

2.1.4 Additional Imported Water Supplies from Banking Programs

- **Flexible Storage Accounts:** One of CLWA's Flexible Storage Accounts described in its 2005 UWMP permits it to store up to 4,684 af in Castaic Lake. Any of this amount that CLWA withdraws must be replaced by CLWA within five years of its withdrawal. CLWA manages this storage by keeping the account full in normal and wet years and then delivering that stored amount (or portion of it) during dry periods. The account is refilled during the next year that adequate SWP supplies are available to CLWA to do so. CLWA has recently negotiated with Ventura County water agencies to obtain the use of its Flexible Storage Account. This will allow CLWA access to another 1,376 af of storage in Castaic Lake. CLWA's access to this additional storage is available on a year-to-year basis for ten years, beginning in 2006.

- **Semitropic Water Storage District Banking:** The 2005 UWMP (pg. 3-22) identifies two existing contracts with the Semitropic Water Storage District under which CLWA has stored 59,000 acre-feet of water. In accordance with the terms of CLWA's storage agreements with

Semitropic, 90 percent of the banked amount, or a total of 50,870 af, is recoverable through 2012/2013 to meet CLWA water demands when needed. CLWA's approval of one of the contracts (for the 2002 banking program) was challenged in *California Water Network v. Castaic Lake Water Agency*, Ventura Superior Court Case No. CIV 215327. The trial court entered judgment in favor of CLWA. This ruling was appealed. All issues regarding the 2002 banking program with Semitropic were conclusively resolved in favor of CLWA in June 2006.

- **Rosedale-Rio Bravo Water Storage District Water Banking:** The 2005 UWMP (pg. 3-23) identifies one existing contract with the Rosedale-Rio Bravo Water Storage District under which CLWA has 64,900 af of recoverable water as of December 31, 2007. This banking program currently offers storage and pump-back capacity of 20,000 afy, with up to 100,000 af of storage capacity. This stored water will be called upon to meet demands when required and is recoverable through 2035.

- **Newhall Land - Semitropic Water Storage District Banking:** The Newhall Ranch Specific Plan project applicant has entered into an agreement to reserve and purchase water storage capacity of up to 55,000 af in the Semitropic Water Storage District Groundwater Banking Project (Los Angeles County 2003). Sources of water that could be stored include, but are not limited to, the Nickel Water. The stored water could be extracted in dry years in amounts up to 4,950 afy (Los Angeles County 2003). As of December 31, 2007, there is 18,828 af of water stored in the Semitropic Groundwater Storage Bank by The Newhall Land and Farming Company for the Newhall Ranch Specific Plan. Newhall Ranch is located within the CLWA service area. Delivery of stored water from the Newhall Land Semitropic Groundwater Bank requires further agreements between CLWA and Newhall Land.

2.2 Groundwater

Water Code section10910(f) requires a WSA to include specific information describing groundwater resources if the water supply for a proposed project includes groundwater. Over the last 25 years, the water purveyors have developed a groundwater operating plan that includes municipal, agricultural and other smaller uses while maintaining the local Basin in a sustainable condition (i.e., no long term depletion of groundwater or interrelated surface water). In 2003, CLWA in cooperation with the retail water purveyors completed and adopted a Groundwater Management Plan in accordance with Water Code section10753. Among the elements of the adopted Plan is the preparation of annual groundwater management reports, such as the Santa Clarita Valley Water Report, that provide information about local groundwater conditions, SWP supplies, water conservation and recycled water. The following important studies have been prepared that serve to substantiate and ensure the sustainability of the local groundwater resources:

1. Slade (2002) updates prior reports and includes a detailed review of the hydrologic conditions and description of groundwater resources available to SCWD and other large municipal and agriculture groundwater producers including NCWD, Valencia Water Company, the Newhall Land and Farming Company and the Wayside Honor Ranch operating within the Santa Clara River Valley East Subbasin, one of several subbasins identified along the Santa Clara River in Los Angeles and Ventura counties by DWR's Updated Bulletin 118. The shallow aquifer system is designated the Alluvial Aquifer and the deeper aquifer is designated the Saugus Formation. Slade reported that both aquifer systems were in good operating condition and not in a condition of overdraft.

Also included are hundreds of other, small scale, water producers that account for less than 1 percent of total production from these aquifer systems (SCVWR, 2006).

2. In August 2005, work was completed in support of a Memorandum of Understanding (MOU) entered into by the SCWD, CLWA and the other water purveyors and United Water Conservation District (MOU, 2001). The MOU is a commitment by the water purveyors to expand on the previous knowledge of groundwater conditions and, using a regional groundwater flow model, evaluate the long term sustainability of the purveyors' groundwater operating plan under a range of existing and potential future hydrologic conditions. The primary conclusion of the modeling analysis is that the groundwater operating plan will not cause detrimental short term or long term effects to the groundwater and surface water resources in the Santa Clarita Valley and is therefore, sustainable (Basin Yield Study, 2005).

The following sub-parts respond to specific requirements of Water Code §10910(f):

2.2.1 Water Code §10910(f)(1)

Review of relevant information contained in the Urban Water Management Plan.

Refer to Chapter 3, Water Resources and Appendix C, Groundwater Resources and Yield in the 2005 UWMP for an overview description of the local Alluvial and Saugus Formation aquifer systems, as well as historical and projected production consistent with the groundwater operating plan.

2.2.2 Water Code §10910(f)(2)

Description of any groundwater basin or basins from which the proposed project will be supplied including information concerning adjudication and overdraft.

As described in the 2005 UWMP, the sole source of local groundwater for urban water supply in the Santa Clarita Valley is the groundwater Basin identified in the DWR Bulletin 118, 2003 Update as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) (Basin No. 4-4.07). The Basin is comprised of two aquifer systems, the Alluvium and the Saugus Formation. The Alluvium generally underlies the Santa Clara River and its several tributaries, and the Saugus Formation underlies nearly the entire Upper Santa Clara River area. There are also some scattered outcrops of Terrace deposits in the Basin that likely contain limited amounts of groundwater. Since these deposits are located in limited areas situated at elevations above the regional water table and are also of limited thickness, they are of no practical significance as aquifers and consequently have not been developed for any significant water supply.

Neither aquifer system is in overdraft (Slade, 2002) (SCVWR, 2006) (Basin Yield Study, 2005). In 2003, CLWA with the cooperation of the retail water purveyors completed and adopted a Groundwater Management Plan in accordance with Water Code §10753. The management objectives of the Plan are to ensure the ongoing use of local groundwater by maintaining the Basin in good operating condition (no overdraft), protecting water quality and preventing adverse impacts to surface waters. The groundwater basin has not been adjudicated and has not been identified as overdrafted or projected to be overdrafted by DWR in the most current Bulletin that characterizes the groundwater Basin (DWR Bulletin 118, 2004).

2.2.3 Water Code §10910(f)(3)

Description and analysis of the amount and location of groundwater pumped by the public water system for the past 5 years from any groundwater basin from which the proposed project will be supplied.

During the 5-year period of 2003 to 2007, SCWD's production was approximately 9,964 afy from the Alluvial Aquifer. A summary of the past 28 years of total groundwater production from the Alluvial Aquifer and Saugus Formation is set forth in Section 4.0 of this WSA.

Total pumpage from the Alluvial Aquifer in 2007 was 38,773 af, a decrease of 4,288 af from the preceding year (SCVWR, 2008). Of the total Alluvial pumpage in 2007, 25,632 af was for municipal water supply, and the balance of 13,141 af was for agriculture and other (minor) miscellaneous uses (SCVWR, 2008).

Over the last two decades, since the inception of SWP deliveries in 1980, total pumpage from the Alluvial Aquifer has ranged from a low of about 20,200 afy (in 1983) to slightly more than 43,400 afy (in 1999) (SCVWR, 2008).

Total pumpage from the Saugus Formation in 2007 was 7,684 af, which is 372 af more than pumped in the prior year (SCVWR, 2008). Of the total Saugus Formation pumpage in 2007, most (6,057 af) was for municipal water supply, and the balance (1,627 af) was for agricultural and other (minor) uses (SCVWR, 2008). Saugus pumpage has remained stable, at an average of about 6,432 afy, since 2003 (SCVWR, 2008). On a long-term average basis since the importation of SWP water, total pumpage from the Saugus Formation has ranged from a low of about 3,700 afy (in 1999) to a high of nearly 14,917 afy in (1991); average pumpage from 1980 to present has been slightly less than 7,000 afy (SCVWR, 2008). These numbers are at the lower end of the estimated range of the operational yield of the Saugus Formation (2005 UWMP).

2.2.4 Water Code §10910(f)(4)

Description and analysis of the amount and location of groundwater that is projected to be pumped by the public water system from any basin from which the proposed project will be supplied.

See Table 3-8 in the 2005 UWMP for a summary of the range of groundwater production projected by the retail water purveyors. To ensure sustainability, the purveyors have committed to jointly ensuring that the annual total amount of groundwater pumped from the East Subbasin will not exceed the purveyors' operating plan as described in the Basin Yield Study (Basin Yield Study, 2005) and reported annually in the Santa Clarita Valley Water Report.

2.2.5 Water Code §10910(f)(5)

Analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project.

SCWD has determined that the sufficiency of groundwater necessary to meet the initial and projected water demand associated with the Project was addressed in the 2005 UWMP. Therefore, as provided in Water Code §10910(f)(5), SCWD incorporates the following 2005 UWMP's conclusions regarding the adequacy of the groundwater supply.

For municipal water supply, with existing wells and pumps, the three retail water purveyors with Alluvial wells (SCWD, NCWD, and VWC) have a combined pumping capacity from active wells (not impacted by perchlorate) of 36,120 gallons per minute (gpm), which translates into a current full-time Alluvial source capacity of approximately 58,000 afy. These capacities do not include one Alluvial Aquifer well that has been temporarily inactivated due to perchlorate contamination: the SCWD Stadium well, which represents another 800 gpm of pumping capacity, or full-time source capacity of about 1,290 afy.

In terms of adequacy and availability, the combined active Alluvial groundwater source capacity of municipal wells is approximately 58,000 afy. This is more than sufficient to meet the municipal, or urban, component of groundwater supply from the Alluvium, which is currently 20,000 to 25,000 afy of the total planned Alluvial pumping of 30,000 to 40,000 afy. (The balance of Alluvial pumping in the operating plan is for agricultural and other, including small private, pumping.)

For municipal water supply with existing wells, the three retail water purveyors with Saugus wells (SCWD, NCWD, and VWC) have a combined pumping capacity from active wells (not impacted by perchlorate) of 14,900 gpm, which translates into a full-time Saugus source capacity of 24,000 afy. These capacities do not include the four Saugus wells impacted by perchlorate, although they indirectly reflect the capacity of one of the impacted wells, VWC's Well 157, which has been sealed and abandoned, and replaced by VWC's Well 206 in a non-impacted part of the Basin. The four impacted wells, one owned by NCWD and two owned by SCWD, in addition to the VWC well, represent a total of 7,900 gpm of pumping capacity (or full-time source capacity of about 12,700 afy) inactivated due to perchlorate contamination.

In terms of adequacy and availability, the combined active Saugus groundwater source capacity of municipal wells of 24,000 afy, is more than sufficient to meet the planned use of Saugus groundwater in normal years of 7,500 to 15,000 afy during the currently scheduled two-year time frame for restoration of impacted Saugus capacity (as discussed further in Chapter 5 of the 2005 UWMP). This currently active capacity is also more than sufficient to meet water demands, in combination with other sources, if both of the next two years are dry. At that time, the combination of currently active capacity and restored impacted capacity, through a combination of treatment at two of the impacted wells and replacement well construction, will provide sufficient total Saugus capacity to meet the planned use of Saugus groundwater during multiple dry-years of 35,000 af, if that third year is also a dry year.

2.2.6 Perchlorate Contamination

Groundwater produced by SCWD consistently meets drinking water standards set by EPA and the California Department of Public Health. However, the 2005 UWMP further describes that ammonium perchlorate (perchlorate) has been a concern with respect to the groundwater quality since it was detected in four wells in the eastern part of the Saugus formation in 1997 and later in two wells in the Alluvial formation. Of the six wells that were initially removed from active water supply service upon the detection of perchlorate, four wells with a combined capacity of 7,200 gpm remain out of service. SCWD, CLWA and the other purveyors have developed an implementation plan that would restore this well capacity. The implementation plan includes a combination of treatment facilities and replacement wells. Treatment facilities and pipelines for several of the impacted wells are under construction, will be operational in early 2009 and the production restoration (replacement) wells will be operational by 2010. The treatment project will treat over 3,800 af per year, stop plume migration and put the water back to beneficial use.

In light of the preceding, with regard to the adequacy of groundwater as the local component of water supply in this WSA, the non-impacted groundwater supply will be sufficient to meet near-term water requirements as described in Section 2.2.5 above. Afterwards, the total groundwater capacity will be sufficient to meet the full range of normal and dry-year conditions as provided in the operating plan for groundwater supply. Additional information on the treatment technology and schedule for restoration of the impacted wells is provided in Chapters 5 and 6, and Appendices D and E of the 2005 UWMP.

2.3 Recycled Water

CLWA currently has a contract with the Los Angeles County Sanitation District for 1,700 af per year of recycled water that became available in 2003 (Reference Table 4-2 in Section 4.0 of this WSA for historical recycled water deliveries). Currently, SCWD does not have any infrastructure in place to utilize recycled water. However, SCWD does indirectly benefit because any recycled water use will allow for an offset of potable water supplies (including groundwater and SWP water) to be used in other areas of the Santa Clarita Valley.

3.0 PLANNED WATER RESOURCES

This WSA includes additional information related to obtaining planned additional water supplies. Potential future water sources discussed in the 2005 UWMP include acquisition of additional imported water supplies, recycled water, desalination, increased dry year Saugus pumping, and additional SWP reliability projects. Demand side management programs (conservation) is also considered an important component of water supply resulting from efforts by SCWD, CLWA and the other retailers to reduce water demands on a long term basis.

The 2005 UWMP specifically identifies the following projected future sources of supply consisting of water transfers, additional groundwater banking programs (pg. 3-20), increased dry year Saugus pumping and additional recycled water (pg. 4-1) as necessary to meet the total projected demands through 2030.

3.1 Water Transfers

Though not identified in the 2005 UWMP, during March 2008 the Agency entered into an agreement to participate in the Yuba Accord Water Program. Approximately 850 acre-feet of non-SWP water supply is available to CLWA in critically dry years as a result of the DWR entering into agreements with Yuba County Water Agency (YCWA) and the Bureau of Reclamation relating to settlement of water rights issues on the Lower Yuba River (Yuba Accord). Additional supplies will be available in wetter years. The quantity of water will vary depending on hydrology, and the extent of participation by other SWP contractors.

3.2 Additional Banking Programs

The 2005 UWMP discusses water banking storage and pumpback capacity both north and south of CLWA's service area, the latter of which would provide an emergency supply in case of catastrophic outage along the California Aqueduct. With short-term storage now existing in the Semitropic program and long-term storage now existing with Rosedale-Rio Bravo, CLWA is assessing southern water banking opportunities with a number of entities.

Groundwater banking and conjunctive-use programs enhance the reliability of both existing and future supplies. Table 3-1 summarizes CLWA's future reliability enhancement programs.

Table 3-1
Future Reliability Enhancement Programs

Project Name	Year Available	Proposed Quantities (af)		
		Average/ Normal Year	Single Dry Year	Multiple Dry Years (1)
Additional Planned Banking Programs	2014	0	20,000	20,000

(1) Supplies shown are the recommended amount and maximum withdrawal capacity for each of four consecutive dry years from the CLWA Water Supply Reliability Plan Draft Report (2003).

3.3 Increased Dry-year Saugus Formation Pumping

The 2005 UWMP concludes (pg. 3-10) that pumping from the Saugus Formation in a given year is tied directly to the availability of other water supplies, particularly from the SWP. During average-year conditions within the SWP system, Saugus pumping ranges between 7,500 and 15,000 afy. Planned dry-year pumping from the Saugus Formation ranges between 15,000 and 25,000 afy during a drought year and can increase to between 21,000 and 25,000 afy if SWP deliveries are reduced for two consecutive years and between 21,000 and 35,000 afy if SWP deliveries are reduced for three consecutive years. Such high pumping would be followed by periods of reduced (average-year) pumping, at rates between 7,500 and 15,000 afy, to further enhance the effectiveness of natural recharge processes that would recover water levels and groundwater storage volumes after the higher pumping during dry years.

As mentioned in Section 2.2.5 of this WSA, the three retail water purveyors with Saugus wells (SCWD, NCWD, and VWC) have a combined pumping capacity from active wells (not impacted by perchlorate) of 14,900 gpm, which translates into a full-time Saugus source capacity of 24,000 afy. These capacities do not include the four Saugus wells impacted by perchlorate, although they indirectly reflect the capacity of one of the impacted wells, VWC's Well 157, which has been sealed and abandoned, and replaced by VWC's Well 206 in a non-impacted part of the Basin. The four impacted wells, one owned by NCWD and two owned by SCWD, in addition to the VWC well, represent a total of 7,900 gpm of pumping capacity (or full-time source capacity of about 12,700 afy) inactivated due to perchlorate contamination. Additional capacity to meet the dry-year operating plan will be met by the restoration of impacted wells and new well construction.

3.4 Additional Recycled Water

Wastewater that has been highly treated and disinfected can be reused for landscape irrigation and other non-potable purposes. It is not suitable for use as potable water. In 1993, CLWA completed a *Reclaimed Water System Master Plan* to use recycled water as a reliable water source to meet some non-potable demand within the Santa Clarita Valley. In March 2007 CLWA certified a Program Environmental Impact Report (PEIR) for the Recycled Water System Master Plan (Master Plan). The Master Plan is a proposed expansion of the existing recycled water system that would ultimately allow for the use of up to 17,400 afy of recycled water within the CLWA service area with full build out in the year 2030. The Master Plan includes facilities that would deliver recycled water to the SCWD service area. The delivery of the recycled water to the remainder of the CLWA service area would free up additional potable supplies for the SCWD. Though not described in the 2005 UWMP, and in addition to the CLWA Master Plan, the

Newhall Ranch Specific Plan and Water Reclamation Plant Revised Draft Additional Analysis, (November 2002) includes an additional 5,400 af of water that will be delivered to the Newhall Ranch development once fully constructed (Newhall Ranch, 2002). Table 4-2 in Section 4.0 of this WSA may be referenced for historical recycled water deliveries.

3.5 Water Conservation

One of the assumptions in the 2005 UWMP is that future potable water demand will be reduced by no less than ten percent through the implementation of water conservation measures. Therefore, the Project can only be consistent with the 2005 UWMP if it incorporates, at a minimum, those conservation measures discussed in the 2005 UWMP. As an example, this includes the use of xeriscaping and drought tolerant/native plantings to ensure all landscaping conserves water.

It is extremely important that water conservation mitigation measures are included in the mitigation and monitoring plan as part of the environmental documentation for the Project and made conditions of Project approval. Until such time as CLWA and its water purveyors formally adopt a set of specific water conservation requirements for application to all development projects, the Project should include (1) water savings fixtures in all interiors and (2) the use of drought tolerant plant materials and design in common areas. In addition, all common area manufactured slopes/newly landscaped areas should include:

- Automatic Weather Based Irrigation Controllers that will control the run times based on evapotranspiration for the time of year of watering
- Irrigation controllers with a rain sensing automatic shutoff

4.0 WATER USE

4.1 Historical Water Use

SCWD's water use for the last 26 years is shown in Table 4-1. Table 4-2 illustrates the region's water use for the same period.

Table 4-1
Historical Water Use for Santa Clarita Water Division
(acre-feet) (SCVWR, 2008)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	**Total**
1980	1,125	9,460	0	**10,585**
1981	4,602	7,109	0	**11,711**
1982	6,454	4,091	0	**10,545**
1983	5,214	4,269	0	**9,483**
1984	6,616	6,057	0	**12,673**
1985	6,910	6,242	0	**13,152**
1986	8,366	5,409	0	**13,775**
1987	9,712	5,582	0	**15,294**
1988	11,430	5,079	63	**16,572**
1989	12,790	5,785	0	**18,575**
1990	12,480	5,983	40	**18,503**
1991	6,158	5,593	4,781	**16,532**
1992	6,350	8,288	2,913	**17,551**
1993	3,429	12,016	2,901	**18,346**
1994	5,052	10,996	3,863	**19,911**
1995	7,955	10,217	1,726	**19,898**
1996	9,385	10,445	2,176	**22,006**
1997	10,120	11,268	1,068	**22,456**
1998	8,893	11,426	0	**20,319**
1999	10,772	13,741	0	**24,513**
2000	13,751	11,529	0	**25,280**
2001	15,648	9,896	0	**25,544**
2002	18,921	9,513	0	**28,434**
2003	20,668	6,424	0	**27,092**
2004	22,045	7,146	0	**29,191**
2005	16,513	12,408	0	**28,921**
2006	17,146	13,156	0	**30,302**
2007	20,669	10,686	0	**31,355**

Table 4-2
Historical Total Water Use for the Santa Clarita Valley Region (acre-feet) (SCVWR, 2008)

Year	*State Water Project*	*Alluvium*	*Saugus Formation*	*Recycled Water*	**Total**
1980	1,125	31,456	4,589	-	**37,170**
1981	5,816	30,793	4,970	-	**41,579**
1982	9,659	21,868	4,090	-	**35,617**
1983	9,185	20,286	3,852	-	**33,323**
1984	10,996	27,318	4,449	-	**42,763**
1985	11,823	25,347	4,715	-	**41,885**
1986	13,759	24,205	5,485	-	**43,449**
1987	16,285	22,642	5,561	-	**44,488**
1988	19,033	21,648	6,928	-	**47,609**
1989	21,618	23,721	7,759	-	**53,098**
1990	21,613	23,876	8,861	-	**54,350**
1991	7,968	27,187	14,917	-	**50,072**
1992	14,898	27,591	10,924	-	**53,413**
1993	13,836	30,126	10,610	-	**54,572**
1994	14,700	33,133	12,025	-	**59,858**
1995	17,002	34,464	8,560	-	**60,026**
1996	18,873	38,438	8,186	-	**65,497**
1997	23,215	39,599	7,745	-	**70,559**
1998	20,266	36,648	5,555	-	**62,469**
1999	27,302	43,406	3,716	-	**74,424**
2000	32,582	39,649	4,080	-	**76,311**
2001	35,369	37,273	4,140	-	**76,782**
2002	41,768	38,103	5,160	-	**85,031**
2003	44,419	33,577	4,207	700	**82,904**
2004	47,205	33,757	6,503	448	**87,914**
2005	38,034	38,648	6,453	438	**83,573**
2006	40,646	43,061	7,312	419	**91,438**
2007	45,332	38,773	7,684	470	***92,260**

***For 2007, this amount includes 11,000 af of water acquired pursuant to the terms of CLWA' BV/RRB Water Acquisition Project.**

4.2 Water Use of Project

Projected Demand – Skyline Ranch:

In 2007, SCWD's service area-wide demands were 31,355 af (SCVWR, 2008). The Project will require approximately 1,818 afy at build-out (See Table 4.3 below).

Table 4-3

Water Use Estimate for the Skyline Ranch Project

(acre-feet)

Land Use Categories	*Water Use Factor (afy)*	*Size of Proposed Project (rounded)* [1]	*Estimated Water Use (afy)*
Single-Family Residential	0.82 per unit	1,270	1,041
Parks	3 per acre	15	45
Elementary School	3 per acre	11	33
Manufactured Slopes	3 per acre	207 [2]	621
Road Parkways	3 per acre	26	78
Total			1,818

[1] Project details provided by CH2M HILL and PCR.

[2] Acreage includes off-site landscaped slope areas of 7.92 acres (VTTM 46018) and 1.96 acres (BLM property).

4.3 Future Water Use

The amount of water delivered by SCWD in the recent past, and future projections by customer are summarized in Table 4-4 below. Table 4-5 summarizes the region's projected water demand as discussed in the 2005 UWMP.

Table 4-4
Past, Current, and Projected Water Demands (by customer type)
Santa Clarita Water Division (2005 UWMP)

Year		Water Use Sectors	Single Family	Multi-Family	Comm-ercial	Construction/ Industrial	Institutional/ Government	Landscape	Total
2000	metered	No. of accounts	16,906	3,784	537	48	83	612	21,970
		Deliveries (af)	15,966	2,669	930	1,096	893	3,726	25,280
2005	metered	No. of accounts	20,550	4,800	650	50	125	700	26,875
		Deliveries (af)	19,139	3,386	1,126	1,142	1,345	4,262	30,400
2010	metered	No. of accounts	23,575	5,800	750	60	175	800	31,160
		Deliveries (af)	21,486	4,091	1,299	1,370	1,883	4,871	35,000
2015	metered	No. of accounts	25,715	6,800	850	70	225	900	34,560
		Deliveries (af)	23,333	4,796	1,472	1,598	2,421	5,480	39,100
2020	metered	No. of accounts	27,855	7,800	950	80	275	1,000	37,960
		Deliveries (af)	25,080	5,501	1,645	1,826	2,959	6,089	43,100
2025	metered	No. of accounts	29,995	8,800	1,050	90	325	1,100	41,360
		Deliveries (af)	26,827	6,206	1,818	2,054	3,497	6,698	47,100
2030	metered	No. of accounts	32,135	9,800	1,150	100	375	1,200	44,760
		Deliveries (af)	28,574	6,911	1,991	2,282	4,035	7,307	51,100

Table 4-5
Regional Projected Water Demands (2005 UWMP)

Purveyor	Demand (af)						Annual Increase
	2005	2010	2015	2020	2025	2030	
CLWA SCWD	30,400	35,000	39,100	43,100	47,100	51,100	2.1%
LACWWD #36	1,300	1,600	1,800	2,000	2,400	2,800	3.1%
NCWD	11,800	14,400	16,000	17,700	19,300	21,000	2.4%
VWC	30,200	35,100	40,200	43,700	50,600	54,400	2.4%
Total Purveyor	73,700	86,100	97,100	106,500	119,400	129,300	2.2%
Agricultural/Private Uses	15,600	13,950	12,300	10,650	9,000	9,000	–
Total (w/o conservation)	89,300	100,050	109,400	117,150	128,400	138,300	–
Conservation (1)	(7,370)	(8,610)	(9,710)	(10,650)	(11,940)	(12,930)	–
Total (w/conservation)	81,930	91,440	99,690	106,500	116,460	125,370	1.3%

(1) UWMP 2005

5.0 NORMAL, SINGLE-DRY, AND MULTIPLE-DRY YEAR PLANNING

The following sections summarize the existing and planned supplies and how they will be utilized during Normal, Single-Dry, and Multiple-Dry Years. The text and tables were taken from the 2005 UWMP, and updated by including the most recent reliability numbers from the State Water Project Delivery Reliability Report 2007, moving the 11,000 af of Buena Vista-Rosedale water from "Planned Supplies" to "Existing Supplies", adding 1,607 af of Nickel Water to "Existing Supplies", moving 20,000 af of Rosedale-Rio Bravo banked water from "Planned Banking" to "Existing Banking", adding the Newhall Land – Semitropic Water Bank, and adding 5,400 af of Recycled Water for Newhall Ranch to "Planned Supplies" (see sections 2.1.1, 2.1.3 and 3.4 above). Updates to the table footnotes were also made as needed to reflect current information.

5.1 Summary of Existing and Planned Supplies

A summary of existing and planned water supplies is presented in Table 5-1 on the following page. Table 5-1 is not intended to be an operational plan for how supplies would be used in a particular year, but rather identifies the complete range of water supplies available under a range of hydrologic conditions. Diversity of supply allows CLWA and the purveyors the option of drawing on multiple sources of supply in response to changing conditions such as varying weather patterns (average/normal years, single dry years, multiple dry years), fluctuations in delivery amounts of SWP water, natural disasters, and contamination with substances such as perchlorate. It is the stated goal of CLWA and the retail water purveyors to deliver a reliable and high quality water supply for their customers, even during dry periods. Based on conservative water supply and demand assumptions over the next 25 years (i.e., through 2030 as described in the 2005 UWMP) in combination with conservation of non-essential demand during certain dry years, the water supply plan described in the 2005 UWMP successfully achieves this goal.

Table 5-1 Summary of Current and Planned Water Supplies and Banking Programs(1)						
Water Supply Sources	Supply (af)					
	2007	2010	2015	2020	2025	2030
Existing Supplies (1)						
Wholesale (Imported)	*64,680*	*78,667*	*79,667*	*79,287*	*80,287*	*80,287*
SWP Table A Supply (2)	60,000	60,000	61,000	62,000	63,000	63,000
Buena Vista-Rosedale	0	11,000	11,000	11,000	11,000	11,000
Nickel Water - Newhall Land	0	1,607	1,607	1,607	1,607	1,607
Flexible Storage Account (CLWA) (3)	4,680	4,680	4,680	4,680	4,680	4,680
Flexible Storage Account (Ventura County) (3) (4)	0	1,380	1,380	0	0	0
Local Supplies						
Groundwater	*40,000*	*46,000*	*46,000*	*46,000*	*46,000*	*46,000*
Alluvial Aquifer	35,000	35,000	35,000	35,000	35,000	35,000
Saugus Formation	5,000	11,000	11,000	11,000	11,000	11,000
Recycled Water	1,700	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	106,380	126,367	127,367	126,987	127,987	127,987
Existing Banking Programs (3)						
Semitropic Water Bank (5)	50,870	50,870	0	0	0	0
Rosedale-Rio Bravo (7)	20,000	20,000	20,000	20,000	20,000	20,000
Semitropic Water Bank – Newhall Land (8)	0	18,828	18,828	18,828	18,828	18,828
Total Existing Banking Programs	70,870	89,698	38,828	38,828	38,828	38,828
Planned Supplies (1)						
Local Supplies						
Groundwater	*0*	*10,000*	*10,000*	*20,000*	*20,000*	*20,000*
Restored wells (Saugus Formation)	0	10,000	10,000	10,000	10,000	10,000
New Wells (Saugus Formation)	0	0	0	10,000	10,000	10,000
Recycled Water - CLWA (6)	0	0	1,600	6,300	11,000	15,700
Recycled Water - Newhall Ranch	0	0	1,500	2,500	3,500	5,400
Total Planned Supplies	0	10,000	13,100	28,800	34,500	41,100
Planned Banking Programs (3)						
Additional Planned Banking	0	0	20,000	20,000	20,000	20,000
Total Planned Banking Programs	0	0	20,000	20,000	20,000	20,000

1. The values shown under "Existing Supplies" and "Planned Supplies" are supplies projected to be available in average/normal years. The values shown under "Existing Banking Programs" and "Planned Banking Programs" are either total amounts currently in storage, or the maximum capacity of program withdrawals.
2. SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available, based on Tables 6-5 and 6-14 of DWR's "State Water Project Delivery Reliability Report 2007". Year 2030 figure is calculated by multiplying by DWR's 2027 percentage of 66%.
3. Supplies shown are total amounts that can be withdrawn, and would typically be used only during dry years.
4. Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).
5. Supplies shown are the total amount currently in storage, and would typically be used only during dry years. Once the current storage amount is withdrawn, this supply would no longer be available and in any event, is not available after 2013.
6. Recycled water supplies based on projections provided in CLWA's 2005 UWMP Chapter 4, Recycled Water.
7. CLWA has 64,900 af of recoverable water as of 12/31/07 in the Rosedale-Rio Bravo Water Banking and Recovery Program.
8. Supplies shown are the total amount currently in storage. As of December 31, 2007, there is 18,828 af of water stored in the Semitropic Groundwater Storage Bank by The Newhall Land and Farming Company for the Newhall Ranch Specific Plan. The stored water can be extracted from the bank in dry years in amounts up to 4,950 afy. Newhall Ranch is located within the CLWA service area.

5.2 Normal Water Year

Table 5-2 summarizes water supplies available to meet demands over the 20-year planning period during an average/normal year. As presented in the table, water supply is broken down into existing and planned water supply sources, including wholesale (imported) water, local supplies, and banking programs. Demands are shown with and without the effects of an assumed 10 percent urban reduction resulting from conservation best management practices.

Table 5-2 Projected Average/Normal Year Supplies and Demands					
	Supply (af)				
Water Supply Sources	2010	2015	2020	2025	2030
Existing Supplies					
Wholesale (Imported)	*73,007*	*73,707*	*74,407*	*75,107*	*75,407*
SWP Table A Supply (1)	60,400	61,100	61,800	62,500	62,800
Buena Vista-Rosedale	11,000	11,000	11,000	11,000	11,000
Nickel Water - Newhall Land	1,607	1,607	1,607	1,607	1,607
Flexible Storage Account (CLWA) (2)	0	0	0	0	0
Flexible Storage Account (Ventura County) (2)	0	0	0	0	0
Local Supplies					
Groundwater	*46,000*	*46,000*	*46,000*	*46,000*	*46,000*
Alluvial Aquifer	35,000	35,000	35,000	35,000	35,000
Saugus Formation	11,000	11,000	11,000	11,000	11,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	120,707	121,407	122,107	122,807	123,107
Existing Banking Programs					
Semitropic Water Bank (2)	0	0	0	0	0
Rosedale-Rio Bravo (2)	0	0	0	0	0
Semitropic Water Bank – Newhall Land (2)	0	0	0	0	0
Total Existing Banking Programs	0	0	0	0	0
Planned Supplies					
Local Supplies					
Groundwater	*0*	*0*	*0*	*0*	*0*
Restored wells (Saugus Formation) (2)	0	0	0	0	0
New Wells (Saugus Formation) (2)	0	0	0	0	0
Recycled Water - CLWA (3)	0	1,600	6,300	11,000	15,700
Recycled Water - Newhall Ranch	0	1,500	2,500	3,500	5,400
Total Planned Supplies	0	3,100	8,800	14,500	21,100
Planned Banking Programs					
Additional Planned Banking (2)	0	0	0	0	0
Total Planned Banking Programs	0	0	0	0	0
Total Existing and Planned Supplies and Banking	120,707	124,507	130,907	137,307	144,207
Total Estimated Demand (w/o conservation) (4)	100,050	109,400	117,150	128,400	138,300
Conservation (5)	(8,600)	(9,700)	(10,700)	(11,900)	(12,900)
Total Adjusted Demand	91,450	99,700	106,450	116,500	125,400

1. SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available on Tables 6-5 and 6-14 of DWR's "State Water Project Delivery Reliability Report 2007". Year 2030 figure is calculated by multiplying by DWR's 2027 percentage of 66%.
2. Not needed during average/normal years.
3. Recycled water supplies based on projections provided in CLWA's 2005 UWMP Chapter 4, Recycled Water.
4. Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area are not included.
5. Assumes 10 percent reduction on urban portion of total demand resulting from conservation best management practices, as discussed in CLWA's 2005 UWMP, Chapter 7.

5.3 Single-Dry Year

The water supplies and demands for CLWA's service area over the 20-year planning period were analyzed in the event that a single-dry year occurs, similar to the drought that occurred in California in 1977. Table 5-3 summarizes the existing and planned supplies available to meet demands during a single-dry year. Demand during dry years was assumed to increase by 10 percent.

Table 5-3 Projected Single-Dry Year Supplies and Demands					
	Supply (af)				
Water Supply Sources	2010	2015	2020	2025	2030
Existing Supplies					
Wholesale (Imported)	*24,567*	*24,767*	*23,587*	*23,887*	*23,987*
SWP Table A Supply (1)	5,900	6,100	6,300	6,600	6,700
Buena Vista-Rosedale	11,000	11,000	11,000	11,000	11,000
Nickel Water - Newhall Land	1,607	1,607	1,607	1,607	1,607
Flexible Storage Account (CLWA)	4,680	4,680	4,680	4,680	4,680
Flexible Storage Account (Ventura County)(2)	1,380	1,380	0	0	0
Local Supplies					
Groundwater	*47,500*	*47,500*	*47,500*	*47,500*	*47,500*
Alluvial Aquifer	32,500	32,500	32,500	32,500	32,500
Saugus Formation	15,000	15,000	15,000	15,000	15,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	73,767	73,967	72,787	73,087	73,187
Existing Banking Programs					
Semitropic Water Bank (3)	17,000	0	0	0	0
Rosedale-Rio Bravo (5)	20,000	20,000	20,000	20,000	20,000
Semitropic Water Bank – Newhall Land (10)	4,950	4,950	4,950	4,950	4,950
Total Existing Banking Programs	41,950	24,950	24,950	24,950	24,950
Planned Supplies					
Local Supplies					
Groundwater	*10,000*	*10,000*	*20,000*	*20,000*	*20,000*
Restored wells (Saugus Formation)	10,000	10,000	10,000	10,000	10,000
New Wells (Saugus Formation)	0	0	10,000	10,000	10,000
Recycled Water - CLWA (4)	0	1,600	6,300	11,000	15,700
Recycled Water - Newhall Ranch	0	1,500	2,500	3,500	5,400
Total Planned Supplies	10,000	13,100	28,800	34,500	41,100
Planned Banking Programs					
Additional Planned Banking (6)	0	20,000	20,000	20,000	20,000
Total Planned Banking Programs	0	20,000	20,000	20,000	20,000
Total Existing and Planned Supplies and Banking	125,717	132,017	146,537	152,537	159,237
Total Estimated Demand (w/o conservation) (7) (8)	110,100	120,300	128,900	141,200	152,100
Conservation (9)	(9,500)	(10,700)	(11,700)	(13,100)	(14,200)
Total Adjusted Demand	100,600	109,600	117,200	128,100	137,900

1. SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of single dry year deliveries projected to be available on Tables 6-5 and 6-14 of DWR's "State Water Project Delivery Reliability Report 2007". Year 2030 figure is calculated by multiplying by DWR's 2027 percentage of 7%.
2. Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).
3. The total amount of water currently in storage is 50,870 af, available through 2013. Withdrawals of up to this amount are potentially available in a dry year, but given possible competition for withdrawal capacity with other Semitropic banking partners in extremely dry years, it is assumed here that about one third of the total amount stored could be withdrawn.
4. Recycled water supplies based on projections provided in CLWA's 2005 UWMP Chapter 4, Recycled Water.
5. CLWA has 64,900 af of recoverable water as of 12/31/07 in the Rosedale-Rio Bravo Water Banking and Recovery Program.
6. Assumes additional planned banking supplies available by 2014.
7. Assumes increase in total demand of 10 percent during dry years.
8. Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area are not included.
9. Assumes 10 percent reduction on urban portion of total normal year demand resulting from conservation best management practices ([urban portion of total normal year demand x 1.10] * 0.10), as discussed in CLWA's 2005 UWMP, Chapter 7.
10. Delivery of stored water from the Newhall Land Semitropic Groundwater Bank requires further agreements between CLWA and Newhall Land.

5.4 Multiple-Dry Year

The water supplies and demands for CLWA's service area over the 20-year planning period were analyzed in the event that a four-year multiple-dry year event occurs, similar to the drought that occurred during the years 1931 to 1934. Table 5-4 summarizes the existing and planned supplies available to meet demands during multiple-dry years. Demand during dry years was assumed to increase by 10 percent.

Table 5-4 Projected Multiple-Dry Year Supplies and Demands(1)					
	Supply (af)				
Water Supply Sources	2010	2015	2020	2025	2030
Existing Supplies					
Wholesale (Imported)	*47,017*	*46,317*	*45,277*	*44,477*	*44,277*
SWP Table A Supply (2)	32,900	32,200	31,500	30,700	30,500
Buena Vista-Rosedale	11,000	11,000	11,000	11,000	11,000
Nickel Water - Newhall Land	1,607	1,607	1,607	1,607	1,607
Flexible Storage Account (CLWA) (3)	1,170	1,170	1,170	1,170	1,170
Flexible Storage Account (Ventura County) (3)	340	340	0	0	0
Local Supplies					
Groundwater	*47,500*	*47,500*	*47,500*	*47,500*	*47,500*
Alluvial Aquifer	32,500	32,500	32,500	32,500	32,500
Saugus Formation (4)	15,000	15,000	15,000	15,000	15,000
Recycled Water	1,700	1,700	1,700	1,700	1,700
Total Existing Supplies	96,217	95,517	94,477	93,677	93,477
Existing Banking Programs					
Semitropic Water Bank (3)	12,700	0	0	0	0
Rosedale-Rio Bravo (6) (7)	5,000	15,000	15,000	15,000	15,000
Semitropic Water Bank – Newhall Land(12)	4,950	4,950	4,950	4,950	4,950
Total Existing Banking Programs	22,650	19,950	19,950	19,950	19,950
Planned Supplies					
Local Supplies					
Groundwater	*6,500*	*6,500*	*6,500*	*6,500*	*6,500*
Restored wells (Saugus Formation) (4)	6,500	6,500	5,000	5,000	5,000
New Wells (Saugus Formation) (4)	0	0	1,500	1,500	1,500
Recycled Water (5)	0	1,600	6,300	11,000	15,700
Recycled Water - Newhall Ranch	0	1,500	2,500	3,500	5,400
Total Planned Supplies	6,500	9,600	15,300	21,000	27,600
Planned Banking Programs					
Additional Planned Banking (7) (8)	0	5,000	15,000	15,000	15,000
Total Planned Banking Programs	0	5,000	15,000	15,000	15,000
Total Existing and Planned Supplies and Banking	125,367	130,067	144,727	149,627	156,027
Total Estimated Demand (w/o conservation) (9) (10)	110,100	120,300	128,900	141,200	152,100
Conservation (11)	(9,500)	(10,700)	(11,700)	(13,100)	(14,200)
Total Adjusted Demand	100,600	109,600	117,200	128,100	137,900

1. Supplies shown are annual averages over four consecutive dry years (unless otherwise noted).
2. SWP supplies are calculated by multiplying CLWA's Table A Amount of 95,200 af by percentages of average deliveries projected to be available during the worst case four-year drought of 1931-1934 as provided in Tables 6-5 and 6-14 of DWR's "State Water Project Delivery Reliability Report 2007." Year 2030 figure is calculated by multiplying by DWR's 2027 percentage of 32%.
3. Based on total amount of storage available divided by 4 (4-year dry period). Initial term of the Ventura County entities' flexible storage account is ten years (from 2006 to 2015).
4. Total Saugus pumping is the average annual amount that would be pumped under the groundwater operating plan, as summarized in Table 3-6 of the 2005 UWMP ([11,000+15,000+25,000+35,000]/4).
5. Recycled water supplies based on projections provided in CLWA's 2005 UWMP Chapter 4, Recycled Water.
6. CLWA has 64,900 af of recoverable water as of 12/31/07 in the Rosedale-Rio Bravo Water Banking and Recovery Program.
7. Average dry year period supplies could be up to 20,000 af for each program depending on storage amounts at the beginning of the dry period.
8. Assumes additional planned banking supplies available by 2014.
9. Assumes increase in total demand of 10 percent during dry years.
10. Demands are for uses within the existing CLWA service area. Demands for any annexations to the CLWA service area are not included.
11. Assumes 10 percent reduction on urban portion of total normal year demand resulting from conservation best management practices ([urban portion of total normal year demand x 1.10] * 0.10), as discussed in CLWA's 2005 UWMP, Chapter 7.
12. Delivery of stored water from the Newhall Land Semitropic Groundwater Bank requires further agreements between CLWA and Newhall Land.

6.0 CONCLUSION

Based on the analysis set forth in this WSA and as supported by the documents relied on for its preparation, SCWD's total projected water supplies available during the ensuing twenty years will meet the projected water demands associated with the Skyline Ranch Project in combination with existing and other planned uses within SCWD's service area. This determination is consistent with current information and CLWA's 2005 UWMP.

I-3

SANTA CLARITA WATER DIVISION CORRESPONDENCE

SANTA CLARITA WATER, A DIVISION OF CASTAIC LAKE WATER AGENCY

SCWD

22722 SOLEDAD CANYON ROAD • SANTA CLARITA, CALIFORNIA 91350 • (661) 259-2737
MAILING ADDRESS: P.O. BOX 903 • SANTA CLARITA, CALIFORNIA 91380-9003

March 5, 2009

Mr. Tom Mitchell
Pardee Homes
10880 Wilshire Blvd., Suite 1900
Los Angeles, Ca 90024

RE: Availability of Water and Feasibility to Serve
Tract 60922
Work Order No. 07-612

Dear Mr. Mitchell:

This letter confirms that the Santa Clarita Water Division (SCWD) of Castaic Lake Agency has performed technical studies of the subject development to determine the feasibility of serving the project in the near future. The project is within the SCWD service boundary and the existing water system will support the development with the improvements identified in our studies. Therefore, it is feasible for SCWD to serve the project. SCWD will own, operate and maintain the water system once it is constructed.

The SCWD has approved the SB 610 Water Supply Assessment (WSA) which shows that there is an adequate water supply to meet the needs of this proposed project. This letter, however, is not intended to create a right or entitlement to water services or any specific level of water service, now or at any time in the future. In addition, this letter is not intended to reserve water, or function as a "will serve" letter or any other form of commitment to supply water.

This determination of this feasibility to serve will remain valid for two years from the date of this letter. If the design of this water system has not been finalized and approved within this two-year time frame, this letter becomes null and void.

On November 9, 2005, the CLWA Board of Directors adopted the 2005 Urban Water Management Plan (UWMP). One of the assumptions in the UWMP is that potable water demand would be reduced by both existing and future users by no less than ten percent. Therefore, it is critical, if the project is to avoid significant cumulative impacts to water supply, that it incorporates water conservation measures into the project design. To ensure this occurs, the entitlements should include water conservation measures as conditions of approval.

In particular, all manufactured slopes/newly landscaped areas should include all appropriate Irrigation Best Management Practices as recommended by the Irrigation Association, Water Management Committee (http://www.irrigation.org/gov/pdf/IA_BMP_APRIL_2005.pdf). These measures can include, but are not limited to:

- Equipping landscaped common areas with an Automatic Weather Based Irrigation Controller that will control the run times based on evapotranspiration for the time of year it is watering

- Providing all irrigation controllers with a rain sensing automatic shutoff

If the above-referenced project includes commercial, industrial, landscaping or fire services, all such services will require backflow devices installed and tested per SCWD policy and specifications prior to the service being activated.

Please feel free to contact the undersigned or Hugo Borja at (661) 964-3993 if you have any additional questions. We look forward to working with you to move this project to completion.

Sincerely,

Mauricio E. Guardado, Jr., P.E.
Retail Manager

MEG/sas

Appendix J: Sewer Area Study Report

SEWER AREA STUDY REPORT FOR TENTATIVE TRACT 060922

PC 11854 AS

HYDRAULIC CALCULATIONS AND EXISTING SYSTEM ANALYSIS

PREPARED FOR:

PARDEE HOMES
10880 Wilshire Blvd., Ste. 1900
Los Angeles, CA 90024

PREPARED BY:

SIKAND ENGINEERING ASSOCIATES
15230 Burbank Blvd., Suite 100
Van Nuys, CA 91411
Tel. 818/787-8550 Fax 818/901-7454

W.O. 5105-041-01
Date: July 17, 2008

Table of Contents

1. Introduction “Will serve” letter from County Sanitation Districts of Los Angeles County.

2. Vicinity Map

3. Sewage flow coefficients and average daily flow (L.A. County)

4. Sewage flow coefficients and sewer area study policy (City of Santa Clarita)

5. On-site Sewer Peak Flow Calculations (L.A. County) - Table 1/ Map 1

6. Off-site / Future Sewer Peak Flow Calculations (L.A. County) - Table 2/ Map 2

7. Sewer Peak Flow Analysis to Trunk Sewer (L.A. County) - Table 3/ Map 3

8. Off-site / Future Sewer Peak Flow Calculations (O.V.O.V.) - Table 4/ Map 4

9. Sewer Peak Flow Analysis to Trunk Sewer (O.V.O.V.) - Table 5/ Map 5

10. <u>Appendix</u>

    a. Sewer Area Study for Canyon Country Educational Center
    b. PC 00-28
    c. PC 10092
    d. PC 02-12

1. Introduction "Will serve" letter from County Sanitation Districts of Los Angeles County.

INTRODUCTION

The project site for Skyline Ranch, TT No. 060922, is located westerly and adjacent to Sierra Highway approximately 0.9 miles northerly of Soledad Canyon Road on unincorporated area of County of Los Angeles. Tentative Tract No. 060922 includes 1270 residential lots, 1 elementary school, 1 community park, 1 neighborhood park, 5 lot size pocket parks, 14 debris basin lots, 4 water pump station lots and 28 open space lots.

The sanitary sewer service is required and provided for all residential lots, school and the community park.

The proposed gravity sewer system has pipe diameters 8", 10" and 12" with the minimum slope of 0.4% and the maximum slope of 7.0%. The proposed sewer system outlets to the existing 21" sewer main in Sierra Highway within the City of Santa Clarita and then is conveyed to the Sanitation District No. 32 Trunk Sewer Line in Soledad Canyon Road.

The purpose of this study is to calculate flow from proposed Skyline Ranch and to determine the impact of additional flow on the existing sewer.

METHODOLOGY

The proposed Los Angeles County General Plan "One Valley One Vision" (OVOV) was utilized to determine the existing and future land use. Sewage coefficients adopted by the LA County and City of Santa Clarita were used to calculate the sewer flow for different types of land development. For multi-use zones within the City of Santa Clarita, an additional 16 residential units per acre were added to commercial/ industrial zones. The Kutter's formula was used to determine the existing and proposed pipe's capacity.

Based off the proposed "OVOV" Master Plan, it has been determined by the city that the ultimate peak flow at the City/County boundary on Sierra Highway is 10.123 cfs.

The County portion of Mint Canyon upstream of the project site has been studied using the approved Sewer Area Study for Tract No. 46353 (P.C. 11534) dated 11-7-2001, the City portion per Sewer Area Study, P.C. 00-28, Tr. 45416-03 approved on November 11, 2001 and the Sewer

Area Study for Canyon Country Educational Center approved 11/8/2006. The ultimate peak flows thus calculated has been compared to the existing sewer capacities.

SEWER CAPACITY ANALYSIS AND MITIGATION MEASURES
(ONLY DOWNSTREAM OF JOINT POINT)

The portion of the existing City sewer from the point where the line turns from Sierra Highway to Sarabande Lane up to the connection to the trunk sewer on Soledad Canyon Road is also under capacity. In order to avoid the upgrading of existing pipes within the residential area and provide uninterrupted service to residents, it is proposed to construct a new sewer line on Sierra Highway from Sarabande Lane to Soledad Canyon Road Trunk Line to convey entire flow – 17.76 cfs. It will require 24" pipe at 1.0% (minimum existing street grade) with capacity 20.91 cfs (see capacity calculation). The length of new sewer line is approximately 3000'. The MH No. 480 base needs to be reconstructed to provide a new 24" outlet on the South and plug the existing 27" outlet on the East. No Country sewers are impacted by this project.

CONCLUSION

Construct a new 24-inch sewer line on Sierra Highway from Sarabande Lane to Soledad Canyon Road. All proposed upgrades and new construction are within the City of Santa Clarita. No upgrades required within the unincorporated country area.

It should be noted that the ultimate flow shown in the Sewer Area Study is for a fully developed county portion of Mint Canyon up to the National Forest. This is not the case today. These areas of Mint Canyon in the County Area have only been sparsely developed with many homes still on septic systems. Without the 10.123 cfs of flow from the County Area, the existing system is adequate to serve 1.41 cfs flow from Skyline Ranch development until further developments are built in Mint Canyon both in the City of Santa Clarita and the County Areas.

This sewer area study shall supersede Tract No. 46353, P.C. 11534 AS.

WATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

JAMES F. STAHL
Chief Engineer and General Manager

November 27, 2006

File No: SCV-00.00-00

Ms. Mari Prutz
Sikand Engineering
15230 Burbank Boulevard, Suite 100
Van Nuys, CA 91411

Dear Ms. Prutz:

Tentative Tract Map No. 060922

This is in reply to your request for a will serve letter for the subject project, which was received by the County Sanitation Districts of Los Angeles County (Districts) on November 22, 2006. We offer the following comments regarding sewerage service:

1. The project area is outside the jurisdictional boundaries of the Districts and will require annexation into the Santa Clarita Valley Sanitation District before sewerage service can be provided to the proposed development. For specific information regarding the annexation procedure and fees, please contact Ms. Margarita Cabrera at extension 2708. Copies of the Districts' Annexation Information and Processing Fees sheets are enclosed for your convenience.

2. The wastewater flow originating from the proposed project will discharge to a local sewer line, which is not maintained by the Districts, for conveyance to the Districts' Soledad Canyon Trunk Sewer, Section 5, located in Soledad Canyon Road at Sierra Highway. This 18-inch diameter trunk sewer has a design capacity of 6.4 million gallons per day (mgd) and conveyed a peak flow of 4.5 mgd when last measured in 2003. The next peak flow measurements for this trunk sewer are scheduled for mid-2007.

3. The District operates two water reclamation plants (WRPs), the Saugus WRP and the Valencia WRP, which provide wastewater treatment in the Santa Clarita Valley. These facilities are interconnected to form a regional treatment system known as the Santa Clarita Valley Joint Sewerage System (SCVJSS). The SCVJSS has a design capacity of 28.1 mgd and currently processes an average flow of 21.1 mgd.

4. The expected average wastewater flow from the project site is approximately 350,000 gallons per day. A copy of the Districts' average wastewater generation factors is enclosed for your information.

5. The Districts are empowered by the California Health and Safety Code to charge a fee for the privilege of connecting (directly or indirectly) to the Districts' Sewerage System or increasing the existing strength and/or quantity of wastewater attributable to a particular parcel or operation

Recycled Paper

already connected. This connection fee is required to construct an incremental expansion of the Sewerage System to accommodate the proposed project, which will mitigate the impact of this project on the present Sewerage System. Payment of a connection fee will be required before a permit to connect to the sewer is issued. A copy of the Connection Fee Information Sheet is enclosed for your convenience. For more specific information regarding the connection fee application procedure and fees, please contact the Connection Fee Counter at extension 2727.

6. In order for the Districts to conform to the requirements of the Federal Clean Air Act (CAA), the design capacities of the Districts' wastewater treatment facilities are based on the regional growth forecast adopted by the Southern California Association of Governments (SCAG). Specific policies included in the development of the SCAG regional growth forecast are incorporated into clean air plans, which are prepared by the South Coast and Antelope Valley Air Quality Management Districts in order to improve air quality in the South Coast and Mojave Desert Air Basins as mandated by the CAA. All expansions of Districts' facilities must be sized and service phased in a manner that will be consistent with the SCAG regional growth forecast for the counties of Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. The available capacity of the Districts' treatment facilities will, therefore, be limited to levels associated with the approved growth identified by SCAG. As such, this letter does not constitute a guarantee of wastewater service, but is to advise you that the Districts intend to provide this service up to the levels that are legally permitted and to inform you of the currently existing capacity and any proposed expansion of the Districts' facilities.

If you have any questions, please contact the undersigned at (562) 908-4288, extension 2717.

Very truly yours,

James F. Stahl

Ruth I. Frazen

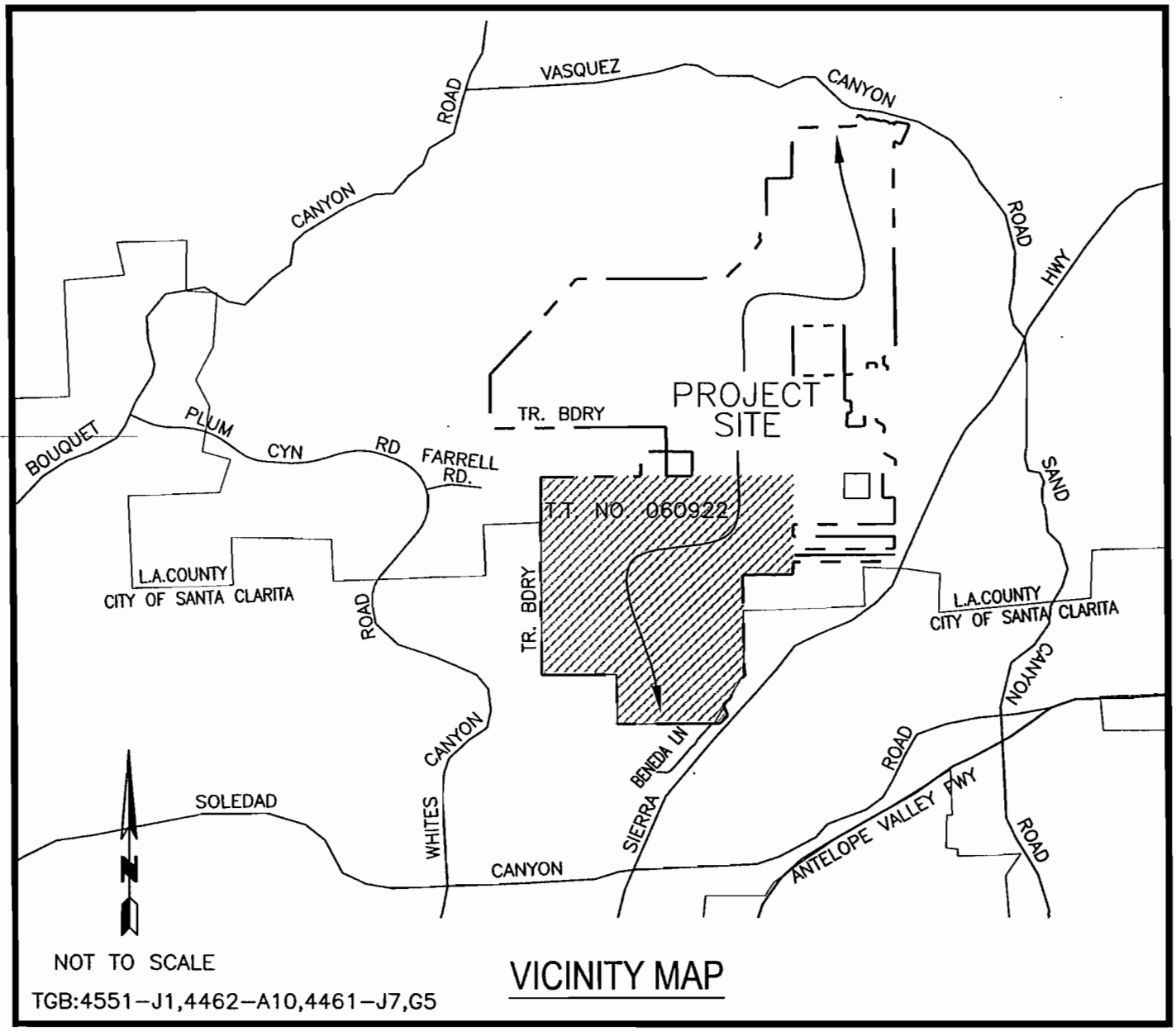
Ruth I. Frazen
Engineering Technician
Facilities Planning Department

RIF:rf

Enclosures

cc: M. Cabrera

2. Vicinity Map



VICINITY MAP

LOT SUMMARY:

SINGLE FAMILY LOTS	1 TO 1270
SCHOOL SITE	1271
PARKS	1272 TO 1278
OPEN SPACE LOTS	1279 TO 1306
DEBRIS BASIN LOTS	1307 TO 1320
WATER TANK / BOOSTER PUMP STA LOTS	1321 TO 1324
TOTAL LOTS	1324

3. Sewage flow coefficients and average daily flow (L.A. County)

BASIS OF FLOW COMPUTATION				AVER. FLOW COEFF.	PEAK FLOW COEFF.*
A. AREA & LAND USE				cfs/acre	cfs/acre
	Residential				
Density Type	Average Area Per Dwelling	Dwellings per Acre	Persons per Acre		
Rural 1 (A-1-5, A-2-5)	5 acres	.2	0.7	.00008	.0002
A-2-2	2 acres	.5	2.5	0.00028	.0007
Rural 2	1 3/4 acres	.8	2.7	.0003	.00075
High Desert (A-1-1)	1 acre	1.0	3.3	.0004	.0010
Very Low	20,000 sq.ft.	1.7	6	.0006	.0015
Low (R-1)	7,000 sq.ft.	4.9	16	.002	.005
Medium (R-2)	3,200 sq.ft.	10.8	25	.0048	.012
Medium High (R-3)	1,800 sq.ft.	18.8	38	.006	.015
High (R-4)	1,400 sq.ft.	30.0	52	.0092	.023
	Commercial (C1 thru C4)			.006	.015
	Industrial (M1 thru M4)			.0084	.021
B. RESIDENTIAL UNIT**				cfs/unit	cfs/unit
	1 & 2 bedroom units			.00032	.0008
	3 & 4 bedroom units			.00044	.0011
	Mobile Home Parks			.0002	.0005
C. POPULATION***				cfs/capita	cfs/capita
	Resident Population			.00012	.0003

*Based on Peak Factor of 2.5, for use up to a peak flow rate of 5.0 cfs. For larger flows, use a lower peak factor per the Average Flow-Peak Flow graph.

**These coefficients are based on the following average flows:

1 & 2 bedroom - 200 g.p.d./unit; 3 & 4 bedroom - 285 g.p.d./unit; and Mobile Home - 130 g.p.d./unit

***This coefficient based on 80 g.p.d./capita.

USE OF FLOW COEFFICIENTS

A. For general studies based on zoning, use the area coefficients listed. If known densities vary from this table, adjust the coefficient accordingly.

B. When estimating flows from developments where number and size of residential units are known, use Residential Unit coefficients.

C. For more of a broad range study based on population, use Population coefficient.

Sewer Master Plans Section
March 1973

ESTIMATED AVERAGE DAILY SEWAGE FLOWS

FOR VARIOUS OCCUPANCIES

Occupancy	Abbr.	Average Daily Flow*
Apartment Buildings:	Apt	
Bachelor or single dwelling units		100 gal/D.U.
1 bedroom dwelling units		150 gal/D.U.
2 bedroom dwelling units		200 gal/D.U.
3 or more bedroom dwelling units		250 gal/D.U.
Auditoriums, churches, etc.	Aud	5 gal/seat
Automobile parking	P	25 gal/1000 sq. ft. gross floor area
Bars, cocktail lounges, etc.	Bar	20 gal/seat
Commercial Shops & Stores	CS	100 gal/1000 sq. ft. gross floor area
Hospitals (surgical)	HS	500 gal/bed
Hospitals (convalescent	HC	85 gal/bed
Hotels	H	150 gal/room
Medical Buildings	MB	300 gal/1000 sq. ft. gross floor area
Motels	M	150 gal/unit
Office Buildings	Off	200 gal/1000 sq. ft. gross floor area
Restaurants, cafeterias, etc.	R	50 gal/seat
Schools:		
Elementary or Jr. High	S	10 gal/student
High Schools	HS	15 gal/student
Universities or Colleges	U	20 gal/student
College Dormitories	CD	85 gal/student**

*These flows in general include an average allowance for operating personnel, and hospital staff, faculty, etc., as appropriate.

**Includes food service, laundry and bathing.

TWG/DWL
Sewer Design

4. Sewage flow coefficients and sewer area study policy (City of Santa Clarita)

City of Santa Clarita
Development Services Division

SEWAGE FLOW COEFFICIENTS

ZONING	DESCRIPTION	COEFFICIENT (cfs/gross acreage)	COEFFICIENT (cfs/dwelling unit)
OS	Open Space	0.0002	------
A	Agricultural - 1 single family home/ legal lot	0.0002	------
RE	Residential Estate – large custom single family homes on uniquely configured lots	0.00075	------
RVL	Residential Very Low Density - 1 DU/AC	0.001	0.001
RL	Residential Low Density – 2.2 DU/AC	0.0015	0.00068
RS	Residential Suburban - 5 DU/AC	0.005	0.001
RM	Residential Moderate – 11 DU/AC	0.012	0.00109
RMH	Residential Medium High – 20 DU/AC	0.015	0.00075
RH	Residential High – 28 DU/AC	0.023	0.00082
CTC	Commercial Town Center	0.015	------
CC	Community Commercial	0.015	------
CN	Commercial Neighborhood	0.015	------
CO	Commercial Office	0.015	------
VSR	Visitor Serving/Resort	0.021	------
BP	Business Park	0.021	------
IC	Industrial Commercial	0.021	------
I	Industrial	0.021	------

Notes:

- The coefficient to be used for any zoned area not listed in this table will be determined by the City Engineer based upon the intended development and use.
- Open space coefficient: this coefficient is to account for water infiltration into sewer pipe.
- Coefficients in cfs/gross acreage shall be used for areas that are not yet developed and not yet entitled.
- Coefficients in cfs/dwelling unit shall be used for developed areas and areas that are entitled.

City of Santa Clarita
Development Services Division

SEWER AREA STUDY POLICY

Capacity Analysis of Proposed Sewer

- Proposed sewers shall be sized using the (area) x (coefficient) method. The coefficient is based on current zoning. Refer to the City's "Sewage Flow Coefficients Table" available on the City's website.
- The study shall include the entire watershed area up to the ridge line.
- Discharge from areas dedicated, or to be dedicated, as open space (OS) areas shall be included in the study. Q from dedicated open space areas shall be determined by multiplying the acreage by the open space coefficient. Areas not dedicated on the final map as open space shall be considered "developable land".
- The study shall extend to LA County Sanitation District's trunk line. Analysis of the downstream system shall conform to the section "Capacity Analysis of Existing Sewer" listed below.

Capacity Analysis of Existing Sewer

- The unit count method may only be used for fully developed areas such as condos/single family homes, as these would likely be built to the same density if the area is redeveloped. Unit counts must be verified by recorded tract maps.
- The (area) x (coefficient) method shall be used to determine discharge from commercial, industrial, multi-family (apartments), under-developed lots (1 house on a large lot), as there is a chance that these could be built to a higher density, and dedicated open space.
- For special cases where downstream improvements might be expensive and difficult to construct (such as river crossings, extra depth, or busy streets/intersections), all existing flow, as well as flow from any future developments that will discharge into the line to be improved, must be included in study. The flow from the future developments shall be determined using the (area) x (coefficient) method.

Capacity Analysis of County Sewer Draining into City Sewer

The following approval process applies when a County project is discharging into the City's sewer system (i.e. when it crosses the City/County boundary).

The developer's engineer will submit a sewer area study concurrently to the County and the City for plan check. The study will analyze the area of the proposed project, as well as the downstream system from the project to the Sanitation District trunk line. A stamp will be placed on the area study map when the County approves the study. By approving the area study, the City will be assured that the County has reviewed the discharge flowing into the City. The County will forward a copy of the approved study to the City for our use.

Using the approved discharge from the County, the City will then assess the effects on the downstream City system. Any upgrades to the City system, as identified in the area study, will become requirements of the tract and can be bonded with the County project. The City will determine the amount of the bond. The City would then sign the County sewer plans "for discharge only," provided all identified upgrades have been bonded or constructed.

The process as described above will assure us that impacts to our sewer system from developments occurring outside the City will be properly mitigated. For projects in the City that discharge into the County sewers, the City will reciprocate the procedure accordingly.

5. On-site Sewer Peak Flow Calculations (L.A. County) - Table 1/ Map 1

TABLE 1 - SEWER PE[illegible] FLOW CALCULATIONS
(ON-S[illegible]E FLOW)
FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

REACH	AREA	NO. OF LOTS	LAND UTILIZATION	PEAK FLOW COEFF. (cfs/unit)	PEAK FLOW (cfs)	TOTAL FLOW FOR REACH (cfs)	AREAS INCLUDED IN REACH	MIN PIPE GRADE (%)	REQUIRED PIPE SIZE (in)	PIPE CAPACITY @ 1/2 FULL (cfs)
1	A	163	Residential	0.001	0.163			0.60	8	0.43
1	B	98	Residential	0.001	0.098			2.00	8	0.79
1 - 2	C	7	Residential	0.001	0.007	0.268	A, B, C	2.80	8	0.93
3	D	140	Residential	0.001	0.140			1.00	8	0.56
3 - 4	E	53	Residential	0.001	0.053	0.193	D, E	1.52	8	0.69
4	F	52	Residential	0.001	0.052			1.00	8	0.56
4 - 5	G	20	Residential	0.001	0.020	0.265	D, E, F, G	1.00	8	0.56
2	H	27	Residential	0.001	0.027			2.00	8	0.79
2 - 5						0.295	A, B, C, H	7.00	8	1.47
6	I	77	Residential	0.001	0.077			1.52	8	0.69
6 - 7	J	112	Residential	0.001	0.112	0.189	I, J	1.80	8	0.75
7 - 8	K (part)	4	Residential	0.001	0.004	0.193	I, J, K (part)	1.00	8	0.56
8	K (part)	46	Residential	0.001	0.046			0.80	8	0.50
8	K	Elem. School (see calculations)			0.039	0.085	K (part) + school	0.80	8	0.50
8 - 10	M (part)	17	Residential	0.001	0.017	0.295	I, J, K, M (part) + school	2.00	8	0.79
9	L		Park (see calculations)		0.096			1.00	8	0.56
9	L	85	Residential	0.001	0.085	0.181	L + (park)	0.40	8	0.35
9 - 10	M (part)	187	Residential	0.001	0.187	0.368	L, M (part) + park	1.00	8	0.56
10 - 11	N	92	Residential	0.001	0.092	0.755	I to N + school + park	2.00	8	0.79
11	O	49	Residential	0.001	0.049			0.80	8	0.50
11 - 12						0.804	I to O + school + park	0.80	10	0.91
12	P	41	Residential	0.001	0.041			1.40	8	0.66
12 - 13						0.845	I to P + school + park	0.80	10	0.91
5 - 13						0.560	A to H	7.00	8	1.47
13 -14		1270				1.405	A to P + school + park	2.40	10	1.57
1 - 14		1270				1.405	A to P + school + park	0.72	12	1.44

TT No. 06099

Sewer Flow Calculation

(on-site)

I. Elementary School

$$Q_{cfs} = \frac{(N)\ (P)\ (A)}{(7.48)\ (24)\ (60)\ (60)}$$, where:

N – number of students = 1,000
P – peak factor = 2.5
A – Average daily flow = 10- gal. / day / student
7.48 gal = 1 cu. ft.

$$Q_{cfs} = \frac{(1{,}000)\ (2.5)\ (10)}{(7.48)\ (24)\ (60)\ (60)} = 0.039 \text{ cfs}$$

II. Community Park / Recreation Area Public Restroom

Ref: California Plumbing Code, 2002

Per Table A-2 (appendix A):

Fixture Type	Quantity	Fixture unit per 1 Fixture	Total F.U.
Water Closet (w/ flushometer valve)	5	5	25
Lavatory	4	1	4
Urinal	1	5	5
Total Fixture Units:			34

Per chart A-3:

Discharge = 43 gpm = 0.096 cfs

(1 gpm = 0.002228 cfs)

COUNTY OF LOS ANGELES

2002 PLUMBING CODE

Adopting by reference portions of the 2001 Edition

CALIFORNIA PLUMBING CODE

TITLE 28
of the Los Angeles County Code

As amended by Ordinance No. 2002-0078
November 1, 2002

Official Compilation

Edited and Proofread by Building and Safety Division,
Department of Public Works, County of Los Angeles

Inch	mm
1/2	15
3/4	20
1	25

TABLE A-2

Water Supply Fixture Units (WSFU) and Minimum Fixture Branch Pipe Sizes[3]

Note: [For HCD & HCD 2} See Chapter 6, Section 610.7, Table 6-4, UPC, for equivalent fixture units.

Appliances, Appurtenances or Fixtures[2]	Minimum Fixture Branch Pipe Size[1,4]	Private	Public	Assembly[6]
Bathtub or Combination Bath/Shower (fill)	1/2"	4.0	4.0	
3/4" Bathtub Fill Valve	3/4"	10.0	10.0	
Bidet	1/2"	1.0		
Clotheswasher	1/2"	4.0	4.0	
Dental Unit, cuspidor	1/2"		1.0	
Dishwasher, domestic	1/2"	1.5	1.5	
Drinking Fountain or Watercooler	1/2"	0.5	0.5	0.75
Hose Bibb	1/2"	2.5	2.5	
Hose Bibb, each additional[7]	1/2"	1.0	1.0	
Lavatory	1/2"	1.0	1.0	1.0
Lawn Sprinkler, each head[5]		1.0	1.0	
Mobile Home, each (minimum) (Not adopted by HCD)		12.0		
Sinks				
Bar	1/2"	1.0	2.0	
Clinic Faucet	1/2"		3.0	
Clinic Flushometer Valve with or without faucet	1"		8.0	
Kitchen, domestic	1/2"	1.5	1.5	
Laundry	1/2"	1.5	1.5	
Service or Mop Basin	1/2"	1.5	3.0	
Washup, each set of faucets	1/2"		2.0	
Shower	1/2"	2.0	2.0	
Urinal, 1.0 GPF	3/4"	3.0	4.0	5.0
Urinal, greater than 1.0 GPF	3/4"	4.0	5.0	6.0
Urinal, flush tank	1/2"	2.0	2.0	3.0
Washfountain, circular spray	3/4"		4.0	
Water Closet, 1.6 GPF Gravity Tank	1/2"	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank	1/2"	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve	1"	5.0	5.0	6.0
Water Closet, greater than 1.6 GPF Gravity Tank	1/2"	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve	1"	7.0	8.0	10.0

Notes:

1. Size of the cold branch outlet pipe, or both the hot and cold branch outlet pipes.
2. Appliances, Appurtenances or Fixtures not included in this Table may be sized by reference to fixtures having a similar flow rate and frequency of use.
3. The listed fixture unit values represent their total load on the cold water service. The separate cold water and hot water fixture unit value for fixtures having both cold and hot water connections shall each be taken as three-quarters (3/4) of the listed total value of the fixture.
4. The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.
5. For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (GPM) and add it separately to the demand (in GPM) for the distribution system or portions thereof.
6. Assembly [Public Use (See Table 4-1)].
7. Reduced fixture unit loading for additional hose bibbs as used is to be used only when sizing total building demand and for pipe sizing when more than one hose bibb is supplied by a segment of water distributing pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.

CHART A-2

Estimate Curves for Demand Load

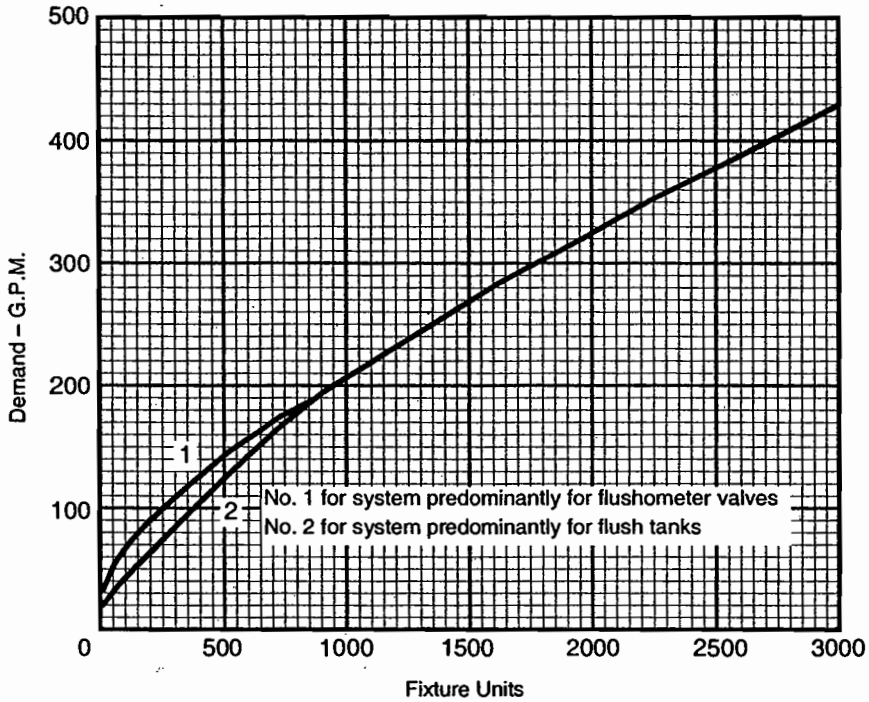


CHART A-2 (Metric)

Estimate Curves for Demand Load

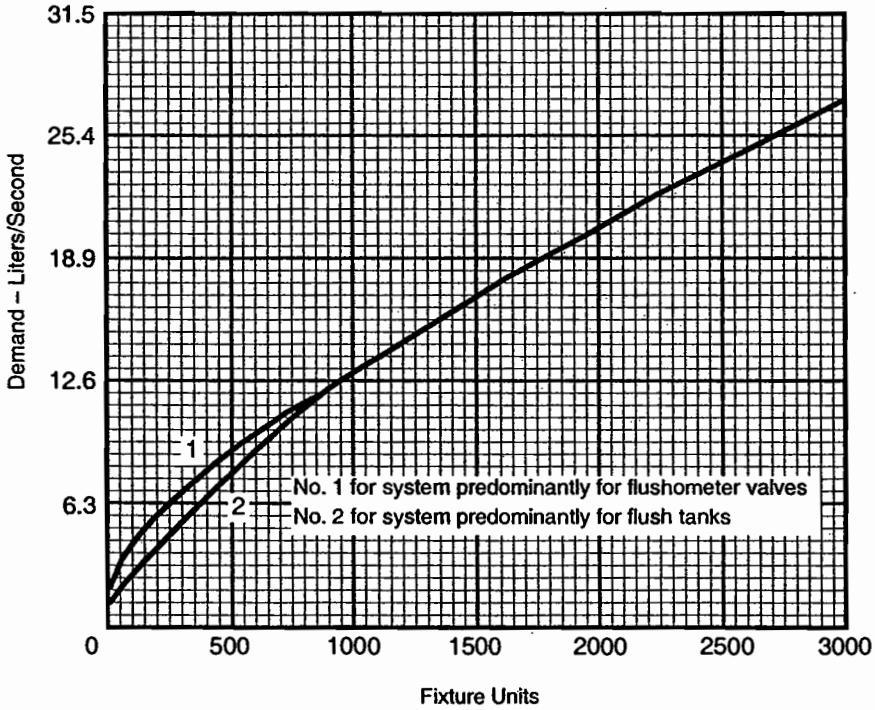


CHART A-3

Enlarged Scale Demand Load

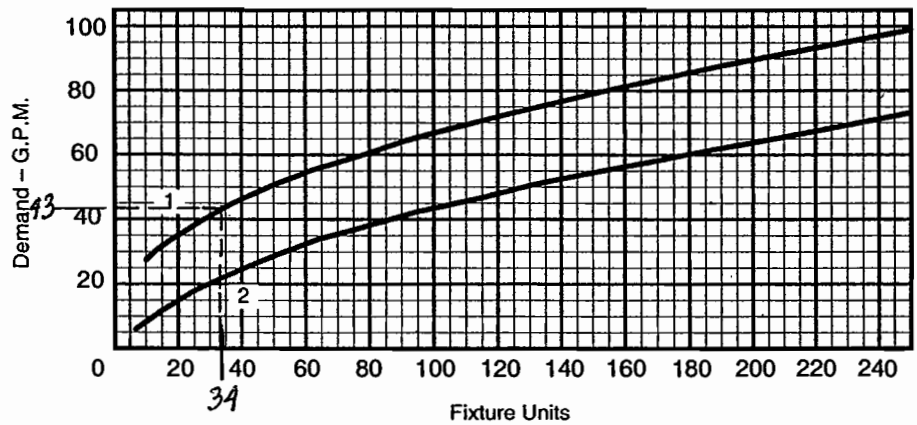
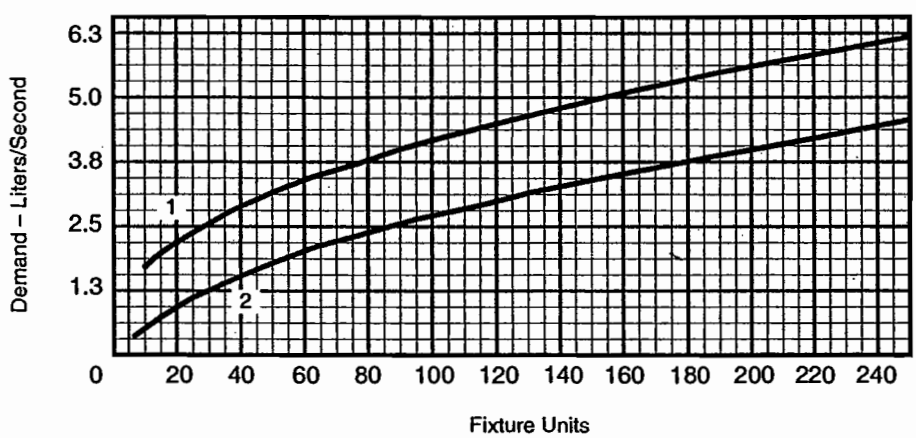


CHART A-3 (Metric)

Enlarged Scale Demand Load



Worksheet for D=8" @ S=0.004

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00400	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.35	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.27	ft
Percent Full	49.8	%
Critical Slope	0.00813	ft/ft
Velocity	2.00	ft/s
Velocity Head	0.06	ft
Specific Energy	0.40	ft
Froude Number	0.69	
Maximum Discharge	0.77	ft^3/s
Discharge Full	0.71	ft^3/s
Slope Full	0.00102	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.006

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00600	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.43	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.31	ft
Percent Full	49.8	%
Critical Slope	0.00826	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	0.43	ft
Froude Number	0.85	
Maximum Discharge	0.95	ft^3/s
Discharge Full	0.87	ft^3/s
Slope Full	0.00150	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.008

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00800	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.50	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.33	ft
Percent Full	49.8	%
Critical Slope	0.00829	ft/ft
Velocity	2.84	ft/s
Velocity Head	0.13	ft
Specific Energy	0.46	ft
Froude Number	0.98	
Maximum Discharge	1.10	ft^3/s
Discharge Full	1.00	ft^3/s
Slope Full	0.00200	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.01

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.56	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.35	ft
Percent Full	49.8	%
Critical Slope	0.00851	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	0.49	ft
Froude Number	1.09	
Maximum Discharge	1.23	ft^3/s
Discharge Full	1.12	ft^3/s
Slope Full	0.00248	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.014

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01400	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.66	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.38	ft
Percent Full	49.8	%
Critical Slope	0.00882	ft/ft
Velocity	3.76	ft/s
Velocity Head	0.22	ft
Specific Energy	0.55	ft
Froude Number	1.30	
Maximum Discharge	1.45	ft^3/s
Discharge Full	1.33	ft^3/s
Slope Full	0.00348	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.0152

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01520	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.69	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.39	ft
Percent Full	49.8	%
Critical Slope	0.00893	ft/ft
Velocity	3.91	ft/s
Velocity Head	0.24	ft
Specific Energy	0.57	ft
Froude Number	1.35	
Maximum Discharge	1.51	ft^3/s
Discharge Full	1.38	ft^3/s
Slope Full	0.00378	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.018

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01800	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.75	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.41	ft
Percent Full	49.8	%
Critical Slope	0.00919	ft/ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Specific Energy	0.62	ft
Froude Number	1.47	
Maximum Discharge	1.65	ft^3/s
Discharge Full	1.51	ft^3/s
Slope Full	0.00447	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.02

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02000	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.79	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.42	ft
Percent Full	49.8	%
Critical Slope	0.00936	ft/ft
Velocity	4.49	ft/s
Velocity Head	0.31	ft
Specific Energy	0.65	ft
Froude Number	1.55	
Maximum Discharge	1.74	ft^3/s
Discharge Full	1.59	ft^3/s
Slope Full	0.00497	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.028

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02800	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	0.93	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.46	ft
Percent Full	49.8	%
Critical Slope	0.01015	ft/ft
Velocity	5.32	ft/s
Velocity Head	0.44	ft
Specific Energy	0.77	ft
Froude Number	1.83	
Maximum Discharge	2.06	ft^3/s
Discharge Full	1.88	ft^3/s
Slope Full	0.00688	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=8" @ S=0.07

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.07000	ft/ft
Normal Depth	0.33	ft
Diameter	0.67	ft

Results

Discharge	1.47	ft^3/s
Flow Area	0.18	ft^2
Wetted Perimeter	1.05	ft
Top Width	0.67	ft
Critical Depth	0.57	ft
Percent Full	49.7	%
Critical Slope	0.01555	ft/ft
Velocity	8.41	ft/s
Velocity Head	1.10	ft
Specific Energy	1.43	ft
Froude Number	2.90	
Maximum Discharge	3.25	ft^3/s
Discharge Full	2.97	ft^3/s
Slope Full	0.01722	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.75	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=10" @ S=0.008

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00800	ft/ft
Normal Depth	0.41	ft
Diameter	0.83	ft

Results

Discharge	0.91	ft^3/s
Flow Area	0.27	ft^2
Wetted Perimeter	1.30	ft
Top Width	0.83	ft
Critical Depth	0.42	ft
Percent Full	49.9	%
Critical Slope	0.00748	ft/ft
Velocity	3.36	ft/s
Velocity Head	0.18	ft
Specific Energy	0.59	ft
Froude Number	1.04	
Maximum Discharge	1.99	ft^3/s
Discharge Full	1.82	ft^3/s
Slope Full	0.00201	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.88	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=10" @ S=.024

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02400	ft/ft
Normal Depth	0.41	ft
Diameter	0.83	ft

Results

Discharge	1.57	ft^3/s
Flow Area	0.27	ft^2
Wetted Perimeter	1.30	ft
Top Width	0.83	ft
Critical Depth	0.56	ft
Percent Full	49.9	%
Critical Slope	0.00898	ft/ft
Velocity	5.82	ft/s
Velocity Head	0.53	ft
Specific Energy	0.94	ft
Froude Number	1.80	
Maximum Discharge	3.44	ft^3/s
Discharge Full	3.15	ft^3/s
Slope Full	0.00597	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	49.88	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for D=12" @ S=0.0072

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00720	ft/ft
Normal Depth	0.50	ft
Diameter	1.00	ft

Results

Discharge	1.44	ft^3/s
Flow Area	0.39	ft^2
Wetted Perimeter	1.57	ft
Top Width	1.00	ft
Critical Depth	0.51	ft
Percent Full	50.0	%
Critical Slope	0.00677	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	0.71	ft
Froude Number	1.03	
Maximum Discharge	3.15	ft^3/s
Discharge Full	2.89	ft^3/s
Slope Full	0.00183	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Copy of Sewer Area Study On-Site Flow
(Sheet 1 of 5)
on file with the
County of Los Angeles,
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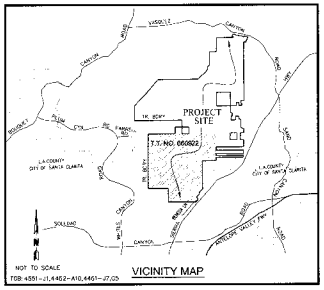
Land Development



VICINITY MAP

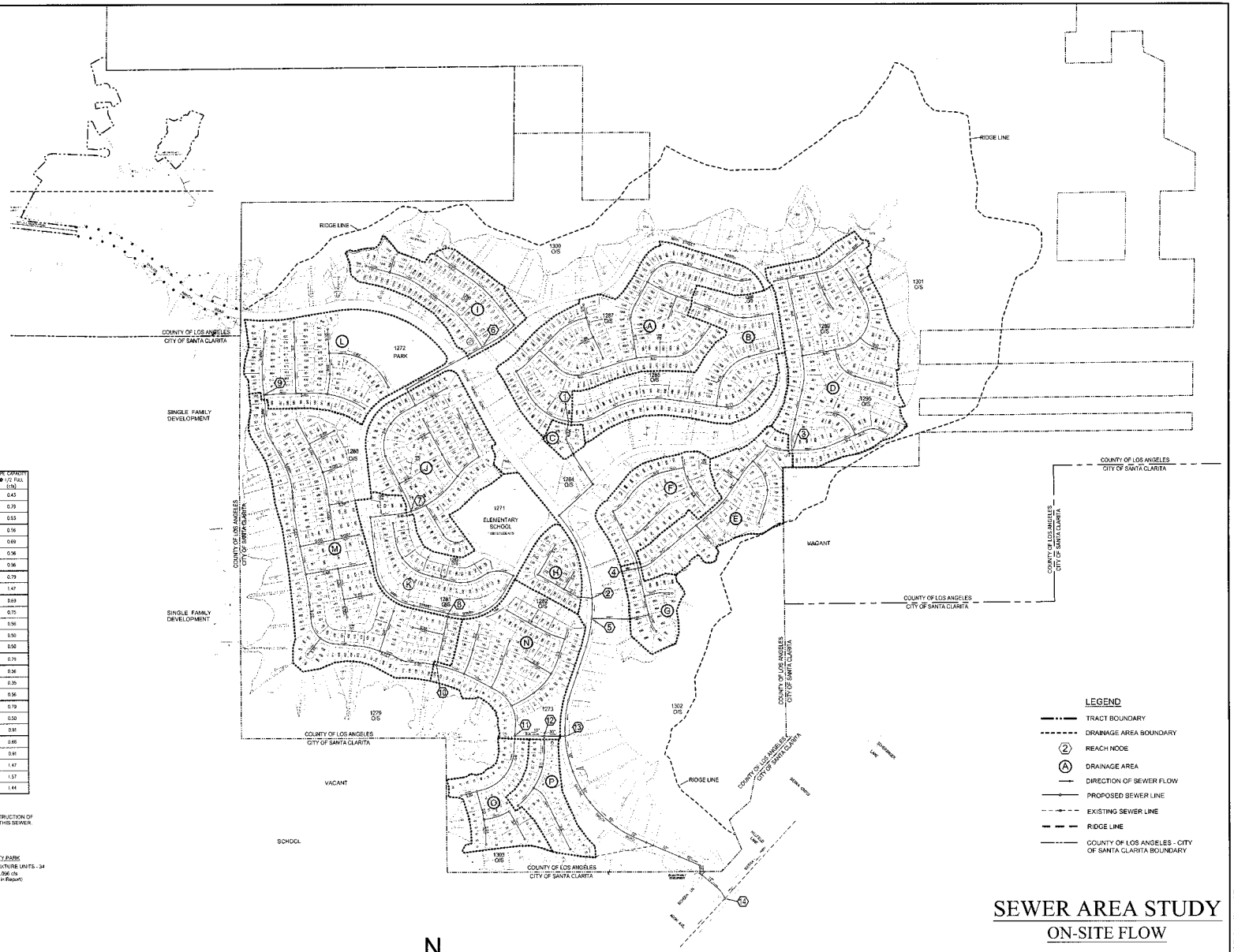


TABLE 1 - SEWER PEAK FLOW CALCULATIONS
(ON-SITE FLOW)
FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

REACH	AREA	NO. OF LOTS	LAND UTILIZATION	PEAK FLOW COEFF. (cfs/acre)	PEAK FLOW (cfs)	TOTAL FLOW FOR REACH (cfs)	AREAS INCLUDED IN REACH	MIN PIPE GRADE (%)	REQUIRED PIPE SIZE (in)	PIPE CAPACITY @ 1/2 FULL (cfs)
1	A	163	Residential	0.001	0.163			0.62	8	0.45
1	B	98	Residential	0.001	0.098			2.00	8	0.79
1 – 2	C	7	Residential	0.001	0.007	0.268	A, B, C	2.00	8	0.53
3	D	140	Residential	0.001	0.140			1.00	8	0.56
3 – 4	E	53	Residential	0.001	0.053	0.193	D, E	1.52	8	0.69
4	F	52	Residential	0.001	0.052			1.00	8	0.56
4 – 5	G	20	Residential	0.001	0.020	0.265	D, E, F, G	1.00	8	0.56
2	H	27	Residential	0.001	0.027			2.00	8	0.79
2 – 5						0.293	A, B, C, H	7.00	8	1.47
6	I	77	Residential	0.001	0.077			1.52	8	0.69
6 – 7	J	112	Residential	0.001	0.112	0.189	I, J	1.50	8	0.75
7 – 8	K (part)	4	Residential	0.001	0.004	0.193	I, J, K (part)	1.00	8	0.56
8	K (part)	46	Residential	0.001	0.046			0.80	8	0.50
8	K	Elem. School (see calculations)			0.039	0.085	K (part) + school	0.80	8	0.50
8 – 10	M (part)	17	Residential	0.001	0.017	0.295	I, J, K, M (part) + school	2.00	8	0.79
9	L	Park (see calculations)			0.066			1.00	8	0.56
9	L	85	Residential	0.001	0.085	0.151	L + (park)	0.40	8	0.35
9 – 10	M (part)	187	Residential	0.001	0.187	0.338	L, M (part) + park	1.00	8	0.56
10 – 11	N	92	Residential	0.001	0.092	0.705	I to N + school + park	3.00	8	0.79
11	O	49	Residential	0.001	0.049			0.80	8	0.50
11 – 12						0.804	I to O + school + park	0.80	10	0.91
12	P	41	Residential	0.001	0.041			1.40	8	0.66
12 – 13						0.845	I to P + school + park	0.80	10	0.91
5 – 13						0.580	A to H	7.00	8	1.47
13 –14		1270				1.425	A to P + school + park	2.40	10	1.57
1 –14		1270				1.425	A to P + school + park	0.72	12	1.44

LOT SUMMARY FOR T.T. 060922

RESIDENTIAL LOTS	1270
SCHOOL	1
COMMUNITY PARK	1
NEIGHBORHOOD PARK	1
POCKET PARK	5
OPEN SPACE	28
DEBRIS BASIN	14
WATER PUMP STATION	4
TOTAL	1324

NOTE: LOTS 1273 TO 1324 ARE RESTRICTED TO NO CONSTRUCTION OF FUTURE BUILDINGS AND WILL NOT BE SERVED BY THIS SEWER.

SEWER FLOW CALCULATION

ELEMENTARY SCHOOL

$Q = \frac{600 \times 10 \times 2.5}{(7.48)(24)(60)(86)} = 0.039$ cfs

COMMUNITY PARK

TOTAL NUMBER OF FIXTURE UNITS - 34

$Q = 43$ gpm $= 0.096$ cfs

(See calculations in Report)

A THOROUGH INVESTIGATION OF AVAILABLE ZONING RECORDS FROM THE L.A. COUNTY DEPARTMENT OF REGIONAL PLANNING AND THE CITY OF SANTA CLARITA HAS BEEN CONDUCTED BY THE UNDERSIGNED AND IS FACTUALLY PRESENTED HEREWITH AS PART OF THE SEWER AREA STUDY FOR TRACT NO. 060922. THE SEWER AREA STUDY SHALL BE INVALIDATED SHOULD THE TOTAL NUMBER OF DWELLING UNITS INCREASE, THE DENSITY INCREASES OR DWELLING UNITS OCCUR ON PREVIOUSLY INDENTIFIED BUILDING RESTRICTED LOTS.

REGISTERED PROFESSIONAL ENGINEER No. 32363 Exp. 12-31-10 CIVIL STATE OF CALIFORNIA

DRAIG YOUNG, R.C.E. 32363

N

SCALE: 1"=300'

LEGEND

- TRACT BOUNDARY
- DRAINAGE AREA BOUNDARY
- REACH NODE
- DRAINAGE AREA
- DIRECTION OF SEWER FLOW
- PROPOSED SEWER LINE
- EXISTING SEWER LINE
- RIDGE LINE
- COUNTY OF LOS ANGELES - CITY OF SANTA CLARITA BOUNDARY

SEWER AREA STUDY

ON-SITE FLOW

SKYLINE RANCH

VESTING TENTATIVE TRACT NO. 060922

SHEET 1 OF 5

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6. Off-site / Future Sewer Peak Flow Calculations (L.A. County) – Table 2/Map 2

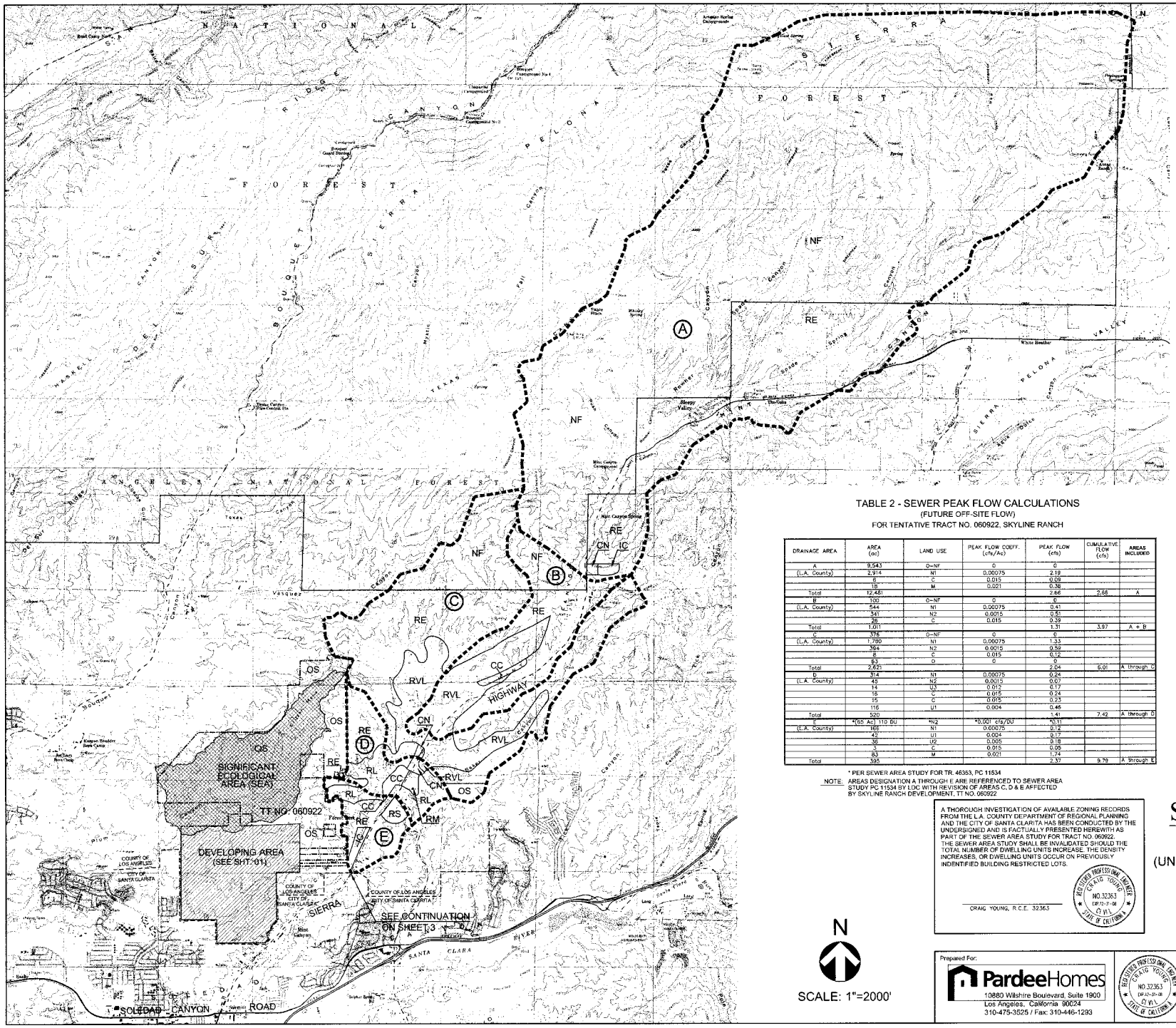
TABLE 2 - OFF-SITE SEWER PEAK FLOW ANALYSIS (COUNTY CALCS)

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/Ac)	PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED
A	9,543	NF	0	0		
(L.A. County)	2,914	RE	0.00075	2.19		
	6	CN	0.015	0.09		
	18	IC	0.021	0.38		
Total	12,481			2.66	2.66	A
B	100	NF	0	0		
(L.A. County)	544	RE	0.00075	0.41		
	341	RVL	0.0015	0.51		
	26	CC	0.015	0.39		
Total	1,011			1.31	3.97	A + B
C	376	NF	0	0		
(L.A. County)	1,780	RE	0.00075	1.33		
	394	RVL	0.0015	0.59		
	8	CN	0.015	0.12		
	63	OS	0	0.00		
Total	2,621			2.04	6.01	A through C
D	314	RE	0.00075	0.24		
(L.A. County)	45	RVL	0.0015	0.07		
	14	RM	0.012	0.17		
	16	CC	0.015	0.24		
	15	CN	0.015	0.23		
	116	RL	0.004	0.46		
Total	445			1.41	7.42	A through D
E	65	TR 46353	From prior study	0.11		
(L.A. County)	166	RE	0.00075	0.12		
	42	RL	0.004	0.17		
	36	RS	0.005	0.18		
	3	CC	0.015	0.05		
	83	IC	0.021	1.74		
Total	395			2.37	9.79	A through E

Note: Area designation A through E are referenced to previously approved sewer area study from LDC with revision of areas C, D, E affected by Skyline Ranch development, TT No. 060922.

Copy of Sewer Area Study Off-Site Flow
(Sheet 2 of 5)
on file with the
County of Los Angeles,
Department of Public Works,
Land Development



ZONES LEGEND - L.A. COUNTY

	TRACT BOUNDARY
	DRAINAGE AREA BOUNDARY
	ZONING BOUNDARY
OS	OPEN SPACE
O-NF	NATIONAL FOREST
N1	NON-URBAN 1 (0.5 DU/AC)
N2	NON-URBAN 2 (1.0 DU/AC)
U1	URBAN 1 (1.1 TO 3.3 DU/AC)
U2	URBAN 2 (3.4 TO 6.6 DU/AC)
U3	URBAN 3 (6.7 TO 15 DU/AC)
C	COMMERCIAL
M	INDUSTRY
	SIGNIFICANT ECOLOGICAL AREA
	DEVELOPING AREA

TABLE 2 - SEWER PEAK FLOW CALCULATIONS
(FUTURE OFF-SITE FLOW)
FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/Ac)	PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDEID
A	9,543	O-NF	0	0		
(L.A. County)	2,914	N1	0.00075	2.19		
	6	C	0.015	0.09		
	18	M	0.021	0.38		
Total	12,481			2.66	2.66	A
B	100	O-NF	0	0		
(L.A. County)	544	N1	0.00075	0.41		
	341	N2	0.0015	0.51		
	26	C	0.015	0.39		
Total	1,011			1.31	3.97	A + B
C	376	O-NF	0	0		
(L.A. County)	1,780	N1	0.00075	1.33		
	394	N2	0.0015	0.59		
	8	C	0.015	0.12		
	63	O	0	0		
Total	2,621			2.04	6.01	A through C
D	314	N1	0.00075	0.24		
(L.A. County)	45	N2	0.0015	0.07		
	14	U3	0.012	0.17		
	16	C	0.015	0.24		
	15	C	0.015	0.23		
	116	U1	0.004	0.46		
Total	520			1.41	7.42	A through D
E	*(55 Ac) 110 DU	*N2	*0.001 cfs/DU	*0.11		
(L.A. County)	166	N1	0.00075	0.12		
	42	U1	0.004	0.17		
	36	U2	0.005	0.18		
	3	C	0.015	0.05		
	83	M	0.021	1.74		
Total	395			2.37	9.79	A through E

* PER SEWER AREA STUDY FOR TR. 46353, PC 11534

NOTE: AREAS DESIGNATION A THROUGH E ARE REFERENCED TO SEWER AREA STUDY PC 11534 BY LDC WITH REVISION OF AREAS C, D & E AFFECTED BY SKYLINE RANCH DEVELOPMENT, TT NO. 060922

A THOROUGH INVESTIGATION OF AVAILABLE ZONING RECORDS FROM THE L.A. COUNTY DEPARTMENT OF REGIONAL PLANNING AND THE CITY OF SANTA CLARITA HAS BEEN CONDUCTED BY THE UNDERSIGNED AND IS FACTUALLY PRESENTED HEREWITH AS PART OF THE SEWER AREA STUDY FOR TRACT NO. 060922. THE SEWER AREA STUDY SHALL BE INVALIDATED SHOULD THE TOTAL NUMBER OF DWELLING UNITS INCREASE, THE DENSITY INCREASES, OR DWELLING UNITS OCCUR ON PREVIOUSLY INDENTIFIED BUILDING RESTRICTED LOTS.

CRAIG YOUNG, R.C.E. 32363

REGISTERED PROFESSIONAL ENGINEER CRAIG YOUNG NO. 32363 EXP. 12-31-08 CIVIL STATE OF CALIFORNIA

N

SCALE: 1"=2000'

SEWER AREA STUDY
OFF-SITE FLOW
(UNINCORPORATED COUNTY OF LOS ANGELES)

SKYLINE RANCH
VESTING TENTATIVE TRACT NO. 060922

SHEET 2 OF 5

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7. Sewer Peak Flow Analysis to Trunk Sewer (L.A. County) – Table 3/Map 3

TABLE 3 - SEWER PEAK FLOW ANALYSIS TO TRUNK LINE (COUNTY CALCS)

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/ac)	PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED	EXIST. SEWER PIPE SIZE (in.)	EXIST. MIN. PIPE GRADE (%)	* EXIST. PIPE CAPACITY 3/4 FULL (cfs)	RESULTS
A-E	395	See table 2			9.79	A through E	-	-	-	-
3	Canyon Country			1.44						
(City of Santa Clarita)	Education Center	(per app'd study by Rothman Engineering)								
	53	IC	0.021	1.12						
	11	CC	0.015	0.17						upgrade to 24" VCP required between manholes
	51	RL	0.0015	0.08						
	31	RS	0.005	0.16						
	30	RE	0.00075	0.02						
Total				2.99	12.78	(A - E) + 3	21	0.75	12.51	502 - 503
2	98	RL	0.004	0.39			21	0.48	10.01	496 - 499
(City of S.C.)							21	0.44	9.58	488 - 489
Total				0.39	13.17	(A - E) + 2 + 3	21	0.50	10.22	
5 (part)	64	RL	0.0015	0.10						
(City of Santa Clarita)	22	RS	0.005	0.11						
	7	IC	0.21	0.15						
						(A - E) + 2 +3 + 5 (part)				
Total				0.36	13.53		21	1.45	17.40	OK
TT 060922 (see Table 1)				1.41						
1	12	RM	0.012	0.14						
(City of S.C.)	51	RL	0.0015	0.08						
4	27	CC	0.015	0.41						
(City of S.C.)										
5 (part)	27	RM	0.012	0.32		(A - E) + (1 - 5) + TT 060922				
Total				2.36	15.89		21	1.60	18.28	OK

Proposed New Sewer Line in Sierra Highway

Pipe Limits	Q (cfs)	Dia (in.)	Slope (%)	3/4 full capacity (cfs)
From MH No. 480 to Soledad Canyon Road Trunk Line	15.89	24	1.0	20.91

Copy of Sewer Area Study Off-Site Flow
(City of Santa Clarita)
(Sheet 3 of 5)
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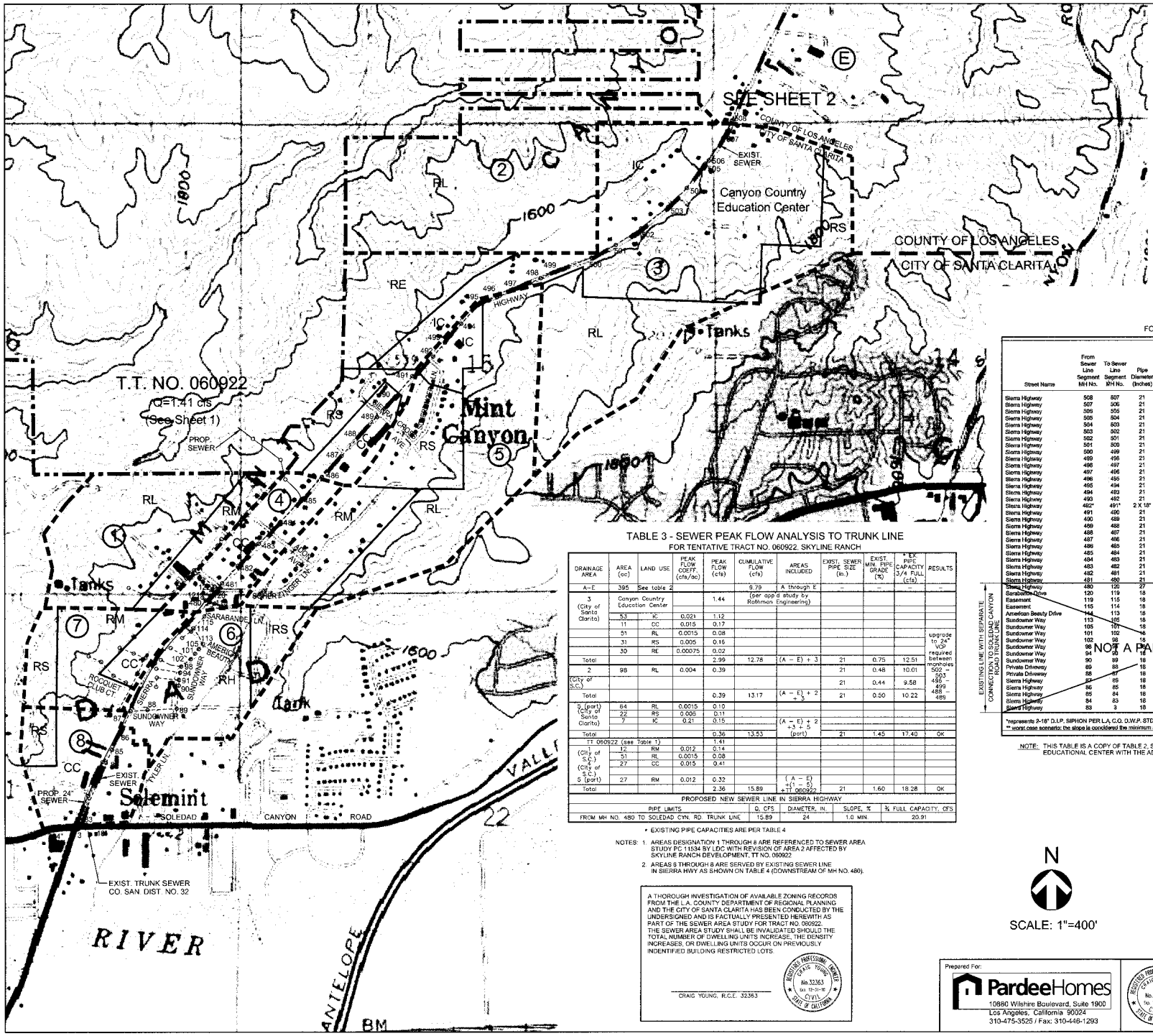
Land Development



ZONES LEGEND - CITY OF SANTA CLARITA

- - - - -	EXISTING SEWER
— — —	EXISTING TRUNK SEWER
———	PROPOSED SEWER
—·—·—	TRACT BOUNDARY
- - - - -	DRAINAGE AREA BOUNDARY
———	ZONING BOUNDARY
CC	COMMUNITY COMMERCIAL
RL	RESIDENTIAL LOW
RM	RESIDENTIAL MODERATE
RH	RESIDENTIAL HIGH
RS	RESIDENTIAL SUBURBAN
RE	RESIDENTIAL ESTATE
IC	INDUSTRIAL COMMERCIAL
EC	EDUCATION CENTER

EXISTING PIPE CAPACITIES

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

Street Name	From Sewer Line Segment MH No.	To Sewer Line Segment MH No.	Pipe Diameter (inches)	Slope (ft/ft)	1/2 Full Design Capacity (cfs) for Pipes up to 12"	3/4 Full Design Capacity (cfs) for Pipes Greater than 15"	Contributing Areas	PER COC AREA STUDY BY ROTHMAN ENGINEERING: Cumulative calculated flow per segment (cfs)	Net Increase above design flow (cfs)	Applicable PC or CI construction Plan Number	INCLUDING OFF-SITE FLOW AND SKYLINE RANCH TRACT 60922: CUMUL FLOW (CFS)	PROP PIPE UPGRADE DIA. (inch)	PROP PIPE CAPACITY (CFS)	% FULL
Sierra Highway	508	507	21	0.0128	n/a	18.3469	3+E	5.41	0	PC 02-12	9.79	-	-	-
Sierra Highway	507	506	21	0.0128	n/a	18.3469	3+E	5.41	0	PC 02-12	12.63	-	-	-
Sierra Highway	506	505	21	0.0128	n/a	18.3469	3+E	5.41	0	PC 02-12	12.63	-	-	-
Sierra Highway	505	504	21	0.0136	n/a	16.85	3+E	5.41	0	PC 02-12	12.83	-	-	-
Sierra Highway	504	503	21	0.0317	n/a	25.7253	3+E	5.41	0	PC 02-12	12.83	-	-	-
Sierra Highway	503	502	21	0.005	n/a	10.2198	3+E	5.41	0	PC 02-12	12.83	24	14.77	75
Sierra Highway	502	501	21	0.0099	n/a	14.3763	3+E	5.41	0	PC 02-12	12.83	-	-	-
Sierra Highway	501	500	21	0.0126	n/a	18.3469	2+3+E	6.39	0	PC 02-12	12.83	-	-	-
Sierra Highway	500	499	21	0.0334	n/a	26.496	2+3+E	6.39	0	PC 00-28	12.91	-	-	-
Sierra Highway	499	498	21	0.0048	n/a	10.0104	2+3+E	6.39	0	PC 00-28	12.91	24	14.47	75
Sierra Highway	498	497	21	0.0044	n/a	9.5842	2+3+E	6.39	0	PC 00-28	12.99	24	13.85	75
Sierra Highway	497	496	21	0.0044	n/a	9.5842	2+3+E	6.39	0	PC 00-28	12.99	24	13.85	75
Sierra Highway	496	495	21	0.0152	n/a	17.8136	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	495	494	21	0.0152	n/a	17.8136	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	494	493	21	0.0196	n/a	20.2262	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	493	492	21	0.0196	n/a	18.6159	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	492*	491*	2 X 18*	0.0119**	n/a	20.8982	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	491	490	21	0.0119	n/a	15.7617	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	490	489	21	0.027	n/a	23.7417	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	489	488	21	0.0075	n/a	12.513	2+3+5+E	7.07	0	PC 00-28	13.47	24	18.10	75
Sierra Highway	488	487	21	0.0145	n/a	17.3986	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	487	486	21	0.016	n/a	18.2764	2+3+5+E	7.07	0	PC 00-28	13.47	-	-	-
Sierra Highway	486	485	21	0.016	n/a	18.2764	2+3+5+E	7.07	0	PC 00-28	15.89	-	-	-
Sierra Highway	485	484	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28	15.89	-	-	-
Sierra Highway	484	483	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28	15.89	-	-	-
Sierra Highway	483	482	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28	15.89	-	-	-
Sierra Highway	482	481	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28	15.89	-	-	-
Sierra Highway	481	480	21	0.0220	n/a	21.431	1 - 5 + E	7.700	0	PC 00-28	15.89	-	-	-
Sierra Highway	480	120	27	0.0024	n/a	15.835	1 - 5 + E	7.700	0	PC 00-28	-	-	-	-
Sarabande Drive	120	119	18	0.0100	n/a	9.575	1 - 5 + E	7.700	0	PC 10092	-	-	-	-
Easement	119	115	18	0.0152	n/a	11.809	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Easement	115	114	18	0.0152	n/a	11.809	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
American Beauty Drive	114	113	18	0.0108	n/a	9.862	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	113	105	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	105	101	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	101	102	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	102	98	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	98	94	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	94	90	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sundowner Way	90	89	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Private Driveway	89	88	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Private Driveway	88	87	18	0.0100	n/a	9.575	1 - 6 + E	8.700	0	PC 10092	-	-	-	-
Sierra Highway	87	86	18	0.0116	n/a	10.317	1 - 8 + E	9.530	0	PC 10092	-	-	-	-
Sierra Highway	86	85	18	0.0120	n/a	10.493	1 - 8 + E	9.530	0	PC 10092	-	-	-	-
Sierra Highway	85	84	18	0.0160	n/a	12.551	1 - 8 + E	9.530	0	PC 10092	-	-	-	-
Sierra Highway	84	83	18	0.0180	n/a	12.861	1 - 8 + E	9.530	0	PC 10092	-	-	-	-
Sierra Highway	83	3	18	0.0200	n/a	13.546	1 - 8 + E	9.530	0	PC 10092	-	-	-	-

EXISTING LINE WITH SEPARATE CONNECTION TO SOLEDAD CANYON ROAD

PROPOSED NEW LINE @ S=1% MIN. Q=15.89 CFS — 24" — 20.91 CFS — 75 %

*represents 2-18" D.I.P. SIPHON PER LA C.O. D.W.P. STD. 2005-0

** worst case scenario: the slope is considered the minimum slope for this section

NOTE: THIS TABLE IS A COPY OF TABLE 2, SHEET C-2 OF APPROVED SEWER AREA STUDY FOR CANYON COUNTRY EDUCATIONAL CENTER WITH THE ADDITIONAL INFORMATION PERTAINED TO T.T. 060922 AREA STUDY.

NOT A PART OF THIS STUDY

TABLE 3 - SEWER PEAK FLOW ANALYSIS TO TRUNK LINE

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/ac)	PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED	EXIST. SEWER PIPE SIZE (in.)	EXIST. MIN. PIPE GRADE (%)	* EX PIPE CAPACITY 3/4 FULL (cfs)	RESULTS
A-E	395	See table 2			9.79	A through E				
3 (City of Santa Clarita)	Canyon Country Education Center			1.44		(per app'd study by Rothman Engineering)				
	53	IC	0.021	1.12						
	11	CC	0.015	0.17						
	51	RL	0.0015	0.08						
	31	RS	0.005	0.16						upgrade to 24" VCP
	30	RE	0.00075	0.02						required between
Total				2.99	12.78	(A – E) + 3	21	0.75	12.51	manholes
2	98	RL	0.004	0.39			21	0.48	10.01	502 – 503
(City of S.C.)							21	0.44	9.58	496 – 499
Total				0.39	13.17	(A – E) + 2 + 3	21	0.50	10.22	488 – 489
5 (part) (City of Santa Clarita)	64	RL	0.0015	0.10						
	22	RS	0.005	0.11						
	7	IC	0.21	0.15		(A – E) + 2 +3 + 5 (part)				
Total				0.36	13.53		21	1.45	17.40	OK
TT 060922 (see Table 1)				1.41						
(City of S.C.) 2	12	RM	0.012	0.14						
	51	RL	0.0015	0.08						
(City of S.C.) 5 (part)	27	CC	0.015	0.41						
	27	RM	0.012	0.32		(A – E) +(1 – 5) +TT 060922				
Total				2.36	15.89		21	1.60	18.28	OK

PROPOSED NEW SEWER LINE IN SIERRA HIGHWAY

PIPE LIMITS	Q, CFS	DIAMETER, IN.	SLOPE, %	% FULL CAPACITY, CFS
FROM MH NO. 480 TO SOLEDAD CYN. RD. TRUNK LINE	15.89	24	1.0 MIN.	20.91

* EXISTING PIPE CAPACITIES ARE PER TABLE 4

NOTES: 1. AREAS DESIGNATION 1 THROUGH 8 ARE REFERENCED TO SEWER AREA STUDY PC 11534 BY LDC WITH REVISION OF AREA 2 AFFECTED BY SKYLINE RANCH DEVELOPMENT, TT NO. 060922.

2. AREAS 5 THROUGH 8 ARE SERVED BY EXISTING SEWER LINE IN SIERRA HWY AS SHOWN ON TABLE 4 (DOWNSTREAM OF MH NO. 480).

A THOROUGH INVESTIGATION OF AVAILABLE ZONING RECORDS FROM THE L.A. COUNTY DEPARTMENT OF REGIONAL PLANNING AND THE CITY OF SANTA CLARITA HAS BEEN CONDUCTED BY THE UNDERSIGNED AND IS FACTUALLY PRESENTED HEREWITH AS PART OF THE SEWER AREA STUDY FOR TRACT NO. 060922. THE SEWER AREA STUDY SHALL BE INVALIDATED SHOULD THE TOTAL NUMBER OF DWELLING UNITS INCREASE, THE DENSITY INCREASES, OR DWELLING UNITS OCCUR ON PREVIOUSLY INDENTIFIED BUILDING RESTRICTED LOTS.

REGISTERED PROFESSIONAL ENGINEER CRAIG YOUNG No.32363 Exp. 12-31-10 CIVIL STATE OF CALIFORNIA

CRAIG YOUNG, R.C.E. 32363

N

SCALE: 1"=400'

SEWER AREA STUDY

OFF-SITE FLOW

(CITY OF SANTA CLARITA)

SKYLINE RANCH

VESTING TENTATIVE TRACT NO. 060922

SHEET 3 OF 5

Prepared For:

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8. Off-site / Future Sewer Peak Flow Calculations (O.V.O.V.) – Table 4/Map 4

TABLE 4 - OFF-SITE SEWER F AK FLOW ANALYSIS (O.V.O.V.)

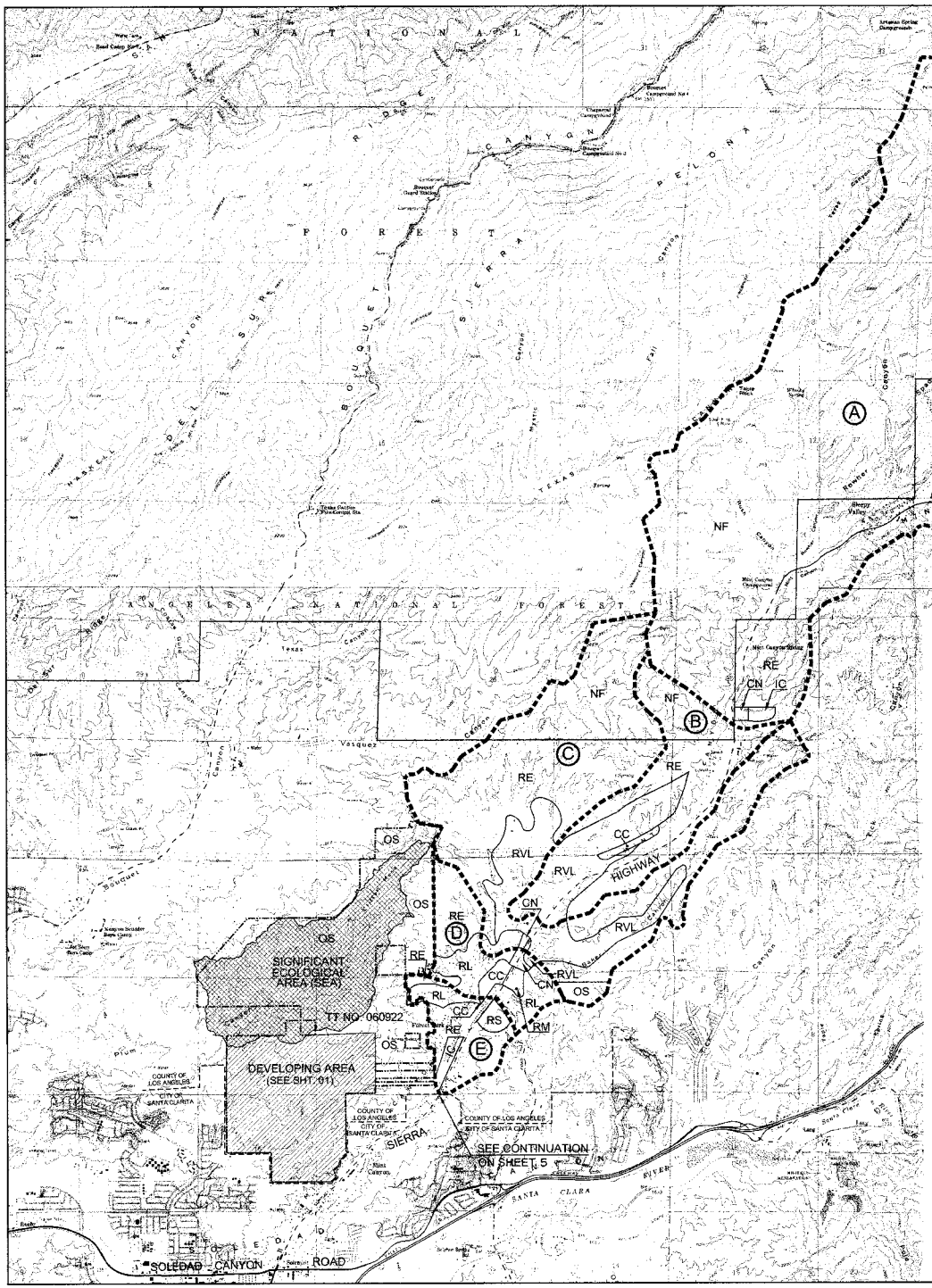
FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/Ac)	ADD'L 16 RES.UNITS COEFF. (cfs/ac)	PEAK FLOW (cfs)	ADD'L 16 RES.UNITS PEAK FLOW (cfs)	TOTAL PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED
A	9,543	NF	0		0.000		0.000		
(L.A. County)	1,954	RE	0.00075		1.466		1.466		
	6	CN	0.015		0.090		0.090		
	18	IC	0.021	0.016	0.378	0.288	0.666		
Total	11,521						2.222	2.222	A
B	100	NF	0		0.000		0.000		
(L.A. County)	544	RE	0.00075		0.408		0.408		
	341	RVL	0.001		0.341		0.341		
	26	CC	0.015	0.016	0.390	0.416	0.806		
Total	1,011						1.555	3.777	A + B
C	376	NF	0		0.000		0.000		
(L.A. County)	1,130	RE	0.00075		0.848		0.848		
	394	RVL	0.001		0.394		0.394		
	8	CN	0.015		0.120		0.120		
	63	OS	0		0.000		0.000		
Total	1,971						1.362	5.138	A through C
D	314	RE	0.00075		0.236		0.236		
(L.A. County)	45	RVL	0.001		0.045		0.045		
	14	RM	0.012		0.168		0.168		
	16	CC	0.015	0.016	0.240	0.256	0.496		
	15	CN	0.015		0.225		0.225		
	116	RL	0.0015		0.174		0.174		
Total	520						1.344	6.482	A through D
E	65	TR 46353	From prior study		0.110		0.110		
(L.A. County)	166	RE	0.00075		0.125		0.125		
	42	RL	0.0015		0.063		0.063		
	36	RS	0.005		0.180		0.180		
	3	CC	0.015	0.016	0.045	0.048	0.093		
	83	IC	0.021	0.016	1.743	1.328	3.071		
Total	395						3.642	10.123	A through E

Note: Area designation A through E are referenced to previously approved sewer area study from LDC with revision of areas C, D, E affected by Skyline Ranch development, TT No. 060922.

X:\sikand\5097-019\13\Planning\Tentative Map\Sewer\Sewer Area Study\Trunk Line Sewer Peak FLow Tables per City Calcs.xls

Copy of O.V.O.V. Sewer Area Off-Site Flow
(Sheet 4 of 5)
on file with the
County of Los Angeles,
Department of Public Works,
Land Development



ZONES LEGEND - L.A. COUNTY

- TRACT BOUNDARY
- DRAINAGE AREA BOUNDARY
- ZONING BOUNDARY

OS	OPEN SPACE
O-NF	NATIONAL FOREST
N1	NON-URBAN 1 (0.5 DU/AC)
N2	NON-URBAN 2 (1.0 DU/AC)
U1	URBAN 1 (1.1 TO 3.3 DU/AC)
U2	URBAN 2 (3.4 TO 6.6 DU/AC)
U3	URBAN 3 (6.7 TO 15 DU/AC)
C	COMMERCIAL
M	INDUSTRY

SIGNIFICANT ECOLOGICAL AREA

DEVELOPING AREA

TABLE 4 - SEWER PEAK FLOW CALCULATIONS (O.V.O.V.)

(FUTURE OFF-SITE FLOW)

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	AREA (ac)	LAND USE	PEAK FLOW COEFF. (cfs/Ac)	ADD'L 16 RES.UNITS COEFF. (cfs/ac)	PEAK FLOW (cfs)	ADD'L 16 RES.UNITS PEAK FLOW (cfs)	TOTAL PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED
A	9.543	NF	0		0.000		0.000		
(L.A. County)	1.954	RE	0.00075		1.466		1.466		
	6	CN	0.015		0.090		0.090		
	18	IC	0.021	0.016	0.378	0.288	0.666		
Total	11.521						2.222	2.222	A
B	100	NF	0		0.000		0.000		
(L.A. County)	544	RE	0.00075		0.408		0.408		
	341	RVL	0.001		0.341		0.341		
	26	CC	0.015	0.016	0.390	0.416	0.806		
Total	1.011						1.555	3.777	A + B
C	376	NF	0		0.000		0.000		
(L.A. County)	1.130	RE	0.00075		0.848		0.848		
	394	RVL	0.001		0.394		0.394		
	8	CN	0.015		0.120		0.120		
	63	OS	0		0.000		0.000		
Total	1.971						1.362	5.138	A through C
D	314	RE	0.00075		0.236		0.236		
(L.A. County)	45	RVL	0.001		0.045		0.045		
	14	RM	0.012		0.168		0.168		
	16	CC	0.015	0.016	0.240	0.256	0.496		
	15	CN	0.015		0.225		0.225		
	116	RL	0.0075		0.174		0.174		
Total	520						1.344	6.482	A through D
E	65	TR 46353	From prior study		0.110		0.110		
(L.A. County)	166	RE	0.00075		0.125		0.125		
	42	RL	0.0015		0.063		0.063		
	36	RS	0.005		0.180		0.180		
	3	CC	0.015	0.016	0.045	0.048	0.093		
	83	IC	0.021	0.016	1.743	1.328	3.071		
Total	395						3.642	10.123	A through E

Note: Area designation A through E are references to previously approved sewer area study from LDC with revision of areas C, D, E affected by Skyline Ranch development, TT No 060922

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N

SCALE: 1"=2000'

O.V.O.V.
SEWER AREA STUDY

OFF-SITE FLOW
(UNINCORPORATED COUNTY OF LOS ANGELES)

SKYLINE RANCH
VESTING TENTATIVE TRACT NO. 060922

SHEET 4 OF 5

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9. Sewer Peak Flow Analysis to Trunk Sewer (O.V.O.V.) - Table 5/ Map 5

TABLE 5 - SEWER PEAK FLOW ANALYSIS TO TRUNK LINE (O.V.O.V.)

FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	LAND USE	AREA (ac)	PEAK FLOW COEFF. (cfs/ac)	ADD'L 16 RES.UNITS COEFF. (cfs/ac)	PEAK FLOW (cfs)	ADD'L 16 RES.UNITS PEAK FLOW (cfs)	TOTAL PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED
City /County Boundary								**10.123**	
3		Canyon Country			1.440		1.440		
(City of Santa		Education Center							
Clarita)	IC	53	0.021	0.016	1.113	0.848	1.961		
	CC	11	0.015	0.016	0.165	0.176	0.341		
	RL	51	0.0015		0.077		0.077		
	RS	31	0.005		0.155		0.155		
	RE	30	0.00075		0.023		0.023		City/County Bdry
Total							*3.996*	**14.119**	+ Area 3
2	RL	98	0.004		0.390		0.390		
(City of S.C.)									City/County Bdry
Total							*0.390*	**14.509**	+ Areas 2 thru 3
5 (part)	RL	64	0.0015		0.096		0.096		
(City of Santa	RS	22	0.005		0.110		0.110		
Clarita)	IC	7	0.021	0.016	0.147	0.112	0.259		City/County Bdry
									+ Areas 2 thru 3
Total							*0.465*	**14.974**	+ Part of Area 5
TT 060922 (Skyline Connection, see Table 1)					1.405		1.405		
1	RM	12	0.012		0.144		0.144		
(City of S.C.)	RL	51	0.0015		0.077		0.077		
4	CC	27	0.015	0.016	0.405	0.432	0.837		
(City of S.C.)									City/County Bdry
5 (part)	RM	27	0.012		0.324		0.324		+ Areas 1 thru 5
Total							*2.787*	**17.761**	**+ TT 060922**

Proposed New Sewer Line in Sierra Highway

Pipe Limits	Q (cfs)	Dia (in.)	Min. Slope (%)	3/4 full capacity (cfs)
From MH No. 480 to Soledad Canyon Road Trunk Line	**17.76**	24	1.0	**20.91**

Worksheet for 21" RCP @ Sarabande Lane

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	15.75	in
Diameter	21.00	in

Results

Discharge	14.56	ft^3/s
Flow Area	1.94	ft^2
Wetted Perimeter	3.67	ft
Top Width	1.52	ft
Critical Depth	1.42	ft
Percent Full	75.0	%
Critical Slope	0.00851	ft/ft
Velocity	7.52	ft/s
Velocity Head	0.88	ft
Specific Energy	2.19	ft
Froude Number	1.17	
Maximum Discharge	17.14	ft^3/s
Discharge Full	15.81	ft^3/s
Slope Full	0.00849	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	75.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 21" RCP @ Sarabande Lane

GVF Output Data

Normal Depth	15.75	in
Critical Depth	1.42	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00851	ft/ft

Worksheet for 24" RCP @ Sarabande Lane

Project Description

Friction Method	Kutter Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	18.00	in
Diameter	24.00	in

Results

Discharge	20.91	ft^3/s
Flow Area	2.53	ft^2
Wetted Perimeter	4.19	ft
Top Width	1.73	ft
Critical Depth	1.64	ft
Percent Full	75.0	%
Critical Slope	0.00832	ft/ft
Velocity	8.27	ft/s
Velocity Head	1.06	ft
Specific Energy	2.56	ft
Froude Number	1.21	
Maximum Discharge	24.63	ft^3/s
Discharge Full	22.73	ft^3/s
Slope Full	0.00846	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	75.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for 24" RCP @ Sarabande Lane

GVF Output Data

Normal Depth	18.00	in
Critical Depth	1.64	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00832	ft/ft

Copy of O.V.O.V. Sewer Area Study Off-Site Flow
(Sheet 5 of 5)
on file with the
County of Los Angeles,
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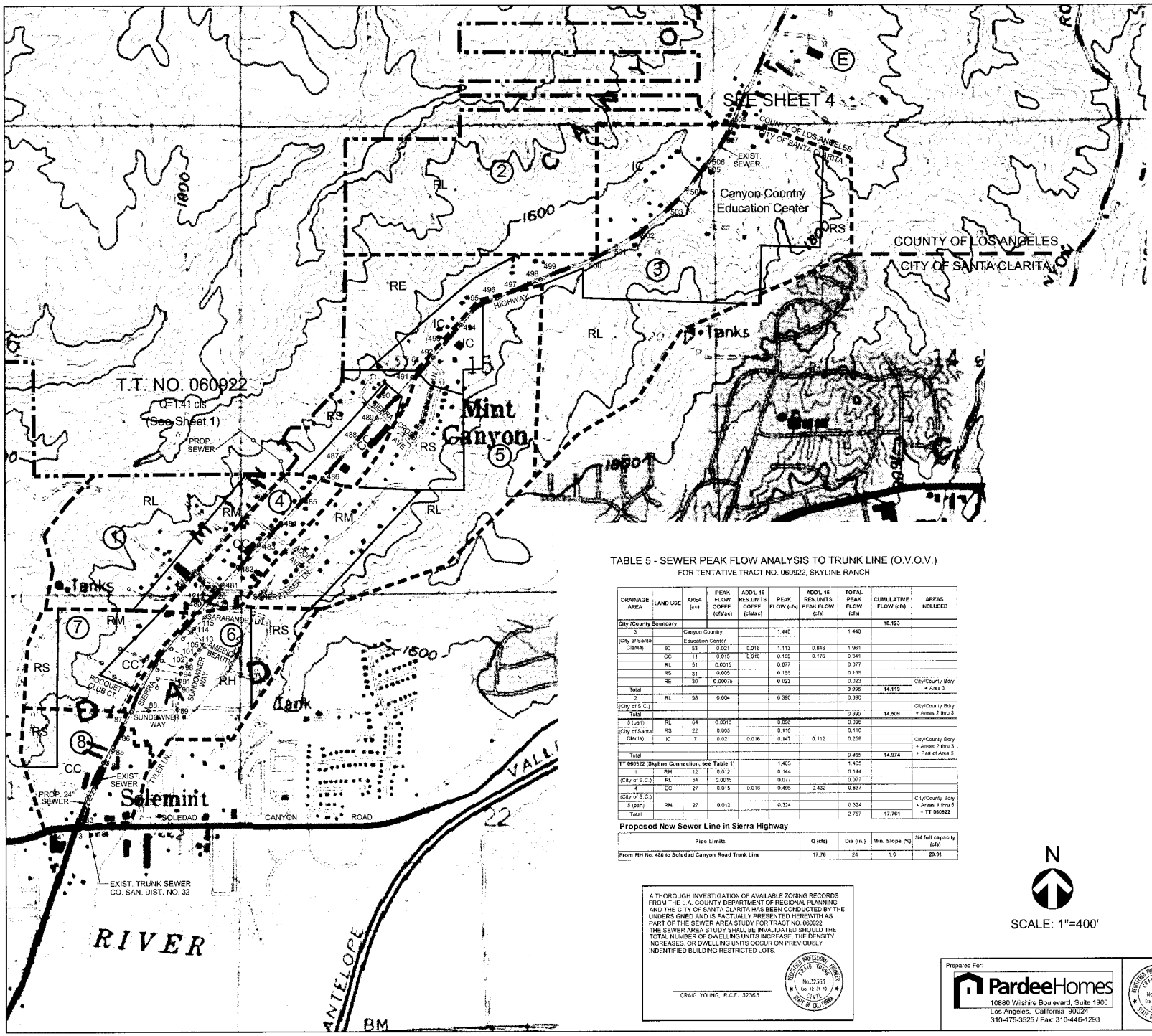

ZONES LEGEND - CITY OF SANTA CLARITA

- - - - - -	EXISTING SEWER
— — —	EXISTING TRUNK SEWER
———	PROPOSED SEWER
—·—·—	TRACT BOUNDARY
- - - - - -	DRAINAGE AREA BOUNDARY
———	ZONING BOUNDARY
CC	COMMUNITY COMMERCIAL
RL	RESIDENTIAL LOW
RM	RESIDENTIAL MODERATE
RH	RESIDENTIAL HIGH
RS	RESIDENTIAL SUBURBAN
RE	RESIDENTIAL ESTATE
IC	INDUSTRIAL COMMERCIAL
EC	EDUCATION CENTER

TABLE 5 - SEWER PEAK FLOW ANALYSIS TO TRUNK LINE (O.V.O.V.)
FOR TENTATIVE TRACT NO. 060922, SKYLINE RANCH

DRAINAGE AREA	LAND USE	AREA (ac)	PEAK FLOW COEFF. (cfs/ac)	ADD'L 16 RES.UNITS COEFF. (cfs/ac)	PEAK FLOW (cfs)	ADD'L 16 RES.UNITS PEAK FLOW (cfs)	TOTAL PEAK FLOW (cfs)	CUMULATIVE FLOW (cfs)	AREAS INCLUDED
City /County Boundary								**10.123**	
3		Canyon Country			1.440		1.440		
(City of Santa		Education Center							
Clarita)	IC	53	0.021	0.016	1.113	0.848	1.961		
	CC	11	0.015	0.016	0.165	0.176	0.341		
	RL	51	0.0015		0.077		0.077		
	RS	31	0.005		0.155		0.155		
	RE	30	0.00075		0.023		0.023		City/County Bdry
Total							3.996	**14.119**	+ Area 3
2	RL	98	0.004		0.390		0.390		
(City of S.C.)									City/County Bdry
Total							0.390	**14.509**	+ Areas 2 thru 3
5 (part)	RL	64	0.0015		0.096		0.096		
(City of Santa	RS	22	0.005		0.110		0.110		
Clarita)	IC	7	0.021	0.016	0.147	0.112	0.259		City/County Bdry
									+ Areas 2 thru 3
Total							0.465	**14.974**	+ Part of Area 5
TT 060922 (Skyline Connection, see Table 1)							1.405		
1	RM	12	0.012		0.144		0.144		
(City of S.C.)	RL	51	0.0015		0.077		0.077		
4	CC	27	0.015	0.016	0.405	0.432	0.837		
(City of S.C.)									City/County Bdry
5 (part)	RM	27	0.012		0.324		0.324		+ Areas 1 thru 5
Total							2.787	**17.761**	+ TT 060922

Proposed New Sewer Line in Sierra Highway

Pipe Limits	Q (cfs)	Dia (in.)	Min. Slope (%)	3/4 full capacity (cfs)
From MH No. 486 to Soledad Canyon Road Trunk Line	17.76	24	1.0	20.91

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N

SCALE: 1"=400'

O.V.O.V.
SEWER AREA STUDY

OFF-SITE FLOW
(CITY OF SANTA CLARITA)

SKYLINE RANCH
VESTING TENTATIVE TRACT NO. 060922

SHEET 5 OF 5

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Los Angeles, California 90024
310-475-3525 / Fax: 310-446-1293

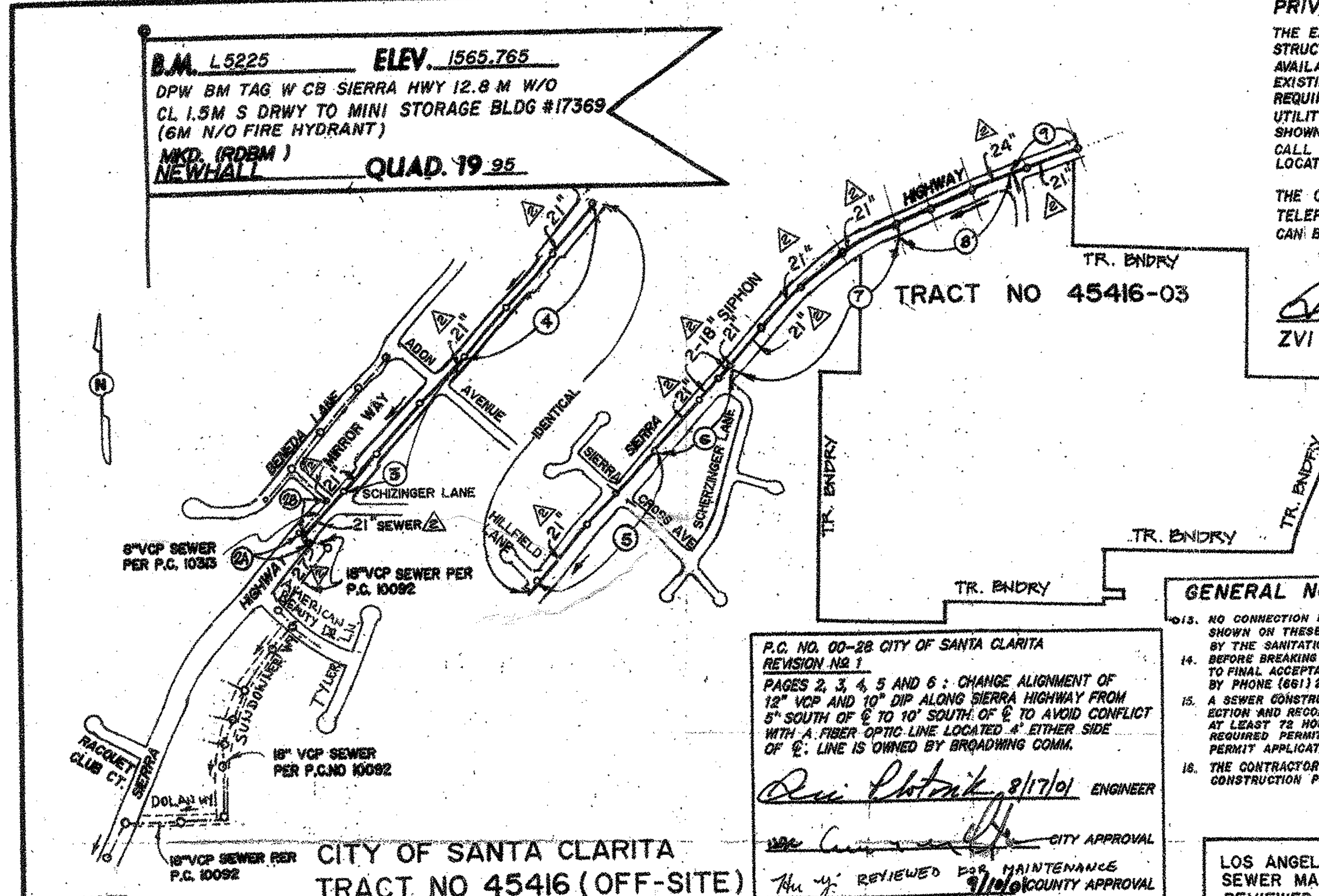
REGISTERED PROFESSIONAL ENGINEER CRAIG YOUNG No.32363 Exp. 12-31-10 CIVIL STATE OF CALIFORNIA

SIKAND
Engineering | Planning | Surveying
15230 Burbank Blvd,
Van Nuys, CA 91411
Tel: (818) 787-8550
Fax: (818) 901-7451
info@sikand.com

10. Appendix
    a. Sewer Area Study for Canyon Country Educational Center
    b. PC 00-28
    c. PC 10092
    d. PC 02-12

Copies of Maps on file with the
County of Los Angeles,
Department of Public Works,
Land Development

B.M. L5225 ELEV. 1565.765
DPW BM TAG W CB SIERRA HWY 12.8 M W/O CL 1.5M S DRWY TO MINI STORAGE BLDG #17369 (6M N/O FIRE HYDRANT)
MKD. (RDBM) NEWHALL QUAD. 19 95



NOTE
NUMBERS IN CIRCLES INDICATE PAGE NUMBERS

CITY OF SANTA CLARITA
TRACT NO 45416 (OFF-SITE)
SIERRA HIGHWAY
P.C. NO. 00-28
INDEX MAP
SCALE 1" = 600'
TG 4551-J1, J2
TG 4552-A1

P.C. NO. 00-28 CITY OF SANTA CLARITA
REVISION NO. 4
PAGE 6: CHANGE ALIGNMENT OF SIPHON SEWER TO AVOID CONFLICT WITH FIBER OPTIC LINE
5/10/02 ENGINEER
CITY APPROVAL
5/20/02 COUNTY APPROVAL

P.C. NO. 00-28 CITY OF SANTA CLARITA
REVISION NO 1
PAGES 2, 3, 4, 5 AND 6 : CHANGE ALIGNMENT OF 12" VCP AND 10" DIP ALONG SIERRA HIGHWAY FROM 5' SOUTH OF ℄ TO 10' SOUTH OF ℄ TO AVOID CONFLICT WITH A FIBER OPTIC LINE LOCATED 4' EITHER SIDE OF ℄. LINE IS OWNED BY BROADWING COMM.
8/17/01 ENGINEER
CITY APPROVAL
REVIEWED FOR MAINTENANCE 9/10/01 COUNTY APPROVAL

16. ALL WYES AND/OR HOUSE LATERALS ARE TO BE LOCATED AT LEAST FIVE (5) FEET APART AND NOT CLOSER THAN FIVE (5) FEET TO ANY MANHOLE.
17. REFER TO THE STANDARD DRAWING 2100-0, "DESIGN REQUIREMENTS FOR SANITARY SEWERS IN THE VICINITY OF PRESSURE WATER MAINS", AND COMPLY WITH ITS REQUIREMENTS.

P.C. NO. 00-28 CITY OF SANTA CLARITA
REVISION NO. 2 11-14-01
ALL PAGES: REVISED PIPE SIZES (SEE REVISED SEWER AREA STUDY) DUE TO ADDITIONAL COUNTY FLOWS.
12/13/01 ENGINEER
12-19-01 CITY APPROVAL
1/7/02 COUNTY APPROVAL

PRIVATE ENGINEER'S NOTICE TO CONTRACTORS

THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY, PIPES, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. TO THE BEST OF OUR KNOWDGE, THERE ARE NO EXISTING UTILITIES EXCEPT AS SHOWN ON THIS MAP. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURES TO PROTECT THE UTILITY LINES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THIS DRAWING. PRIOR TO EXCAVATION THE CONTRACTOR SHALL CALL TOLL FREE 800-422-4133 TO VERIFY THE UNDERGROUND LOCATION OF GAS AND TELEPHONE LINES.

THE CONTRACTOR SHALL ALSO CALL MR ROY CUMMINGS OF GENERAL TELEPHONE COMPANY AT 805-948-4871 SO THAT REQUIRED INSPECTION CAN BE MADE.

ZVI PLOTNIK 5/29/01 DATE 29604 R.C.E.

P.C. NO. 00-28 CITY OF SANTA CLARITA
REVISION NO. 3
PAGES 6, 7, 8 AND 9 : CHANGE ALIGNMENT OF 18" D.I.P. AND 21" AND 24" VCP TO AVOID CONFLICTS WITH EXISTING 60" STORM DRAIN AND STREET IMPROVEMENTS, REVISE PROFILE PAGE 5
4/16/02 ENGINEER
CITY APPROVAL
COUNTY APPROVAL

GENERAL NOTES (CONTINUED):

13. NO CONNECTION FOR THE DISPOSAL OF INDUSTRIAL WASTES SHALL BE MADE TO SEWERS SHOWN ON THESE DRAWINGS UNTIL A PERMIT FOR INDUSTRIAL DISCHARGE HAS BEEN ISSUED BY THE SANITATION DISTRICTS FOR SAID CONNECTION.
14. BEFORE BREAKING INTO OR CONSTRUCTION OF A COUNTY SANITATION DISTRICT SEWER AND PRIOR TO FINAL ACCEPTANCE OF THE PROJECT, A SANITATION DISTRICT INSPECTOR SHALL BE NOTIFIED BY PHONE (661) 266-4665 SO THAT REQUIRED INSPECTIONS CAN BE MADE.
15. A SEWER CONSTRUCTION PERMIT SHALL BE OBTAINED AND A FEE PAID FOR CONSTRUCTION, INSPECTION AND RECORD PLANS TO THE CITY OF SANTA CLARITA, 23920 VALENCIA BLVD., SUITE 300 AT LEAST 72 HOURS PRIOR TO STARTING WORK UNDER THIS CONTRACT. COPIES OF ALL OTHER REQUIRED PERMITS, SUCH AS ROAD EXCAVATION, CALTRANS, ETC. MUST BE FILED WITH THE PERMIT APPLICATION.
16. THE CONTRACTOR SHALL CONTACT THE DISTRICT OFFICE LISTED ON THE "APPLICATION FOR CONSTRUCTION PERMIT" TO ARRANGE FOR AN ACCEPTABLE CONSTRUCTION START DATE.

LOS ANGELES COUNTY DEPT. OF PUBLIC WORKS CONSOLIDATED SEWER MAINTENANCE DISTRICT.
REVIEWED FOR MAINTENANCE.
REVIEWED BY: 6/19/01 DATE

IMPORTANT NOTICE

SECTION 4216/4217 OF THE GOVERNMENT CODE REQURES A DIG ALERT IDENTIFICATION NUMBER BE ISSUED BEFORE A "PERMIT TO EXCAVATE" WILL BE VALID FOR YOUR DIG ALERT I.D. NUMBER CALL UNDERGROUND SERVICE ALERT TOLL FREE 1-800-422-4133 TWO WORKING DAYS BEFORE YOU DIG.

GENERAL NOTES:

1. ELEVATIONS ARE IN FEET ABOVE U.S.C. & G.S. SEA LEVEL DATUM OF 1929.
2. NO REVISIONS SHALL BE MADE IN THESE PLANS WITHOUT THE APPROVAL OF THE CITY ENGINEER.
3. NO REPRESENTATIVE OF THE CITY OF SANTA CLARITA WILL SURVEY OR LAY OUT ANY PORTION OF THE WORK.
4. GRADES TO WHICH THIS IMPROVEMENT IS TO BE CONSTRUCTED ARE SHOWN ON PLANS AND PROFILES. GRADE POINTS FOR TOP OF CURBS, CENTER LINE OF STREETS, OR CENTER LINE OF ALLEYS ARE SHOWN BY CIRCLES ON PROFILES. AT ALL POINTS BETWEEN DESIGNATED POINTS THE GRADE SHALL BE ESTABLISHED SO AS TO CONFORM TO A STRAIGHT LINE DRAWN BETWEEN SAID DESIGNATED POINTS.
5. THE PRIVATE ENGINEER SHALL FURNISH THE CITY OF SANTA CLARITA WITH GRADE SHEETS AND STATIONING FOR ALL HOUSE LATERALS AND "Y" OR "T" BRANCHES AND SHALL PROVIDE STAKES FOR THEM AT THEIR PROPER LOCATIONS WITH STATIONING PLAINLY MARKED. ALL HOUSE LATERALS SHALL BE CONSTRUCTED IN A STRAIGHT ALIGNMENT AT RIGHT ANGLES FROM THE MAIN LINE SEWER EXCEPT AS SHOWN ON THE PLANS. HOUSE LATERALS FROM CHIMNEYS SHALL NOT HAVE AN ANGLE OF LESS THAN 45° WITH THE MAIN LINE SEWER. ANY CHANGE IN ALIGNMENT SHALL BE REQUESTED IN WRITING BY THE PRIVATE ENGINEER.
6. THE PRIVATE ENGINEER SHALL FURNISH THE HOUSE LATERAL DEPTH AT THE PROPERTY LINE BELOW THE TOP OF CURB ELEVATION FOR EACH HOUSE LATERAL ON THE GRADE SHEET.
7. BEFORE WORK CAN BE STARTED, THE CONTRACTOR MUST OBTAIN A PERMIT TO EXCAVATE IN CITY STREETS FROM THE CITY OF SANTA CLARITA, 23920 VALENCIA BLVD., SUITE 300 AND PAY FEE TO THE DEPARTMENT OF TRANSPORTATION AND ENGINEERING SERVICES COVER THE COST OF CONSTRUCTION INSPECTION AND RECORD PLANS.
8. IF WORK IS TO DONE IN A STATE HIGHWAY, A PERMIT MUST BE OBTAINED FROM THE STATE OF CALIFORNIA, DIVISION OF HIGHWAYS, 120 SOUTH SPRING STREET, LOS ANGELES, CALIFORNIA.
9. APPROVAL OF THIS PLAN BY THE CITY OF SANTA CLARITA DOES NOT CONSTITUTE A REPRESENTATION AS TO THE ACCURACY OF THE LOCATION OF OR THE EXISTENCE OR NON-EXISTENCE OF ANY UNDERGROUND UTILITY PIPE, OR STRUCTURE WITHIN THE LIMITS OF THIS PROJECT. THIS NOTE APPLIES TO ALL PAGES
10. REFER TO SECTION 7.10.4.1 OF THE STANDARD SPECIFICATIONS, REGARDING SAFETY ORDERS AND SHALL CONFORM TO THE "MINIMUM PUBLIC SAFETY REQUIREMENTS" AS SHOWN ON L.A. DEPT. OF PUBLIC WORKS STANDARD 6008-0.
11. PRIOR TO THE ISSUANCE OF THE REQUIRED SEWER CONSTRUCTION PERMIT, THE CONTRACTOR SHALL OBTAIN AND FILE WITH THE CITY OF SANTA CLARITA, 23920 VALENCIA BLVD., SUITE 300, SANTA CLARITA, CA. 91355 COPIES OF A PERMIT TO EXCAVATE IN CITY STREETS AND A PERMIT FOR EXCAVATION AND TRENCHES FROM THE STATE OF CALIFORNIA DIVISION OF INDUSTRIAL SAFETY AND A CERTIFICATE OF WORKERS COMPENSATION INSURANCE WITH THE CITY OF SANTA CLARITA NAMED AS THE CERTIFICATE HOLDER TO BE NOTIFIED 30 DAYS PRIOR TO CANCELLATION OF POLICY.
12. THE EXISTANCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS.

CONSTRUCTION NOTES:

1. WORK SHALL BE CONSTRUCTED ACCORDING TO THE 2000 EDITION OF STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION AND DEPARTMENT OF PUBLIC WORKS AND 2001 SUPPLEMENT, AND 1991 SPECIAL PROVISIONS FOR THE CONSTRUCTION OF SANITARY SEWERS AND SHALL BE PROSECUTED ONLY IN THE PRESENCE OF THE CITY OF SANTA CLARITA.
2. THE CONTRACTOR SHALL NOTIFY THE ENGINEERING DIVISION BY TELEPHONE (661)255-4935 AT LEAST TWENTY-FOUR HOURS BEFORE STARTING ANY WORK UNDER THIS CONTRACT
3. HOUSE LATERALS TO BE CONSTRUCTED WITH INVERTS AT PROPERTY LINE 6 FEET BELOW CURB GRADE EXCEPT AS NOTED
4. WYE OR TEE BRANCHES MAY BE USED FOR CONNECTIONS TO MAINLINE SEWERS EXCEPTED AS NOTED.
5. ALL STRUCTURES SHALL BE NON-REINFORCED PRECAST CONCRETE MANHOLE PER APWA 200-2.
6. PROVIDE STAKES ON THE PROPERTY LINE OR PROPERTY LINES PRODUCED AT RIGHT ANGLES TO THE SEWER LINE AT THE CENTER LINE OF EACH MANHOLE
7. MANHOLE TOPS IN UNIMPROVED RIGHTS OF WAY TO BE SIX INCHES ABOVE FINISHED GRADE. MANHOLE TOPS IN IMPROVED RIGHTS OF WAY SHALL BE LEVEL WITH FINISHED GRADE.
8. VITRIFIED CLAY PIPE JOINTS SHALL BE TYPE "D" OR "G" PER STANDARD SPECIFICATIONS SECTION 208-2
9. IF A POWER POLE IS WITHIN THREE FEET OF THE SEWER, THE SEWER SHALL BE ENCASED PER 2023-2 TWO FEET ON EACH SIDE FROM THE POINT OF INTERFERENCE
10. IF DURING THE COURSE OF CONSTRUCTION IT IS DETERMINED THAT THERE IS LESS THAN FOUR FEET OF COVER OVER THE TOP OF A MAIN LINE OR HOUSE LATERAL V.C.P. SEWER WHICH IS NOT INDICATED ON THE PLANS, THE PIPE SHALL BE ENCASED PER 2023-2 UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF PUBLIC WORKS
11. ALL JOINTS BETWEEN CAST IRON PIPE AND VITRIFIED CLAY PIPE SHALL BE MADE WITH A RUBBER SLEEVE JOINT TYPE "C" OR "D" WITH BUSHING IF NECESSARY PER STANDARD SPECIFICATIONS, SECTION 208-2
12. SEWERS TO BE TESTED FOR LEAKAGE PER SECTION 306-1.4 OF THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS
13. RESURFACE ALL TRENCHES WITHIN PAVED AREAS TO MEET CITY OF SANTA CLARITA OR CALIFORNIA STATE HIGHWAY REQUIREMENTS IN ACCORDANCE WITH PERMITS
14. FULL COMPLIANCE WITH SECTION 306-1.3.4 OF THE STANDARD SPECIFICATIONS WILL BE REQUIRED FOR BACKFILL IN STREETS. CERTIFICATION OF BACKFILL COMPACTION AND SAND EQUIVALENTS BY A QUALIFIED, REGISTERED TESTING LABORATORY SHALL BE PROVIDED BY THE PERMITTEE PRIOR TO THE ISSUANCE OF A CERTIFICATE OF PARTIAL ACCEPTANCE
15. SEWER TRENCH BACKFILL WITHIN EASEMENT:
A) BACKFILL TRENCH AND REPLACE OTHER EARTH REMOVED, SO AS TO ACHIEVE THE NATURAL OR FINISHED GRADES AND SLOPES SHOWN ON THE GRADING PLAN APPROVED FOR THIS PARCEL / TRACT MAP BY THE CITY OF SANTA CLARITA.
B) ALL BACKFILL AND FILLS OUTSIDE OF STREET RIGHT-OF-WAY SHALL BE COMPACTED TO A MINIMUM OF 90% OF MAXIMUM DENSITY AS DETERMINED BY ASTM SOIL COMPACTION TEST D 1557-91, UNLESS OTHERWISE SPECIFIED. THIS SHALL BE CERTIFIED BY A QUALIFIED CIVIL ENGINEER. THIS CERTIFICATION SHALL BE SUBMITTED TO THE CITY ENGINEER, CITY SANTA CLARITA PRIOR TO ACCEPTANCE OF THE WORK BY THE CITY.

PROFILE, ALIGNMENT AND GRADE OF

SANITARY SEWERS

TO BE CONSTRUCTED IN
TRACT NO 45416 (OFF-SITE)
IN THE CITY OF SANTA CLARITA
IN SIERRA HIGHWAY

PRIVATE CONTRACT NO. 00-28

W.S.
5 SHEETS; 9 PAGES

REGISTERED PROFESSIONAL ENGINEER ZVI PLOTNIK No. 29604 Exp. 3-31-03 CIVIL STATE OF CALIFORNIA

SCALE: VERT. 1" = 4' HORIZ. 1" = 40'

PREPARED IN THE OFFICES OF:
PLOTNIK & ASSOCIATES
18710 S. WILMINGTON AVENUE; SUITE 203
RANCHO DOMINGUEZ, CALIFORNIA 90220
PHONE: 310-605-6657

BY: ZVI PLOTNIK REG. CE. NO. 29604

THE FOLLOWING LATEST REVISED STANDARD PLANS ON FILE IN THE OFFICE OF THE DEPARTMENT OF PUBLIC WORKS SHALL APPLY IN THE CONSTRUCTION OF THIS PROJECT

LEGEND	2000-1
MINIMUM PUBLIC SAFETY	6008-1
BRICK SEWER MANHOLE	APWA 203-0
STANDARD MANHOLE STEP	2015-1
BEDDING FOR SEWER PIPE	2021-1
CRADLING AND ENCASEMENT	2023-2
WYE OR TEE SUPPORT	2024-1
ALLOWABLE TRENCH WIDTHS	2027-1
JACKING STEEL CASING FOR SEWER PIPE	2028-1
LOCKING MANHOLE FRAME AND COVER	APWA 210-2
NON-REINFORCED PRECAST CONCRETE MANHOLE	APWA 200-2
DESIGN REQUIREMENTS FOR SANITARY SEWER IN THE VICINITY OF PRESSURE WATER MAINS	2100-1
BREAKING INTO EXISTING MANHOLES	APWA 208-1
CHIMNEYS	APWA 220-2
JACKING PIPE	2028-1
SIPHON MANHOLE	2005-2

CITY OF SANTA CLARITA, CALIFORNIA

ANTHONY NISICH
CITY ENGINEER
APPROVED 6/19/01 (DATE)

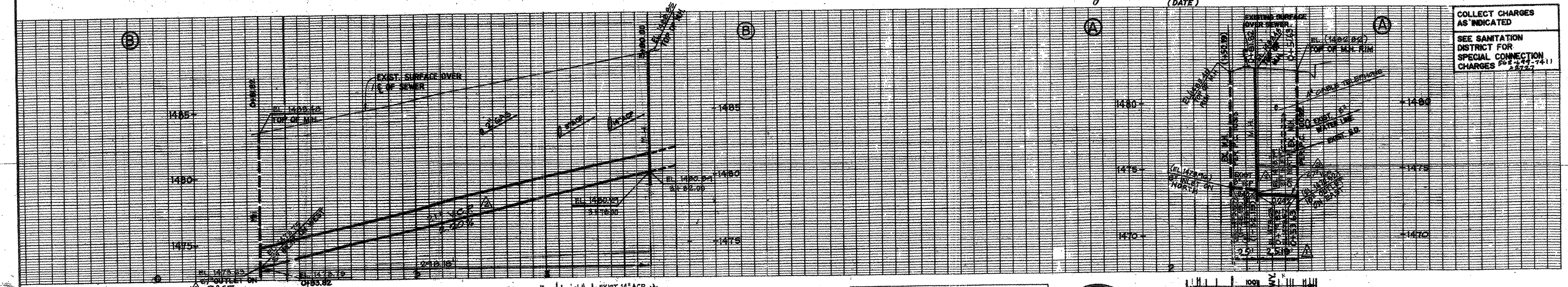
JAMES F. STAHL
CHIEF ENGINEER AND GENERAL MANAGER
CO. SAN DIST NO. 26
APPROVED OFFICE ENGINEER 7/3/01 DATE

CHECKED Harry Corden 5/22/01 (DATE)

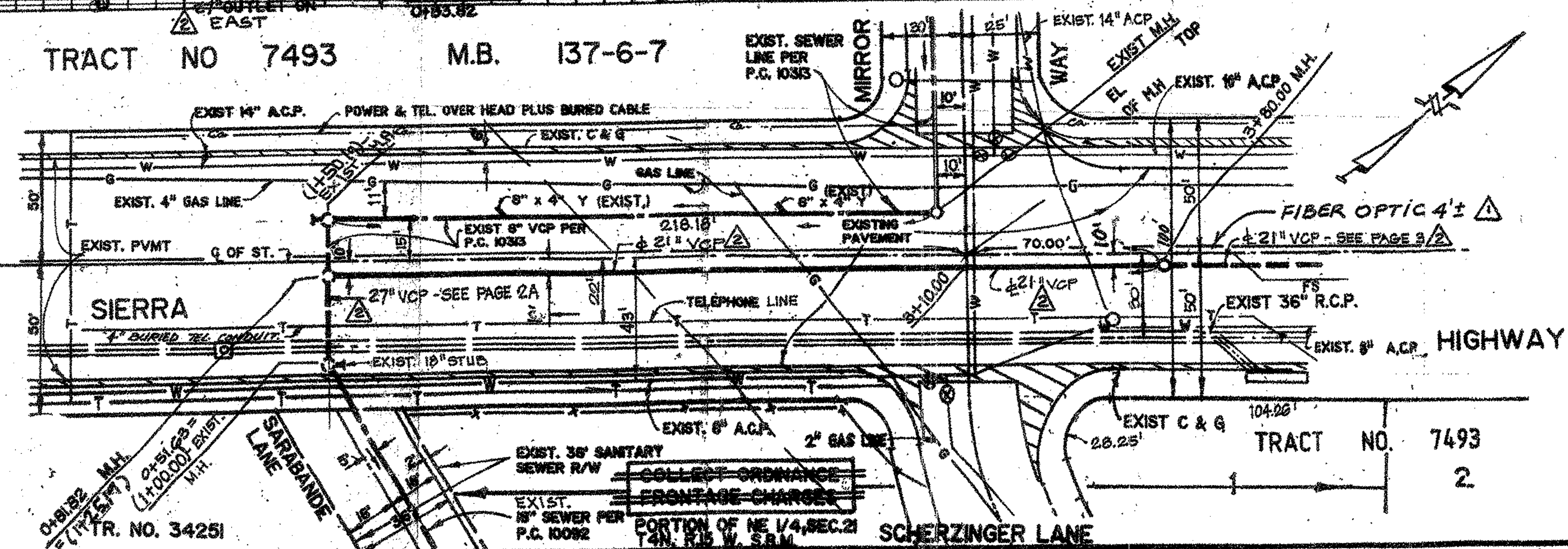
AS-BUILTS
TN 3005

REVIEWED BY: Harry Corden 5/22/01 (DATE) **SANTA CLARITA PC 00-28**

COLLECT CHARGES AS INDICATED
SEE SANITATION DISTRICT FOR SPECIAL CONNECTION CHARGES

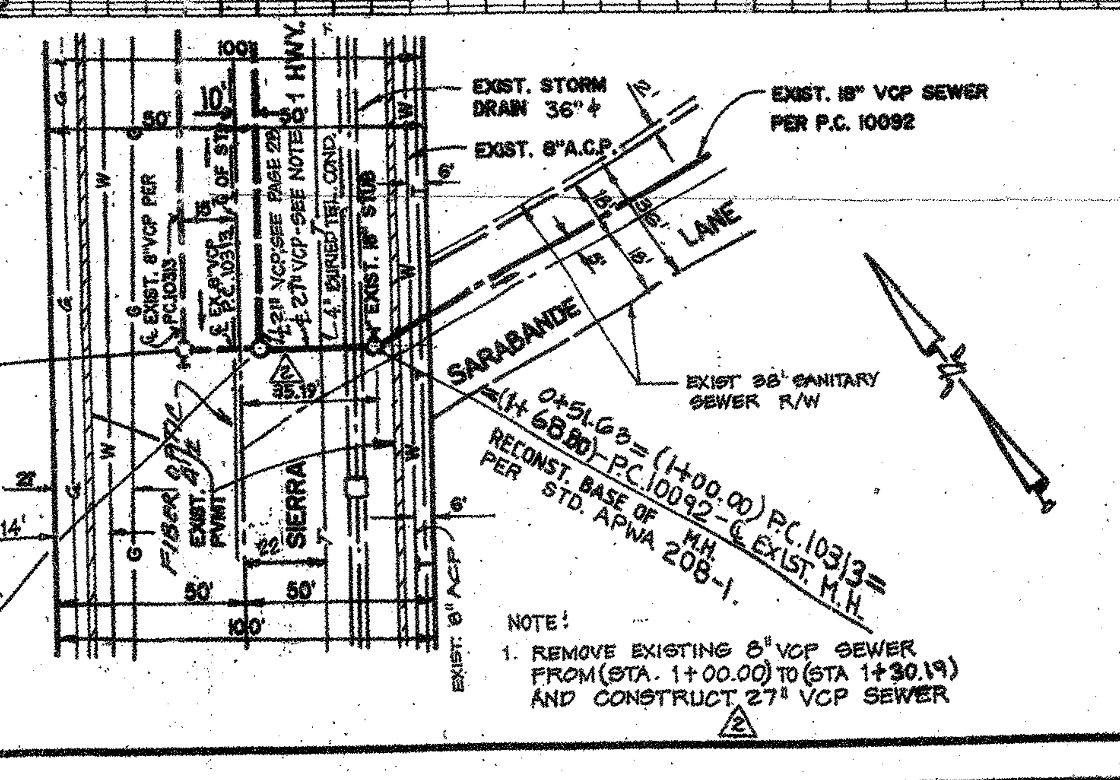


TRACT NO 7493 M.B. 137-6-7

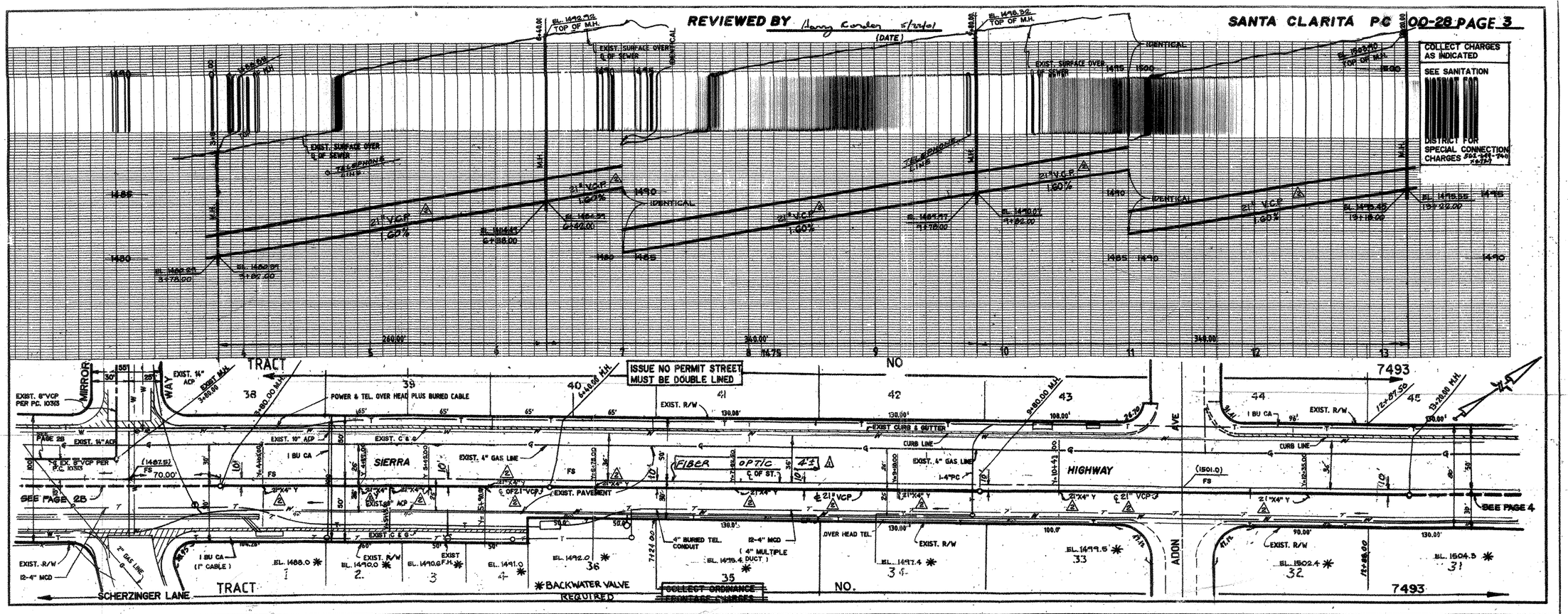


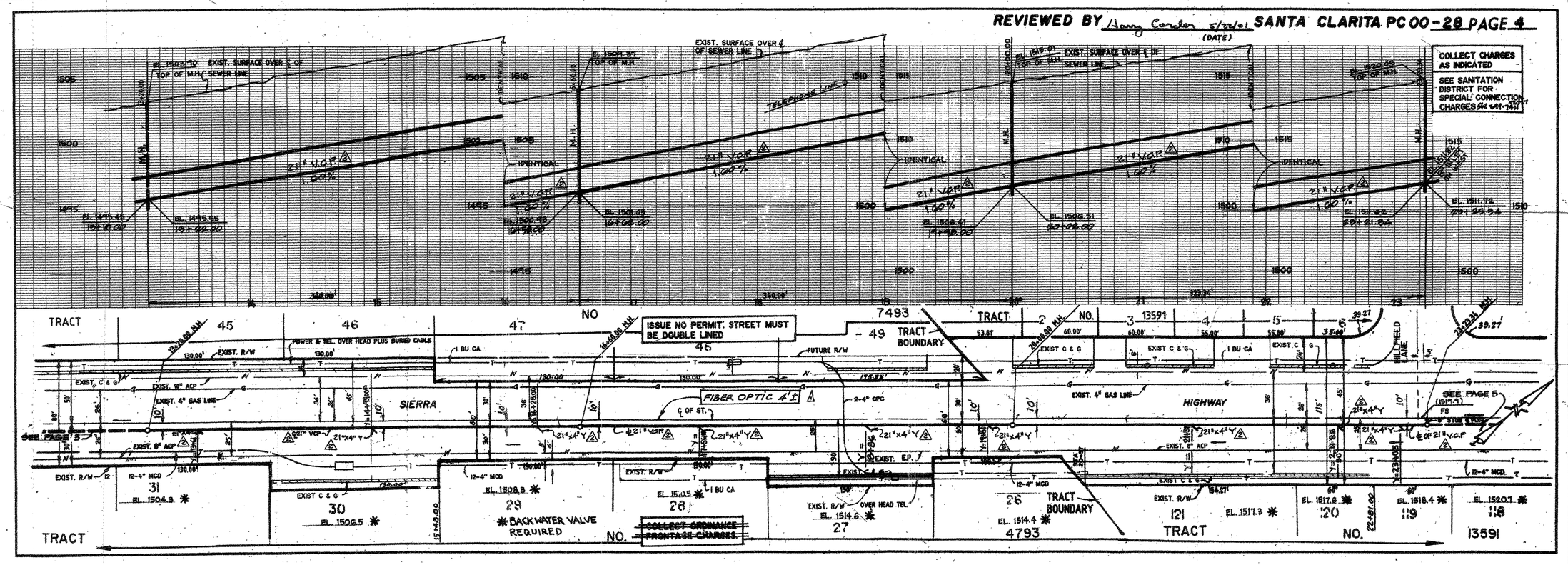
PC NO. 00-28 CITY OF SANTA CLARITA
REVISION NO 4
PAGE 9 ; ADD 8" VCP LINE AND MANHOLE W'LY OF STA. 65+45.93
REVISED BY : GRC ENTERPRISES
27600 BOUQUET CANYON ROAD #200
SANTA CLARITA, CA 91351
(661) 297-2336
26AUG 03
RON KOESTER RCE 42399 EXP 3-31-04 DATE
CITY APPROVAL

PC NO. 00-28 CITY OF SANTA CLARITA
REVISION NO. 5
PAGE 6, JOIN NEW 8" MAINLINE AT MH AT STA. 32+25.98
REVISED BY : GRC ENTERPRISES
27600 BOUQUET CANYON ROAD # 200
SANTA CLARITA CA. 91350 661-297-2336
18APR 05
RON KOESTER RCE 42399 EXP 3-31-06 DATE
7/6/05 CITY APPROVAL
7/12/05 COUNTY APPROVAL

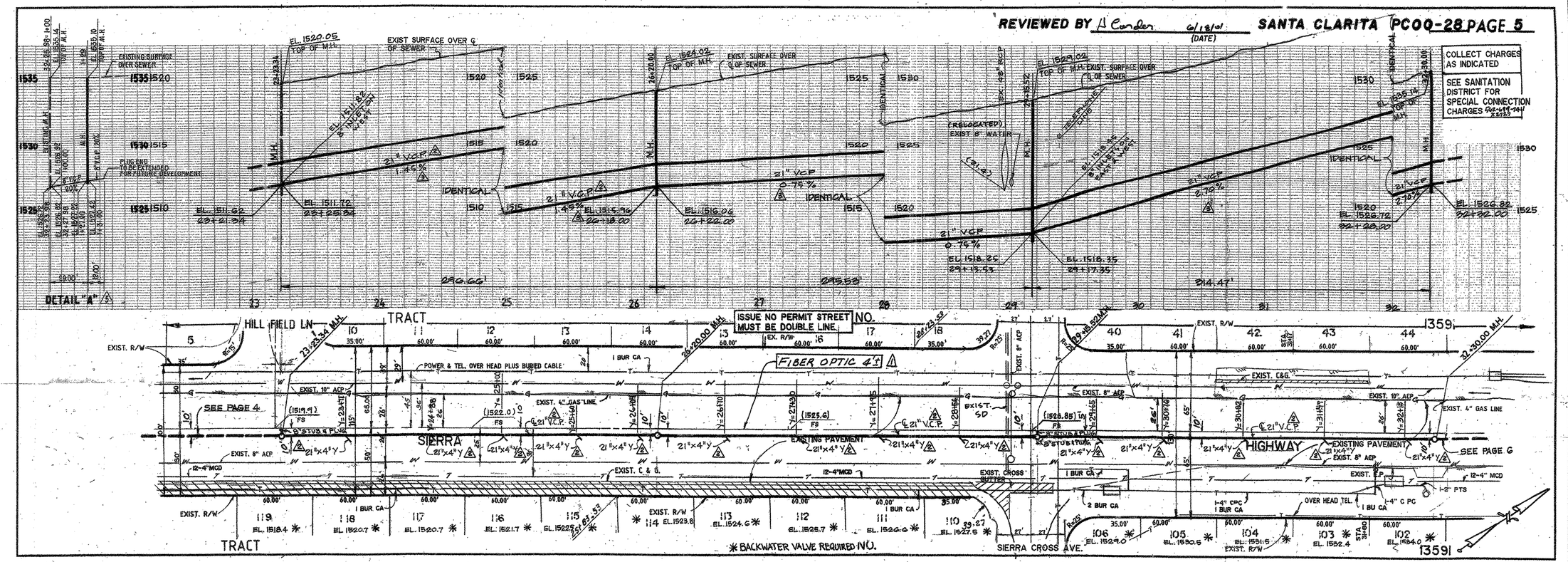


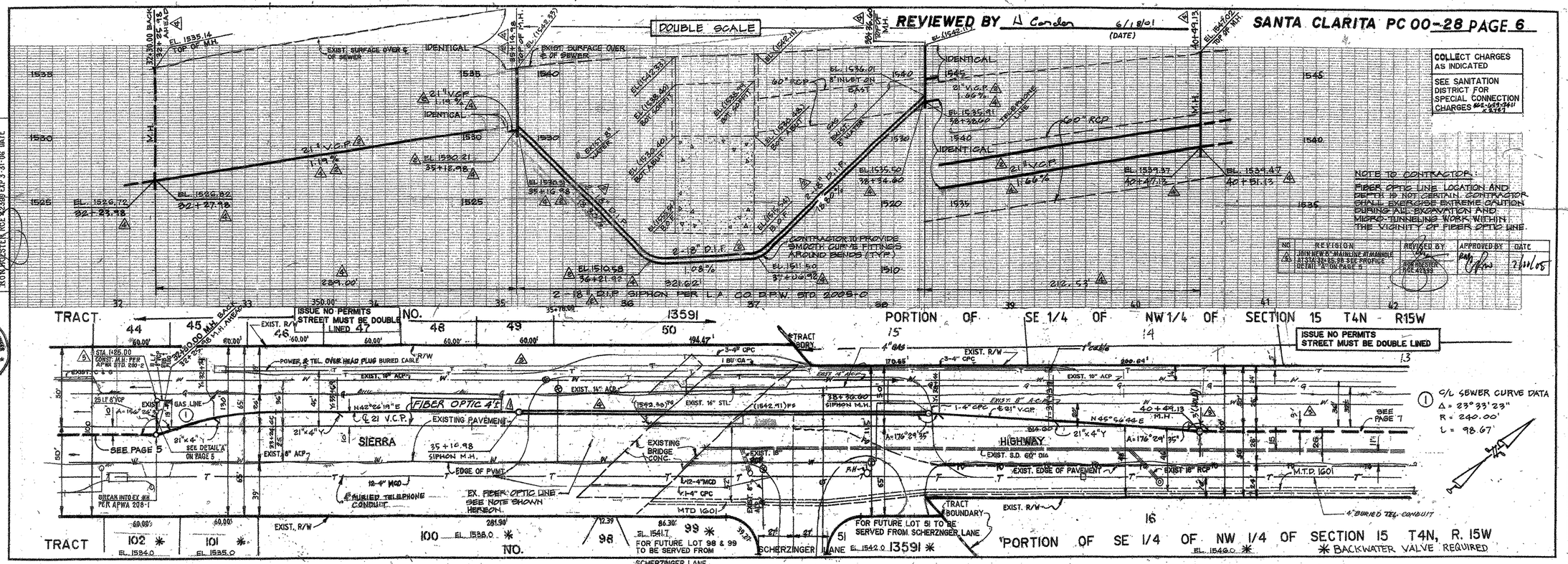
NOTE:
1. REMOVE EXISTING 8" VCP SEWER FROM (STA. 1+00.00) TO (STA 1+30.19) AND CONSTRUCT 27" VCP SEWER


REVIEWED BY Larry Carden 5/22/01 (DATE)
SANTA CLARITA PC 00-28 PAGE 3
COLLECT CHARGES AS INDICATED
SEE SANITATION DISTRICT FOR SPECIAL CONNECTION CHARGES
ISSUE NO PERMIT STREET MUST BE DOUBLE LINED
TRACT NO 7493
SIERRA HIGHWAY
FIBER OPTIC 4"I
POWER & TEL. OVER HEAD PLUS BURIED CABLE
SCHERZINGER LANE
MIRROR WAY
ADON AVE
SEE PAGE 2B
SEE PAGE 4
BACKWATER VALVE REQUIRED
COLLECT ORDINANCE FRONTAGE CHARGES
TRACT NO. 7493


REVIEWED BY Larry Carden 5/22/01 (DATE)
SANTA CLARITA PC 00-28 PAGE 4
COLLECT CHARGES AS INDICATED
SEE SANITATION DISTRICT FOR SPECIAL CONNECTION CHARGES
ISSUE NO PERMIT STREET MUST BE DOUBLE LINED
TRACT NO 7493
TRACT NO. 13591
SIERRA HIGHWAY
FIBER OPTIC 4"I
TRACT BOUNDARY
MILLFIELD LANE
SEE PAGE 5
BACKWATER VALVE REQUIRED
COLLECT ORDINANCE FRONTAGE CHARGES

PC 00-28





REVISIONS BY
ORC ENTERPRISES
27600 BOUQUET CANYON ROAD, SUITE 200
SANTA CLARITA CA. 91350 (661) 297-2336
RON ROCHESTER, RCE 42399 EXP. 3-31-06 DATE 16 APRIL 05

REGISTERED PROFESSIONAL ENGINEER
RONALD R. ROCHESTER
No. 42399
Exp. Mar. 31, 2006
CIVIL
STATE OF CALIFORNIA

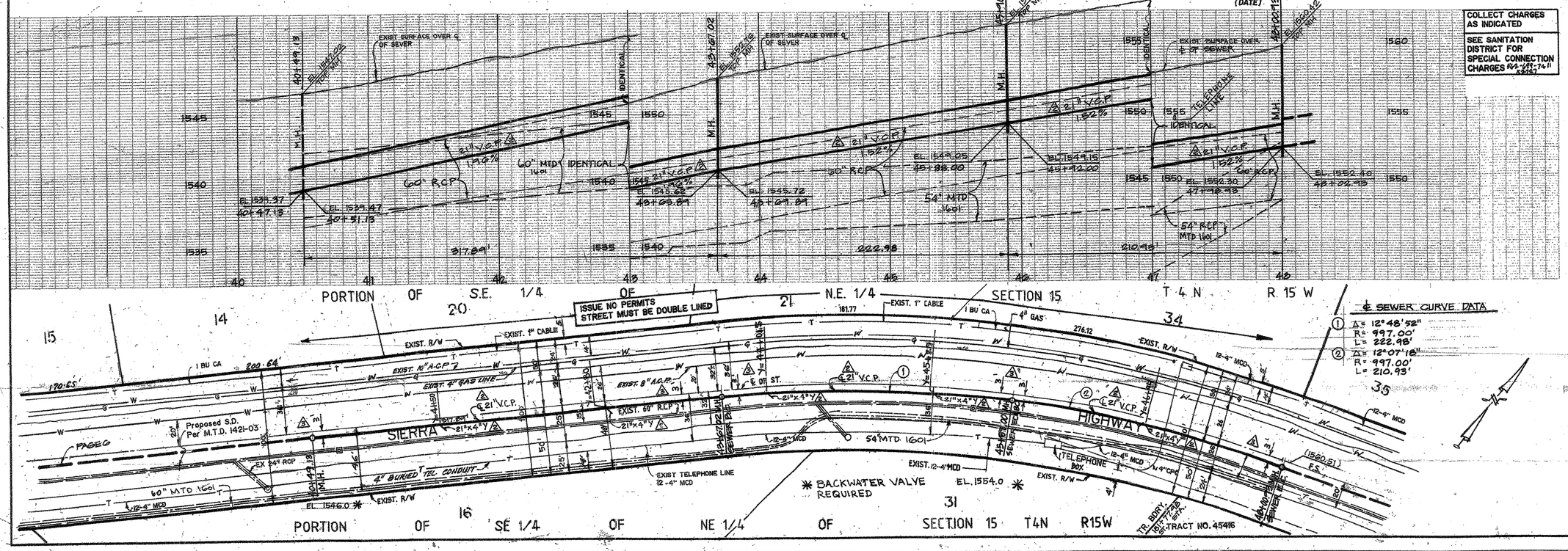
NO.	REVISION	REVISED BY	APPROVED BY	DATE
1	ADD NEW C.O. MAINLINE & MANHOLE AT 23+23.34 & 32+30.00 SEE PROFILE DETAIL "A" ON PAGE 5	RON ROCHESTER RCE 42399		7/11/05

BC 00-28

REVIEWED BY A Conden 6/18/01 (DATE) SANTA CLARITA PC 00-28 PAGE 7

COLLECT CHARGES AS INDICATED

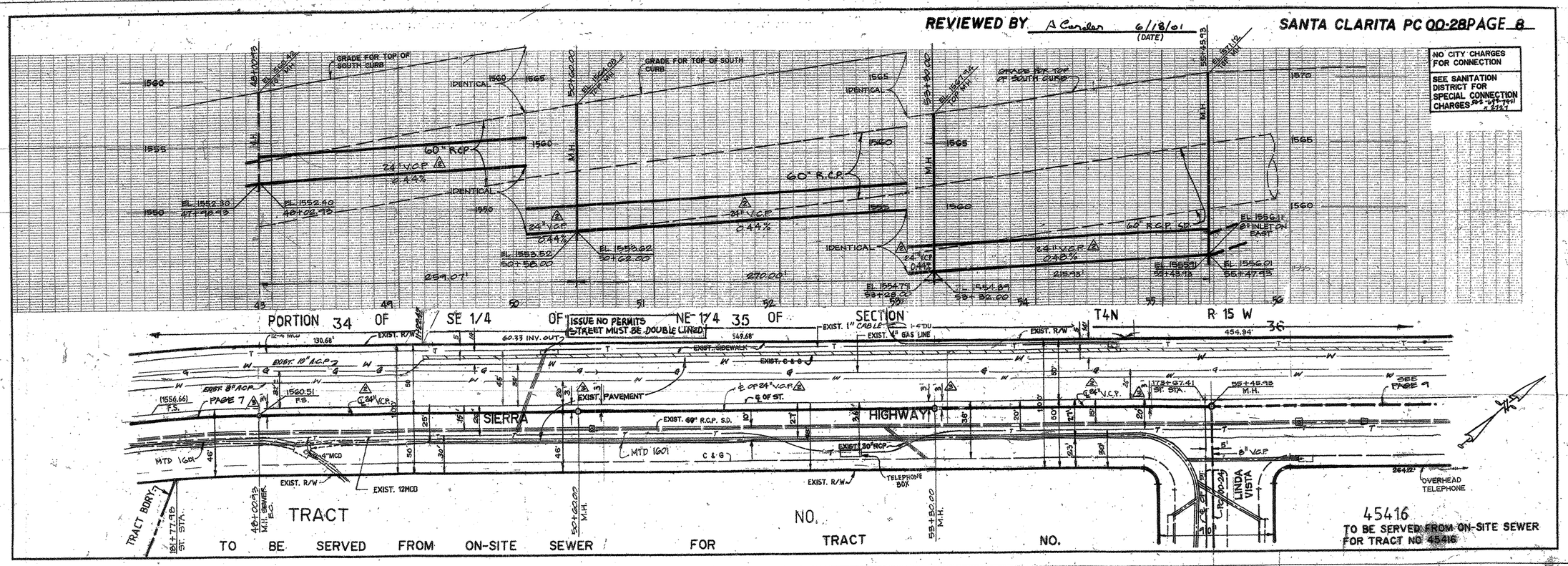
SEE SANITATION DISTRICT FOR SPECIAL CONNECTION CHARGES



REVIEWED BY A Conden 6/18/01 (DATE) SANTA CLARITA PC 00-28 PAGE 8

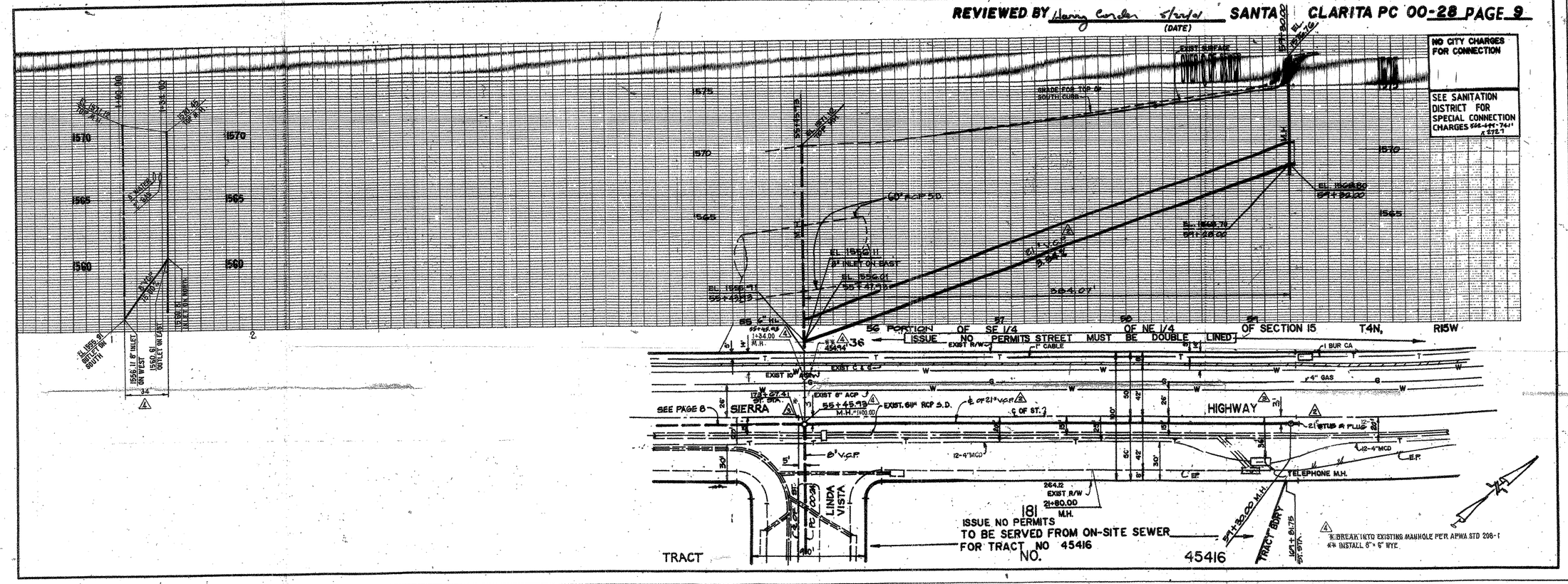
NO CITY CHARGES FOR CONNECTION

SEE SANITATION DISTRICT FOR SPECIAL CONNECTION CHARGES

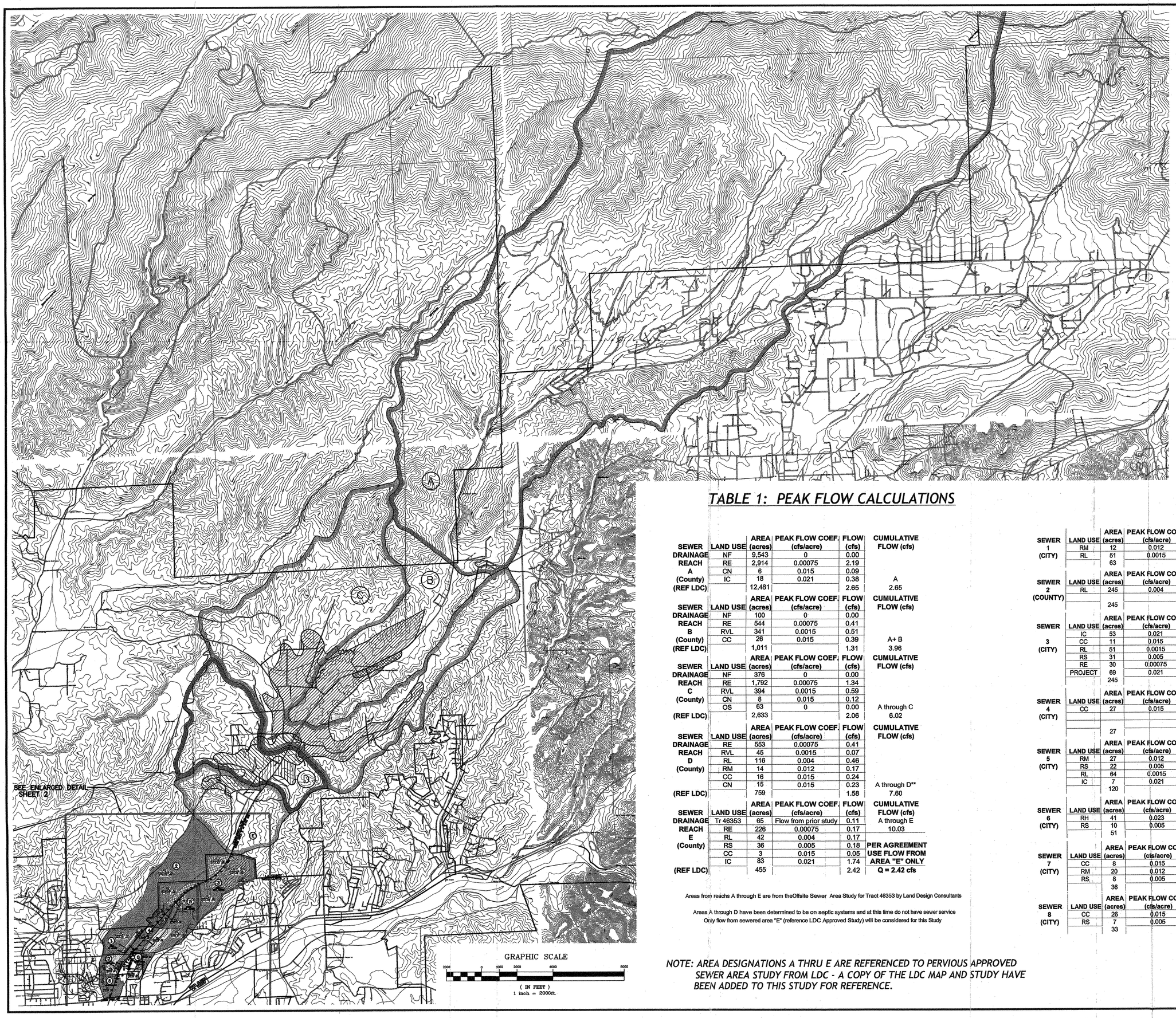


PC 00-28

REVIEWED BY Harry Condon 8/2/01 (DATE) SANTA CLARITA PC 00-28 PAGE 9



P.C. _____ PAGE _____



ZONES LEGEND – SANTA CLARITA

- CC — COMMUNITY COMMERCIAL
- RL — RESIDENTIAL LOW
- RM — RESIDENTIAL MODERATE
- RH — RESIDENTIAL HIGH
- RS — RESIDENTIAL SUBURBAN
- RE — RESIDENTIAL ESTATE
- IC — INDUSTRIAL COMMERCIAL
- PROJ — PROJECT SITE

ZONES LEGEND – L.A. COUNTY

- MAIN TRIBUTARY BOUNDARY
- SUB-AREA BOUNDARY
- RE — RESIDENTIAL ESTATE
- RVL — RESIDENTIAL VERY LOW
- RL — RESIDENTIAL LOW
- RS — RESIDENTIAL SUBURBAN
- RM — RESIDENTIAL MODERATE
- CN — COMMERCIAL NEIGHBORHOOD
- CC — COMMUNITY COMMERCIAL
- IC — INDUSTRIAL COMMERCIAL
- OS — OPEN SPACE
- NF — NATIONAL FOREST
- (A) — AREA

TABLE 1: PEAK FLOW CALCULATIONS

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
A	NF	9,543	0	0.00	
	RE	2,914	0.00075	2.19	
	CN	6	0.015	0.09	
(County)	IC	18	0.021	0.38	A
(REF LDC)		12,481		2.65	2.65

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
B	NF	100	0	0.00	
	RE	544	0.00075	0.41	
	RVL	341	0.0015	0.51	
(County)	CC	26	0.015	0.39	A+ B
(REF LDC)		1,011		1.31	3.96

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
C	NF	376	0	0.00	
	RE	1,792	0.00075	1.34	
	RVL	394	0.0015	0.59	
(County)	CN	8	0.015	0.12	
	OS	63	0	0.00	A through C
(REF LDC)		2,633		2.06	6.02

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
D	RE	553	0.00075	0.41	
	RVL	45	0.0015	0.07	
	RL	116	0.004	0.46	
(County)	RM	14	0.012	0.17	
	CC	16	0.015	0.24	
	CN	15	0.015	0.23	A through D**
(REF LDC)		759		1.58	7.60

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
E	Tr 46353	65	Flow from prior study	0.11	A through E
	RE	226	0.00075	0.17	10.03
	RL	42	0.004	0.17	
(County)	RS	36	0.005	0.18	PER AGREEMENT
	CC	3	0.015	0.05	USE FLOW FROM
	IC	83	0.021	1.74	AREA "E" ONLY
(REF LDC)		455		2.42	Q = 2.42 cfs

Areas from reachs A through E are from theOffsite Sewer Area Study for Tract 46353 by Land Design Consultants

Areas A through D have been determined to be on septic systems and at this time do not have sewer service
Only flow from sewered area "E" (reference LDC Approved Study) will be considered for this Study

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
1	RM	12	0.012	0.14	
(CITY)	RL	51	0.0015	0.08	1
		63		0.22	0.22

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
2	RL	245	0.004	0.98	
(COUNTY)					2
		245		0.98	0.98

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
	IC	53	0.021	1.12	
3	CC	11	0.015	0.17	
(CITY)	RL	51	0.0015	0.08	
	RS	31	0.005	0.16	
	RE	30	0.00075	0.02	3
	PROJECT	69	0.021	1.44	
		245		2.99	2.99

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
4	CC	27	0.015	0.41	Areas 1 thru 4
(CITY)					4.59
					E+1 thru 4
		27		0.41	7.01

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
5	RM	27	0.012	0.32	
(CITY)	RS	22	0.005	0.11	
	RL	64	0.0015	0.10	
	IC	7	0.021	0.15	E+1 thru 5
		120		0.68	7.69

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
6	RH	41	0.023	0.95	
(CITY)	RS	10	0.005	0.05	E+1 thru 6
		51		1.00	8.69

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
7	CC	8	0.015	0.12	
(CITY)	RM	20	0.012	0.24	
	RS	8	0.005	0.04	E+1 thru 7
		36		0.40	9.09

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
8	CC	26	0.015	0.40	
(CITY)	RS	7	0.005	0.03	E+1 thru 8
		33		0.43	9.52

APPROVED
CITY OF SANTA CLARITA
DEVELOPMENT SERVICES DIVISION
SIGNATURE
DATE 11/8/06

REGISTERED PROFESSIONAL ENGINEER
RONALD F. PROPMAN
No. C17701
Exp. 12/31/07
CIVIL
STATE OF CALIFORNIA

NOTE: AREA DESIGNATIONS A THRU E ARE REFERENCED TO PERVIOUS APPROVED SEWER AREA STUDY FROM LDC - A COPY OF THE LDC MAP AND STUDY HAVE BEEN ADDED TO THIS STUDY FOR REFERENCE.

PLAN PREPARED IN THE OFFICES OF:
ROTHMAN-HAHN, INC.
28145 AVENUE CROCKER, SECOND FLOOR
VALENCIA, CALIFORNIA 91355
(661) 775-9500 FAX (661) 775-9939

ROTHMAN•HAHN

CLIENT
KBZ ARCHITECTS, INC.

PROJECT
CANYON COUNTRY EDUCATION CENTER
SANTA CLARITA, CA

SHEET TITLE
OFFSITE SEWER AREA STUDY

REVISIONS

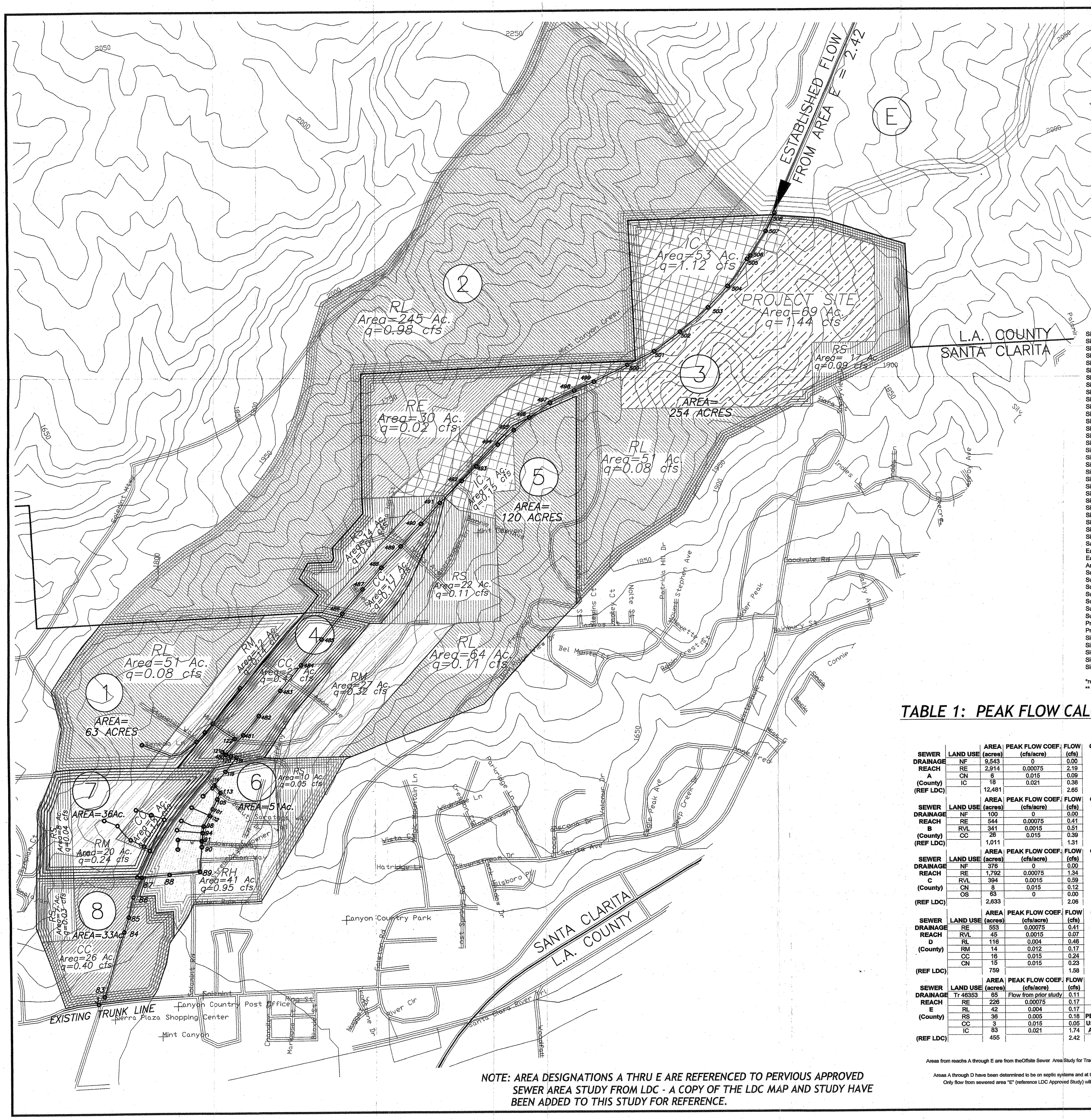
No.	DESCRIPTION	BY	DATE

DESIGNER: MT	APPR'D BY: --
DRAFTER: GF	REVISED BY:
SCALE: AS SHOWN	DATE: 07/27/06

CIVIL

C - 1 of 2

JOB NUMBER 0093-06-001



NOTE: AREA DESIGNATIONS A THRU E ARE REFERENCED TO PERVIOUS APPROVED SEWER AREA STUDY FROM LDC - A COPY OF THE LDC MAP AND STUDY HAVE BEEN ADDED TO THIS STUDY FOR REFERENCE.

TABLE 2: PIPE CAPACITIES

Street Name	From Sewer Line Segment MH No.	To Sewer Line Segment MH No.	Pipe Diameter (Inches)	Slope (ft/ft)	1/2 Full Design Capacity (cfs) for Pipes up to 12"	3/4 Full Design Capacity (cfs) for Pipes Greater than 15"	Contributing Areas	Cumulative calculated flow per segment (cfs)	Net Increase above design flow (cfs)	Applicable PC or CI construction Plan Number
Sierra Highway	508	507	21	0.0128	n/a	16.3469	3+E	5.41	0	PC 02-12
Sierra Highway	507	506	21	0.0128	n/a	16.3469	3+E	5.41	0	PC 02-12
Sierra Highway	506	505	21	0.0128	n/a	16.3469	3+E	5.41	0	PC 02-12
Sierra Highway	505	504	21	0.0136	n/a	16.85	3+E	5.41	0	PC 02-12
Sierra Highway	504	503	21	0.0317	n/a	25.7253	3+E	5.41	0	PC 02-12
Sierra Highway	503	502	21	0.005	n/a	10.2168	3+E	5.41	0	PC 02-12
Sierra Highway	502	501	21	0.0099	n/a	14.3763	3+E	5.41	0	PC 02-12
Sierra Highway	501	500	21	0.0128	n/a	16.3469	2+3+E	6.39	0	PC 02-12
Sierra Highway	500	499	21	0.0334	n/a	26.406	2+3+E	6.39	0	PC 00-28
Sierra Highway	499	498	21	0.0048	n/a	10.0104	2+3+E	6.39	0	PC 00-28
Sierra Highway	498	497	21	0.0044	n/a	9.5842	2+3+E	6.39	0	PC 00-28
Sierra Highway	497	496	21	0.0044	n/a	9.5842	2+3+E	6.39	0	PC 00-28
Sierra Highway	496	495	21	0.0152	n/a	17.8136	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	495	494	21	0.0152	n/a	17.8136	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	494	493	21	0.0196	n/a	20.2282	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	493	492	21	0.0166	n/a	18.6159	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	492*	491*	2 X 18*	0.0119**	n/a	20.8982	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	491	490	21	0.0119	n/a	15.7617	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	490	489	21	0.027	n/a	23.7417	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	489	488	21	0.0075	n/a	12.513	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	488	487	21	0.0145	n/a	17.3986	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	487	486	21	0.016	n/a	18.2764	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	486	485	21	0.016	n/a	18.2764	2+3+5+E	7.07	0	PC 00-28
Sierra Highway	485	484	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28
Sierra Highway	484	483	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28
Sierra Highway	483	482	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28
Sierra Highway	482	481	21	0.0160	n/a	18.2764	2 - 5 + E	7.480	0	PC 00-28
Sierra Highway	481	480	21	0.0220	n/a	21.431	1 - 5 + E	7.700	0	PC 00-28
Sierra Highway	480	120	27	0.0024	n/a	13.835	1 - 5 + E	7.700	0	PC 00-28
Sarabande Drive	120	119	18	0.0100	n/a	9.579	1 - 5 + E	7.700	0	PC 10092
Easement	119	115	18	0.0152	n/a	11.809	1 - 6 + E	8.700	0	PC 10092
Easement	115	114	18	0.0152	n/a	11.809	1 - 6 + E	8.700	0	PC 10092
American Beauty Drive	114	113	18	0.0106	n/a	9.862	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	113	105	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	105	101	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	101	102	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	102	98	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	98	94	18	0.0412	n/a	19.443	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	94	90	18	0.0412	n/a	19.443	1 - 6 + E	8.700	0	PC 10092
Sundowner Way	90	89	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Private Driveway	89	88	18	0.0100	n/a	9.579	1 - 6 + E	8.700	0	PC 10092
Private Driveway	88	87	18	0.0100	n/a	9.579	1 - 7 + E	9.100	0	PC 10092
Sierra Highway	87	86	18	0.0116	n/a	10.317	1 - 8 + E	9.530	0	PC 10092
Sierra Highway	86	85	18	0.0120	n/a	10.493	1 - 8 + E	9.530	0	PC 10092
Sierra Highway	85	84	18	0.0180	n/a	12.851	1 - 8 + E	9.530	0	PC 10092
Sierra Highway	84	83	18	0.0180	n/a	12.851	1 - 8 + E	9.530	0	PC 10092
Sierra Highway	83	3	18	0.0200	n/a	13.546	1 - 8 + E	9.530	0	PC 10092

*represents 2-18" D.I.P. SIPHON PER L.A. C.O. D.W.P. STD. 2005-0
** worst case scenario: the slope is concidered the minimum slope for this section

TABLE 1: PEAK FLOW CALCULATIONS

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
A (County) (REF LDC)	NF	9,543	0	0.00	
	RE	2,914	0.00075	2.19	
	CN	6	0.015	0.09	
	IC	18	0.021	0.38	A
		12,481		2.65	2.65

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
B (County) (REF LDC)	NF	100	0	0.00	
	RE	544	0.00075	0.41	
	RVL	341	0.0015	0.51	
	CC	26	0.015	0.39	A+ B
		1,011		1.31	3.96

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
C (County) (REF LDC)	NF	376	0	0.00	
	RE	1,792	0.00075	1.34	
	RVL	394	0.0015	0.59	
	CN	8	0.015	0.12	
	OS	63	0	0.00	A through C
		2,633		2.06	6.02

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
D (County) (REF LDC)	RE	553	0.00075	0.41	
	RVL	45	0.0015	0.07	
	RL	116	0.004	0.46	
	RM	14	0.012	0.17	
	CC	16	0.015	0.24	
	CN	15	0.015	0.23	A through D**
		759		1.58	7.60

SEWER DRAINAGE REACH	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
E (County) (REF LDC)	Tr 46353	65	Flow from prior study	0.11	A through E
	RE	226	0.00075	0.17	10.03
	RL	42	0.004	0.17	
	RS	36	0.005	0.18	PER AGREEMENT
	CC	3	0.015	0.05	USE FLOW FROM
	IC	83	0.021	1.74	AREA "E" ONLY
		455		2.42	Q = 2.42 cfs

Areas from reachs A through E are from theOffsite Sewer Area Study for Tract 46353 by Land Design Consultants

Areas A through D have been determined to be on septic systems and at this time do not have sewer service
Only flow from sewered area "E" (reference LDC Approved Study) will be considered for this Study

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
1 (CITY)	RM	12	0.012	0.14	
	RL	51	0.0015	0.08	1
		63		0.22	0.22

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
2 (COUNTY)	RL	245	0.004	0.98	
					2
		245		0.98	0.98

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
3 (CITY)	IC	53	0.021	1.12	
	CC	11	0.015	0.17	
	RL	51	0.0015	0.08	
	RS	31	0.005	0.16	
	RE	30	0.00075	0.02	3
	PROJECT	69	0.021	1.44	
		245		2.99	2.99

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
4 (CITY)	CC	27	0.015	0.41	Areas 1 thru 4
					4.59
					E+1 thru 4
		27		0.41	7.01

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
5 (CITY)	RM	27	0.012	0.32	
	RS	22	0.005	0.11	
	RL	64	0.0015	0.10	
	IC	7	0.021	0.15	E+1 thru 5
		120		0.68	7.69

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
6 (CITY)	RH	41	0.023	0.95	
	RS	10	0.005	0.05	E+1 thru 6
		51		1.00	8.69

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
7 (CITY)	CC	8	0.015	0.12	
	RM	20	0.012	0.24	
	RS	8	0.005	0.04	E+1 thru 7
		36		0.40	9.09

SEWER	LAND USE	AREA (acres)	PEAK FLOW COEF. (cfs/acre)	FLOW (cfs)	CUMULATIVE FLOW (cfs)
8 (CITY)	CC	26	0.015	0.40	
	RS	7	0.005	0.03	E+1 thru 8
		33		0.43	9.52

REGISTERED PROFESSIONAL ENGINEER ROLAND P. ROTHMAN No. C47790 CIVIL STATE OF CALIFORNIA

APPROVED — CITY OF SANTA CLARITA DEVELOPMENT SERVICES DIVISION — SIGNATURE — DATE

PLAN PREPARED IN THE OFFICES OF:
ROTHMAN-HAHN, INC.
28145 AVENUE CROCKER, SECOND FLOOR
VALENCIA, CALIFORNIA 91355
(661) 775-9500 FAX (661) 775-9939

ROTHMAN•HAHN

CLIENT: KBZ ARCHITECTS, INC.
PROJECT: CANYON COUNTRY EDUCATION CENTER, SANTA CLARITA, CA

SHEET TITLE: OFFSITE SEWER AREA STUDY

REVISIONS			
No.	DESCRIPTION	BY	DATE

DESIGNER: MT	APPR'D BY: --
DRAFTER: GF	REVISED BY:
SCALE: AS SHOWN	DATE: 07/27/06

CIVIL

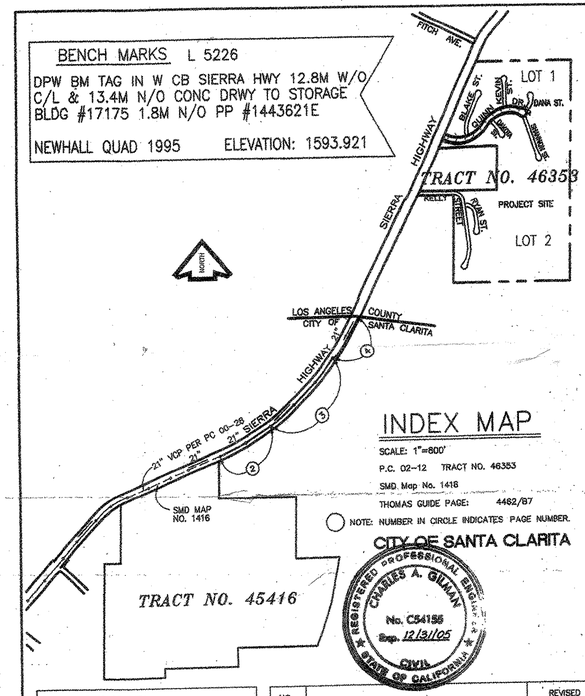
C-2 of 2

JOB NUMBER 0093-06-001

BENCH MARKS L 5226

DPW BM TAG IN W CB SIERRA HWY 12.8M W/O C/L & 13.4M N/O CONC DRWY TO STORAGE BLDG #17175 1.8M N/O PP #1443621E

NEWHALL QUAD 1995 ELEVATION: 1593.921



INDEX MAP

SCALE: 1"=800'

P.C. 02-12 TRACT NO. 46353

SMD Map No. 1416

THOMAS GUIDE PAGE: 4462/B7

NOTE: NUMBER IN CIRCLE INDICATES PAGE NUMBER.

CITY OF SANTA CLARITA

REGISTERED PROFESSIONAL ENGINEER CHARLES A. GUMAN No. C54156 Exp. 12/31/05 CIVIL STATE OF CALIFORNIA

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
CONSOLIDATED SEWER MAINTENANCE DISTRICT
REVIEWED FOR MAINTENANCE

REVIEWED BY 12/5/02 DATE

NO.		REVISED BY	APPROVED BY	DATE
2	REV. ALIGNMENT OF MAIN U/S OF M.H. AT 78+10.00	CAGuman		2/27/04
3	MOVE M.H. AT 81+25.43 TO 81+62.43.	CAGuman		6/3/04
4	ADDED "AS-BUILT" STATION ON WYES	CAGuman	MH	9/9/04

STORM POLLUTION PLAN NOTES

1. ERODED SEDIMENTS AND OTHER POLLUTANTS MUST BE RETAINED ON SITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEETFLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSES, OR WIND.
2. STOCKPILES OF EARTH AND OTHER CONSTRUCTION-RELATED MATERIALS MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY THE FORCES OF WIND OR WATER.
3. FUELS, OILS, SOLVENTS, AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING, AND MAY NOT CONTAMINATE THE SOIL AND SURFACE WATERS. ALL APPROVED STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MUST BE CLEANED UP IMMEDIATELY AND DISPOSED OF IN A PROPER MANNER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM.
4. EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO THE PUBLIC WAY OR ANY OTHER DRAINAGE SYSTEM. PROVISIONS SHALL BE MADE TO RETAIN CONCRETE WASTES ON SITE UNTIL THEY CAN BE DISPOSED OF AS SOLID WASTE.
5. TRASH AND CONSTRUCTION-RELATED SOLID WASTES MUST BE DEPOSITED INTO A COVERED RECEPTACLE TO PREVENT CONTAMINATION OF RAINWATER AND DISPERSAL BY WIND.
6. SEDIMENTS AND OTHER MATERIALS MAY NOT BE TRACKED FROM THE SITE BY VEHICLE TRAFFIC. THE CONSTRUCTION ENTRANCE ROADWAYS MUST BE STABILIZED SO AS TO INHIBIT SEDIMENTS FROM BEING DEPOSITED INTO THE PUBLIC WAY. ACCIDENTAL DEPOSITIONS MUST BE SWEPT UP IMMEDIATELY AND MAY NOT BE WASHED DOWN BY RAIN OR OTHER MEANS.
7. ANY SLOPES WITH DISTURBED SOILS OR DENUDED OF VEGETATION MUST BE STABILIZED SO AS TO INHIBIT EROSION BY WIND AND WATER.
8. THE FOLLOWING BMPS AS OUTLINED IN, BUT NOT LIMITED TO, THE "BEST MANAGEMENT PRACTICE HANDBOOK, CALIFORNIA STORMWATER QUALITY TASK FORCE, SACRAMENTO, CALIFORNIA, 1993," OR THE LATEST REVISED EDITION, MAY APPLY DURING THE CONSTRUCTION OF THIS PROJECT (ADDITIONAL MEASURES MAY BE REQUIRED IF DEEMED APPROPRIATE BY CITY INSPECTORS):

CA001 – DEWATERING OPERATIONS
CA002 – PAVING OPERATIONS
CA003 – STRUCTURE CONSTRUCTION AND PAINTING
CA010 – MATERIAL DELIVERY AND STORAGE
CA011 – MATERIAL USE
CA012 – SPILL PREVENTION AND CONTROL
CA020 – SOLID WASTE MANAGEMENT
CA021 – HAZARDOUS WASTE MANAGEMENT
CA022 – CONTAMINATED SOIL MANAGEMENT
CA023 – CONCRETE WASTE MANAGEMENT
CA030 – VEHICLE AND EQUIPMENT CLEANING
CA031 – VEHICLE AND EQUIPMENT FUELING
CA032 – VEHICLE AND EQUIPMENT MAINTENANCE
CA040 – EMPLOYEE/SUBCONTRACTOR TRAINING
ESC01 – SCHEDULING
ESC02 – PRESERVATION OF EXISTING VEGETATION
ESC21 – DUST CONTROLS
ESC22 – TEMPORARY STREAM CROSSING
ESC23 – CONSTRUCTION ROAD STABILIZATION
ESC24 – STABILIZED CONSTRUCTION ENTRANCE
ESC40 – OUTLET PROTECTION
ESC41 – CHECK DAMS
ESC51 – STRAW BALE BARRIERS
ESC52 – SAND BAG BARRIER
ESC53 – BRUSH OR ROCK FILTER
ESC54 – STORM DRAIN INLET PROTECTION

GENERAL NOTES:

1. A SEWER CONSTRUCTION PERMIT SHALL BE OBTAINED AND A FEE PAID FOR CONSTRUCTION INSPECTION AND RECORD PLANS TO THE CITY OF SANTA CLARITA, 23920 VALENCIA BLVD. SUITE 300, AT LEAST 72 HOURS PRIOR TO STARTING WORK UNDER THIS PERMIT. COPIES OF ALL OTHER REQUIRED PERMITS, SUCH AS ROAD EXCAVATION, CALTRANS, ETC. MUST BE FILED WITH THE PERMIT APPLICATION.
2. THE CONTRACTOR SHALL NOTIFY THE PUBLIC WORKS INSPECTORS BY TELEPHONE AT (661) 255-4942 AT LEAST 24 HOURS BEFORE STARTING ANY WORK UNDER THIS CONTRACT.
3. PRIOR TO ISSUANCE OF THE REQUIRED SEWER CONSTRUCTION PERMIT, THE CONTRACTOR SHALL OBTAIN AND FILE WITH THE CITY OF SANTA CLARITA, COPIES OF A PERMIT TO EXCAVATE IN CITY STREETS AND A PERMIT FOR EXCAVATION AND TRENCHES FROM THE STATE OF CALIFORNIA DIVISION OF INDUSTRIAL SAFETY, AND A CERTIFICATE OF WORKER'S COMPENSATION INSURANCE WITH THE CITY OF SANTA CLARITA NAMED AS THE CERTIFICATE HOLDER TO BE NOTIFIED 30 DAYS PRIOR TO CANCELLATION OF POLICY.
4. IF WORK IS DONE ON A STATE HIGHWAY, A PERMIT MUST BE OBTAINED FROM THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION, 120 SOUTH SPRING STREET, LOS ANGELES, CALIFORNIA.
5. APPROVAL OF THIS PLAN BY THE CITY OF SANTA CLARITA DOES NOT CONSTITUTE A REPRESENTATION AS TO ACCURACY OF THE LOCATION OR THE EXISTENCE OR NON-EXISTENCE OF ANY UNDERGROUND UTILITY PIPE OR STRUCTURE WITHIN THE LIMITS OF THIS PROJECT. THIS NOTE APPLIES TO ALL PAGES.
6. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS.
7. ALL WORK SHALL BE IN ACCORDANCE WITH THE LATEST APPROVED EDITION OF THE "STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION", INCLUDING SUPPLEMENTS AND THE LATEST SPECIAL PROVISION FOR THE CONSTRUCTION OF SANITARY SEWERS, AND SHALL BE PROSECUTED ONLY IN THE PRESENCE OF THE CITY OF SANTA CLARITA.
8. THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 7-10.4.1 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION IN REGARD TO SAFETY ORDERS AND SHALL CONFORM TO THE "MINIMUM PUBLIC SAFETY REQUIREMENT FOR OPEN EXCAVATIONS" AS SHOWN IN THE LOS ANGELES COUNTY PUBLIC WORKS STANDARD 6008-1.
9. ELEVATIONS ARE IN FEET ABOVE U.S.C. AND G.S. SEA LEVEL DATUM OF 1929.
10. NO REVISIONS SHALL BE MADE IN THESE PLANS WITHOUT THE APPROVAL OF THE CITY ENGINEER.
11. NO REPRESENTATIVE OF THE CITY OF SANTA CLARITA WILL SURVEY OR LAY OUT ANY PORTION OF THE WORK.
12. GRADES TO WHICH THIS IMPROVEMENT IS TO BE CONSTRUCTED ARE SHOWN ON THE PLANS AND PROFILES. THE GRADE POINTS FOR THE TOP OF CURBS, CENTERLINE OF STREETS, OR CENTERLINE OF VALLEYS ARE SHOWN BY CIRCLES ON PROFILES AT ALL POINTS BETWEEN DESIGNATED POINTS. THE GRADE SHALL BE ESTABLISHED SO AS TO CONFORM TO A STRAIGHT LINE BETWEEN SAID DESIGNATED POINTS.
13. THE PRIVATE ENGINEER SHALL FURNISH THE CITY OF SANTA CLARITA WITH GRADE SHEETS AND STATIONING FOR ALL HOUSE LATERALS AND "Y" OR "T" BRANCHES, AND SHALL PROVIDE STAKES FOR THEM AT THEIR PROPER LOCATIONS WITH STATIONING PLAINLY MARKED. ALL HOUSE LATERALS SHALL BE CONSTRUCTED TO A STRAIGHT ALIGNMENT AT RIGHT ANGLES FROM THE MAIN LINE SEWER EXCEPT AS SHOWN ON THE PLANS. HOUSE LATERALS FROM CHIMNEYS SHALL NOT HAVE AN ANGLE OF LESS THAN 45 DEGREES WITH THE M.L. SEWER. ANY CHANGE IN ALIGNMENT SHALL BE REQUESTED IN WRITING BY THE PRIVATE ENGINEER.
14. THE PRIVATE ENGINEER SHALL FURNISH THE HOUSE LATERAL DEPTH AT THE PROPERTY LINE BELOW THE TOP OF THE CURB ELEVATION FOR EACH HOUSE LATERAL ON THE GRADE SHEET.
15. NO CONNECTION FOR THE DISPOSAL OF INDUSTRIAL WASTES SHALL BE MADE TO SEWERS SHOWN ON THESE DRAWINGS UNTIL A PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE HAS BEEN ISSUED BY THE SANITATION DISTRICTS FOR SAID CONNECTION.
16. BEFORE BREAKING INTO OR CONSTRUCTION OF A COUNTY SANITATION DISTRICT SEWER AND PRIOR TO FINAL ACCEPTANCE OF THE PROJECT, A SANITATION DISTRICT INSPECTOR SHALL BE NOTIFIED BY TELEPHONE AT (661) 268-4683, SO THAT REQUIRED INSPECTIONS CAN BE MADE.

REGISTERED PROFESSIONAL ENGINEER JAY PLOTNIK No. 28604 Exp. 3-31-03 CIVIL STATE OF CALIFORNIA

P.C. NO. 02-12 CITY OF SANTA CLARITA
REVISION NO. 4
PAGES 2, 3 & 4 - REVISED M.H. LOCATION FROM STA. 64+30.00 TO STA. 64+72.14. REVISED VERTICAL ALIGNMENT FROM STA. 62+50.00 TO STA. 72+70.00 TO ALLOW CONNECTION AT STA. 64+72.14. ADDED LINE "A".

ENGINEER
CITY APPROVAL
2/10/03 COUNTY APPROVAL

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL PROVIDE SURVEY STAKES ON THE PROPERTY LINE OR PROPERTY LINES PRODUCED AT RIGHT ANGLES TO THE SEWER LINE AT THE CENTERLINE OF EACH MANHOLE.
2. VITRIFIED CLAY PIPE JOINTS SHALL BE TYPE "D" OR "G" IN ACCORDANCE WITH STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION SECTION 208-2.
3. IF A POWERPOLE IS WITHIN THREE FEET OF THE SEWER, THE SEWER SHALL BE ENCASED PER STANDARD PLAN 2023-2, CASE II, TWO FEET ON EACH SIDE FROM THE POINT OF INTERFERENCE.
4. ALL JOINTS BETWEEN CAST IRON PIPE AND VITRIFIED CLAY SHALL BE MADE WITH A RUBBER SLEEVE JOINT, TYPE "D" (WITH BUSHING IF NECESSARY) PER STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION SECTION 208-2.
5. HOUSE LATERALS TO BE CONSTRUCTED WITH INVERTS AT THE PROPERTY LINE SIX FEET BELOW CURB GRADE, EXCEPT AS NOTED.
6. ALL WYES AND/OR HOUSE LATERALS ARE TO BE LOCATED AT LEAST FIVE (5) FEET APART AND NOT CLOSER THAN FIVE (5) FEET TO ANY MANHOLE PER LOS ANGELES COUNTY'S STANDARD.
7. WYE OR TEE BRANCHES MAY BE USED FOR CONNECTIONS TO THE MAINLINE SEWERS, EXCEPT AS NOTED.
8. IF DURING THE COURSE OF CONSTRUCTION, IT IS DETERMINED THAT THERE IS LESS THAN FOUR FEET OF COVER OVER THE TOP OF A MAINLINE OR HOUSE LATERAL V.C.P. SEWER WHICH IS NOT INDICATED ON THE PLANS, THE PIPES SHALL BE ENCASED PER LOS ANGELES COUNTY STANDARD PLAN 2023-1, CASE II, UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
9. REFER TO THE STANDARD DRAWING 2100-1, "DESIGN REQUIREMENTS FOR SANITARY SEWERS IN THE VICINITY OF PRESSURE WATER MAINS", AND COMPLY WITH THE REQUIREMENTS.
10. ALL STRUCTURES SHALL BE EITHER BRICK SEWER MANHOLES PER APWA STANDARD PLAN 203-0, PRECAST CONCRETE SEWER MANHOLES PER APWA STANDARD PLAN 200-2, OR REINFORCED PRECAST CONCRETE MANHOLE PER LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS STANDARD PLAN 2003-2, EXCEPT AS NOTED.
11. RESURFACE ALL TRENCHES WITHIN PAVED AREAS TO MEET THE CITY OF SANTA CLARITA, LOS ANGELES COUNTY PUBLIC WORKS, OR CALIFORNIA'S STATE HIGHWAY REQUIREMENTS IN ACCORDANCE WITH THE PERMITS.
12. FULL COMPLIANCE WITH SECTION 306-1.3.4 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION WILL BE REQUIRED FOR BACKFILL IN STREET, CERTIFICATION OF BACKFILL COMPACTION, AND SAND EQUIVALENTS BY A QUALIFIED CIVIL ENGINEER. THIS SHALL BE PROVIDED BY THE PERMITEE PRIOR TO THE ISSUANCE OF A CERTIFICATE OF PARTIAL ACCEPTANCE.
13. ALL BACKFILL AND FILLS OUTSIDE OF THE STREET RIGHT-OF-WAY SHALL BE COMPACTED TO 90 PERCENT OF THE MAXIMUM DENSITY AS DETERMINED BY ASTM SOIL COMPACTION TEST D 1557-78 METHOD "D", UNLESS OTHERWISE SPECIFIED. THIS SHALL BE CERTIFIED BY A QUALIFIED CIVIL ENGINEER. THIS CERTIFICATION SHALL BE SUBMITTED TO THE CITY OF SANTA CLARITA PRIOR TO THE ACCEPTANCE OF THE WORK BY THE CITY.
14. MANHOLE TOPS IN UNIMPROVED RIGHT-OF-WAYS TO BE SIX INCHES ABOVE FINISHED GRADE.
15. SEWERS TO BE TESTED FOR LEAKAGE PER SECTION 306-1.4.4 OF THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION.

PRIVATE ENGINEER'S NOTICE TO CONTRACTORS

THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. TO THE BEST OF OUR KNOWLEDGE, THERE ARE NO EXISTING UTILITIES EXCEPT AS SHOWN ON THIS MAP. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURES TO PROTECT THE UTILITY LINES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THIS DRAWING. PRIOR TO EXCAVATION THE CONTRACTOR SHALL CALL UNDERGROUND SERVICE ALERT AT 800-422-4133.

REG. C.E. NO. 21649 DATE

PROFILE, ALIGNMENT AND GRADE OF

SANITARY SEWERS

TO BE CONSTRUCTED IN

THE CITY OF SANTA CLARITA

TRACT NO. 46353 (OFF-SITE)

PRIVATE CONTRACT NO. 02-12

...2...SHEETS; ...4...PAGES

REGISTERED PROFESSIONAL ENGINEER ROBERT R. SIMS No. 21649 EXP. 9-30-05 CIVIL STATE OF CALIFORNIA

SCALE: VERT.: 1"= 8'
HORIZ.: 1"=40'

JUNE, 2002

PREPARED IN THE OFFICES OF
LAND DESIGN CONSULTANTS, INC.
25570 Rye Canyon Road, Suite H Valencia, California 91355
PH. (661) 775-3940 FAX (661) 775-3942

BY: 11/25/02

REG. C.E. NO. 21649 EXP. 9-30-05

THE FOLLOWING LATEST REVISED STANDARD PLANS ON FILE IN THE OFFICE OF THE DEPT. OF PUBLIC WORKS SHALL APPLY IN THE CONSTRUCTION OF THIS PROJECT:

LEGEND	2000-0
MINIMUM PUBLIC SAFETY REQUIREMENTS	6008-1
BRICK MANHOLE	APWA 203-0
STANDARD MANHOLE STEP	2015-1
BEDDING FOR SEWER PIPE	2021-1
CRADLING AND ENCASEMENT	2023-2
WYE OR TEE SUPPORT	2024-1
ALLOWABLE TRENCH WIDTHS	2027-1
LOCKING MANHOLE FRAME AND COVER	APWA 210-2
NON-REINFORCED PRECAST CONCRETE MANHOLE	APWA 200-2
BREAK INTO EXISTING MANHOLE	APWA 208-1
SPECIAL HOUSE LATERALS	APWA 222-1
EROSION PROTECTION IN STEEP SLOPES	2026-1
ANCHOR BLOCKS	APWA 221-1
JACKING SEWER CASING FOR SEWER PIPE	2028-1
CHIMNEYS	APWA 220-2
DESIGN REQUIREMENTS FOR SANITARY SEWER IN THE VICINITY OF PRESSURE WATER MAINS	2100-1

CITY OF SANTA CLARITA, CALIFORNIA

ROBERT G. NEWMAN
DIRECTOR OF TRANSPORTATION & ENGINEERING SERVICES

JAMES F. STAHL
CHIEF ENGINEER & GENERAL MANAGER
CO. SAN DIST. NO. 28, MANAGER

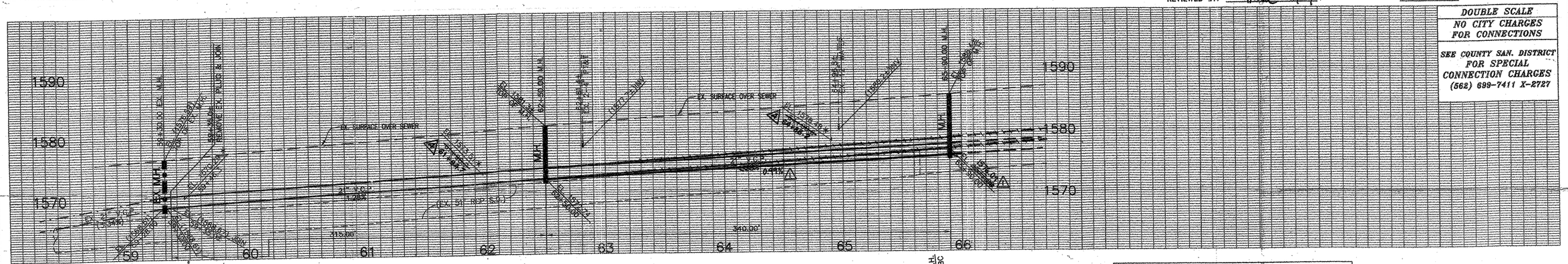
APPROVED 12/10/02 (DATE) APPROVED 12/10/02 OFFICE ENGINEER

CHECKED 11/27/02 (DATE)

REVIEWED BY: 11/27/02

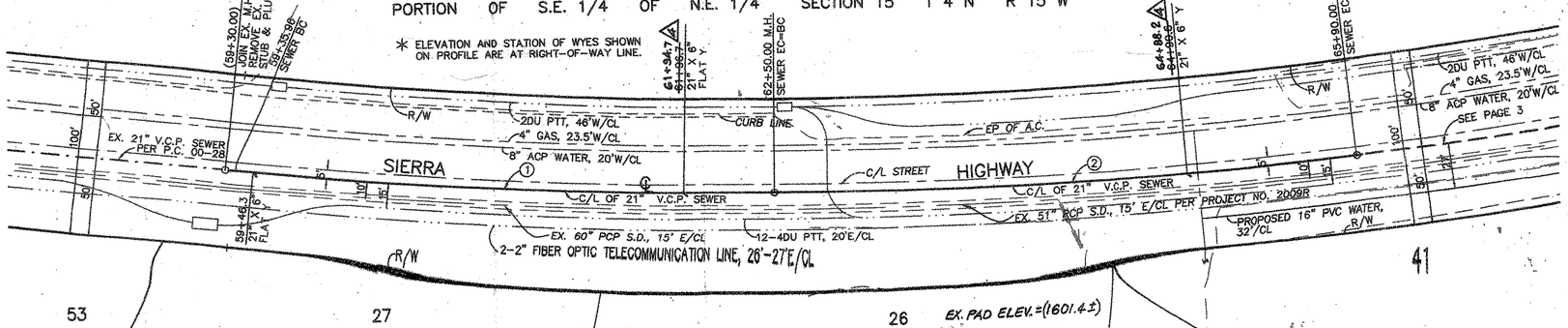
DOUBLE SCALE
NO CITY CHARGES FOR CONNECTIONS

SEE COUNTY SAN. DISTRICT FOR SPECIAL CONNECTION CHARGES (562) 699-7411 X-2727



PORTION OF S.E. 1/4 OF N.E. 1/4 SECTION 15 T 4 N R 15 W

* ELEVATION AND STATION OF WYES SHOWN ON PROFILE ARE AT RIGHT-OF-WAY LINE.



PORTION OF S.E. 1/4 OF N.E. 1/4 SECTION 15 T 4 N R 15 W

CURVE DATA				
○	Δ	R	L	T
1	6°24'53"	2805.00'	314.04'	157.18'
2	6°56'42"	2805.00'	340.00'	170.21'

REGISTERED PROFESSIONAL ENGINEER ROBERT R. SIMS No. 21649 EXP. 9-30-05 CIVIL STATE OF CALIFORNIA 11/25/02

SCALE: VERT: 1"= 8'
HORIZ: 1"=40'

20 0 40 80

TR. NO. 46353 P.C. 02-12

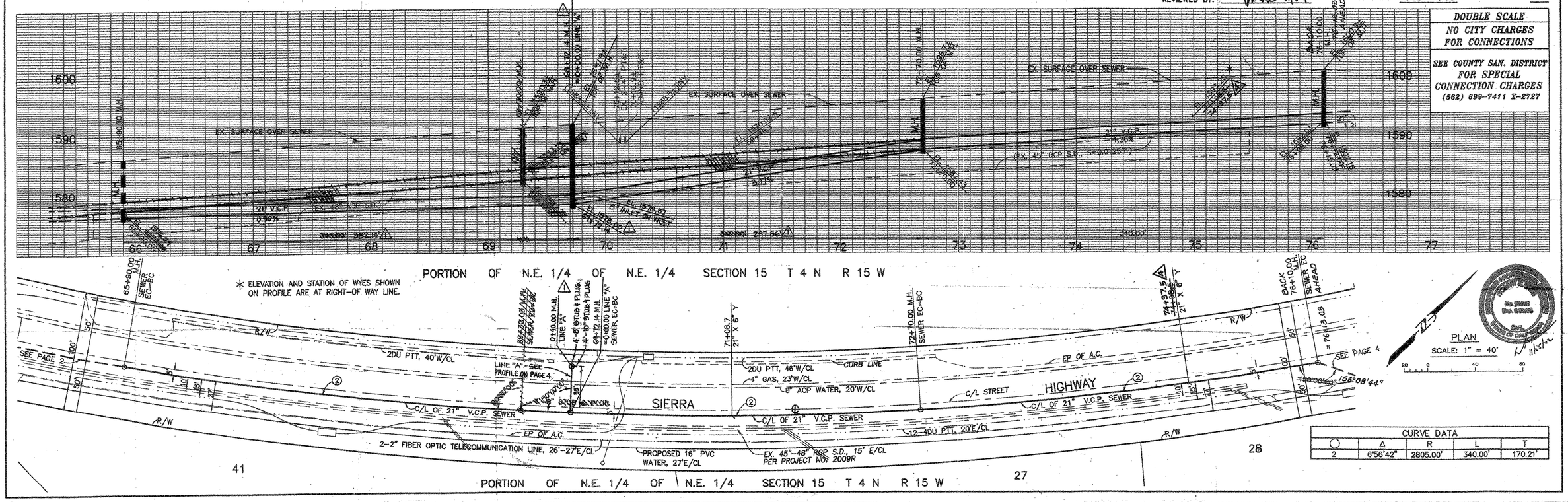
1

a:\PROJ\99020307\ENGR\SEWER\SHEETS\CITY\S50FF-01-02.dwg 11/25/02 11:28:48 johnw

REVIEWED BY: 11/27/02 P.C. 02-12 PAGE 3

DOUBLE SCALE
NO CITY CHARGES FOR CONNECTIONS

SEE COUNTY SAN. DISTRICT FOR SPECIAL CONNECTION CHARGES (562) 699-7411 X-2727



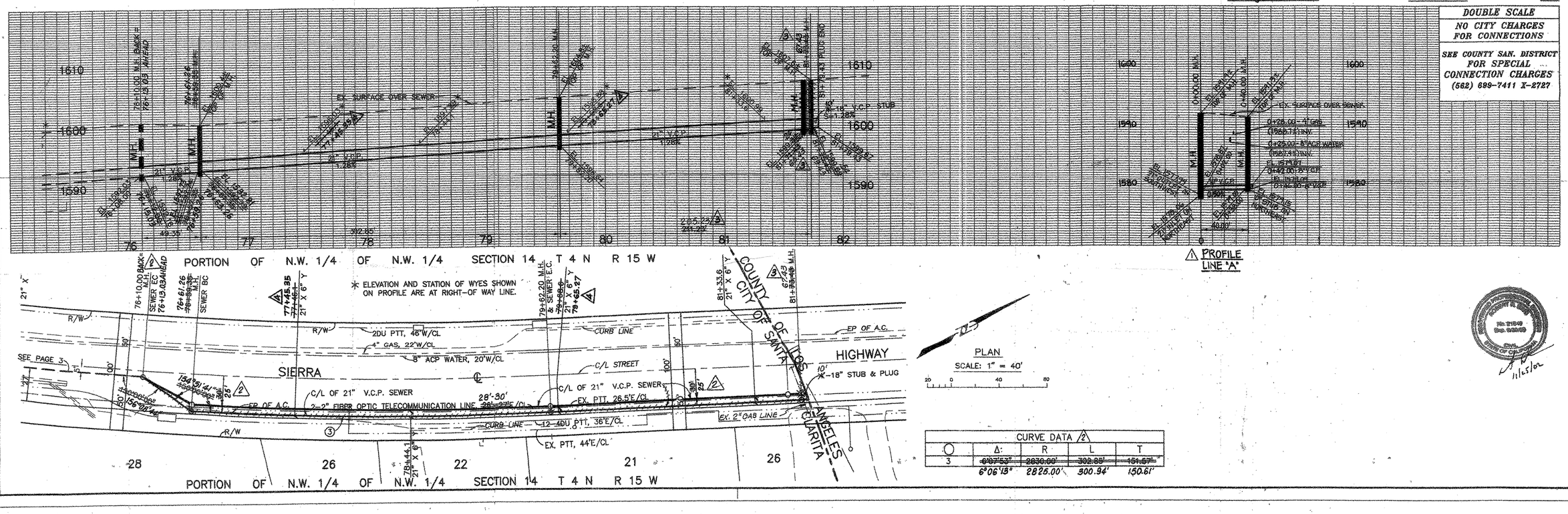
PLAN
SCALE: 1" = 40'

CURVE DATA				
○	Δ	R	L	T
2	6°56'42"	2805.00'	340.00'	170.21'

REVIEWED BY: 11/27/02 P.C. 02-12 PAGE 4

DOUBLE SCALE
NO CITY CHARGES FOR CONNECTIONS

SEE COUNTY SAN. DISTRICT FOR SPECIAL CONNECTION CHARGES (562) 699-7411 X-2727



PLAN
SCALE: 1" = 40'

CURVE DATA /2				
○	Δ:	R	L	T
3	~~6°07'53"~~ 6°06'13"	~~2830.00'~~ 2825.00'	~~302.85'~~ 300.94'	~~151.57'~~ 150.61'

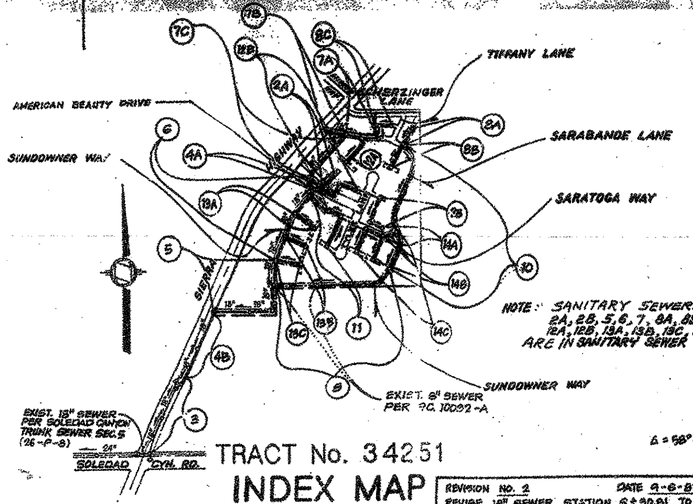
JT NO. 92623 P.C. 02-12

S

J:\PROJ\99023007\ENGR\SEWER\SHEETS\CITY\SS-0FF-03-04.dwg 11/25/02 11:16:19 Johnw

B.M. C.L. 1594 ELEV. 1474.995
CONC. MON. W. KANE. CULV. & 91 ℄ 63
26 FT. W. CL SIERRA HWY. ℄ 0.1 MI.
S. MIRADA WAY 12 FT. W. OF 14435 TOE
NEWHALL QUAD. 1978

DOUBLE SCALE



TRACT No. 34251

INDEX MAP

P.C. No. 10092

SCALE: 1 INCH = 600 FEET

REVISION NO. 2 DATE 9-6-83
REVISE 18" SEWER STATION 6+90.91 TO 12+75.91 ON PAGES 3 & 4. REVISE 18" SEWER STA. 0+45.56 TO STA. 3+90.00 ON PAGE 5.
APPROVED Sanjo G. Hoh RCE 33134
OFFICE OF COUNTY ENGINEER

REVISION NO. 1 DATE 7-7-83
JOIN EXISTING 8" SEWER PER P.C. 10092-A PAGE 9, AT STATION 4+50.00 AND AT STATIONS 7+85.07 & 7+89.07 ON PAGE 5.
APPROVED Sanjo G. Hoh RCE 33134
OFFICE OF COUNTY ENGINEER

NO CONNECTION FOR THE DISPOSAL OF INDUSTRIAL WASTES SHALL BE MADE TO SEWERS SHOWN ON THESE DRAWINGS UNTIL A PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE HAS BEEN ISSUED BY THE SANITATION DISTRICTS FOR SAID CONNECTION.

BEFORE BREAKING INTO OR CONSTRUCTION ON A COUNTY SANITATION DISTRICT SEWERAGE PRIOR TO FINAL ACCEPTANCE OF THE PROJECT, SANITATION DISTRICT INSPECTOR SHALL BE NOTIFIED BY PHONE - 962-8605, 622-1161 SO THAT REQUIRED INSPECTION CAN BE MADE.

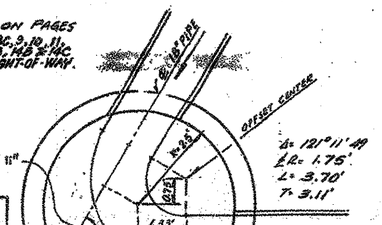
CONSTRUCTION NOTES: (CONT.)

16. WYE BRANCHES ONLY MAY BE USED FOR CONNECTIONS TO MAIN LINE SEWER IF A.B.S.C.P. IS USED.
17. ALL JOINTS BETWEEN CAST IRON PIPE AND A.B.S.C.P. SHALL BE MADE WITH APPROVED FITTINGS.
18. FULL COUPLINGS WITH ANSI B. OR TYPE 1 PROVISION IS REQUIRED FOR THE INSTALLATION OF A.B.S. COUPLINGS TYPE AND ALL MAIN SHALL HOLD LATERALS.
19. MANHOLE OFFSET STUB MAY BE USED AND PLANS ARE REQUIRED FOR THE CONNECTION OF A.B.S. SEWERS TO THE MAIN LINE STRUCTURE.
20. A.B.S. SOLID WALL PIPE MUST BE USED FOR WYE AND HOUSE LATERAL CONNECTIONS TO A.B.S. CORRUGATED WALL SEWER PIPE.
21. 5 DEGREE DEFLECTION DEFLECTIONS MUST BE USED TO ACCOMPLISH RADIUS OF CURVATURE LESS THAN 350'.
22. A.B.S. COMPOSITE PIPE SHALL BE DESIGNED IN CONFORMANCE WITH THE TABLE IN SECTION B-3.1 OF PART IV OF SPECIAL PROVISIONS.

SPECIAL 5' I.D. MANHOLES PER S-3 OR S-2-206, CASE III WITH S-95 FRAMES & COVERS.

Page 2B	M.H. 12+74.41
Page 5	M.H. 5+81.68
	M.H. 9+57.62
Page 6	M.H. 16+14.53
	M.H. 17+24.14
Page 7B	M.H. 1+68.80
Page 7C	M.H. 21+52.61

NOTE: SANITARY SEWERS ON PAGES 2A, 2B, 5, 6, 7, 8A, 8B, 8C, 9, 10, 11, 12A, 12B, 13A, 13B, 13C, 14A, 14B & 14C ARE IN SANITARY SEWER RIGHT-OF-WAY.



DETAIL
5' I.D. MANHOLE BASE
PAGE 7B 1+68.80

REVISION NO. 4 DATE: 12-13-83
MOVE MANHOLE FROM STA. 4+24.68 TO STA. 4+00 AND CHAT CONSTRUCTION OF 8" VCP.
APPROVED: Sanjo G. Hoh RCE 33134
OFFICE OF COUNTY ENGINEER

REVISION NO. 3 DATE: 9-21-83
Move M.H. from Sta. 2+80.00 to Sta. 4+24.68 and Const. S.L.E. of 8" V.C.P. Page 5.
Const. S.L.E. of 8" V.C.P. in Sundowner Way at M.H. Sta. 7+82.02, Page 8.
Const. 37.50 L.F. of 8" D.I.P. in American Beauty Drive Sta. 1+24.16 to Sta. 1+61.66 Page 7c.
APPROVED: Sanjo G. Hoh RCE 33134
OFFICE OF COUNTY ENGINEER

GENERAL NOTES:

1. ELEVATIONS ARE IN FEET ABOVE U.S.C. & G.S. SEA LEVEL DATUM OF 1929.
2. NO REVISIONS SHALL BE MADE IN THESE PLANS WITHOUT THE APPROVAL OF THE COUNTY ENGINEER.
3. NO REPRESENTATIVE OF THE COUNTY ENGINEER WILL SURVEY OR LAY OUT ANY PORTION OF THE WORK.
4. GRADES TO WHICH THIS IMPROVEMENT IS TO BE CONSTRUCTED ARE SHOWN ON PLANS AND PROFILES. GRADE POINTS FOR TOP OF CURBS, CENTER LINE OF STREETS, OR CENTER LINE OF ALLEYS ARE SHOWN BY CIRCLES ON PROFILES. AT ALL POINTS BETWEEN DESIGNATED POINTS THE GRADE SHALL BE ESTABLISHED SO AS TO CONFORM TO A STRAIGHT LINE DRAWN BETWEEN SAID DESIGNATED POINTS.
5. THE PRIVATE ENGINEER SHALL FURNISH THE COUNTY ENGINEER WITH GRADE SHEETS AND STATIONING FOR ALL HOUSE LATERALS AND "Y" OR "T" BRANCHES AND SHALL PROVIDE STAKES FOR THEM AT THEIR PROPER LOCATIONS WITH STATIONING PLAINLY MARKED. ALL HOUSE LATERALS SHALL BE CONSTRUCTED IN A STRAIGHT ALIGNMENT AT RIGHT ANGLES FROM THE MAIN LINE SEWER EXCEPT AS SHOWN ON THE PLANS. HOUSE LATERALS FROM CHIMNEYS SHALL NOT HAVE AN ANGLE OF LESS THAN 45° WITH THE MAIN LINE SEWER. ANY CHANGE IN ALIGNMENT SHALL BE REQUESTED IN WRITING BY THE PRIVATE ENGINEER.
6. THE PRIVATE ENGINEER SHALL FURNISH THE HOUSE LATERAL DEPTH AT THE PROPERTY LINE BELOW THE TOP OF CURB ELEVATION FOR EACH HOUSE LATERAL ON THE GRADE SHEET.
7. BEFORE WORK CAN BE STARTED, THE CONTRACTOR MUST OBTAIN A PERMIT TO EXCAVATE IN COUNTY STREETS FROM THE L.A. COUNTY ROAD DEPT., DISTRICT OFFICE NO. 6, AND PAY A FEE TO THE COUNTY ENGINEER, 580 S. VERMONT AVENUE, LOS ANGELES, CA 90020, TO COVER THE COST OF CONSTRUCTION INSPECTION AND RECORD PLANS.
8. IF WORK IS TO BE DONE IN A STATE HIGHWAY, A PERMIT MUST BE OBTAINED FROM THE STATE OF CALIFORNIA, DIVISION OF HIGHWAYS, 120 SOUTH SPRING STREET, LOS ANGELES, CALIFORNIA.
9. APPROVAL OF THIS PLAN BY THE COUNTY OF LOS ANGELES DOES NOT CONSTITUTE A REPRESENTATION AS TO THE ACCURACY OR THE LOCATION OF OR THE EXISTENCE OR NON-EXISTENCE OF ANY UNDERGROUND UTILITY PIPE, OR STRUCTURE WITHIN THE LIMITS OF THIS PROJECT. THIS NOTE APPLIES TO ALL PAGES.
10. REFER TO SECTION 7.10.4.1 OF THE STANDARD SPECIFICATIONS, REGARDING SAFETY ORDERS.
11. PRIOR TO THE ISSUANCE OF THE REQUIRED SEWER CONSTRUCTION PERMIT, THE CONTRACTOR SHALL OBTAIN AND FILE WITH THE COUNTY ENGINEER COPIES OF A PERMIT TO EXCAVATE IN COUNTY STREETS FROM THE LOS ANGELES COUNTY ROAD DEPARTMENT, A PERMIT FOR EXCAVATIONS AND TRENCHES FROM THE STATE OF CALIFORNIA, DIVISION OF INDUSTRIAL SAFETY AND A CERTIFICATE OF WORKER'S COMPENSATION INSURANCE WITH THE DEPARTMENT OF COUNTY ENGINEER, 580 SOUTH VERMONT, RM. 408, LOS ANGELES, CALIFORNIA 90020, NAMED AS THE CERTIFICATE HOLDER TO BE NOTIFIED 30 DAYS PRIOR TO CANCELLATION OF POLICY.

CONSTRUCTION NOTES:

1. WORK SHALL BE CONSTRUCTED ACCORDING TO THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (1982 EDITION WITH 1983 SUPPLEMENT) AND COUNTY ENGINEER SPECIAL PROVISIONS FOR THE CONSTRUCTION OF SANITARY SEWERS DATED SEPT. 21, 1976 AND SHALL BE PROSECUTED ONLY IN THE PRESENCE OF THE COUNTY ENGINEER.
2. THE CONTRACTOR SHALL NOTIFY THE ENVIRONMENTAL DEVELOPMENT DIVISION BY TELEPHONE, 738-2155, AT LEAST TWENTY-FOUR HOURS BEFORE STARTING ANY WORK UNDER THIS CONTRACT.
3. HOUSE LATERALS TO BE CONSTRUCTED WITH INVERTS AT PROPERTY LINE 9 FEET BELOW CURB GRADE EXCEPT AS NOTED.
4. WYE OR TEE BRANCHES MAY BE USED FOR CONNECTIONS TO MAINLINE SEWERS EXCEPT AS NOTED.
5. ALL STRUCTURES SHALL BE EITHER BRICK MANHOLES PER S-3 OR PRECAST CONCRETE MANHOLES PER S-24, EXCEPT AS NOTED.
6. PROVIDE STAKES ON THE PROPERTY LINE OR PROPERTY LINES PRODUCED AT RIGHT ANGLES TO THE SEWER LINE AT THE CENTER LINE OF EACH MANHOLE.
7. MANHOLE TOPS IN IMPROVED RIGHTS OF WAY TO BE LEVEL WITH FINISHED GRADE.
8. VITRIFIED CLAY PIPE JOINTS SHALL BE TYPE "D" OR "S" PER STANDARD SPECIFICATIONS SECTION 208-2.
9. IF A POWER POLE IS WITHIN THREE FEET OF THE SEWER, THE SEWER SHALL BE ENCASED, PER S-29, CASE II, TWO FEET ON EACH SIDE FROM THE POINT OF INTERFERENCE.
10. IF DURING THE COURSE OF CONSTRUCTION IT IS DETERMINED THAT THERE IS LESS THAN FOUR FEET OF COVER OVER THE TOP OF A MAIN LINE OR HOUSE LATERAL OR V.C.P. OR A.B.S.C.P. SEWER WHICH IS NOT INDICATED ON THE PLANS, THE PIPE SHALL BE ENCASED PER S-29, CASE II UNLESS OTHERWISE APPROVED BY THE COUNTY ENGINEER.
11. ALL JOINTS BETWEEN CAST IRON PIPE AND VITRIFIED CLAY PIPE SHALL BE MADE WITH A RUBBER SLEEVE JOINT, TYPE "O" OR "D", (WITH BUSHING IF NECESSARY) PER STANDARD SPECIFICATIONS, SECTION 208-2.
12. SEWERS TO BE TESTED FOR LEAKAGE PER SECTION 208-1.4 OF THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
13. RESURFACE ALL TRENCHES WITHIN PAVED AREAS TO MEET L.A. COUNTY ROAD DEPT. OR CALIFORNIA STATE HIGHWAY REQUIREMENTS IN ACCORDANCE WITH PERMITS.
14. FULL COMPLIANCE WITH SECTION 306-1.3.5 OF THE SPECIAL PROVISIONS WILL BE REQUIRED FOR BACKFILL IN STREETS. CERTIFICATION OF BACKFILL COMPACTION AND SAND EQUIVALENTS BY A QUALIFIED, REGISTERED TESTING LABORATORY SHALL BE PROVIDED BY THE PERMITTEE PRIOR TO THE ISSUANCE OF A CERTIFICATE OF PARTIAL ACCEPTANCE.
15. SPECIAL BACKFILL IN EASEMENT CONSTRUCTION: (A) BACKFILL TRENCH AND REPLACE OTHER EARTH SO AS TO ACHIEVE THE NATURAL OR FINISHED GRADES AND SLOPES SHOWN ON THE GRADING PLAN APPROVED FOR THIS DEVELOPMENT BY THE BUILDING AND SAFETY DIVISION. (B) ALL BACKFILL AND EARTH REPLACED SHALL BE COMPACTED TO A MINIMUM OF 90% OF MAXIMUM DENSITY PER A.S.T.M. STD. METHOD OF TEST D698-57 AS MODIFIED. ACCEPTABLE CERTIFICATION OF SUCH COMPACTION SHALL BE SUBMITTED TO THE ENVIRONMENTAL DEVELOPMENT DIVISION.

PROFILE, ALIGNMENT AND GRADE OF

PAGE 1

SANITARY SEWERS

TO BE CONSTRUCTED IN

TRACT Nº 34251

PRIVATE CONTRACT NO. 10092

C-A-60
W.S. 62
7 SHEETS; 14 PAGES

50319

SCALE: VERT. 1"=6' HORIZ. 1"=40'
AUG. 26, 1982

PREPARED IN THE OFFICES OF
ENGINEERING SERVICE CORPORATION
6017 BEVERLY BOULEVARD, POST OFFICE BOX 2, BUSINESS PARK, COLVER CITY, CALIFORNIA 90230 TELEPHONE: (213) 477-7999
BY: [signature]
REG. C. E. No. 13095

THE FOLLOWING LATEST REVISED STANDARD PLANS ON FILE IN THE OFFICE OF THE COUNTY ENGINEER SHALL APPLY IN THE CONSTRUCTION OF THIS PROJECT:

LEGEND	S-1
MINIMUM PUBLIC SAFETY REQUIREMENTS	S-2
BRICK MANHOLE	S-3
STANDARD MANHOLE STEP	S-17
BEDDING FOR SEWER PIPE	S-21
CRADLING AND ENCASEMENT	S-22
WYE OR TEE SUPPORT	S-26
ALLOWABLE TRENCH WIDTHS	S-33
LOCKING MANHOLE FRAME AND COVER	S-95
NON-REINFORCED PRECAST CONCRETE MANHOLE	S-24

IN ADDITION THE FOLLOWING COUNTY SANITATION DISTRICT STANDARDS SHALL APPLY TO THE CONSTRUCTION OF THIS PROJECT.

STANDARD MANHOLE TYPE "D"	S-0-204
STANDARD MANHOLE TYPE "E"	S-0-206

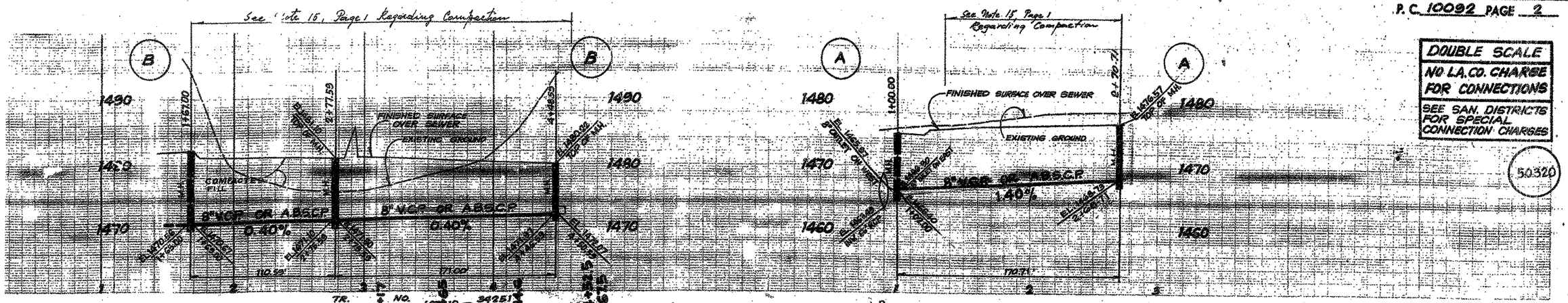
COUNTY OF LOS ANGELES, CALIFORNIA

STEPHEN J. KOONCE, COUNTY ENGINEER — WALTER E. GARRISON, CHIEF ENGINEER

APPROVED Walter E. Murphy 5-18-83 (DATE) — APPROVED [signature] 5/23/83 FOR OFFICE ENGINEER

CHECKED Ralph David Quist 5/17/83 (DATE)
REG. C.E. NO. 16883

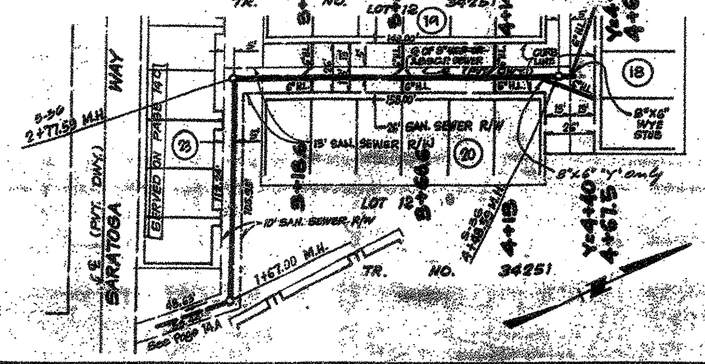
SANTA CLARITA VALLEY BLDG. DIST. 8-2

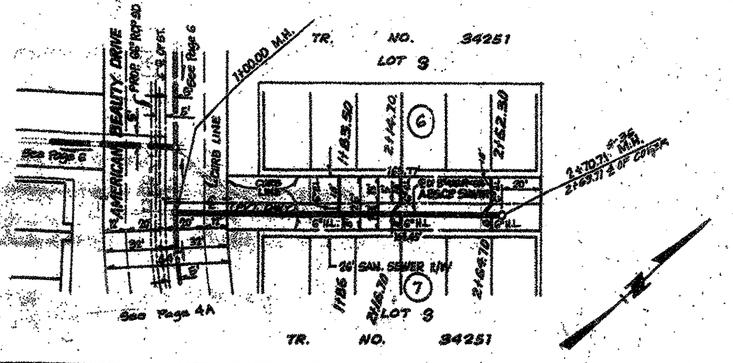


DOUBLE SCALE
NO L.A. CO. CHARGE FOR CONNECTIONS
SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES

50320

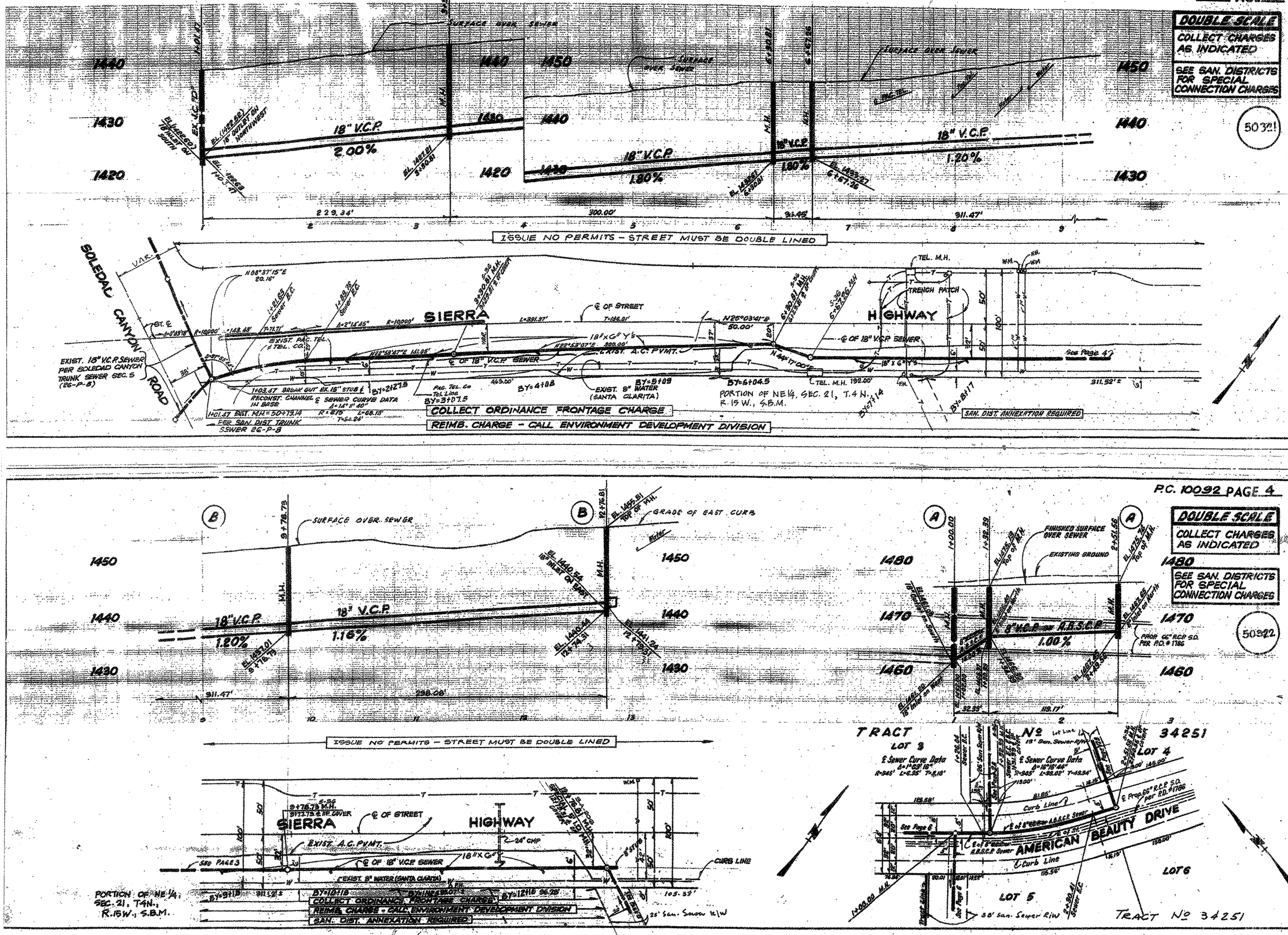
P.C. 10092 PAGE 2





DOUBLE SCALE
COLLECT CHARGES AS INDICATED
SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES

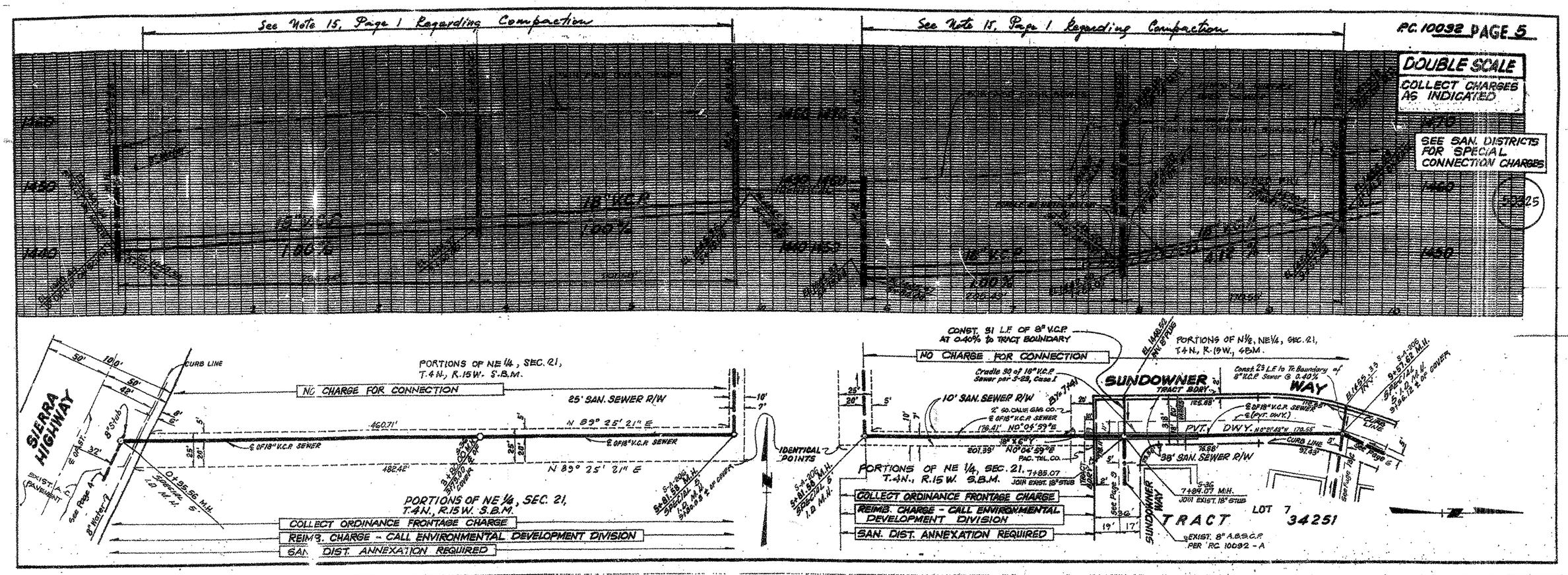
50321

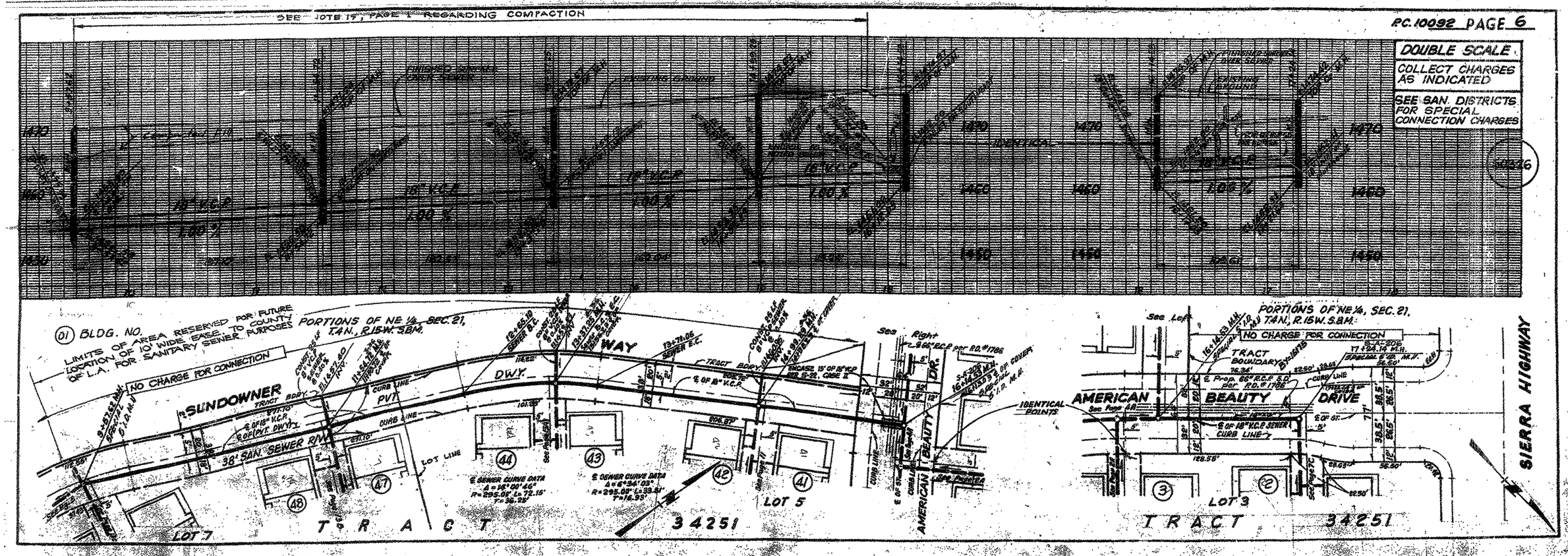


DOUBLE SCALE
COLLECT CHARGES AS INDICATED
SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES

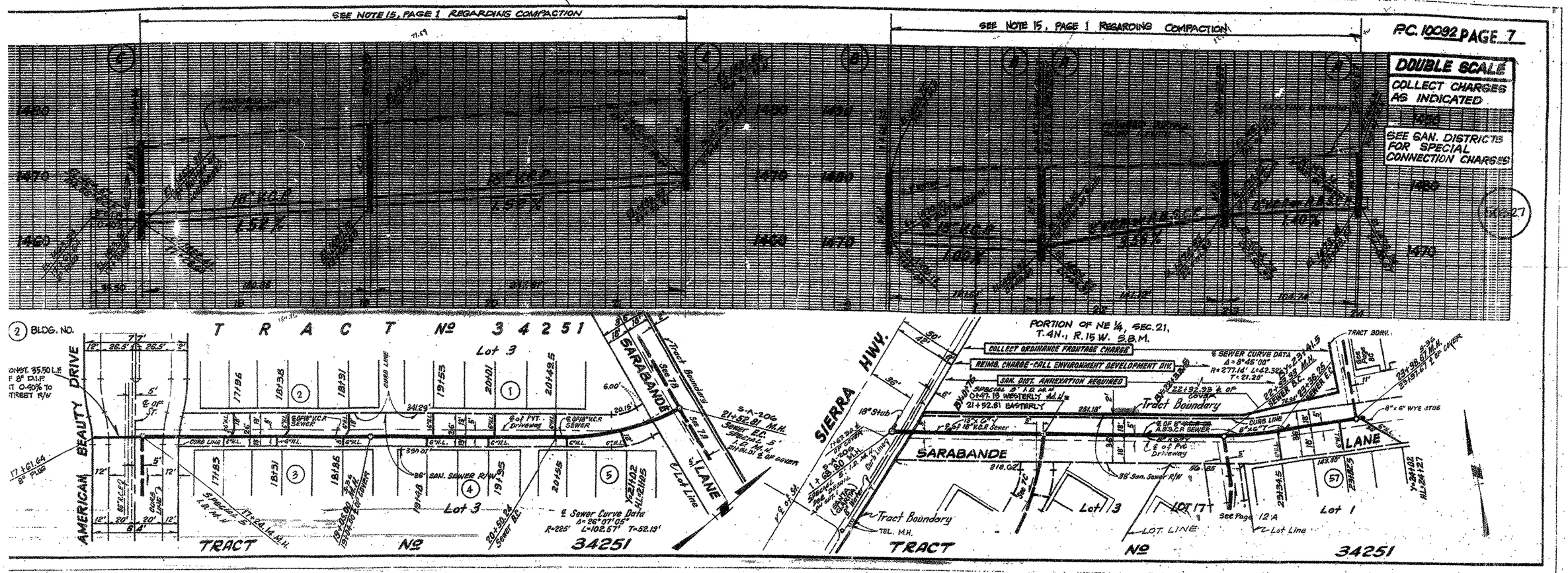
50322

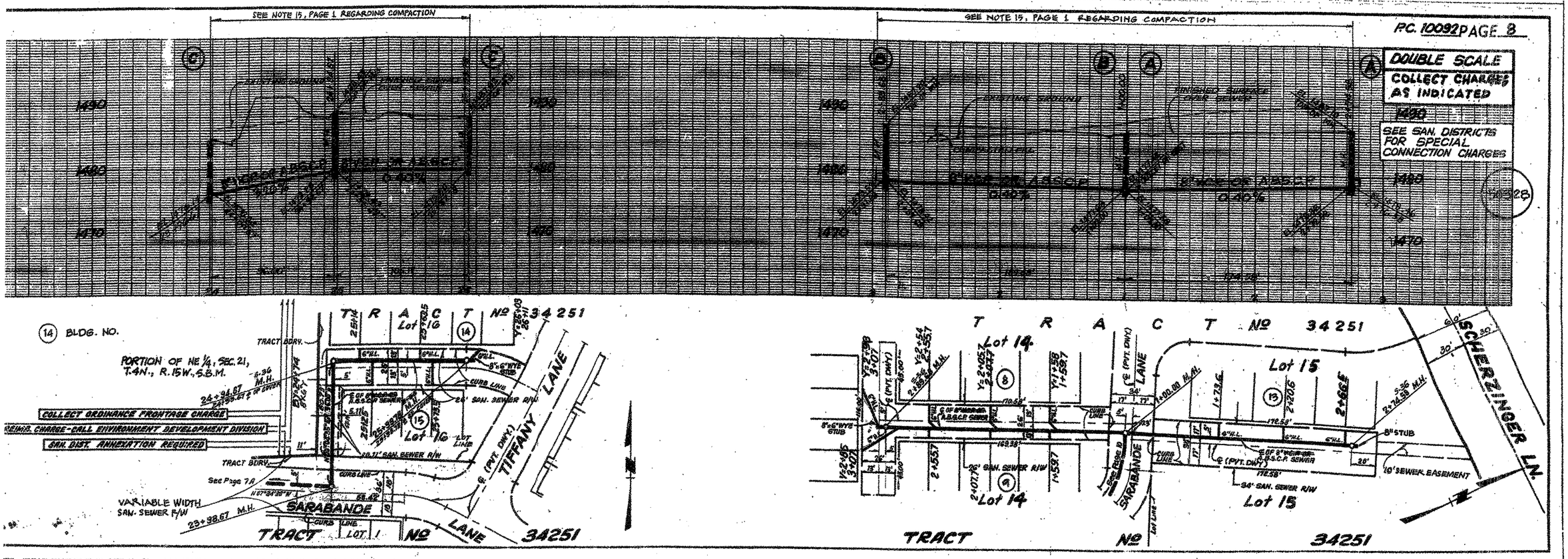
FOR SHEET NO. 2 SOUTHERN CALIFORNIA BLUEPRINT CO.





P.C. 10092 TRACT 34251





PC 10092 SHEET 1 OF 1 TRACT

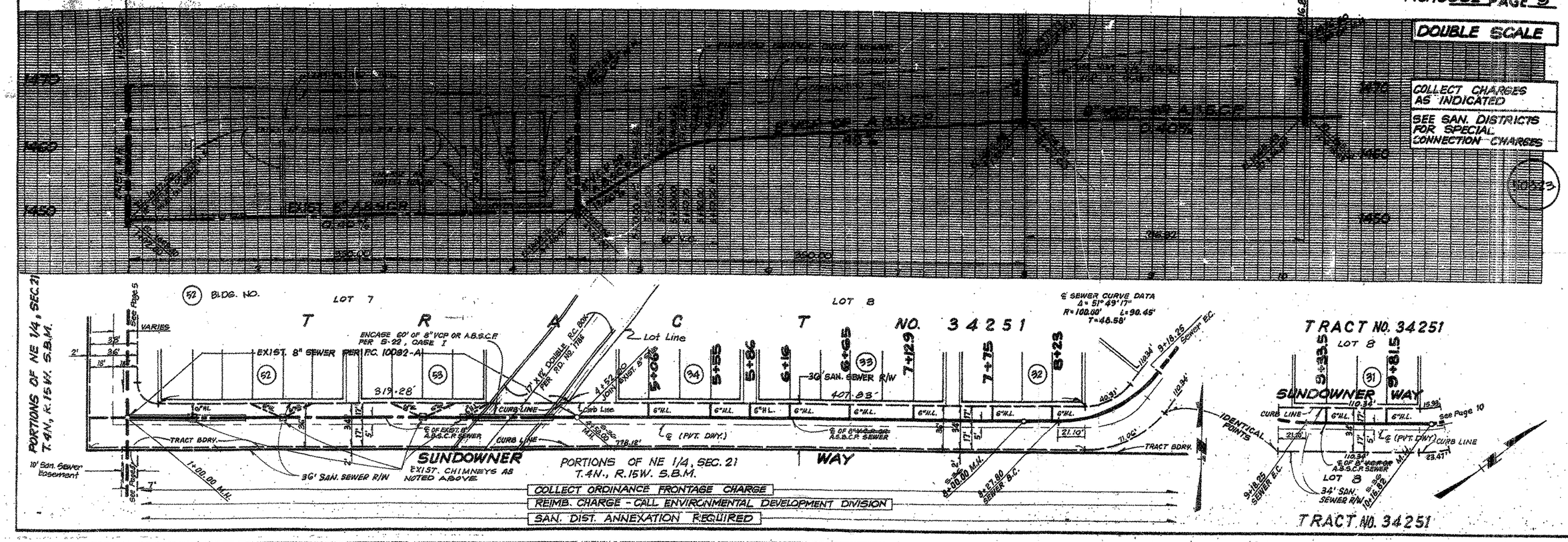
SEE NOTE 15, PAGE 1 REGARDING COMPACTION

P.C. 10092 PAGE 9

DOUBLE SCALE

COLLECT CHARGES AS INDICATED

SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES



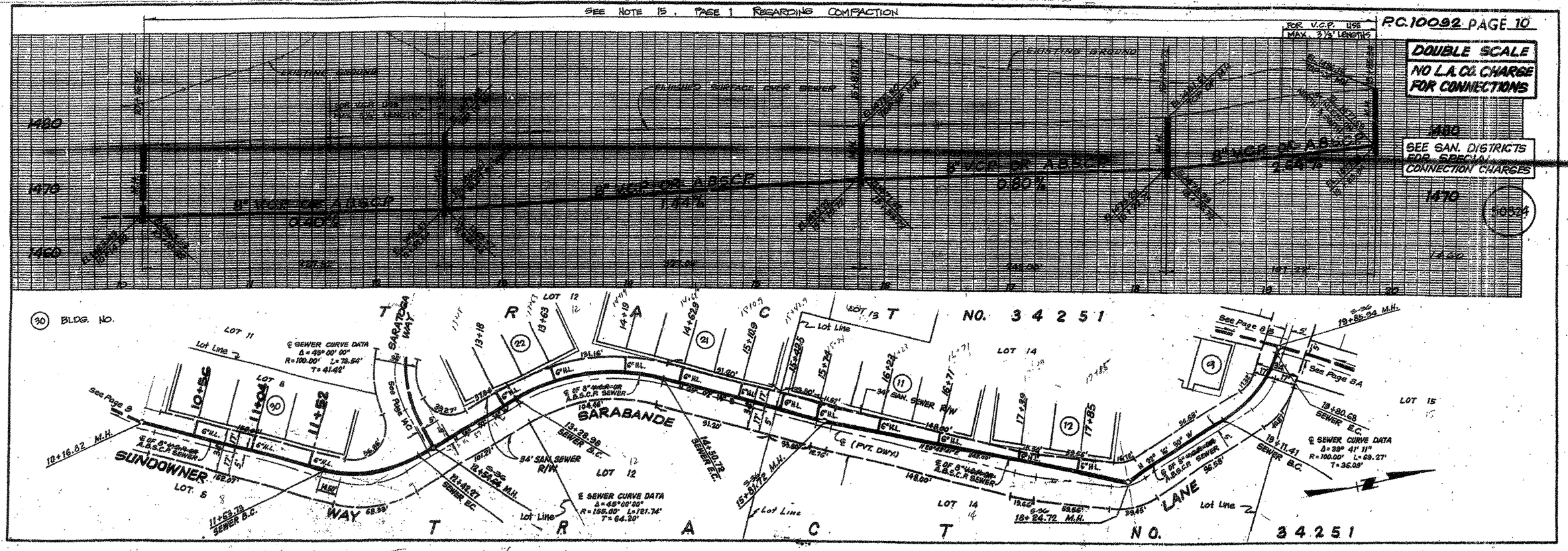
SEE NOTE 15, PAGE 1 REGARDING COMPACTION

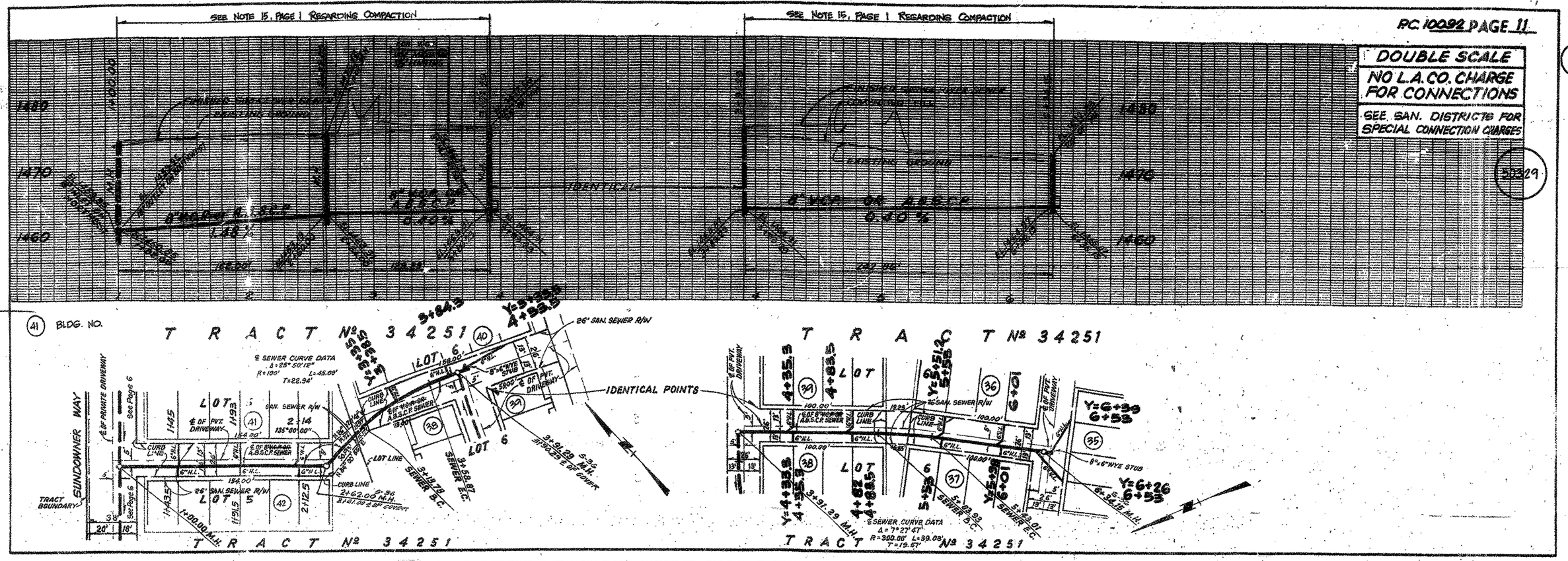
P.C. 10092 PAGE 10

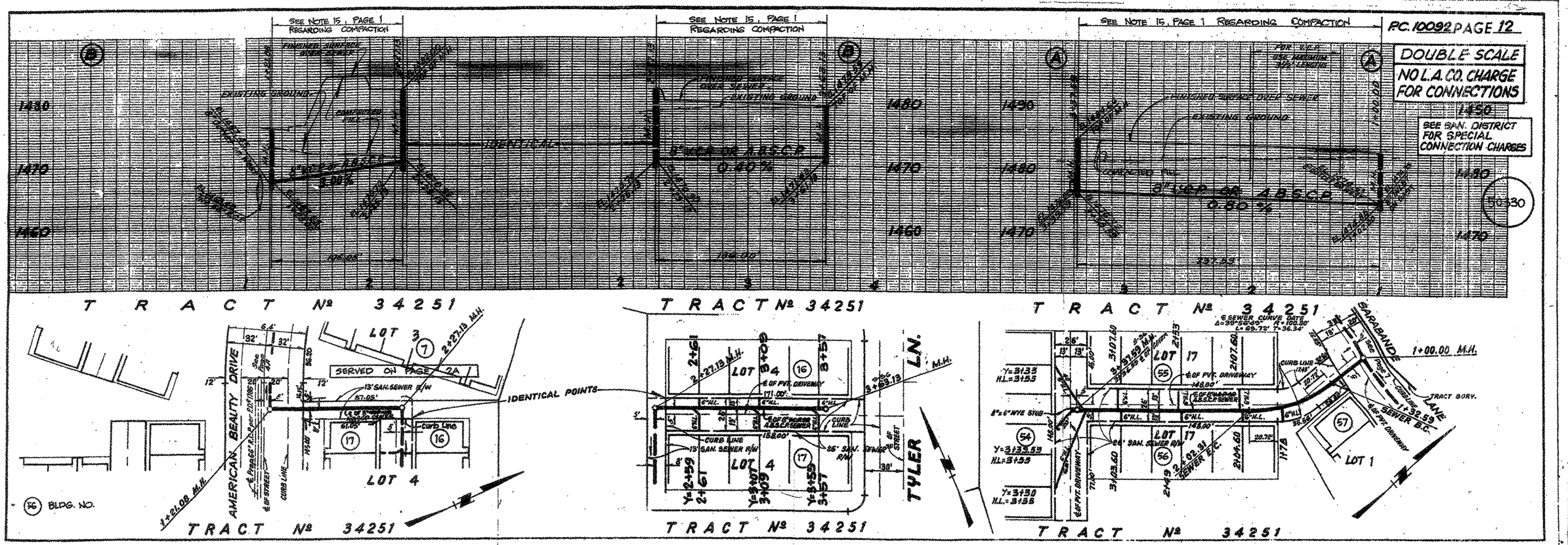
DOUBLE SCALE

NO L.A. CO. CHARGE FOR CONNECTIONS

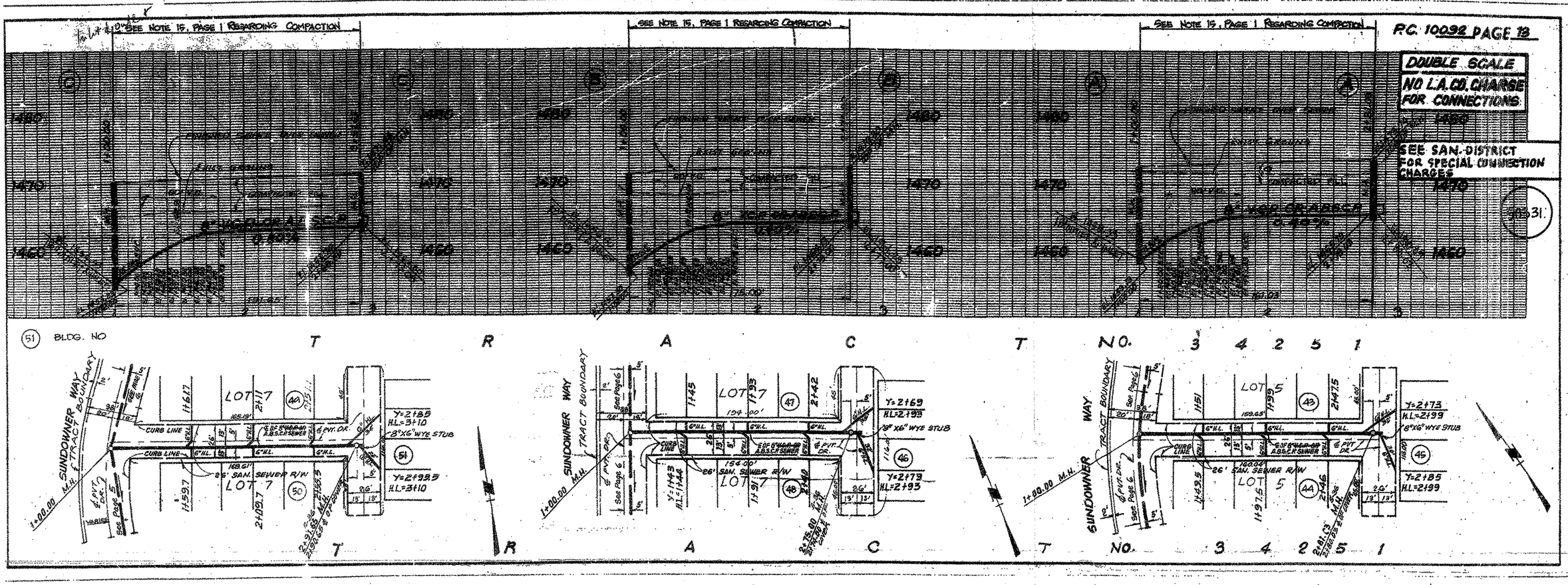
SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES

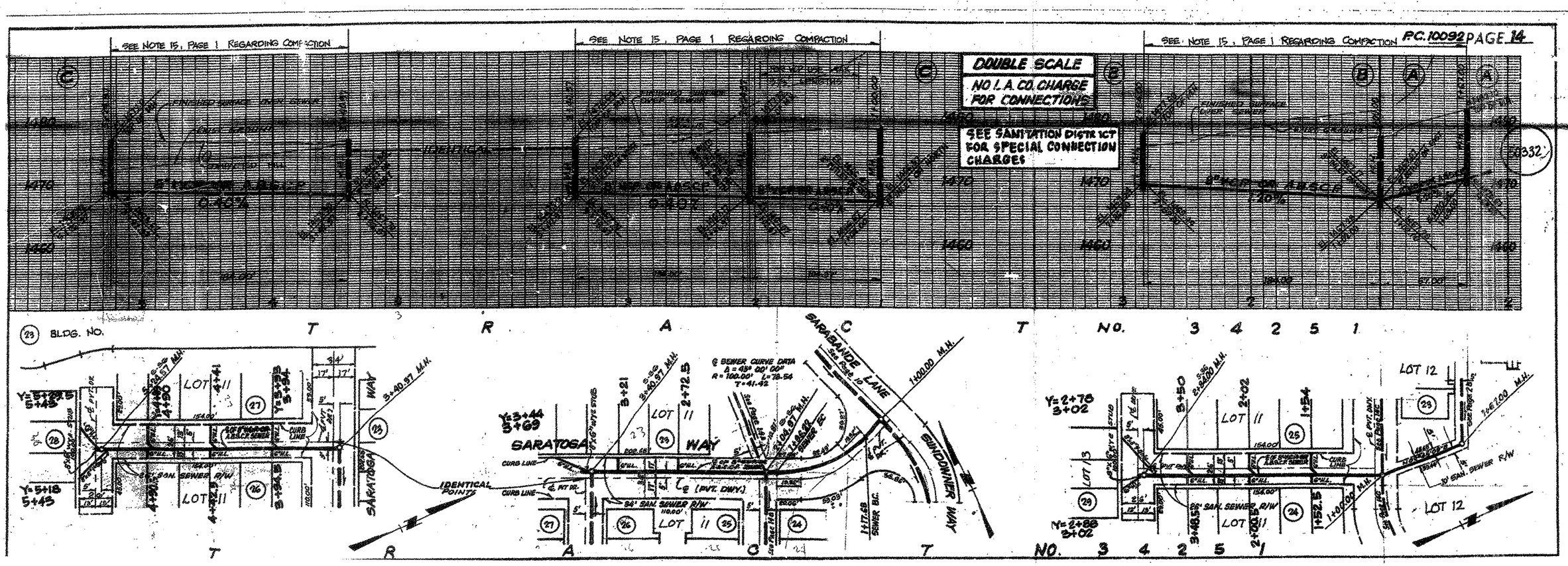



SEE NOTE 15, PAGE 1 REGARDING COMPACTION
P.C. 10092 PAGE 11
DOUBLE SCALE
NO L.A. CO. CHARGE FOR CONNECTIONS
SEE SAN. DISTRICTS FOR SPECIAL CONNECTION CHARGES
50329
IDENTICAL
8" VCP OR A.B.S.C.P.
0.40 %
0.40 %
1480
1470
1460
TRACT Nº 34251
BLDG. NO.
26' SAN. SEWER R/W
IDENTICAL POINTS
SUNDOWNER WAY
TRACT BOUNDARY
LOT 6
LOT 5
LOT 4
LOT 3
LOT 2
LOT 1
SEWER B.C.
SEWER E.C.
8"x6" WYE STUB
SEWER CURVE DATA
Δ = 7° 27' 47"
R = 300.00' L = 39.08'
T = 19.57'


SEE NOTE 15, PAGE 1 REGARDING COMPACTION
P.C. 10092 PAGE 12
DOUBLE SCALE
NO L.A. CO. CHARGE FOR CONNECTIONS
SEE SAN. DISTRICT FOR SPECIAL CONNECTION CHARGES
50330
IDENTICAL
8" VCP OR A.B.S.C.P.
0.40 %
3" VCP OR A.B.S.C.P.
0.80 %
1480
1470
1460
1450
TRACT Nº 34251
BLDG. NO.
SERVED ON PAGE 2A
13' SAN. SEWER R/W
IDENTICAL POINTS
AMERICAN BEAUTY DRIVE
TYLER LN.
SARABANDE LANE
LOT 1
LOT 4
LOT 17
8"x6" WYE STUB
26' SAN. SEWER R/W
TRACT BDRY.
SEWER B.C.
SEWER E.C.
SEWER CURVE DATA
Δ = 39°55'00"
R = 100.00'
L = 69.72'
T = 36.34'

TRACT NO 34251 P.C. 10092





Appendix K: Global Climate Change

Skyline Ranch

Draft Environmental Impact Report
Appendix K

Air Quality Assessment Files

Provided by PCR Services Corporation

May 2009

- K-1 Construction Greenhouse Gas Emissions
- K-2 GHG Analysis- Operational Greenhouse Gas Emissions
- K-3 Greenhouse Gas Reference Material

K-1

CONSTRUCTION GREENHOUSE GAS EMISSIONS

Appendix K-1

- Construction GHG Emissions Table
- Construction Equipment GHG Emission Calculation Worksheet
- Construction Mobile Source GHG Emission Calculation Worksheet

Note: Dates used in these analyses represent the earliest estimated start date and are based on the best information available at the time the study was initiated. The results of these analyses represent the "worst-case" scenario and are conservative, since emission factors and profiles typically improve with time.

Construction Greenhouse Gas Emissions

	CO_2E[d] (Metric Tons)								
Emission Source	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
On Road Mobile Sources[a]	116	426	642	4,335	4,380	4,308	4,308	4,308	4,308
On Site Construction Equipment[b]	2,453	7,355	192	2,586	2,719	742	742	742	742
Total	**2,569**	**7,781**	**834**	**6,921**	**7,099**	**5,051**	**5,051**	**5,050**	**5,050**
2004 Statewide Total[c]	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000
Net Increase as Percentage of 2004 Statewide Inventory	**0.00051%**	**0.00156%**	**0.00017%**	**0.00139%**	**0.00142%**	**0.00101%**	**0.00101%**	**0.00101%**	**0.00101%**

[a] *Mobile source values were derived using URBEMIS2007 in addition to the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

[b] *On site construction equipment values were derived using URBEMIS2007 in addition to the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

c Statewide totals were derived from the California Energy Commission: http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF.

[d] *All CO_2E factors were derived using the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

Source: PCR Services Corporation, 2007.

Concurrent Construction and Operations

CO_2E[d] (Metric Tons)						
Emission Source	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Consruction	6,921	7,099	5,051	5,051	5,050	5,050
Operation	5,739	11,160	16,595	21,927	27,745	32,252
Total	**12,660**	**18,259**	**21,646**	**26,978**	**32,795**	**37,302**
2004 Statewide Total[c]	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000	499,080,000
Net Increase as Percentage of 2004 Statewide Inventory	**0.00254%**	**0.00366%**	**0.00434%**	**0.00541%**	**0.00657%**	**0.00747%**

[a] *Mobile source values were derived using URBEMIS2007 in addition to the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

[b] *On site construction equipment values were derived using URBEMIS2007 in addition to the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

c Statewide totals were derived from the California Energy Commission: http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF.

[d] *All CO_2E factors were derived using the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007.*

Source: PCR Services Corporation, 2007.

Construction Equipment GHG Emission Calculation Worksheet

	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO2 Tons/Yr[a]	2,698	8,090	211	2,844	2,990	816	816	816	816
Totals Metric Tons/year CO2	2,447	7,339	191	2,580	2,713	741	741	741	741
Total Metric Tons/year CH4	0.25	0.76	0.02	0.27	0.28	0.08	0.08	0.08	0.08
CH4 Factor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH4 to CO2E	5.31	15.92	0.41	5.60	5.88	1.61	1.61	1.61	1.61
Total CO2E	**2,453**	**7,355**	**192**	**2,586**	**2,719**	**742**	**742**	**742**	**742**

[a] CO2 values derived from URBEMIS2007 Output File

Year	Mobile Trips	CO2 (tons/year)
2008	Trucks	56.59653041
	Worker	59.54782276
	Off Road	2697.618145
2008 Total		**2813.762498**
2009	Trucks	239.2610982
	Worker	187.2306893
	Off Road	8089.931849
2009 Total		**8516.423636**
2010	Trucks	266.7980283
	Worker	375.0012441
	Off Road	210.8722921
2010 Total		**852.6715645**
2011	Trucks	222.9560289
	Worker	4112.279903
	Off Road	2843.867354
2011 Total		**7179.103287**
2012	Trucks	237.6826313
	Worker	4142.786536
	Off Road	2990.264255
2012 Total		**7370.733422**
2013	Trucks	223.8135521
	Worker	4084.635283
	Off Road	816.4183485
2013 Total		**5124.867184**
2014	Trucks	223.8135521
	Worker	4084.33489
	Off Road	816.4183485
2014 Total		**5124.566791**
2015	Trucks	223.8135521
	Worker	4084.106308
	Off Road	816.4183485
2015 Total		**5124.338208**
2016	Trucks	223.8135521
	Worker	4083.782366
	Off Road	816.4183485
2016 Total		**5124.014266**

K-2

OPERATIONAL GREENHOUSE GAS EMISSIONS

Appendix K-2

- K-2 Operational Greenhouse Gas Emissions
  - 2011- GHG Analysis
  - 2012- GHG Analysis
  - 2013- GHG Analysis
  - 2014- GHG Analysis
  - 2015- GHG Analysis
  - 2016- GHG Analysis
  - 2017 (Build-out)- GHG Analysis

- EMFAC2007 Emission Rates

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	2,519
Electricity[b]	1,515
Water	451
Natural gas[c]	478
Total	**4,964**
Net Increase	
Total	4,964
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0010%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Existing				
Office	0.0	13.55	0	0.00
Food Store	0.0	53.30	0	0.00
Warehouse	0.0	4.35	0	0.00
Water Usage (Mg/Yr)	0.00	12,700.00	0.00	0.00
Banquet Hall	0.0	10.50	0	0.00
Total Existing			**0**	**0.00**
Project				
Retail	0.0	13.55	0	0.00
Restaurant	0.0	47.45	0	0.00
Elementary School	750.0	5.9	4,425,000	4425.00
Residential (DU)	30.0	5,627	168,795	168.80
Total Project			**4,593,795**	**4593.80**
Net Project			**4,593,795**	**4593.80**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	3326458.835	1508.855116	1508.855116
CH_4	0.0302	138.732609	0.062928002	1.321488033
N_2O	0.0081	37.2097395	0.01687804	5.232192449

1515.41 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	30.0	DU	0.72	0.235	7.0	208	0.076	2.3
Total Project					**48.0**			**57.0**
Net Project					48.0			57.0

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	0.29	13,022	**1,368,143**	**1,368**
Net Project Water Power Usage			**1,368,143**	**1,368**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**451.33**
CO_2	724.12	990,700	449	449
CH_4	0.0302	41	0.02	0.39
N_2O	0.0081	11	0.01	2
				451

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	30.0	4,012.00	120,360	1,444,320	1,473
Total Project			**1,620,360**	**19,444,320**	**19,833**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	1,052,349.93	477.34	477.34
CH_4	0.001	19.83	0.01	0.19
N_2O	0.0001	1.98	0.00	0.28

477.81 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Project			
Total Project	**-**	**12,219**	**4,459,935.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2011 AVG Gram/Mile[c]	**548.6873571**
LA County CH_4 2011 AVG Gram/Mile[c]	**0.034571429**
LA County N_2O 2011 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	548.68736	2,447,109,948.18	2,447.11	2,447.11
CH_4	0.0345714	154,186.32	0.15	3.24
N_2O	0.05	222,996.75	0.22	69.13

2519.48 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	346.127
5	1199.616
10	914.016
15	722.506
20	593.243
25	509.184
30	452.496
35	415.847
40	394.889
45	387.313
50	392.38
55	410.771
60	444.726
65	498.509
AVG	**548.6873571**

CH4	
Speed	**Grams/Mile**
0	0.038
5	0.083
10	0.062
15	0.047
20	0.037
25	0.031
30	0.027
35	0.024
40	0.022
45	0.021
50	0.021
55	0.022
60	0.023
65	0.026
AVG	**0.034571429**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	947.613	5162.628	0	0	346.127
5	949.802	1183.247	1712.445	2880.771	2741.866	246.217	1199.616
10	717.833	894.577	1264.156	2401.798	2532.955	207.638	914.016
15	563.089	702.009	975.314	2030.673	2409.586	179.272	722.506
20	458.45	571.792	785.295	1769.991	2334.468	158.423	593.243
25	387.401	483.377	659.031	1668.981	2287.784	143.303	509.184
30	339.765	424.097	575.789	1589.795	2258.699	132.736	452.496
35	309.27	386.148	523.213	1528.928	2241.198	125.992	415.847
40	292.168	364.866	494.113	1484.464	2231.986	122.684	394.889
45	286.457	357.759	484.735	1455.458	2229.443	122.733	387.313
50	291.486	364.017	493.919	1441.657	2233.135	126.378	392.38
55	307.827	384.352	522.846	1443.43	2243.694	134.239	410.771
60	337.389	421.141	575.303	1461.868	2262.995	147.467	444.726
65	383.793	478.887	658.562	1499.121	2294.726	168.006	498.509

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.161	0.41	0	0	0.038
5	0.061	0.076	0.096	0.329	0.174	0.31	0.083
10	0.047	0.059	0.075	0.191	0.123	0.264	0.062
15	0.037	0.047	0.061	0.102	0.09	0.234	0.047
20	0.03	0.039	0.05	0.062	0.069	0.215	0.037
25	0.025	0.032	0.042	0.051	0.055	0.203	0.031
30	0.021	0.028	0.037	0.042	0.046	0.197	0.027
35	0.019	0.025	0.033	0.036	0.039	0.195	0.024
40	0.017	0.023	0.031	0.032	0.035	0.198	0.022
45	0.016	0.022	0.029	0.029	0.033	0.206	0.021
50	0.016	0.022	0.029	0.029	0.031	0.22	0.021
55	0.017	0.022	0.029	0.03	0.03	0.241	0.022
60	0.018	0.024	0.031	0.034	0.031	0.274	0.023
65	0.02	0.026	0.034	0.039	0.032	0.325	0.026

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	6,954
Electricity[b]	1,927
Water	747
Natural gas[c]	738
Total	**10,367**
Net Increase	
Total	10,367
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0022%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	750.0	5.9	4,425,000	4425.00
Residential (DU)	252.0	5,627	1,417,878	1417.88
Total Project			**5,842,878**	**5842.88**
Net Project			**5,842,878**	**5842.88**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	4230944.817	1919.122722	1919.122722
CH_4	0.0302	176.4549156	0.080038538	1.6808093
N_2O	0.0081	47.3273118	0.02146729	6.654859904

1927.46 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	252.0	DU	0.72	0.235	59.1	208	0.076	19.1
Total Project					**100.1**			**73.9**
Net Project					100.1			73.9

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	0.48	13,022	**2,265,858**	**2,266**
Net Project Water Power Usage			**2,265,858**	**2,266**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**747.46**
CO_2	724.12	1,640,753	744	744
CH_4	0.0302	68	0.03	0.65
N_2O	0.0081	18	0.01	3
				747

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	252.0	4,012.00	1,011,024	12,132,288	12,375
Total Project			**2,511,024**	**30,132,288**	**30,735**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	1,630,795.59	739.72	739.72
CH_4	0.001	30.73	0.01	0.29
N_2O	0.0001	3.07	0.00	0.43

740.44 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Project			
Total Project	**-**	**33,683**	**12,294,295.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2012 AVG Gram/Mile[c]	**549.4195714**
LA County CH_4 2012 AVG Gram/Mile[c]	**0.032571429**
LA County N_2O 2012 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	549.41957	6,754,726,289.92	6,754.73	6,754.73
CH_4	0.0325714	400,442.75	0.40	8.41
N_2O	0.05	614,714.75	0.61	190.56

6953.70 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	350.94
5	1199.982
10	914.453
15	722.919
20	593.624
25	509.63
30	452.972
35	416.331
40	395.366
45	387.774
50	392.816
55	411.174
60	445.086
65	498.807
AVG	**549.4195714**

CH4	
Speed	**Grams/Mile**
0	0.038
5	0.078
10	0.058
15	0.044
20	0.035
25	0.029
30	0.025
35	0.022
40	0.021
45	0.02
50	0.02
55	0.02
60	0.022
65	0.024
AVG	**0.032571429**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	953.037	5186.907	0	0	350.94
5	947.416	1183.568	1712.094	2892.813	2733.268	249.804	1199.982
10	716.014	894.781	1263.809	2412.356	2519.063	210.213	914.453
15	561.65	702.136	975.009	2039.224	2392.568	181.323	722.919
20	457.266	571.867	785.039	1776.876	2315.547	160.272	593.624
25	386.392	483.416	658.819	1675.611	2267.679	145.179	509.63
30	338.872	424.112	575.611	1596.058	2237.858	134.824	452.972
35	308.451	386.148	523.06	1534.802	2219.913	128.464	416.331
40	291.391	364.857	493.976	1489.973	2210.468	125.729	395.366
45	285.695	357.747	484.605	1460.652	2207.86	126.584	387.774
50	290.711	364.008	493.787	1446.593	2211.646	131.345	392.816
55	307.012	384.351	522.702	1448.153	2222.472	140.759	411.174
60	336.502	421.155	575.142	1466.398	2242.262	156.179	445.086
65	382.792	478.925	658.375	1503.422	2274.798	179.868	498.807

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.161	0.397	0	0	0.038
5	0.057	0.073	0.092	0.302	0.174	0.307	0.078
10	0.043	0.057	0.072	0.175	0.122	0.261	0.058
15	0.035	0.045	0.058	0.093	0.09	0.232	0.044
20	0.028	0.037	0.047	0.056	0.069	0.213	0.035
25	0.023	0.031	0.04	0.046	0.055	0.201	0.029
30	0.019	0.026	0.035	0.039	0.045	0.194	0.025
35	0.017	0.024	0.031	0.033	0.039	0.193	0.022
40	0.016	0.022	0.029	0.029	0.035	0.195	0.021
45	0.015	0.021	0.028	0.027	0.032	0.203	0.02
50	0.015	0.021	0.027	0.026	0.031	0.216	0.02
55	0.015	0.021	0.028	0.028	0.03	0.237	0.02
60	0.016	0.023	0.029	0.03	0.03	0.269	0.022
65	0.018	0.025	0.032	0.035	0.032	0.318	0.024

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	11,401
Electricity[b]	2,340
Water	1,044
Natural gas[c]	1,003
Total	**15,788**
Net Increase	
Total	15,788
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0033%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	750.0	5.9	4,425,000	4425.00
Residential (DU)	474.0	5,627	2,666,961	2666.96
Total Project			**7,091,961**	**7091.96**
Net Project			**7,091,961**	**7091.96**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	5135430.799	2329.390327	2329.390327
CH_4	0.0302	214.1772222	0.097149075	2.040130566
N_2O	0.0081	57.4448841	0.02605654	8.077527359

2339.51 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	474.0	DU	0.72	0.235	111.2	208	0.076	36.0
Total Project					**152.2**			**90.7**
Net Project					152.2			90.7

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	0.67	13,022	**3,163,573**	**3,164**
Net Project Water Power Usage			**3,163,573**	**3,164**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**1043.60**
CO_2	724.12	2,290,806	1,039	1,039
CH_4	0.0302	96	0.04	0.91
N_2O	0.0081	26	0.01	4
				1,044

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	474.0	4,012.00	1,901,688	22,820,256	23,277
Total Project			**3,401,688**	**40,820,256**	**41,637**
Net Project			**3,401,688**	**40,820,256**	**41,637**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	2,209,241.24	1,002.09	1,002.09
CH_4	0.001	41.64	0.02	0.40
N_2O	0.0001	4.16	0.00	0.59

1003.08 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Project			
Total Project	**-**	**55,146**	**20,128,290.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2013 AVG Gram/Mile[c]	**550.2973571**
LA County CH_4 2013 AVG Gram/Mile[c]	**0.030571429**
LA County N_2O 2013 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	550.29736	11,076,544,790.81	11,076.54	11,076.54
CH_4	0.0305714	615,350.58	0.62	12.92
N_2O	0.05	1,006,414.50	1.01	311.99

11401.46 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	355.947
5	1200.75
10	915.183
15	723.544
20	594.16
25	510.201
30	453.55
35	416.901
40	395.92
45	388.306
50	393.323
55	411.651
60	445.527
65	499.2
AVG	**550.2973571**

CH4	
Speed	**Grams/Mile**
0	0.037
5	0.074
10	0.055
15	0.042
20	0.033
25	0.027
30	0.023
35	0.021
40	0.019
45	0.018
50	0.018
55	0.019
60	0.02
65	0.022
AVG	**0.030571429**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	956.84	5213.547	0	0	355.947
5	945.353	1183.877	1711.512	2906.894	2713.833	252.857	1200.75
10	714.442	894.977	1263.355	2424.358	2487.756	212.402	915.183
15	560.404	702.256	974.661	2048.722	2354.25	183.066	723.544
20	456.242	571.935	784.771	1784.348	2272.959	161.843	594.16
25	385.517	483.449	658.612	1682.706	2222.439	146.774	510.201
30	338.098	424.122	575.447	1602.683	2190.965	136.602	453.55
35	307.742	386.142	522.926	1540.953	2172.026	130.572	416.901
40	290.718	364.843	493.858	1495.695	2162.057	128.33	395.92
45	285.033	357.731	484.493	1466.013	2159.305	129.876	388.306
50	290.039	363.993	493.672	1451.669	2163.3	135.595	393.323
55	306.305	384.345	522.573	1453.01	2174.726	146.342	411.651
60	335.733	421.163	574.987	1471.074	2195.613	163.642	445.527
65	381.926	478.956	658.182	1507.9	2229.952	190.032	499.2

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.16	0.386	0	0	0.037
5	0.053	0.071	0.089	0.274	0.174	0.304	0.074
10	0.041	0.055	0.069	0.159	0.122	0.259	0.055
15	0.032	0.043	0.055	0.084	0.09	0.229	0.042
20	0.025	0.035	0.045	0.051	0.068	0.21	0.033
25	0.021	0.029	0.038	0.042	0.054	0.199	0.027
30	0.018	0.025	0.033	0.035	0.045	0.192	0.023
35	0.016	0.022	0.03	0.03	0.039	0.19	0.021
40	0.014	0.02	0.027	0.026	0.035	0.193	0.019
45	0.014	0.019	0.026	0.025	0.032	0.2	0.018
50	0.013	0.019	0.026	0.024	0.03	0.213	0.018
55	0.014	0.02	0.026	0.025	0.03	0.233	0.019
60	0.015	0.021	0.028	0.027	0.03	0.264	0.02
65	0.017	0.023	0.03	0.031	0.031	0.312	0.022

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	15,775
Electricity[b]	2,740
Water	1,332
Natural gas[c]	1,259
Total	**21,105**
Net Increase	
Total	21,105
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0044%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	750.00	5.9	4,425,000	4425.00
Residential (DU)	690.00	5,627	3,882,285	3882.29
Total Project			**8,307,285**	**8307.29**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	6015471.214	2728.569619	2728.569619
CH_4	0.0302	250.880007	0.113797164	2.389740447
N_2O	0.0081	67.2890085	0.030521756	9.461744342

2740.42 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	690.0	DU	0.72	0.235	161.9	208	0.076	52.4
Total Project					**202.9**			**107.1**
Net Project					202.9			107.1

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	0.85	13,022	**4,037,025**	**4,037**
Net Project Water Power Usage			**4,037,025**	**4,037**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**1331.74**
CO_2	724.12	2,923,291	1,326	1,326
CH_4	0.0302	122	0.06	1.16
N_2O	0.0081	33	0.01	5
				1,332

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	690.0	4,012.00	2,768,280	33,219,360	33,884
Total Project			**4,268,280**	**51,219,360**	**52,244**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	2,772,053.23	1,257.38	1,257.38
CH_4	0.001	52.24	0.02	0.50
N_2O	0.0001	5.22	0.00	0.73

1258.61 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Total Project	**-**	**76,030**	**27,750,950.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2014 AVG Gram/Mile[c]	**552.3267857**
LA County CH_4 2014 AVG Gram/Mile[c]	**0.028928571**
LA County N_2O 2014 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	552.32679	15,327,593,014.02	15,327.59	15,327.59
CH_4	0.0289286	802,795.34	0.80	16.86
N_2O	0.05	1,387,547.50	1.39	430.14

15774.59 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	365.324
5	1202.986
10	917.126
15	725.196
20	595.597
25	511.637
30	454.965
35	418.284
40	397.266
45	389.615
50	394.597
55	412.891
60	446.73
65	500.361
AVG	**552.3267857**

CH4	
Speed	**Grams/Mile**
0	0.038
5	0.07
10	0.052
15	0.039
20	0.031
25	0.025
30	0.022
35	0.019
40	0.018
45	0.017
50	0.017
55	0.017
60	0.019
65	0.021
AVG	**0.028928571**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	970.728	5241.469	0	0	365.324
5	943.616	1184.12	1711.855	2921.245	2705.249	255.385	1202.986
10	713.117	895.126	1263.292	2436.559	2474.408	214.212	917.126
15	559.355	702.343	974.454	2058.357	2338.089	184.504	725.196
20	455.379	571.98	784.533	1791.911	2255.087	163.14	595.597
25	384.781	483.466	658.386	1689.877	2203.502	148.093	511.637
30	337.447	424.119	575.247	1609.37	2171.365	138.074	454.965
35	307.145	386.128	522.751	1547.155	2152.026	132.322	418.284
40	290.152	364.822	493.703	1501.46	2141.847	130.492	397.266
45	284.477	357.707	484.348	1471.412	2139.037	132.616	389.615
50	289.474	363.972	493.529	1456.779	2143.117	139.134	394.597
55	305.711	384.33	522.426	1457.899	2154.783	150.995	412.891
60	335.086	421.16	574.834	1475.782	2176.11	169.864	446.73
65	381.196	478.971	658.03	1512.413	2211.173	198.509	500.361

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.162	0.375	0	0	0.038
5	0.05	0.068	0.085	0.247	0.173	0.303	0.07
10	0.038	0.053	0.066	0.143	0.121	0.257	0.052
15	0.03	0.041	0.053	0.075	0.089	0.228	0.039
20	0.024	0.033	0.043	0.046	0.068	0.209	0.031
25	0.019	0.028	0.036	0.038	0.054	0.197	0.025
30	0.016	0.024	0.031	0.032	0.044	0.19	0.022
35	0.014	0.021	0.028	0.027	0.038	0.188	0.019
40	0.013	0.019	0.026	0.024	0.034	0.191	0.018
45	0.012	0.018	0.024	0.022	0.031	0.198	0.017
50	0.012	0.018	0.024	0.022	0.03	0.21	0.017
55	0.013	0.019	0.025	0.022	0.029	0.23	0.017
60	0.014	0.02	0.026	0.024	0.03	0.261	0.019
65	0.015	0.022	0.028	0.027	0.031	0.308	0.021

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	20,553
Electricity[b]	3,175
Water	1,644
Natural gas[c]	1,535
Total	**26,907**
Net Increase	
Total	26,907
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0056%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	750.0	5.9	4,425,000	4425.00
Residential (DU)	924.0	5,627	5,198,886	5198.89
Total Project			**9,623,886**	**9623.89**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	6968848.33	3161.013852	3161.013852
CH_4	0.0302	290.6413572	0.131832594	2.768484484
N_2O	0.0081	77.9534766	0.035359073	10.96131274

3174.74 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	924.0	DU	0.72	0.235	216.8	208	0.076	70.2
Total Project					**257.8**			**124.9**
Net Project					257.8			124.9

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	1.05	13,022	**4,983,265**	**4,983**
Net Project Water Power Usage			**4,983,265**	**4,983**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**1643.89**
CO_2	724.12	3,608,482	1,637	1,637
CH_4	0.0302	150	0.07	1.43
N_2O	0.0081	40	0.02	6
				1,644

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	924.0	4,012.00	3,707,088	44,485,056	45,375
Total Project			**5,207,088**	**62,485,056**	**63,735**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	3,381,766.21	1,533.94	1,533.94
CH_4	0.001	63.73	0.03	0.61
N_2O	0.0001	6.37	0.00	0.90

1535.45 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Project			
Total Project	**-**	**98,654**	**36,008,710.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2015 AVG Gram/Mile[c]	**554.7062143**
LA County CH_4 2015 AVG Gram/Mile[c]	**0.0275**
LA County N_2O 2015 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	554.70621	19,974,255,205.41	19,974.26	19,974.26
CH_4	0.0275	990,239.53	0.99	20.80
N_2O	0.05	1,800,435.50	1.80	558.14

20553.19 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	374.852
5	1205.227
10	919.076
15	726.852
20	597.036
25	513.077
30	456.384
35	419.67
40	398.615
45	390.926
50	395.87
55	414.127
60	447.926
65	506.249
AVG	**554.7062143**

CH4	
Speed	**Grams/Mile**
0	0.038
5	0.067
10	0.049
15	0.037
20	0.029
25	0.024
30	0.02
35	0.018
40	0.017
45	0.016
50	0.016
55	0.016
60	0.018
65	0.02
AVG	**0.0275**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	983.323	5269.623	0	0	374.852
5	941.655	1184.226	1712.124	2935.877	2695.021	257.504	1205.227
10	711.625	895.174	1263.207	2448.879	2458.606	215.726	919.076
15	558.176	702.353	974.246	2068.004	2318.994	185.707	726.852
20	454.411	571.964	784.301	1799.418	2233.987	164.225	597.036
25	383.957	483.432	658.169	1696.956	2181.156	149.198	513.077
30	336.719	424.073	575.056	1615.943	2148.243	139.31	456.384
35	306.479	386.074	522.584	1553.227	2128.437	133.793	419.67
40	289.52	364.764	493.554	1507.084	2118.013	132.311	398.615
45	283.857	357.647	484.209	1476.665	2115.135	134.924	390.926
50	288.843	363.913	493.391	1461.743	2119.313	142.118	395.87
55	305.048	384.276	522.284	1462.648	2131.261	154.919	414.127
60	334.363	421.113	574.685	1480.363	2153.103	175.115	447.926
65	384.401	479.45	658.182	1507.9	2229.952	190.032	506.249

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.163	0.366	0	0	0.038
5	0.047	0.066	0.082	0.221	0.17	0.301	0.067
10	0.036	0.051	0.063	0.128	0.119	0.255	0.049
15	0.028	0.039	0.05	0.067	0.087	0.226	0.037
20	0.022	0.032	0.04	0.041	0.066	0.207	0.029
25	0.018	0.026	0.034	0.034	0.053	0.195	0.024
30	0.015	0.022	0.029	0.029	0.044	0.189	0.02
35	0.013	0.02	0.026	0.025	0.037	0.187	0.018
40	0.012	0.018	0.024	0.022	0.033	0.189	0.017
45	0.011	0.017	0.023	0.02	0.031	0.196	0.016
50	0.011	0.017	0.023	0.019	0.029	0.208	0.016
55	0.012	0.017	0.023	0.02	0.029	0.228	0.016
60	0.013	0.019	0.024	0.021	0.029	0.258	0.018
65	0.014	0.021	0.026	0.024	0.03	0.304	0.02

Skyline Ranch Greenhouse Gas Analysis: Operations 2016
Table of Report

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	24,251
Electricity[b]	3,513
Water	1,887
Natural gas[c]	1,751
Total	**31,401**
Net Increase	
Total	31,401
2004 Statewide Total[d]	479,740,000
Percent of 2004 Statewide Total	**0.0065%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	750.00	5.90	4,425,000	4425.00
Residential (DU)	1106.00	5,626.50	6,222,909	6222.91
Total Project			**10,647,909**	**10647.91**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	724.12	7710363.865	3497.359366	3497.359366
CH_4	0.0302	321.5668518	0.145860151	3.06306318
N_2O	0.0081	86.2480629	0.039121431	12.12764372

Total Annual CO2E
3,512.55

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Water and Wastewater Generation Factors

			Water			Wastewater		
Land Use	**Amount**	**Units**	**AF/Year/Unit**	**MG/Year/Unit**	**MG/Year**	**GPD/Unit**	**MG/Year/Unit**	**MG/Year**
Project								
Elementary School	750.0	KSF	0.17	0.055	41.0	200	0.073	54.8
Residential (DU)	1106.0	DU	0.72	0.235	259.5	208	0.076	84.0
Total Project					**300.5**			**138.7**
Net Project					300.5			138.7

1 acre foot = 325851.433266421 gallon [US, liquid]

Water Conveyance (Water and Wastewater)

		Usage Rate [c]		
	MGD	**kWh/MG**	**(KWh\year)**	**MWh\year**
Water Supply, Conveyance, Treatment, and Distribution, and Wastewater Treatment	1.20	13,022	**5,719,230**	**5,719**
Net Project Water Power Usage			**5,719,230**	**5,719**

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E (metric tons)
Net				**1886.67**
CO_2	724.12	4,141,409	1,879	1,879
CH_4	0.0302	173	0.08	1.65
N_2O	0.0081	46	0.02	7
				1,887

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	750.0	2.00	1,500,000	18,000,000	18,360
Residential (DU)	1106.0	4,012.00	4,437,272	53,247,264	54,312
Net Project			**5,937,272**	**71,247,264**	**72,672**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	53.06	3,855,987.42	1,749.05	1,749.05
CH_4	0.001	72.67	0.03	0.69
N_2O	0.0001	7.27	0.00	1.02

1750.76 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Total Project	**-**	**116,250**	**42,431,250.00**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2016 AVG Gram/Mile[c]	**555.4969286**
LA County CH_4 2016 AVG Gram/Mile[c]	**0.026**
LA County N_2O 2016 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	555.49693	23,570,429,050.45	23,570.43	23,570.43
CH_4	0.026	1,103,212.50	1.10	23.17
N_2O	0.05	2,121,562.50	2.12	657.68

24251.28 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	380.344
5	1206.425
10	920.14
15	727.753
20	597.812
25	513.866
30	457.165
35	420.434
40	399.356
45	391.643
50	396.562
55	414.791
60	448.56
65	502.106
AVG	**555.4969286**

CH4	
Speed	**Grams/Mile**
0	0.038
5	0.064
10	0.047
15	0.035
20	0.027
25	0.022
30	0.019
35	0.017
40	0.016
45	0.015
50	0.015
55	0.015
60	0.016
65	0.018
AVG	**0.026**

Pollutant Name: Carbon Dioxide **Temperature: 60F Relative Humidity: 50%**

Speed

MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	987.247	5288.644	0	0	380.344
5	940.015	1184.317	1711.833	2946.429	2677.444	259.218	1206.425
10	710.378	895.214	1262.935	2457.694	2429.785	216.949	920.14
15	557.19	702.357	974.013	2074.862	2283.533	186.678	727.753
20	453.602	571.945	784.109	1804.717	2194.482	165.101	597.812
25	383.267	483.397	658.013	1701.931	2139.139	150.09	513.866
30	336.11	424.027	574.927	1620.544	2104.66	140.31	457.165
35	305.921	386.021	522.475	1557.464	2083.913	134.984	420.434
40	288.991	364.707	493.457	1510.998	2072.992	133.786	399.356
45	283.338	357.59	484.117	1480.312	2069.977	136.797	391.643
50	288.316	363.857	493.298	1465.186	2074.354	144.542	396.562
55	304.492	384.223	522.182	1465.941	2086.871	158.109	414.791
60	333.758	421.067	574.568	1483.544	2109.752	179.384	448.56
65	379.696	478.9	657.742	1519.889	2147.369	211.486	502.106

Pollutant Name: Methane **Temperature: 60F Relative Humidity: 50%**

Speed

MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0	0	0.162	0.357	0	0	0.038
5	0.045	0.064	0.079	0.2	0.17	0.3	0.064
10	0.034	0.049	0.061	0.115	0.118	0.254	0.047
15	0.026	0.038	0.048	0.061	0.086	0.225	0.035
20	0.02	0.03	0.038	0.037	0.066	0.206	0.027
25	0.016	0.025	0.032	0.031	0.052	0.194	0.022
30	0.014	0.021	0.028	0.026	0.043	0.188	0.019
35	0.012	0.019	0.025	0.022	0.037	0.186	0.017
40	0.011	0.017	0.023	0.02	0.033	0.188	0.016
45	0.011	0.016	0.022	0.018	0.03	0.194	0.015
50	0.01	0.016	0.021	0.018	0.029	0.206	0.015
55	0.011	0.017	0.022	0.018	0.028	0.226	0.015
60	0.012	0.018	0.023	0.019	0.028	0.255	0.016
65	0.013	0.02	0.025	0.021	0.03	0.3	0.018

Skyline Ranch Greenhouse Gas Analysis: Operations 2017
Table of Report

Emission Source	CO_2E[e] (Metric Tons)
Project	
On Road Mobile Sources[a]	27,293
Electricity[b]	7,066
Natural gas[c]	1,968
Total	**36,327**
Net Increase	
Total	36,327
2004 Statewide Total[d]	391,000,000
Percent of 2004 Statewide Total	**0.0093%**

Electricity

Land Use	1,000 Sqft	Usage Rate [a] (kWh\sq.ft\yr)	(KWh\year)	MWh\year
Project				
Elementary School	800.00	5.9	4,720,000	4720.00
Water Usage (Mg/Yr)	587.86	12,700.00	7,465,836.23	7,465.84
Residential (DU)	1270.00	5,627	7,145,655	7145.66
Net Project			**19,331,491**	**19331.49**

[a] Electricity Usage Rates from Table A9-11-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	lbs/MWh[b]	lbs	metric tons	CO_2E
CO_2	804.54	15552957.95	7054.697303	7054.697303
CH_4	0.0067	129.5209912	0.058749685	1.233743394
N_2O	0.0037	71.52651754	0.032443856	10.0575954

Total Annual CO2E
7065.99

Natural Gas

Land Use	1,000 Sqft	Usage Rate[c] (cu.ft\sq.ft\mo)	Total Natural Gas Usage (cu.ft\mo)	Total Natural Gas Usage (cu.ft\year)	Total Natural Gas Usage (MMBTU\year)
Project					
Elementary School	800.0	2.00	1,600,000	19,200,000	19,584
Residential (DU)	1270.0	4,012.00	5,095,240	61,142,880	62,366
Net Project			**6,695,240**	**80,342,880**	**81,950**

[a] Natural Gas Usage Rates from Table A9-12-A, CEQA Air Quality Handbook, SCAQMD, 1993.

GHG	Kg/MMBtu[b]	Kg	metric tons	CO_2E (Metric Tons)
CO_2	52.78	4,325,307.15	1,961.92	1,961.92
CH_4	0.0059	483.50	0.22	4.61
N_2O	0.0001	8.19	0.00	1.15

1967.68 Total Annual CO2E

[b] Emission factors for CO_2, CH_4, and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

Mobile Source

Land Use	ADT	Daily VMT	Annual VMT[a]
Existing			
Office	n/a	n/a	n/a
Food Store	n/a	n/a	n/a
Warehouse	n/a	n/a	n/a
Banquet Hall	n/a	n/a	n/a
Total Existing	-	-	-
Project			
Retail	n/a	n/a	n/a
Restaurant	n/a	n/a	n/a
Elementary School	n/a	n/a	n/a
Residential (DU)	n/a	n/a	n/a
Total Project	-	**130,648**	**47,686,403.20**
Net Project	-	**130,648**	**47,686,403.20**

[a] Multiplied Daily VMT by 365 to get Annual VMT
[b] Factors dervied from URBEMIS2007

LA County CO_2 2010 AVG Gram/Mile[c]	**556.3339286**
LA County CH_4 2010 AVG Gram/Mile[c]	**0.024642857**
LA County N_2O 2010 AVG Gram/Mile[d]	**0.05**

GHG	Gram/Mile	Gram	metric tons	CO_2E (Metric Tons)
CO_2	556.33393	26,529,564,031.70	26,529.56	26,529.56
CH_4	0.0246429	1,175,129.22	1.18	24.68
N_2O	0.05	2,384,320.16	2.38	739.14

27293.38 Total Annual CO2E

[c] Averaged EMFAC2007 fleet values for 0-65mph
[d] Emission factors for CH_4 and N_2O were derived from the California Climate Action Registry General Reporting Protocol; Version 2.2, March 2007

EMFAC2007 Summary

CO2	
Speed	**Grams/Mile**
0	384.445
5	1207.262
10	920.904
15	728.41
20	598.383
25	514.454
30	457.753
35	421.011
40	399.917
45	392.185
50	397.083
55	415.291
60	449.033
65	502.544
AVG	**556.3339286**

CH4	
Speed	**Grams/Mile**
0	0.037
5	0.061
10	0.044
15	0.033
20	0.026
25	0.021
30	0.018
35	0.016
40	0.015
45	0.014
50	0.014
55	0.014
60	0.015
65	0.017
AVG	**0.024642857**

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season : Annual
Area : Los Angeles
****
****

Year: 2011 -- Model Years 1967 to 2011 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.161	0.410	0.000	0.000	0.038
5	0.061	0.076	0.096	0.329	0.174	0.310	0.083
10	0.047	0.059	0.075	0.191	0.123	0.264	0.062
15	0.037	0.047	0.061	0.102	0.090	0.234	0.047
20	0.030	0.039	0.050	0.062	0.069	0.215	0.037
25	0.025	0.032	0.042	0.051	0.055	0.203	0.031
30	0.021	0.028	0.037	0.042	0.046	0.197	0.027
35	0.019	0.025	0.033	0.036	0.039	0.195	0.024
40	0.017	0.023	0.031	0.032	0.035	0.198	0.022
45	0.016	0.022	0.029	0.029	0.033	0.206	0.021
50	0.016	0.022	0.029	0.029	0.031	0.220	0.021
55	0.017	0.022	0.029	0.030	0.030	0.241	0.022
60	0.018	0.024	0.031	0.034	0.031	0.274	0.023
65	0.020	0.026	0.034	0.039	0.032	0.325	0.026

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	947.613	5162.628	0.000	0.000	346.127
5	949.802	1183.247	1712.445	2880.771	2741.866	246.217	1199.616
10	717.833	894.577	1264.156	2401.798	2532.955	207.638	914.016
15	563.089	702.009	975.314	2030.673	2409.586	179.272	722.506
20	458.450	571.792	785.295	1769.991	2334.468	158.423	593.243
25	387.401	483.377	659.031	1668.981	2287.784	143.303	509.184
30	339.765	424.097	575.789	1589.795	2258.699	132.736	452.496
35	309.270	386.148	523.213	1528.928	2241.198	125.992	415.847
40	292.168	364.866	494.113	1484.464	2231.986	122.684	394.889
45	286.457	357.759	484.735	1455.458	2229.443	122.733	387.313
50	291.486	364.017	493.919	1441.657	2233.135	126.378	392.380
55	307.827	384.352	522.846	1443.430	2243.694	134.239	410.771
60	337.389	421.141	575.303	1461.868	2262.995	147.467	444.726
65	383.793	478.887	658.562	1499.121	2294.726	168.006	498.509

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2012 -- All model years in the range 1968 to 2012 selected
Season : Annual
Area : Los Angeles
****
****

Year: 2012 -- Model Years 1968 to 2012 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.161	0.397	0.000	0.000	0.038
5	0.057	0.073	0.092	0.302	0.174	0.307	0.078
10	0.043	0.057	0.072	0.175	0.122	0.261	0.058
15	0.035	0.045	0.058	0.093	0.090	0.232	0.044
20	0.028	0.037	0.047	0.056	0.069	0.213	0.035
25	0.023	0.031	0.040	0.046	0.055	0.201	0.029
30	0.019	0.026	0.035	0.039	0.045	0.194	0.025
35	0.017	0.024	0.031	0.033	0.039	0.193	0.022
40	0.016	0.022	0.029	0.029	0.035	0.195	0.021
45	0.015	0.021	0.028	0.027	0.032	0.203	0.020
50	0.015	0.021	0.027	0.026	0.031	0.216	0.020
55	0.015	0.021	0.028	0.028	0.030	0.237	0.020
60	0.016	0.023	0.029	0.030	0.030	0.269	0.022
65	0.018	0.025	0.032	0.035	0.032	0.318	0.024

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	953.037	5186.907	0.000	0.000	350.940
5	947.416	1183.568	1712.094	2892.813	2733.268	249.804	1199.982
10	716.014	894.781	1263.809	2412.356	2519.063	210.213	914.453
15	561.650	702.136	975.009	2039.224	2392.568	181.323	722.919
20	457.266	571.867	785.039	1776.876	2315.547	160.272	593.624
25	386.392	483.416	658.819	1675.611	2267.679	145.179	509.630
30	338.872	424.112	575.611	1596.058	2237.858	134.824	452.972
35	308.451	386.148	523.060	1534.802	2219.913	128.464	416.331
40	291.391	364.857	493.976	1489.973	2210.468	125.729	395.366
45	285.695	357.747	484.605	1460.652	2207.860	126.584	387.774
50	290.711	364.008	493.787	1446.593	2211.646	131.345	392.816
55	307.012	384.351	522.702	1448.153	2222.472	140.759	411.174
60	336.502	421.155	575.142	1466.398	2242.262	156.179	445.086
65	382.792	478.925	658.375	1503.422	2274.798	179.868	498.807

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2013 -- All model years in the range 1969 to 2013 selected
Season : Annual
Area : Los Angeles
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Year: 2013 -- Model Years 1969 to 2013 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.160	0.386	0.000	0.000	0.037
5	0.053	0.071	0.089	0.274	0.174	0.304	0.074
10	0.041	0.055	0.069	0.159	0.122	0.259	0.055
15	0.032	0.043	0.055	0.084	0.090	0.229	0.042
20	0.025	0.035	0.045	0.051	0.068	0.210	0.033
25	0.021	0.029	0.038	0.042	0.054	0.199	0.027
30	0.018	0.025	0.033	0.035	0.045	0.192	0.023
35	0.016	0.022	0.030	0.030	0.039	0.190	0.021
40	0.014	0.020	0.027	0.026	0.035	0.193	0.019
45	0.014	0.019	0.026	0.025	0.032	0.200	0.018
50	0.013	0.019	0.026	0.024	0.030	0.213	0.018
55	0.014	0.020	0.026	0.025	0.030	0.233	0.019
60	0.015	0.021	0.028	0.027	0.030	0.264	0.020
65	0.017	0.023	0.030	0.031	0.031	0.312	0.022

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	956.840	5213.547	0.000	0.000	355.947
5	945.353	1183.877	1711.512	2906.894	2713.833	252.857	1200.750
10	714.442	894.977	1263.355	2424.358	2487.756	212.402	915.183
15	560.404	702.256	974.661	2048.722	2354.250	183.066	723.544
20	456.242	571.935	784.771	1784.348	2272.959	161.843	594.160
25	385.517	483.449	658.612	1682.706	2222.439	146.774	510.201
30	338.098	424.122	575.447	1602.683	2190.965	136.602	453.550
35	307.742	386.142	522.926	1540.953	2172.026	130.572	416.901
40	290.718	364.843	493.858	1495.695	2162.057	128.330	395.920
45	285.033	357.731	484.493	1466.013	2159.305	129.876	388.306
50	290.039	363.993	493.672	1451.669	2163.300	135.595	393.323
55	306.305	384.345	522.573	1453.010	2174.726	146.342	411.651
60	335.733	421.163	574.987	1471.074	2195.613	163.642	445.527
65	381.926	478.956	658.182	1507.900	2229.952	190.032	499.200

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2014 -- All model years in the range 1970 to 2014 selected
Season : Annual
Area : Los Angeles
****
****

Year: 2014 -- Model Years 1970 to 2014 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.162	0.375	0.000	0.000	0.038
5	0.050	0.068	0.085	0.247	0.173	0.303	0.070
10	0.038	0.053	0.066	0.143	0.121	0.257	0.052
15	0.030	0.041	0.053	0.075	0.089	0.228	0.039
20	0.024	0.033	0.043	0.046	0.068	0.209	0.031
25	0.019	0.028	0.036	0.038	0.054	0.197	0.025
30	0.016	0.024	0.031	0.032	0.044	0.190	0.022
35	0.014	0.021	0.028	0.027	0.038	0.188	0.019
40	0.013	0.019	0.026	0.024	0.034	0.191	0.018
45	0.012	0.018	0.024	0.022	0.031	0.198	0.017
50	0.012	0.018	0.024	0.022	0.030	0.210	0.017
55	0.013	0.019	0.025	0.022	0.029	0.230	0.017
60	0.014	0.020	0.026	0.024	0.030	0.261	0.019
65	0.015	0.022	0.028	0.027	0.031	0.308	0.021

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	970.728	5241.469	0.000	0.000	365.324
5	943.616	1184.120	1711.855	2921.245	2705.249	255.385	1202.986
10	713.117	895.126	1263.292	2436.559	2474.408	214.212	917.126
15	559.355	702.343	974.454	2058.357	2338.089	184.504	725.196
20	455.379	571.980	784.533	1791.911	2255.087	163.140	595.597
25	384.781	483.466	658.386	1689.877	2203.502	148.093	511.637
30	337.447	424.119	575.247	1609.370	2171.365	138.074	454.965
35	307.145	386.128	522.751	1547.155	2152.026	132.322	418.284
40	290.152	364.822	493.703	1501.460	2141.847	130.492	397.266
45	284.477	357.707	484.348	1471.412	2139.037	132.616	389.615
50	289.474	363.972	493.529	1456.779	2143.117	139.134	394.597
55	305.711	384.330	522.426	1457.899	2154.783	150.995	412.891
60	335.086	421.160	574.834	1475.782	2176.110	169.864	446.730
65	381.196	478.971	658.030	1512.413	2211.173	198.509	500.361

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2015 -- All model years in the range 1971 to 2015 selected
Season : Annual
Area : Los Angeles
****
****

Year: 2015 -- Model Years 1971 to 2015 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.163	0.366	0.000	0.000	0.038
5	0.047	0.066	0.082	0.221	0.170	0.301	0.067
10	0.036	0.051	0.063	0.128	0.119	0.255	0.049
15	0.028	0.039	0.050	0.067	0.087	0.226	0.037
20	0.022	0.032	0.040	0.041	0.066	0.207	0.029
25	0.018	0.026	0.034	0.034	0.053	0.195	0.024
30	0.015	0.022	0.029	0.029	0.044	0.189	0.020
35	0.013	0.020	0.026	0.025	0.037	0.187	0.018
40	0.012	0.018	0.024	0.022	0.033	0.189	0.017
45	0.011	0.017	0.023	0.020	0.031	0.196	0.016
50	0.011	0.017	0.023	0.019	0.029	0.208	0.016
55	0.012	0.017	0.023	0.020	0.029	0.228	0.016
60	0.013	0.019	0.024	0.021	0.029	0.258	0.018
65	0.014	0.021	0.026	0.024	0.030	0.304	0.020

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	983.323	5269.623	0.000	0.000	374.852
5	941.655	1184.226	1712.124	2935.877	2695.021	257.504	1205.227
10	711.625	895.174	1263.207	2448.879	2458.606	215.726	919.076
15	558.176	702.353	974.246	2068.004	2318.994	185.707	726.852
20	454.411	571.964	784.301	1799.418	2233.987	164.225	597.036
25	383.957	483.432	658.169	1696.956	2181.156	149.198	513.077
30	336.719	424.073	575.056	1615.943	2148.243	139.310	456.384
35	306.479	386.074	522.584	1553.227	2128.437	133.793	419.670
40	289.520	364.764	493.554	1507.084	2118.013	132.311	398.615
45	283.857	357.647	484.209	1476.665	2115.135	134.924	390.926
50	288.843	363.913	493.391	1461.743	2119.313	142.118	395.870
55	305.048	384.276	522.284	1462.648	2131.261	154.919	414.127
60	334.363	421.113	574.685	1480.363	2153.103	175.115	447.926
65	380.379	478.936	657.881	1516.820	2189.013	205.666	501.510

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2016 -- All model years in the range 1972 to 2016 selected
Season : Annual

Area : Los Angeles
****
Year: 2016 -- Model Years 1972 to 2016 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.162	0.357	0.000	0.000	0.038
5	0.045	0.064	0.079	0.200	0.170	0.300	0.064
10	0.034	0.049	0.061	0.115	0.118	0.254	0.047
15	0.026	0.038	0.048	0.061	0.086	0.225	0.035
20	0.020	0.030	0.038	0.037	0.066	0.206	0.027
25	0.016	0.025	0.032	0.031	0.052	0.194	0.022
30	0.014	0.021	0.028	0.026	0.043	0.188	0.019
35	0.012	0.019	0.025	0.022	0.037	0.186	0.017
40	0.011	0.017	0.023	0.020	0.033	0.188	0.016
45	0.011	0.016	0.022	0.018	0.030	0.194	0.015
50	0.010	0.016	0.021	0.018	0.029	0.206	0.015
55	0.011	0.017	0.022	0.018	0.028	0.226	0.015
60	0.012	0.018	0.023	0.019	0.028	0.255	0.016
65	0.013	0.020	0.025	0.021	0.030	0.300	0.018

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	987.247	5288.644	0.000	0.000	380.344
5	940.015	1184.317	1711.833	2946.429	2677.444	259.218	1206.425
10	710.378	895.214	1262.935	2457.694	2429.785	216.949	920.140
15	557.190	702.357	974.013	2074.862	2283.533	186.678	727.753
20	453.602	571.945	784.109	1804.717	2194.482	165.101	597.812
25	383.267	483.397	658.013	1701.931	2139.139	150.090	513.866
30	336.110	424.027	574.927	1620.544	2104.660	140.310	457.165
35	305.921	386.021	522.475	1557.464	2083.913	134.984	420.434
40	288.991	364.707	493.457	1510.998	2072.992	133.786	399.356
45	283.338	357.590	484.117	1480.312	2069.977	136.797	391.643
50	288.316	363.857	493.298	1465.186	2074.354	144.542	396.562
55	304.492	384.223	522.182	1465.941	2086.871	158.109	414.791
60	333.758	421.067	574.568	1483.544	2109.752	179.384	448.560
65	379.696	478.900	657.742	1519.889	2147.369	211.486	502.106

Title : 2007-2020
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/08/14 13:37:40
Scen Year: 2017 -- All model years in the range 1973 to 2017 selected
Season : Annual
Area : Los Angeles
****
Year: 2017 -- Model Years 1973 to 2017 Inclusive -- Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average Los Angeles County Average

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Methane Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	0.161	0.350	0.000	0.000	0.037
5	0.042	0.062	0.076	0.181	0.168	0.299	0.061
10	0.032	0.047	0.058	0.104	0.117	0.253	0.044
15	0.024	0.036	0.046	0.055	0.085	0.224	0.033
20	0.019	0.029	0.036	0.034	0.065	0.205	0.026
25	0.015	0.024	0.030	0.028	0.051	0.193	0.021
30	0.013	0.020	0.026	0.024	0.042	0.187	0.018
35	0.011	0.018	0.023	0.021	0.036	0.184	0.016
40	0.010	0.016	0.021	0.018	0.032	0.187	0.015
45	0.010	0.015	0.020	0.017	0.030	0.193	0.014
50	0.010	0.015	0.020	0.016	0.028	0.205	0.014
55	0.010	0.016	0.020	0.016	0.028	0.224	0.014
60	0.011	0.017	0.022	0.017	0.028	0.253	0.015
65	0.012	0.019	0.024	0.019	0.029	0.298	0.017

Pollutant Name: Carbon Dioxide Temperature: 60F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
0	0.000	0.000	989.320	5303.941	0.000	0.000	384.445
5	938.519	1184.362	1711.597	2955.091	2669.860	260.650	1207.262
10	709.240	895.220	1262.728	2464.923	2418.406	217.971	920.904
15	556.290	702.337	973.839	2080.481	2269.915	187.489	728.410
20	452.864	571.907	783.965	1809.054	2179.500	165.832	598.383
25	382.639	483.347	657.892	1705.999	2123.309	150.836	514.454
30	335.555	423.970	574.824	1624.304	2088.302	141.145	457.753
35	305.413	385.959	522.385	1560.925	2067.237	135.980	421.011
40	288.510	364.642	493.373	1514.193	2056.149	135.020	399.917
45	282.865	357.524	484.037	1483.290	2053.088	138.364	392.185
50	287.835	363.792	493.216	1467.995	2057.532	146.570	397.083
55	303.987	384.160	522.095	1468.629	2070.241	160.778	415.291
60	333.207	421.009	574.470	1486.141	2093.472	182.957	449.033
65	379.073	478.850	657.631	1522.396	2131.666	216.357	502.544

K-3

GREENHOUSE GAS REFERENCE MATERIAL

Appendix K-3

- Greenhouse Gas Reference Material

A report of Working Group I of the Intergovernmental Panel on Climate Change

Summary for Policymakers

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This Summary for Policymakers should be cited as:

IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Introduction

The Working Group I contribution to the IPCC Fourth Assessment Report describes progress in understanding of the human and natural drivers of climate change,[1] observed climate change, climate processes and attribution, and estimates of projected future climate change. It builds upon past IPCC assessments and incorporates new findings from the past six years of research. Scientific progress since the Third Assessment Report (TAR) is based upon large amounts of new and more comprehensive data, more sophisticated analyses of data, improvements in understanding of processes and their simulation in models and more extensive exploration of uncertainty ranges.

The basis for substantive paragraphs in this Summary for Policymakers can be found in the chapter sections specified in curly brackets.

Human and Natural Drivers of Climate Change

Changes in the atmospheric abundance of greenhouse gases and aerosols, in solar radiation and in land surface properties alter the energy balance of the climate system. These changes are expressed in terms of radiative forcing,[2] which is used to compare how a range of human and natural factors drive warming or cooling influences on global climate. Since the TAR, new observations and related modelling of greenhouse gases, solar activity, land surface properties and some aspects of aerosols have led to improvements in the quantitative estimates of radiative forcing.

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years (see Figure SPM.1). The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture. {2.3, 6.4, 7.3}

- Carbon dioxide is the most important anthropogenic greenhouse gas (see Figure SPM.2). The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm[3] in 2005. The atmospheric concentration of carbon dioxide in 2005 exceeds by far the natural range over the last 650,000 years (180 to 300 ppm) as determined from ice cores. The annual carbon dioxide concentration growth rate was larger during the last 10 years (1995–2005 average: 1.9 ppm per year), than it has been since the beginning of continuous direct atmospheric measurements (1960–2005 average: 1.4 ppm per year) although there is year-to-year variability in growth rates. {2.3, 7.3}

- The primary source of the increased atmospheric concentration of carbon dioxide since the pre-industrial period results from fossil fuel use, with land-use change providing another significant but smaller contribution. Annual fossil carbon dioxide emissions[4] increased from an average of 6.4 [6.0 to 6.8][5] GtC (23.5 [22.0 to 25.0] $GtCO_2$) per year in the 1990s to 7.2 [6.9 to 7.5] GtC (26.4 [25.3 to 27.5] $GtCO_2$) per year in 2000–2005 (2004 and 2005 data are interim estimates). Carbon dioxide emissions associated with land-use change

[1] *Climate change* in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

[2] *Radiative forcing* is a measure of the influence that a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. Positive forcing tends to warm the surface while negative forcing tends to cool it. In this report, radiative forcing values are for 2005 relative to pre-industrial conditions defined at 1750 and are expressed in watts per square metre ($W\ m^{-2}$). See Glossary and Section 2.2 for further details.

[3] ppm (parts per million) or ppb (parts per billion, 1 billion = 1,000 million) is the ratio of the number of greenhouse gas molecules to the total number of molecules of dry air. For example, 300 ppm means 300 molecules of a greenhouse gas per million molecules of dry air.

[4] Fossil carbon dioxide emissions include those from the production, distribution and consumption of fossil fuels and as a by-product from cement production. An emission of 1 GtC corresponds to 3.67 $GtCO_2$.

[5] In general, uncertainty ranges for results given in this Summary for Policymakers are 90% uncertainty intervals unless stated otherwise, that is, there is an estimated 5% likelihood that the value could be above the range given in square brackets and 5% likelihood that the value could be below that range. Best estimates are given where available. Assessed uncertainty intervals are not always symmetric about the corresponding best estimate. Note that a number of uncertainty ranges in the Working Group I TAR corresponded to 2 standard deviations (95%), often using expert judgement.

Changes in Greenhouse Gases from Ice Core and Modern Data

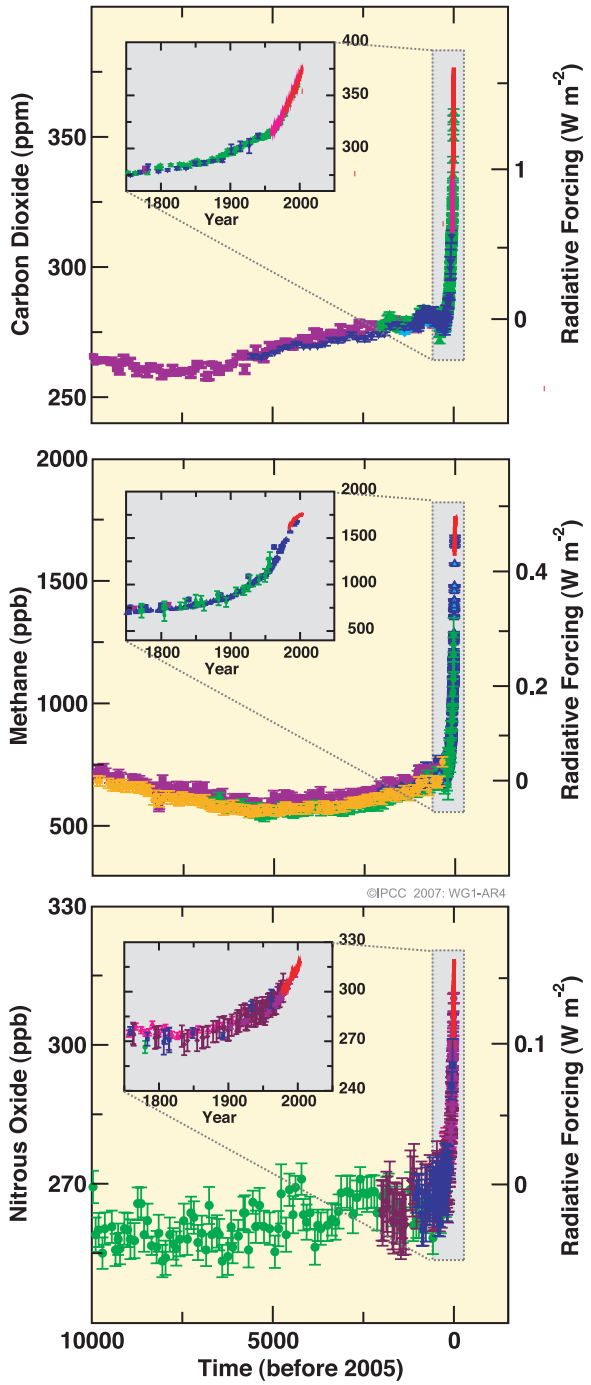

Figure SPM.1. *Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines). The corresponding radiative forcings are shown on the right hand axes of the large panels. {Figure 6.4}*

are estimated to be 1.6 [0.5 to 2.7] GtC (5.9 [1.8 to 9.9] $GtCO_2$) per year over the 1990s, although these estimates have a large uncertainty. {7.3}

- The global atmospheric concentration of methane has increased from a pre-industrial value of about 715 ppb to 1732 ppb in the early 1990s, and was 1774 ppb in 2005. The atmospheric concentration of methane in 2005 exceeds by far the natural range of the last 650,000 years (320 to 790 ppb) as determined from ice cores. Growth rates have declined since the early 1990s, consistent with total emissions (sum of anthropogenic and natural sources) being nearly constant during this period. It is *very likely*[6] that the observed increase in methane concentration is due to anthropogenic activities, predominantly agriculture and fossil fuel use, but relative contributions from different source types are not well determined. {2.3, 7.4}

- The global atmospheric nitrous oxide concentration increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005. The growth rate has been approximately constant since 1980. More than a third of all nitrous oxide emissions are anthropogenic and are primarily due to agriculture. {2.3, 7.4}

The understanding of anthropogenic warming and cooling influences on climate has improved since the TAR, leading to *very high confidence*[7] that the global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W m^{-2} (see Figure SPM.2). {2.3., 6.5, 2.9}

- The combined radiative forcing due to increases in carbon dioxide, methane, and nitrous oxide is +2.30 [+2.07 to +2.53] W m^{-2}, and its rate of increase during the industrial era is *very likely* to have been unprecedented in more than 10,000 years (see Figures

[6] In this Summary for Policymakers, the following terms have been used to indicate the assessed likelihood, using expert judgement, of an outcome or a result: *Virtually certain* > 99% probability of occurrence, *Extremely likely* > 95%, *Very likely* > 90%, *Likely* > 66%, *More likely than not* > 50%, *Unlikely* < 33%, *Very unlikely* < 10%, *Extremely unlikely* < 5% (see Box TS.1 for more details).

[7] In this Summary for Policymakers the following levels of confidence have been used to express expert judgements on the correctness of the underlying science: *very high confidence* represents at least a 9 out of 10 chance of being correct; *high confidence* represents about an 8 out of 10 chance of being correct (see Box TS.1)

SPM.1 and SPM.2). The carbon dioxide radiative forcing increased by 20% from 1995 to 2005, the largest change for any decade in at least the last 200 years. {2.3, 6.4}

- Anthropogenic contributions to aerosols (primarily sulphate, organic carbon, black carbon, nitrate and dust) together produce a cooling effect, with a total direct radiative forcing of –0.5 [–0.9 to –0.1] W m^{-2} and an indirect cloud albedo forcing of –0.7 [–1.8 to –0.3] W m^{-2}. These forcings are now better understood than at the time of the TAR due to improved *in situ*, satellite and ground-based measurements and more comprehensive modelling, but remain the dominant uncertainty in radiative forcing. Aerosols also influence cloud lifetime and precipitation. {2.4, 2.9, 7.5}

- Significant anthropogenic contributions to radiative forcing come from several other sources. Tropospheric ozone changes due to emissions of ozone-forming chemicals (nitrogen oxides, carbon monoxide, and hydrocarbons) contribute +0.35 [+0.25 to +0.65] W m^{-2}. The direct radiative forcing due to changes in halocarbons[8] is +0.34 [+0.31 to +0.37] W m^{-2}. Changes in surface albedo, due to land cover changes and deposition of black carbon aerosols on snow, exert

Radiative Forcing Components

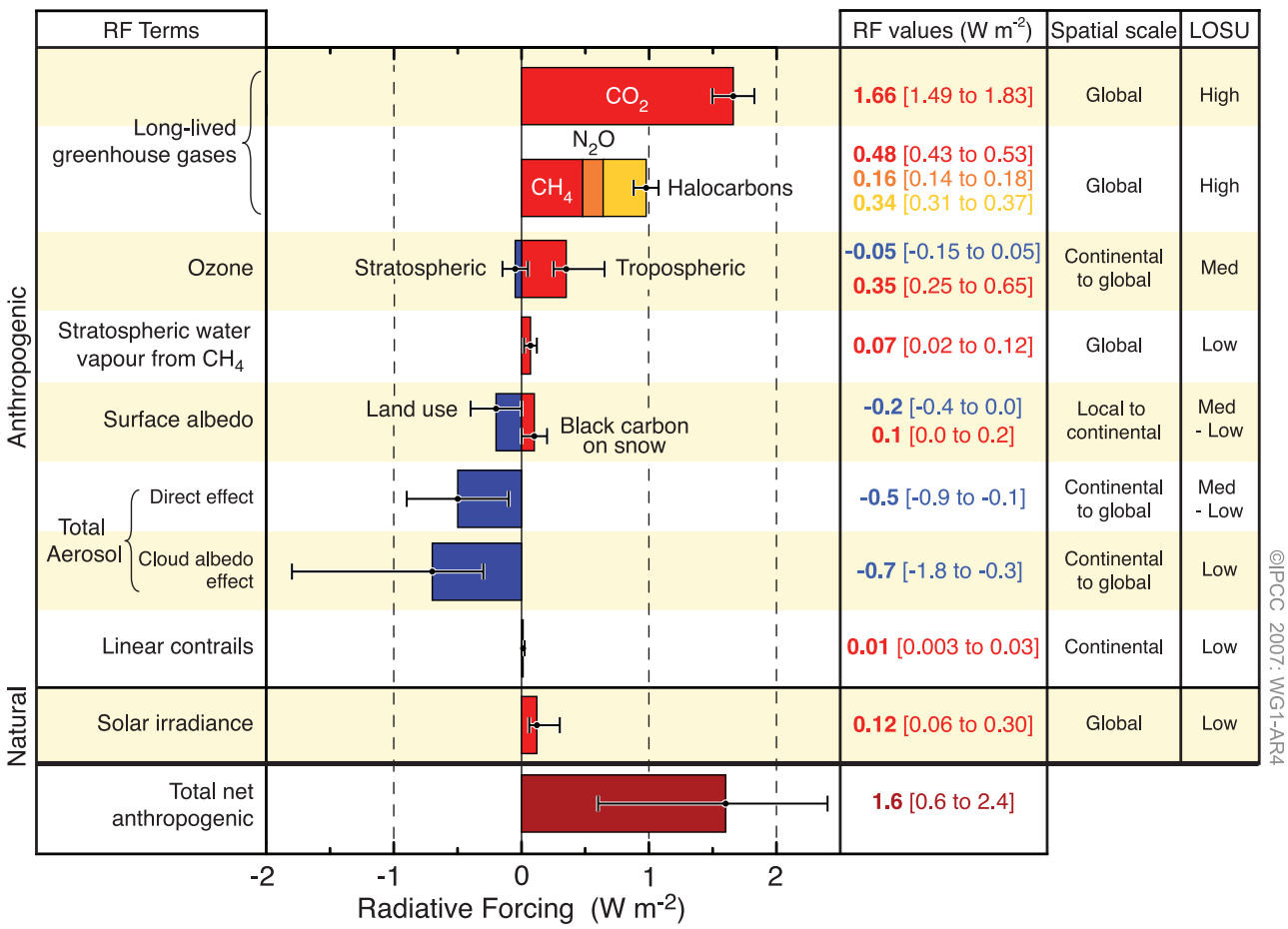

Figure SPM.2. *Global average radiative forcing (RF) estimates and ranges in 2005 for anthropogenic carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net anthropogenic radiative forcing and its range are also shown. These require summing asymmetric uncertainty estimates from the component terms, and cannot be obtained by simple addition. Additional forcing factors not included here are considered to have a very low LOSU. Volcanic aerosols contribute an additional natural forcing but are not included in this figure due to their episodic nature. The range for linear contrails does not include other possible effects of aviation on cloudiness. {2.9, Figure 2.20}*

[8] Halocarbon radiative forcing has been recently assessed in detail in *IPCC's Special Report on Safeguarding the Ozone Layer and the Global Climate System* (2005).

respective forcings of –0.2 [–0.4 to 0.0] and +0.1 [0.0 to +0.2] W m^{-2}. Additional terms smaller than ±0.1 W m^{-2} are shown in Figure SPM.2. {2.3, 2.5, 7.2}

- Changes in solar irradiance since 1750 are estimated to cause a radiative forcing of +0.12 [+0.06 to +0.30] W m^{-2}, which is less than half the estimate given in the TAR. {2.7}

Direct Observations of Recent Climate Change

Since the TAR, progress in understanding how climate is changing in space and in time has been gained through improvements and extensions of numerous datasets and data analyses, broader geographical coverage, better understanding of uncertainties, and a wider variety of measurements. Increasingly comprehensive observations are available for glaciers and snow cover since the 1960s, and for sea level and ice sheets since about the past decade. However, data coverage remains limited in some regions.

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (see Figure SPM.3). {3.2, 4.2, 5.5}

- Eleven of the last twelve years (1995–2006) rank among the 12 warmest years in the instrumental record of global surface temperature[9] (since 1850). The updated 100-year linear trend (1906 to 2005) of 0.74°C [0.56°C to 0.92°C] is therefore larger than the corresponding trend for 1901 to 2000 given in the TAR of 0.6°C [0.4°C to 0.8°C]. The linear warming trend over the last 50 years (0.13°C [0.10°C to 0.16°C] per decade) is nearly twice that for the last 100 years. The total temperature increase from 1850–1899 to 2001–2005 is 0.76°C [0.57°C to 0.95°C]. Urban heat island effects are real but local, and have a negligible influence (less than 0.006°C per decade over land and zero over the oceans) on these values. {3.2}

- New analyses of balloon-borne and satellite measurements of lower- and mid-tropospheric temperature show warming rates that are similar to those of the surface temperature record and are consistent within their respective uncertainties, largely reconciling a discrepancy noted in the TAR. {3.2, 3.4}

- The average atmospheric water vapour content has increased since at least the 1980s over land and ocean as well as in the upper troposphere. The increase is broadly consistent with the extra water vapour that warmer air can hold. {3.4}

- Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000 m and that the ocean has been absorbing more than 80% of the heat added to the climate system. Such warming causes seawater to expand, contributing to sea level rise (see Table SPM.1). {5.2, 5.5}

- Mountain glaciers and snow cover have declined on average in both hemispheres. Widespread decreases in glaciers and ice caps have contributed to sea level rise (ice caps do not include contributions from the Greenland and Antarctic Ice Sheets). (See Table SPM.1.) {4.6, 4.7, 4.8, 5.5}

- New data since the TAR now show that losses from the ice sheets of Greenland and Antarctica have *very likely* contributed to sea level rise over 1993 to 2003 (see Table SPM.1). Flow speed has increased for some Greenland and Antarctic outlet glaciers, which drain ice from the interior of the ice sheets. The corresponding increased ice sheet mass loss has often followed thinning, reduction or loss of ice shelves or loss of floating glacier tongues. Such dynamical ice loss is sufficient to explain most of the Antarctic net mass loss and approximately half of the Greenland net mass loss. The remainder of the ice loss from Greenland has occurred because losses due to melting have exceeded accumulation due to snowfall. {4.6, 4.8, 5.5}

- Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 [2.4 to 3.8] mm per year. Whether the faster rate for 1993 to 2003 reflects decadal variability or an increase in the longer-term trend is unclear. There is *high confidence* that

[9] The average of near-surface air temperature over land and sea surface temperature.

Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover

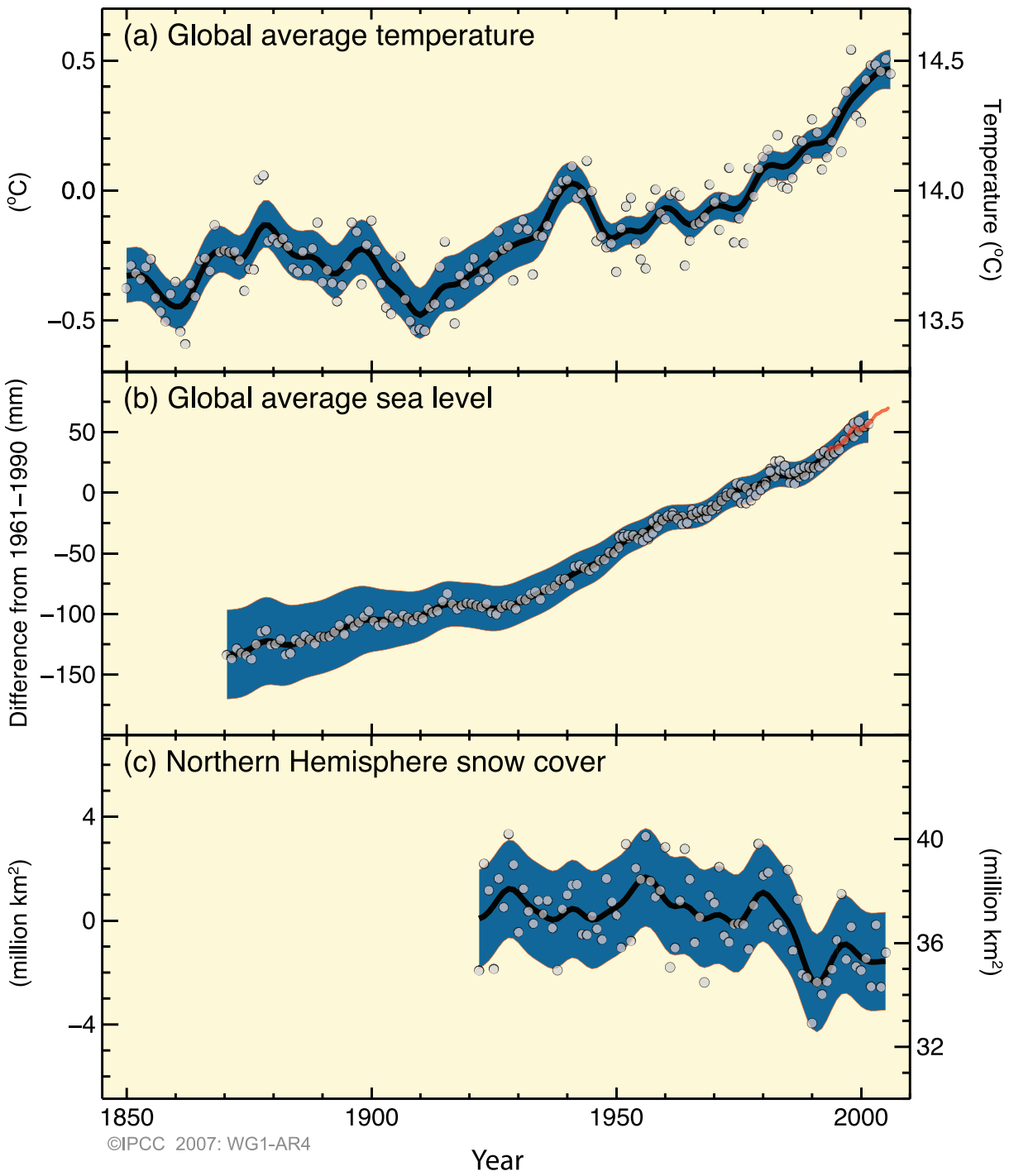

Figure SPM.3. *Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c). {FAQ 3.1, Figure 1, Figure 4.2, Figure 5.13}*

the rate of observed sea level rise increased from the 19th to the 20th century. The total 20th-century rise is estimated to be 0.17 [0.12 to 0.22] m. {5.5}

- For 1993 to 2003, the sum of the climate contributions is consistent within uncertainties with the total sea level rise that is directly observed (see Table SPM.1). These estimates are based on improved satellite and *in situ* data now available. For the period 1961 to 2003, the sum of climate contributions is estimated to be smaller than the observed sea level rise. The TAR reported a similar discrepancy for 1910 to 1990. {5.5}

At continental, regional and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones.[10] {3.2, 3.3, 3.4, 3.5, 3.6, 5.2}

- Average arctic temperatures increased at almost twice the global average rate in the past 100 years. Arctic temperatures have high decadal variability, and a warm period was also observed from 1925 to 1945. {3.2}

- Satellite data since 1978 show that annual average arctic sea ice extent has shrunk by 2.7 [2.1 to 3.3]% per decade, with larger decreases in summer of 7.4 [5.0 to 9.8]% per decade. These values are consistent with those reported in the TAR. {4.4}

- Temperatures at the top of the permafrost layer have generally increased since the 1980s in the Arctic (by up to 3°C). The maximum area covered by seasonally frozen ground has decreased by about 7% in the Northern Hemisphere since 1900, with a decrease in spring of up to 15%. {4.7}

- Long-term trends from 1900 to 2005 have been observed in precipitation amount over many large regions.[11] Significantly increased precipitation has been observed in eastern parts of North and South America, northern Europe and northern and central Asia. Drying has been observed in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. Precipitation is highly variable spatially and temporally, and data are limited in some regions. Long-term trends have not been observed for the other large regions assessed.[11] {3.3, 3.9}

- Changes in precipitation and evaporation over the oceans are suggested by freshening of mid- and high-latitude waters together with increased salinity in low-latitude waters. {5.2}

Table SPM.1. *Observed rate of sea level rise and estimated contributions from different sources. {5.5, Table 5.3}*

Source of sea level rise	Rate of sea level rise (mm per year) 1961–2003	1993–2003
Thermal expansion	0.42 ± 0.12	1.6 ± 0.5
Glaciers and ice caps	0.50 ± 0.18	0.77 ± 0.22
Greenland Ice Sheet	0.05 ± 0.12	0.21 ± 0.07
Antarctic Ice Sheet	0.14 ± 0.41	0.21 ± 0.35
Sum of individual climate contributions to sea level rise	1.1 ± 0.5	2.8 ± 0.7
Observed total sea level rise	1.8 ± 0.5[a]	3.1 ± 0.7[a]
Difference (Observed minus sum of estimated climate contributions)	0.7 ± 0.7	0.3 ± 1.0

Table note:
[a] Data prior to 1993 are from tide gauges and after 1993 are from satellite altimetry.

[10] Tropical cyclones include hurricanes and typhoons.

[11] The assessed regions are those considered in the regional projections chapter of the TAR and in Chapter 11 of this report.

- Mid-latitude westerly winds have strengthened in both hemispheres since the 1960s. {3.5}

- More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics. Increased drying linked with higher temperatures and decreased precipitation has contributed to changes in drought. Changes in sea surface temperatures, wind patterns and decreased snowpack and snow cover have also been linked to droughts. {3.3}

- The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapour. {3.8, 3.9}

- Widespread changes in extreme temperatures have been observed over the last 50 years. Cold days, cold nights and frost have become less frequent, while hot days, hot nights and heat waves have become more frequent (see Table SPM.2). {3.8}

Table SPM.2. *Recent trends, assessment of human influence on the trend and projections for extreme weather events for which there is an observed late-20th century trend. {Tables 3.7, 3.8, 9.4; Sections 3.8, 5.5, 9.7, 11.2–11.9}*

Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

Table notes:

[a] See Table 3.7 for further details regarding definitions.

[b] See Table TS.4, Box TS.5 and Table 9.4.

[c] Decreased frequency of cold days and nights (coldest 10%).

[d] Warming of the most extreme days and nights each year.

[e] Increased frequency of hot days and nights (hottest 10%).

[f] Magnitude of anthropogenic contributions not assessed. Attribution for these phenomena based on expert judgement rather than formal attribution studies.

[g] Extreme high sea level depends on average sea level and on regional weather systems. It is defined here as the highest 1% of hourly values of observed sea level at a station for a given reference period.

[h] Changes in observed extreme high sea level closely follow the changes in average sea level. {5.5} It is *very likely* that anthropogenic activity contributed to a rise in average sea level. {9.5}

[i] In all scenarios, the projected global average sea level at 2100 is higher than in the reference period. {10.6} The effect of changes in regional weather systems on sea level extremes has not been assessed.

- There is observational evidence for an increase in intense tropical cyclone activity in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures. There are also suggestions of increased intense tropical cyclone activity in some other regions where concerns over data quality are greater. Multi-decadal variability and the quality of the tropical cyclone records prior to routine satellite observations in about 1970 complicate the detection of long-term trends in tropical cyclone activity. There is no clear trend in the annual numbers of tropical cyclones. {3.8}

Some aspects of climate have not been observed to change. {3.2, 3.8, 4.4, 5.3}

- A decrease in diurnal temperature range (DTR) was reported in the TAR, but the data available then extended only from 1950 to 1993. Updated observations reveal that DTR has not changed from 1979 to 2004 as both day- and night-time temperature have risen at about the same rate. The trends are highly variable from one region to another. {3.2}

- Antarctic sea ice extent continues to show interannual variability and localised changes but no statistically significant average trends, consistent with the lack of warming reflected in atmospheric temperatures averaged across the region. {3.2, 4.4}

- There is insufficient evidence to determine whether trends exist in the meridional overturning circulation (MOC) of the global ocean or in small-scale phenomena such as tornadoes, hail, lightning and dust-storms. {3.8, 5.3}

A Palaeoclimatic Perspective

Palaeoclimatic studies use changes in climatically sensitive indicators to infer past changes in global climate on time scales ranging from decades to millions of years. Such proxy data (e.g., tree ring width) may be influenced by both local temperature and other factors such as precipitation, and are often representative of particular seasons rather than full years. Studies since the TAR draw increased confidence from additional data showing coherent behaviour across multiple indicators in different parts of the world. However, uncertainties generally increase with time into the past due to increasingly limited spatial coverage.

Palaeoclimatic information supports the interpretation that the warmth of the last half century is unusual in at least the previous 1,300 years. The last time the polar regions were significantly warmer than present for an extended period (about 125,000 years ago), reductions in polar ice volume led to 4 to 6 m of sea level rise. {6.4, 6.6}

- Average Northern Hemisphere temperatures during the second half of the 20th century were *very likely* higher than during any other 50-year period in the last 500 years and *likely* the highest in at least the past 1,300 years. Some recent studies indicate greater variability in Northern Hemisphere temperatures than suggested in the TAR, particularly finding that cooler periods existed in the 12th to 14th, 17th and 19th centuries. Warmer periods prior to the 20th century are within the uncertainty range given in the TAR. {6.6}

- Global average sea level in the last interglacial period (about 125,000 years ago) was *likely* 4 to 6 m higher than during the 20th century, mainly due to the retreat of polar ice. Ice core data indicate that average polar temperatures at that time were 3°C to 5°C higher than present, because of differences in the Earth's orbit. The Greenland Ice Sheet and other arctic ice fields *likely* contributed no more than 4 m of the observed sea level rise. There may also have been a contribution from Antarctica. {6.4}

Understanding and Attributing Climate Change

This assessment considers longer and improved records, an expanded range of observations and improvements in the simulation of many aspects of climate and its variability based on studies since the TAR. It also considers the results of new attribution studies that have evaluated whether observed changes are quantitatively consistent with the expected response to external forcings and inconsistent with alternative physically plausible explanations.

Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.[12] This is an advance since the TAR's conclusion that "most of the observed warming over the last 50 years is *likely* to have been due to the increase in greenhouse gas concentrations". Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns (see Figure SPM.4 and Table SPM.2). {9.4, 9.5}

- It is *likely* that increases in greenhouse gas concentrations alone would have caused more warming than observed because volcanic and anthropogenic aerosols have offset some warming that would otherwise have taken place. {2.9, 7.5, 9.4}

- The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is *extremely unlikely* that global climate change of the past 50 years can be explained without external forcing, and *very likely* that it is not due to known natural causes alone. {4.8, 5.2, 9.4, 9.5, 9.7}

- Warming of the climate system has been detected in changes of surface and atmospheric temperatures in the upper several hundred metres of the ocean, and in contributions to sea level rise. Attribution studies have established anthropogenic contributions to all of these changes. The observed pattern of tropospheric warming and stratospheric cooling is *very likely* due to the combined influences of greenhouse gas increases and stratospheric ozone depletion. {3.2, 3.4, 9.4, 9.5}

- It is *likely* that there has been significant anthropogenic warming over the past 50 years averaged over each continent except Antarctica (see Figure SPM.4). The observed patterns of warming, including greater warming over land than over the ocean, and their changes over time, are only simulated by models that include anthropogenic forcing. The ability of coupled climate models to simulate the observed temperature evolution on each of six continents provides stronger evidence of human influence on climate than was available in the TAR. {3.2, 9.4}

- Difficulties remain in reliably simulating and attributing observed temperature changes at smaller scales. On these scales, natural climate variability is relatively larger, making it harder to distinguish changes expected due to external forcings. Uncertainties in local forcings and feedbacks also make it difficult to estimate the contribution of greenhouse gas increases to observed small-scale temperature changes. {8.3, 9.4}

- Anthropogenic forcing is *likely* to have contributed to changes in wind patterns,[13] affecting extra-tropical storm tracks and temperature patterns in both hemispheres. However, the observed changes in the Northern Hemisphere circulation are larger than simulated in response to 20th-century forcing change. {3.5, 3.6, 9.5, 10.3}

- Temperatures of the most extreme hot nights, cold nights and cold days are *likely* to have increased due to anthropogenic forcing. It is *more likely than not* that anthropogenic forcing has increased the risk of heat waves (see Table SPM.2). {9.4}

[12] Consideration of remaining uncertainty is based on current methodologies.

[13] In particular, the Southern and Northern Annular Modes and related changes in the North Atlantic Oscillation. {3.6, 9.5, Box TS.2}

Global and Continental Temperature Change

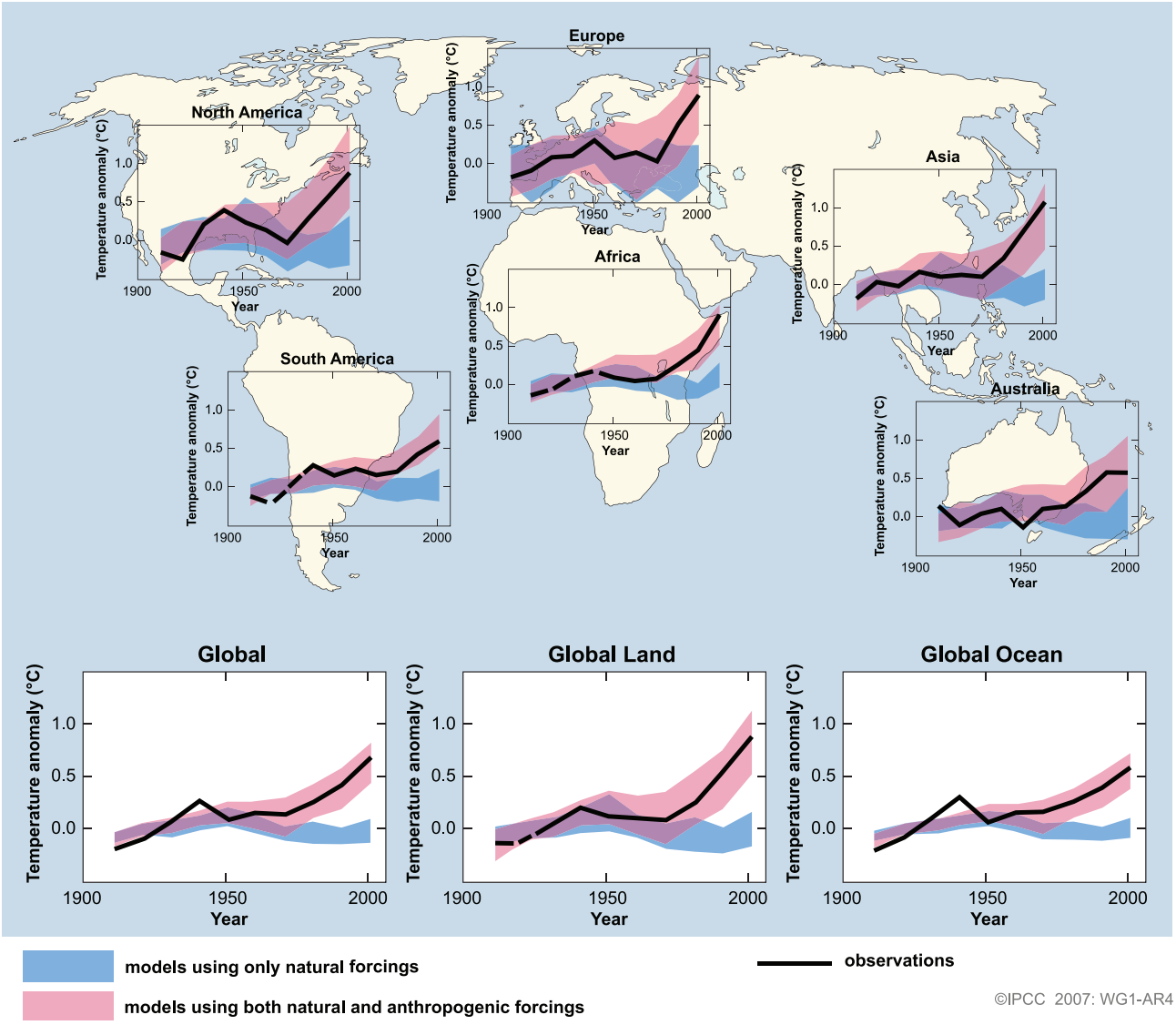

Figure SPM.4. *Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906 to 2005 (black line) plotted against the centre of the decade and relative to the corresponding average for 1901–1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5–95% range for 19 simulations from five climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5–95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings. {FAQ 9.2, Figure 1}*

Analysis of climate models together with constraints from observations enables an assessed *likely* range to be given for climate sensitivity for the first time and provides increased confidence in the understanding of the climate system response to radiative forcing. {6.6, 8.6, 9.6, Box 10.2}

- The equilibrium climate sensitivity is a measure of the climate system response to sustained radiative forcing. It is not a projection but is defined as the global average surface warming following a doubling of carbon dioxide concentrations. It is *likely* to be in the range 2°C to 4.5°C with a best estimate of about 3°C, and is *very unlikely* to be less than 1.5°C. Values substantially higher than 4.5°C cannot be excluded, but agreement of models with observations is not as good for those values. Water vapour changes represent the largest feedback affecting climate sensitivity and are now better understood than in the TAR. Cloud feedbacks remain the largest source of uncertainty. {8.6, 9.6, Box 10.2}

- It is *very unlikely* that climate changes of at least the seven centuries prior to 1950 were due to variability generated within the climate system alone. A significant fraction of the reconstructed Northern Hemisphere inter-decadal temperature variability over those centuries is *very likely* attributable to volcanic eruptions and changes in solar irradiance, and it is *likely* that anthropogenic forcing contributed to the early 20th-century warming evident in these records. {2.7, 2.8, 6.6, 9.3}

Projections of Future Changes in Climate

A major advance of this assessment of climate change projections compared with the TAR is the large number of simulations available from a broader range of models. Taken together with additional information from observations, these provide a quantitative basis for estimating likelihoods for many aspects of future climate change. Model simulations cover a range of possible futures including idealised emission or concentration assumptions. These include SRES[14] illustrative marker scenarios for the 2000 to 2100 period and model experiments with greenhouse gases and aerosol concentrations held constant after year 2000 or 2100.

For the next two decades, a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. {10.3, 10.7}

- Since IPCC's first report in 1990, assessed projections have suggested global average temperature increases between about 0.15°C and 0.3°C per decade for 1990 to 2005. This can now be compared with observed values of about 0.2°C per decade, strengthening confidence in near-term projections. {1.2, 3.2}

- Model experiments show that even if all radiative forcing agents were held constant at year 2000 levels, a further warming trend would occur in the next two decades at a rate of about 0.1°C per decade, due mainly to the slow response of the oceans. About twice as much warming (0.2°C per decade) would be expected if emissions are within the range of the SRES scenarios. Best-estimate projections from models indicate that decadal average warming over each inhabited continent by 2030 is insensitive to the choice among SRES scenarios and is *very likely* to be at least twice as large as the corresponding model-estimated natural variability during the 20th century. {9.4, 10.3, 10.5, 11.2–11.7, Figure TS-29}

[14] SRES refers to the *IPCC Special Report on Emission Scenarios* (2000). The SRES scenario families and illustrative cases, which did not include additional climate initiatives, are summarised in a box at the end of this Summary for Policymakers. Approximate carbon dioxide equivalent concentrations corresponding to the computed radiative forcing due to anthropogenic greenhouse gases and aerosols in 2100 (see p. 823 of the TAR) for the SRES B1, A1T, B2, A1B, A2 and A1FI illustrative marker scenarios are about 600, 700, 800, 850, 1250 and 1,550 ppm respectively. Scenarios B1, A1B and A2 have been the focus of model intercomparison studies and many of those results are assessed in this report.

Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century. {10.3}

- Advances in climate change modelling now enable best estimates and *likely* assessed uncertainty ranges to be given for projected warming for different emission scenarios. Results for different emission scenarios are provided explicitly in this report to avoid loss of this policy-relevant information. Projected global average surface warmings for the end of the 21st century (2090–2099) relative to 1980–1999 are shown in Table SPM.3. These illustrate the differences between lower and higher SRES emission scenarios, and the projected warming uncertainty associated with these scenarios. {10.5}

- Best estimates and *likely* ranges for global average surface air warming for six SRES emissions marker scenarios are given in this assessment and are shown in Table SPM.3. For example, the best estimate for the low scenario (B1) is 1.8°C (*likely* range is 1.1°C to 2.9°C), and the best estimate for the high scenario (A1FI) is 4.0°C (*likely* range is 2.4°C to 6.4°C). Although these projections are broadly consistent with the span quoted in the TAR (1.4°C to 5.8°C), they are not directly comparable (see Figure SPM.5). The Fourth Assessment Report is more advanced as it provides best estimates and an assessed likelihood range for each of the marker scenarios. The new assessment of the *likely* ranges now relies on a larger number of climate models of increasing complexity and realism, as well as new information regarding the nature of feedbacks from the carbon cycle and constraints on climate response from observations. {10.5}

- Warming tends to reduce land and ocean uptake of atmospheric carbon dioxide, increasing the fraction of anthropogenic emissions that remains in the atmosphere. For the A2 scenario, for example, the climate-carbon cycle feedback increases the corresponding global average warming at 2100 by more than 1°C. Assessed upper ranges for temperature projections are larger than in the TAR (see Table SPM.3) mainly because the broader range of models now available suggests stronger climate-carbon cycle feedbacks. {7.3, 10.5}

- Model-based projections of global average sea level rise at the end of the 21st century (2090–2099) are shown in Table SPM.3. For each scenario, the midpoint of the range in Table SPM.3 is within 10% of the

Table SPM.3. *Projected global average surface warming and sea level rise at the end of the 21st century. {10.5, 10.6, Table 10.7}*

	Temperature Change (°C at 2090-2099 relative to 1980-1999)[a]		Sea Level Rise (m at 2090-2099 relative to 1980-1999)
Case	Best estimate	*Likely* range	Model-based range excluding future rapid dynamical changes in ice flow
Constant Year 2000 concentrations[b]	0.6	0.3 – 0.9	NA
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Table notes:
[a] These estimates are assessed from a hierarchy of models that encompass a simple climate model, several Earth System Models of Intermediate Complexity and a large number of Atmosphere-Ocean General Circulation Models (AOGCMs).
[b] Year 2000 constant composition is derived from AOGCMs only.

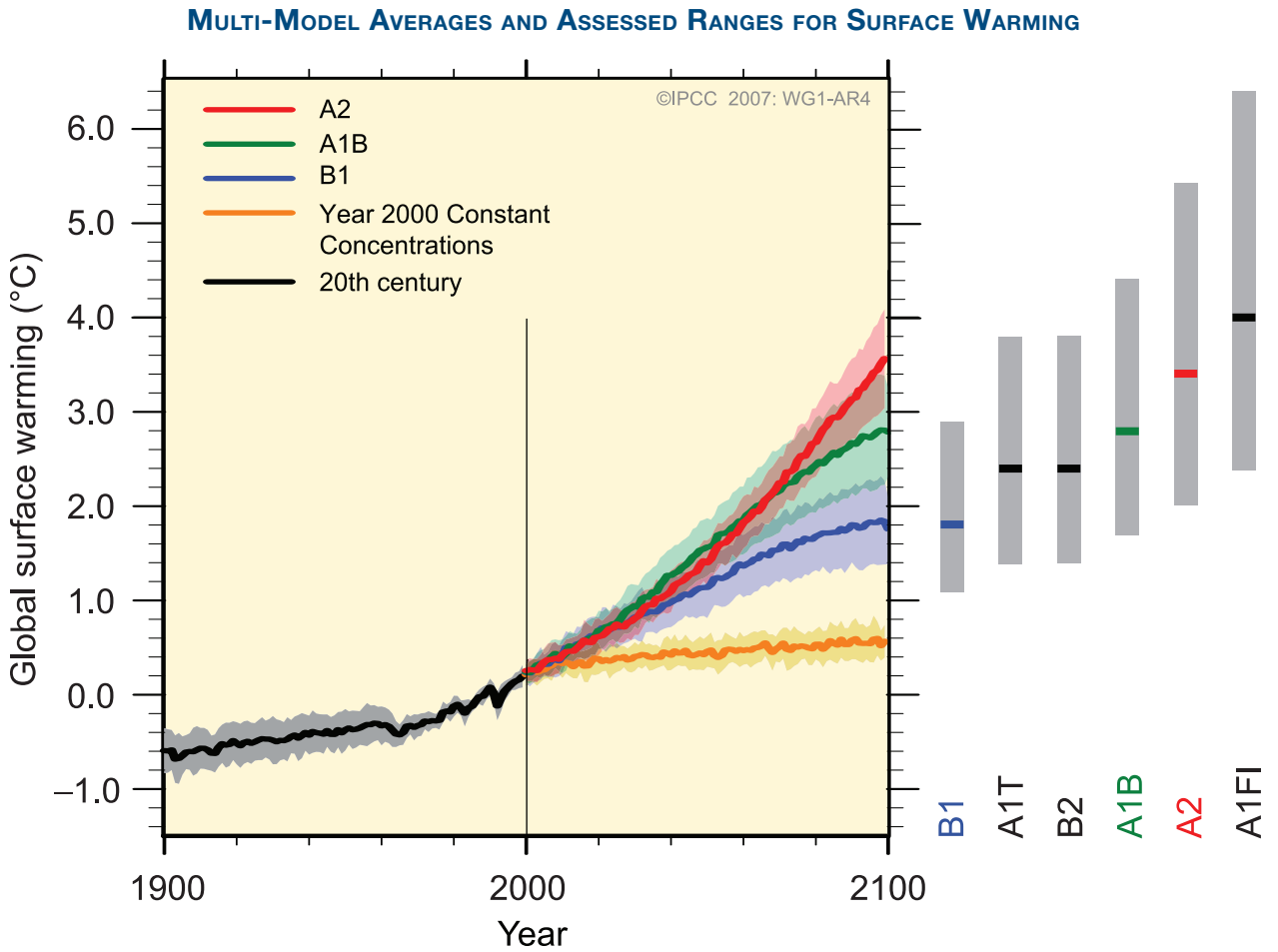

Figure SPM.5. *Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at right indicate the best estimate (solid line within each bar) and the* ***likely*** *range assessed for the six SRES marker scenarios. The assessment of the best estimate and* ***likely*** *ranges in the grey bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints. {Figures 10.4 and 10.29}*

TAR model average for 2090–2099. The ranges are narrower than in the TAR mainly because of improved information about some uncertainties in the projected contributions.[15] {10.6}

- Models used to date do not include uncertainties in climate-carbon cycle feedback nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking. The projections include a contribution due to increased ice flow from Greenland and Antarctica at the rates observed for 1993 to 2003, but these flow rates could increase or decrease in the future. For example, if this contribution were to grow linearly with global average temperature change, the upper ranges of sea level rise for SRES scenarios shown in Table SPM.3 would increase by 0.1 to 0.2 m. Larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea level rise. {10.6}

- Increasing atmospheric carbon dioxide concentrations lead to increasing acidification of the ocean. Projections based on SRES scenarios give reductions in average global surface ocean pH[16] of between 0.14 and 0.35 units over the 21st century, adding to the present decrease of 0.1 units since pre-industrial times. {5.4, Box 7.3, 10.4}

[15] TAR projections were made for 2100, whereas projections in this report are for 2090–2099. The TAR would have had similar ranges to those in Table SPM.3 if it had treated the uncertainties in the same way.

[16] Decreases in pH correspond to increases in acidity of a solution. See Glossary for further details.

There is now higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation and some aspects of extremes and of ice. {8.2, 8.3, 8.4, 8.5, 9.4, 9.5, 10.3, 11.1}

- Projected warming in the 21st century shows scenario-independent geographical patterns similar to those observed over the past several decades. Warming is expected to be greatest over land and at most high northern latitudes, and least over the Southern Ocean and parts of the North Atlantic Ocean (see Figure SPM.6). {10.3}

- Snow cover is projected to contract. Widespread increases in thaw depth are projected over most permafrost regions. {10.3, 10.6}

- Sea ice is projected to shrink in both the Arctic and Antarctic under all SRES scenarios. In some projections, arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century. {10.3}

- It is *very likely* that hot extremes, heat waves and heavy precipitation events will continue to become more frequent. {10.3}

- Based on a range of models, it is *likely* that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea surface temperatures. There is less confidence in projections of a global decrease in numbers of tropical cyclones. The apparent increase in the proportion of very intense storms since 1970 in some regions is much larger than simulated by current models for that period. {9.5, 10.3, 3.8}

Projections of Surface Temperatures

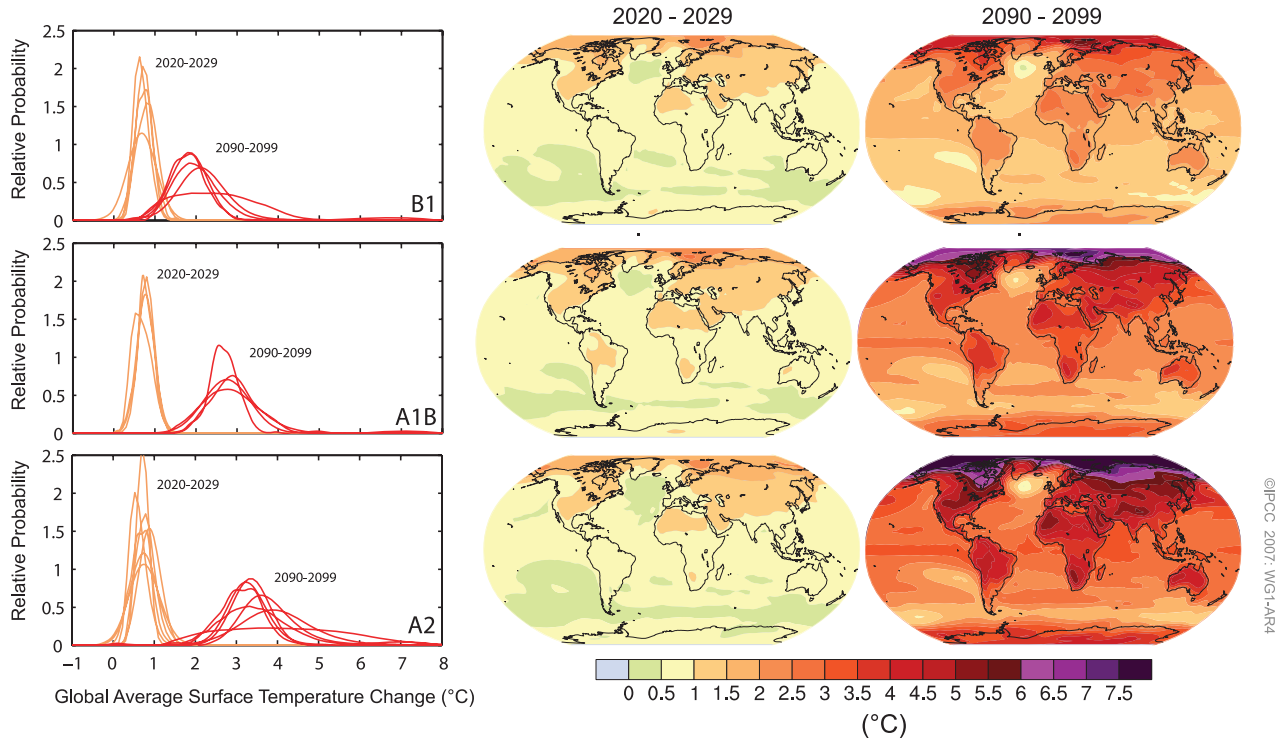

Figure SPM.6. *Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the AOGCM multi-model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over the decades 2020–2029 (centre) and 2090–2099 (right). The left panels show corresponding uncertainties as the relative probabilities of estimated global average warming from several different AOGCM and Earth System Model of Intermediate Complexity studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves shown in the left-hand panels is due only to differences in the availability of results. {Figures 10.8 and 10.28}*

Projected Patterns of Precipitation Changes

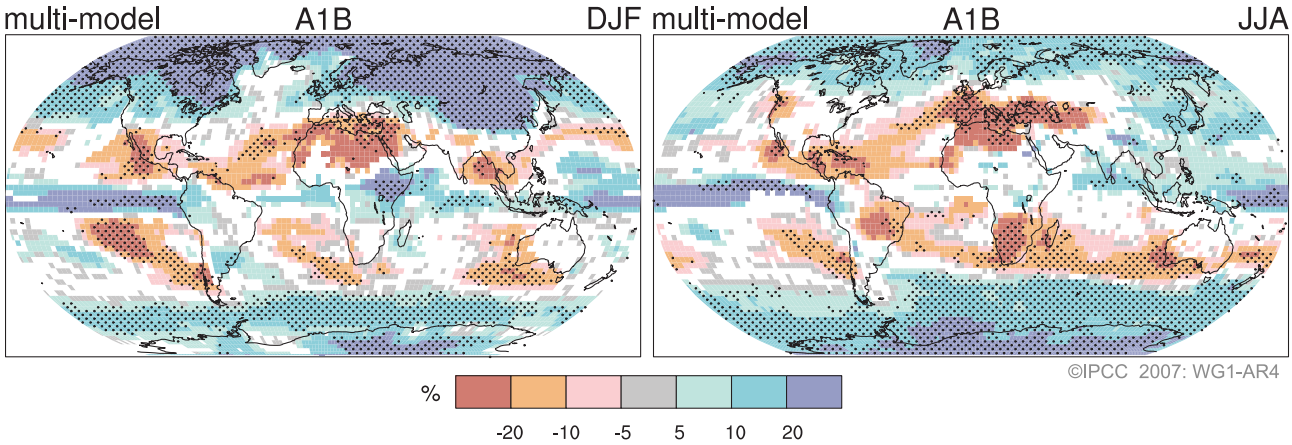

Figure SPM.7. *Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. {Figure 10.9}*

- Extratropical storm tracks are projected to move poleward, with consequent changes in wind, precipitation and temperature patterns, continuing the broad pattern of observed trends over the last half-century. {3.6, 10.3}

- Since the TAR, there is an improving understanding of projected patterns of precipitation. Increases in the amount of precipitation are *very likely* in high latitudes, while decreases are *likely* in most subtropical land regions (by as much as about 20% in the A1B scenario in 2100, see Figure SPM.7), continuing observed patterns in recent trends. {3.3, 8.3, 9.5, 10.3, 11.2 to 11.9}

- Based on current model simulations, it is *very likely* that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century. The multi-model average reduction by 2100 is 25% (range from zero to about 50%) for SRES emission scenario A1B. Temperatures in the Atlantic region are projected to increase despite such changes due to the much larger warming associated with projected increases in greenhouse gases. It is *very unlikely* that the MOC will undergo a large abrupt transition during the 21st century. Longer-term changes in the MOC cannot be assessed with confidence. {10.3, 10.7}

Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilised. {10.4, 10.5, 10.7}

- Climate-carbon cycle coupling is expected to add carbon dioxide to the atmosphere as the climate system warms, but the magnitude of this feedback is uncertain. This increases the uncertainty in the trajectory of carbon dioxide emissions required to achieve a particular stabilisation level of atmospheric carbon dioxide concentration. Based on current understanding of climate-carbon cycle feedback, model studies suggest that to stabilise at 450 ppm carbon dioxide could require that cumulative emissions over the 21st century be reduced from an average of approximately 670 [630 to 710] GtC (2460 [2310 to 2600] $GtCO_2$) to approximately 490 [375 to 600] GtC (1800 [1370 to 2200] $GtCO_2$). Similarly, to stabilise at 1000 ppm, this feedback could require that cumulative emissions be reduced from a model average of approximately 1415 [1340 to 1490] GtC (5190 [4910 to 5460] $GtCO_2$) to approximately 1100 [980 to 1250] GtC (4030 [3590 to 4580] $GtCO_2$). {7.3, 10.4}

- If radiative forcing were to be stabilised in 2100 at B1 or A1B levels[14] a further increase in global average temperature of about 0.5°C would still be expected, mostly by 2200. {10.7}

- If radiative forcing were to be stabilised in 2100 at A1B levels[14], thermal expansion alone would lead to 0.3 to 0.8 m of sea level rise by 2300 (relative to 1980–1999). Thermal expansion would continue for many centuries, due to the time required to transport heat into the deep ocean. {10.7}

- Contraction of the Greenland Ice Sheet is projected to continue to contribute to sea level rise after 2100. Current models suggest that ice mass losses increase with temperature more rapidly than gains due to precipitation and that the surface mass balance becomes negative at a global average warming (relative to pre-industrial values) in excess of 1.9°C to 4.6°C. If a negative surface mass balance were sustained for millennia, that would lead to virtually complete elimination of the Greenland Ice Sheet and a resulting contribution to sea level rise of about 7 m. The corresponding future temperatures in Greenland are comparable to those inferred for the last interglacial period 125,000 years ago, when palaeoclimatic information suggests reductions of polar land ice extent and 4 to 6 m of sea level rise. {6.4, 10.7}

- Dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude. {4.6, 10.7}

- Current global model studies project that the Antarctic Ice Sheet will remain too cold for widespread surface melting and is expected to gain in mass due to increased snowfall. However, net loss of ice mass could occur if dynamical ice discharge dominates the ice sheet mass balance. {10.7}

- Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium, due to the time scales required for removal of this gas from the atmosphere. {7.3, 10.3}

The Emission Scenarios of the IPCC Special Report on Emission Scenarios (SRES)[17]

A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1. The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

An illustrative scenario was chosen for each of the six scenario groups A1B, A1FI, A1T, A2, B1 and B2. All should be considered equally sound.

The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol.

[17] Emission scenarios are not assessed in this Working Group I Report of the IPCC. This box summarising the SRES scenarios is taken from the TAR and has been subject to prior line-by-line approval by the Panel.

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Climate Action Team Report to Governor Schwarzenegger and the Legislature

March 2006

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TABLE OF CONTENTS

1 INTRODUCTION 5
1.1 Organization of the Report 5
2 CLIMATE CHANGE OVERVIEW 6
2.1 Climate Change Causes and Projections 6
2.2 Climate Change Emission Sources and Pollutants 9
2.3 Global Warming Potentials 13
2.4 Abrupt Climate Change 15
2.5 Summary 15
3 CALIFORNIA ACTIONS TO ADDRESS CLIMATE CHANGE 16
3.1 Summary of California Activities Underway 16
3.2 Executive Order S-3-05 18
3.3 Climate Action Team 19
4 SCENARIO ANALYSIS 19
4.1 Climate Change Scenarios 22
4.2 Public Health Impacts 25
4.3 Water Resources Impacts 28
4.4 Agriculture Impacts 29
4.5 Coastal Sea Level Impacts 31
4.6 Forests and Natural Landscapes Impacts 33
4.7 Electricity Sector Impacts 35
4.8 Implications for Mitigation and Adaptation 37
5 RECOMMENDATIONS FOR EMISSION REDUCTION STRATEGIES 39
5.1 Process for Strategy Selection 40
5.2 Strategies Cal/EPA Will Implement Over the Next Two Years 40
5.3 Strategies the Resources Agency will Implement over the Next Two Years 47
5.4 Strategies Other State Agencies will Implement over the Next Two Years 57
5.5 Strategies the Public Utilities Commission will Implement Over the Next Two Years 60
5.6 The Governor's Targets Can Be Met 63
5.7 Emission Baseline Development 64

5.8 Economic Assessment....65
6 MARKET-BASED OPTIONS FOR CALIFORNIA....65
6.1 Market-Based Program Design Options....66
6.2 Compliance Tracking and Enforcement....76
6.3 Conclusions and Next Steps....78
7 IMPLEMENTATION OPTIONS....79
7.1 Programmatic....81
7.2 Market-Based Program....81
7.3 Public Goods Charge for Transportation Fuels....81
7.4 Fee-Based Option....82
7.5 Offset Program....82
7.6 Voluntary Actions....83
7.7 Mandatory Emission Reporting....83
8 ECONOMIC ASSESSMENT....84
8.1 Economic Model....85
8.2 Analysis of Climate Change Emission Reduction Strategies....87
8.3 Discussion....91
8.4 Summary....92
8.5 Implementation Options Assessment....93
9 IMPACTS ON LOW INCOME AND MINORITY COMMUNITIES....93
9.1 Environmental Justice Programs....94
9.2 Outreach to Minority and Low Income Communities....94
9.3 Strategy Evaluation....95
9.4 Scenario Analysis....95
9.5 Market-Based Options....95
9.6 Implementation Options....96
10 SUMMARY AND CLIMATE ACTION TEAM RECOMMENDATIONS....96
10.1 Climate Action Team Overarching Recommendations....97
10.2 General Recommendations....100
11 LIST OF ACRONYMS AND ABBREVIATIONS....102
12 ENDNOTES....105

TABLE OF FIGURES

Figure 2-1: Past and future CO_2 atmospheric concentrations. (Source: IPCC 2001 Synthesis report) 8

Figure 2-2. Variations of the Earth's surface temperature: years 1000 to 2100 (Source: IPCC 2001 Synthesis report) 9

Figure 2-3: Sources of California's Climate Change Emissions, 2002 Expressed in Terms of CO2 Equivalence (adapted from CEC, 2005)....10

Figure 2-4: California Composition of Gross Climate Change Pollutants, 2002 Expressed in Terms of CO2 Equivalence (adapted from CEC, 2005)....11

Figure 4-1. Special Report on Emissions Scenarios 22

Figure 4-2. Change in California Annual Average Daily Mean Temperature Relative to 1961-1990 25

Figure 4-3. Projected Days at Riverside Meteorologically Conducive to Exceedances of the 1-Hour California Ambient Air Quality Standard for Ozone of 0.09 Parts Per Million (ppm)....26

Figure 4-4. Projected increase in extreme heat days relative to 1961–1990. "Extreme heat" defined as by the average temperature which is exceeded less than 10% of the days during the historical period (1961-1990), or approximately 36 days a year....27

Figure 4-5. April 1 Snow water equivalent 2070-2099 fraction of 1961–1990 ...28

Figure 4-6. Cotton/pink bollworm (PBW): Predicting areas favored by PBW 31

Figure 4-7. Observed Change in Sea Level in San Francisco during the last century and Projections of Global Mean Sea Level during next century. 32

Figure 4-8. Percent change in the expected minimum number of large fires per year in California 34

Figure 4-9. Projected Impacts End of Century 38

Figure 6-1: Climate Change Emissions Covered Under Three Definitions for Program Scope 73

Figure 8-1 Circular Flow of Goods and Services in the Economy 86

Figure 8-2 Complete Circular Flow of Goods and Services in the Economy.....87

TABLE OF TABLES

Table 2-1. Numerical Estimates of Global Warming Potentials Compared with CO_2 (Kilograms of Gas Per Kilogram of CO_2 adapted from IPCC 2001).....15

Table 3-1 Emission Reduction Strategies Underway in California 17

Table 5-1. Environmental Protection Agency 40

Table 5-2. Resources Agency 47

Table 5-3. Other State Agencies 57

Table 5-4. Public Utilities Commission 60

Table 5-5 Baseline Inventory Estimates* 64

Table 6-1. Market-Based Scope Defined by Sectors 68

Table 7-1. Implementation Options for Meeting Statewide Climate Change Emission Reduction Targets 80

Table 8-1. Impacts of Achieving the Climate Change Emission Reduction Targets on California Economy in 2010* 88

Table 8-2. Impacts of Achieving the Climate Change Emission Reduction Targets on California Economy in 2020* 89

1 INTRODUCTION

California has a long history of environmental leadership. Motivated by the stunning natural beauty of our coastline, inland valleys, forests and mountains, as well as by the public health and environmental challenges brought on by increasing levels of pollution, California's citizens have repeatedly called for and supported measures to protect California's environmental heritage. Our political leadership and governmental institutions have responded with a variety of initiatives that restore, protect, and enhance the environment to ensure public health, environmental quality, and economic vitality. Often these California initiatives have provided a benchmark and template for further action both nationally and internationally.

This tradition of environmental leadership continues to this day. In 2005, recognizing that global warming will impose compelling and extraordinary impacts on California, the Governor signed Executive Order S-3-05 which established climate change emission reduction targets for the state and set in motion a process to ensure the targets are met. This Executive Order also recognized the importance of preparedness in that it directed the Secretary of the California Environmental Protection Agency (Cal/EPA) to lead an effort to evaluate the impacts of climate change on California and to examine adaptation measures that would best prepare the state to respond to the adverse consequences of climate change.

1.1 Organization of the Report

The report begins (Section 2) with an overview of the scientific evidence regarding climate change and its potential effects in California. Section 3 outlines the long history of previous actions that California has taken to understand and address the threat of climate change. Section 4 provides an overview of the scenario analysis that was done to evaluate the impacts of climate change on California, potential adaptation measures that can be taken to best respond to those impacts, and an economic assessment of the impacts. Section 5 presents the Climate Action Team recommendations regarding strategies the state should pursue to reduce climate change emissions.

Section 6 outlines market-based options for the state and includes a discussion of design choices that need to be further evaluated prior to adoption of a market-based program for the state. Section 7 discusses all possible emission reduction implementation options that were considered by the Climate Action Team, including market-based options. Section 8 covers a broad assessment of the economic implications of state actions to reduce climate change emissions. Section 9 looks specifically at potential impacts on minority and low-income communities. Section 10 contains the Climate Action Team's recommendations to the Governor and the Legislature.

2 CLIMATE CHANGE OVERVIEW

The Earth's climate has always evolved—the extremes of the 100,000-year ice-age cycles in both climate and climate change emissions over the last half million years are well documented. The period of the last 10,000 years has been warm and stable, and the last millennium, over which current societies have developed, has been one of the most stable climates observed. Yet, during the 20th century, we have observed a rapid change in the climate and climate change pollutants that is attributable to human activities.

These recent changes in climate change pollutants far exceed the extremes of the ice ages, and the global mean temperature is warming at a rate that cannot be explained by natural causes alone. Human activities are directly altering the chemical composition of the atmosphere through the buildup of climate change pollutants.

It is true that levels of natural climate change pollutants have fluctuated in the past. However, there are several reasons for attributing the rise in climate change pollutants to anthropogenic, rather than natural emissions. The first indicator comes from comparing the current increase with changes that have occurred in the past.

At the end of the last ice age, the concentration of CO_2 increased by around 100 ppm (parts per million) over about 8,000 years, or approximately 1.25 ppm per century. Since the start of the industrial revolution, the rate of increase has accelerated markedly. The rate of CO_2 accumulation currently stands at around 150 ppm/century—more than 200 times faster than the background rate for the past 15,000 years.

The heat-trapping property of climate change pollutants is undisputed. Although there is uncertainty about exactly how and when the Earth's climate will respond to increasing concentrations of climate change pollutants, combining observations with climate models indicates that detectable changes are underway. There most likely are and will continue to be changes beyond global mean warming, such as changes in regional temperature extremes, precipitation, soil moisture, and sea level, all of which could have significant adverse effects on many ecological systems, as well as on human health and the economy.

This section first presents the causes and projections for climate change, then discusses climate change pollutants. It includes a definition of global warming potentials and climate change pollutants. The section concludes with a brief discussion of abrupt climate change.

2.1 Climate Change Causes and Projections

Climate change is a shift in the "average weather" that a given region experiences. This is measured by changes in the features that we associate with weather, such as temperature, wind patterns, precipitation, and storms. Global climate change means change in the climate of the Earth as a whole. The Earth's natural climate has always been, and still is, constantly changing. The

climate change we are seeing today, however, differs from previous climate change in both its rate and its magnitude.

The temperature on Earth is regulated by a system commonly known as the "greenhouse effect." Naturally occurring climate change pollutants, primarily water vapor, CO_2, CH_4, and N_2O, absorb heat radiated from the Earth's surface. As the atmosphere warms, it in turn radiates heat back to the surface to create the greenhouse effect. The Earth's surface temperature would be about 34°C (61°F) colder than it is now if it were not for the natural heat trapping effect of climate change pollutants like CO_2, CH_4, N_2O, and water vapor.

Human activities are exerting a major and growing influence on some of the key factors that govern climate by changing the composition of the atmosphere and by modifying the land surface. The concentration of CO_2 in the atmosphere has risen about 30 percent since the late 1800s (National Assessment Synthesis Team [NAST], 2001). This increase has resulted from the burning of coal, oil, and natural gas, and the destruction of forests around the world to provide space for agriculture and other human activities.

Global projections of population growth and assumptions about energy use indicate that the CO_2 concentration will continue to rise, likely reaching between two and three times its late-19th-century level by 2100. Figure 2-1 shows the atmospheric CO_2 concentration from year 1000 to year 2000 from ice core data and from direct atmospheric measurements during the past few decades. Projections of CO_2 concentrations for the period 2000 to 2100 are based on model predictions.

Figure 2-1: Past and future CO_2 atmospheric concentrations. (Source: IPCC 2001 Synthesis report)

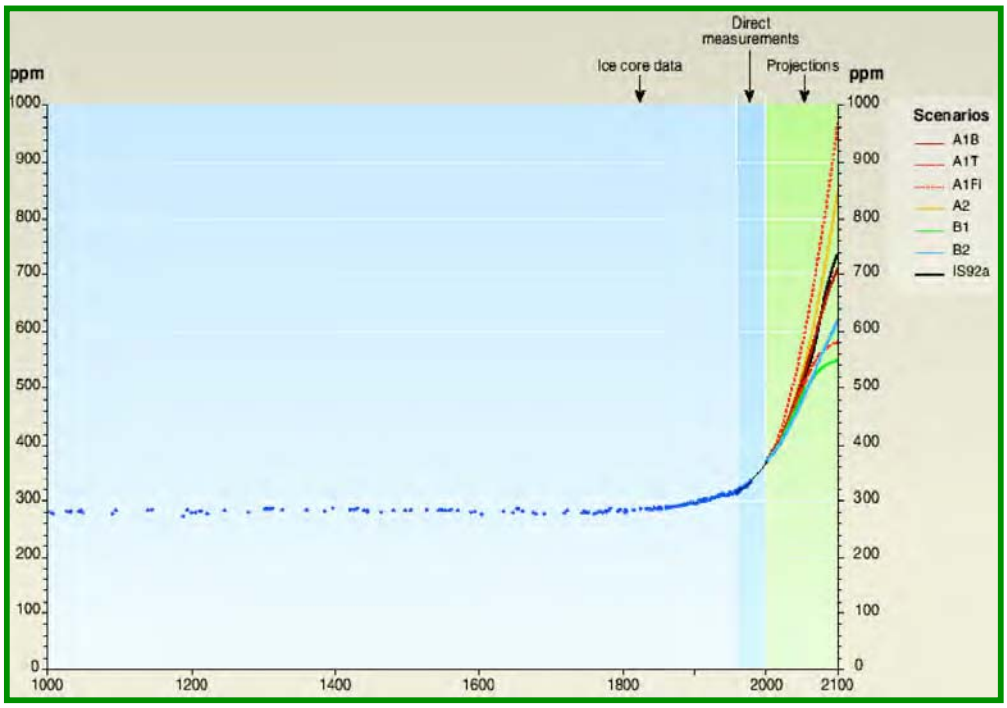
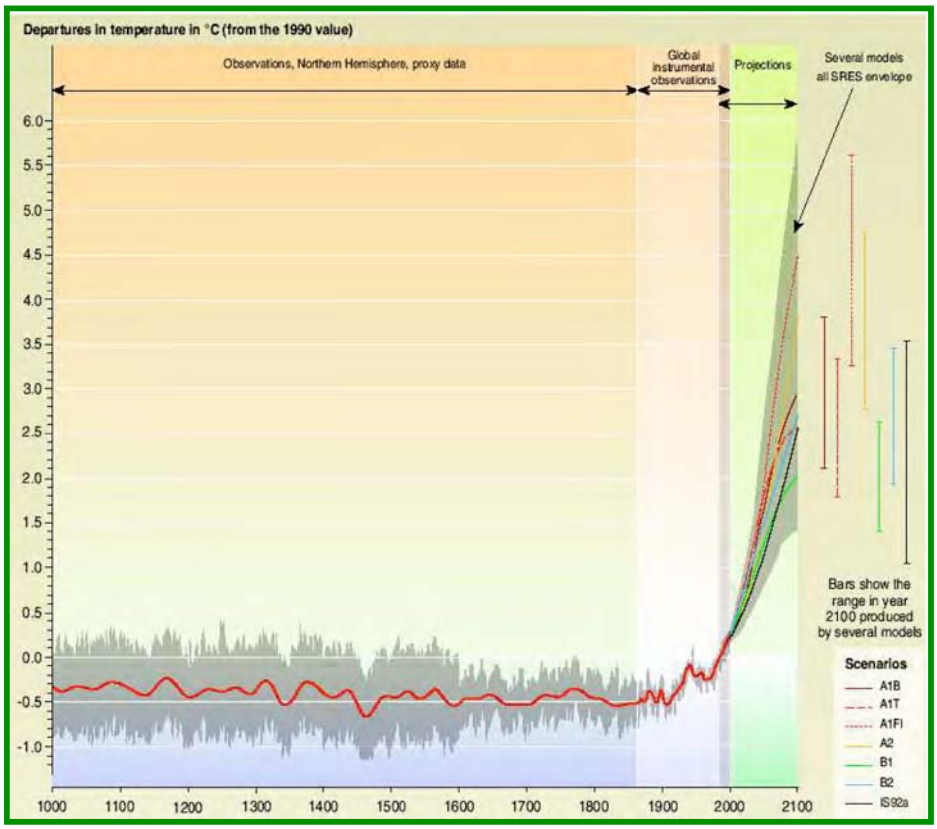


Figure 2-2 shows variations of the Earth's surface temperature for years 1000 to 2100. From year 1000 to year 1860 variations in average surface temperature of the Northern Hemisphere are reconstructed from proxy data (tree rings, corals, ice cores, and historical records). The line shows the 50-year average; the gray region, the 95 percent confidence limit in the annual data.

For the period 1860 to 2000, the figure shows variations in observations of globally and annually averaged surface temperature from the instrumental record; the line shows the decadal average. For 2000 to 2100, projections of globally averaged surface temperature are shown for several model scenarios using a global climate model.

The Third Assessment Report of the International Panel on Climate Change (IPCC, Synthesis Report, 2001) and the National Research Council of the National Academies (NRC, 2001) conclude that the global climate is changing at a rate unmatched in the past 1,000 years. The IPCC assessment cites new and stronger evidence that most of the global warming observed over the last 50 years is attributable to human activities and that anthropogenic climate change will persist for many centuries.

Figure 2-2. Variations of the Earth's surface temperature: years 1000 to 2100 (Source: IPCC 2001 Synthesis report)



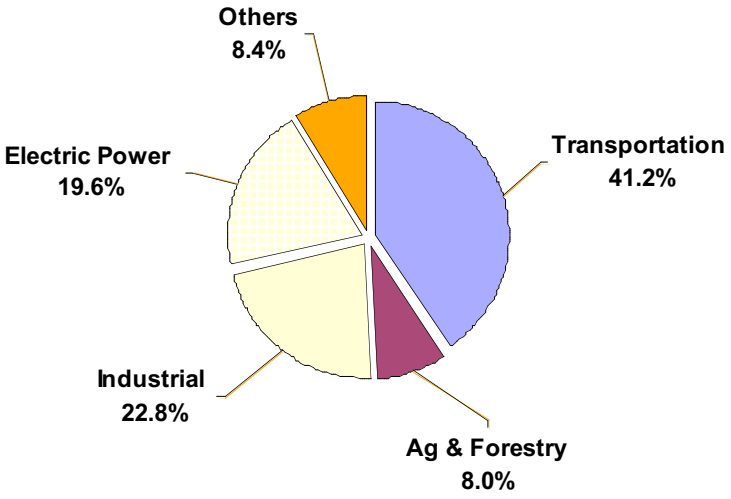
Many sources of data indicate that the Earth is warming faster than at any time in the previous 1,000 years. The global mean surface temperature has increased by 1.1° F since the 19th century (IPCC Synthesis report, 2001). The 10 warmest years of the last century all occurred within the last 15 years.

For example, 2002 and 2003 are tied as the second warmest years on record, according to a year-end review of climate data by the National Oceanic and Atmospheric Administration. Both the IPCC (2001) and the NAST (2001) reports project that warming in the 21st century will be significantly larger than in the 20th century. Scenarios examined in these assessments indicate that temperatures in the U.S. will rise by about 5° to 9°F (3° to 5°C) on average in the next 100 years.

2.2 Climate Change Emission Sources and Pollutants

As shown in Figure 2-3, fossil fuel consumption in the transportation sector was the single largest source of California's climate change emissions in 2002, with the industrial sector as the second-largest source. Electricity production, from both in-state and out-of-state sources, was the third-largest source. Agriculture, forestry, commercial, and residential activities comprised the balance of California's climate change emissions (CEC, 2005).

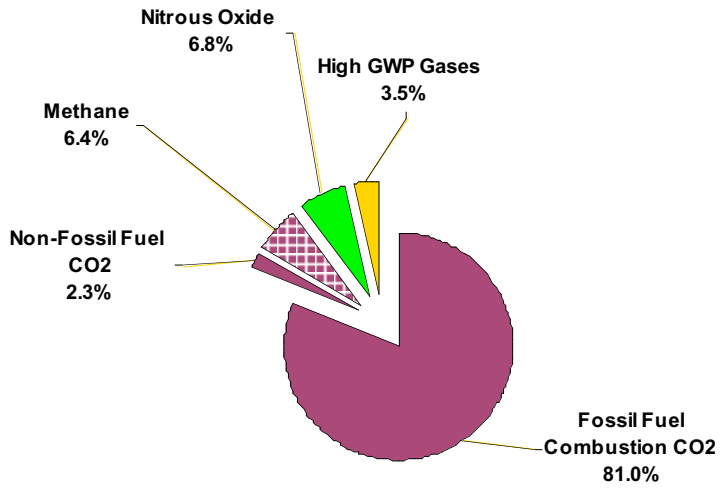
Figure 2-3: Sources of California's Climate Change Emissions, 2002 Expressed in Terms of CO2 Equivalence (adapted from CEC, 2005).



As previously indicated, human activities are altering the chemical composition of the Earth's atmosphere through the release and build-up of climate change emissions. However, climate change pollutants such as water vapor, CO2, CH4, N2O, and O3 can also be associated with natural sources. Conversely, several classes of halogenated substances that contain fluorine, chlorine, or bromine are also climate change emissions, but they are, for the most part, solely a product of industrial activities.

Figure 2-4 provides a distribution of California anthropogenic climate change pollutants by gas in 2002, expressed in terms of CO_2 equivalence. In addition, there are a number of other pollutants such as carbon monoxide, nitrogen oxides, and aerosols that have direct or indirect effects on terrestrial or solar radiation absorption. Individual climate change species are briefly discussed in the following section.

Figure 2-4: California Composition of Gross Climate Change Pollutants, 2002 Expressed in Terms of CO2 Equivalence (adapted from CEC, 2005).



Carbon Dioxide (CO_2)

In the atmosphere, carbon generally exists in its oxidized form, as CO_2. Increased CO_2 concentrations in the atmosphere have been primarily linked to increased combustion of fossil fuels. Fossil fuel combustion accounted for 98 percent of gross California CO_2 emissions. California's total CO_2 emissions from fossil fuel combustion in 2002 were 360 million metric tons CO_2, which accounts for approximately 7 percent of the U.S. emissions from this source. The transportation sector accounted for the largest portion of CO_2 emissions with gasoline consumption accounting for the greatest portion of emissions.

Methane (CH_4)

Methane accounted for approximately 6 percent of gross 2002 climate change emissions in California (CO_2 equivalent). Methane is produced during anaerobic decomposition of organic matter in biological systems. Decomposition occurring in landfills accounts for the majority of anthropogenic CH_4 emissions in California and in the United States as a whole. Agricultural processes such as enteric fermentation, manure management, and rice cultivation are also significant sources of CH_4 in California.

Nitrous Oxide (N_2O)

Nitrous oxide emissions accounted for nearly 7 percent of climate change emissions (CO_2 equivalent) in California in 2002. The primary sources of anthropogenic N_2O emissions in California are agricultural soil management and fossil fuel combustion in mobile sources.

Nitrous oxide is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. Both mobile and stationary combustion emit N_2O, and the quantity emitted varies according to the type of fuel, technology, and pollution control device used, as well as maintenance and operating practices. U.S.EPA estimates from 2003 suggest that in 2001, N_2O emissions from mobile combustion were 13 percent of U.S. N_2O emissions, while stationary combustion accounted for 3 percent.

Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6)

HFCs, PFCs and SF_6 accounted for about 3.5 percent of gross 2002 climate change emissions in California (CO_2 equivalent). HFCs are primarily used as substitutes for ozone-depleting substances (ODS) regulated under the Montreal Protocol. PFCs and SF_6 are generally emitted from various industrial processes including aluminum smelting, semiconductor manufacturing, electric power transmission and distribution, and magnesium casting. There is no aluminum or magnesium production in California; however, the rapid growth in the semiconductor industry leads to greater use of PFCs.

Other Radiatively Important Gases

In addition, there are a number of man-made pollutants, emitted primarily as by-products of combustion (both of fossil fuels and of biomass), that have indirect effects on terrestrial or solar radiation absorption by influencing the formation or destruction of other climate change emissions. These include carbon monoxide (CO), nitrogen oxides (NO_X), nonmethane volatile organic compounds (NMVOCs), and sulfur dioxide (SO_2).

These compounds, regulated in the U.S. and California pursuant to the Clean Air Act, are often referred to as “criteria pollutants.” The criteria pollutants are reactive compounds, and they tend to remain in the atmosphere for a much shorter time (typically hours to months) than the previously discussed gases. As shown in Table 2-1, CO_2, N_2O, CH_4, and HFC-134a have atmospheric lifetimes ranging from a century to 10 years.

The sequence of reactions that removes CO, NO_X, and NMVOCs from the atmosphere, however, tends to promote the formation of tropospheric O_3 which is also a potent climate change emission. At present, there is large scientific uncertainty in estimating the radiative forcing effects of criteria pollutants.

Aerosols

Aerosols are extremely small particles or liquid droplets found in the atmosphere. Various categories of aerosols include naturally produced aerosols (e.g., soil dust, sea salt, biogenic aerosols, and volcanic aerosols), and anthropogenic aerosols (e.g., sulfates, ammonium nitrate, industrial dust, and carbonaceous aerosols including black carbon and organic carbon). Anthropogenic aerosols are derived directly or indirectly from transportation, coal combustion, cement manufacturing, waste incineration, and biomass burning.

Aerosols affect radiative forcing in both direct and indirect ways: directly by scattering and absorbing solar and thermal infrared radiation; and indirectly by altering the cloud properties and atmospheric heating rates that in turn modify the formation, precipitation efficiency, and radiative properties of clouds. The effect of aerosols on regional and global climate is complex: in general, sulfate aerosols enhance the reflection of sunlight and cool the Earth, while black carbon aerosols enhance the absorption of sunlight and warm the Earth.

Understanding the role of aerosols in climate change requires inclusion of realistic representations of aerosols and their radiative forcings in climate models. However, uncertainty in aerosol radiative forcing arises because neither emissions, atmospheric abundance, optical properties, nor indirect effects are well characterized. The IPCC (2001) and the NACIP (2002) have identified the total (direct and indirect) radiative forcing due to aerosols, and in particular light absorbing aerosols, as one of the most uncertain components of climate change models.

Water Vapor

It should be noted that just because water vapor is the most important contributor to the natural greenhouse effect does not mean that human-made climate change emissions are unimportant. However, human activities do not seem to be appreciably changing the atmospheric concentration of water vapor in any direct way on the global average.

A simple comparison of the relative greenhouse efficiencies of water vapor and CO_2 quickly becomes problematic because water vapor enters the climate system mostly as a "feedback" gas. Further, water stays in the atmosphere for a few days, while other climate change emissions linger for decades or centuries. The overall impact of water vapor with respect to global climate change is not well understood as it can lead to both warming (absorption of long-wave radiation from Earth) and cooling (cloud formation/reflection of solar radiation).

2.3 Global Warming Potentials

Radiative forcing is often defined as a net imbalance in energy flux in the atmosphere, and is expressed in watts per square meter (W/m^2), i.e. heat per area of the Earth's surface. Radiative forcing of the surface-troposphere system, resulting, for example, from a change in climate change pollutant concentrations, is the change in the balance between radiation coming into the atmosphere and radiation going out. A positive radiative forcing tends, on average, to warm the surface of the Earth, and negative forcing tends, on average, to cool the surface.

The impact of a climate change pollutant upon the atmosphere is related not only to radiative properties of the gas and its initial abundance, but also to the length of time the climate change pollutants remain in the atmosphere. Radiative properties control the absorption of radiation per kilogram of gas present at any instant, but the lifetime of the gas controls how long an emitted kilogram remains

in the atmosphere and hence its cumulative impact on the atmosphere's thermal budget.

Gases in the atmosphere can contribute to the greenhouse effect both directly and indirectly. Direct effects occur when the gas itself is a climate change pollutant. Indirect radiative forcing occurs when chemical transformations of the original gas produce other climate change pollutants, when a gas influences the atmospheric lifetimes of other gases, and/or when a gas affects atmospheric processes that alter the radiative balance of the Earth (e.g., cloud formation).

The concept of a Global Warming Potential (GWP) has been developed in parallel to the concept of ozone depletion potential developed under the Montreal Protocol to compare the ability of each climate change pollutant to trap heat in the atmosphere relative to another gas.

Carbon dioxide, as the primary anthropogenic climate change pollutant, has been chosen as the reference gas. GWP is defined as the ratio of the time-integrated radiative forcing from the release of 1 kilogram of a trace substance relative to that of 1 kg of CO_2 (IPCC 2001). While any length of integration can be selected, the 100-year GWPs are recommended by the IPCC and will be employed for policy-making and reporting purposes.

GWP values allow a comparison of the impacts of emission changes (reductions or increases) of different gases. According to the IPCC (2001), GWPs typically have an uncertainty of ±35 percent. In addition to communicating climate change pollutants in units of mass, we have also chosen to use GWPs to reflect their inventories in CO_2-equivalent terms because it effectively places all of the climate change pollutants on the same comparative scale.

Table 2-1 lists GWPs for CO_2, CH_4, N_2O, and HFC-134a for the 20-, 100-, and 500-year time horizons. It should be noted that when the lifetime of the species in question differs substantially from the response time of CO_2 (nominally about 150 years), then the GWP becomes very sensitive to the choice of time horizon. The GWP concept is only relevant for compounds that have sufficiently long lifetimes to become globally well-mixed. Therefore, short-lived gases and aerosols with varying atmospheric distributions and lifetimes pose a problem in the simple GWP framework.

Table 2-1. Numerical Estimates of Global Warming Potentials Compared with CO_2 (Kilograms of Gas Per Kilogram of CO_2 adapted from IPCC 2001).

Climate Change Pollutants	Lifetime (years)	Global Warming Potential		
		20 years	100 years	500 years
CO_2	~150	1	1	1
CH_4	12	62	23	7
N_2O	114	275	296	156
HFC-134a	14	3,300	1,300	400

2.4 Abrupt Climate Change

When most people think about climate change, they imagine gradual increases in temperature and only marginal changes in other climatic conditions, continuing indefinitely or even leveling off at some time in the future. It is assumed that human societies can adapt to gradual climate change. However, recent climate change research has uncovered a disturbing feature of the Earth's climate system: it is capable of sudden, violent shifts. This is a critically important realization.

Climate change will not necessarily be gradual, as assumed in most climate change projections, but may instead involve relatively sudden jumps between very different states. A mounting body of evidence suggests that continued increasing climate change emissions may push the oceans past a critical threshold and into a drastically different future.

Abrupt climate change is the subject of reports commissioned by the National Academy of Science (NRC 2002) and the U.S. Department of Defense (Schwartz and Randall, 2003). Thus, in addition to the gradual (albeit accelerated) climate changes projected by current climate models, Californians need to be aware of the possibility of much more sudden climate shifts.

2.5 Summary

There is little doubt that climate change is happening today, that human-caused increases in the atmospheric abundance of climate change pollutants are a large cause of that change, and the 21st century climate change will be greater than that we have experienced in the 20th century. Much of that projected climate change is as yet unrealized warming from the climate change pollutants in the atmosphere today. Nevertheless, actions taken to reduce climate change emissions today can reduce the magnitude and rate of climate change this century.

There is no scientific uncertainty about the fact that human activities have increased the atmospheric abundance of climate change pollutants. The uncertainties center on predicting exactly what the climate changes will be in various local areas of the Earth and what the effects of clouds will be in determining the rate at which the mean temperature will increase.

There are also uncertainties associated with characterizing the timing and magnitude of other consequences of a warmer planet: sea level rise, spread of certain diseases out of their usual geographic range, the effect on agricultural production, water supply, sustainability of ecosystems, increased strength and frequency of storms, extreme heat events, air pollution episodes, and the impact of these effects on human health and the economy.

3 CALIFORNIA ACTIONS TO ADDRESS CLIMATE CHANGE

The State of California has traditionally been a pioneer in efforts to reduce air pollution, dating back to 1963 when the California New Motor Vehicle Pollution Control Board adopted the nation's first motor vehicle emission standards. California likewise has a long history of actions undertaken in response to the threat posed by climate change.

Beginning in 1988, legislation was enacted that directed the California Energy Commission, in consultation with the Air Resources Board and other agencies, to study the implications of global warming on California's environment, economy, and water supply.

This effort continued with Governor Schwarzenegger's June 2005 Executive Order creating climate change emission reduction targets for the state. The Order requested a report that specifically addresses the impacts of climate change on the state and includes adaptation measures the state can implement to best respond. California state government has consistently recognized the necessity for state action on climate change to protect California's interests.

3.1 Summary of California Activities Underway

California has a long history of environmental leadership and has continued that leadership in the efforts to reduce climate change emissions. Table 3-1 indicates those strategies that are underway in California.

Section 2.1 asserted that the transportation sector is the largest source of emissions in California. The motor vehicle standards of the Air Resources Board (ARB) provide significant emission reductions in this sector in the 2020 time frame. Two other key strategies in the state are the Renewable Portfolio Standard and the Energy Efficiency Programs. These strategies have been instrumental in California's efforts to provide energy security for the state and have also provided significant climate change emission reductions. The state's Energy Efficiency Programs have resulted in a stable per-capita energy use in the state even while California's economy has soared.

It is important to note that these strategies, though underway, will require continuing efforts by the responsible agencies as well as strong leadership to ensure they remain in place. Governor Schwarzenegger has pledged his support of the ARB's motor vehicle regulations and the acceleration of the Renewable Portfolio Standard. The Governor's support and the continuing support of the Legislature will be essential as the state implements these strategies successfully.

Table 3-1 Emission Reduction Strategies Underway in California

Agency Responsible Strategies	Climate Change Emission Reductions (Million Tons CO_2 Equivalent)	
	2010	2020
Air Resources Board		
Vehicle Climate Change Standards	1	30
Diesel Anti-idling	1	1.2
Public Utilities Commission		
Accelerated Renewable Portfolio Std to 33% by 2020 (including load-serving entities [LSE])	5	11
California Solar Initiative	0.4	3
Investor Owned Utility Energy Efficiency Programs(including LSEs)	4	8.8
Integrated Waste Management Board		
Achieve 50% Statewide Recycling Goal	3	3
Energy Commission		
Building Energy Efficiency Standards	1	2
Appliance Energy Efficiency Standards	3	5
Fuel-efficient Replacement Tires & Inflation Programs	1.5	1.5
State and Consumer Services and Cal/EPA		
Green Buildings Initiative	0.5	1.8
Air Resources Board andCal/EPA		
Hydrogen Highway	Included*	
Total Potential Emission Reductions	22	68

* The benefits of the Hydrogen Highway have been captured in other programs such as the motor vehicle regulations and green buildings initiative.

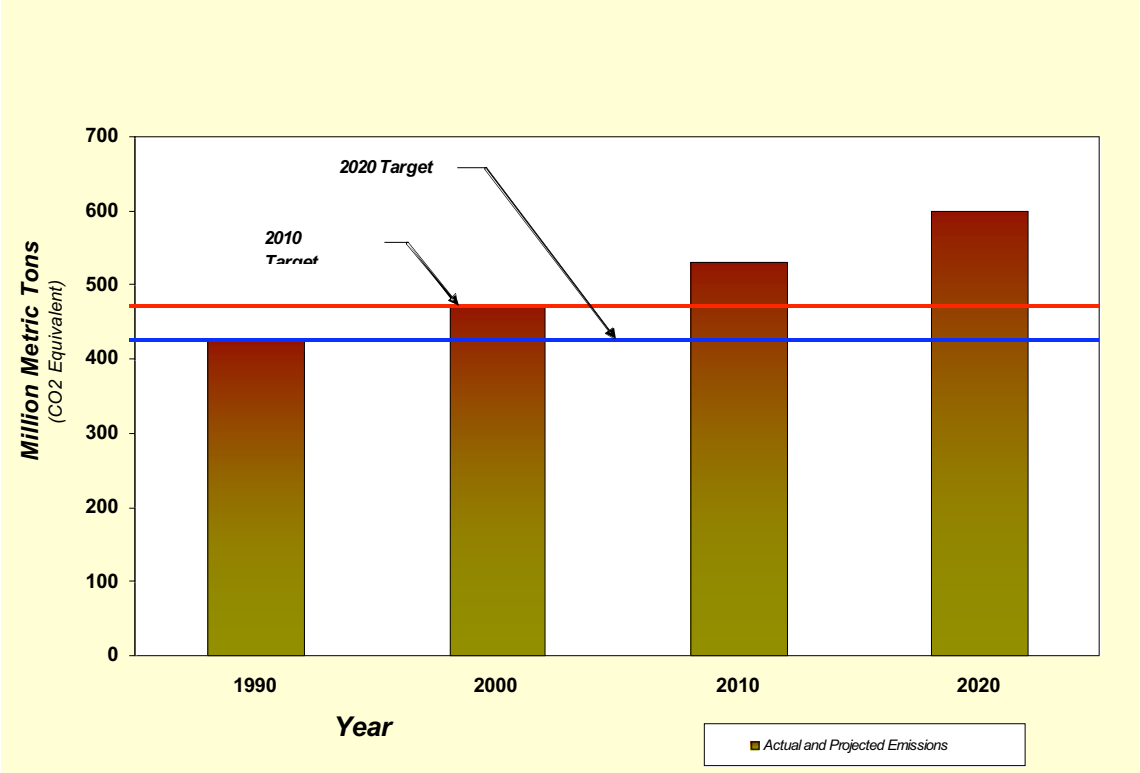
3.2 Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger signed Executive Order S-3-05 (EO) during the United Nations World Environment Day event in San Francisco. The EO established climate change emission reduction targets for California and was heralded in the nation and around the world as a landmark event signaling that California is taking a leadership role in the United States in addressing the issue of climate change. The Governor said in his remarks preceding the signing of the EO, "…the debate is over. We know the science. We see the threat. And we know the time for action is now."

This quote appeared in the media throughout the world. Internationally the developed nations agree that the issue of climate change must be addressed. It is no exaggeration to say that the world had been waiting for a strong signal that the state which has led a nation on so many public health and environmental issues would continue that leadership in addressing climate change.

The targets established by the EO are shown in Figure 3-1. The 2010 and 2020 targets are based on an ambitious estimate of how much the state can reduce emissions with strong top-down leadership and a coordinated effort amongst various state agencies. Cal/EPA worked with the ARB, CEC and Tellus, a technical contractor, to develop the targets in the 2010 and 2020 timeframes. The 2050 target is based on emission reductions the science indicates will be necessary from all developed nations to ensure protection of the planet in the 100-year time frame.

Figure 3-1. California's Climate Change Emissions and Targets



In addition to setting targets for the state, the EO placed Cal/EPA in the lead to coordinate efforts to meet these targets among the following agencies: Business, Transportation and Housing Agency (BT&H), Department of Food and Agriculture (CDFA), Energy Commission (CEC), Resources Agency, and Public Utilities Commission (PUC). A coordinated effort is essential to success in climate change emission reduction strategies. Programmatic, incentive-based, or market-based strategies will require the efforts of agencies whose purview stretches across all sectors of the economy, from transportation to energy to agriculture to waste management.

Finally, the EO directed Cal/EPA to lead an evaluation of the impacts of climate change in California, mitigation strategies to reduce emissions, and adaptation measures that can be taken by the state to best respond to the adverse impacts of climate change. This effort is built upon the work of the CEC under the Public Interest Energy Research plan.

The CEC is currently about half way through a five-year plan that responds to many of the same directives included in the EO. Cal/EPA worked with CEC and other agencies to incorporate a broader scope and provide the Governor and Legislature with a mid-point estimate of what California can expect as a result of climate change and how the state can best respond to the adverse consequences.

3.3 Climate Action Team

In response to the EO, the Secretary of Cal/EPA created the Climate Action Team (CAT). The CAT includes knowledgeable representatives from Air Resources Board; Business, Transportation, & Housing; Department of Food and Agriculture; Energy Commission; California Integrated Waste Management Board (CIWMB), Resources Agency, and Public Utilities Commission (PUC). The CAT has prepared a recommended list of strategies for the state to pursue to reduce climate change emissions in the state. This list in described in detail in Section 0. The CAT has also contributed to and reviewed the scenario analysis described in Section 4.

There are two subgroups of the CAT, the market-based options subgroup and the scenario analysis subgroup. Both subgroups are made up of representatives appointed by the CAT and experts as appropriate. The market-based options subgroup was created by the Secretary of Cal/EPA because of the cross-cutting nature of a market-based program for the state. The scenario analysis subgroup addressed the directive in the EO to evaluate the impacts of climate change on the state and adaptation measures that can be taken by the state to best prepare for the adverse consequences of climate change.

4 SCENARIO ANALYSIS

In California and throughout western North America, signs of a changing climate are evident. Over the last 50 years, observations reveal trends toward warmer

Furthermore, there are limits to adaptation, especially in addressing the threats of abrupt climate changes or in dealing with those impacts on natural, unmanaged species and ecosystems. These species may not be able to keep up with the increasingly rapid and severe climate change expected in future decades. Finally, the ability to cope and adapt is differentiated across populations, economic sectors, and regions within the state. As a result, without appropriate actions climate change will likely aggravate existing equity issues within California and the rest of the U.S.

For example, the most vulnerable populations to the health impacts of climate change are children, elderly people, and residents of minority and low-income communities—the same groups that already face the greatest health and environmental risks.

The Department of Water Resources and other State agencies have already started to include climate change considerations in their long-range plans. However, no cities in California have a heat emergency action plan; such plans are especially crucial to assist the elderly, especially those living in housing without air conditioning, who may be the most at risk from heat waves.

Thus, the Department of Health Services should develop heat emergency action plans for California (with a focus on protecting the economically disadvantaged) before the need arises. Existing air pollution control programs do not consider the effect of climate change on vulnerable populations; children and the elderly (especially those with pre-existing heart disease) are among the groups most vulnerable to air pollution episodes. Those that live closer to freeways and other emission sources (disproportionately in low-income and minority communities) are exposed to higher levels of pollution.

The Air Resources Board should work with the U.S. Environmental Protection Agency to begin to build climate change considerations into efforts to attain and maintain the health-based air quality standards over the long term.

Better monitoring of California's climate and sensitive climate related sectors will be crucial to detecting and understanding a complex chain of impacts. Finally, the State should continue to generate public discussion and build awareness of the need to manage climate change, develop enabling (or eliminating constraining) adaptation policies, and foster the political will necessary to critically assess and ultimately realize the State's significant adaptive potential.

5 RECOMMENDATIONS FOR EMISSION REDUCTION STRATEGIES

The CAT evaluated a significant number of strategies that could be implemented in California to reduce climate change emissions. The strategies listed in the section represent the recommendations of the CAT regarding activities that should be undertaken in the state agencies to ensure the Governor's targets are met. Most of these strategies can be implemented with existing authority of the state agencies represented on the CAT.

5.1 Process for Strategy Selection

As a starting point for emission reduction strategy selection, the CAT relied upon information provided by the Tellus Institute, Center for Clean Air Policy, CEC's Integrated Energy Policy Report, and other existing evaluations of climate change emission reduction policies. The CAT agency representatives then went through a brainstorming exercise and each representative contributed to a larger list of potential emission reduction strategies that either their own agency or other agencies could implement.

The CAT as a whole discussed each strategy and reviewed work plans that included implementation steps, a timeline, and estimated potential emission reductions and costs. From these work plans it was determined which emission reduction strategies could be recommended to the Governor and Legislature at this time and which were either infeasible or would require further analysis.

The CAT then held two public workshops to review the strategies with the public. CAT representatives also met with representatives from low-income and minority communities, environmental organizations, industry representatives, and non-government organizations to review and discuss the list of strategies. Based on comment received at those workshops and meetings, the group made revisions and developed a final list of recommended strategies included in this document.

5.2 Strategies Cal/EPA Will Implement Over the Next Two Years

Table 5-1Table 5-2 lists all of the strategies that Cal/EPA will implement over the next two years. By 2020, the Air Resources Board's vehicle climate change emission standards will provide the largest emission reductions of any of the strategies being recommended by the Climate Action Team. The large auto manufacturers are currently challenging California's right to set climate change emission standards for vehicles. Governor Schwarzenegger has pledged his support in defending the State's right to require the sale of cleaner cars. The Integrated Waste Management Board will continue to pursue stringent waste reduction and recycling goals and is working towards better understanding of landfill gas emissions and best practices for capture and use of those emissions.

Table 5-1. Environmental Protection Agency

Climate Change Emission Reductions (Million Metric Tons CO_2 Equivalent)[1]	2010	2020
Air Resources Board		
Vehicle Climate Change Standards	1	30
Diesel Anti-Idling	1	1.2
Other New Light Duty Vehicle Technology	0	4

Improvements		
HFC Reduction Strategies	2.7	8.5
Transport Refrigeration Units, Off-road Electrification, Port Electrification (ship to shore)	<1	<1
Manure Management	1	1
Semi Conductor Industry Targets (PFC Emissions)	2	2
Alternative Fuels: Biodiesel Blends	<1	<1
Alternative Fuels: Ethanol	<1	3.2
Heavy-Duty Vehicle Emission Reduction Measures	0	3
Reduced Venting and Leaks in Oil and Gas Systems	1	1
Hydrogen Highway	Included[2]	
Integrated Waste Management Board		
Achieve 50% Statewide Recycling Goal	3	3
Landfill Methane Capture	2	3
Zero Waste—High Recycling		3

[1] These estimates are based on best available current information and will be updated as needed.

[2] The benefits of the Hydrogen Highway have been captured in other programs such as the motor vehicle regulations and green buildings initiative.

A summary description of each of the strategies in Table 5-1 is included below:

Vehicle Climate Change Standards

With the passage of AB 1493, Pavley, Chapter 200, Statutes of 2002, California moved to the forefront of reducing vehicle climate change emissions. This bill required the state to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of climate change emissions emitted by passenger vehicles and light duty trucks. Regulations were adopted by the ARB in September 2004.

The ARB analysis of this regulation indicates emissions savings of 1 million tons CO_2 equivalent ($MMtCO_2e$) by 2010 and 30 million tons CO_2 equivalent by 2020.[23] This analysis also suggests that operating cost savings will more than offset the incremental costs of improved technologies, resulting in consumer savings of $5 billion annually by 2020.

Diesel Anti-Idling

Reduced idling times and the electrification of truck stops can reduce diesel use in trucks by about 4 percent, with major air quality benefits. In July 2004 the ARB adopted a measure to limit diesel-fueled commercial motor vehicle idling.[24] ARB

analysis indicates that anti-idling measures could reduce climate change emissions by 1.2 MMtCO2e in 2020.[25] ARB also estimates that the proposed measures would provide savings of up to $575 million (NPV through 2013) to California businesses as a result of fuel savings and reduced engine maintenance costs.

Other New Light Duty Vehicle Technology Improvements

In September 2004 the California Air Resources Board approved regulations to reduce climate change emissions from new motor vehicles. The regulations apply to new passenger vehicles and light duty trucks beginning with the 2009 model year. The standards adopted by the Board phase in during the 2009 through 2016 model years. When fully phased in, the near term (2009–2012) standards will result in about a 22 percent reduction as compared to the 2002 fleet, and the mid-term (2013–2016) standards will result in about a 30 percent reduction.

New standards would be adopted to phase in beginning in the 2017 model year (following up on the existing mid-term standards that reach maximum stringency in 2016). Assuming that the new standards call for about a 50 percent reduction, phased in beginning in 2017, this measure would achieve about a 4 MMT reduction in 2020. The reduction achieved by this measure would significantly increase in subsequent years as clean new vehicles replace older vehicles in the fleet—staff estimates a 2030 reduction of about 27 MMT.

Hydrofluorocarbon Reduction Strategies

ARB staff has identified five possible measures to reduce HFC emissions from vehicular and commercial refrigeration systems:

1. *Ban the retail sale of hydrofluorocarbon* (*HFC) in small (mostly 12-oz.) cans*. This would end the loss of can "heels" (small amounts of HFCs remaining in the can after service is complete) and prevent do-it-yourself re-filling of vehicular air conditioning systems.

2. *Require that only low-GWP refrigerants be used in new vehicular systems*. For vehicles subject to the ARB motor vehicle climate change emission reduction regulations, this requirement would take effect in 2017 because the adopted regulations already specify standards and compliance options through 2016. For medium- and heavy-duty vehicles not subject to the AB 1493 regulation, the requirement would take effect in the 2010 timeframe.

3. *Adopt specifications for new commercial refrigeration*. Limit the global warming potential of refrigerants used in refrigerators in retail food stores, restaurants, and refrigerated transport vehicles (trucks and railcars) and/or require that centralized systems with large refrigerant charges and long distribution lines be avoided in favor of systems that use much less refrigerant and lack long distribution lines.

4. Add refrigerant leak-tightness to the "pass" criteria for vehicular Inspection and Maintenance programs (all vehicles) and adopt an "inspect

and repair" measure for commercial systems. Require that systems either be leak-free at smog-check or be empty and inoperable.

5. *Enforce the federal ban on releasing HFCs.* This measure would focus on reducing emissions during the servicing and dismantling of vehicular air conditioners and commercial refrigeration systems.

<u>Transportation Refrigeration Units, Off-road Electrification, Port Electrification (ship to shore)</u>

Transportation Refrigeration Units

Require all new transportation refrigeration units (TRU) to be equipped with electric standby.

Require cold storage facilities to install electric infrastructure to support electric standby TRUs.

The technologies to be employed in this measure include electric standby for TRUs and electric infrastructure at cold storage facilities.

Emission reduction estimates are about 0.14 MMT in 2020 assuming 50 percent electrification and TRU operation at a facility of about 30 percent.

Off-road Electrification

Off-road electrification would likely be achieved using a combination of regulatory and incentive approaches. ARB could conduct outreach to encourage replacement of diesel engines with electric motors to take advantage of the incentive rate structure and Moyer funding, and to comply with District and pending ARB regulations.

The in-use stationary diesel agricultural engine regulation currently under development at ARB will propose emission performance standards for engines rather than mandate electrification or any other specific technology. Staff believes that most engines will be replaced with new cleaner certified diesel engines or with electric motors. Retrofit and alternative fuels are other potential means of compliance.

Port Electrification

ARB would require phase-in of vessel modifications and infrastructure to support expanded use of shore-side power.

Technologies to be employed in this measure include vessel modifications and shore-side infrastructure.

Shore-side power could be used in 2 to 5 percent of ship visits in 2010 and 20 to 25 percent of ship visits in 2020. The reductions in CO_2 emissions are calculated as the difference between the CO_2 emissions resulting from the generation of shore-side power supplied by utility companies and the CO_2 emissions resulting from power generated by shipboard diesel generators.

2010

Goal: 5 percent of ship visits use shore-side power

Estimated CO_2 reduction: 0.016 MMT

2020

Goal: 25 percent of ship visits use shore-side power

Estimated CO_2 reductions: 0.18 MMT

Manure Management

Proposed San Joaquin Valley Rule 4570, Confined Animal Facilities, is intended to reduce volatile organic compounds (VOC) from confined animal facilities and is in the initial stages of development. Some general concepts that may appear in the rule include: (1) different requirements based on facility size; (2) specific control requirements included on a list of technologies; (3) a mix of control options selected from a list; and (4) a facility-wide control efficiency that will achieve a certain percentage reduction. Possible control options include management practices, manure handling practices, and lagoon/liquid waste control options.

Emission reduction estimates of approximately 1 million tons (MMT) could be achieved through the use of biogas digesters along with the production of electricity and/or heating applications. ARB estimates of climate change emission reductions through implementation of anaerobic digesters have yet to be determined.

Semi Conductor Industry Targets (PFC Emissions)

ARB could help target climate change emission reductions through development of a model rule to be considered for adoption by the districts. Based on the voluntary target outlined in the Memorandum of Understanding between the U.S. EPA and the Semiconductor Industry Association, emission reduction estimates of approximately 2 MMT for semiconductor operations in both 2010 and 2020 are possible.

Alternative Fuels: Biodiesel Blends

ARB would develop regulations to require the use of 1 to 4 percent biodiesel displacement of California diesel fuel. A climate change emission reduction of about 0.4 MMT would be achieved in 2010 based on 2 percent displacement of diesel fuel. ARB and CEC staff estimate that biodiesel could likely provide up to a 4 percent displacement of diesel fuel by 2020. This would provide about 0.8 MMT of climate change emission reductions. It is important to note, however, that current supplies of biodiesel are limited in California. Thus this strategy presumes significant market expansion in addition to regulatory steps.

Alternative Fuels: Ethanol

More than 200,000 flexible fueled vehicles are present in California today that could use E-85 without any equipment modifications. This number will increase as manufacturers continue to produce additional new cars that are E-85 compatible. If E-85 became widely available at prices competitive with gasoline, a significant portion of the fleet could be fueled primarily with ethanol by 2015.

The percentage of ethanol used in gasoline could be increased to the maximum 10 percent (E-10) that is compatible with current vehicles. (The current gasoline supply contains 5.7 percent ethanol). However, significant permeation emissions caused by low percentage ethanol blends used in the summertime suggest that low percentage blends are best limited to wintertime use. In addition, other fuel properties may need to be adjusted to ensure that the use of E-10 does not increase emissions of smog forming compounds.

If ethanol used in California continues to be derived from corn or other similar grains, the climate change emission benefits due to increased use of E-85 would be negligible in 2010 and 2.7 MMT in 2020 (assumes that about 10 percent of the entire light duty vehicle fleet uses E-85 regularly.) Use of ethanol derived from biomass or waste material would more than double the climate change emission reduction benefit.

Using 10 percent ethanol content in gasoline during the wintertime (six months) would result in ethanol use roughly equivalent to the level required under the recently adopted federal energy bill, and thus produce no additional climate change emission reduction benefits.

Heavy-Duty Vehicle Emission Reduction Measures

Climate change emissions can be reduced with improved aerodynamics, climate engine-based improved efficiency, vehicle weight reduction, and rolling and inertia resistance improvements. ARB has also identified other possible measures, such as an education program for the heavy duty vehicle sector as well as the light and medium duty vehicle sectors that would educate drivers as to how to optimize vehicle operation.

Emission reduction estimates of about 0.2 MMT for 2010 and about 3 MMT for 2020 were derived assuming an efficiency improvement of 65 percent from 1990 levels is possible by 2030. These estimates were based on ARB/CEC estimates of fleet-wide diesel-use reductions achievable under a national approach based on DOE's 21st Century Truck Program.

Reduced Venting and Leaks in Oil and Gas Systems

A model rule would be developed to be considered for adoption by the Air Pollution Control Districts. This measure involves improved management practices and does not rely on the application of new technology.

Estimated potential climate change emission reductions of 1 MMt CO_2 equivalent were derived assuming reduced leak and venting in the production, processing, transport, and distribution of oil and natural gas in 2010 and 2020. This goal is based on U.S.EPA estimates that approximately 33 percent of emissions from oil and gas systems can be avoided cost-effectively.

Hydrogen Highway

The California Hydrogen Highway Network (CA H2 Net) is a State initiative to promote the use of hydrogen as a means of diversifying the sources of transportation energy in order achieve a secure energy future, address

environmental, public health, and economic challenges, and work in partnership with other State programs to advance energy efficiency and renewable energy. The CA H2 Net mission is to assure that hydrogen infrastructure is in place as fuel cells and other hydrogen technologies reach commercial readiness.

Hydrogen can be derived from a variety of sources including petroleum based feedstock to a range of renewable resources. To assure that the production of hydrogen and operation of hydrogen fueled vehicles is environmentally beneficial the CA H2 Net has the clearly defined goals of utilizing at least 20 percent renewable resources in the production of hydrogen, reducing climate change emissions by at lease 30 percent, and to not increase smog forming and toxic pollutants relative to fossil fuel vehicle use.

Achieve 50% Statewide Recycling Goal

Achieving the State's 50 percent waste diversion mandate as established by the Integrated Waste Management Act of 1989, (AB 939, Sher, Chapter 1095, Statutes of 1989), will reduce climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. Currently a diversion rate of 48 percent has been achieved on a statewide basis. This strategy would result in achieving an additional 2% waste diversion of recyclables from landfills using existing authorities and mandates, collection infrastructures, and recycling processes.

Landfill Methane Capture

Methane production varies greatly from landfill to landfill depending on site-specific characteristics such as the quantity of waste in place, waste composition, moisture content, landfill design and operating practices, and climate. Unless captured first by a gas recovery system, methane generated by the landfill is emitted when it migrates through the landfill cover to the atmosphere and becomes a potent climate change emission.

Landfills can install direct gas use projects or electricity projects with backup flare systems to capture and use methane. The technical applicability of any mitigation option is dependent on the amount of landfill gas generated by landfills in a given size category.

Zero Waste—High Recycling

Additional recovery of recyclable materials from landfills will reduce the climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. Transforming organics/biomass and plastic waste into marketable products will also reduce the amount of material going to landfill, and therefore will further reduce climate change emissions. Currently, the State is mandated to divert 50 percent of waste going to landfills as established by the Integrated Waste Management Act of 1989. Efforts to exceed the 50 percent goal would allow for additional reductions in climate change emissions.

5.3 Strategies the Resources Agency will Implement over the Next Two Years

Table 5-2 lists all of the strategies that Resources Agency will implement over the next two years. The Forest management efforts promise not only climate change emission reductions but also protect biodiversity, water quality and habitat resources. For three decades the California Energy Commission has led the world with the most progressive new building and appliance efficiency standards. These efficiency standards have provided substantial climate change emission reductions and have saved consumers about $1,000 per household in California. Finally, by reducing the energy used to transport and deliver water in the State and increasing water use efficiency California can both protect our water supply and reduce climate change emissions.

Table 5-2. Resources Agency

Climate Change Emission Reductions (Million Metric Tons CO_2 Equivalent)[1]	2010	2020
Department of Forestry		
Forest Management	1-2	2-4
Forest Conservation	4.2	8.4
Fuels Management/Biomass	3.4	6.8
Urban Forestry	0	3.5
Afforestation/Reforestation	0	12.5
Department of Water Resources		
Water Use Efficiency	0.4	1.2
Energy Commission		
Building Energy Efficiency Standards in Place	1	2
Appliance Energy Efficiency Standards in Place	3	5
Fuel-Efficient Replacement Tires & Inflation Programs	1.5	1.5
Building Energy Efficiency Standards in Progress	TBD	TBD
Appliance Energy Efficiency Standards in Progress	TBD	TBD
Cement Manufacturing	<1	<1
Municipal Utility Energy Efficiency Programs/ Demand Response	1	5.9

Municipal Utility Renewable Portfolio Standard	<1	3.2
Municipal Utility Combined Heat and Power	0	<1
Municipal Utility Electricity Sector Carbon Policy	3	9
Alternative Fuels: Non-Petroleum Fuels	TBD	TBD

[1] These estimates are based on best available current information and will be updated as needed.

A summary description of each of the strategies in Table 5-2 is included below:

Forest Management

Strategies for storing more carbon through forest management activities can involve a range of management activities such as increasing either the growth of individual trees, the overall age of trees prior to harvest, or dedicating land to older aged trees. With roughly 4 million acres of private managed forestland in California, changes in forest management can produce significant amounts of climate change emission reduction benefits for the state.

Inclusion of the forest sector in climate mitigation policy can lead to additional local environmental benefits that may help the state's resources adapt to potential negative effects of climate change. Overall changes in forest management can enhance and protect biodiversity, water quality, and habitat resources that the state will increasingly seek to protect in the advent of climate change.

Forest management projects could be included in a broader multi-sector climate change emission market-based program or climate trust system. In a market-based program, forest management projects could provide offsets that would be purchased by capped entities. In a climate trust program, the state would fund forest management projects and recapture the costs by selling carbon credits to industries needing to reduce their climate change emissions.

The regulatory framework for timber harvesting requires landowners to secure permits from a large number of agencies to meet the requirements of the Forest Practice Act, Endangered Species Act, and Clean Water Act. Together the time and cost of obtaining these permits have led to conversions of timberlands to other uses and made it more difficult and time consuming to implement forest management activities that would increase carbon storage. Simplification of the permitting processes for forest management and timber harvesting would result in additional carbon being stored over a larger number of acres.

Forest Conservation

Conservation projects are designed to minimize/prevent the climate change emissions that are associated with the conversion of forestland to non-forest uses by adding incentives to maintain an undeveloped forest landscape.

California is losing forestland at increasing rates: 35,000 to 40,000 acres of private forestland is converted annually to non-forest uses (Bill Stewart, 2005),

which could contribute as much as 12 million tons of CO_2 emissions annually. Policies designed to minimize or prevent forestland conversion to non-forest uses could provide significant benefits by 1) preventing or minimizing climate change emissions that are associated with increasing forestland conversion in California and 2) maintaining the opportunity to increase forest carbon stocks on these lands through additional sequestration over time.

Forest conservation can also enhance and protect biodiversity, water quality, and habitat resources that the state will increasingly seek to protect from the negative effects of climate change. Finally, in contrast to the other forest sector strategies such as reforestation, the climate benefits of forest conservation are immediate.

Specific actions that can be taken include establishing a state forest conservation program that operates independently from the federal Forest Legacy program; increasing Forest Legacy Program Funding with an $11 million annual investment that could prevent the conversion of 14,000 acres of forestland. Another step could include directing the Wildlife Conservation Board, the State Conservancies, and other state land acquisition and easement programs to consider climate benefits in evaluating and ranking projects to be funded. Finally, the state could include forestland conservation as an emission reduction project in a broader multi-sector climate change market-based program or climate trust system.

Fuels Management/Biomass

Large, episodic, unnaturally hot fires are an increasing trend on California's wild lands because of decades of fire suppression activities, sustained drought, and increasing insect, disease, and invasive plant infestations. Actions taken to reduce wildfire severity through fuel reduction and biomass development would reduce climate change emissions from wildfire, increase carbon sequestration, replace fossil fuels, and provide significant local economic development opportunities.

Fire management and biomass development projects could be accelerated by establishing a new state goal of thinning, removing, and treating 212,000 acres of public and privately owned forestland annually by 2010, and 275,000 acres by 2020. Such projects would: 1) reduce the intensity of wildfires and their associated climate change emissions; 2) increase the carbon stock of the remaining trees, 3) remove pests that create mortality of live stored carbon and reduce large damaging wildfires, 4) reduce state and local fire suppression costs; 5) provide a source of renewable alternative fuel; and 6) provide significant rural economic development opportunities.

Urban Forestry

This strategy would expand the State Urban Forestry Program. A new state-wide goal of planting 5 million trees in urban areas by 2020 would be achieved through the expansion of local urban forestry programs. At a cost of $100 per tree, $500 million would have to be invested by local urban forestry programs to meet this target.

This could be achieved by issuing an Executive Order to establish a new state-wide goal and directing the Board of Forestry and California Department of Forestry to launch an aggressive public assistance and outreach campaign to expand local urban forestry programs. The state could request that the California Climate Action Registry develop and adopt a protocol for the certification of climate change emission reductions from local urban forestry programs.

This strategy would develop new urban biomass programs. The California Department of Forestry would develop an urban biomass utilization program to provide technical advice, planning, education, and seed money for local government marketing centers for biomass waste.

Afforestation (Planting Trees)/Reforestation Projects

Reforestation projects focus on restoring native tree cover on lands that were previously forested and are now covered with other vegetative types. Recent studies have estimated that approximately 9 million acres of land in California could be reforested to increase carbon stocks and provide other benefits. Each of these acres has the potential to store between 150 to 230 tons of carbon.

Specific actions that could be taken include: establishing a new statewide goal of reforesting 500,000 acres of forestlands by 2020, including 250,000 acres on private lands and 250,000 acres on federal lands; seeking $30 million annually, or $300 million in bond funds to meet these targets; establishing a long-term loan program to fund private land reforestation; establishing a multisector market-based program where reforestation projects can be included as offsets in a broader, mulit-sector climate change market-based program; and establishing a state-owned carbon bank, modeled after Oregon's Climate Trust, as part of a market-based program.

Water Use Efficiency

Approximately 19 percent of all electricity, 30 percent of all natural gas, and 88 million gallons of diesel are used to convey, treat, distribute and use water and wastewater. The California Energy Commission (CEC) estimates 44 million tons of CO2 emissions are expelled annually on average to provide the 44 million acre feet (MAF) of water used statewide.

The key to the reduction of climate change emissions through water use efficiency is strategic investment in measures tied to water energy intensity. When a unit of water is saved, so too is the energy required to convey, treat, affect local delivery, perform wastewater treatment and safely dispose of that unit of water. In short, saving water saves energy. Saving water that gets treated as wastewater saves more energy. Saving water that gets heated or additionally pressurized saves still more.

Region, elevation, water use sector, and energy source, among other factors, all influence water energy intensity. The statewide average for climate change emissions per acre foot is skewed by the wide local variation in the water energy intensity. Everything else being equal, a cooling tower condition meter installed in an industrial plant in Northern California will save 2,920 kWh compared to

9,270 kWh saved annually in a comparable plant south of the Tehachapi Mountains.

Increased water use efficiency is the key element in the California Water Plan Update (Bulletin 160-05) plans to meet the state's needs for water in 2030 with a growing population. The plan calls for reducing urban water use by 1.1 to 2.3 MAF per year and agricultural water use by 0.5 to 2.0 MAF per year by 2030. Accelerating the investment to attain that water use savings by 2015 would result in an estimated additional climate change emission reductions of approximately 30 million tons cumulatively by 2030. Accelerating the investment to 2010 would result in a further cumulative reduction of 10 million tons.

The California Bay-Delta Authority's larger estimated potential for 3.0 MAF per year urban water use reduction requires a greater rate of local and state/federal investment in conservation. Incentive driven advances in water-saving technology over the next 25 years potentially could further push savings beyond the levels indicated.

A comprehensive program focused on the state's water and wastewater agencies and their customers would yield significant benefits to the state including: meeting the state's water plan, increasing energy system reliability and price stability, meeting the state's renewable portfolio standard goals and reducing the state's climate change emissions. Following are measures to include in this comprehensive program:

- Accelerate investment in water use efficiency: Accelerate implementation of best management practices and efficient water management practices (EWMP) and incentives. Coordinate this accelerated investment with the state's investments in energy efficiency. Start in the areas of the state with most energy-intensive water use cycles.
- Increase the energy efficiency of all water and wastewater treatment operations. Develop long-term programs to better mesh with the long-term investments in water and wastewater infrastructure.
- Improve price signals so that water-related energy use can be shifted off periods of peak energy demand.
- Increase water storage to increase operational flexibility throughout the water use cycle and reduce peak electric system energy requirements.
- Identify suitable locations for new pumped storage facilities. Construct facilities at these locations.
- Increase energy production by water and wastewater agencies from renewable sources such as in-conduit hydropower and biogas. Add generation from solar and wind resources.

<u>Building Energy Efficiency Standards in Place</u>

Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its building energy efficiency standards (that apply to newly constructed buildings and additions to and alterations to existing buildings). The

Energy Commission updates the standards at its discretion (i.e. three-year cycle for building standards). In addition to the long existing legislative mandates, recent policies have placed priority on and established specific goals for updating of the standards.

The Energy Action Plan and the Integrated Energy Policy Report both call for ongoing updating of the standards, including meeting energy efficiency goals, addressing demand response and promoting the combination of solar photovoltaics and high-energy efficiency buildings. The Energy Commission has also initiated work for the building standards that will go into effect in 2008 (i.e. the first of three update cycles that will occur prior to 2015).

Appliance Energy Efficiency Standards in Place

Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its appliance energy efficiency standards (that apply to devices and equipment using energy that are sold or offered for sale in California). The Energy Commission updates the standards at its discretion. In addition to the long existing legislative mandates, recent policies have placed priority on and established specific goals for updating of the standards.

New standards for a variety of appliances were adopted in December 2004. Some standards under consideration in December were delayed to further consider manufacturer comments. Those standards are being developed by the Energy Commission at the present time. The estimates in Table 5-1 represent the expectation of full adoption of these standards.

Fuel-Efficient Replacement Tires and Inflation Programs

State legislation (Chapter 912, Statutes of 2001) directed the Energy Commission to investigate and to recommend ways to improve fuel efficiency of vehicle tires. The bill established a statewide program to encourage the production and use of more fuel efficient tires, and required the Energy Commission to:

- Establish a test procedure for measuring tire fuel efficiency.
- Develop a database on the fuel efficiency of existing tires in order to establish an accurate baseline of tire efficiency.
- Develop a rating system for tires that provides consumers with information on the fuel efficiency of individual tire models.
- Develop a consumer-friendly system to disseminate tire fuel-efficiency information as broadly as possible.
- Study the safety implications of different policies to promote fuel efficient replacement tires in the consumer market.
- Evaluate a mandatory fuel efficiency standard for all after-market tires sold in California.

- Develop consumer incentive programs that would offer a rebate to purchasers of replacement tires that are more fuel-efficient than the average replacement tire.
- Study ways to improve the fuel-efficiency of vehicles in the State's fleet.
- AB 844 later required tire manufacturers to report to the Energy Commission the rolling resistance and relative fuel economy of replacement tires sold in California.

Building Energy Efficiency Standards in Progress

As part of the process of updating the Building Energy Efficiency Standards, the Energy Commission evaluates new and emerging technology for possible inclusion in the standards. The CEC administers an ongoing "compliance option" process which evaluates to what extent compliance credit should be approved for new technologies and develops algorithms that can be used to properly evaluate their energy consequence within building simulation computer programs that are used for standards compliance.

Upon commission approval, compliance options can be used to demonstrate compliance with the performance approach in the standards. Once a compliance option has been in existence for a period of time, the commission often considers whether or not the compliance option should be made a requirement of the standards (as a prescriptive requirement and basis of the energy budget established for the performance standards).

Appliance Energy Efficiency Standards in Progress

As part of the process of updating the Appliance Energy Efficiency Standards, the CEC evaluates new and emerging technology for increasing the energy efficiency of appliances and equipment for possible inclusion in the standards. The Commission's Buildings and Appliances Office works on an ongoing basis with the Public Interest Energy Research (PIER) program and with the Utility Codes and Standards Programs to track promising new technologies and consider their appropriate inclusion in the standards.

Fundamentally, the standards updating process is achieved thorough technology assessment of the potential to include new technologies in the standards, and the program is continuously evaluating new technologies.

Cement Manufacturing

This strategy involves cost-effective reductions to reduce energy consumption and to lower carbon dioxide emissions in the cement industry. There is a large technical potential to improve energy efficiency in cement operations at a reasonable cost.

Climate change emissions from burning fossil fuels in the manufacturing of cement produces 1.5 to 2.0 percent of U.S. carbon dioxide emissions. Roughly half is from fossil fuel combustion and roughly half is from the conversion of limestone (45 million tons per year). California's cement industry produced 5.6

million metric tons in 2001; total statewide climate change emissions approached 500 million metric tons in 2001.

Annual emissions from the manufacturing of cement are growing at a rate of 2 percent per year, according to industry sources and using California-specific data. Direct emissions of carbon dioxide are estimated to rise from 10.4 million metric tons in 2005 to more than 15 million metric tons in 2025. Use of limestone Portland cement and the use of blended cement account for 70 percent of the potential emission reductions and would cost less than $10 per metric ton.

State policy options can take several forms, including technology mandates, financial incentives, negotiated agreements, voluntary commitments, emissions-intensity benchmarking, or mandatory measures. Policy changes would be needed to encourage the use of limestone and blended cement and to allow waste tires to be used as a fuel in cement manufacturing. Based on CEC's analysis, these measures have been shown to provide cost-effective climate change emission reduction benefits.

Municipal Utility Energy Efficiency Programs

The Energy Commission and the California PUC are collaborating on additional energy efficiency programs beyond those programs already adopted.

While the Energy Commission does not have regulatory authority over the publicly owned utilities in the way that the CPUC regulates the IOUs, the publicly owned utilities are required to report their energy savings to the CEC. A process to ensure comparability between public benefit program savings and funding data reported by public and investor-owned utilities will need to be established. Possible steps for implementing this strategy include:

- Pursuing statutory modifications or a cooperative agreement with the publicly owned utilities to achieve the needed CO_2 reductions.
- Seeking statutory modifications or the establishment of a formal memorandum of understanding (MOU) with the utilities to achieve these targets.
- Pursuing statutory modifications or another mechanism to ensure that all load-serving entities account for climate change emissions and emission reductions in a manner consistent with investor-owned utilities.

Municipal Utility Renewable Portfolio Standard

California's Renewable Portfolio Standard (RPS), established in 2002, requires that all load serving entities achieve a goal of 20 percent of retail electricity sales from renewable energy sources by 2017, within certain cost constraints. The *2003 Energy Action Plan* and the *2003 Integrated Energy Policy Report* (2003 *Energy Report*) accelerated the 20 percent goal from 2017 to 2010. The *2004 Energy Report Update* further recommended an increased goal of 33 percent renewable by 2020, which the California Public Utilities Commission (CPUC) and the California Energy Commission (Energy Commission) adopted in the *2005 Energy Action Plan II*.

The Energy Commission and the CPUC are responsible for implementing the RPS for the investor-owned utilities, electric service providers, and community choice aggregators. The publicly-owned utilities are responsible for implementing their own RPS programs.

The CPUC has undertaken a study to identify the steps necessary to achieve the 33 percent goal for the state's IOUs. The Energy Commission is undertaking a similar related study on RPS programs adopted by publicly-owned utilities, including barriers and policy options to accelerate those programs to reach the 20 percent goal by 2010 and 33 percent goal by 2020. Possible steps for implementing this strategy include:

- Pursuing a cooperative agreement with the publicly-owned utilities to achieve the needed climate change emission reductions.
- Seeking statutory modifications to require the publicly owned utilities to contribute proportionally to the state's RPS goals.
- Seeking statutory modifications or a cooperative agreement to ensure that publicly-owned utilities account for climate change emissions and emission reductions in a manner consistent with investor-owned utilities.

Municipal Utility Combined Heat and Power

This strategy constitutes cost-effective reductions from fossil fuel consumption in the commercial and industrial sector through application of on-site power production to meet both heat and electricity loads. To effectively implement this strategy, various policy instruments will likely be needed to attain the realistic market potential and subsequent climate change emission reductions.

These policy mechanisms may include regulatory incentives to encourage utilities to promote customer and utility-owned CHP, utility rate structures that are transparent and connected to market forces where externalities such as environmental impacts and transmission and distribution constraints are internalized, rules and regulations enabling easier access to wholesale markets, production tax credits for CHP, and other measures or incentives directed at key commercial and industrial activities in California.

Through existing efficiency commercialization programs at the CEC where relationships have been well established with the commercial and industrial sectors, a set of implementation activities will be developed that include:

- Utility tariffs to enable CHP owners to sell excess on-site electricity generation to the utility at prevailing wholesale prices. Existing analysis suggests this would be very effective in stimulating the near-team (next 5 years) market.
- Climate change emission reduction credits to reflect the net reduction of climate change emissions for the CHP systems compared to the avoided electricity and boiler fuel emissions.
- Transmission and distribution benefit payments that reflect the local and temporal benefits CHP provides utilities.

- Utility regulatory incentives to encourage utilities to promote installation of customer- and utility-owned CHP projects.

Municipal Utility Electricity Sector Carbon Policy

The Energy Commission and the CPUC are collaborating on additional programs to address ways to transition investor-owned utilities away from carbon-intensive electricity sources. Some publicly owned utilities have historically relied on coal-based generation, and many of these facilities will reach the end of their design life by 2020. The Energy Commission will explore options to encourage municipal utilities to transition away from carbon-intensive generation to low-carbon alternatives, and to reduce purchases of carbon-intensive power. Options include establishing emissions targets or caps, providing incentives for preferred generation options, and setting a climate change emission performance standard for new utility resource procurement, including both coal and non-coal resource additions.

In its recently adopted *2005 Integrated Energy Policy Report*, the Energy Commission recommends:

- Any climate change emission performance standard for utility procurement should be set no higher than emission levels achieved by a new combined-cycle natural gas turbines. In the case of coal-fired generation, the capacity to capture and store carbon dioxide safely and inexpensively is essential for meeting these standards.
- The state should specify a climate change emission performance standard and apply it to all utility procurement, including in-state generation and out-of-state purchases, coal, and non-coal resources.
- Additional consideration is needed before determining what role climate change emission offsets could play in complying with such a standard.
- The Energy Commission should work with the CPUC to develop a framework that accounts for the financial risk of reliance on carbon-based generation.
- California should have a consistent electricity carbon policy for all electric utilities within the state that applies to both in-state generation and out-of-state power purchases.

Alternative Fuels: non-Petroleum Fuels

This strategy involves increasing the use of non-petroleum fuels in California's transportation sector, as recommended in the Energy Commission's *2003 and 2005 Integrated Energy Policy Reports.* The Governor has also directed the Energy Commission to develop a workable, long-term transportation fuels plan that will result in significant reductions in gasoline and diesel use and that will establish realistic and achievable objectives. The Bio-Energy Interagency Working Group, which the Energy Commission is leading, has been asked to recommend options for optimizing the market potential for bio-fuels through a coordinated state level effort.

State policy options can take several forms, including technology performance standards, financial incentives, negotiated agreements, voluntary commitments, emissions-intensity benchmarking for fuel producers or automobile manufacturers, or other mandatory measures, such as fuels or motor vehicle standards or a market-based program. Based on our analysis, some alternative fuels have been shown to provide cost-effective climate change emission reduction benefits. But they face economic, market, or regulatory barriers that are impeding their use.

To achieve the benefits of this strategy, the following implementation issues would need to be overcome:

- The high first cost of alternative-fuel vehicles, when compared to conventional vehicles using internal combustion engines.
- The absence of a convenient retail fueling network to dispense alternative fuels to customers.
- Other regulatory and market barriers.

5.4 Strategies Other State Agencies will Implement over the Next Two Years

Table 5-3 lists all of the strategies that other state agencies will implement over the next two years. Many participants at the Climate Action Team public meetings, particularly in Southern California, indicated that smart land use and increased transit availability should be a priority in the state. The participation of Business, Transportation and Housing Agency on the Climate Action Team has highlighted the fact that such strategies can provide substantial climate change emission reductions. Similarly the efforts of the Department of Food and Agriculture and the State and Consumer Resources Agency provide benefits beyond their climate change emission reduction potential.

Table 5-3. Other State Agencies

Climate Change Emission Reductions (Million Metric Tons CO_2 Equivalent)[1]	2010	2020
Business, Transportation and Housing		
Measures to Improve Transportation Energy Efficiency	1.8	9
Smart Land Use and Intelligent Transportation	5.5	18
Department of Food and Agriculture		
Conservation tillage/cover crops	TBD	
Enteric Fermentation	<1	<1

State and Consumer Services Agency		
Green Buildings Initiative	0.5	1.8
Transportation Policy Implementation	TBD	

[1] These estimates are based on best available current information and will be updated as needed.

A summary description of each of the strategies in Table 5-3 is included below:

Measures to Improve Transportation Energy Efficiency

This strategy builds on current efforts to provide a framework for expanded and new initiatives including incentives, tools and information that advance cleaner transportation and reduce climate change emissions.

The effort includes the following:

- Incorporating energy efficiency and climate change emissions reduction measures into the policy framework governing land use and transportation, including framework for developing energy element in state transportation and regional planning documents. Better coordination on cross-agency climate change and energy policy framework to ensure a concerted effort and synergy among state agencies' climate change emission reduction activities.
- Increasing incentives and accelerating technology applications to improve transportation system productivity and move toward cleaner and more efficient vehicles, especially for the public sector fleet. Enhancing outreach and educational programs to bring a coordinated message of sustainable transportation and root causes of climate change emissions.
- Diversifying transportation energy infrastructure and advancing measures to slow the rate of vehicle miles traveled growth and excessive reliance on petroleum.

Smart Land Use and Intelligent Transportation

Smart land use is an umbrella term for strategies that integrate transportation and land-use decisions. Such strategies generally encourage jobs/housing proximity, promote transit-oriented development, and encourage high-density residential/commercial development along transit corridors. These strategies develop more efficient land-use patterns within each jurisdiction or region to match population increases, workforce and socioeconomic needs for the full spectrum of the population.

Intelligent Transportation Systems (ITS) is the application of advanced technology systems and management strategies to improve operational efficiency of transportation systems and movement of people, goods and services. Smart growth/land use and ITS would minimize the need for major capital improvements and can provide a host of benefits including more livable communities, transportation energy efficiency, lower emissions from mobile sources, and a lower-cost provision of public services (e.g., sewer, water).

Governor Schwarzenegger is finalizing a comprehensive 10-year strategic growth plan with the intent of developing ways to promote, through state investments, incentives and technical assistance, land use, and technology strategies that provide for a prosperous economy, social equity, and a quality environment. The Administration is pursuing funding and budgetary measures to support the strategic growth plan.

Smart land use, demand management, ITS, and value pricing are critical elements in this plan for improving mobility and transportation efficiency. Specific strategies include: promoting jobs/housing proximity and transit-oriented development; encouraging high density residential/commercial development along transit/rail corridor; valuing and congestion pricing; implementing intelligent transportation systems, traveler information/traffic control, incident management; accelerating the development of broadband infrastructure; and comprehensive, integrated, multimodal/intermodal transportation planning.

Conservation/Tillage Cover Crops

Conservation tillage and cover crops practices are increasingly being used by California farmers for a variety of reasons, including improved soil tilth, improved water use efficiency, reduced tillage requirements, saving labor and fuel, and reduced fertilizer inputs. However, due to the wide diversity of California agriculture, these practices must be demonstrated in a wide variety of cropping systems, soil types, irrigation regimes, and climate conditions.

This diversity also creates difficulty in quantifying both carbon emissions and potential carbon sequestration benefits from implementing conservation tillage and cover crops in the myriad of California cropping systems. This potential needs to be verified through extensive research directly applied to California conditions. Thus, the potential climate change emission reductions for 2010 and 2020 remains to be determined.

Enteric Fermentation

Enteric fermentation is the process of feed digestion by ruminant animals (primarily dairy and beef cattle). This process results in methane emission from the animals. To reduce climate change emissions resulting from enteric fermentation, feed adjustments may be made that improve milk and meat productivity.

New measures would include establishing a research initiative to quantify emission changes from enteric fermentation resulting from changing feed regimens versus productivity impacts. Different animal populations would have differing abilities to manage feed rations. For example, grass-fed beef would have little to no ability to reduce enteric emissions. Dairy operators vary feed rations based on numerous factors. Feed rations are a complex system that not only provide nutrition to the animal, but also provide cost-effective and efficient use of other agricultural by-products including food processing residuals, fruit culls, almond hulls, cotton seed, and even rice straw.

This system would have to be carefully analyzed to determine overall climate change emission effects if the use of these other residuals is altered. This analysis would include both a technical analysis and a cost effectiveness analysis that would be initiated in 2006.

Pricing of food commodities to reflect embodied climate change emissions is not recommended for any action at this time. A "calcium crisis" currently exists in this country, where a significant portion of women and children are calcium deficient. Milk and dairy products are a major source of calcium that should be available to these at-risk populations, especially those of low and moderate income, at affordable prices.

Green Buildings Initiative

Governor Schwarzenegger's Green Building Executive Order, S-20-04, sets an ambitious goal of reducing energy use in public and private buildings by 20 percent by the year 2015, as compared with 2003 levels. The Executive Order and related action plan spell out specific actions state agencies are to take with state-owned and -leased buildings. The order and plan also discuss various strategies and incentives to encourage private building owners and operators to achieve the 20 percent target.

Preliminary estimates indicate that 6.5 million tons of CO_2 will be reduced annually by the year 2015 through building efficiency efforts in commercial and institutional buildings. This number is based on the average displaced power generation being an efficient natural gas combined cycle turbine. The 6.5 million-ton estimate has been adjusted in Table 5-2 to ensure against double counting amongst other strategies being recommended by the CAT.

5.5 Strategies the Public Utilities Commission will Implement Over the Next Two Years

Table 5-4 lists all of the strategies that the Public Utilities Commission will implement over the next two years. Working in cooperation with the Energy Commission, the Public Utilities Commission has implemented the most progressive Renewable Portfolio Standard in the nation. The Public Utilities Commission has also been progressive in energy efficiency and clean energy programs for investor-owned utilities. Many stakeholders indicated that these programs should apply to the publicly-owned utilities as well.

Table 5-4. Public Utilities Commission

Climate Change Emission Reductions (Million Metric Tons CO_2 Equivalent)[1]	2010	2020
Accelerated Renewable Portfolio Std to33% by 2020 (includes load-serving entities)	5	11

California Solar Initiative	0.4	3
Investor Owned Utility Energy Efficiency Programs(including LSEs)	4	8.8
Investor-Owned Utility (IOU) Additional Energy Efficiency Programs/Demand Response	NA	6.3
IOU Combined Heat and Power Initiative	1.1	4.4
IOU Electricity Sector Carbon Policy	1.6	2.7

[1] These estimates are based on best available current information and will be updated as needed.

A summary description of each of the strategies in Table 5-4 is included below:

Accelerated Renewable Portfolio Standard (33 percent by 2020)

The Governor has set a goal of achieving 33 percent renewables in the State's resource mix by 2020. The joint PUC/Energy Commission September 2005 Energy Action Plan II (EAP II) adopts the 33 percent goal. The PUC and Energy Commission have already commenced review of the legal, regulatory, and infrastructure changes necessary to achieve the Governor's goal.

The Center for Resource Solutions has prepared a preliminary report for the CPUC entitled *Achieving a 33% Renewable Energy Target* (The Center for Resource Solutions, November 1, 2005), which concludes that the 33 percent target by 2020 is achievable and discusses the major hurdles and necessary implementation steps. The report is a starting point for further review by the CPUC on instituting a 33 percent goal.

California Solar Initiative

The solar initiative includes installation of 1 million solar roofs or an equivalent 3,000 MW by 2017 on homes and businesses, increased use of solar thermal systems to offset the increasing demand for natural gas, use of advanced metering in solar applications, and creation of a funding source that can provide rebates over 10 years through a declining incentive schedule.

Legislation to codify the Governor's initiative (SB 1) failed to pass the California Assembly in the fall of 2005. However, the PUC, in cooperation with the Energy Commission and the Governor's Office, will implement the California Solar Initiative under its existing statutory authority.

Investor-Owned Utility Energy Efficiency Programs

In September 2004, the PUC adopted aggressive savings targets for the investor-owned utility energy efficiency programs through 2013. The savings targets through 2013 are challenging goals to meet, and the PUC will reassess these targets and adopt more realistic goals during each three-year program cycle.

The PUC funds energy efficiency programs through the Public Goods Charge and the resource procurement budgets of the utilities. For the 2006–2008 program cycle, the total energy efficiency budget for all of the investor-owned

utilities is approximately $2 billion, for a total projected annual net savings of 7,371 gigawatt hours and 121,989 million therms. These projections exceed the savings targets by 108 percent and 109 percent respectively. By 2008 these programs will reduce annual carbon dioxide emissions by more than 3 million tons per year.

Investor Owned Utility Additional Energy Efficiency Programs/Demand Response

In September 2004, the PUC adopted aggressive savings targets for the IOUs' energy efficiency programs through 2013. The savings targets through 2013 are stretch goals and the PUC will reassess these targets and adopt the actual goals during each three-year program cycle. The PUC funds energy efficiency programs through the Public Goods Charge and the IOUs' resource procurement budgets. For the 2006–2008 program cycle, the total energy efficiency budget for all of the IOUs is approximately $2 billion, for a total projected annual net savings of 7,371 gigawatt hours and 121,989 million therms. These projections exceed the savings targets by 108 percent and 109 percent respectively. By 2008 these programs will reduce annual carbon dioxide emissions by more than 3 million tons per year.

Over the next year, the PUC will develop a risk/reward incentive mechanism for the IOUs and refine energy measurement and verification protocols. In 2008, the PUC will evaluate and adopt the 2009–2011 energy efficiency savings goals and programs of the IOUs.

Investor-Owned Utility Combined Heat and Power Initiative

This strategy encourages the installation of on-site power production to meet both heat and electricity loads, known as combined heat and power projects (CHP). The PUC's existing Self-Generation Incentive Program allocates $0.80 per watt to eligible CHP projects in the territories of the IOUs, up to a capacity size of 5 MW. Currently, all SGIP funds are reserved through 2007, although funding may become available if proposed projects do not materialize.

This strategy would seek to develop additional programs to further encourage the development of CHP. These additional programs are not yet underway, will require further consideration, and could likely require administrative, legislative, regulatory, and budget initiatives. To effectively implement this strategy, it is likely various policy instruments will be needed to attain the realistic market potential and subsequent CO_2 reductions.

These policy mechanisms may include regulatory incentives to encourage IOUs to promote customer and utility-owned CHP, changes to IOU rate design, market rules and regulations enabling easier access to wholesale markets, production tax credits for CHP, and other measures or incentives directed at key commercial and industrial activities in California. Statutory modifications are required in order to apply a similar strategy for CHP programs implemented by publicly-owned utilities.

Investor Owned Utility Electricity Sector Carbon Policy

The PUC is currently investigating various strategies and incentives to encourage the IOUs to make cost-effective procurement decisions that are based in part on reducing climate change emissions. These strategies include emissions targets or caps, incentives for preferred procurement options, and incentives for portfolio optimization and total cost minimization.

The PUC conducted workshops in March 2005 on the procurement incentive framework and issued a staff report in March 2005. The post-workshop comments were filed in April and May 2005. A final decision to include a carbon cap on emissions associated with all utility procurement activities was adopted in February of 2006. This strategy includes the following steps:

- Determine a methodology the IOUs will use to report their climate change emissions.
- Continue to work with the CEC to ensure that the IOUs and the municipal utilities use consistent methodologies to report their emissions.
- Begin work to establish emission baselines for IOUs.

5.6 The Governor's Targets Can Be Met

Based on the emission reduction potential demonstrated in the tables above and illustrated in Figure 2-1 below, it is clear the Governor's targets are achievable. However, continued top-down leadership as has been demonstrated by this Governor as well as a coordinated agency-level effort as has been achieved via the Climate Action Team will be essential to success.

Figure 5-1. California's Target Can Be Met

UNITED NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
GENERAL

FCCC/SBI/2006/26
19 October 2006

Original: ENGLISH

SUBSIDIARY BODY FOR IMPLEMENTATION
Twenty-fifth session
Nairobi, 6–14 November 2006

Item 3 (b) of the provisional agenda
National communications from Parties included in Annex I to the Convention
Report on national greenhouse gas inventory data from Parties included in Annex I to the Convention for the period 1990–2004

National greenhouse gas inventory data for the period 1990–2004 and status of reporting

Note by the secretariat*

Summary

In 2006, all 41 Parties included in Annex I to the Convention (Annex I Parties) submitted their greenhouse gas (GHG) inventories. Twenty-five inventories were submitted by the deadline of 15 April and most of the submissions (37 of 41) contained a national inventory report.

Total aggregate GHG emissions without emissions/removals from land use, land-use change and forestry (LULUCF) for Annex I Parties as a whole decreased by 3.3 per cent between 1990 and 2004 (by 4.9 per cent for GHG emissions with LULUCF). For Annex I Parties with economies in transition (EIT Parties) GHG emissions without LULUCF decreased by 36.8 per cent and GHG emissions with LULUCF decreased by 44.8 per cent. For the Annex I non-EIT Parties, GHG emissions without LULUCF increased by 11.0 per cent and GHG emissions with LULUCF increased by 12.1 per cent.

* This document was submitted later than originally expected in order to take into account the submissions and resubmissions of greenhouse gas inventories in September and October 2006.

CONTENTS

			Paragraphs	Page
I.	INTRODUCTION		1–4	3
	A.	Mandate	1	3
	B.	Scope of the note	2–3	3
	C.	Possible action by the Conference of the Parties and the Subsidiary Body for Implementation	4	3
II.	STATUS OF REPORTING		5–14	3
	A.	Inventory submissions in 2006	5	3
	B.	Reporting issues	6–12	4
	C.	Recalculations	13–14	6
III.	OVERVIEW OF EMISSION TRENDS AND SOURCES IN PARTIES INCLUDED IN ANNEX I TO THE CONVENTION		15–26	7
	A.	Total aggregate greenhouse gas emissions	15–17	7
	B.	Greenhouse gas emissions by gas	18	9
	C.	Greenhouse gas emissions by sector	19–21	9
	D.	Comparison of emissions estimates in 2005 and 2006 reports	22	10
	E.	Emissions data for individual Annex I Parties	23–26	11

I. Introduction

A. Mandate

1. The Conference of the Parties (COP), by its decisions 9/CP.2, 3/CP.5 and 18/CP.8, requested that Parties included in Annex I to the Convention (Annex I Parties) submit national inventory data on greenhouse gas (GHG) emissions from sources and removals by sinks by 15 April each year. Decision 19/CP.8 requested the secretariat to prepare annual reports on GHG inventory data submitted by Annex I Parties for consideration by the Subsidiary Body of Implementation (SBI) and the COP.[1] This document is a report on GHG inventory data submitted by Annex I Parties in 2006.

B. Scope of the note

2. This note presents the latest available data on GHG emissions and removals from Annex I Parties for the period 1990–2004, based on the national GHG inventories received by the secretariat by 9 October 2006. The document also shows the status of reporting of annual GHG emission inventories from Annex I Parties, highlighting the timeliness and completeness of reporting.

3. Data are provided for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and for hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together. In addition, total[2] aggregate[3] GHG emissions are presented, both including and excluding net GHG emissions/removals from land use, land-use change and forestry (LULUCF). Data on net emissions/removals from LULUCF (for CO_2, CH_4, and N_2O) are also provided.

C. Possible action by the Conference of the Parties and the Subsidiary Body for Implementation

4. The COP and the SBI may wish to take note of the information contained in this document and provide further guidance to Parties and the secretariat.

II. Status of reporting

A. Inventory submissions in 2006

5. The UNFCCC reporting guidelines on annual inventories require that Annex I Parties annually submit a national inventory report (NIR) and common reporting format (CRF) data tables covering data from the base year up to two years before the year of submission,[4] i.e., from 1990 up to 2004 in the 2006 submission. Table 1 summarizes the status of reporting for the 2006 submissions. It shows that all 41 Annex I Parties submitted their inventories in 2006 (25 of them by the due date of 15 April). In 2006, a GHG inventory of Turkey was received for the first time,[5] and a GHG inventory of the Russian Federation pursuant to decision 3/CP.5 was received[6] for the first time since 2000.

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[1] UNFCCC "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" (FCCC/CP/2002/8), paragraphs 42 and 43.

[2] The term 'total' implies that emissions from sectors of the common reporting format (CRF) are summed up; the inclusion of land use, land-use change and forestry (LULUCF) into the sum is indicated separately.

[3] The term 'aggregate' implies that GHG emissions are calculated as a weighted sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6; the sum is made using the global warming potentials agreed under the Convention (1 for CO_2, 21 for CH_4, 310 for N_2O, and specific values for individual HFCs, PFCs and SF_6).

[4] "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (FCCC/SBSTA/2006/9).

[5] Turkey ratified the Convention on 24 February 2004. Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Annex I Parties.

[6] The Russian Federation provided inventory data informally; the data are still subject to a formal approval procedure in the Russian Federation.

Table 1. Greenhouse gas inventory submissions from Annex I Parties in 2006

Party	CRF submission date[a]	CRF submission format[b]	Years reported[c]	Submission of NIR	Reporting of LULUCF data
Australia	*24 May 2006*	CRF-R	1990–2004	✓	✓
Austria	13 April 2006	CRF-R	1990–2004	✓	✓
Belarus	14 April 2006	CRF-R	1990–2004	✓	✓
Belgium	14 April 2006	CRF-A	1990–2004	✓	✓
Bulgaria	*18 April 2006*	CRF-A/CRF-R[d]	1988, 1990–2004	✓	✓
Canada	*11 May 2006*	CRF-R	1990–2004	✓	✓
Croatia	***31 August 2006***	CRF-R	1990–2004	–	✓
Czech Republic	13 April 2006	CRF-R	1990–2004	✓	✓
Denmark	12 April 2006	CRF-R	1990–2004	✓	✓
Estonia	12 April 2006	CRF-A	1990–2004	✓	✓[e]
European Community	15 April 2006	CRF-R	1990–2004	✓	✓
Finland	6 April 2006	CRF-R	1990–2004	✓	✓
France	15 February 2006	CRF-A/CRF-R[d]	1990–2004	✓	✓
Germany	3 March 2006	CRF-A	1990–2004	✓	✓
Greece	*16 April 2006*	CRF-R	1990–2004	✓	✓
Hungary	*19 April 2006*	CRF-R	1985–1987, 1985–2004	✓	✓
Iceland	***26 July 2006***	CRF-A	1990–2004	–	✓
Ireland	13 April 2006	CRF-R	1990–2004	✓	✓
Italy	*18 April 2006*	CRF-A	1990–2004	✓	✓
Japan	*25 May 2006*	CRF-R	1990–2004	✓	✓
Latvia	13 April 2006	CRF-R	1990–2004	✓	✓
Liechtenstein	***30 May 2006***	CRF-R	1990, 2004	✓	✓[e]
Lithuania	15 April 2006	CRF-R	2004	✓	✓[e]
Luxembourg	6 February 2006	CRF-A	1990–2004	✓	–
Monaco	***16 June 2006***	CRF-A	1990–2004	✓	✓
Netherlands	14 April 2006	CRF-R	1990–2004	✓	✓
New Zealand	13 April 2006	CRF-R	1990–2004	✓	✓
Norway	*27 May 2006*	CRF-R	1990–2004	✓	✓
Poland	15 April 2006	CRF-R	2004	✓	✓[e]
Portugal	13 April 2006	CRF-A	1990–2004	✓	✓
Romania	*5 May 2006*	CRF-R	1989–2004	✓	✓
Russian Federation	***9 October 2006***[f]	CRF-R	1990–2004	–	✓
Slovakia	13 April 2006	CRF-R	1990, 2000–2004	✓	✓
Slovenia	*26 April 2006*	CRF-R	1986, 1990–2004	–	✓[e]
Spain	12 April 2006	CRF-R	1990–2004	✓	✓
Sweden	13 April 2006	CRF-R	1990–2004	✓	✓
Switzerland	13 April 2006	CRF-A	1990–2004	✓	✓[e]
Turkey	14 April 2006	CRF-A	1990–2004	✓	–
Ukraine	*26 May 2006*	CRF-R	1990–2004	✓	✓
United Kingdom of Great Britain and Northern Ireland	13 April 2006	CRF-R	1990–2004	✓	✓
United States of America	5 April 2006	CRF-R	1990–2004	✓	✓

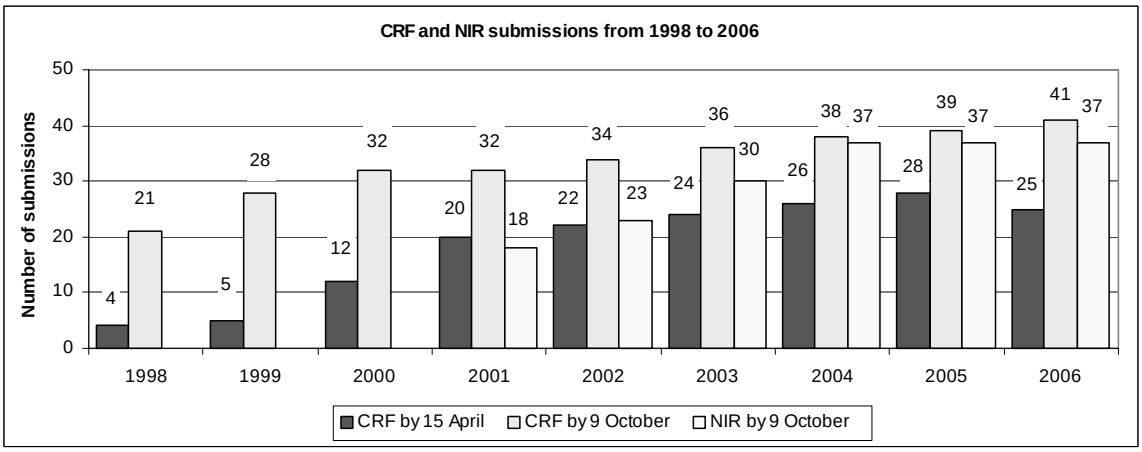
[a] Date of submission of common reporting format (CRF) data; the submission date for the national inventory report (NIR) may differ. The dates after 15 April 2006 are shown in italics; the dates after 27 May (six weeks after the submission deadline) are shown in bold.
[b] CRF-R indicates that the Party reported using the CRF Reporter software; CRF-A indicates that the Party reported using the CRF application.
[c] Indicates the years for which complete CRF tables were submitted in 2006; for some Parties, information on 1990–2004 emissions was provided in the CRF trend tables, although complete CRF tables were not submitted in 2006 for some years.
[d] The initial submission was with the CRF application, but later a resubmission with the CRF Reporter was made.
[e] Not all years from 1990 to 2004 were covered in the submitted land use, land-use change and forestry (LULUCF) data.
[f] An informal provision of national inventory data.

B. Reporting issues

1. Completeness and timeliness of reporting

6. Figure 1 illustrates the number of inventory submissions since 1998. It shows that 2006 was the first year when all 41 Annex I Parties submitted their inventories. Twenty-five submissions were made by the due date of 15 April and 37 of the submissions included an NIR.

Figure 1. Greenhouse gas inventory submissions from Annex I Parties, 1998–2006



Note: CRF = common reporting format; NIR = national inventory report.

7. According to table 1, 37 Parties reported complete CRF tables for all years from 1990[7] to 2004, which means a further improvement in the completeness of reporting (in 2005, 29 Parties reported complete CRF tables for all years). Twenty Parties submitted a revised version of their inventory after making the initial submission in order to improve the GHG estimates reported.

8. Some Parties still face problems in reporting complete annual GHG inventories on time. Five Parties (Croatia, Iceland, Liechtenstein, Monaco and the Russian Federation) submitted their CRF tables more than six weeks late and seven Parties (Italy, Liechtenstein, Lithuania, Monaco, Slovakia, Spain and Turkey) were late, also by more than six weeks, in submitting their NIR. Four Parties (Croatia, Iceland, Slovenia and the Russian Federation) had not submitted their NIRs by the time this document was prepared. Three reporting Parties have not provided data for some years (Liechtenstein, Lithuania and Poland).

2. Reporting of LULUCF data

9. The COP decided in 2003 (decision 13/CP.9) that Annex I Parties should use the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry* for preparing annual inventories under the Convention, due in 2005[8] and beyond.

10. The reporting of LULUCF data considerably improved in 2006. In 2005, only 20 Parties reported LULUCF data, whereas in 2006, 39 Parties (all reporting Parties except Luxembourg and Turkey) provided LULUCF data, although some Parties (Estonia, Liechtenstein, Lithuania, Poland, Slovenia and Switzerland) did not provide LULUCF data for some years (table 1).

3. Use of the CRF Reporter software

11. The COP, by its decision 18/CP.8, requested the secretariat to develop new software for reporting in the CRF in order to facilitate Parties' inventory submissions. The Subsidiary Body for Scientific and Technological Advice (SBSTA) invited Annex I Parties to use the new CRF software (CRF Reporter) to report the inventory submissions due in 2005. In 2005, the COP decided

[7] The Parties that are allowed to use a base year other than 1990 have also provided data for their respective base years as per COP decisions 9/CP.2 and 11/CP.4. These Parties and their base years are Bulgaria (1988), Hungary (average of 1985–1987), Poland (1988), Romania (1989) and Slovenia (1986).

[8] The year 2005 was a trial period for reporting under decision 13/CP.9.

(decision 7/CP.11) that Annex I Parties should use the CRF Reporter for the submission of their annual GHG inventories due from April 2006.

12. The number of Annex I Parties using the CRF Reporter increased greatly in 2006 – to 31 from only four in 2005. The ongoing work of the secretariat on the improvement of the CRF Reporter is expected to facilitate the further increase in the use of the CRF Reporter, aiming to ensure that all inventory submissions are made with the CRF Reporter as required by decision 7/CP.11.

C. Recalculations

13. The 2006 submissions confirm that Parties continue to implement recalculations, when required, in order to improve the quality of emission estimates. In 2006, 34 Parties conducted recalculations reflecting changes in activity data, emission factors and the methodologies used (table 2).

14. Many Parties conducted recalculations for all GHGs and all sectors, and, as a general rule, for all years in order to ensure the consistency of the time series. The impact of recalculations on GHG emissions varied widely – from very small numbers to sizeable values. For example, for 21 Parties the change in total aggregate GHG emissions without LULUCF in the base year after recalculations was less than 2 per cent but for 7 Parties the change was above 5 per cent (table 2).

Table 2. Inventory recalculations by Annex I Parties in 2006

Party	Recalculations conducted in 2006	Impact on base year GHG emissions without LULUCF (%)	Party	Recalculations conducted in 2006	Impact on base year GHG emissions without LULUCF (%)
Australia	✓	1.24	Liechtenstein	✓	106.99
Austria	✓	0.43	Lithuania	–	–
Belarus	✓	–2.55	Luxembourg	–	–
Belgium	✓	0.07	Monaco	–	–
Bulgaria	✓	–4.38	Netherlands	✓	0.46
Canada	✓	0.51	New Zealand	✓	0.60
Croatia	✓	19.10	Norway	✓	1.45
Czech Republic	✓	2.48	Poland	–	–
Denmark	✓	–1.09	Portugal	✓	0.98
Estonia	–	–	Romania	✓	–1.07
European Community	✓	6.57	Russian Federation	–	–
Finland	✓	1.02	Slovakia	✓	–
France	✓	–0.19	Slovenia	✓	0.17
Germany	✓	–1.40[a]	Spain	✓	1.13
Greece	✓	–0.62	Sweden	✓	0.21
Hungary	✓	0.75	Switzerland	✓	0.72
Iceland	✓	10.62	Turkey	–	–
Ireland	✓	3.38	Ukraine	✓	–6.75
Italy	✓	1.65	United Kingdom of Great Britain and Northern Ireland	✓	1.04[a]
Japan	✓	–11.69	United States of America	✓	17.49
Latvia	✓	2.14			

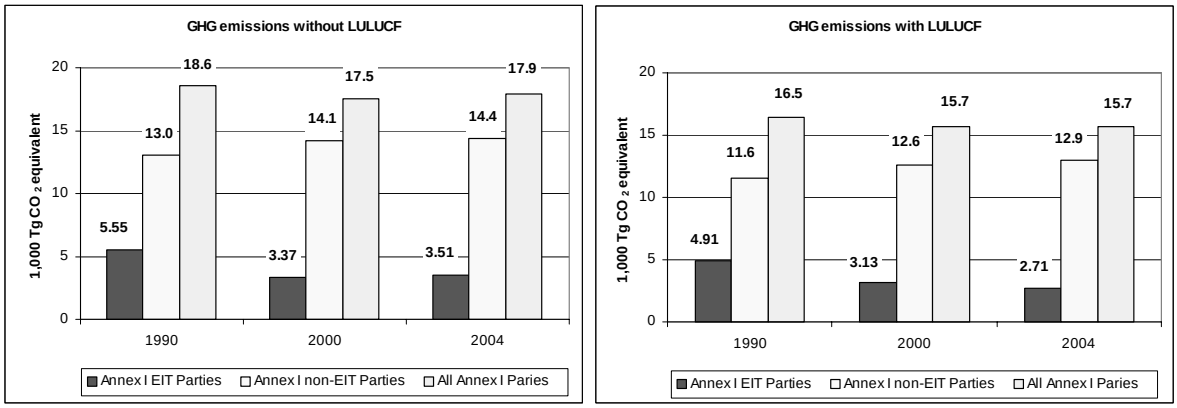
Note 1: The information in this table is based on the latest available inventory submissions.
Note 2: The recalculations for land use, land-use change and forestry (LULUCF) and the impact of recalculations on GHG emissions with LULUCF are not covered in this table because many Parties switched in 2006 from reporting with the LULUCF Excel tables to reporting with the LULUCF tables in the CRF Reporter, and therefore the recalculations were not reflected fully in the corresponding reporting tables.
[a] The Party has not estimated the impact of recalculations on base year emissions but the recalculated data were provided.

III. Overview of emission trends and sources in Parties included in Annex I to the Convention

A. Total aggregate greenhouse gas emissions

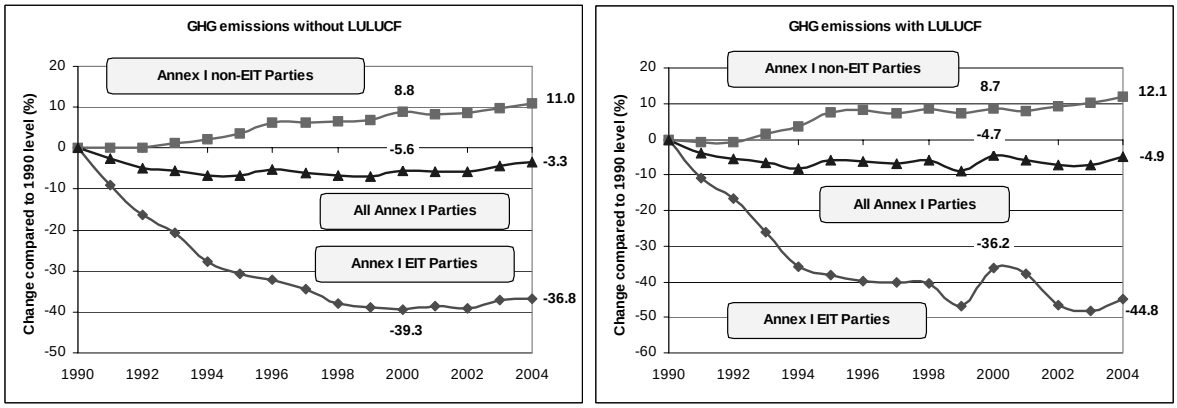
15. From 1990[9] to 2004, total aggregate GHG emissions without emissions/removals from LULUCF from Annex I Parties taken together decreased by 3.3 per cent, from 18.6 thousand to 17.9 thousand Tg[10] CO_2 equivalent (figures 2 and 3[11]). Total aggregate GHG emissions with LULUCF decreased by 4.9 per cent, from 16.5 thousand to 15.7 thousand Tg CO_2 equivalent. Since 2000, the emissions without LULUCF have increased somewhat, and the emissions with LULUCF have decreased slightly.

Figure 2. GHG emissions from Annex I Parties, 1990, 2000 and 2004



Note: For greenhouse gas (GHG) emissions with land use, land-use change and forestry (LULUCF), data for Estonia, Lithuania, Luxembourg, Poland, Slovenia, Switzerland and Turkey are not included because of the unavailability or incompleteness of some LULUCF data in the period 1990–2004.

Figure 3. Changes in GHG emissions from Annex I Parties, 1990–2004



Note: For greenhouse gas (GHG) emissions with land use, land-use change and forestry (LULUCF), data for Estonia, Lithuania, Luxembourg, Poland, Slovenia, Switzerland and Turkey are not included because of the unavailability or incompleteness of some LULUCF data in the period 1990–2004.

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[9] Unless specified otherwise, here and elsewhere in this document base year data are used in sums and totals instead of 1990 data (as per COP decisions 9/CP.2 and 11/CP.4) for Bulgaria (1988), Hungary (average of 1985–1987), Poland (1988), Romania (1989) and Slovenia (1986).

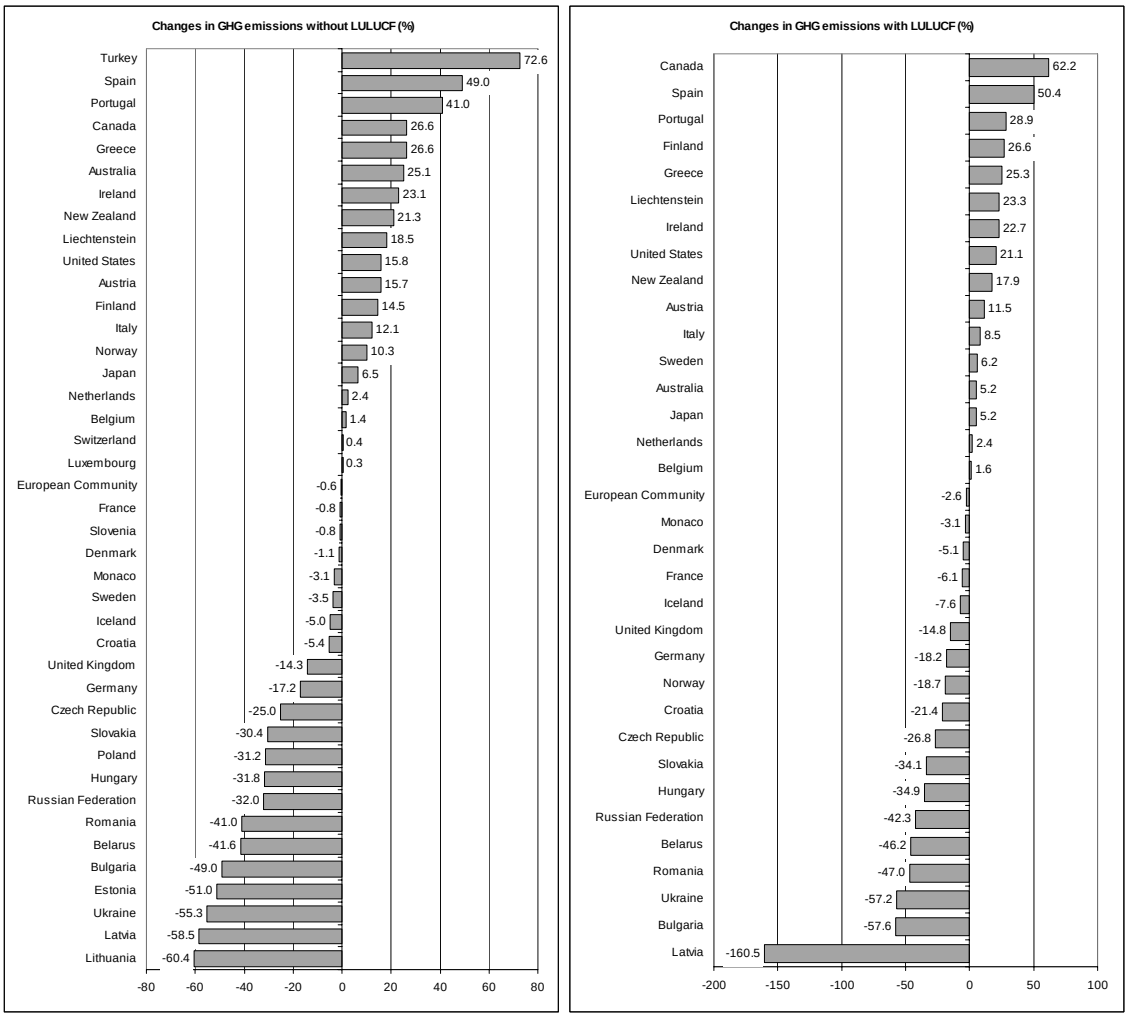
[10] One teragram (Tg) equals one million tonnes; one thousand Tg equals one billion tonnes.

[11] In these and other figures, interpolation was used for some Parties to fill in the missing data for some years; this did not have a meaningful impact on the totals and trends.

16. For Annex I Parties with economies in transition (EIT Parties), total aggregate GHG emissions without LULUCF decreased from 5.55 thousand Tg CO_2 equivalent in 1990 to 3.51 thousand Tg CO_2 equivalent in 2004 – a decrease of 36.8 per cent (of 44.8 per cent for GHG emissions with LULUCF). For the non-EIT Annex I Parties, total aggregate GHG emissions without LULUCF increased from 13.0 thousand Tg CO_2 equivalent in 1990 to 14.4 thousand Tg CO_2 equivalent in 2004 – an increase of 11.0 per cent (of 12.1 per cent for GHG emissions with LULUCF).

17. By country, changes in total aggregate GHG emissions from 1990 to 2004 varied greatly: from a decrease of 60.4 per cent (Lithuania) to an increase of 72.6 per cent (Turkey) for GHG emissions without LULUCF; and from a decrease of 160.5 per cent (Latvia) to an increase of 62.2 per cent (Canada) for GHG emissions with LULUCF (figure 4). Altogether, in 22 Annex I Parties total aggregate GHG emissions without LULUCF decreased from 1990 to 2004, whereas in 19 Parties the emissions increased. For total aggregate GHG emissions with LULUCF, in 18 Annex I Parties the emissions decreased from 1990 to 2004 and in 16 Parties the emissions increased.

Figure 4. Changes in total aggregate greenhouse gas emissions of individual Annex I Parties, 1990–2004

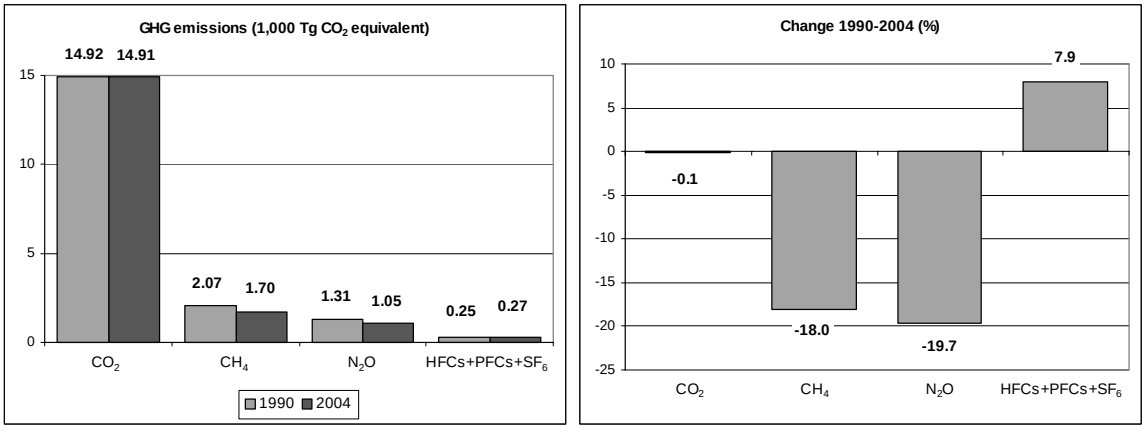


Note: For greenhouse gas (GHG) emissions with land use, land-use change and forestry (LULUCF), data for Estonia, Lithuania, Luxembourg, Poland, Slovenia, Switzerland and Turkey are not included because of the unavailability or incompleteness of some LULUCF data in the period 1990–2004.

B. Greenhouse gas emissions by gas

18. Figure 5 shows changes in total emissions (without LULUCF) of individual GHGs from Annex I Parties over the period 1990–2004. CO_2 emissions decreased by 0.1 per cent over this period, whereas the emissions of CH_4 and N_2O decreased by 18.0 and 19.7 per cent, respectively. The emissions of HFCs, PFCs and SF_6 taken together increased by 7.9 per cent (mostly because of increases in HFCs).

Figure 5. Annex I Party greenhouse gas emissions by gas, 1990 and 2004

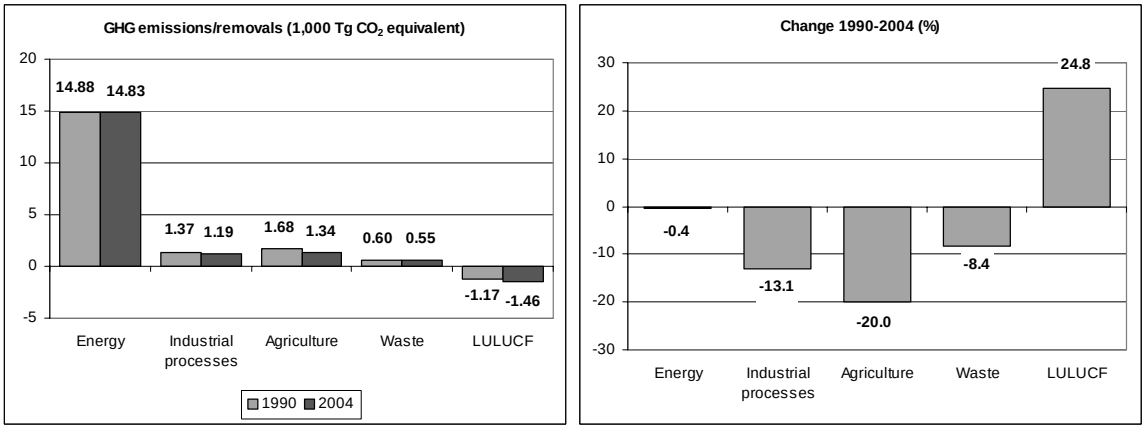


Note: HFCs = hydrofluorocarbons; PFCs = perfluorocarbons; SF_6 = sulphur hexafluoride.

C. Greenhouse gas emissions by sector

19. Figure 6 illustrates trends in aggregate GHG emissions from Annex I Parties by sector. For all Annex I Parties taken together, sectoral emissions decreased from 1990 to 2004, with the greatest decreases in agriculture (–20.0 per cent) and industrial processes (–13.1 per cent). The decrease in energy was the smallest (–0.4 per cent). Net GHG removals by LULUCF increased by 24.8 per cent.

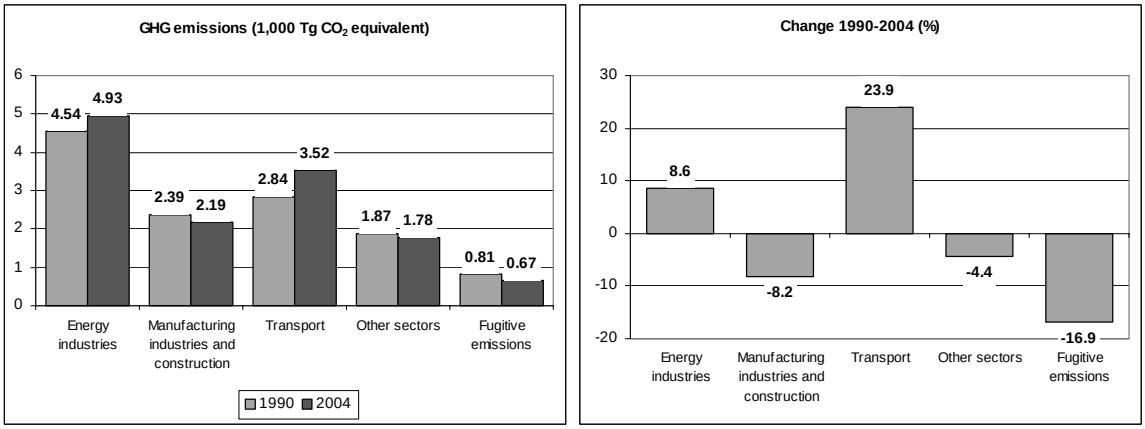
Figure 6. Annex I Party greenhouse gas emissions/removals by sector, 1990 and 2004



Note: LULUCF = land use, land-use change and forestry.

20. Within the Energy sector (figure 7), an increase in emissions occurred for energy industries and transport, whereas for manufacturing industries and construction as well as for other sectors and fugitive emissions the emissions decreased. The greatest increase occurred for transport, 23.9 per cent from 1990 to 2004; the greatest decline occurred for fugitive emissions, 16.9 per cent.

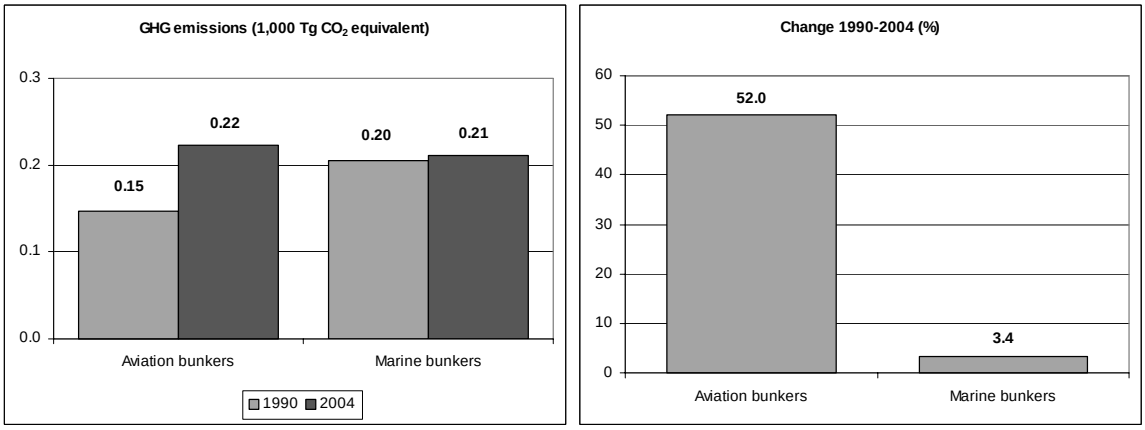
Figure 7. Annex I Party greenhouse gas emissions in the energy sector, 1990 and 2004



Note: Except for fugitive emissions, data for the Russian Federation are not included here because the emissions from subsectors in the energy sectors were reported with notation keys.

21. GHG emissions from fuels sold for use in international aviation increased by 52.0 per cent from 1990 to 2004 (figure 8). The emissions relating to fuels sold for use in international marine transportation increased by 3.4 per cent between 1990 and 2004.

Figure 8. Annex I Party greenhouse gas emissions from bunker fuels, 1990 and 2004



Note 1: For aviation bunker fuels, data for Estonia, Liechtenstein, Lithuania, Monaco, Poland, Romania, the Russian Federation, Slovakia, Turkey and Ukraine are not included because of their unavailability or incompleteness, or because the emissions were reported with notation keys for some years in the period 1990–2004.
Note 2: For marine bunker fuels, data for Estonia, Lithuania, Luxembourg, Poland, Romania, the Russian Federation and Turkey are not included because of their unavailability or incompleteness, or because the emissions were reported with notation keys for some years in the period 1990–2004.

D. Comparison of emissions estimates in 2005 and 2006 reports

22. In 2005, the UNFCCC secretariat published a similar GHG data report based on the submissions of GHG inventories in 2005. For transparency, table 3 compares the estimates for total aggregate GHG emissions without LULUCF in 1990 provided in that report (FCCC/SBI/2005/17) with the 1990 estimates provided in this report. This comparison shows that although the estimates have changed, there are substantive reasons for these changes.

Table 3. Comparison of the 2005 and 2006 estimates for total aggregate GHG emissions without LULUCF from Annex I Parties in 1990

	This document (FCCC/SBI/2006/26)	Last year's document (FCCC/SBI/2005/17)	Explanation for the difference between the 2006 and 2005 estimates
Total aggregate GHG emissions without LULUCF in 1990 (1,000 Tg CO_2 equivalent)			
All Annex I Parties	18.6	18.4	A combination of changes for EIT and non-EIT Parties, see the relevant explanations below.
EIT Parties	5.55	5.68	Inventory recalculations, in particular for Belarus, Bulgaria, Croatia, the Russian Federation and Ukraine.
Non-EIT Parties	13.0	12.7	The inclusion of Turkey in the 2006 data set (about 0.17 thousand Tg CO_2 equivalent in 1990); inventory recalculations, in particular for Ireland, Japan, and the United Kingdom.
Changes in total aggregate GHG emissions without LULUCF from 1990 to the latest available year (%)			
All Annex I Parties	–3.3	–5.9	A combination of changes for EIT and non-EIT Parties, see the relevant explanations below.
EIT Parties	–36.8	–39.6	Inventory recalculations, in particular for the Russian Federation and Ukraine; the difference between the extrapolated (in 2005) and real (in 2006) latest year data for the Russian Federation.
Non-EIT Parties	11.0	9.2	The inclusion of Turkey in the 2006 data set (with a higher emission growth from 1990 to 2004 than for the other non-EIT Parties); an increase in emissions from 2003 to 2004 in some Parties (e.g., in Spain and the United States).

Note: The explanations are intended to indicate only the major reasons for the changes. As emissions are driven by many parameters, it is not possible to list all possible reasons.

E. Emissions data for individual Annex I Parties

23. Tables 4–15 present detailed GHG data for individual Annex I Parties. Tables 4–5 contain total aggregate anthropogenic GHG emissions with and without net emissions/removals from LULUCF; tables 6–12 contain data on the emissions of CO_2, CH_4, N_2O (both with and without emissions/removals from LULUCF) and for the sum of HFCs, PFCs and SF_6; and tables 13–15 contain data on net GHG emissions/removals from LULUCF. Blank spaces in tables indicate that either no data were available by the time this document was prepared, or the emissions were reported, using the relevant notation keys, as not occurring (NO), not estimated (NE), not applicable (NA), included elsewhere (IE) or confidential (C).

24. The changes in emissions from 1990 to 2004 were calculated using the exact (not rounded) values and they may differ from a ratio calculated with the rounded numbers provided in the tables.

25. For the tables containing GHG emissions without LULUCF it should be noted that the presentations of national totals without emissions and removals from LULUCF exclude emissions and removals associated with carbon stock changes and other emission sources covered in the LULUCF sector. For the Parties which did not provide LULUCF data in 2006 or provided incomplete LULUCF data, the data on emissions with LULUCF are not included in the tables (either for the entire period from 1990 to 2004, or only for those years for which LULUCF data were not available).

26. Due to a page limitation on this report, data are presented only for 1990, 1995 and 2000–2004. More detailed data for the whole period 1990–2004, including disaggregated data by gas and by sector, can be found on the GHG page at the UNFCCC website <http://unfccc.int>.[12]

[12] Data from individual national submissions of GHG inventories from Annex I Parties can be found at <http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/3734.php>.

Table 4. Total aggregate anthropogenic emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, excluding emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004
	1990	1995	2000	2001	2002	2003	2004	(%)
Australia	423 074	450 243	504 196	517 407	520 073	520 199	529 230	25.1
Austria	78 944	80 218	81 263	85 130	86 843	92 511	91 299	15.7
Belarus*	127 361	72 938	69 788	68 172	68 145	69 815	74 364	–41.6
Belgium	145 766	152 339	147 411	146 841	145 090	147 530	147 873	1.4
Bulgaria*[a]	132 303	83 022	64 254	64 852	62 119	67 731	67 511	–49.0
Canada	598 911	648 685	725 048	718 819	725 547	753 751	758 067	26.6
Croatia*	31 124	21 913	25 268	26 424	27 609	29 192	29 432	–5.4
Czech Republic*	196 205	154 463	149 165	149 497	144 090	147 583	147 111	–25.0
Denmark	70 416	77 423	69 585	71 152	70 330	75 541	69 620	–1.1
Estonia*	43 491	22 287	19 662	19 416	19 524	21 387	21 322	–51.0
European Community[b]	4 252 461	4 144 433	4 129 317	4 174 119	4 155 328	4 216 469	4 228 006	–0.6
Finland	71 093	71 470	69 965	75 366	77 505	85 660	81 435	14.5
France	567 094	561 765	561 436	561 660	556 084	561 093	562 635	–0.8
Germany	1 226 296	1 094 740	1 022 798	1 034 912	1 018 644	1 024 377	1 015 273	–17.2
Greece	108 742	113 195	131 756	133 288	133 017	137 284	137 633	26.6
Hungary*[a]	123 145	84 360	81 875	84 546	81 556	84 334	83 924	–31.8
Iceland	3 277	3 080	3 545	3 515	3 536	3 459	3 112	–5.0
Ireland	55 614	58 923	68 729	70 550	68 985	68 361	68 460	23.1
Italy	519 600	532 642	554 611	561 290	561 790	577 411	582 520	12.1
Japan	1 272 095	1 342 084	1 345 531	1 320 588	1 352 996	1 358 324	1 355 175	6.5
Latvia*	25 893	12 184	9 929	10 660	10 581	10 705	10 746	–58.5
Liechtenstein	229					264	271	18.5
Lithuania*	50 934			20 356	19 588	17 224	20 193	–60.4
Luxembourg	12 688	9 977	9 688	9 966	10 964	11 433	12 722	0.3
Monaco	108	115	117	119	117	111	104	–3.1
Netherlands	212 963	225 070	214 433	216 206	214 932	215 697	218 086	2.4
New Zealand	61 893	64 535	70 315	73 065	73 618	75 606	75 088	21.3
Norway	49 792	49 895	53 500	54 730	53 469	54 332	54 931	10.3
Poland*[a]	564 408	417 349	386 181	382 787	370 239	382 639	388 063	–31.2
Portugal	59 954	71 263	82 178	83 728	88 198	83 682	84 546	41.0
Romania*[a]	262 281	176 670	131 842	136 569	142 672	148 622	154 626	–41.0
Russian Federation*	2 974 863	2 173 890	1 944 767	1 974 872	1 961 415	2 021 587	2 024 229	–32.0
Slovakia*	73 360	53 347	49 378	52 499	50 516	51 091	51 025	–30.4
Slovenia*[a]	20 220	18 543	18 822	19 746	19 939	19 666	20 059	–0.8
Spain	287 152	317 941	384 246	384 552	402 060	408 169	427 905	49.0
Sweden	72 361	73 894	68 389	69 067	70 073	70 907	69 854	–3.5
Switzerland	52 826	51 029	51 655	52 506	51 493	52 529	53 019	0.4
Turkey**	170 187	220 864	278 924	260 963	268 849	284 135	293 810	72.6
Ukraine*	925 362	521 149	395 095	398 950	400 479	416 017	413 411	–55.3
United Kingdom	776 142	714 321	672 195	679 700	659 243	664 471	665 330	–14.3
United States of America	6 103 283	6 477 148	6 975 929	6 886 890	6 909 407	6 952 561	7 067 570	15.8
Decrease in emissions by more than 1 per cent (number of Parties)								*19*
Change in emissions within 1 per cent (number of Parties)								*5*
Increase in emissions by more than 1 per cent (number of Parties)								*17*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 5. Total aggregate anthropogenic emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, including emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	506 886	470 410	520 757	530 445	537 070	514 585	533 495	5.2
Austria	66 983	65 806	65 237	66 367	71 718	75 914	74 670	11.5
Belarus*	116 054	57 509	55 662	53 766	54 848	57 830	62 464	–46.2
Belgium	144 335	150 953	145 860	144 043	142 753	145 813	146 700	1.6
Bulgaria*[a]	106 997	62 566	45 447	44 268	40 624	52 868	45 403	–57.6
Canada	517 146	842 979	594 115	597 730	731 670	742 425	838 907	62.2
Croatia*	16 687	1 378	5 983	8 647	10 813	12 544	13 111	–21.4
Czech Republic*	194 474	146 694	142 338	142 483	137 984	141 894	142 306	–26.8
Denmark	70 968	75 758	71 227	70 396	68 365	73 600	67 341	–5.1
Estonia*							13 307	
European Community[b]	4 047 252	3 904 730	3 875 904	3 892 234	3 863 562	3 937 559	3 941 605	–2.6
Finland	49 711	56 092	53 673	56 341	58 641	67 815	62 949	26.6
France	543 719	534 185	527 547	521 721	508 864	510 693	510 818	–6.1
Germany	1 198 055	1 063 578	988 866	1 000 206	983 716	988 929	979 442	–18.2
Greece	105 549	108 826	128 797	127 990	127 561	131 755	132 231	25.3
Hungary*[a]	120 408	76 312	78 656	80 093	77 001	79 496	78 405	–34.9
Iceland	5 372	5 113	5 491	5 445	5 447	5 346	4 963	–7.6
Ireland	55 722	59 129	68 727	70 376	68 793	67 978	68 389	22.7
Italy	439 879	429 436	454 899	451 133	447 455	466 070	477 412	8.5
Japan	1 197 474	1 260 713	1 260 566	1 235 780	1 267 663	1 263 346	1 260 296	5.2
Latvia*	5 223	–5 465	–4 181	–3 527	–2 545	–2 930	–3 158	–160.5
Liechtenstein	190						235	23.3
Lithuania*						10 234	24 547	
Luxembourg								
Monaco	108	115	117	119	117	111	104	–3.1
Netherlands	215 355	227 271	216 850	218 594	217 314	218 071	220 441	2.4
New Zealand	42 915	49 450	50 099	52 551	52 374	52 864	50 606	17.9
Norway	35 224	36 071	28 242	27 615	27 224	28 347	28 623	–18.7
Poland*[a]							361 907	
Portugal	63 484	69 361	78 095	79 831	83 773	91 603	81 804	28.9
Romania*[a]	226 338	139 215	95 017	98 902	107 542	113 822	119 959	–47.0
Russian Federation*	3 165 135	2 034 099	2 310 060	2 224 094	1 784 954	1 659 440	1 825 709	–42.3
Slovakia*	70 972	50 663	46 992	47 291	45 290	46 276	46 795	–34.1
Slovenia*[a]		13 526	13 647	14 471	14 443	14 348	14 415	
Spain	264 125	293 194	354 026	352 792	370 637	377 935	397 362	50.4
Sweden	50 244	56 816	50 276	52 909	53 565	54 567	53 375	6.2
Switzerland	51 047							
Turkey**								
Ukraine*	891 541	478 741	357 059	356 958	363 154	376 803	381 274	–57.2
United Kingdom	779 072	715 367	671 776	679 129	658 145	663 312	663 407	–14.8
United States of America	5 198 588	5 868 408	6 222 796	6 125 140	6 147 158	6 184 290	6 294 315	21.1
Decrease in emissions by more than 1 per cent (number of Parties)								*18*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*16*

Note: Negative values in Gg mean removals; positive values in Gg mean emissions.

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.

[b] Emission estimates of the European Community are reported separately from those of its member States.

[*] A Party undergoing the process of transition to a market economy (an EIT Party).

[**] Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 6. Total anthropogenic CO_2 emissions excluding emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 1990	1995	2000	2001	2002	2003	2004	Change from 1990 to 2004 (%)
Australia	279 384	306 736	351 951	359 603	364 728	372 879	381 803	36.7
Austria	61 925	63 655	66 178	70 171	71 935	77 553	77 077	24.5
Belarus*	101 947	56 233	51 911	50 988	51 231	51 396	54 920	–46.1
Belgium	119 081	123 632	123 986	124 110	123 311	126 974	126 907	6.6
Bulgaria*[a]	98 302	64 744	50 176	51 851	49 083	53 795	53 096	–46.0
Canada	460 331	493 437	566 257	559 937	567 463	593 063	593 093	28.8
Croatia*	23 035	16 250	19 417	20 434	21 498	22 883	22 551	–2.1
Czech Republic*	165 060	132 125	129 017	129 033	124 040	128 075	127 297	–22.9
Denmark	54 045	61 514	54 428	56 077	55 630	60 879	55 395	2.5
Estonia*	38 107	19 315	16 849	17 083	17 312	19 106	19 232	–49.5
European Community[b]	3 357 255	3 283 298	3 355 237	3 420 438	3 415 643	3 484 853	3 505 887	4.4
Finland	56 745	58 105	57 113	62 563	65 043	73 099	69 115	21.8
France	395 085	392 983	405 647	409 263	404 705	412 091	417 353	5.6
Germany	1 030 231	920 155	886 258	899 301	886 480	892 545	885 854	–14.0
Greece	84 314	87 426	103 963	106 210	105 905	109 914	110 280	30.8
Hungary*[a]	85 596	61 655	58 735	60 260	58 623	61 686	59 994	–29.9
Iceland	2 084	2 216	2 582	2 592	2 683	2 626	2 283	9.5
Ireland	32 559	34 783	44 241	46 704	45 701	44 519	45 266	39.0
Italy	434 489	445 384	463 311	469 062	470 821	486 126	489 590	12.7
Japan	1 144 130	1 226 390	1 254 619	1 239 275	1 276 772	1 284 376	1 285 814	12.4
Latvia*	18 598	8 802	6 907	7 410	7 331	7 477	7 485	–59.8
Liechtenstein	201					240	239	18.8
Lithuania*	38 920			13 326	12 704	12 287	13 350	–65.7
Luxembourg	11 995	9 276	8 952	9 227	10 226	10 702	11 997	0.0
Monaco	105	112	113	114	112	107	100	–4.9
Netherlands	159 389	170 625	169 577	175 163	174 910	178 528	180 944	13.5
New Zealand	25 373	27 201	31 037	33 042	33 030	34 681	34 039	34.2
Norway	34 758	37 774	41 531	42 917	42 036	43 550	43 982	26.5
Poland*[a]	476 625	348 172	314 812	317 844	308 277	319 082	316 700	–33.6
Portugal	43 366	53 131	63 762	65 018	69 250	64 600	65 705	51.5
Romania*[a]	188 488	132 826	95 621	100 380	107 626	113 050	116 361	–38.3
Russian Federation*	2 392 524	1 728 177	1 556 492	1 583 130	1 565 952	1 619 711	1 617 937	–32.4
Slovakia*	60 537	43 841	40 924	43 896	41 945	42 362	42 498	–29.8
Slovenia*[a]	16 217	14 908	15 177	16 145	16 212	16 012	16 464	1.5
Spain	228 562	255 724	307 673	311 552	330 551	333 837	354 562	55.1
Sweden	56 601	58 206	53 503	54 245	55 401	56 469	55 360	–2.2
Switzerland	44 513	43 336	43 918	44 697	43 798	44 894	45 317	1.8
Turkey**	139 594	171 854	223 806	207 379	216 433	230 987	241 884	73.3
Ukraine*	719 367	393 514	296 534	298 875	301 293	320 543	316 942	–55.9
United Kingdom	590 319	549 820	548 045	563 371	547 341	558 938	562 359	–4.7
United States of America	5 005 255	5 325 290	5 864 465	5 795 192	5 815 889	5 877 677	5 987 984	19.6
Decrease in emissions by more than 1 per cent (number of Parties)								*17*
Change in emissions within 1 per cent (number of Parties)								*1*
Increase in emissions by more than 1 per cent (number of Parties)								*23*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 7. Total anthropogenic CO_2 emissions including emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 1990	1995	2000	2001	2002	2003	2004	Change from 1990 to 2004 (%)
Australia	356 938	323 190	364 979	368 295	374 067	360 341	378 694	6.1
Austria	49 953	49 232	50 141	51 395	56 799	60 947	60 436	21.0
Belarus*	90 629	40 791	37 770	36 570	37 906	39 392	43 006	–52.5
Belgium	117 650	122 246	122 436	121 313	120 974	125 257	125 734	6.9
Bulgaria*[a]	72 996	44 287	31 369	31 267	27 588	38 932	30 987	–57.5
Canada	372 936	649 398	433 020	434 912	557 681	568 573	651 956	74.8
Croatia*	8 598	-4 285	131	2 657	4 701	6 235	6 230	–27.5
Czech Republic*	163 281	124 314	122 136	121 960	117 875	122 326	122 427	–25.0
Denmark	54 597	59 849	56 070	55 321	53 665	58 939	53 115	–2.7
Estonia*							11 216	
European Community[b]	3 147 251	3 039 463	3 097 511	3 134 853	3 120 253	3 201 867	3 215 255	2.2
Finland	35 305	42 698	40 788	43 501	46 140	55 220	50 602	43.3
France	367 983	362 191	368 775	366 500	354 721	358 980	362 925	–1.4
Germany	1 001 616	888 618	851 904	864 173	851 131	856 675	849 602	–15.2
Greece	81 065	83 019	100 821	100 886	100 445	104 381	104 866	29.4
Hungary*[a]	82 827	53 583	55 486	55 779	54 040	56 819	54 447	–34.3
Iceland	3 715	3 784	4 064	4 058	4 128	4 048	3 669	–1.2
Ireland	32 668	34 988	44 239	46 530	45 509	44 137	45 195	38.3
Italy	354 575	342 067	363 283	358 845	356 452	374 713	383 670	8.2
Japan	1 069 336	1 144 901	1 169 583	1 154 394	1 191 376	1 189 358	1 190 889	11.4
Latvia*	–2 094	–8 886	–7 265	–6 815	–5 838	–6 200	–6 456	208.4
Liechtenstein	163						203	24.5
Lithuania*						5 298	17 705	
Luxembourg								
Monaco	105	112	113	114	112	107	100	–4.9
Netherlands	161 781	172 826	171 993	177 551	177 292	180 902	183 300	13.3
New Zealand	6 292	11 970	10 714	12 425	11 688	11 845	9 473	50.6
Norway	20 157	23 934	16 256	15 788	15 773	17 533	17 659	–12.4
Poland*[a]							290 541	
Portugal	46 727	51 043	59 533	61 024	64 687	71 913	62 842	34.5
Romania*[a]	152 544	95 371	58 787	62 711	72 486	78 247	81 693	–46.4
Russian Federation*	2 578 794	1 587 445	1 918 147	1 830 252	1 385 925	1 251 645	1 417 864	–45.0
Slovakia*	58 131	41 145	38 521	38 671	36 702	37 529	38 247	–34.2
Slovenia*[a]		9 891	10 001	10 870	10 716	10 694	10 821	
Spain	205 535	230 977	277 453	279 792	299 128	303 602	324 020	57.6
Sweden	34 313	40 993	35 213	37 914	38 722	39 958	38 709	12.8
Switzerland	42 729							
Turkey**								
Ukraine*	685 528	351 081	258 490	256 863	263 951	281 319	284 800	–58.5
United Kingdom	593 235	550 854	547 605	562 774	546 221	557 759	560 418	–5.5
United States of America	4 094 882	4 710 403	5 104 958	5 027 205	5 047 250	5 102 830	5 207 890	27.2
Decrease in emissions by more than 1 per cent (number of Parties)								*16*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*18*

Note: Negative values in Gg mean removals; positive values in Gg mean emissions.

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.

[b] Emission estimates of the European Community are reported separately from those of its member States.

[*] A Party undergoing the process of transition to a market economy (an EIT Party).

[**] Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 8. Total anthropogenic CH_4 emissions excluding emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	119 497	120 006	123 514	126 894	124 438	117 982	117 874	–1.4
Austria	9 171	8 513	7 592	7 470	7 329	7 357	7 407	–19.2
Belarus*	15 122	11 719	11 479	11 298	11 234	12 126	12 645	–16.4
Belgium	10 825	10 661	9 471	8 960	8 468	8 085	7 916	–26.9
Bulgaria*[a]	21 864	12 390	9 035	8 317	8 480	9 358	9 766	–55.3
Canada	81 922	96 257	105 930	107 487	107 319	108 167	110 233	34.6
Croatia*	3 233	2 532	2 544	2 690	2 745	2 925	3 015	–6.7
Czech Republic*	18 546	13 542	11 483	11 405	11 380	11 054	10 835	–41.6
Denmark	5 710	6 044	5 900	6 047	6 005	5 986	5 794	1.5
Estonia*	4 360	2 561	2 403	1 969	1 898	1 968	1 725	–60.4
European Community[b]	428 461	403 589	358 485	347 223	337 883	327 675	318 596	–25.6
Finland	6 323	6 098	5 410	5 283	5 078	4 876	4 694	–25.8
France	68 728	69 540	64 377	63 133	61 476	60 148	58 840	–14.4
Germany	99 795	81 748	64 912	62 084	59 162	56 172	51 443	–48.5
Greece	9 119	9 188	8 950	8 562	8 553	8 477	8 412	–7.8
Hungary*[a]	13 355	10 030	10 074	10 331	9 734	9 494	9 136	–31.6
Iceland	413	466	488	490	473	472	469	13.4
Ireland	13 216	13 659	13 376	13 173	13 147	13 736	13 285	0.5
Italy	41 522	44 075	45 012	44 313	42 839	42 510	41 823	0.7
Japan	33 382	30 960	26 977	26 181	25 219	24 735	24 424	–26.8
Latvia*	3 485	2 008	1 742	1 835	1 844	1 748	1 804	–48.2
Liechtenstein	12.9					15.2	13.9	7.7
Lithuania*	7 938			3 172	3 557	3 600	3 251	–59.0
Luxembourg	497	483	479	473	471	471	455	–8.5
Monaco	0.64	0.79	0.79	0.81	0.76	0.68	0.63	–1.1
Netherlands	25 441	23 792	19 251	18 884	17 992	17 547	17 304	–32.0
New Zealand	25 572	25 836	26 860	27 034	27 051	27 015	27 086	5.9
Norway	4 762	5 084	4 953	4 959	4 792	4 823	4 801	0.8
Poland*[a]	65 944	51 598	45 848	38 816	37 787	37 684	39 025	–40.8
Portugal	11 226	12 352	12 325	12 243	12 537	12 554	12 256	9.2
Romania*[a]	50 853	30 689	26 774	26 062	26 376	26 569	26 939	–47.0
Russian Federation*	353 092	294 906	267 085	269 552	272 370	281 040	286 041	–19.0
Slovakia*	6 430	5 182	4 532	4 443	4 556	4 570	4 265	–33.7
Slovenia*[a]	2 354	2 107	2 139	2 084	2 154	2 104	2 075	–11.8
Spain	27 467	30 123	34 759	35 516	36 069	36 112	36 633	33.4
Sweden	6 673	6 672	6 091	6 072	5 899	5 737	5 753	–13.8
Switzerland	4 529	4 080	3 769	3 795	3 705	3 678	3 683	–18.7
Turkey**	29 336	42 683	49 347	48 721	46 956	47 854	46 367	58.1
Ukraine*	151 162	94 340	76 883	76 463	75 766	74 519	74 113	–51.0
United Kingdom	103 640	90 242	68 505	62 671	59 691	53 603	51 823	–50.0
United States of America	618 064	608 945	566 941	560 259	559 804	564 371	556 737	–9.9
Decrease in emissions by more than 1 per cent (number of Parties)								*30*
Change in emissions within 1 per cent (number of Parties)								*3*
Increase in emissions by more than 1 per cent (number of Parties)								*8*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 9. Total anthropogenic CH_4 emissions including emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	124 412	122 922	126 290	130 307	130 453	123 421	123 666	–0.6
Austria	9 172	8 513	7 592	7 470	7 329	7 357	7 407	–19.2
Belarus*	15 126	11 725	11 484	11 301	11 250	12 135	12 648	–16.4
Belgium								
Bulgaria*[a]								
Canada	85 376	119 886	107 334	109 896	117 113	116 269	123 775	45.0
Croatia*								
Czech Republic*	18 590	13 580	11 531	11 458	11 434	11 109	10 895	–41.4
Denmark								
Estonia*							1 726	
European Community[b]	429 703	404 628	359 699	348 150	338 808	329 071	319 418	–25.7
Finland	6 345	6 112	5 420	5 300	5 095	4 890	4 702	–25.9
France	69 576	70 311	65 165	63 843	62 192	60 875	59 468	–14.5
Germany								
Greece	9 169	9 222	9 117	8 585	8 556	8 482	8 423	–8.1
Hungary*[a]	13 385	10 052	10 101	10 356	9 760	9 520	9 162	–31.6
Iceland	462	515	537	539	522	521	518	12.0
Ireland								
Italy	41 665	44 103	45 099	44 368	42 870	42 575	41 858	0.5
Japan	33 482	31 031	27 024	26 231	25 262	24 759	24 456	–27.0
Latvia*	3 504	2 044	1 798	1 870	1 882	1 785	1 837	–47.6
Liechtenstein								
Lithuania*								
Luxembourg								
Monaco								
Netherlands								
New Zealand	25 665	25 970	26 956	27 128	27 140	27 100	27 161	5.8
Norway	4 779	5 086	4 957	4 960	4 796	4 840	4 803	0.5
Poland*[a]	65 944	51 598	45 848	38 816	37 787	37 684	39 027	–40.8
Portugal	11 379	12 521	12 457	12 330	12 663	13 106	12 366	8.7
Romania*[a]	50 853	30 690	26 782	26 065	26 384	26 570	26 940	–47.0
Russian Federation*	356 725	295 760	270 389	271 459	275 607	286 414	287 451	–19.4
Slovakia*	6 444	5 192	4 546	4 457	4 570	4 586	4 282	–33.6
Slovenia*[a]								
Spain	27 467	30 123	34 759	35 516	36 069	36 112	36 633	33.4
Sweden	6 685	6 684	6 103	6 083	5 911	5 751	5 766	–13.7
Switzerland	4 530							
Turkey**								
Ukraine*	151 171	94 355	76 886	76 477	75 777	74 525	74 114	–51.0
United Kingdom	103 654	90 254	68 525	62 694	59 711	53 622	51 840	–50.0
United States of America								
Decrease in emissions by more than 1 per cent (number of Parties)								*17*
Change in emissions within 1 per cent (number of Parties)								*4*
Increase in emissions by more than 1 per cent (number of Parties)								*5*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 10. Total anthropogenic N_2O emissions excluding emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	18 607	20 781	25 428	26 765	26 402	24 448	24 198	30.0
Austria	6 242	6 575	6 192	6 075	6 069	6 039	5 283	–15.4
Belarus*	10 293	4 985	6 398	5 885	5 680	6 208	6 718	–34.7
Belgium	12 010	13 071	12 588	12 413	11 886	10 782	11 210	–6.7
Bulgaria*[a]	12 061	5 838	4 911	4 568	4 443	4 434	4 395	–63.6
Canada	45 123	49 295	41 212	39 967	39 786	40 941	43 982	–2.5
Croatia*	3 920	3 123	3 284	3 251	3 317	3 221	3 677	–6.2
Czech Republic*	12 599	8 720	8 253	8 486	8 198	7 739	8 312	–34.0
Denmark	10 616	9 539	8 575	8 328	7 975	7 929	7 628	–28.1
Estonia*	1 024	410	410	364	314	313	364	–64.4
European Community[b]	410 895	390 153	351 793	345 177	337 475	337 404	337 032	–18.0
Finland	7 930	7 169	6 867	6 788	6 857	6 976	6 895	–13.1
France	93 253	91 441	79 820	77 456	75 546	73 510	71 200	–23.6
Germany	84 408	77 308	59 205	59 930	59 358	62 012	63 861	–24.3
Greece	14 113	13 073	13 408	13 217	13 169	13 252	13 155	–6.8
Hungary*[a]	23 844	12 435	12 509	13 368	12 473	12 304	13 889	–41.8
Iceland	360	339	348	342	308	302	322	–10.5
Ireland	9 802	10 279	10 521	10 054	9 566	9 400	9 243	–5.7
Italy	41 098	41 420	43 443	43 905	43 410	43 215	44 398	8.0
Japan	32 744	33 547	29 916	26 425	26 028	25 754	25 795	–21.2
Latvia*	3 810	1 372	1 270	1 403	1 392	1 463	1 436	–62.3
Liechtenstein	14.3					8.6	13.9	–2.8
Lithuania*	4 077			3 844	3 292	1 314	3 554	–12.8
Luxembourg	180	202	211	220	220	214	223	24.1
Monaco	1.6	2.6	3.3	3.4	3.3	3.2	3.1	90.6
Netherlands	21 219	22 394	19 867	18 844	17 970	17 374	17 748	–16.4
New Zealand	10 420	11 190	12 100	12 476	12 816	13 071	13 257	27.2
Norway	4 703	4 397	4 524	4 428	4 609	4 436	4 591	–2.4
Poland*[a]	21 840	16 734	23 895	23 946	22 633	23 936	30 004	37.4
Portugal	5 360	5 771	5 951	6 295	6 195	6 225	6 227	16.2
Romania*[a]	19 591	11 380	9 031	9 694	8 223	8 527	10 806	–44.8
Russian Federation*	214 774	136 304	104 578	105 203	105 770	102 756	101 466	–52.8
Slovakia*	6 122	4 178	3 821	4 053	3 885	3 989	4 073	–33.5
Slovenia*[a]	1 363	1 201	1 341	1 339	1 369	1 331	1 284	–5.8
Spain	27 771	26 508	33 028	31 777	31 076	32 750	31 570	13.7
Sweden	8 535	8 373	7 880	7 776	7 730	7 653	7 647	–10.4
Switzerland	3 541	3 349	3 264	3 233	3 225	3 157	3 156	–10.9
Turkey**	1 257	6 327	5 740	4 836	5 414	5 252	5 494	336.9
Ukraine*	54 630	33 142	21 579	23 516	23 336	20 888	22 276	–59.2
United Kingdom	68 376	57 055	44 256	42 122	40 473	40 108	40 795	–40.3
United States of America	389 204	448 086	409 834	406 583	401 007	379 500	379 874	–2.4
Decrease in emissions by more than 1 per cent (number of Parties)								*32*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*9*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
[*] A Party undergoing the process of transition to a market economy (an EIT Party).
[**] Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 11. Total anthropogenic N_2O emissions including emissions/removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	19 950	21 577	26 186	27 698	28 045	25 933	25 779	29.2
Austria	6 254	6 586	6 203	6 088	6 080	6 049	5 295	–15.3
Belarus*	10 299	4 992	6 409	5 895	5 691	6 218	6 727	–34.7
Belgium								
Bulgaria*[a]								
Canada	47 298	63 998	42 113	41 493	45 896	46 002	52 416	10.8
Croatia*								
Czech Republic*	12 604	8 724	8 258	8 491	8 204	7 744	8 318	–34.0
Denmark	10 616	9 539	8 575	8 328	7 975	7 929	7 628	–28.1
Estonia*								
European Community[b]	414 449	393 247	354 892	347 949	340 175	340 084	340 441	–17.9
Finland	7 967	7 185	6 890	6 808	6 878	6 997	6 915	–13.2
France	96 132	93 882	82 016	79 570	77 594	75 495	73 184	–23.9
Germany	84 783	77 683	59 627	60 352	59 780	62 433	64 282	–24.2
Greece	14 119	13 077	13 425	13 220	13 169	13 252	13 156	–6.8
Hungary*[a]	23 847	12 438	12 512	13 371	12 475	12 307	13 891	–41.7
Iceland	775	754	764	757	724	717	738	–4.9
Ireland								
Italy	41 147	41 503	43 673	43 911	43 413	43 222	45 177	9.8
Japan	32 816	33 594	29 940	26 448	26 048	25 770	25 808	–21.4
Latvia*	3 812	1 376	1 276	1 407	1 396	1 467	1 440	–62.2
Liechtenstein								
Lithuania*								
Luxembourg								
Monaco								
Netherlands								
New Zealand	10 429	11 203	12 110	12 486	12 825	13 080	13 265	27.2
Norway	4 718	4 410	4 537	4 441	4 623	4 451	4 604	–2.4
Poland*[a]							30 004	
Portugal	5 376	5 788	5 964	6 304	6 208	6 281	6 238	16.0
Romania*[a]	19 591	11 380	9 032	9 695	8 224	8 527	10 806	–44.8
Russian Federation*	215 143	136 391	104 912	105 396	106 098	103 302	101 608	–52.8
Slovakia*	6 125	4 181	3 824	4 056	3 888	3 992	4 077	–33.4
Slovenia*[a]								
Spain								
Sweden	8 694	8 497	8 044	7 937	7 888	7 812	7 806	–10.2
Switzerland	3 544							
Turkey**								
Ukraine*	54 639	33 153	21 584	23 522	23 341	20 892	22 280	–59.2
United Kingdom	68 377	57 056	44 258	42 125	40 475	40 110	40 797	–40.3
United States of America	394 881	454 233	416 208	412 820	407 397	386 077	386 714	–2.1
Decrease in emissions by more than 1 per cent (number of Parties)								*21*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*5*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 12. Total aggregate anthropogenic emissions of HFCs, PFCs and SF_6, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	5 586	2 721	3 303	4 144	4 504	4 890	5 356	–4.1
Austria	1 605	1 475	1 302	1 414	1 510	1 561	1 532	–4.6
Belarus*						84	82	
Belgium	3 850	4 974	1 366	1 358	1 425	1 690	1 840	–52.2
Bulgaria*[a]	76	51	131	116	114	144	254	236.4
Canada	11 535	9 696	11 649	11 428	10 979	11 581	10 759	–6.7
Croatia*	937	8	23	49	49	164	189	–79.8
Czech Republic*		76	413	574	472	715	667	
Denmark	44	326	682	700	719	746	803	1707.2
Estonia*								
European Community[b]	55 850	67 393	63 802	61 281	64 326	66 537	66 491	19.1
Finland	94	98	576	732	528	709	730	673.2
France	10 028	7 801	11 591	11 808	14 357	15 344	15 242	52.0
Germany	11 861	15 529	12 422	13 597	13 643	13 648	14 115	19.0
Greece	1 196	3 508	5 435	5 299	5 390	5 640	5 786	383.8
Hungary*[a]	350	239	557	587	726	850	905	159.0
Iceland	420	59	127	92	73	60	39	–90.8
Ireland	36	203	590	618	571	705	666	1739.2
Italy	2 492	1 764	2 845	4 009	4 720	5 560	6 708	169.2
Japan	61 840	51 187	34 019	28 707	24 976	23 459	19 142	–69.0
Latvia*		1	10	12	15	17	21	
Liechtenstein						0.06	3.84	
Lithuania*				14	34	22	37	
Luxembourg	17	17	47	47	47	47	47	181.9
Monaco		0.02	0.04	0.39	0.89	0.63	0.34	
Netherlands	6 914	8 259	5 739	3 314	4 059	2 248	2 090	–69.8
New Zealand	528	308	318	513	721	839	706	33.8
Norway	5 570	2 641	2 492	2 426	2 032	1 523	1 557	–72.1
Poland*[a]		845	1 627	2 181	1 541	1 937	2 334	
Portugal	2	9	140	173	215	303	358	19607.4
Romania*[a]	3 350	1 774	416	432	448	477	521	–84.5
Russian Federation*	14 473	14 503	16 612	16 987	17 324	18 080	18 786	29.8
Slovakia*	271	146	101	108	129	169	190	–30.1
Slovenia*[a]	287	328	166	177	203	220	235	–17.8
Spain	3 353	5 586	8 786	5 707	4 364	5 471	5 140	53.3
Sweden	551	642	916	974	1 044	1 047	1 094	98.5
Switzerland	244	264	704	781	764	800	862	253.7
Turkey**			31	27	46	41	64	
Ukraine*	203	153	100	97	85	66	80	–60.4
United Kingdom	13 807	17 204	11 388	11 536	11 739	11 822	10 353	–25.0
United States of America	90 761	94 827	134 689	124 856	132 706	131 012	142 973	57.5
Decrease in emissions by more than 1 per cent (number of Parties)								*14*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*18*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
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Table 13. Net anthropogenic CO_2 emissions and removals from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 1990	1995	2000	2001	2002	2003	2004	Change from 1990 to 2004 (%)
Australia	77 554	16 454	13 027	8 692	9 340	–12 538	–3 109	–104.0
Austria	–11 972	–14 423	–16 037	–18 775	–15 136	–16 606	–16 641	39.0
Belarus*	–11 317	–15 442	–14 141	–14 418	–13 325	–12 004	–11 913	5.3
Belgium	–1 431	–1 386	–1 550	–2 798	–2 337	–1 717	–1 173	–18.0
Bulgaria*[a]	–25 306	–20 457	–18 808	–20 584	–21 495	–14 863	–22 108	–12.6
Canada	–87 395	155 962	–133 237	–125 025	–9 781	–24 490	58 864	–167.4
Croatia*	–14 437	–20 535	–19 285	–17 777	–16 796	–16 648	–16 321	13.0
Czech Republic*	–1 779	–7 811	–6 881	–7 073	–6 165	–5 750	–4 871	173.8
Denmark	552	–1 664	1 642	–757	–1 965	–1 940	–2 280	–513.2
Estonia*							–8 016	
European Community[b]	–210 004	–243 836	–257 726	–285 584	–295 391	–282 986	–290 632	38.4
Finland	–21 440	–15 408	–16 325	–19 062	–18 902	–17 880	–18 513	–13.6
France	–27 102	–30 792	–36 872	–42 763	–49 984	–53 111	–54 428	100.8
Germany	–28 616	–31 537	–34 354	–35 128	–35 349	–35 870	–36 252	26.7
Greece	–3 248	–4 407	–3 142	–5 324	–5 460	–5 533	–5 415	66.7
Hungary*[a]	–2 770	–8 072	–3 249	–4 481	–4 583	–4 867	–5 547	100.3
Iceland	1 631	1 568	1 482	1 466	1 446	1 422	1 387	–15.0
Ireland	108	205	–2	–174	–191	–383	–72	–166.2
Italy	–79 914	–103 317	–100 028	–110 217	–114 369	–111 413	–105 920	32.5
Japan	–74 794	–81 489	–85 036	–84 881	–85 396	–95 019	–94 925	26.9
Latvia*	–20 691	–17 688	–14 172	–14 225	–13 169	–13 676	–13 942	–32.6
Liechtenstein	–38						–36	–5.7
Lithuania*						–6 989	4 355	
Luxembourg								
Monaco	–0.030	–0.040	–0.040	–0.040	–0.040	–0.040	–0.036	21.6
Netherlands	2 392	2 201	2 417	2 388	2 382	2 374	2 356	–1.5
New Zealand	–19 081	–15 231	–20 322	–20 617	–21 342	–22 836	–24 565	28.7
Norway	–14 601	–13 840	–25 274	–27 129	–26 263	–26 017	–26 323	80.3
Poland*[a]							–26 159	
Portugal	3 362	–2 088	–4 230	–3 994	–4 564	7 313	–2 863	–185.2
Romania*[a]	–35 944	–37 455	–36 835	–37 669	–35 140	–34 803	–34 668	–3.5
Russian Federation*	186 270	–140 732	361 655	247 122	–180 027	–368 066	–200 073	–207.4
Slovakia*	–2 407	–2 696	–2 403	–5 225	–5 243	–4 833	–4 251	76.6
Slovenia*[a]		–5 017	–5 175	–5 275	–5 496	–5 318	–5 644	
Spain	–23 027	–24 747	–30 220	–31 760	–31 423	–30 234	–30 543	32.6
Sweden	–22 288	–17 212	–18 290	–16 330	–16 679	–16 511	–16 651	–25.3
Switzerland	–1 784							
Turkey**								
Ukraine*	–33 839	–42 433	–38 044	–42 012	–37 342	–39 223	–32 142	–5.0
United Kingdom	2 915	1 034	–440	–596	–1 120	–1 180	–1 942	–166.6
United States of America	–910 373	–614 887	–759 507	–767 987	–768 639	–774 848	–780 094	–14.3
Decrease in emissions by more than 1 per cent (number of Parties)								*18*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*16*

Note: Negative values in Gg mean removals; positive values in Gg mean emissions.

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.

[b] Emission estimates of the European Community are reported separately from those of its member States.

[*] A Party undergoing the process of transition to a market economy (an EIT Party).

[**] Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 14. Anthropogenic CH_4 emissions from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	4 915.2	2 916.4	2 775.4	3 413.1	6 015.1	5 439.0	5 791.8	17.8
Austria	0.25	0.04	0.06	0.03	0.25	0.09	0.09	–64.9
Belarus*	4.1	6.2	4.9	2.5	16.0	8.7	3.4	–16.7
Belgium								
Bulgaria*[a]								
Canada	3 454.0	23 629.1	1 404.2	2 409.4	9 793.8	8 102.2	13 542.2	292.1
Croatia*								
Czech Republic*	44.3	38.1	48.0	52.9	54.0	55.3	60.2	35.9
Denmark								
Estonia*							1.1	
European Community[b]	1 241.9	1 039.2	1 214.3	927.5	925.1	1 395.5	821.8	–33.8
Finland	22.3	14.1	10.0	17.0	17.3	14.3	8.2	–63.3
France	847.4	770.5	787.2	710.4	715.7	727.4	628.0	–25.9
Germany								
Greece	49.9	34.8	166.1	22.9	3.2	4.5	11.1	–77.8
Hungary*[a]	30.1	22.0	26.7	25.5	25.7	25.9	26.1	–13.2
Iceland	49.1	49.1	49.1	49.1	49.1	49.1	49.1	
Ireland								
Italy	142.9	27.4	87.0	55.2	30.9	65.0	34.6	–75.8
Japan	99.3	70.6	46.9	50.1	43.2	24.5	32.4	–67.4
Latvia*	18.8	35.1	56.2	34.7	38.1	36.9	33.4	77.4
Liechtenstein								
Lithuania*								
Luxembourg								
Monaco								
Netherlands								
New Zealand	93.5	133.2	96.8	94.1	89.5	85.4	75.1	–19.7
Norway	17.7	2.1	3.2	1.7	4.2	17.8	2.2	–87.5
Poland*[a]							2.3	
Portugal	153.6	169.0	132.5	87.5	125.8	552.3	109.5	–28.7
Romania*[a]	0.2	0.5	8.2	2.3	8.1	1.7	1.0	377.0
Russian Federation*	3 632.6	854.1	3 303.7	1 907.4	3 237.6	5 373.7	1 410.6	–61.2
Slovakia*	14.7	9.6	14.1	14.3	13.9	15.3	17.3	17.6
Slovenia*[a]								
Spain								
Sweden	11.8	11.8	12.0	11.3	12.4	13.6	13.6	14.9
Switzerland	1.5							
Turkey**								
Ukraine*	8.4	14.3	3.4	14.2	11.2	5.6	0.9	–89.5
United Kingdom	13.8	11.5	19.4	23.2	19.5	18.4	16.8	21.1
United States of America								
Decrease in emissions by more than 1 per cent (number of Parties)								*14*
Change in emissions within 1 per cent (number of Parties)								*0*
Increase in emissions by more than 1 per cent (number of Parties)								*8*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
** Decision 26/CP.7 invited Parties to recognize the special circumstances of Turkey, which place Turkey in a situation different from that of other Parties included in Annex I to the Convention.

Table 15. Anthropogenic N_2O emissions from land use, land-use change and forestry, 1990, 1995 and 2000–2004

Party	Gg CO_2 equivalent							Change from 1990 to 2004 (%)
	1990	1995	2000	2001	2002	2003	2004	
Australia	1 342.8	796.7	758.3	932.3	1 642.3	1 484.9	1 581.3	17.8
Austria	11.4	11.2	11.0	13.1	10.7	9.3	11.6	2.1
Belarus*	6.2	6.6	10.1	9.8	11.1	10.1	9.4	52.4
Belgium								
Bulgaria*[a]								
Canada	2 175.5	14 702.8	900.4	1 526.5	6 110.6	5 061.0	8 433.9	287.7
Croatia*								
Czech Republic*	4.5	3.9	4.9	5.4	5.5	5.6	6.1	35.9
Denmark	0.09	0.09	0.07	0.07	0.07	0.07	0.07	–17.1
Estonia*								
European Community[b]	3 553.9	3 093.4	3 099.0	2 771.5	2 699.8	2 680.4	3 408.5	–4.1
Finland	36.2	15.7	22.4	20.6	21.5	20.3	19.9	–44.9
France	2 879.2	2 441.6	2 195.8	2 114.1	2 047.8	1 984.2	1 983.3	–31.1
Germany	375.1	375.1	421.6	421.6	421.6	421.6	421.6	12.4
Greece	5.1	3.5	16.9	2.3	0.3	0.5	1.1	–77.8
Hungary*[a]	3.1	2.2	2.7	2.6	2.6	2.6	2.7	–12.8
Iceland	415.4	415.4	415.4	415.4	415.4	415.4	415.4	
Ireland								
Italy	49.3	83.2	229.8	5.6	3.1	6.6	778.1	1479.7
Japan	72.9	47.0	24.5	22.8	19.3	15.9	13.2	–82.0
Latvia*	1.9	3.6	5.8	3.8	4.5	4.5	3.8	96.7
Liechtenstein								
Lithuania*								
Luxembourg								
Monaco								
Netherlands								
New Zealand	9.5	13.5	9.8	9.6	9.1	8.7	7.6	–19.7
Norway	15.2	13.8	13.4	13.1	13.6	14.4	12.8	–15.6
Poland*[a]							0.3	
Portugal	15.6	17.2	13.5	8.9	12.8	56.1	11.1	–28.7
Romania*[a]	0.0	0.1	1.7	0.5	1.6	0.4	0.2	377.0
Russian Federation*	368.9	86.8	334.8	192.2	328.6	545.6	142.6	–61.3
Slovakia*	3.4	2.3	3.1	3.1	3.1	3.1	3.5	1.8
Slovenia*[a]								
Spain								
Sweden	159.2	123.2	164.3	161.1	158.1	158.3	158.3	–0.6
Switzerland	3.4							
Turkey**								
Ukraine*	9.7	10.7	4.5	6.1	5.4	3.9	3.4	–65.1
United Kingdom	1.4	1.2	2.0	2.4	2.0	1.9	1.7	21.1
United States of America	5 677.3	6 147.3	6 373.9	6 236.9	6 389.4	6 577.0	6 839.6	20.5
Decrease in emissions by more than 1 per cent (number of Parties)								*11*
Change in emissions within 1 per cent (number of Parties)								*2*
Increase in emissions by more than 1 per cent (number of Parties)								*12*

[a] Data for the base year defined by decisions 9/CP.2 and 11/CP.4 (Bulgaria (1988), Hungary (average of 1985 to 1987), Poland (1988), Romania (1989), Slovenia (1986)) are used for this Party instead of 1990 data.
[b] Emission estimates of the European Community are reported separately from those of its member States.
* A Party undergoing the process of transition to a market economy (an EIT Party).
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Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

Summary for Policymakers

This Summary for Policymakers was formally approved at the 9th Session of Working Group III of the IPCC, Bangkok, Thailand. 30 April - 4 May 2007

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This Summary for Policymakers should be cited as:

IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Table of Contents

A. Introduction 3

B. Greenhouse gas emission trends 3

C. Mitigation in the short and medium term (until 2030) 9

D. Mitigation in the long term (after 2030) 15

E. Policies, measures and instruments to mitigate climate change 19

F. Sustainable development and climate change mitigation 21

G. Gaps in knowledge 22

Endbox 1: Uncertainty representation 23

A. Introduction

1. The Working Group III contribution to the IPCC Fourth Assessment Report (AR4) focuses on new literature on the scientific, technological, environmental, economic and social aspects of mitigation of climate change, published since the IPCC Third Assessment Report (TAR) and the Special Reports on CO_2 Capture and Storage (SRCCS) and on Safeguarding the Ozone Layer and the Global Climate System (SROC).

The following summary is organised into six sections after this introduction:

- Greenhouse gas (GHG) emission trends
- Mitigation in the short and medium term, across different economic sectors (until 2030)
- Mitigation in the long-term (beyond 2030)
- Policies, measures and instruments to mitigate climate change
- Sustainable development and climate change mitigation
- Gaps in knowledge.

References to the corresponding chapter sections are indicated at each paragraph in square brackets. An explanation of terms, acronyms and chemical symbols used in this SPM can be found in the glossary to the main report.

B. Greenhouse gas emission trends

2. **Global greenhouse gas (GHG) emissions have grown since pre-industrial times, with an increase of 70% between 1970 and 2004** *(high agreement, much evidence)*[1].
   - Since pre-industrial times, increasing emissions of GHGs due to human activities have led to a marked increase in atmospheric GHG concentrations [1.3; Working Group I SPM].
   - Between 1970 and 2004, global emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, weighted by their global warming potential (GWP), have increased by 70% (24% between 1990 and 2004), from 28.7 to 49 Gigatonnes of carbon dioxide equivalents ($GtCO_2$-eq)[2] (see Figure SPM.1). The emissions of these gases have increased at different rates. CO_2 emissions have grown between 1970 and 2004 by about 80% (28% between 1990 and 2004) and represented 77% of total anthropogenic GHG emissions in 2004.
   - The largest growth in global GHG emissions between 1970 and 2004 has come from the energy supply sector (an increase of 145%). The growth in direct emissions[3] from transport in this period was 120%, industry 65% and land use, land use change, and forestry (LULUCF)[4] 40%[5]. Between 1970 and 1990 direct emissions from agriculture grew by 27% and from buildings by 26%, and the latter remained at approximately at 1990 levels thereafter. However, the buildings sector has a high level of electricity use and hence the total of direct and indirect emissions in this sector is much higher (75%) than direct emissions [1.3, 6.1, 11.3, Figures 1.1 and 1.3].
   - The effect on global emissions of the decrease in global energy intensity (-33%) during 1970 to 2004 has been smaller than the combined effect of global per capita income growth (77 %) and global population growth (69%); both drivers of increasing energy-related CO_2 emissions (Figure SPM.2). The long-term trend of a declining carbon intensity of energy supply reversed after 2000. Differences in terms of per capita income, per capita emissions, and energy intensity among countries remain significant. (Figure SPM.3). In 2004 UNFCCC Annex I countries held a 20% share in world population, produced 57% of world Gross Domestic Product based on Purchasing Power Parity (GDP_{ppp})[6], and accounted for 46% of global GHG emissions (Figure SPM.3) [1.3].
   - The emissions of ozone depleting substances (ODS) controlled under the Montreal Protocol[7], which are also GHGs, have declined significantly since the 1990s. By 2004 the emissions of these gases were about 20% of their 1990 level [1.3].
   - A range of policies, including those on climate change, energy security[8], and sustainable development, have been effective in reducing GHG emissions in different sectors and many countries. The scale of such measures, however, has not yet been large enough to counteract the global growth in emissions [1.3, 12.2].

1 Each headline statement has an "agreement/evidence" assessment attached that is supported by the bullets underneath. This does not necessarily mean that this level of "agreement/evidence"applies to each bullet. Endbox 1 provides an explanation of this representation of uncertainty.
2 The definition of carbon dioxide equivalent (CO_2-eq) is the amount of CO2 emission that would cause the same radiative forcing as an emitted amount of a well mixed greenhouse gas or a mixture of well mixed greenhouse gases, all multiplied with their respective GWPs to take into account the differing times they remain in the atmosphere [WGI AR4 Glossary].
3 Direct emissions in each sector do not include emissions from the electricity sector for the electricity consumed in the building, industry and agricultural sectors or of the emissions from refinery operations supplying fuel to the transport sector.
4 The term "land use, land use change and forestry" is used here to describe the aggregated emissions of CO_2, CH_4, N_2O from deforestation, biomass and burning, decay of biomass from logging and deforestation, decay of peat and peat fires [1.3.1]. This is broader than emissions from deforestation, which is included as a subset. The emissions reported here do not include carbon uptake (removals).
5 This trend is for the total LULUCF emissions, of which emissions from deforestation are a subset and, owing to large data uncertainties, is significantly less certain than for other sectors. The rate of deforestation globally was slightly lower in the 2000-2005 period than in the 1990-2000 period [9.2.1].
6 The GDPppp metric is used for illustrative purposes only for this report. For an explanation of PPP and Market Exchange Rate (MER) GDP calculations, see footnote 12.
7 Halons, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), methyl chloroform (CH_3CCl_3), carbon tetrachloride (CCl_4) and methyl bromide (CH_3Br).
8 Energy security refers to security of energy supply.

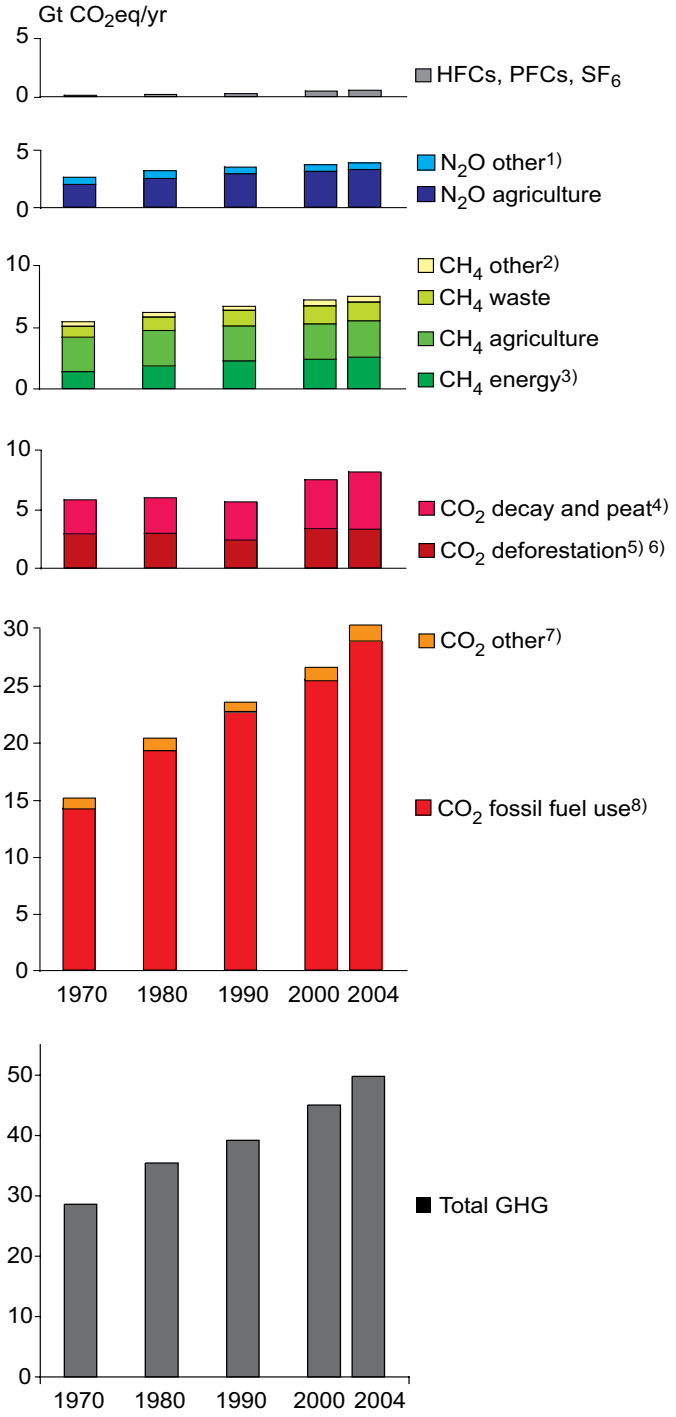


Figure SPM.1: *Global Warming Potential (GWP) weighted global greenhouse gas emissions 1970-2004. 100 year GWPs from IPCC 1996 (SAR) were used to convert emissions to CO_2-eq. (cf. UNFCCC reporting guidelines). CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 from all sources are included.*
The two CO_2 emission categories reflect CO_2 emissions from energy production and use (second from bottom) and from land use changes (third from the bottom) [Figure 1.1a].

Notes:
1. Other N_2O includes industrial processes, deforestation/savannah burning, waste water and waste incineration.
2. Other is CH_4 from industrial processes and savannah burning.
3. Including emissions from bioenergy production and use
4. CO_2 emissions from decay (decomposition) of above ground biomass that remains after logging and deforestation and CO_2 from peat fires and decay of drained peat soils.
5. As well as traditional biomass use at 10% of total, assuming 90% is from sustainable biomass production. Corrected for 10% carbon of biomass that is assumed to remain as charcoal after combustion.
6. For large-scale forest and scrubland biomass burning averaged data for 1997-2002 based on Global Fire Emissions Data base satellite data.
7. Cement production and natural gas flaring.
8. Fossil fuel use includes emissions from feedstocks.

3. **With current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades** *(high agreement, much evidence).*
   - The SRES (non-mitigation) scenarios project an increase of baseline global GHG emissions by a range of 9.7 $GtCO_2$-eq to 36.7 $GtCO_2$-eq (25-90%) between 2000 and 2030[9] (Box SPM.1 and Figure SPM.4). In these scenarios, fossil fuels are projected to maintain their dominant position in the global energy mix to 2030 and beyond. Hence CO_2 emissions between 2000 and 2030 from energy use are projected to grow 40 to 110% over that period. Two thirds to three quarters of this increase in energy CO_2 emissions is projected to come from non-Annex I regions, with their average per capita energy CO_2 emissions being projected to remain substantially lower (2.8-5.1 tCO_2/cap) than those in Annex I regions (9.6-15.1 tCO_2/cap) by 2030. According to SRES scenarios, their economies are projected to have a lower energy use per unit of GDP (6.2 – 9.9 MJ/US$ GDP) than that of non-Annex I countries (11.0 – 21.6 MJ/US$ GDP). [1.3, 3.2]

9 The SRES 2000 GHG emissions assumed here are 39.8 GtCO2-eq, i.e. lower than the emissions reported in the EDGAR database for 2000 (45 GtCO2-eq). This is mostly due to differences in LULUCF emissions.

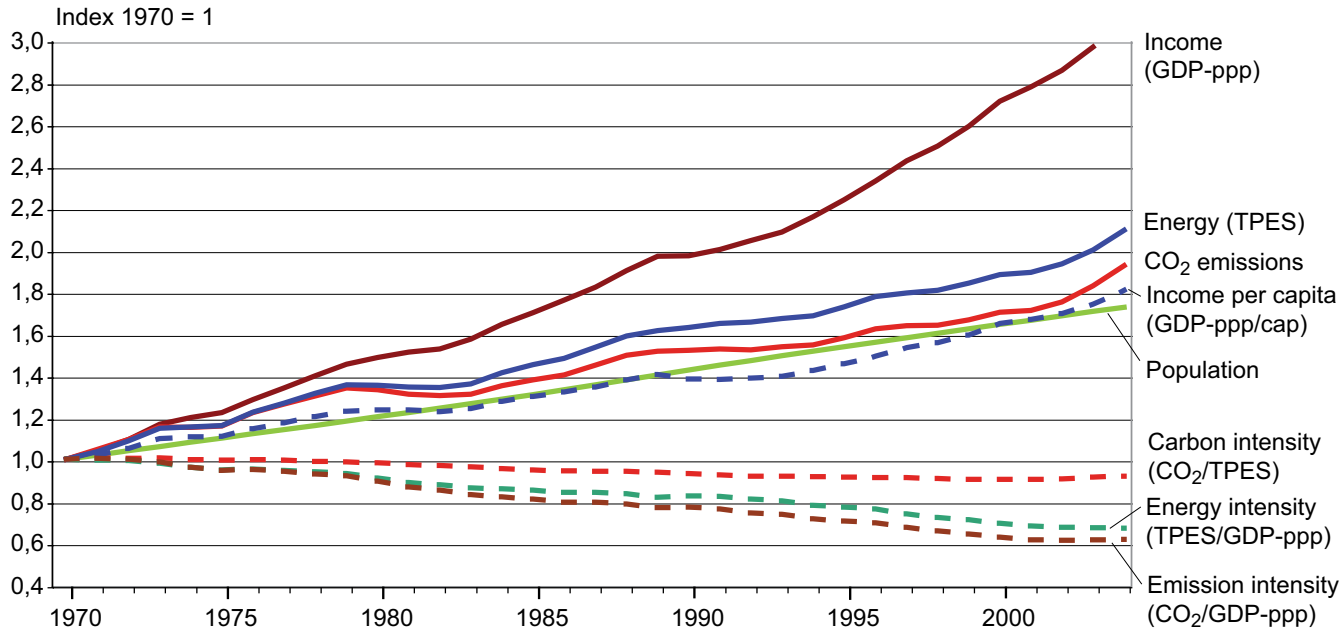


Figure SPM.2: *Relative global development of Gross Domestic Product measured in PPP (GDP_{ppp}), Total Primary Energy Supply (TPES), CO_2 emissions (from fossil fuel burning, gas flaring and cement manufacturing) and Population (Pop). In addition, in dotted lines, the figure shows Income per capita (GDP_{ppp}/Pop), Energy Intensity (TPES/GDP_{ppp}), Carbon Intensity of energy supply (CO_2/TPES), and Emission Intensity of the economic production process (CO_2/GDP_{ppp}) for the period 1970-2004. [Figure 1.5]*

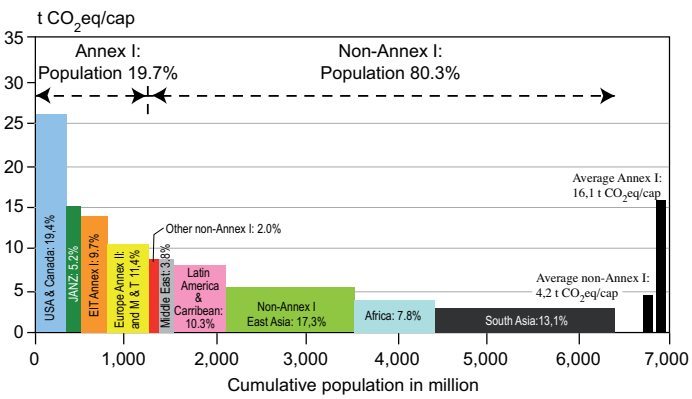


Figure SPM.3a: *Year 2004 distribution of regional per capita GHG emissions (all Kyoto gases, including those from land-use) over the population of different country groupings. The percentages in the bars indicate a regions share in global GHG emissions [Figure 1.4a].*

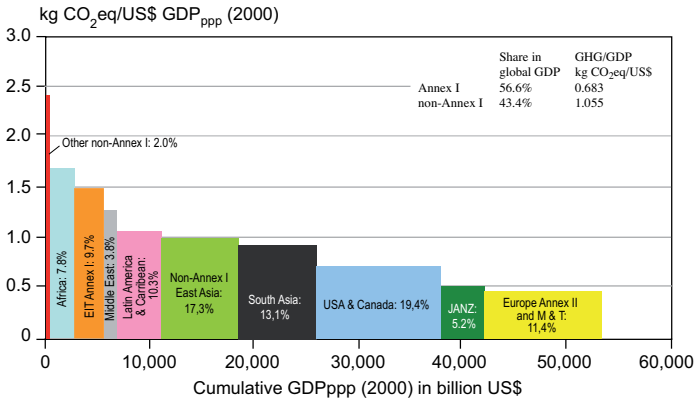


Figure SPM.3b: *Year 2004 distribution of regional GHG emissions (all Kyoto gases, including those from land-use) per US$ of GDP_{ppp} over the GDP_{ppp} of different country groupings. The percentages in the bars indicate a regions share in global GHG emissions [Figure 1.4b].*

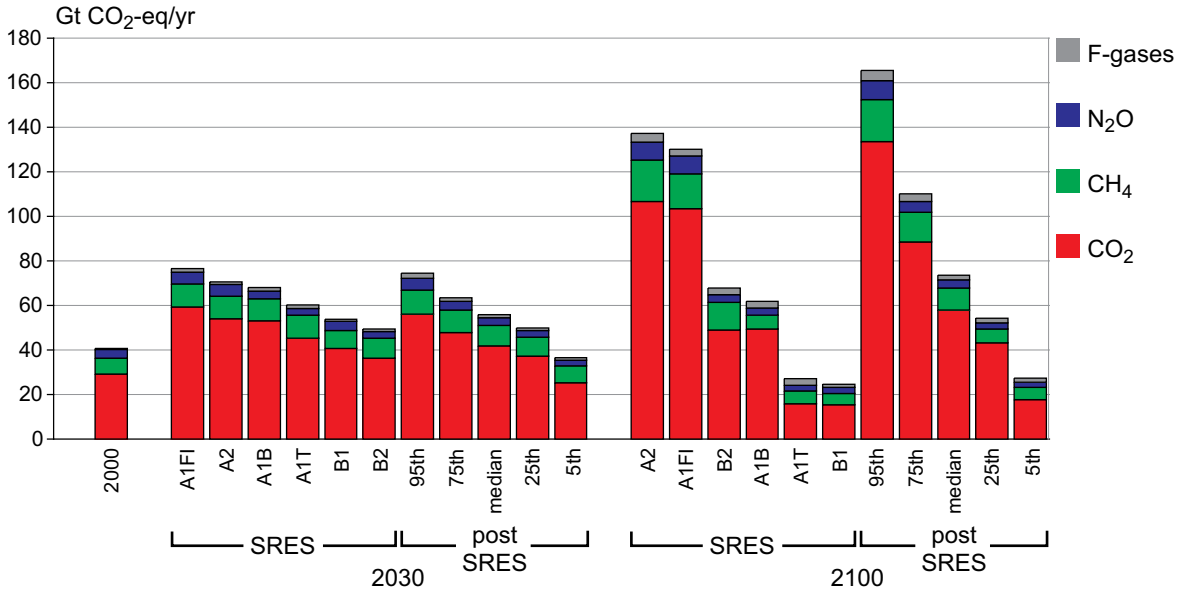


Figure SPM.4: *Global GHG emissions for 2000 and projected baseline emissions[10] for 2030 and 2100 from IPCC SRES and the post-SRES literature. The figure provides the emissions from the six illustrative SRES scenarios. It also provides the frequency distribution of the emissions in the post-SRES scenarios (5th, 25th, median, 75th, 95th percentile), as covered in Chapter 3. F-gases cover HFCs, PFCs and SF_6 [1.3, 3.2, Figure 1.7].*

4. **Baseline emissions scenarios published since SRES[10], are comparable in range to those presented in the IPCC Special Report on Emission Scenarios (SRES) (25- 135 $GtCO_2$-eq/yr in 2100, see Figure SPM.4)** *(high agreement, much evidence)*.
   - Studies since SRES used lower values for some drivers for emissions, notably population projections. However, for those studies incorporating these new population projections, changes in other drivers, such as economic growth, resulted in little change in overall emission levels. Economic growth projections for Africa, Latin America and the Middle East to 2030 in post-SRES baseline scenarios are lower than in SRES, but this has only minor effects on global economic growth and overall emissions [3.2].
   - Representation of aerosol and aerosol precursor emissions, including sulphur dioxide, black carbon, and organic carbon, which have a net cooling effect[11] has improved. Generally, they are projected to be lower than reported in SRES [3.2].
   - Available studies indicate that the choice of exchange rate for GDP (MER or PPP) does not appreciably affect the projected emissions, when used consistently[12]. The differences, if any, are small compared to the uncertainties caused by assumptions on other parameters in the scenarios, e.g. technological change [3.2].

10 Baseline scenarios do not include additional climate policy above current ones; more recent studies differ with respect to UNFCCC and Kyoto Protocol inclusion.
11 See AR4 WG I report, Chapter 10.2.
12 Since TAR, there has been a debate on the use of different exchange rates in emission scenarios. Two metrics are used to compare GDP between countries. Use of MER is preferable for analyses involving internationally traded products. Use of PPP, is preferable for analyses involving comparisons of income between countries at very different stages of development. Most of the monetary units in this report are expressed in MER. This reflects the large majority of emissions mitigation literature that is calibrated in MER. When monetary units are expressed in PPP, this is denoted by GDP_{ppp}.

Box SPM.1: The emission scenarios of the IPCC Special Report on Emission Scenarios (SRES)

A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1. The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

An illustrative scenario was chosen for each of the six scenario groups A1B, A1FI, A1T, A2, B1 and B2. All should be considered equally sound.

The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol.

This box summarizing the SRES scenarios is taken from the Third Assessment Report and has been subject to prior line by line approval by the Panel.

Box SPM.2: Mitigation potential and analytical approaches

The concept of “mitigation potential” has been developed to assess the scale of GHG reductions that could be made, relative to emission baselines, for a given level of carbon price (expressed in cost per unit of carbon dioxide equivalent emissions avoided or reduced). Mitigation potential is further differentiated in terms of “market potential” and “economic potential”.

Market potential is the mitigation potential based on private costs and private discount rates[13], which might be expected to occur under forecast market conditions, including policies and measures currently in place, noting that barriers limit actual uptake [2.4].

13 Private costs and discount rates reflect the perspective of private consumers and companies; see Glossary for a fuller description.

(Box SPM.2 Continued)

Economic potential is the mitigation potential, which takes into account social costs and benefits and social discount rates[14], assuming that market efficiency is improved by policies and measures and barriers are removed [2.4].

Studies of market potential can be used to inform policy makers about mitigation potential with existing policies and barriers, while studies of economic potentials show what might be achieved if appropriate new and additional policies were put into place to remove barriers and include social costs and benefits. The economic potential is therefore generally greater than the market potential.

Mitigation potential is estimated using different types of approaches. There are two broad classes – "bottom-up" and "top-down" approaches, which primarily have been used to assess the economic potential.

Bottom-up studies are based on assessment of mitigation options, emphasizing specific technologies and regulations. They are typically sectoral studies taking the macro-economy as unchanged. Sector estimates have been aggregated, as in the TAR, to provide an estimate of global mitigation potential for this assessment.

Top-down studies assess the economy-wide potential of mitigation options. They use globally consistent frameworks and aggregated information about mitigation options and capture macro-economic and market feedbacks.

Bottom-up and top-down models have become more similar since the TAR as top-down models have incorporated more technological mitigation options and bottom-up models have incorporated more macroeconomic and market feedbacks as well as adopting barrier analysis into their model structures. Bottom-up studies in particular are useful for the assessment of specific policy options at sectoral level, e.g. options for improving energy efficiency, while top-down studies are useful for assessing cross-sectoral and economy-wide climate change policies, such as carbon taxes and stabilization policies. However, current bottom-up and top-down studies of economic potential have limitations in considering life-style choices, and in including all externalities such as local air pollution. They have limited representation of some regions, countries, sectors, gases, and barriers. The projected mitigation costs do not take into account potential benefits of avoided climate change.

Box SPM.3: Assumptions in studies on mitigation portfolios and macro-economic costs

Studies on mitigation portfolios and macro-economic costs assessed in this report are based on top-down modelling. Most models use a global least cost approach to mitigation portfolios and with universal emissions trading, assuming transparent markets, no transaction cost, and thus perfect implementation of mitigation measures throughout the 21st century. Costs are given for a specific point in time.

Global modelled costs will increase if some regions, sectors (e.g. land-use), options or gases are excluded. Global modelled costs will decrease with lower baselines, use of revenues from carbon taxes and auctioned permits, and if induced technological learning is included. These models do not consider climate benefits and generally also co-benefits of mitigation measures, or equity issues.

Box SPM.4: Modelling induced technological change

Relevant literature implies that policies and measures may induce technological change. Remarkable progress has been achieved in applying approaches based on induced technological change to stabilisation studies; however, conceptual issues remain. In the models that adopt these approaches, projected costs for a given stabilization level are reduced; the reductions are greater at lower stabilisation levels.

14 Social costs and discount rates reflect the perspective of society. Social discount rates are lower than those used by private investors; see Glossary for a fuller description.

C. Mitigation in the short and medium term (until 2030)

5. **Both bottom-up and top-down studies indicate that there is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels** *(high agreement, much evidence).*

Uncertainties in the estimates are shown as ranges in the tables below to reflect the ranges of baselines, rates of technological change and other factors that are specific to the different approaches. Furthermore, uncertainties also arise from the limited information for global coverage of countries, sectors and gases.

Bottom-up studies:

- In 2030, the economic potential estimated for this assessment from bottom-up approaches (see Box SPM.2) is presented in Table SPM.1 below and Figure SPM.5A. For reference: emissions in 2000 were equal to 43 $GtCO_2$-eq. [11.3]:
- Studies suggest that mitigation opportunities with net negative costs[15] have the potential to reduce emissions by around 6 $GtCO_2$-eq/yr in 2030. Realizing these requires dealing with implementation barriers [11.3].
- No one sector or technology can address the entire mitigation challenge. All assessed sectors contribute to the total (see Figure SPM.6). The key mitigation technologies and practices for the respective sectors are shown in Table SPM 3 [4.3, 4.4, 5.4, 6.5, 7.5, 8.4, 9.4, 10.4].

Top-down studies:

- Top-down studies calculate an emission reduction for 2030 as presented in Table SPM.2 below and Figure SPM.5B. The global economic potentials found in the top-down studies are in line with bottom-up studies (see Box SPM.2), though there are considerable differences at the sectoral level [3.6].
- The estimates in Table SPM.2 were derived from stabilization scenarios, i.e., runs towards long-run stabilization of atmospheric GHG concentration [3.6].

Table SPM.1: *Global economic mitigation potential in 2030 estimated from bottom-up studies.*

Carbon price (US$/$tCO_2$-eq)	**Economic potential** ($GtCO_2$-eq/yr)	**Reduction relative to SRES A1 B** (68 $GtCO_2$-eq/yr) (%)	**Reduction relative to SRES B2** (49 $GtCO_2$-eq/yr) (%)
0	5-7	7-10	10-14
20	9-17	14-25	19-35
50	13-26	20-38	27-52
100	16-31	23-46	32-63

Table SPM.2: *Global economic mitigation potential in 2030 estimated from top-down studies.*

Carbon price (US$/$tCO_2$-eq)	**Economic potential** ($GtCO_2$-eq/yr)	**Reduction relative to SRES A1 B** (68 $GtCO_2$-eq/yr) (%)	**Reduction relative to SRES B2** (49 $GtCO_2$-eq/yr) (%)
20	9-18	13-27	18-37
50	14-23	21-34	29-47
100	17-26	25-38	35-53

15 In this report, as in the SAR and the TAR, options with net negative costs (no regrets opportunities) are defined as those options whose benefits such as reduced energy costs and reduced emissions of local/regional pollutants equal or exceed their costs to society, excluding the benefits of avoided climate change (see Box SPM.1).

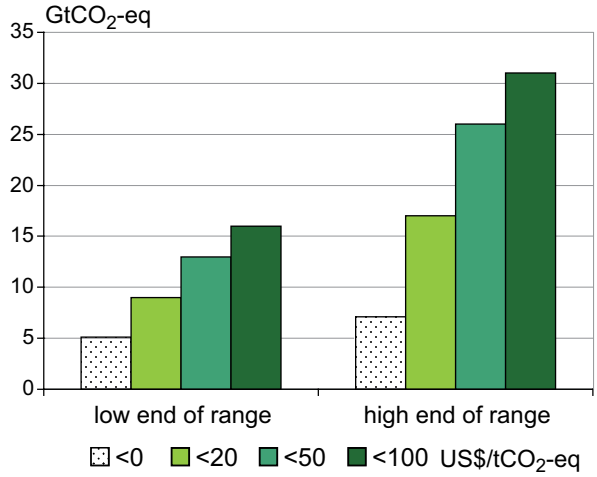


Figure SPM.5A: *Global economic mitigation potential in 2030 estimated from bottom-up studies (data from Table SPM.1)*

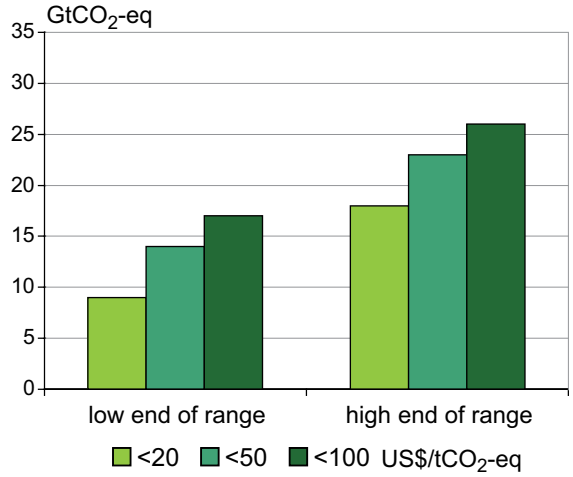


Figure SPM.5B: *Global economic mitigation potential in 2030 estimated from top-down studies (data from Table SPM.2)*

Table SPM.3: *Key mitigation technologies and practices by sector. Sectors and technologies are listed in no particular order. Non-technological practices, such as lifestyle changes, which are cross-cutting, are not included in this table (but are addressed in paragraph 7 in this SPM).*

Sector	**Key mitigation technologies and practices currently commercially available**	**Key mitigation technologies and practices projected to be commercialized before 2030**
Energy supply [4.3, 4.4]	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of Carbon Capture and Storage (CCS, e.g. storage of removed CO_2 from natural gas).	CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and waves energy, concentrating solar, and solar PV.
Transport [5.4]	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning.	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries.
Buildings [6.5]	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation ; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycle of fluorinated gases.	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings.
Industry [7.5]	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO_2 gas emissions; and a wide array of process-specific technologies.	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture.
Agriculture [8.4]	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH_4 emissions; improved nitrogen fertilizer application techniques to reduce N_2O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency.	Improvements of crops yields.
Forestry/forests [9.4]	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use.	Tree species improvement to increase biomass productivity and carbon sequestration. Improved remote sensing technologies for analysis of vegetation/ soil carbon sequestration potential and mapping land use change.
Waste management [10.4]	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimization.	Biocovers and biofilters to optimize CH_4 oxidation.

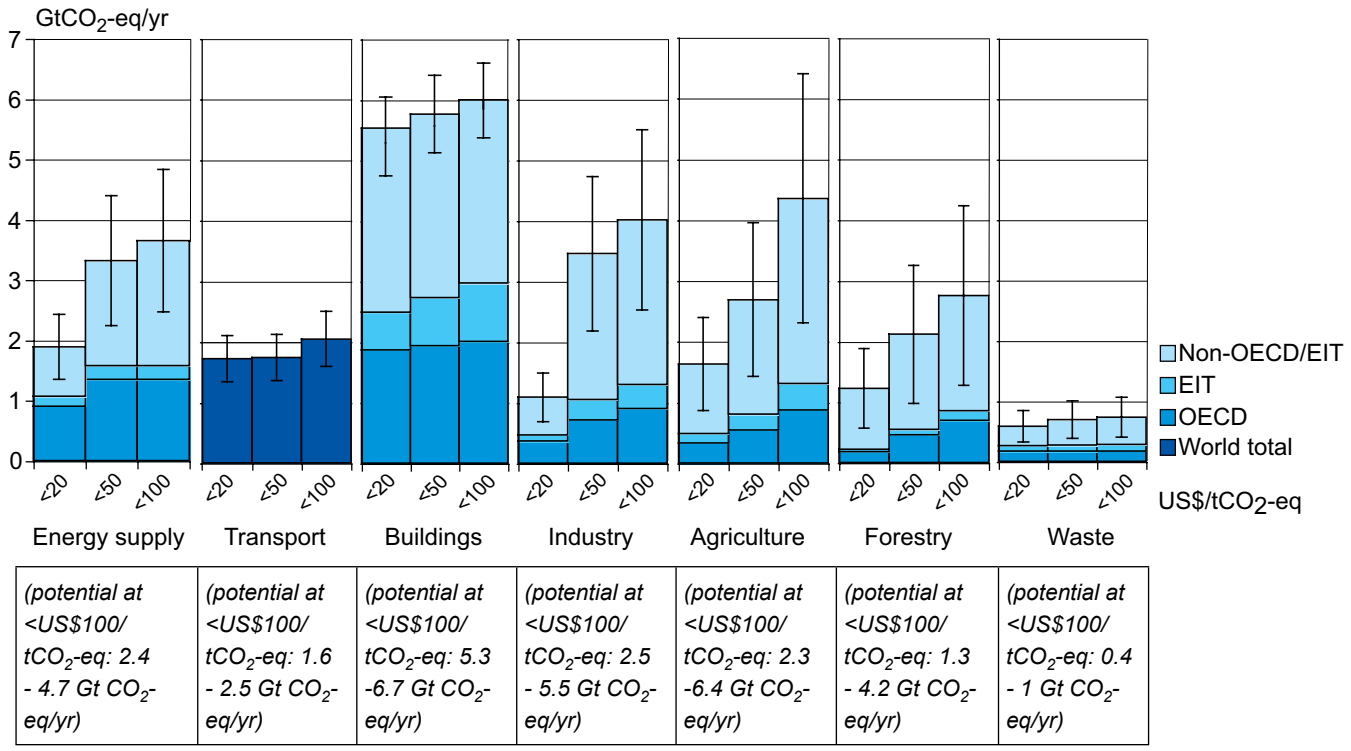


Figure SPM.6: *Estimated sectoral economic potential for global mitigation for different regions as a function of carbon price in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. A full explanation of the derivation of this figure is found in Section 11.3.*

Notes:
1. The ranges for global economic potentials as assessed in each sector are shown by vertical lines. The ranges are based on end-use allocations of emissions, meaning that emissions of electricity use are counted towards the end-use sectors and not to the energy supply sector.
2. The estimated potentials have been constrained by the availability of studies particularly at high carbon price levels.
3. Sectors used different baselines. For industry the SRES B2 baseline was taken, for energy supply and transport the WEO 2004 baseline was used; the building sector is based on a baseline in between SRES B2 and A1B; for waste, SRES A1B driving forces were used to construct a waste specific baseline, agriculture and forestry used baselines that mostly used B2 driving forces.
4. Only global totals for transport are shown because international aviation is included [5.4].
5. Categories excluded are: non-CO_2 emissions in buildings and transport, part of material efficiency options, heat production and cogeneration in energy supply, heavy duty vehicles, shipping and high-occupancy passenger transport, most high-cost options for buildings, wastewater treatment, emission reduction from coal mines and gas pipelines, fluorinated gases from energy supply and transport. The underestimation of the total economic potential from these emissions is of the order of 10-15%.

6. **In 2030 macro-economic costs for multi-gas mitigation, consistent with emissions trajectories towards stabilization between 445 and 710 ppm CO_2-eq, are estimated at between a 3% decrease of global GDP and a small increase, compared to the baseline (see Table SPM.4). However, regional costs may differ significantly from global averages** (*high agreement, medium evidence)* **(see Box SPM.3 for the methodologies and assumptions of these results).**
   - The majority of studies conclude that reduction of GDP relative to the GDP baseline increases with the stringency of the stabilization target.
   - Depending on the existing tax system and spending of the revenues, modelling studies indicate that costs may be substantially lower under the assumption that revenues from carbon taxes or auctioned permits under an emission trading system are used to promote low-carbon technologies or reform of existing taxes [11.4].
   - Studies that assume the possibility that climate change policy induces enhanced technological change also give lower costs. However, this may require higher upfront investment in order to achieve costs reductions thereafter (see Box SPM.4) [3.3, 3.4, 11.4, 11.5, 11.6].
   - Although most models show GDP losses, some show GDP gains because they assume that baselines are non-optimal and mitigation policies improve market efficiencies, or they assume that more technological change may be induced by mitigation policies. Examples of market inefficiencies include unemployed resources, distortionary taxes and/or subsidies [3.3, 11.4].
   - A multi-gas approach and inclusion of carbon sinks generally reduces costs substantially compared to CO_2 emission abatement only [3.3].
   - Regional costs are largely dependent on the assumed stabilization level and baseline scenario. The allocation regime is also important, but for most countries to a lesser extent than the stabilization level [11.4, 13.3].

Table SPM.4: *Estimated global macro-economic costs in 2030[a)] for least-cost trajectories towards different long-term stabilization levels.[b), c)]*

Stabilization levels (ppm CO_2-eq)	Median GDP reduction[d)] (%)	Range of GDP reduction[d), e)] (%)	Reduction of average annual GDP growth rates[d), f)] (percentage points)
590-710	0.2	-0.6-1.2	<0.06
535-590	0.6	0.2-2.5	<0.1
445-535[g)]	not available	<3	<0.12

Notes:
a) For a given stabilization level, GDP reduction would increase over time in most models after 2030. Long-term costs also become more uncertain. [Figure 3.25]
b) Results based on studies using various baselines.
c) Studies vary in terms of the point in time stabilization is achieved; generally this is in 2100 or later.
d) This is global GDP based market exchange rates.
e) The median and the 10th and 90th percentile range of the analyzed data are given.
f) The calculation of the reduction of the annual growth rate is based on the average reduction during the period till 2030 that would result in the indicated GDP decrease in 2030.
g) The number of studies that report GDP results is relatively small and they generally use low baselines.

7. **Changes in lifestyle and behaviour patterns can contribute to climate change mitigation across all sectors. Management practices can also have a positive role** *(high agreement, medium evidence).*
   - Lifestyle changes can reduce GHG emissions. Changes in lifestyles and consumption patterns that emphasize resource conservation can contribute to developing a low-carbon economy that is both equitable and sustainable [4.1, 6.7].
   - Education and training programmes can help overcome barriers to the market acceptance of energy efficiency, particularly in combination with other measures [Table 6.6].
   - Changes in occupant behaviour, cultural patterns and consumer choice and use of technologies can result in considerable reduction in CO_2 emissions related to energy use in buildings [6.7].
   - Transport Demand Management, which includes urban planning (that can reduce the demand for travel) and provision of information and educational techniques (that can reduce car usage and lead to an efficient driving style) can support GHG mitigation [5.1].
   - In industry, management tools that include staff training, reward systems, regular feedback, documentation of existing practices can help overcome industrial organization barriers, reduce energy use, and GHG emissions [7.3].

8. **While studies use different methodologies, in all analyzed world regions near-term health co-benefits from reduced air pollution as a result of actions to reduce GHG emissions can be substantial and may offset a substantial fraction of mitigation costs** *(high agreement, much evidence).*
   - Including co-benefits other than health, such as increased energy security, and increased agricultural production and reduced pressure on natural ecosystems, due to decreased tropospheric ozone concentrations, would further enhance cost savings [11.8].
   - Integrating air pollution abatement and climate change mitigation policies offers potentially large cost reductions compared to treating those policies in isolation [11.8].

9. **Literature since TAR confirms that there may be effects from Annex I countries' action on the global economy and global emissions, although the scale of carbon leakage remains uncertain** *(high agreement, medium evidence).*
   - Fossil fuel exporting nations (in both Annex I and non-Annex I countries) may expect, as indicated in TAR[16], lower demand and prices and lower GDP growth due to mitigation policies. The extent of this spill over[17] depends strongly on assumptions related to policy decisions and oil market conditions [11.7].
   - Critical uncertainties remain in the assessment of carbon leakage[18]. Most equilibrium modelling support the conclusion in the TAR of economy-wide leakage from Kyoto action in the order of 5-20%, which would be less if competitive low-emissions technologies were effectively diffused [11.7] .

10. **New energy infrastructure investments in developing countries, upgrades of energy infrastructure in industrialized countries, and policies that promote energy security, can, in many cases, create opportunities to achieve GHG emission reductions[19] compared to baseline scenarios. Additional co-benefits are country-**

16 See TAR WG III (2001) SPM paragraph 16.
17 Spill over effects of mitigation in a cross-sectoral perspective are the effects of mitigation policies and measures in one country or group of countries on sectors in other countries.
18 Carbon leakage is defined as the increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries.
19 See table SPM.1 and Figure SPM.6

specific but often include air pollution abatement, balance of trade improvement, provision of modern energy services to rural areas and employment *(high agreement, much evidence)*.

- Future energy infrastructure investment decisions, expected to total over 20 trillion US$[20] between now and 2030, will have long term impacts on GHG emissions, because of the long life-times of energy plants and other infrastructure capital stock. The widespread diffusion of low-carbon technologies may take many decades, even if early investments in these technologies are made attractive. Initial estimates show that returning global energy-related CO_2 emissions to 2005 levels by 2030 would require a large shift in the pattern of investment, although the net additional investment required ranges from negligible to 5-10% [4.1, 4.4, 11.6].
- It is often more cost-effective to invest in end-use energy efficiency improvement than in increasing energy supply to satisfy demand for energy services. Efficiency improvement has a positive effect on energy security, local and regional air pollution abatement, and employment [4.2, 4.3, 6.5, 7.7, 11.3, 11.8].
- Renewable energy generally has a positive effect on energy security, employment and on air quality. Given costs relative to other supply options, renewable electricity, which accounted for 18% of the electricity supply in 2005, can have a 30-35% share of the total electricity supply in 2030 at carbon prices up to 50 US$/t$CO_2$-eq [4.3, 4.4, 11.3, 11.6, 11.8].
- The higher the market prices of fossil fuels, the more low-carbon alternatives will be competitive, although price volatility will be a disincentive for investors. Higher priced conventional oil resources, on the other hand, may be replaced by high carbon alternatives such as from oil sands, oil shales, heavy oils, and synthetic fuels from coal and gas, leading to increasing GHG emissions, unless production plants are equipped with CCS [4.2, 4.3, 4.4, 4.5].
- Given costs relative to other supply options, nuclear power, which accounted for 16% of the electricity supply in 2005, can have an 18% share of the total electricity supply in 2030 at carbon prices up to 50 US$/t$CO_2$-eq, but safety, weapons proliferation and waste remain as constraints [4.2, 4.3, 4.4][21].
- CCS in underground geological formations is a new technology with the potential to make an important contribution to mitigation by 2030. Technical, economic and regulatory developments will affect the actual contribution [4.3, 4.4, 7.3].

11. There are multiple mitigation options in the transport sector[19], but their effect may be counteracted by growth in the sector. Mitigation options are faced with many barriers, such as consumer preferences and lack of policy frameworks *(medium agreement, medium evidence)*.

- Improved vehicle efficiency measures, leading to fuel savings, in many cases have net benefits (at least for light-duty vehicles), but the market potential is much lower than the economic potential due to the influence of other consumer considerations, such as performance and size. There is not enough information to assess the mitigation potential for heavy-duty vehicles. Market forces alone, including rising fuel costs, are therefore not expected to lead to significant emission reductions [5.3, 5.4].
- Biofuels might play an important role in addressing GHG emissions in the transport sector, depending on their production pathway. Biofuels used as gasoline and diesel fuel additives/substitutes are projected to grow to 3% of total transport energy demand in the baseline in 2030. This could increase to about 5-10%, depending on future oil and carbon prices, improvements in vehicle efficiency and the success of technologies to utilise cellulose biomass [5.3, 5.4].
- Modal shifts from road to rail and to inland and coastal shipping and from low-occupancy to high-occupancy passenger transportation[22], as well as land-use, urban planning and non-motorized transport offer opportunities for GHG mitigation, depending on local conditions and policies [5.3, 5.5].
- Medium term mitigation potential for CO_2 emissions from the aviation sector can come from improved fuel efficiency, which can be achieved through a variety of means, including technology, operations and air traffic management. However, such improvements are expected to only partially offset the growth of aviation emissions. Total mitigation potential in the sector would also need to account for non-CO_2 climate impacts of aviation emissions [5.3, 5.4].
- Realizing emissions reductions in the transport sector is often a co-benefit of addressing traffic congestion, air quality and energy security [5.5].

12. Energy efficiency options[19] for new and existing buildings could considerably reduce CO_2 emissions with net economic benefit. Many barriers exist against tapping this potential, but there are also large co-benefits *(high agreement, much evidence)*.

- By 2030, about 30% of the projected GHG emissions in the building sector can be avoided with net economic benefit [6.4, 6.5].

20 20 trillion = 20000 billion= $20*10^{12}$.
21 Austria could not agree with this statement.
22 Including rail, road and marine mass transit and carpooling.

- Energy efficient buildings, while limiting the growth of CO_2 emissions, can also improve indoor and outdoor air quality, improve social welfare and enhance energy security [6.6, 6.7].
- Opportunities for realising GHG reductions in the building sector exist worldwide. However, multiple barriers make it difficult to realise this potential. These barriers include availability of technology, financing, poverty, higher costs of reliable information, limitations inherent in building designs and an appropriate portfolio of policies and programs [6.7, 6.8].
- The magnitude of the above barriers is higher in the developing countries and this makes it more difficult for them to achieve the GHG reduction potential of the building sector [6.7].

13. The economic potential in the industrial sector[19] is predominantly located in energy intensive industries. Full use of available mitigation options is not being made in either industrialized or developing nations (*high agreement, much evidence*).

- Many industrial facilities in developing countries are new and include the latest technology with the lowest specific emissions. However, many older, inefficient facilities remain in both industrialized and developing countries. Upgrading these facilities can deliver significant emission reductions [7.1, 7.3, 7.4].
- The slow rate of capital stock turnover, lack of financial and technical resources, and limitations in the ability of firms, particularly small and medium-sized enterprises, to access and absorb technological information are key barriers to full use of available mitigation options [7.6].

14. Agricultural practices collectively can make a significant contribution at low cost[19] to increasing soil carbon sinks, to GHG emission reductions, and by contributing biomass feedstocks for energy use *(medium agreement, medium evidence)***.**

- A large proportion of the mitigation potential of agriculture (excluding bioenergy) arises from soil carbon sequestration, which has strong synergies with sustainable agriculture and generally reduces vulnerability to climate change [8.4, 8.5, 8.8].
- Stored soil carbon may be vulnerable to loss through both land management change and climate change [8.10].
- Considerable mitigation potential is also available from reductions in methane and nitrous oxide emissions in some agricultural systems [8.4, 8.5].
- There is no universally applicable list of mitigation practices; practices need to be evaluated for individual agricultural systems and settings [8.4].
- Biomass from agricultural residues and dedicated energy crops can be an important bioenergy feedstock, but its contribution to mitigation depends on demand for bioenergy from transport and energy supply, on water availability, and on requirements of land for food and fibre production. Widespread use of agricultural land for biomass production for energy may compete with other land uses and can have positive and negative environmental impacts and implications for food security [8.4, 8.8].

15. Forest-related mitigation activities can considerably reduce emissions from sources and increase CO_2 removals by sinks at low costs[19], and can be designed to create synergies with adaptation and sustainable development *(high agreement, much evidence)*[23].

- About 65% of the total mitigation potential (up to 100 US$/t$CO_2$-eq) is located in the tropics and about 50% of the total could be achieved by reducing emissions from deforestation [9.4].
- Climate change can affect the mitigation potential of the forest sector (i.e., native and planted forests) and is expected to be different for different regions and sub-regions, both in magnitude and direction [9.5].
- Forest-related mitigation options can be designed and implemented to be compatible with adaptation, and can have substantial co-benefits in terms of employment, income generation, biodiversity and watershed conservation, renewable energy supply and poverty alleviation [9.5, 9.6, 9.7].

16. Post-consumer waste[24] is a small contributor to global GHG emissions[25] (<5%), but the waste sector can positively contribute to GHG mitigation at low cost[19] and promote sustainable development *(high agreement, much evidence).*

- Existing waste management practices can provide effective mitigation of GHG emissions from this sector: a wide range of mature, environmentally effective technologies are commercially available to mitigate emissions and provide co-benefits for improved public health and safety, soil protection and pollution prevention, and local energy supply [10.3, 10.4, 10.5].
- Waste minimization and recycling provide important indirect mitigation benefits through the conservation of energy and materials [10.4].

23 Tuvalu noted difficulties with the reference to "low costs" as Chapter 9, page 15 of the WG III report states that: "the cost of forest mitigation projects rise significantly when opportunity costs of land are taken into account".
24 Industrial waste is covered in the industry sector.
25 GHGs from waste include landfill and wastewater methane, wastewater N_2O, and CO_2 from incineration of fossil carbon.

- Lack of local capital is a key constraint for waste and wastewater management in developing countries and countries with economies in transition. Lack of expertise on sustainable technology is also an important barrier [10.6].

17. Geo-engineering options, such as ocean fertilization to remove CO_2 directly from the atmosphere, or blocking sunlight by bringing material into the upper atmosphere, remain largely speculative and unproven, and with the risk of unknown side-effects. Reliable cost estimates for these options have not been published *(medium agreement, limited evidence)* [11.2].

D. Mitigation in the long term (after 2030)

18. In order to stabilize the concentration of GHGs in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilization level, the more quickly this peak and decline would need to occur. Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels (see Table SPM.5, and Figure SPM. 8)[26] (*high agreement, much evidence*).

- Recent studies using multi-gas reduction have explored lower stabilization levels than reported in TAR [3.3].
- Assessed studies contain a range of emissions profiles for achieving stabilization of GHG concentrations[27]. Most of these studies used a least cost approach and include both early and delayed emission reductions (Figure SPM.7) [Box SPM.2]. Table SPM.5 summarizes the required emissions levels for different groups of stabilization concentrations and the associated equilibrium global mean temperature increase[28], using the 'best estimate' of climate sensitivity (see also Figure SPM.8 for the likely range of uncertainty)[29]. Stabilization at lower concentration and related equilibrium temperature levels advances the date when emissions need to peak, and requires greater emissions reductions by 2050 [3.3].

Table SPM.5: *Characteristics of post-TAR stabilization scenarios [Table TS 2, 3.10][a)]*

Category	Radiative forcing (W/m^2)	CO_2 concentration[c)] (ppm)	CO_2-eq concentration[c)] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b), c)] (°C)	Peaking year for CO_2 emissions[d)]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d)]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000-2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000-2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010-2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020-2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050-2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060-2090	+90 to +140	5
						Total	177

a) The understanding of the climate system response to radiative forcing as well as feedbacks is assessed in detail in the AR4 WGI Report. Feedbacks between the carbon cycle and climate change affect the required mitigation for a particular stabilization level of atmospheric carbon dioxide concentration. These feedbacks are expected to increase the fraction of anthropogenic emissions that remains in the atmosphere as the climate system warms. Therefore, the emission reductions to meet a particular stabilization level reported in the mitigation studies assessed here might be underestimated.
b) The best estimate of climate sensitivity is 3°C [WG 1 SPM].
c) Note that global mean temperature at equilibrium is different from expected global mean temperature at the time of stabilization of GHG concentrations due to the inertia of the climate system. For the majority of scenarios assessed, stabilisation of GHG concentrations occurs between 2100 and 2150.
d) Ranges correspond to the 15th to 85th percentile of the post-TAR scenario distribution. CO_2 emissions are shown so multi-gas scenarios can be compared with CO_2-only scenarios.

26 Paragraph 2 addresses historical GHG emissions since pre-industrial times.
27 Studies vary in terms of the point in time stabilization is achieved; generally this is around 2100 or later.
28 The information on global mean temperature is taken from the AR4 WGI report, chapter 10.8. These temperatures are reached well after concentrations are stabilized.
29 The equilibrium climate sensitivity is a measure of the climate system response to sustained radiative forcing. It is not a projection but is defined as the global average surface warming following a doubling of carbon dioxide concentrations [AR4 WGI SPM].

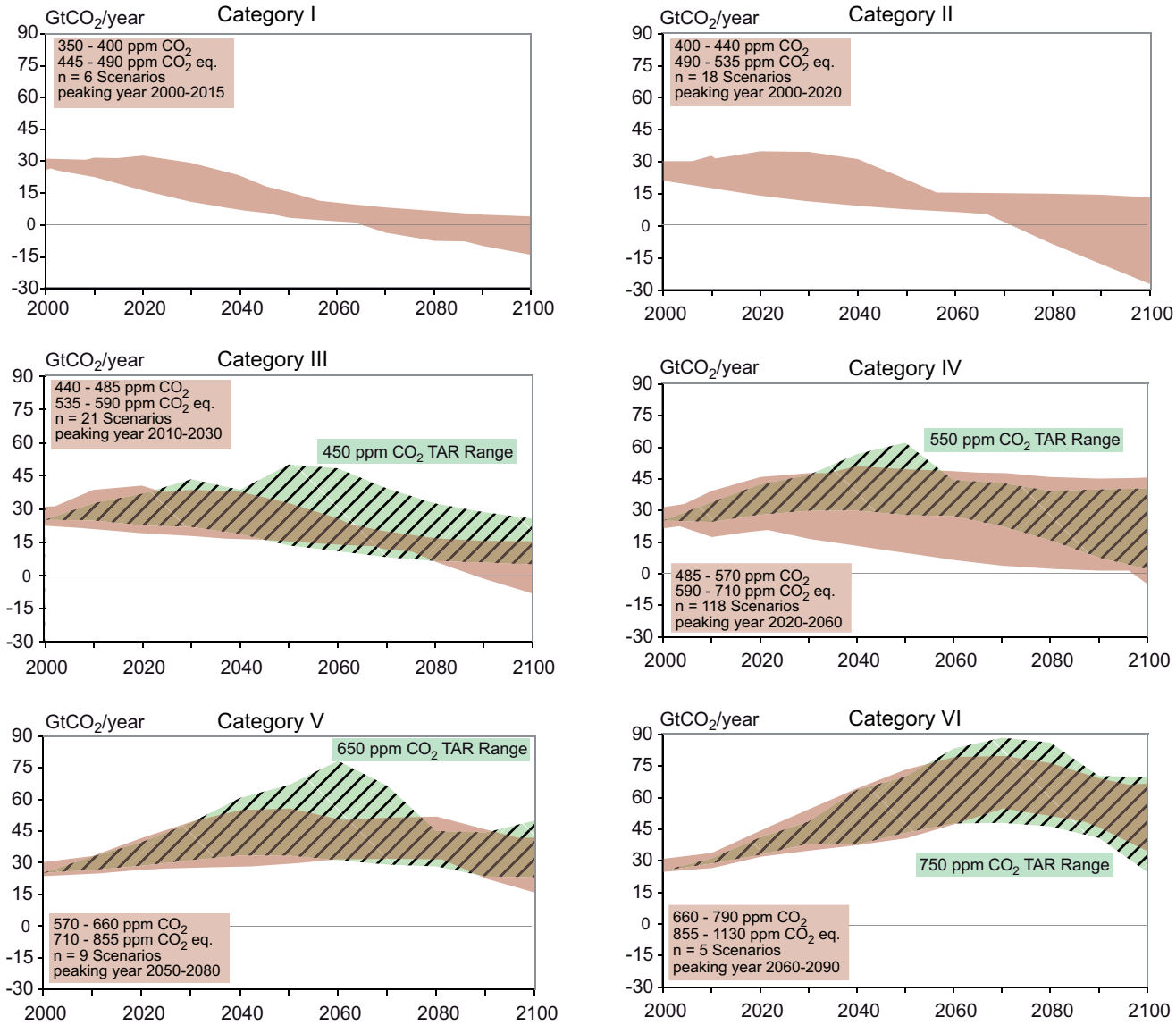


Figure SPM.7: *Emissions pathways of mitigation scenarios for alternative categories of stabilization levels (Category I to VI as defined in the box in each panel). The pathways are for CO_2 emissions only. Light brown shaded areas give the CO_2 emissions for the post-TAR emissions scenarios. Green shaded and hatched areas depict the range of more than 80 TAR stabilization scenarios. Base year emissions may differ between models due to differences in sector and industry coverage. To reach the lower stabilization levels some scenarios deploy removal of CO_2 from the atmosphere (negative emissions) using technologies such as biomass energy production utilizing carbon capture and storage. [Figure 3.17]*

19. **The range of stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are currently available and those that are expected to be commercialised in coming decades. This assumes that appropriate and effective incentives are in place for development, acquisition, deployment and diffusion of technologies and for addressing related barriers** *(high agreement, much evidence).*
    - The contribution of different technologies to emission reductions required for stabilization will vary over time, region and stabilization level.
        - o Energy efficiency plays a key role across many scenarios for most regions and timescales.
        - o For lower stabilization levels, scenarios put more emphasis on the use of low-carbon energy sources, such as renewable energy and nuclear power, and the use of CO_2 capture and storage (CCS). In these scenarios improvements of carbon intensity of energy supply and the whole economy need to be much faster than in the past.
        - o Including non-CO_2 and CO_2 land-use and forestry mitigation options provides greater flexibility and cost-effectiveness for achieving stabilization. Modern bioenergy could contribute substantially to the share of renewable energy in the mitigation portfolio.

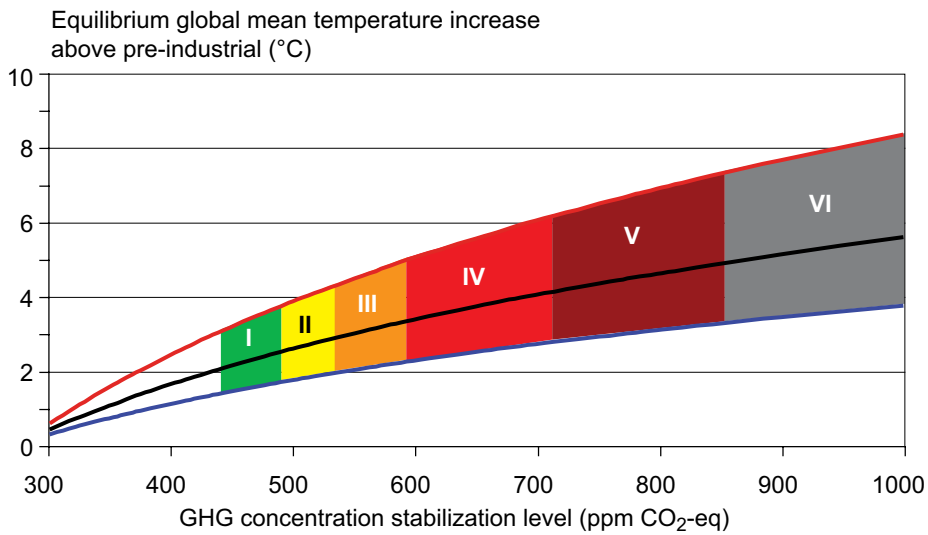


Figure SPM.8: *Stabilization scenario categories as reported in Figure SPM.7 (coloured bands) and their relationship to equilibrium global mean temperature change above pre-industrial, using (i) "best estimate" climate sensitivity of 3°C (black line in middle of shaded area), (ii) upper bound of likely range of climate sensitivity of 4.5°C (red line at top of shaded area) (iii) lower bound of likely range of climate sensitivity of 2°C (blue line at bottom of shaded area). Coloured shading shows the concentration bands for stabilization of greenhouse gases in the atmosphere corresponding to the stabilization scenario categories I to VI as indicated in Figure SPM.7. The data are drawn from AR4 WGI, Chapter 10.8.*

- For illustrative examples of portfolios of mitigation options, see figure SPM.9 [3.3, 3.4].

- Investments in and world-wide deployment of low-GHG emission technologies as well as technology improvements through public and private Research, Development & Demonstration (RD&D) would be required for achieving stabilization targets as well as cost reduction. The lower the stabilization levels, especially those of 550 ppm CO_2-eq or lower, the greater the need for more efficient RD&D efforts and investment in new

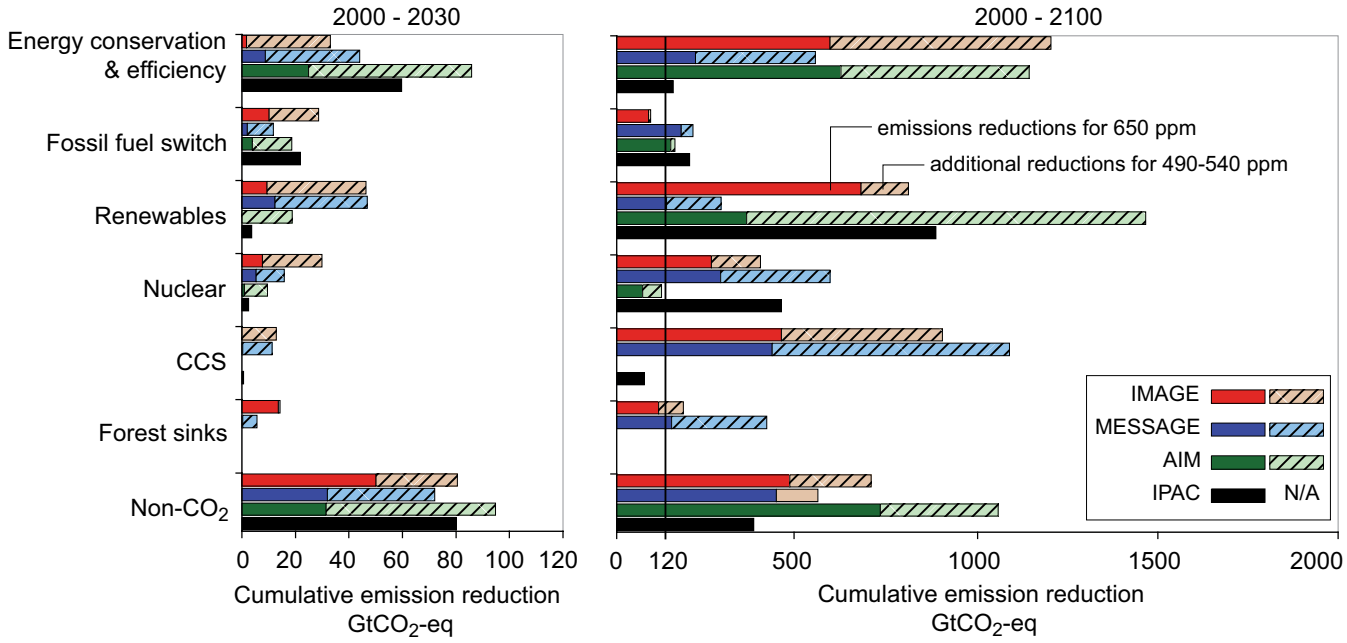


Figure SPM.9: *Cumulative emissions reductions for alternative mitigation measures for 2000 to 2030 (left-hand panel) and for 2000-2100 (right-hand panel). The figure shows illustrative scenarios from four models (AIM, IMAGE, IPAC and MESSAGE) aiming at the stabilization at 490-540 ppm CO_2-eq and levels of 650 ppm CO_2-eq, respectively. Dark bars denote reductions for a target of 650 ppm CO_2-eq and light bars the additional reductions to achieve 490-540 ppm CO_2-eq. Note that some models do not consider mitigation through forest sink enhancement (AIM and IPAC) or CCS (AIM) and that the share of low-carbon energy options in total energy supply is also determined by inclusion of these options in the baseline. CCS includes carbon capture and storage from biomass. Forest sinks include reducing emissions from deforestation. [Figure 3.23]*

technologies during the next few decades. This requires that barriers to development, acquisition, deployment and diffusion of technologies are effectively addressed.

- Appropriate incentives could address these barriers and help realize the goals across a wide portfolio of technologies. [2.7, 3.3, 3.4, 3.6, 4.3, 4.4, 4.6].

20. In 2050[30] global average macro-economic costs for multi-gas mitigation towards stabilization between 710 and 445 ppm CO_2-eq, are between a 1% gain to a 5.5% decrease of global GDP (see Table SPM.6). For specific countries and sectors, costs vary considerably from the global average. (See Box SPM.3 and SPM.4 for the methodologies and assumptions and paragraph 5 for explanation of negative costs) *(high agreement, medium evidence)*.

21. Decision-making about the appropriate level of global mitigation over time involves an iterative risk management process that includes mitigation and adaptation, taking into account actual and avoided climate change damages, co-benefits, sustainability, equity, and attitudes to risk. Choices about the scale and timing of GHG mitigation involve balancing the economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay *[high agreement, much evidence]*.

- Limited and early analytical results from integrated analyses of the costs and benefits of mitigation indicate that these are broadly comparable in magnitude, but do not as yet permit an unambiguous determination of an emissions pathway or stabilization level where benefits exceed costs [3.5].
- Integrated assessment of the economic costs and benefits of different mitigation pathways shows that the economically optimal timing and level of mitigation depends upon the uncertain shape and character of the assumed climate change damage cost curve. To illustrate this dependency:
  - o if the climate change damage cost curve grows slowly and regularly, and there is good foresight (which increases the potential for timely adaptation), later and less stringent mitigation is economically justified;
  - o alternatively if the damage cost curve increases steeply, or contains non-linearities (e.g. vulnerability thresholds or even small probabilities of catastrophic events), earlier and more stringent mitigation is economically justified [3.6].
- Climate sensitivity is a key uncertainty for mitigation scenarios that aim to meet a specific temperature level. Studies show that if climate sensitivity is high then the timing and level of mitigation is earlier and more stringent than when it is low [3.5, 3.6].
- Delayed emission reductions lead to investments that lock in more emission-intensive infrastructure and development pathways. This significantly constrains the opportunities to achieve lower stabilization levels (as shown in Table SPM.5) and increases the risk of more severe climate change impacts [3.4, 3.1, 3.5, 3.6]

Table SPM.6: *Estimated global macro-economic costs in 2050 relative to the baseline for least-cost trajectories towards different long-term stabilization targets[a)] [3.3, 13.3]*

Stabilization levels (ppm CO_2-eq)	Median GDP reduction[b)] (%)	Range of GDP reduction[b), c)] (%)	Reduction of average annual GDP growth rates[b), d)] (percentage points)
590-710	0.5	-1 - 2	<0.05
535-590	1.3	slightly negative - 4	<0.1
445-535[e)]	not available	<5.5	<0.12

Notes:
a) This corresponds to the full literature across all baselines and mitigation scenarios that provide GDP numbers.
b) This is global GDP based market exchange rates.
c) The median and the 10th and 90th percentile range of the analyzed data are given.
d) The calculation of the reduction of the annual growth rate is based on the average reduction during the period until 2050 that would result in the indicated GDP decrease in 2050.
e) The number of studies is relatively small and they generally use low baselines. High emissions baselines generally lead to higher costs.

30 Cost estimates for 2030 are presented in paragraph 5.

E. Policies, measures and instruments to mitigate climate change

22. A wide variety of national policies and instruments are available to governments to create the incentives for mitigation action. Their applicability depends on national circumstances and an understanding of their interactions, but experience from implementation in various countries and sectors shows there are advantages and disadvantages for any given instrument *(high agreement, much evidence).*

- Four main criteria are used to evaluate policies and instruments: environmental effectiveness, cost effectiveness, distributional effects, including equity, and institutional feasibility [13.2].
- All instruments can be designed well or poorly, and be stringent or lax. In addition, monitoring to improve implementation is an important issue for all instruments. General findings about the performance of policies are: [7.9, 12.2,13.2]
  - *Integrating climate policies in broader development policies* makes implementation and overcoming barriers easier.
  - *Regulations and standards* generally provide some certainty about emission levels. They may be preferable to other instruments when information or other barriers prevent producers and consumers from responding to price signals. However, they may not induce innovations and more advanced technologies.
  - *Taxes and charges* can set a price for carbon, but cannot guarantee a particular level of emissions. Literature identifies taxes as an efficient way of internalizing costs of GHG emissions.
  - *Tradable permits* will establish a carbon price. The volume of allowed emissions determines their environmental effectiveness, while the allocation of permits has distributional consequences. Fluctuation in the price of carbon makes it difficult to estimate the total cost of complying with emission permits.
  - *Financial incentives* (subsidies and tax credits) are frequently used by governments to stimulate the development and diffusion of new technologies. While economic costs are generally higher than for the instruments listed above, they are often critical to overcome barriers.
  - *Voluntary agreements* between industry and governments are politically attractive, raise awareness among stakeholders, and have played a role in the evolution of many national policies. The majority of agreements has not achieved significant emissions reductions beyond business as usual. However, some recent agreements, in a few countries, have accelerated the application of best available technology and led to measurable emission reductions.
  - *Information instruments* (e.g. awareness campaigns) may positively affect environmental quality by promoting informed choices and possibly contributing to behavioural change, however, their impact on emissions has not been measured yet.
  - *RD&D* can stimulate technological advances, reduce costs, and enable progress toward stabilization.
- Some corporations, local and regional authorities, NGOs and civil groups are adopting a wide variety of voluntary actions. These voluntary actions may limit GHG emissions, stimulate innovative policies, and encourage the deployment of new technologies. On their own, they generally have limited impact on the national or regional level emissions [13.4].
- Lessons learned from specific sector application of national policies and instruments are shown in Table SPM.7.

23. Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes. Such policies could include economic instruments, government funding and regulation (*high agreement, much evidence*).

- An effective carbon-price signal could realize significant mitigation potential in all sectors [11.3, 13.2].
- Modelling studies, consistent with stabilization at around 550 ppm CO_2-eq by 2100 (see Box SPM.3), show carbon prices rising to 20 to 80 US\$/tCO_2-eq by 2030 and 30 to 155 US\$/tCO_2-eq by 2050. For the same stabilization level, studies since TAR that take into account induced technological change lower these price ranges to 5 to 65 US\$/tCO_2-eq in 2030 and 15 to 130 US\$/tCO_2-eq in 2050 [3.3, 11.4, 11.5].
- Most top-down, as well as some 2050 bottom-up assessments, suggest that real or implicit carbon prices of 20 to 50 US\$/tCO_2-eq, sustained or increased over decades, could lead to a power generation sector with low-GHG emissions by 2050 and make many mitigation options in the end-use sectors economically attractive. [4.4,11.6]
- Barriers to the implementation of mitigation options are manifold and vary by country and sector. They can be related to financial, technological, institutional, informational and behavioural aspects [4.5, 5.5, 6.7, 7.6, 8.6, 9.6, 10.5].

Table SPM.7: *Selected sectoral policies, measures and instruments that have shown to be environmentally effective in the respective sector in at least a number of national cases.*

Sector	Policies[a)], measures and instruments shown to be environmentally effective	Key constraints or opportunities
Energy supply [4.5]	Reduction of fossil fuel subsidies Taxes or carbon charges on fossil fuels	Resistance by vested interests may make them difficult to implement
	Feed-in tariffs for renewable energy technologies Renewable energy obligations Producer subsidies	May be appropriate to create markets for low emissions technologies
Transport [5.5]	Mandatory fuel economy, biofuel blending and CO_2 standards for road transport	Partial coverage of vehicle fleet may limit effectiveness
	Taxes on vehicle purchase, registration, use and motor fuels, road and parking pricing	Effectiveness may drop with higher incomes
	Influence mobility needs through land use regulations, and infrastructure planning Investment in attractive public transport facilities and non-motorised forms of transport	Particularly appropriate for countries that are building up their transportation systems
Buildings [6.8]	Appliance standards and labelling	Periodic revision of standards needed
	Building codes and certification	Attractive for new buildings. Enforcement can be difficult
	Demand-side management programmes	Need for regulations so that utilities may profit
	Public sector leadership programmes, including procurement	Government purchasing can expand demand for energy-efficient products
	Incentives for energy service companies (ESCOs)	Success factor: Access to third party financing
Industry [7.9]	Provision of benchmark information Performance standards Subsidies, tax credits	May be appropriate to stimulate technology uptake. Stability of national policy important in view of international competitiveness
	Tradable permits	Predictable allocation mechanisms and stable price signals important for investments
	Voluntary agreements	Success factors include: clear targets, a baseline scenario, third party involvement in design and review and formal provisions of monitoring, close cooperation between government and industry
Agriculture [8.6, 8.7, 8.8]	Financial incentives and regulations for improved land management, maintaining soil carbon content, efficient use of fertilizers and irrigation	May encourage synergy with sustainable development and with reducing vulnerability to climate change, thereby overcoming barriers to implementation
Forestry/ forests [9.6]	Financial incentives (national and international) to increase forest area, to reduce deforestation, and to maintain and manage forests	Constraints include lack of investment capital and land tenure issues. Can help poverty alleviation
	Land use regulation and enforcement	
Waste management [10.5]	Financial incentives for improved waste and wastewater management	May stimulate technology diffusion
	Renewable energy incentives or obligations	Local availability of low-cost fuel
	Waste management regulations	Most effectively applied at national level with enforcement strategies

Note:
a) Public RD & D investment in low emissions technologies have proven to be effective in all sectors

24. Government support through financial contributions, tax credits, standard setting and market creation is important for effective technology development, innovation and deployment. Transfer of technology to developing countries depends on enabling conditions and financing *(high agreement, much evidence).*

- Public benefits of RD&D investments are bigger than the benefits captured by the private sector, justifying government support of RD&D.
- Government funding in real absolute terms for most energy research programmes has been flat or declining for nearly two decades (even after the UNFCCC came into force) and is now about half of the 1980 level [2.7, 3.4, 4.5, 11.5, 13.2].

- Governments have a crucial supportive role in providing appropriate enabling environment, such as, institutional, policy, legal and regulatory frameworks[31], to sustain investment flows and for effective technology transfer – without which it may be difficult to achieve emission reductions at a significant scale. Mobilizing financing of incremental costs of low-carbon technologies is important. International technology agreements could strengthen the knowledge infrastructure [13.3].
- The potential beneficial effect of technology transfer to developing countries brought about by Annex I countries action may be substantial, but no reliable estimates are available [11.7].
- Financial flows to developing countries through Clean Development Mechanism (CDM) projects have the potential to reach levels of the order of several billions US$ per year[32], which is higher than the flows through the Global Environment Facility (GEF), comparable to the energy oriented development assistance flows, but at least an order of magnitude lower than total foreign direct investment flows. The financial flows through CDM, GEF and development assistance for technology transfer have so far been limited and geographically unequally distributed [12.3, 13.3].

25. Notable achievements of the UNFCCC and its Kyoto Protocol are the establishment of a global response to the climate problem, stimulation of an array of national policies, the creation of an international carbon market and the establishment of new institutional mechanisms that may provide the foundation for future mitigation efforts *(high agreement, much evidence).*

- The impact of the Protocol's first commitment period relative to global emissions is projected to be limited. Its economic impacts on participating Annex-B countries are projected to be smaller than presented in TAR, that showed 0.2-2% lower GDP in 2012 without emissions trading, and 0.1-1.1% lower GDP with emissions trading among Annex-B countries [1.4, 11.4, 13.3].

26. The literature identifies many options for achieving reductions of global GHG emissions at the international level through cooperation. It also suggests that successful agreements are environmentally effective, cost-effective, incorporate distributional considerations and equity, and are institutionally feasible *(high agreement, much evidence).*

- Greater cooperative efforts to reduce emissions will help to reduce global costs for achieving a given level of mitigation, or will improve environmental effectiveness [13.3].
- Improving, and expanding the scope of, market mechanisms (such as emission trading, Joint Implementation and CDM) could reduce overall mitigation costs [13.3].
- Efforts to address climate change can include diverse elements such as emissions targets; sectoral, local, sub-national and regional actions; RD&D programmes; adopting common policies; implementing development oriented actions; or expanding financing instruments. These elements can be implemented in an integrated fashion, but comparing the efforts made by different countries quantitatively would be complex and resource intensive [13.3].
- Actions that could be taken by participating countries can be differentiated both in terms of when such action is undertaken, who participates and what the action will be. Actions can be binding or non-binding, include fixed or dynamic targets, and participation can be static or vary over time [13.3].

F. Sustainable development and climate change mitigation

27. Making development more sustainable by changing development paths can make a major contribution to climate change mitigation, but implementation may require resources to overcome multiple barriers. There is a growing understanding of the possibilities to choose and implement mitigation options in several sectors to realize synergies and avoid conflicts with other dimensions of sustainable development *(high agreement, much evidence).*

- Irrespective of the scale of mitigation measures, adaptation measures are necessary [1.2].
- Addressing climate change can be considered an integral element of sustainable development policies. National circumstances and the strengths of institutions determine how development policies impact GHG emissions. Changes in development paths emerge from the interactions of public and private decision processes involving government, business and civil society, many of which are not traditionally considered as climate policy. This process is most effective when actors participate equitably and decentralized decision making processes are coordinated [2.2, 3.3, 12.2].
- Climate change and other sustainable development policies are often but not always synergistic. There is growing evidence that decisions about macroeconomic policy, agricultural policy, multilateral development bank lending, insurance practices, electricity market reform, energy security and forest conservation, for example, which are often treated as being apart from

31 See the IPCC Special Report on Methodological and Technological Issues in Technology Transfer.
32 Depends strongly on the market price that has fluctuated between 4 and 26 US$/tCO2-eq and based on approximately 1000 CDM proposed plus registered projects likely to generate more than 1.3 billion emission reduction credits before 2012.

climate policy, can significantly reduce emissions. On the other hand, decisions about improving rural access to modern energy sources for example may not have much influence on global GHG emissions [12.2].

- Climate change policies related to energy efficiency and renewable energy are often economically beneficial, improve energy security and reduce local pollutant emissions. Other energy supply mitigation options can be designed to also achieve sustainable development benefits such as avoided displacement of local populations, job creation, and health benefits [4.5,12.3].
- Reducing both loss of natural habitat and deforestation can have significant biodiversity, soil and water conservation benefits, and can be implemented in a socially and economically sustainable manner. Forestation and bioenergy plantations can lead to restoration of degraded land, manage water runoff, retain soil carbon and benefit rural economies, but could compete with land for food production and may be negative for biodiversity, if not properly designed [9.7, 12.3].
- There are also good possibilities for reinforcing sustainable development through mitigation actions in the waste management, transportation and buildings sectors [5.4, 6.6, 10.5, 12.3].
- Making development more sustainable can enhance both mitigative and adaptive capacity, and reduce emissions and vulnerability to climate change. Synergies between mitigation and adaptation can exist, for example properly designed biomass production, formation of protected areas, land management, energy use in buildings and forestry. In other situations, there may be trade-offs, such as increased GHG emissions due to increased consumption of energy related to adaptive responses [2.5, 3.5, 4.5, 6.9, 7.8, 8.5, 9.5, 11.9, 12.1].

G. Gaps in knowledge

28. There are still relevant gaps in currently available knowledge regarding some aspects of mitigation of climate change, especially in developing countries. Additional research addressing those gaps would further reduce uncertainties and thus facilitate decision-making related to mitigation of climate change [TS.14].

Endbox 1: Uncertainty representation

Uncertainty is an inherent feature of any assessment. The fourth assessment report clarifies the uncertainties associated with essential statements.

Fundamental differences between the underlying disciplinary sciences of the three Working Group reports make a common approach impractical. The "likelihood" approach applied in "Climate change 2007, the physical science basis" and the "confidence" and "likelihood" approaches used in "Climate change 2007, impacts, adaptation, and vulnerability" were judged to be inadequate to deal with the specific uncertainties involved in this mitigation report, as here human choices are considered.

In this report a two-dimensional scale is used for the treatment of uncertainty. The scale is based on the expert judgment of the authors of WGIII on the level of concurrence in the literature on a particular finding (level of agreement), and the number and quality of independent sources qualifying under the IPCC rules upon which the finding is based (amount of evidence[1]) (see Table SPM.E.1). This is not a quantitative approach, from which probabilities relating to uncertainty can be derived.

Table SPM.E.1: *Qualitative definition of uncertainty*

Level of agreement (on a particular finding) ↑			
	High agreement, limited evidence	**High agreement, medium evidence**	**High agreement, much evidence**
	Medium agreement, limited evidence	**Medium agreement, medium evidence**	**Medium agreement, much evidence**
	Low agreement, limited evidence	**Low agreement, medium evidence**	**Low agreement, much evidence**

Amount of evidence[33] (number and quality of independent sources) →

Because the future is inherently uncertain, scenarios i.e. internally consistent images of different futures - not predictions of the future - have been used extensively in this report.

33 "Evidence" in this report is defined as: Information or signs indicating whether a belief or proposition is true or valid. See Glossary.

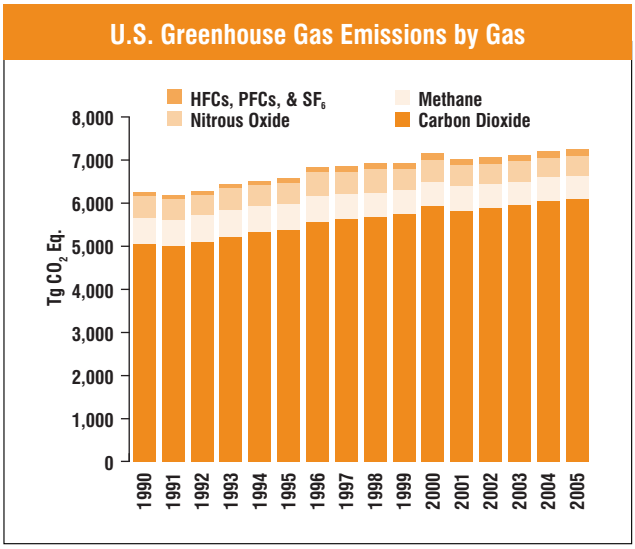
2. Trends in Greenhouse Gas Emissions

2.1. Recent Trends in U.S. Greenhouse Gas Emissions

In 2005, total U.S. greenhouse gas emissions were 7,260.4 teragrams of carbon dioxide equivalents (Tg CO_2 Eq.).[1] Overall, total U.S. emissions have risen by 16.3 percent from 1990 to 2005, while the U.S. gross domestic product has increased by 55 percent over the same period (BEA 2006). Emissions rose from 2004 to 2005, increasing by 0.8 percent (56.7 Tg CO_2 Eq.). The following factors were primary contributors to this increase: (1) strong economic growth in 2005, leading to increased demand for electricity and (2) an increase in the demand for electricity due to warmer summer conditions. These factors were moderated by decreasing demand for fuels due to warmer winter conditions and higher fuel prices. Figure 2-1 through Figure 2-3 illustrate the overall trends in total U.S. emissions by gas,[2] annual changes, and absolute changes since 1990.

As the largest source of U.S. greenhouse gas emissions, carbon dioxide (CO_2) from fossil fuel combustion has accounted for approximately 77 percent of global warming potential (GWP) weighted emissions since 1990, growing slowly from 76 percent of total GWP-weighted emissions in 1990 to 79 percent in 2005. Emissions from this source category grew by 21.7 percent (1,027.1 Tg CO_2 Eq.) from 1990 to 2005 and were responsible for most of the increase in national emissions during this period. From 2004 to 2005, these emissions increased by 0.7 percent (38.2 Tg CO_2 Eq.), slightly less than the source's average annual growth rate of 1.4 percent from 1990 through 2005. Historically, changes in emissions from fossil fuel combustion have been the dominant factor affecting U.S. emission trends.

Figure 2-1



Changes in CO_2 emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population and economic growth, energy price fluctuations, technological changes, and seasonal temperatures. On an annual basis, the overall consumption of fossil fuels in the United States generally fluctuates in response to changes in general economic conditions, energy prices, weather, and the availability of non-fossil alternatives.

[1] Estimates are presented in units of teragrams of carbon dioxide equivalent (Tg CO_2 Eq.), which weight each gas by its global warming potential, or GWP, value. (See section on global warming potentials, Chapter 1.)

[2] See the following section for an analysis of emission trends by general economic sector.

Figure 2-2

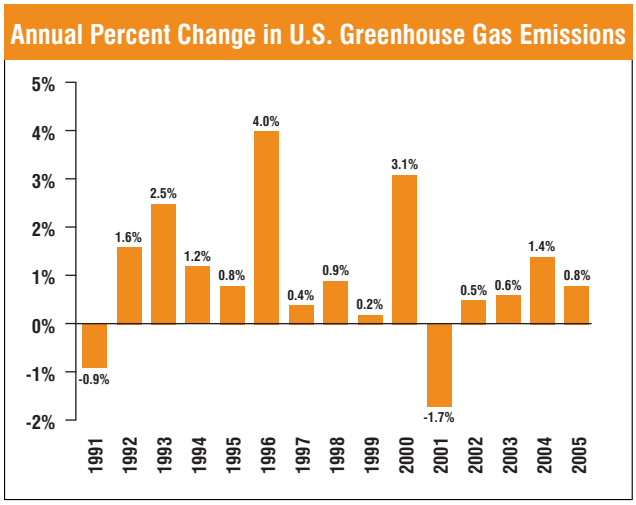
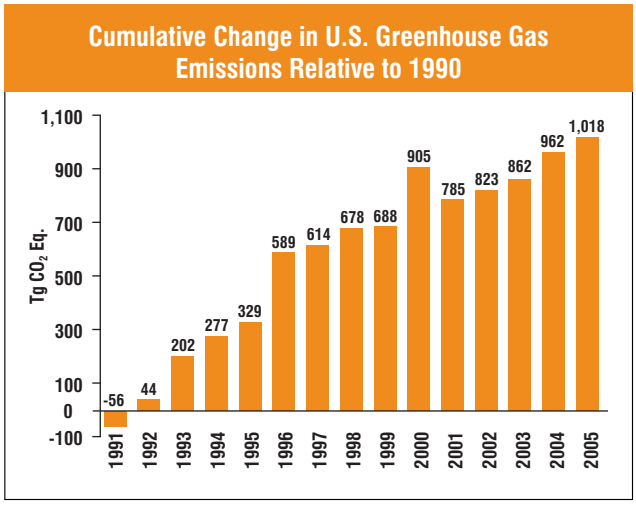


Figure 2-3



For example, in a year with increased consumption of goods and services, low fuel prices, severe summer and winter weather conditions, nuclear plant closures, and lower precipitation feeding hydroelectric dams, there would likely be proportionally greater fossil fuel consumption than in a year with poor economic performance, high fuel prices, mild temperatures, and increased output from nuclear and hydroelectric plants.

In the longer-term, energy consumption patterns respond to changes that affect the scale of consumption (e.g., population, number of cars, and size of houses), the efficiency with which energy is used in equipment (e.g., cars, power plants, steel mills, and light bulbs) and consumer behavior (e.g., walking, bicycling, or telecommuting to work instead of driving).

Energy-related CO_2 emissions also depend on the type of fuel or energy consumed and its carbon (C) intensity. Producing a unit of heat or electricity using natural gas instead of coal, for example, can reduce the CO_2 emissions because of the lower C content of natural gas. Table 2-1 shows annual changes in emissions during the last five years for coal, petroleum, and natural gas in selected sectors.

After emissions significantly decreased in 2001 due to the economic slowdown, emissions from fuel combustion resumed modest growth in 2002, slightly less than the average annual growth rate since 1990. There were a number of reasons behind this increase. The U.S. economy experienced moderate growth, recovering from weak economic conditions in 2001. Prices for fuels remained at or below 2001 levels; the cost of natural gas, motor gasoline, and electricity were all lower—triggering an increase in demand for fuel. In addition, the United States experienced one of the hottest summers on record, causing a significant increase in electricity use in the residential sector as the use of air-conditioners increased. Partially offsetting this increased consumption of fossil fuels, however, were

Table 2-1: Annual Change in CO_2 Emissions from Fossil Fuel Combustion for Selected Fuels and Sectors (Tg CO_2 Eq. and Percent)

Sector	Fuel Type	2001 to 2002		2002 to 2003		2003 to 2004		2004 to 2005	
Electricity Generation	Coal	16.0	0.9%	38.0	2.0%	11.4	0.6%	40.8	2.1%
Electricity Generation	Natural Gas	16.1	5.5%	-27.7	-9.0%	18.4	6.6%	22.4	7.5%
Electricity Generation	Petroleum	-22.9	-22.5%	19.0	24.0%	2.0	2.0%	2.2	2.2%
Transportation[a]	Petroleum	51.8	3.0%	2.0	0.1%	55.1	3.1%	28.8	1.6%
Residential	Natural Gas	6.4	2.5%	11.5	4.3%	-12.2	-4.4%	-3.4	-1.3%
Commercial	Natural Gas	6.6	4.0%	2.6	1.5%	-3.1	-1.8%	-4.2	-2.5%
Industrial	Coal	-10.1	-7.6%	0.6	0.5%	2.3	1.8%	-4.0	-3.2%
Industrial	Natural Gas	9.4	2.2%	-14.5	-3.3%	0.6	0.1%	-34.8	-8.2%
All Sectors[b]	**All Fuels[b]**	**45.5**	**0.8%**	**67.3**	**1.2%**	**88.5**	**1.6%**	**38.2**	**0.7%**

[a] Excludes emissions from International Bunker Fuels.
[b] Includes fuels and sectors not shown in table (see Table 3-3 for complete list of fuels by sector).

increases in the use of nuclear and renewable fuels. Nuclear facilities operated at the highest capacity on record in 2002. Furthermore, there was a considerable increase in the use of hydroelectric power in 2002 after a very low output the previous year.

Emissions from fuel combustion continued growing in 2003, at about the average annual growth rate since 1990. A number of factors played a major role in the magnitude of this increase. The U.S. economy experienced moderate growth from 2002, causing an increase in the demand for fuels. The price of natural gas escalated dramatically, causing some electric power producers to switch to coal, which remained at relatively stable prices. Colder winter conditions brought on more demand for heating fuels, primarily in the residential sector. Though a cooler summer partially offset demand for electricity as the use of air-conditioners decreased, electricity consumption continued to increase in 2003. The primary drivers behind this trend were the growing economy and the increase in U.S. housing stock. Nuclear capacity decreased slightly, for the first time since 1997. Use of renewable fuels rose slightly due to increases in the use of hydroelectric power and biofuels.

From 2003 to 2004, these emissions increased at a rate slightly higher than the average growth rate since 1990. A number of factors played a major role in the magnitude of this increase. A primary reason behind this trend was strong growth in the U.S. economy and industrial production, particularly in energy-intensive industries, causing an increase in the demand for electricity and fossil fuels. Demand for travel was also higher, causing an increase in petroleum consumed for transportation. In contrast, the warmer winter conditions led to decreases in demand for heating fuels, principally natural gas, in both the residential and commercial sectors. Moreover, much of the increased electricity demanded was generated by natural gas combustion and nuclear power, which moderated the increase in CO_2 emissions from electricity generation. Use of renewable fuels rose very slightly due to increases in the use of biofuels.

Emissions from fuel combustion increased from 2004 to 2005 at a rate slightly lower than the average annual growth rate since 1990. A number of factors played a role in this slight increase. This small increase is primarily a result of the restraint on fuel consumption, primarily in the transportation sector, caused by rising fuel prices. Although electricity prices increased slightly, there was a significant increase in electricity consumption in the residential and commercial sectors due to warmer summer weather conditions. This led to an increase in emissions in these sectors with the increased use of air-conditioners. As electricity emissions increased among all end-use sectors, the fuels used to generate electricity increased as well. Despite a slight decrease in industrial energy-related emissions, industrial production and manufacturing output actually increased. The price of natural gas escalated dramatically, causing a decrease in consumption of natural gas in the industrial sector. Use of renewable fuels decreased slightly due to decreased use of biofuels and decreased electricity output by hydroelectric power plants.

Other significant trends in emissions from additional source categories over the fifteen-year period from 1990 through 2005 included the following:

- CO_2 emissions from waste combustion increased by 10.0 Tg CO_2 Eq. (91percent), as the volume of plastics and other fossil-carbon-containing materials in municipal solid waste grew.
- Net CO_2 sequestration from Land Use, Land-Use Change, and Forestry increased by 115.7 Tg CO_2 Eq. (16 percent) from 1990 through 2005. This increase was primarily due to an increase in the rate of net C accumulation in forest C stocks, particularly in aboveground and belowground tree biomass. Annual C accumulation in landfilled yard trimmings and food scraps slowed over this period, while the rate of C accumulation in urban trees increased.
- Methane (CH_4) emissions from coal mining declined by 29.5 Tg CO_2 Eq. (36 percent) from 1990 to 2005 as a result of the mining of less gassy coal from underground mines and the increased combustion of CH_4 collected from degasification systems.
- From 1990 to 2005, nitrous oxide (N_2O) emissions from mobile combustion decreased by 13.1 percent. However, from 1990 to 1998 emissions increased by 26 percent, due to control technologies that reduced CH_4 emissions while increasing N_2O emissions. Since 1998, new control technologies have led to a steady decline in N_2O from this source.
- Emissions resulting from the substitution of ozone depleting substances (ODS, e.g., chlorofluorocarbons

Box 2-1: Recent Trends in Various U.S. Greenhouse Gas Emissions-Related Data

Total emissions can be compared to other economic and social indices to highlight changes over time. These comparisons include: (1) emissions per unit of aggregate energy consumption, because energy-related activities are the largest sources of emissions; (2) emissions per unit of fossil fuel consumption, because almost all energy-related emissions involve the combustion of fossil fuels; (3) emissions per unit of electricity consumption, because the electric power industry—utilities and nonutilities combined—was the largest source of U.S. greenhouse gas emissions in 2005; (4) emissions per unit of total gross domestic product as a measure of national economic activity; or (5) emissions per capita.

Table 2-2 provides data on various statistics related to U.S. greenhouse gas emissions normalized to 1990 as a baseline year. Greenhouse gas emissions in the United States have grown at an average annual rate of 1.1 percent since 1990. This rate is slightly slower than that for total energy or fossil fuel consumption and much slower than that for either electricity consumption or overall gross domestic product. Total U.S. greenhouse gas emissions have also grown slightly slower than national population since 1990 (see Figure 2-4).

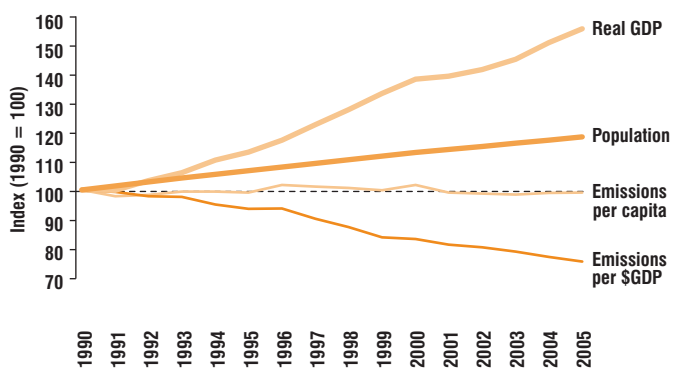
Table 2-2: Recent Trends in Various U.S. Data (Index 1990 = 100)

Variable	1990	1995	2000	2001	2002	2003	2004	2005	Growth Rate[a]
GDP[b]	100	113	138	139	141	145	150	155	3.0%
Electricity Consumption[c]	100	112	127	125	128	129	131	134	2.0%
Fossil Fuel Consumption[c]	100	107	117	115	116	118	119	119	1.2%
Energy Consumption[c]	100	108	117	114	116	117	119	118	1.1%
Population[d]	100	107	113	114	115	116	117	118	1.1%
Greenhouse Gas Emissions[e]	100	105	115	113	113	114	115	116	1.0%

[a] Average annual growth rate
[b] Gross Domestic Product in chained 2000 dollars (BEA 2006)
[c] Energy-content-weighted values (EIA 2006b)
[d] U.S. Census Bureau (2006)
[e] GWP-weighted values

Figure 2-4

U.S. Greenhouse Gas Emissions Per Capita and Per Dollar of Gross Domestic Product



Source: BEA (2006), U.S. Census Bureau (2006), and emission estimates in the this report.

[CFCs]) have increased dramatically, from small amounts in 1990 to 123.3 Tg CO_2 Eq. in 2005. These emissions have been increasing as phase-outs of ODS required under the Montreal Protocol come into effect.

- The increase in ODS substitutes emissions is offset substantially by decreases in emission of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) from other sources. Emissions from aluminum production decreased by 84 percent (15.6 Tg CO_2 Eq.) from 1990 to 2005, due to both industry emission reduction efforts and lower domestic aluminum production. Emissions from the production of HCFC-22 decreased by 53 percent (18.4 Tg CO_2 Eq.) from 1990 to 2005, due to a steady decline in the emission rate of HFC-23 (i.e., the amount of HFC-23 emitted per kilogram of HCFC-22 manufactured) and the use of thermal oxidation at some plants to reduce HFC-23 emissions. Emissions from electric power transmission and distribution systems decreased by 51 percent (13.9 Tg CO_2 Eq.) from 1990 to 2005, primarily because of higher purchase prices for SF_6 and efforts by industry to reduce emissions.

Overall, from 1990 to 2005, total emissions of CO_2 increased by 1,027.9 Tg CO_2 Eq. (20 percent), while CH_4 and N_2O emissions decreased by 69.8 Tg CO_2 Eq. (11 percent) and 13.4 Tg CO_2 Eq. (2.8 percent) respectively. During the same period, aggregate weighted emissions of HFCs, PFCs, and SF_6 rose by 73.7 Tg CO_2 Eq. (82.5 percent). Despite being emitted in smaller quantities relative to the other principal greenhouse gases, emissions of HFCs, PFCs, and SF_6 are significant because many of them have extremely high GWPs and, in the cases of PFCs and SF_6, long atmospheric lifetimes. Conversely, U.S. greenhouse gas emissions were partly offset by C sequestration in managed forests, trees in urban areas, agricultural soils, and landfilled yard trimmings, which was estimated to be 11 percent of total emissions in 2005.

Table 2-3 summarizes emissions and sinks from all U.S. anthropogenic sources in weighted units of Tg CO_2 Eq., while unweighted gas emissions and sinks in gigagrams (Gg) are provided in Table 2-4. Figure 2-5 and Table 2-5 show emissions and sinks aggregated by sector/chapter.

Emissions of all gases can be summed from each source category from Intergovernmental Panel on Climate Change (IPCC) guidance. Over the fifteen-year period of 1990 to 2005, total emissions in the Energy, Industrial Processes, and Agriculture sectors climbed by 1,001.5 Tg CO_2 Eq. (19 percent), 33.6 Tg CO_2 Eq. (11 percent), and 6.0 Tg CO_2 Eq. (1.1 percent), respectively. Emissions decreased from the Solvent and Other Product Use and Waste sectors by 0.02 Tg CO_2 Eq. (less than 1 percent) and 26.7 Tg CO_2 Eq. (14 percent), respectively. Over the same period, estimates of net C sequestration in the Land Use, Land-Use Change, and Forestry sector increased by 109.5 Tg CO_2 Eq. (16 percent).

Figure 2-5

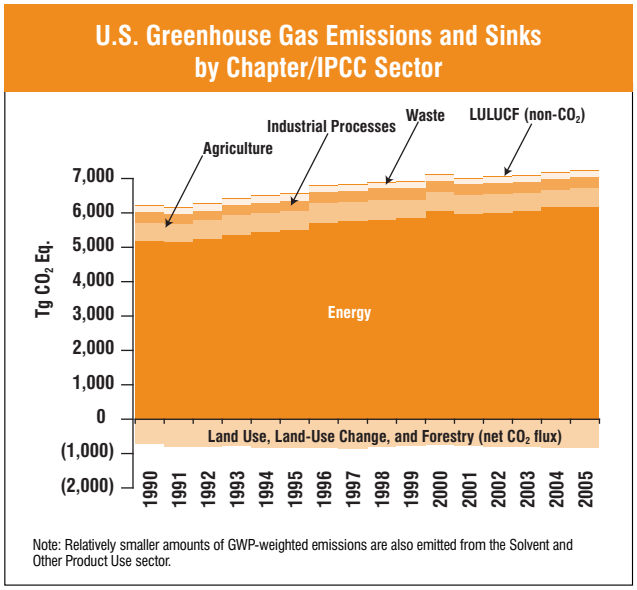


Table 2-3: Recent Trends in U.S. Greenhouse Gas Emissions and Sinks (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**5,061.6**	**5,384.6**	**5,940.0**	**5,843.0**	**5,892.7**	**5,952.5**	**6,064.3**	**6,089.5**
Fossil Fuel Combustion	4,724.1	5,030.0	5,584.9	5,511.7	5,557.2	5,624.5	5,713.0	5,751.2
Non-Energy Use of Fuels	117.3	133.2	141.0	131.4	135.3	131.3	150.2	142.4
Cement Manufacture	33.3	36.8	41.2	41.4	42.9	43.1	45.6	45.9
Iron and Steel Production	84.9	73.3	65.1	57.9	54.6	53.4	51.3	45.2
Natural Gas Systems	33.7	33.8	29.4	28.8	29.6	28.4	28.2	28.2
Municipal Solid Waste Combustion	10.9	15.7	17.9	18.3	18.5	19.5	20.1	20.9
Ammonia Manufacture and Urea Application	19.3	20.5	19.6	16.7	17.8	16.2	16.9	16.3
Lime Manufacture	11.3	12.8	13.3	12.9	12.3	13.0	13.7	13.7
Limestone and Dolomite Use	5.5	7.4	6.0	5.7	5.9	4.7	6.7	7.4
Soda Ash Manufacture and Consumption	4.1	4.3	4.2	4.1	4.1	4.1	4.2	4.2
Aluminum Production	6.8	5.7	6.1	4.4	4.5	4.5	4.2	4.2
Petrochemical Production	2.2	2.8	3.0	2.8	2.9	2.8	2.9	2.9
Titanium Dioxide Production	1.3	1.7	1.9	1.9	2.0	2.0	2.3	1.9
Ferroalloy Production	2.2	2.0	1.9	1.5	1.3	1.3	1.4	1.4
Phosphoric Acid Production	1.5	1.5	1.4	1.3	1.3	1.4	1.4	1.4
CO_2 Consumption	1.4	1.4	1.4	0.8	1.0	1.3	1.2	1.3
Zinc Production	0.9	1.0	1.1	1.0	0.9	0.5	0.5	0.5
Lead Production	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Silicon Carbide Production and Consumption	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Net CO_2 Flux from Land Use, Land-Use Change, and Forestry[a]	*(712.8)*	*(828.8)*	*(756.7)*	*(767.5)*	*(811.9)*	*(811.9)*	*(824.8)*	*(828.5)*
International Bunker Fuels[b]	*113.7*	*100.6*	*101.1*	*97.6*	*89.1*	*83.7*	*97.2*	*97.2*
Wood Biomass and Ethanol Consumption[b]	*219.3*	*236.8*	*228.3*	*203.2*	*204.4*	*209.6*	*224.8*	*206.5*
CH_4	**609.1**	**598.7**	**563.7**	**547.7**	**549.7**	**549.2**	**540.3**	**539.3**
Landfills	161.0	157.1	131.9	127.6	130.4	134.9	132.1	132.0
Enteric Fermentation	115.7	120.6	113.5	112.5	112.6	113.0	110.5	112.1
Natural Gas Systems	124.5	128.1	126.6	125.4	125.0	123.7	119.0	111.1
Coal Mining	81.9	66.5	55.9	55.5	52.0	52.1	54.5	52.4
Manure Management	30.9	35.1	38.7	40.1	41.1	40.5	39.7	41.3
Petroleum Systems	34.4	31.1	27.8	27.4	26.8	25.8	25.4	28.5
Wastewater Treatment	24.8	25.1	26.4	25.9	25.8	25.6	25.7	25.4
Forest Land Remaining Forest Land	7.1	4.0	14.0	6.0	10.4	8.1	6.9	11.6
Stationary Combustion	8.0	7.8	7.4	6.8	6.8	7.0	7.1	6.9
Rice Cultivation	7.1	7.6	7.5	7.6	6.8	6.9	7.6	6.9
Abandoned Underground Coal Mines	6.0	8.2	7.3	6.7	6.1	5.9	5.8	5.5
Mobile Combustion	4.7	4.3	3.5	3.2	3.1	2.9	2.8	2.6
Petrochemical Production	0.9	1.1	1.2	1.1	1.1	1.1	1.2	1.1
Iron and Steel Production	1.3	1.3	1.2	1.1	1.0	1.0	1.0	1.0
Field Burning of Agricultural Residues	0.7	0.7	0.8	0.8	0.7	0.8	0.9	0.9
Ferroalloy Production	+	+	+	+	+	+	+	+
Silicon Carbide Production and Consumption	+	+	+	+	+	+	+	+
International Bunker Fuels[b]	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
N_2O	**482.0**	**484.2**	**499.8**	**502.5**	**479.2**	**459.8**	**445.2**	**468.6**
Agricultural Soil Management	366.9	353.4	376.8	389.0	366.1	350.2	338.8	365.1
Mobile Combustion	43.7	53.7	53.2	49.7	47.1	43.8	41.2	38.0
Nitric Acid Production	17.8	19.9	19.6	15.9	17.2	16.7	16.0	15.7
Stationary Combustion	12.3	12.8	14.0	13.5	13.4	13.7	13.9	13.8
Manure Management	8.6	9.0	9.6	9.8	9.7	9.3	9.4	9.5
Wastewater Treatment	6.4	6.9	7.6	7.6	7.7	7.8	7.9	8.0
Adipic Acid Production	15.2	17.2	6.0	4.9	5.9	6.2	5.7	6.0
Settlements Remaining Settlements	5.1	5.5	5.6	5.5	5.6	5.8	6.0	5.8
N_2O Product Usage	4.3	4.5	4.8	4.8	4.3	4.3	4.3	4.3
Forest Land Remaining Forest Land	0.8	0.6	1.7	1.0	1.4	1.2	1.1	1.5
Municipal Solid Waste Combustion	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Field Burning of Agricultural Residues	0.4	0.4	0.5	0.5	0.4	0.4	0.5	0.5
International Bunker Fuels[b]	*1.0*	*0.9*	*0.9*	*0.9*	*0.8*	*0.8*	*0.9*	*0.9*
HFCs, PFCs, and SF_6	**89.3**	**103.5**	**143.8**	**133.8**	**143.0**	**142.7**	**153.9**	**163.0**
Substitution of Ozone Depleting Substances	0.3	32.2	80.9	88.6	96.9	105.5	114.5	123.3
HCFC-22 Production	35.0	27.0	29.8	19.8	19.8	12.3	15.6	16.5
Electrical Transmission and Distribution	27.1	21.8	15.2	15.1	14.3	13.8	13.6	13.2
Semiconductor Manufacture	2.9	5.0	6.3	4.5	4.4	4.3	4.7	4.3
Aluminum Production	18.5	11.8	8.6	3.5	5.2	3.8	2.8	3.0
Magnesium Production and Processing	5.4	5.6	3.0	2.4	2.4	2.9	2.6	2.7
Total	**6,242.0**	**6,571.0**	**7,147.2**	**7,027.0**	**7,064.6**	**7,104.2**	**7,203.7**	**7,260.4**
Net Emissions (Sources and Sinks)	**5,529.2**	**5,742.2**	**6,390.5**	**6,259.5**	**6,252.7**	**6,292.3**	**6,378.9**	**6,431.9**

+ Does not exceed 0.05 Tg CO_2 Eq.

[a] The net CO_2 flux total includes both emissions and sequestration, and constitutes a sink in the United States. Sinks are only included in net emissions total. Parentheses indicate negative values or sequestration.

[b] Emissions from International Bunker Fuels and Wood Biomass and Ethanol Consumption are not included in totals.

Note: Totals may not sum due to independent rounding.

Table 2-4: Recent Trends in U.S. Greenhouse Gas Emissions and Sinks (Gg)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**5,061,634**	**5,384,615**	**5,939,968**	**5,843,025**	**5,892,744**	**5,952,538**	**6,064,329**	**6,089,490**
Fossil Fuel Combustion	4,724,149	5,030,036	5,584,880	5,511,719	5,557,242	5,624,500	5,713,018	5,751,200
Non-Energy Use of Fuels	117,307	133,228	141,005	131,375	135,327	131,334	150,208	142,368
Cement Manufacture	33,278	36,847	41,190	41,357	42,898	43,082	45,603	45,910
Iron and Steel Production	84,904	73,333	65,115	57,927	54,595	53,370	51,309	45,235
Natural Gas Systems	33,729	33,807	29,390	28,793	29,630	28,445	28,190	28,185
Municipal Solid Waste Combustion	10,950	15,712	17,889	18,344	18,513	19,490	20,115	20,912
Ammonia Manufacture and Urea Application	19,306	20,453	19,616	16,719	17,766	16,173	16,894	16,321
Lime Manufacture	11,273	12,844	13,344	12,861	12,330	13,022	13,728	13,660
Limestone and Dolomite Use	5,533	7,359	5,960	5,733	5,885	4,720	6,702	7,397
Soda Ash Manufacture and Consumption	4,141	4,304	4,181	4,147	4,139	4,111	4,205	4,228
Aluminum Production	6,831	5,659	6,086	4,381	4,490	4,503	4,231	4,208
Petrochemical Production	2,221	2,750	3,004	2,787	2,857	2,777	2,895	2,897
Titanium Dioxide Production	1,308	1,670	1,918	1,857	1,997	2,013	2,259	1,921
Ferroalloy Production	2,152	2,036	1,893	1,459	1,349	1,305	1,419	1,392
Phosphoric Acid Production	1,529	1,513	1,382	1,264	1,338	1,382	1,395	1,383
CO_2 Consumption	1,415	1,423	1,416	825	978	1,310	1,199	1,324
Zinc Production	949	1,013	1,140	986	937	507	477	465
Lead Production	285	298	311	293	290	289	259	265
Silicon Carbide Production and Consumption	375	329	248	199	183	202	224	219
Net CO_2 Flux from Land Use, Land-Use Change, and Forestry[a]	*(712,778)*	*(828,798)*	*(756,705)*	*(767,472)*	*(811,892)*	*(811,945)*	*(824,785)*	*(828,453)*
International Bunker Fuels[b]	*113,683*	*100,627*	*101,125*	*97,563*	*89,101*	*83,690*	*97,177*	*97,191*
Wood Biomass and Ethanol Consumption[b]	*219,341*	*236,775*	*228,308*	*203,163*	*204,351*	*209,603*	*224,825*	*206,475*
CH_4	**29,003**	**28,509**	**26,842**	**26,080**	**26,176**	**26,154**	**25,727**	**25,681**
Landfills	7,668	7,479	6,280	6,078	6,210	6,425	6,292	6,286
Enteric Fermentation	5,510	5,744	5,404	5,356	5,361	5,379	5,262	5,340
Natural Gas Systems	5,927	6,101	6,027	5,971	5,951	5,891	5,669	5,292
Coal Mining	3,899	3,165	2,662	2,644	2,476	2,480	2,597	2,494
Manure Management	1,471	1,673	1,844	1,911	1,959	1,928	1,892	1,966
Petroleum Systems	1,640	1,482	1,325	1,303	1,275	1,229	1,209	1,357
Wastewater Treatment	1,180	1,195	1,257	1,232	1,229	1,220	1,222	1,210
Forest Land Remaining Forest Land	337	189	667	285	494	384	330	551
Stationary Combustion	382	373	351	324	324	334	340	330
Rice Cultivation	339	363	357	364	325	328	360	328
Abandoned Underground Coal Mines	286	391	349	318	292	282	275	263
Mobile Combustion	226	207	165	154	146	136	131	125
Petrochemical Production	41	52	58	51	52	51	55	51
Iron and Steel Production	63	62	57	51	48	49	50	45
Field Burning of Agricultural Residues	33	32	38	37	34	38	42	41
Ferroalloy Production	1	1	1	+	+	+	+	+
Silicon Carbide Production and Consumption	1	1	1	+	+	+	+	+
International Bunker Fuels[b]	*8*	*6*	*6*	*5*	*4*	*4*	*5*	*5*
N_2O	**1,555**	**1,562**	**1,612**	**1,621**	**1,546**	**1,483**	**1,436**	**1,512**
Agricultural Soil Management	1,184	1,140	1,215	1,255	1,181	1,130	1,093	1,178
Mobile Combustion	141	173	172	160	152	141	133	123
Nitric Acid Production	58	64	63	51	56	54	52	51
Stationary Combustion	40	41	45	44	43	44	45	45
Manure Management	28	29	31	32	31	30	30	31
Wastewater Treatment	21	22	24	25	25	25	26	26
Adipic Acid Production	49	56	19	16	19	20	19	19
Settlements Remaining Settlements	17	18	18	18	18	19	19	19
N_2O Product Usage	14	14	15	15	14	14	14	14
Forest Land Remaining Forest Land	2	2	6	3	5	4	3	5
Municipal Solid Waste Combustion	2	1	1	1	1	1	1	1
Field Burning of Agricultural Residues	1	1	1	1	1	1	2	2
International Bunker Fuels[b]	*3*	*3*	*3*	*3*	*3*	*2*	*3*	*3*
HFCs, PFCs, and SF_6	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**
Substitution of Ozone Depleting Substances	M	M	M	M	M	M	M	M
HCFC-22 Production	3	2	3	2	2	1	1	1
Electrical Transmission and Distribution	1	1	1	1	1	1	1	1
Semiconductor Manufacture	M	M	M	M	M	M	M	M
Aluminum Production	M	M	M	M	M	M	M	M
Magnesium Production and Processing	+	+	+	+	+	+	+	+

+ Does not exceed 0.5 Gg.

M Mixture of multiple gases.

[a] The net CO_2 flux total includes both emissions and sequestration, and constitutes a sink in the United States. Sinks are only included in net emissions total. Parentheses indicate negative values or sequestration.

[b] Emissions from International Bunker Fuels and Wood Biomass and Ethanol Consumption are not included in totals.

Note: Totals may not sum due to independent rounding.

Table 2-5: Recent Trends in U.S. Greenhouse Gas Emissions and Sinks by Chapter/IPCC Sector (Tg CO_2 Eq.)

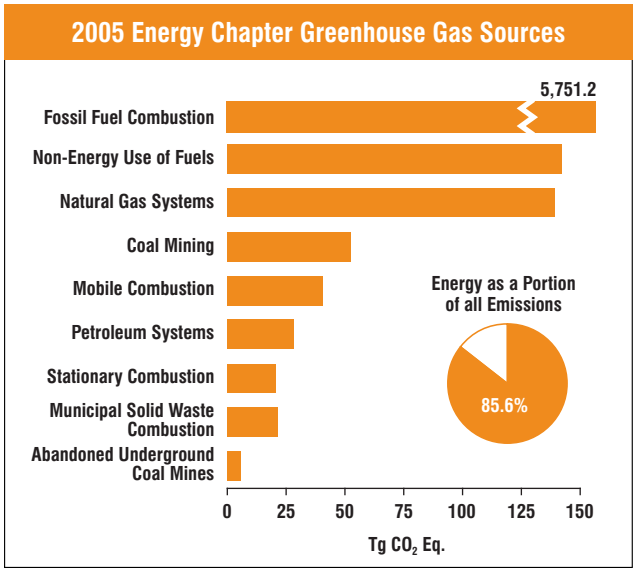
Chapter/IPCC Sector	1990	1995	2000	2001	2002	2003	2004	2005
Energy	5,202.2	5,525.8	6,069.2	5,978.9	6,021.4	6,079.1	6,181.7	6,201.9
Industrial Processes	300.1	314.8	338.7	309.6	320.2	316.4	330.6	333.6
Solvent and Other Product Use	4.3	4.5	4.8	4.8	4.3	4.3	4.3	4.3
Agriculture	530.3	526.8	547.4	560.3	537.4	521.1	507.4	536.3
Land Use, Land-Use Change, and Forestry (Non-CO_2 Emissions)	13.0	10.1	21.3	12.4	17.4	15.0	13.9	18.9
Waste	192.2	189.1	165.9	161.1	163.9	168.4	165.7	165.4
Total	**6,242.0**	**6,571.0**	**7,147.2**	**7,027.0**	**7,064.6**	**7,104.2**	**7,203.7**	**7,260.4**
Net CO_2 Flux from Land Use, Land-Use Change, and Forestry*	(712.8)	(828.8)	(756.7)	(767.5)	(811.9)	(811.9)	(824.8)	(828.5)
Net Emissions (Sources and Sinks)	**5,529.2**	**5,742.2**	**6,390.5**	**6,259.5**	**6,252.7**	**6,292.3**	**6,378.9**	**6,431.9**

* The net CO_2 flux total includes both emissions and sequestration, and constitutes a sink in the United States. Sinks are only included in net emissions total.
Note: Totals may not sum due to independent rounding.
Note: Parentheses indicate negative values or sequestration.

Energy

Energy-related activities, primarily fossil fuel combustion, accounted for the vast majority of U.S. CO_2 emissions for the period of 1990 through 2005. In 2005, approximately 86 percent of the energy consumed in the United States (on a Btu basis) was produced through the combustion of fossil fuels. The remaining 14 percent came from other energy sources such as hydropower, biomass, nuclear, wind, and solar energy (see Figure 2-6 and Figure 2-7). A discussion of specific trends related to CO_2 as well as other greenhouse gas emissions from energy consumption is presented below. Energy-related activities are also responsible for CH_4 and N_2O emissions (38 percent and 11 percent of total U.S. emissions of each gas, respectively). Table 2-6 presents greenhouse gas emissions from the Energy chapter, by source and gas.

Figure 2-6



Fossil Fuel Combustion (5,751.2 Tg CO_2 Eq.)

As fossil fuels are combusted, the C stored in them is emitted almost entirely as CO_2. The amount of C in fuels per unit of energy content varies significantly by fuel type. For example, coal contains the highest amount of C per unit of energy, while petroleum and natural gas have about 25 percent and 45 percent less C than coal, respectively. From 1990 through 2005, petroleum supplied the largest share of U.S. energy demands, accounting for an average of 44 percent of total energy consumption, with natural gas and coal each accounting for 28 percent of total energy consumption. Petroleum was consumed primarily in the transportation end-use sector, the vast majority of coal was used by electric power generators, and natural gas was consumed largely in the industrial and residential end-use sectors.

Emissions of CO_2 from fossil fuel combustion increased at an average annual rate of 1.4 percent from 1990 to 2005. The fundamental factors influencing this trend include (1) a generally growing domestic economy over the last 15 years, and (2) significant growth in emissions from electricity generation and transportation activities. Between 1990 and 2005, CO_2 emissions from fossil fuel combustion increased from 4,724.1 Tg CO_2 Eq. to 5,751.2 Tg CO_2 Eq.—a 21.7 percent total increase over the fifteen-year period.

The four major end-use sectors contributing to CO_2 emissions from fossil fuel combustion are industrial, transportation, residential, and commercial. Electricity generation also emits CO_2, although these emissions are produced as they consume fossil fuel to provide electricity to one of the four end-use sectors. For the discussion below, electricity generation emissions have been distributed to

Figure 2-7

2005 U.S. Fossil Carbon Flows (Tg CO_2 Eq.)

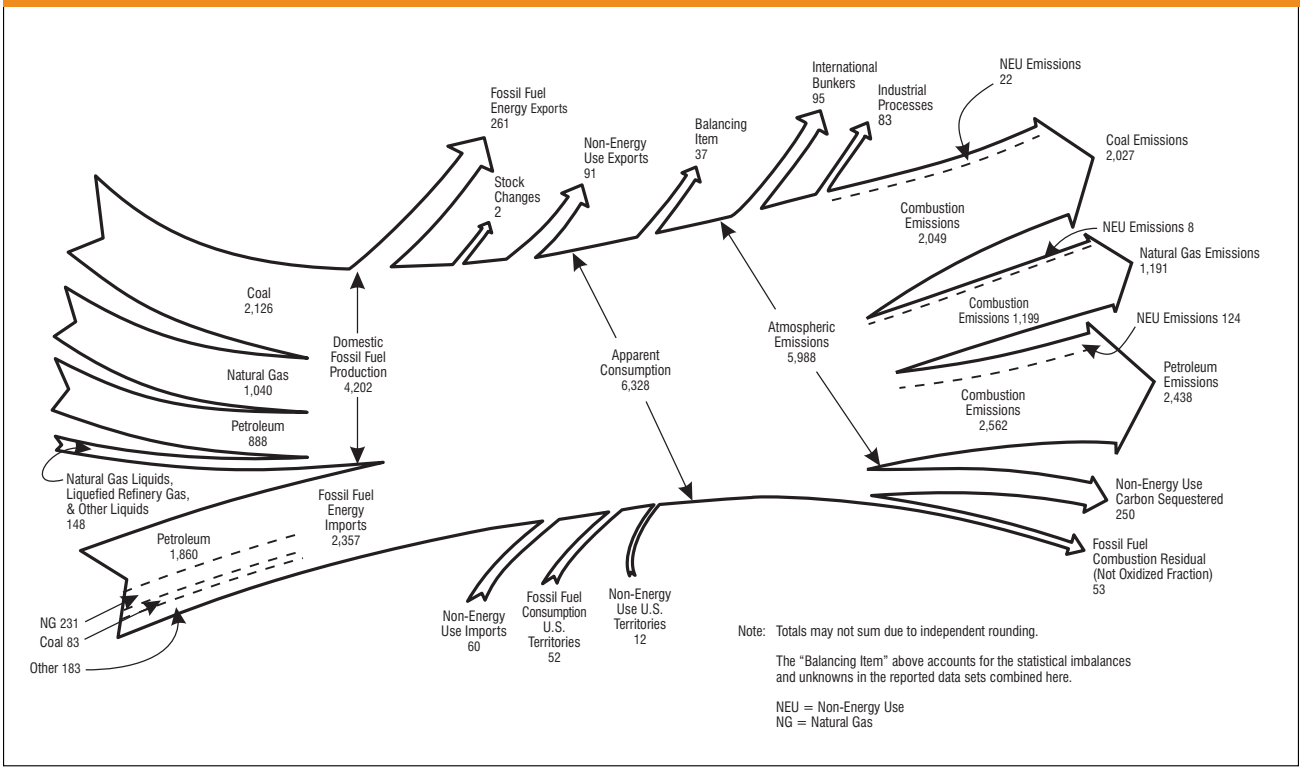


Table 2-6: Emissions from Energy (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**4,886.1**	**5,212.8**	**5,773.2**	**5,690.2**	**5,740.7**	**5,803.8**	**5,911.5**	**5,942.7**
Fossil Fuel Combustion	4,724.1	5,030.0	5,584.9	5,511.7	5,557.2	5,624.5	5,713.0	5,751.2
Non-Energy Use of Fuels	117.3	133.2	141.0	131.4	135.3	131.3	150.2	142.4
Natural Gas Systems	33.7	33.8	29.4	28.8	29.6	28.4	28.2	28.2
Municipal Solid Waste Combustion	10.9	15.7	17.9	18.3	18.5	19.5	20.1	20.9
*International Bunker Fuels**	*113.7*	*100.6*	*101.1*	*97.6*	*89.1*	*83.7*	*97.2*	*97.2*
*Wood Biomass and Ethanol Consumption**	*219.3*	*236.8*	*228.3*	*203.2*	*204.4*	*209.6*	*224.8*	*206.5*
CH_4	**259.6**	**246.1**	**228.5**	**225.0**	**219.7**	**217.4**	**214.6**	**207.1**
Natural Gas Systems	124.5	128.1	126.6	125.4	125.0	123.7	119.0	111.1
Coal Mining	81.9	66.5	55.9	55.5	52.0	52.1	54.5	52.4
Petroleum Systems	34.4	31.1	27.8	27.4	26.8	25.8	25.4	28.5
Stationary Combustion	8.0	7.8	7.4	6.8	6.8	7.0	7.1	6.9
Abandoned Underground Coal Mines	6.0	8.2	7.3	6.7	6.1	5.9	5.8	5.5
Mobile Combustion	4.7	4.3	3.5	3.2	3.1	2.9	2.8	2.6
*International Bunker Fuels**	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
N_2O	**56.5**	**66.9**	**67.6**	**63.6**	**60.9**	**57.9**	**55.5**	**52.2**
Mobile Combustion	43.7	53.7	53.2	49.7	47.1	43.8	41.2	38.0
Stationary Combustion	12.3	12.8	14.0	13.5	13.4	13.7	13.9	13.8
Municipal Solid Waste Combustion	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
*International Bunker Fuels**	*1.0*	*0.9*	*0.9*	*0.9*	*0.8*	*0.8*	*0.9*	*0.9*
Total	**5,202.2**	**5,525.8**	**6,069.2**	**5,978.9**	**6,021.4**	**6,079.1**	**6,181.7**	**6,201.9**

* These values are presented for informational purposes only and are not included in totals or are already accounted for in other source categories.
Note: Totals may not sum due to independent rounding.

each end-use sector on the basis of each sector's share of aggregate electricity consumption. This method of distributing emissions assumes that each end-use sector consumes electricity that is generated from the national average mix of fuels according to their C intensity. Emissions from electricity generation are also addressed separately after the end-use sectors have been discussed.

Note that emissions from U.S. territories are calculated separately due to a lack of specific consumption data for the individual end-use sectors.

Table 2-7, Figure 2-8, and Figure 2-9 summarize CO_2 emissions from fossil fuel combustion by end-use sector.

Transportation End-Use Sector. Transportation activities (excluding international bunker fuels) accounted for 33 percent of CO_2 emissions from fossil fuel combustion in 2005.[3] Virtually all of the energy consumed in this end-use sector came from petroleum products. Over 60 percent of the emissions resulted from gasoline consumption for personal vehicle use. The remaining emissions came from other

Table 2-7: CO_2 Emissions from Fossil Fuel Combustion by End-Use Sector (Tg CO_2 Eq.)

End-Use Sector	1990	1995	2000	2001	2002	2003	2004	2005
Transportation	**1,467.0**	**1,593.3**	**1,787.8**	**1,761.5**	**1,815.7**	**1,814.8**	**1,868.9**	**1,897.9**
Combustion	1,464.0	1,590.2	1,784.4	1,758.2	1,812.3	1,810.5	1,864.5	1,892.8
Electricity	3.0	3.0	3.4	3.3	3.4	4.3	4.4	5.2
Industrial	**1,539.8**	**1,595.8**	**1,660.1**	**1,596.6**	**1,575.5**	**1,595.1**	**1,615.2**	**1,575.2**
Combustion	857.1	882.7	875.0	869.9	857.7	858.3	875.6	840.1
Electricity	682.7	713.1	785.1	726.7	717.8	736.8	739.6	735.1
Residential	**929.9**	**995.4**	**1,131.5**	**1,124.8**	**1,147.9**	**1,179.1**	**1,175.9**	**1,208.7**
Combustion	340.3	356.4	373.5	363.9	362.4	383.8	369.9	358.7
Electricity	589.6	639.0	758.0	760.9	785.5	795.3	806.0	849.9
Commercial	**759.2**	**810.6**	**969.3**	**979.7**	**973.8**	**984.2**	**999.1**	**1,016.8**
Combustion	224.3	226.4	232.3	225.1	225.7	236.6	233.3	225.8
Electricity	534.9	584.2	736.9	754.6	748.0	747.6	765.8	791.0
U.S. Territories	**28.3**	**35.0**	**36.2**	**49.0**	**44.3**	**51.3**	**54.0**	**52.5**
Total	**4,724.1**	**5,030.0**	**5,584.9**	**5,511.7**	**5,557.2**	**5,624.5**	**5,713.0**	**5,751.2**
Electricity Generation	**1,810.2**	**1,939.3**	**2,283.5**	**2,245.5**	**2,254.7**	**2,284.0**	**2,315.8**	**2,381.2**

Note: Totals may not sum due to independent rounding. Combustion-related emissions from electricity generation are allocated based on aggregate national electricity consumption by each end-use sector.

Figure 2-8

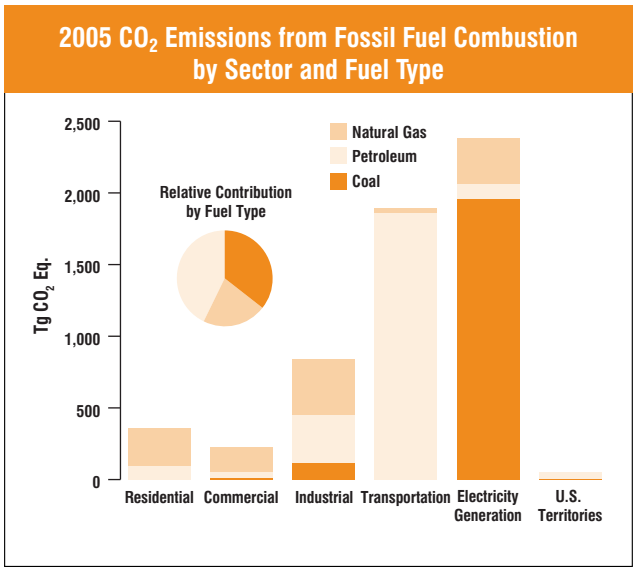
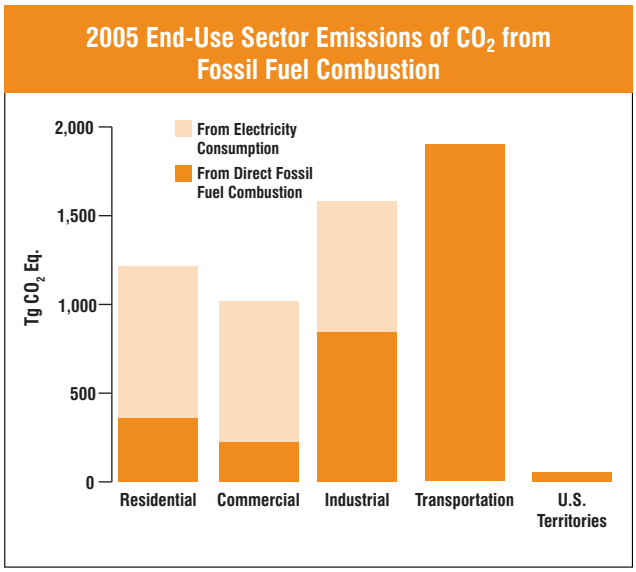


Figure 2-9



[3] If emissions from international bunker fuels are included, the transportation end-use sector accounted for 35 percent of U.S. emissions from fossil fuel combustion in 2005.

transportation activities, including the combustion of diesel fuel in heavy-duty vehicles and jet fuel in aircraft.

Industrial End-Use Sector. Industrial CO_2 emissions, resulting both directly from the combustion of fossil fuels and indirectly from the generation of electricity that is consumed by industry, accounted for 27 percent of CO_2 emissions from fossil fuel combustion in 2005. About half of these emissions resulted from direct fossil fuel combustion to produce steam and/or heat for industrial processes. The other half of the emissions resulted from consuming electricity for motors, electric furnaces, ovens, lighting, and other applications.

Residential and Commercial End-Use Sectors. The residential and commercial end-use sectors accounted for 21 and 18 percent, respectively, of CO_2 emissions from fossil fuel combustion in 2005. Both sectors relied heavily on electricity for meeting energy demands, with 70 and 78 percent, respectively, of their emissions attributable to electricity consumption for lighting, heating, cooling, and operating appliances. The remaining emissions were due to the consumption of natural gas and petroleum for heating and cooking.

Electricity Generation. The United States relies on electricity to meet a significant portion of its energy demands, especially for lighting, electric motors, heating, and air conditioning. Electricity generators consumed 36 percent of U.S. energy from fossil fuels and emitted 41 percent of the CO_2 from fossil fuel combustion in 2005. The type of fuel combusted by electricity generators has a significant effect on their emissions. For example, some electricity is generated with low-CO_2-emitting energy technologies, particularly non-fossil options such as nuclear, hydroelectric, or geothermal energy. However, electricity generators rely on coal for over half of their total energy requirements and accounted for 93 percent of all coal consumed for energy in the United States in 2005. Consequently, changes in electricity demand have a significant impact on coal consumption and associated CO_2 emissions.

Non-Energy Use of Fossil Fuels (142.4 Tg CO_2 Eq.)

In addition to being combusted for energy, fossil fuels are also consumed for non-energy uses (NEUs). Fuels are used in the industrial and transportation end-use sectors for a variety of NEUs, including application as solvents, lubricants, and waxes, or as raw materials in the manufacture of plastics, rubber, and synthetic fibers. CO_2 emissions arise from non-energy uses via several pathways. Emissions may occur during the manufacture of a product, as is the case in producing plastics or rubber from fuel-derived feedstocks. Additionally, emissions may occur during the product's lifetime, such as during solvent use. Where appropriate data and methodologies are available, NEUs of fossil fuels used for industrial processes are reported in the Industrial Processes chapter. Emissions in 2005 for non-energy uses of fossil fuels were 142.4 Tg CO_2 Eq., which constituted 2.5 percent of overall fossil fuel CO_2 emissions and 2 percent of total national CO_2 emissions, approximately the same proportion as in 1990. CO_2 emissions from non-energy use of fossil fuels increased by 25.1 Tg CO_2 Eq. (21 percent) from 1990 through 2005.

Natural Gas Systems (139.3 Tg CO_2 Eq.)

CH_4 and non-energy CO_2 emissions from natural gas systems are generally process-related, with normal operations, routine maintenance, and system upsets being the primary contributors. Emissions from normal operations include: natural gas engines and turbine uncombusted exhaust, bleed and discharge emissions from pneumatic devices, and fugitive emissions from system components. Routine maintenance emissions originate from pipelines, equipment, and wells during repair and maintenance activities. Pressure surge relief systems and accidents can lead to system upset emissions. In 2005, CH_4 emissions from U.S. natural gas systems accounted for approximately 21 percent of U.S. CH_4 emissions. Also in 2005, natural gas systems accounted for approximately 0.5 percent of U.S. CO_2 emissions (28.2 Tg CO_2 Eq.). From 1990 through 2005, CH_4 and CO_2 emissions from natural gas systems decreased by 13.3 Tg CO_2 Eq. (11 percent), and 5.5 Tg CO_2 Eq. (16 percent) respectively.

Coal Mining (52.4 Tg CO_2 Eq.)

Produced millions of years ago during the formation of coal, CH_4 trapped within coal seams and surrounding rock strata is released when the coal is mined. The quantity of CH_4 released to the atmosphere during coal mining operations depends primarily upon the type of coal and the method and rate of mining.

CH_4 from surface mines is emitted directly to the atmosphere as the rock strata overlying the coal seam are removed. Because CH_4 in underground mines is explosive at concentrations of 5 to 15 percent in air, most active underground mines are required to vent this CH_4, typically to the atmosphere. At some mines, CH_4-recovery systems

may supplement these ventilation systems. During 2005, coal mining activities emitted 10 percent of U.S. CH_4 emissions. From 1990 to 2005, emissions from this source decreased by 29.5 Tg CO_2 Eq. (36 percent) due to increased use of the CH_4 collected by mine degasification systems and a general shift toward surface mining.

Mobile Combustion (40.6 Tg CO_2 Eq.)

In addition to CO_2, mobile combustion results in N_2O and CH_4 emissions. N_2O is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. The quantity emitted varies according to the type of fuel, technology, and pollution control device used, as well as maintenance and operating practices. For example, some types of catalytic converters installed to reduce motor vehicle pollution can promote the formation of N_2O. In 2005, N_2O emissions from mobile combustion were 38.0 Tg CO_2 Eq. (8 percent of U.S. N_2O emissions). From 1990 to 2005, N_2O emissions from mobile combustion decreased by 5.7 Tg CO_2 Eq. (13 percent). In 2005, CH_4 emissions were estimated to be 2.6 Tg CO_2 Eq. The combustion of gasoline in highway vehicles was responsible for the majority of the CH_4 emitted from mobile combustion. From 1990 to 2005, CH_4 emissions from mobile combustion decreased by 2.1 Tg CO_2 Eq. (45 percent).

Petroleum Systems (28.5 Tg CO_2 Eq.)

Petroleum is often found in the same geological structures as natural gas, and the two are often retrieved together. Crude oil is saturated with many lighter hydrocarbons, including CH_4. When the oil is brought to the surface and processed, many of the dissolved lighter hydrocarbons (as well as water) are removed through a series of high-pressure and low-pressure separators. The remaining hydrocarbons in the oil are emitted at various points along the system. CH_4 emissions from the components of petroleum systems generally occur as a result of system leaks, disruptions, and routine maintenance. In 2005, emissions from petroleum systems were about 5 percent of U.S. CH_4 emissions. From 1990 to 2005, CH_4 emissions from petroleum systems decreased by 6 Tg CO_2 Eq. (17 percent).

Municipal Solid Waste Combustion (21.3 Tg CO_2 Eq.)

Combustion is used to manage about 14 percent of the municipal solid waste generated in the United States. The burning of garbage and non-hazardous solids, referred to as municipal solid waste, as well as the burning of hazardous waste, is usually performed to recover energy from the waste materials. CO_2 and N_2O emissions arise from the organic materials found in these wastes. The CO_2 emissions from municipal solid waste containing C of biogenic origin (e.g., paper, yard trimmings) are not accounted for in this Inventory, since they are presumed to be offset by regrowth of the original living source, and are ultimately accounted for in the Land Use, Land-Use Change, and Forestry chapter. Several components of municipal solid waste, such as plastics, synthetic rubber, synthetic fibers, and carbon black, are of fossil-fuel origin, and are included as sources of CO_2 and N_2O emissions. In 2005, CO_2 emissions from waste combustion amounted to 20.9 Tg CO_2 Eq., while N_2O emissions amounted to 0.4 Tg CO_2 Eq. From 1990 through 2005, CO_2 emissions from waste combustion increased by 10 Tg CO_2 Eq. (91 percent), while N_2O emissions decreased by 0.1 Tg CO_2 Eq. (15 percent).

Stationary Combustion (20.7 Tg CO_2 Eq.)

In addition to CO_2, stationary combustion results in N_2O and CH_4 emissions. In 2005, N_2O emissions from stationary combustion accounted for 13.8 Tg CO_2 Eq. (3 percent of U.S. N_2O emissions). From 1990 to 2005, N_2O emissions from stationary combustion increased by 1.5 Tg CO_2 Eq. (12 percent), due to increased fuel consumption. In 2005, CH_4 emissions were 6.9 Tg CO_2 Eq. (1 percent of U.S. CH_4 emissions). From 1990 to 2005, CH_4 emissions from stationary combustion decreased by 1.1 Tg CO_2 Eq. (13.5 percent). The majority of CH_4 emissions from stationary combustion resulted from the burning of wood in the residential end-use sector.

Abandoned Underground Coal Mines (5.5 Tg CO_2 Eq.)

Coal mining activities result in the emission of CH_4 into the atmosphere. However, the closure of a coal mine does not correspond with an immediate cessation in the release of emissions. Following an initial decline, abandoned mines can liberate CH_4 at a near-steady rate over an extended period of time, or, if flooded, produce gas for only a few years. In 2005, the emissions from abandoned underground coal mines constituted 1 percent of U.S. CH_4 emissions. Between 1990 and 2005, emissions from this source decreased by 0.5 Tg CO_2 Eq. (8 percent).

Wood Biomass and Ethanol Consumption (206.5 Tg CO_2 Eq.)

Biomass refers to organically-based C fuels (as opposed to fossil-based). Biomass in the form of fuel wood and wood

waste was used primarily in the industrial sector, while the transportation sector was the predominant user of biomass-based fuels, such as ethanol from corn and woody crops.

Although these fuels do emit CO_2, in the long run the CO_2 emitted from biomass consumption does not increase atmospheric CO_2 concentrations if the biogenic C emitted is offset by the growth of new biomass. For example, fuel wood burned one year but re-grown the next only recycles C, rather than creating a net increase in total atmospheric C. Net C fluxes from changes in biogenic C reservoirs in forest lands or croplands are accounted for in the estimates for the Land Use, Land-Use Change, and Forestry sector. As a result, CO_2 emissions from biomass combustion have been estimated separately from fossil-fuel-based emissions and are not included in the U.S. totals. CH_4 emissions from biomass combustion are included in the Stationary Combustion source.

The consumption of wood biomass in the industrial, residential, electric power, and commercial end-use sectors accounted for 56, 21, 8, and 4 percent of gross CO_2 emissions from wood biomass and ethanol consumption, respectively. Ethanol consumption in the transportation end-use sector accounted for the remaining 11 percent.

CO_2 emissions from wood biomass and ethanol consumption decreased by 12.9 Tg CO_2 Eq. (approximately 6 percent) from 1990 through 2005.

International Bunker Fuels (98.2 Tg CO_2 Eq.)

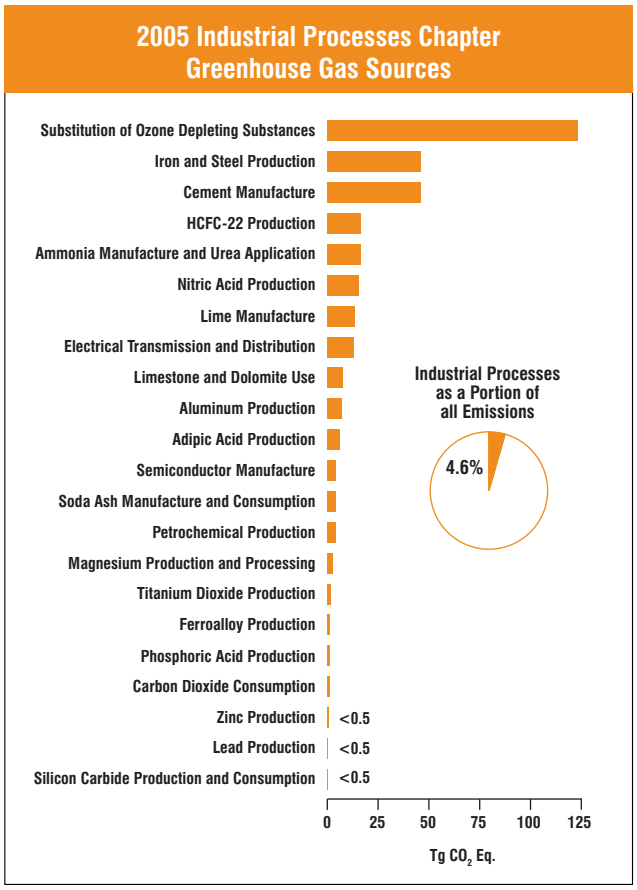
Greenhouse gases emitted from the combustion of fuels used for international transport activities, termed international bunker fuels under the UNFCCC, include CO_2, CH_4, and N_2O. Emissions from these activities are currently not included in national emission totals, but are reported separately based upon location of fuel sales. The decision to report emissions from international bunker fuels separately, instead of allocating them to a particular country, was made by the Intergovernmental Negotiating Committee in establishing the Framework Convention on Climate Change. These decisions are reflected in the *Revised 1996 IPCC Guidelines*, in which countries are requested to report emissions from ships or aircraft that depart from their ports with fuel purchased within national boundaries and are engaged in international transport separately from national totals (IPCC/UNEP/OECD/IEA 1997).

Two transport modes are addressed under the IPCC definition of international bunker fuels: aviation and marine. Emissions from ground transport activities—by road vehicles and trains, even when crossing international borders—are allocated to the country where the fuel was loaded into the vehicle and, therefore, are not counted as bunker fuel emissions. Emissions of CO_2, CH_4, and N_2O from international bunker fuel combustion were 97.2, 0.1, and 0.9 Tg CO_2 Eq. in 2005, respectively. From 1990 through 2005, CO_2, CH_4, and N_2O emissions from international bunker fuels decreased by 16.5 Tg CO_2 Eq. (15 percent), 0.1 Tg CO_2 Eq. (35 percent), and 0.1 Tg CO_2 Eq. (9 percent), respectively.

Industrial Processes

Emissions are produced as a by-product of many non-energy-related industrial process activities. For example, industrial processes can chemically transform raw materials, which often release waste gases such as CO_2, CH_4, and N_2O. These processes include iron and steel production, cement manufacture, ammonia manufacture and urea application, lime manufacture, limestone and dolomite use (e.g., flux stone, flue gas desulfurization, and glass manufacturing), soda ash manufacture and use, titanium dioxide production, phosphoric acid production, ferroalloy production, CO_2

Figure 2-10



consumption, silicon carbide production and consumption, aluminum production, petrochemical production, nitric acid production, adipic acid production, lead production, and zinc production (see Figure 2-10). Additionally, emissions from industrial processes release HFCs, PFCs and SF_6. Table 2-8 presents greenhouse gas emissions from industrial processes by source category.

Substitution of Ozone Depleting Substances (123.3 Tg CO_2 Eq.)

The use and subsequent emissions of HFCs and PFCs as substitutes for ODSs have increased from small amounts in 1990 to 123 Tg CO_2 Eq. in 2005, accounting for 76 percent of aggregate HFC, PFC, and SF_6 emissions, an increase of 36,899 percent over this time period. This increase was in large part the result of efforts to phase-out CFCs and other ODSs in the United States, especially the introduction of HFC-134a as a CFC substitute in refrigeration and air-conditioning applications. In the short term, this trend is expected to continue, and will likely accelerate over the coming decade as HCFCs, which are interim substitutes in many applications, are themselves phased-out under the provisions of the Copenhagen Amendments to the Montreal

Table 2-8: Emissions from Industrial Processes (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**175.5**	**171.8**	**166.8**	**152.8**	**152.0**	**148.8**	**152.8**	**146.8**
Cement Manufacture	33.3	36.8	41.2	41.4	42.9	43.1	45.6	45.9
Iron and Steel Production	84.9	73.3	65.1	57.9	54.6	53.4	51.3	45.2
Ammonia Manufacture & Urea Application	19.3	20.5	19.6	16.7	17.8	16.2	16.9	16.3
Lime Manufacture	11.3	12.8	13.3	12.9	12.3	13.0	13.7	13.7
Limestone and Dolomite Use	5.5	7.4	6.0	5.7	5.9	4.7	6.7	7.4
Aluminum Production	4.1	4.3	4.2	4.1	4.1	4.1	4.2	4.2
Soda Ash Manufacture and Consumption	6.8	5.7	6.1	4.4	4.5	4.5	4.2	4.2
Petrochemical Production	2.2	2.8	3.0	2.8	2.9	2.8	2.9	2.9
Titanium Dioxide Production	1.3	1.7	1.9	1.9	2.0	2.0	2.3	1.9
Phosphoric Acid Production	2.2	2.0	1.9	1.5	1.3	1.3	1.4	1.4
Ferroalloy Production	1.5	1.5	1.4	1.3	1.3	1.4	1.4	1.4
CO_2 Consumption	1.4	1.4	1.4	0.8	1.0	1.3	1.2	1.3
Zinc Production	0.9	1.0	1.1	1.0	0.9	0.5	0.5	0.5
Lead Production	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Silicon Carbide Production and Consumption	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2
CH_4	**2.2**	**2.4**	**2.5**	**2.2**	**2.1**	**2.1**	**2.2**	**2.0**
Petrochemical Production	0.9	1.1	1.2	1.1	1.1	1.1	1.2	1.1
Iron and Steel Production	1.3	1.3	1.2	1.1	1.0	1.0	1.0	1.0
Ferroalloy Production	+	+	+	+	+	+	+	+
Silicon Carbide Production and Consumption	+	+	+	+	+	+	+	+
N_2O	**33.0**	**37.1**	**25.6**	**20.8**	**23.1**	**22.9**	**21.8**	**21.7**
Nitric Acid Production	17.8	19.9	19.6	15.9	17.2	16.7	16.0	15.7
Adipic Acid Production	15.2	17.2	6.0	4.9	5.9	6.2	5.7	6.0
HFCs, PFCs, and SF_6	**89.3**	**103.5**	**143.8**	**133.8**	**143.0**	**142.7**	**153.9**	**163.0**
Substitution of Ozone Depleting Substances	0.3	32.2	80.9	88.6	96.9	105.5	114.5	123.3
HCFC-22 Production	35.0	27.0	29.8	19.8	19.8	12.3	15.6	16.5
Electrical Transmission and Distribution	27.1	21.8	15.2	15.1	14.3	13.8	13.6	13.2
Semiconductor Manufacture	2.9	5.0	6.3	4.5	4.4	4.3	4.7	4.3
Aluminum Production	18.5	11.8	8.6	3.5	5.2	3.8	2.8	3.0
Magnesium Production and Processing	5.4	5.6	3.0	2.4	2.4	2.9	2.6	2.7
Total	**300.1**	**314.8**	**338.7**	**309.6**	**320.2**	**316.4**	**330.6**	**333.6**

+ Does not exceed 0.05 Tg CO_2 Eq.
Note: Totals may not sum due to independent rounding.

Protocol. Improvements in the technologies associated with the use of these gases and the introduction of alternative gases and technologies, however, may help to offset this anticipated increase in emissions.

Iron and Steel Production (46.2 Tg CO_2 Eq.)

Pig iron is the product of combining iron oxide (i.e., iron ore) and sinter with metallurgical coke in a blast furnace. The pig iron production process, as well as the thermal processes used to create sinter and metallurgical coke, results in emissions of CO_2 and CH_4. In 2005, iron and steel production resulted in 1.0 Tg CO_2 Eq. of CH_4 emissions, with the majority of the emissions coming from the pig iron production process. The majority of CO_2 emissions from iron and steel processes come from the production of coke for use in pig iron creation, with smaller amounts evolving from the removal of carbon from pig iron used to produce steel. CO_2 emissions from iron and steel amounted to 45.2 Tg CO_2 Eq. in 2005. From 1990 to 2005, CO_2 and CH_4 emissions from this source decreased by 39.7 Tg CO_2 Eq. (47 percent), and 0.4 Tg CO_2 Eq. (28 percent) respectively.

Cement Manufacture (45.9 Tg CO_2 Eq.)

Clinker is an intermediate product in the formation of finished portland and masonry cement. Heating calcium carbonate ($CaCO_3$) in a cement kiln forms lime and CO_2. The lime combines with other materials to produce clinker, and the CO_2 is released into the atmosphere. From 1990 to 2005, emissions from this source increased by 12.6 Tg CO_2 Eq. (38 percent).

HCFC-22 Production (16.5 Tg CO_2 Eq.)

HFC-23 is a by-product of the production of HCFC-22. Emissions from this source have decreased by 18.4 Tg CO_2 Eq. (53 percent) since 1990. The HFC-23 emission rate (i.e., the amount of HFC-23 emitted per kilogram of HCFC-22 manufactured) has declined significantly since 1990, although production has been increasing.

Ammonia Manufacture and Urea Application (16.3 Tg CO_2 Eq.)

In the United States, roughly 98 percent of synthetic ammonia is produced by catalytic steam reforming of natural gas, and the remainder is produced using naphtha (i.e., a petroleum fraction) or the electrolysis of brine at chlorine plants (EPA 1997). The two fossil fuel-based reactions produce carbon monoxide and hydrogen gas. This carbon monoxide is transformed into CO_2 in the presence of a catalyst. The CO_2 is generally released into the atmosphere, but some of the CO_2, together with ammonia, is used as a raw material in the production of urea [$CO(NH_2)_2$], which is a type of nitrogenous fertilizer. The carbon in the urea that is produced and assumed to be subsequently applied to agricultural land as a nitrogenous fertilizer is ultimately released into the environment as CO_2. Since 1990, CO_2 emissions from ammonia manufacture and urea application have decreased by 3.0 Tg CO_2 Eq. (15.5 percent).

Nitric Acid Production (15.7 Tg CO_2 Eq.)

Nitric acid production is an industrial source of N_2O emissions. Used primarily to make synthetic commercial fertilizer, this raw material is also a major component in the production of adipic acid and explosives. Virtually all of the nitric acid manufactured in the United States is produced by the oxidation of ammonia, during which N_2O is formed and emitted to the atmosphere. In 2005, N_2O emissions from nitric acid production accounted for 3 percent of U.S. N_2O emissions. From 1990 to 2005, emissions from this source category decreased by 2.2 Tg CO_2 Eq. (12 percent) with the trend in the time series closely tracking the changes in production.

Lime Manufacture (13.7 Tg CO_2 Eq.)

Lime is used in steel making, construction, flue gas desulfurization, and water and sewage treatment. It is manufactured by heating limestone (mostly $CaCO_3$) in a kiln, creating quicklime (calcium oxide, CaO) and CO_2, which is normally emitted to the atmosphere. From 1990 to 2005, CO_2 emissions from lime manufacture increased by 2.4 Tg CO_2 Eq. (21 percent).

Electrical Transmission and Distribution Systems (13.2 Tg CO_2 Eq.)

The primary use of SF_6 is as a dielectric in electrical transmission and distribution systems. Fugitive emissions of SF_6 occur from leaks in and servicing of substations and circuit breakers, especially from older equipment. The gas can also be released during equipment manufacturing, installation, servicing, and disposal. Estimated emissions from this source decreased by 13.9 Tg CO_2 Eq. (51 percent) since 1990, primarily due to higher SF_6 prices and industrial efforts to reduce emissions.

Limestone and Dolomite Use (7.4 Tg CO_2 Eq.)

Limestone ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$) are basic raw materials used in a wide variety of industries, including construction, agriculture, chemical, and metallurgy. For example, limestone can be used as a purifier in refining metals. In the case of iron ore, limestone heated in a blast furnace reacts with impurities in the iron ore and fuels, generating CO_2 as a by-product. Limestone is also used in flue gas desulfurization systems to remove sulfur dioxide from the exhaust gases. From 1990 to 2005, emissions from this source increased by 1.9 Tg CO_2 Eq. (34 percent).

Aluminum Production (7.2 Tg CO_2 Eq.)

Aluminum production results in emissions of CO_2, CF_4 and C_2F_6. CO_2 is emitted when alumina (aluminum oxide, Al_2O_3) is reduced to aluminum. The reduction of the alumina occurs through electrolysis in a molten bath of natural or synthetic cryolite. The reduction cells contain a carbon lining that serves as the cathode. Carbon is also contained in the anode, which can be a carbon mass of paste, coke briquettes, or prebaked carbon blocks from petroleum coke. During reduction, some of this carbon is oxidized and released to the atmosphere as CO_2. In 2005, CO_2 emissions from aluminum production amounted to 4.2 Tg CO_2 Eq. Since 1990, CO_2 emissions from this source have decreased by 2.6 Tg CO_2 Eq. (38 percent).

During the production of primary aluminum, CF_4 and C_2F_6 are emitted as intermittent by-products of the smelting process. These PFCs are formed when fluorine from the cryolite bath combines with carbon from the electrolyte anode. PFC emissions from aluminum production have decreased by 15.6 Tg CO_2 Eq. (84 percent) between 1990 and 2005 due to emission reduction efforts by the industry and falling domestic aluminum production, although there was a slight increase in emissions between 2004 and 2005, due to slightly higher production. In 2005, CF_4 and C_2F_6 emissions from aluminum production amounted to 3.0 Tg CO_2 Eq.

Adipic Acid Production (6.0 Tg CO_2 Eq.)

Most adipic acid produced in the United States is used to manufacture nylon 6,6. Adipic acid is also used to produce some low-temperature lubricants and to add a "tangy" flavor to foods. N_2O is emitted as a by-product of the chemical synthesis of adipic acid. In 2005, U.S. adipic acid plants emitted 1.3 percent of U.S. N_2O emissions. Even though adipic acid production has increased in recent years, by 1998 all three major adipic acid plants in the United States had voluntarily implemented N_2O abatement technology. As a result, emissions have decreased by 9.2 Tg CO_2 Eq. (61 percent) between 1990 and 2005.

Semiconductor Manufacture (4.3 Tg CO_2 Eq.)

The semiconductor industry uses combinations of HFCs, PFCs, SF_6, and other gases for plasma etching and to clean chemical vapor deposition tools. Emissions from this source category have increased 1.4 Tg CO_2 Eq. (48 percent) since 1990 with the growth in the semiconductor industry and the rising intricacy of chip designs. However, the growth rate in emissions has slowed since 1997, and emissions actually declined between 1999 and 2005. This later reduction is due to the implementation of PFC emission reduction methods, such as process optimization.

Soda Ash Manufacture and Consumption (4.2 Tg CO_2 Eq.)

Commercial soda ash (sodium carbonate, Na_2CO_3) is used in many consumer products, such as glass, soap and detergents, paper, textiles, and food. During the manufacturing of soda ash, some natural sources of sodium carbonate are heated and transformed into a crude soda ash, in which CO_2 is generated as a by-product. In addition, CO_2 is often released when the soda ash is consumed. From 1990 to 2005, emissions from this source increased by 0.1 Tg CO_2 Eq. (2 percent).

Petrochemical Production (4.0 Tg CO_2 Eq.)

The production process for carbon black results in the release CO_2 emissions to the atmosphere. Carbon black is a black powder generated by the incomplete combustion of an aromatic petroleum or coal-based feedstock production. The majority of carbon black produced in the United States is consumed by the tire industry, which adds it to rubber to increase strength and abrasion resistance. Small amounts of CH_4 are also released during the production of five petrochemicals: carbon black, ethylene, ethylene dichloride, styrene, and methanol. These production processes resulted in emissions of 2.9 Tg CO_2 Eq. of CO_2 and 1.1 Tg CO_2 Eq. of CH_4 in 2005. Emissions from this source increased by 0.9 Tg CO_2 Eq. (29 percent) between 1990 and 2005.

Magnesium Production and Processing (2.7 Tg CO_2 Eq.)

Sulfur hexafluoride is also used as a protective cover gas for the casting of molten magnesium. Emissions from

primary magnesium production and magnesium casting have decreased by 2.8 Tg CO_2 Eq. (51 percent) since 1990. This decrease has primarily taken place since 1999, due to a decline in the quantity of magnesium die cast and the closure of a U.S. primary magnesium production facility.

Titanium Dioxide Production (1.9 Tg CO_2 Eq.)

Titanium dioxide (TiO_2) is a metal oxide manufactured from titanium ore, and is principally used as a pigment. It is used in white paint and as a pigment in the manufacture of white paper, foods, and other products. Two processes, the chloride process and the sulfate process, are used for making TiO_2. CO_2 is emitted from the chloride process, which uses petroleum coke and chlorine as raw materials. Since 1990, emissions from this source increased by 0.6 Tg CO_2 Eq. (47 percent).

Phosphoric Acid Production (1.4 Tg CO_2 Eq.)

Phosphoric acid is a basic raw material in the production of phosphate-based fertilizers. The phosphate rock consumed in the United States originates from both domestic mines, located primarily in Florida, North Carolina, Idaho, and Utah, and foreign mining operations in Morocco. The primary use of this material is as a basic component of a series of chemical reactions that lead to the production of phosphoric acid, as well as the by-products CO_2 and phosphogypsum. From 1990 to 2005, CO_2 emissions from phosphoric acid production decreased by 0.1 Tg CO_2 Eq. (9.5 percent).

Ferroalloy Production (1.4 Tg CO_2 Eq.)

CO_2 is emitted from the production of several ferroalloys. Ferroalloys are composites of iron and other elements such as silicon, manganese, and chromium. When incorporated in alloy steels, ferroalloys are used to alter the material properties of the steel. From 1990 to 2005, emissions from this source decreased by 0.8 Tg CO_2 Eq. (35 percent).

Carbon Dioxide Consumption (1.3 Tg CO_2 Eq.)

Many segments of the economy consume CO_2, including food processing, beverage manufacturing, chemical processing, and a host of industrial and other miscellaneous applications. CO_2 may be produced as a by-product from the production of certain chemicals (e.g., ammonia), from select natural gas wells, or by separating it from crude oil and natural gas. The majority of the CO_2 used in these applications is eventually released to the atmosphere. Since 1990, emissions from CO_2 consumption have decreased by 0.1 Tg CO_2 Eq. (6.5 percent).

Zinc Production (0.5 Tg CO_2 Eq.)

CO_2 emissions from the production of zinc in the United States occur through the primary production of zinc in the electro-thermic production process, or through the secondary production of zinc using a Waelz Kiln furnace or the electro-thermic production process. Both the electro-thermic and Waelz Kiln processes are emissive due to the use of a carbon-based material (often metallurgical coke); however, zinc is also produced in the United States using non-emissive processes. Due to the closure of an electro-thermic plant in 2003, the only emissive zinc production process remaining occurs through the recycling of electric-arc-furnace (EAF) dust in a Waelz Kiln furnace (secondary production) at a plant in Palmerton, Pennsylvania. From 1990 to 2005, CO_2 emissions from zinc production decreased by 0.5 Tg CO_2 Eq. (51 percent).

Lead Production (0.3 Tg CO_2 Eq.)

Primary and secondary production of lead in the United States results in CO_2 emissions when carbon-based materials (often metallurgical coke) are used as a reducing agent. Primary production involves the direct smelting of lead concentrates while secondary production largely occurs through the recycling of lead-acid batteries. In 2005, emissions from primary lead production decreased by 40 percent due to the closure of one of two primary lead production plants located in Missouri. Secondary lead production accounted for 86 percent of total lead production emissions in 2005. Since 1990, emissions from this source have decreased by 7.2 percent.

Silicon Carbide Production and Consumption (0.2 Tg CO_2 Eq.)

Small amounts of CH_4 are released during the production of silicon carbide (SiC), a material used as an industrial abrasive. Additionally, small amounts of CO_2 are released when SiC is consumed for metallurgical and other non-abrasive purposes (e.g., iron and steel production). Silicon carbide is made through a reaction of quartz (SiO_2) and carbon (in the form of petroleum coke). CH_4 is produced during this reaction from volatile compounds in the petroleum coke. CH_4 emissions from silicon carbide production have declined significantly due to a 67 percent decrease in silicon carbide production since 1990. CO_2 emissions from SiC

Table 2-9: N_2O Emissions from Solvent and Other Product Use (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
N_2O	**4.3**	**4.5**	**4.8**	**4.8**	**4.3**	**4.3**	**4.3**	**4.3**
N_2O Product Usage	4.3	4.5	4.8	4.8	4.3	4.3	4.3	4.3
Total	**4.3**	**4.5**	**4.8**	**4.8**	**4.3**	**4.3**	**4.3**	**4.3**

consumption have fluctuated significantly between years dependent on consumption, but overall have decreased by 42 percent since 1990.

Solvent and Other Product Use

Greenhouse gas emissions are produced as a by-product of various solvent and other product uses. In the United States, emissions from N_2O Product Usage, the only source of greenhouse gas emissions from this chapter, accounted for 4.3 Tg CO_2 Eq. of N_2O, or less than 0.1 percent of total U.S. emissions in 2005 (see Table 2-9).

N_2O Product Usage (4.3 Tg CO_2 Eq.)

N_2O is used in carrier gases with oxygen to administer more potent inhalation anesthetics for general anesthesia and as an anesthetic in various dental and veterinary applications. As such, it is used to treat short-term pain, for sedation in minor elective surgeries, and as an induction anesthetic. The second main use of N_2O is as a propellant in pressure and aerosol products, the largest application being pressure-packaged whipped cream. In 2005, N_2O emissions from product usage constituted approximately 1 percent of U.S. N_2O emissions. From 1990 to 2005, emissions from this source category decreased by less than 1 percent.

Agriculture

Agricultural activities contribute directly to emissions of greenhouse gases through a variety of processes, including the following source categories: enteric fermentation in domestic livestock, livestock manure management, rice cultivation, agricultural soil management, and field burning of agricultural residues.

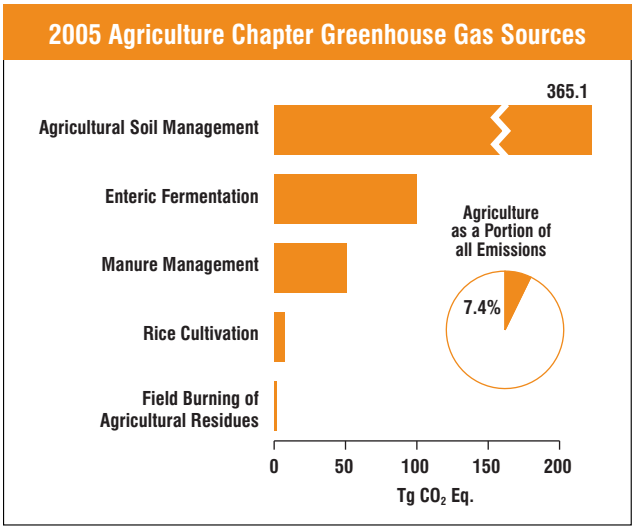
In 2005, agricultural activities were responsible for emissions of 536.3 Tg CO_2 Eq., or 7.4 percent of total U.S. greenhouse gas emissions. CH_4 and N_2O were the primary greenhouse gases emitted by agricultural activities. CH_4 emissions from enteric fermentation and manure management represented about 21 percent and 8 percent of total CH_4 emissions from anthropogenic activities, respectively, in 2005. Agricultural soil management activities, such as fertilizer application and other cropping practices, were the largest source of U.S. N_2O emissions in 2005, accounting for 78 percent. Table 2-10 and Figure 2-11 present emission estimates for the Agriculture chapter.

Table 2-10: Emissions from Agriculture (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CH_4	**154.4**	**164.0**	**160.5**	**161.0**	**161.2**	**161.1**	**158.7**	**161.2**
Enteric Fermentation	115.7	120.6	113.5	112.5	112.6	113.0	110.5	112.1
Manure Management	30.9	35.1	38.7	40.1	41.1	40.5	39.7	41.3
Rice Cultivation	7.1	7.6	7.5	7.6	6.8	6.9	7.6	6.9
Field Burning of Agricultural Residues	0.7	0.7	0.8	0.8	0.7	0.8	0.9	0.9
N_2O	**375.9**	**362.7**	**386.9**	**399.2**	**376.3**	**359.9**	**348.7**	**375.1**
Agricultural Soil Management	366.9	353.4	376.8	389.0	366.1	350.2	338.8	365.1
Manure Management	8.6	9.0	9.6	9.8	9.7	9.3	9.4	9.5
Field Burning of Agricultural Residues	0.4	0.4	0.5	0.5	0.4	0.4	0.5	0.5
Total	**530.3**	**526.8**	**547.4**	**560.3**	**537.4**	**521.1**	**507.4**	**536.3**

Note: Totals may not sum due to independent rounding.

Figure 2-11



Agricultural Soil Management (365.1 Tg CO_2 Eq.)

N_2O is produced naturally in soils through microbial nitrification and denitrification processes. A number of anthropogenic activities add to the amount of nitrogen available to be emitted as N_2O by microbial processes. These activities may add nitrogen to soils either directly or indirectly. Direct additions occur through the application of synthetic and organic fertilizers; production of nitrogen-fixing crops and forages; the application of livestock manure, crop residues, and sewage sludge; cultivation of high-organic-content soils; and direct excretion by animals onto soil. Indirect additions result from volatilization and subsequent atmospheric deposition, and from leaching and surface run-off of some of the nitrogen applied to or deposited on soils as fertilizer, livestock manure, and sewage sludge. In 2005, agricultural soil management accounted for 78 percent of U.S. N_2O emissions. From 1990 to 2005, emissions from this source decreased by 1.8 Tg CO_2 Eq. (0.5 percent); year-to-year fluctuations are largely a reflection of annual variations in weather, synthetic fertilizer consumption, and crop production.

Enteric Fermentation (112.1 Tg CO_2 Eq.)

During animal digestion, CH_4 is produced through the process of enteric fermentation, in which microbes residing in animal digestive systems break down food. Ruminants, which include cattle, buffalo, sheep, and goats, have the highest CH_4 emissions among all animal types because they have a rumen, or large fore-stomach, in which CH_4-producing fermentation occurs. Non-ruminant domestic animals, such as pigs and horses, have much lower CH_4 emissions. In 2005, enteric fermentation was the source of about 21 percent of U.S. CH_4 emissions, and about 70 percent of the CH_4 emissions from agriculture. From 1990 to 2005, emissions from this source decreased by 3.6 Tg CO_2 Eq. (3 percent). Generally, emissions have been decreasing since 1995, mainly due to decreasing populations of both beef and dairy cattle and improved feed quality for feedlot cattle.

Manure Management (50.8 Tg CO_2 Eq.)

Both CH_4 and N_2O result from manure management. The decomposition of organic animal waste in an anaerobic environment produces CH_4. The most important factor affecting the amount of CH_4 produced is how the manure is managed, because certain types of storage and treatment systems promote an oxygen-free environment. In particular, liquid systems tend to encourage anaerobic conditions and produce significant quantities of CH_4, whereas solid waste management approaches produce little or no CH_4. Higher temperatures and moist climatic conditions also promote CH_4 production.

CH_4 emissions from manure management were 41.3 Tg CO_2 Eq., or about 8 percent of U.S. CH_4 emissions in 2005 and 26 percent of the CH_4 emissions from agriculture. From 1990 to 2005, emissions from this source increased by 10.4 Tg CO_2 Eq. (34 percent). The bulk of this increase was from swine and dairy cow manure, and is attributed to the shift of the swine and dairy industries towards larger facilities. Larger swine and dairy farms tend to use liquid management systems.

N_2O is also produced as part of microbial nitrification and denitrification processes in managed and unmanaged manure. Emissions from unmanaged manure are accounted for within the agricultural soil management source category. Total N_2O emissions from managed manure systems in 2005 accounted for 9.5 Tg CO_2 Eq., or 2 percent of U.S. N_2O emissions. From 1990 to 2005, emissions from this source category increased by 0.9 Tg CO_2 Eq. (10 percent), primarily due to increases in swine and poultry populations over the same period.

Rice Cultivation (6.9 Tg CO_2 Eq.)

Most of the world's rice, and all of the rice in the United States, is grown on flooded fields. When fields are flooded, anaerobic conditions develop and the organic matter in the soil decomposes, releasing CH_4 to the atmosphere, primarily

through the rice plants. In 2005, rice cultivation was the source of 1 percent of U.S. CH_4 emissions, and about 4 percent of U.S. CH_4 emissions from agriculture. Emission estimates from this source have decreased about 3 percent since 1990.

Field Burning of Agricultural Residues (1.4 Tg CO_2 Eq.)

Burning crop residues releases N_2O and CH_4. Because field burning is not a common debris clearing method in the United States, it was responsible for only 0.2 percent of U.S. CH_4 (0.9 Tg CO_2 Eq.) and 0.1 percent of U.S. N_2O (0.5 Tg CO_2 Eq.) emissions in 2005. Since 1990, emissions from this source have increased by approximately 28 percent.

Land Use, Land-Use Change, and Forestry

When humans alter the terrestrial biosphere through land use, changes in land use, and land management practices, they also alter the background carbon fluxes between biomass, soils, and the atmosphere. Forest management practices, tree planting in urban areas, the management of agricultural soils, and the landfilling of yard trimmings and food scraps have resulted in a net uptake (sequestration) of carbon in the United States, which offset about 11 percent of total U.S. greenhouse gas emissions in 2005. Forests (including vegetation, soils, and harvested wood) accounted for approximately 85 percent of total 2005 sequestration, urban trees accounted for 11 percent, agricultural soils (including mineral and organic soils and the application of lime) accounted for 3 percent, and landfilled yard trimmings and food scraps accounted for 1 percent of the total sequestration in 2005. The net forest sequestration is a result of net forest growth and increasing forest area, as well as a net accumulation of carbon stocks in harvested wood pools. The net sequestration in urban forests is a result of net tree growth in these areas. In agricultural soils, mineral soils account for a net carbon sink that is almost two times larger than the sum of emissions from organic soils and liming. The mineral soil C sequestration is largely due to the conversion of cropland to permanent pastures and hay production, a reduction in summer fallow areas in semi-arid areas, an increase in the adoption of conservation tillage practices, and an increase in the amounts of organic fertilizers (i.e., manure and sewage sludge) applied to agriculture lands. The landfilled yard trimmings and food scraps net sequestration is due to the long-term accumulation of yard trimming carbon and food scraps in landfills.

Land use, land-use change, and forestry activities in 2005 resulted in a net C sequestration of 828.4 Tg CO_2 Eq. (Table 2-11). This represents an offset of approximately 13.6 percent of total U.S. CO_2 emissions, or 11.4 percent of total greenhouse gas emissions in 2005. Total land use, land-use change, and forestry net C sequestration increased by approximately 16 percent between 1990 and 2005, primarily due to an increase in the rate of net C accumulation in forest C stocks, particularly in aboveground and belowground tree biomass. Annual C accumulation in landfilled yard trimmings and food scraps slowed over this period, while the rate of annual C accumulation increased in urban trees. Net U.S. emissions (all sources and sinks) increased by 16.4 percent from 1990 to 2005.

Table 2-11: Net CO_2 Flux from Land Use, Land-Use Change, and Forestry (Tg CO_2 Eq.)

Sink Category	1990	1995	2000	2001	2002	2003	2004	2005
Forest Land Remaining Forest Land	**(598.5)**	**(717.5)**	**(638.7)**	**(645.7)**	**(688.1)**	**(687.0)**	**(697.3)**	**(698.7)**
Changes in Forest Carbon Stocks	(598.5)	(717.5)	(638.7)	(645.7)	(688.1)	(687.0)	(697.3)	(698.7)
Cropland Remaining Cropland	**(28.1)**	**(37.4)**	**(36.5)**	**(38.0)**	**(37.8)**	**(38.3)**	**(39.4)**	**(39.4)**
Changes in Agricultural Soil Carbon Stocks and Liming Emissions	(28.1)	(37.4)	(36.5)	(38.0)	(37.8)	(38.3)	(39.4)	(39.4)
Land Converted to Cropland	**8.7**	**7.2**	**7.2**	**7.2**	**7.2**	**7.2**	**7.2**	**7.2**
Changes in Agricultural Soil Carbon Stocks	8.7	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Grassland Remaining Grassland	**0.1**	**16.4**	**16.3**	**16.2**	**16.2**	**16.2**	**16.1**	**16.1**
Changes in Agricultural Soil Carbon Stocks	0.1	16.4	16.3	16.2	16.2	16.2	16.1	16.1
Land Converted to Grassland	**(14.6)**	**(16.3)**	**(16.3)**	**(16.3)**	**(16.3)**	**(16.3)**	**(16.3)**	**(16.3)**
Changes in Agricultural Soil Carbon Stocks	(14.6)	(16.3)	(16.3)	(16.3)	(16.3)	(16.3)	(16.3)	(16.3)
Settlements Remaining Settlements	**(57.5)**	**(67.8)**	**(78.2)**	**(80.2)**	**(82.3)**	**(84.4)**	**(86.4)**	**(88.5)**
Urban Trees	(57.5)	(67.8)	(78.2)	(80.2)	(82.3)	(84.4)	(86.4)	(88.5)
Other	**(22.8)**	**(13.3)**	**(10.5)**	**(10.6)**	**(10.8)**	**(9.3)**	**(8.7)**	**(8.8)**
Landfilled Yard Trimmings and Food Scraps	(22.8)	(13.3)	(10.5)	(10.6)	(10.8)	(9.3)	(8.7)	(8.8)
Total	**(712.8)**	**(828.8)**	**(756.7)**	**(767.5)**	**(811.9)**	**(811.9)**	**(824.8)**	**(828.5)**

Note: Totals may not sum due to independent rounding. Parentheses indicate net sequestration.

Table 2-12: Non-CO_2 Emissions from Land Use, Land-Use Change, and Forestry (Tg CO_2 Eq.)

Land-Use Category	1990	1995	2000	2001	2002	2003	2004	2005
Forest Land Remaining Forest Land	**7.8**	**4.5**	**15.7**	**6.9**	**11.8**	**9.2**	**8.0**	**13.1**
CH_4 Emissions from Forest Fires	7.1	4.0	14.0	6.0	10.4	8.1	6.9	11.6
N_2O Emissions from Forest Fires	0.7	0.4	1.4	0.6	1.1	0.8	0.7	1.2
N_2O Emissions from Soils	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Settlements Remaining Settlements	**5.1**	**5.5**	**5.6**	**5.5**	**5.6**	**5.8**	**6.0**	**5.8**
N_2O Emissions from Soils	5.1	5.5	5.6	5.5	5.6	5.8	6.0	5.8
Total	**13.0**	**10.1**	**21.3**	**12.4**	**17.4**	**15.0**	**13.9**	**18.9**

Note: Totals may not sum due to independent rounding.

Land use, land-use change, and forestry activities in 2005 also resulted in emissions of N_2O (7.3 Tg CO_2 Eq.) from application of fertilizers to forests and settlements and from forest fires, and of CH_4 (11.6 Tg CO_2 Eq.) from forest fires, as shown in Table 2-12. Total N_2O emissions from the application of fertilizers to forests and settlements increased by approximately 19 percent between 1990 and 2005. Emissions of CH_4 and N_2O from forest fires fluctuate widely from year to year, but overall increased by 64 percent between 1990 and 2005.

Forest Land Remaining Forest Land (13.1 Tg CO_2 Eq.)

As with other agricultural applications, forests may be fertilized to stimulate growth rates. The relative magnitude of the impact of this practice is limited, however, because forests are generally only fertilized twice during their life cycles, and applications account for no more than one percent of total U.S. fertilizer applications annually. In terms of trends, however, N_2O emissions from forest soils for 2005 were more than 5 times higher than in 1990, primarily the result of an increase in the fertilized area of pine plantations in the southeastern United States. This source accounts for approximately 0.1 percent of total U.S. N_2O emissions. Non-CO_2 emissions from forest fires are directly related to the area of forest burned, which varies greatly from year to year. CH_4 from this source (11.6 Tg CO_2 Eq.) accounts for approximately 2 percent of total U.S. CH_4 emissions, while N_2O from forest fires (1.2 Tg CO_2 Eq.) accounts for about 0.3 percent of U.S. N_2O emissions. From 1990 to 2005, CH_4 and N_2O emissions from *Forest Land Remaining Forest Land* increased by 4.5 Tg CO_2 Eq. (64 percent) and 0.8 Tg CO_2 Eq. (98 percent), respectively.

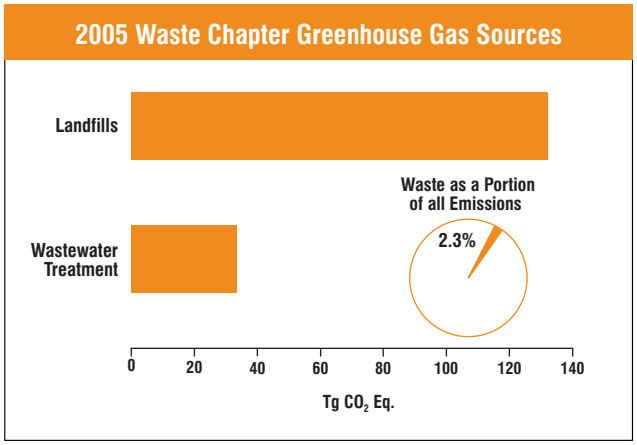
Settlements Remaining Settlements (5.8 Tg CO_2 Eq.)

Of the fertilizers applied to soils in the United States, approximately 10 percent are applied to lawns, golf courses, and other landscaping within settled areas. In 2005, N_2O emissions from settlement soils constituted approximately 1 percent of total U.S. N_2O emissions. There has been an overall increase in emissions of 13 percent since 1990, a result of a general increase in the applications of synthetic fertilizers.

Waste

Waste management and treatment activities are sources of greenhouse gas emissions (see Figure 2-12). Landfills were the largest source of anthropogenic CH_4 emissions, accounting for 24 percent of total U.S. CH_4 emissions.[4] Additionally, wastewater treatment accounts for 5 percent of U.S. CH_4 emissions, and 2 percent of N_2O emissions. Nitrogen oxides (NO_x), carbon monoxide (CO), and non-CH_4 volatile organic compounds (NMVOCs) are also emitted by

Figure 2-12



[4] Landfills also store carbon, due to incomplete degradation of organic materials such as wood products and yard trimmings, as described in the Land Use, Land-Use Change, and Forestry chapter.

Table 2-13: Emissions from Waste (Tg CO_2 Eq.)

Gas/Source	1990	1995	2000	2001	2002	2003	2004	2005
CH_4	**185.8**	**182.2**	**158.3**	**153.5**	**156.2**	**160.5**	**157.8**	**157.4**
Landfills	161.0	157.1	131.9	127.6	130.4	134.9	132.1	132.0
Wastewater Treatment	24.8	25.1	26.4	25.9	25.8	25.6	25.7	25.4
N_2O	**6.4**	**6.9**	**7.6**	**7.6**	**7.7**	**7.8**	**7.9**	**8.0**
Wastewater Treatment	6.4	6.9	7.6	7.6	7.7	7.8	7.9	8.0
Total	**192.2**	**189.1**	**165.9**	**161.1**	**163.9**	**168.4**	**165.7**	**165.4**

Note: Totals may not sum due to independent rounding.

waste activities. A summary of greenhouse gas emissions from the Waste chapter is presented in Table 2-13.

Overall, in 2005, waste activities generated emissions of 165.4 Tg CO_2 Eq., or 2.3 percent of total U.S. greenhouse gas emissions.

Landfills (132.0 Tg CO_2 Eq.)

Landfills are the largest anthropogenic source of CH_4 emissions in the United States, accounting for approximately 24 percent of total CH_4 emissions in 2005. In an environment where the oxygen content is low or zero, anaerobic bacteria decompose organic materials, such as yard waste, household waste, food waste, and paper, resulting in the generation of CH_4 and biogenic CO_2. Factors such as waste composition and moisture influence the level of CH_4 generation. From 1990 to 2005, net CH_4 emissions from landfills decreased by 29 Tg CO_2 Eq. (18 percent), with small increases occurring in some interim years. This downward trend in overall emissions is the result of increases in the amount of landfill gas collected and combusted,[5] which has more than offset the additional CH_4 emissions resulting from an increase in the amount of municipal solid waste landfilled.

Wastewater Treatment (33.4 Tg CO_2 Eq.)

Wastewater from domestic sources (i.e., municipal sewage) and industrial sources is treated to remove soluble organic matter, suspended solids, pathogenic organisms and chemical contaminants. Soluble organic matter is generally removed using biological processes in which microorganisms consume the organic matter for maintenance and growth. Microorganisms can biodegrade soluble organic material in wastewater under aerobic or anaerobic conditions, with the latter condition producing CH_4. During collection and treatment, wastewater may be accidentally or deliberately managed under anaerobic conditions. In addition, the sludge may be further biodegraded under aerobic or anaerobic conditions. Untreated wastewater may also produce CH_4 if contained under anaerobic conditions. N_2O may be generated during both nitrification and denitrification of the nitrogen present, usually in the form of urea, ammonia, and proteins. In 2005, wastewater treatment was the source of approximately 5 percent of U.S. CH_4 emissions, and 2 percent of N_2O emissions. From 1990 to 2005, CH_4 and N_2O emissions from wastewater treatment increased by 0.6 Tg CO_2 Eq. (2.5 percent) and 1.6 Tg CO_2 Eq. (26 percent), respectively.

2.2. Emissions by Economic Sector

Throughout this report, emission estimates are grouped into six sectors (i.e., chapters) defined by the IPCC: Energy; Industrial Processes; Solvent and Other Product Use; Agriculture; Land Use, Land-Use Change, and Forestry; and Waste. While it is important to use this characterization for consistency with UNFCCC reporting guidelines, it is also useful to allocate emissions into more commonly used sectoral categories. This section reports emissions by the following economic sectors: residential, commercial, industry, transportation, electricity generation, and agriculture, as well as U.S. territories.

Using this categorization, emissions from electricity generation accounted for the largest portion (34 percent) of U.S. greenhouse gas emissions in 2005. Transportation activities, in aggregate, accounted for the second largest portion (28 percent). Emissions from industry accounted for 19 percent of U.S. greenhouse gas emissions in 2005. In contrast to electricity generation and transportation, emissions from industry have in general declined over the past decade. The long-term decline in these emissions

[5] The CO_2 produced from combusted landfill CH_4 at landfills is not counted in national inventories as it is considered part of the natural C cycle of decomposition.

has been due to structural changes in the U.S. economy (i.e., shifts from a manufacturing-based to a service-based economy), fuel switching, and efficiency improvements. The remaining 20 percent of U.S. greenhouse gas emissions were contributed by the residential, agriculture, and commercial sectors, plus emissions from U.S. territories. The residential sector accounted for about 5 percent, and primarily consisted of CO_2 emissions from fossil fuel combustion. Activities related to agriculture accounted for roughly 8 percent of U.S. emissions; unlike other economic sectors, agricultural sector emissions were dominated by N_2O emissions from agricultural soil management and CH_4 emissions from enteric fermentation, rather than CO_2 from fossil fuel combustion. The commercial sector accounted for about 6 percent of emissions, while U.S. territories accounted for 1 percent.

CO_2 was also emitted and sequestered by a variety of activities related to forest management practices, tree planting in urban areas, the management of agricultural soils, and landfilling of yard trimmings.

Table 2-14 presents a detailed breakdown of emissions from each of these economic sectors by source category, as they are defined in this report. Figure 2-13 shows the trend in emissions by sector from 1990 to 2005.

Table 2-14: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (Tg CO_2 Eq. and Percent of Total in 2005)

Sector/Source	1990	1995	2000	2001	2002	2003	2004	2005	Percent[a]
Electric Power Industry	**1,859.7**	**1,989.5**	**2,329.9**	**2,292.0**	**2,300.7**	**2,330.2**	**2,363.4**	**2,429.8**	**33.5%**
CO_2 from Fossil Fuel Combustion	1,810.2	1,939.3	2,283.5	2,245.5	2,254.7	2,284.0	2,315.8	2,381.2	32.8%
Municipal Solid Waste Combustion	11.4	16.2	18.3	18.7	18.9	19.9	20.5	21.3	0.3%
Electrical Transmission and Distribution	27.1	21.8	15.2	15.1	14.3	13.8	13.6	13.2	0.2%
Stationary Combustion	8.1	8.6	10.0	9.8	9.8	10.1	10.1	10.4	0.1%
Limestone and Dolomite Use	2.8	3.7	3.0	2.9	2.9	2.4	3.4	3.7	0.1%
Transportation	**1,523.0**	**1,677.2**	**1,903.2**	**1,876.4**	**1,931.2**	**1,928.2**	**1,982.6**	**2,008.9**	**27.7%**
CO_2 from Fossil Fuel Combustion	1,464.0	1,590.2	1,784.4	1,758.2	1,812.3	1,810.5	1,864.5	1,892.8	26.1%
Substitution of Ozone Depleting Substances	+	19.2	51.6	55.8	59.4	62.5	65.6	67.1	0.9%
Mobile Combustion	47.2	56.5	55.2	51.3	48.5	45.0	42.2	38.9	0.5%
Non-Energy Use of Fuels	11.9	11.3	12.1	11.1	10.9	10.1	10.2	10.2	0.1%
Industry	**1,470.9**	**1,478.4**	**1,443.3**	**1,395.4**	**1,380.0**	**1,371.8**	**1,403.3**	**1,352.8**	**18.6%**
CO_2 from Fossil Fuel Combustion	810.3	825.4	824.1	819.3	804.8	813.3	824.5	794.6	10.9%
Natural Gas Systems	158.2	161.9	156.0	154.2	154.6	152.1	147.2	139.3	1.9%
Non-Energy Use of Fuels	99.7	115.9	118.0	115.0	115.2	112.8	130.9	123.4	1.7%
Coal Mining	81.9	66.5	55.9	55.5	52.0	52.1	54.5	52.4	0.7%
Iron and Steel Production	86.2	74.6	66.3	59.0	55.6	54.4	52.4	46.2	0.6%
Cement Manufacture	33.3	36.8	41.2	41.4	42.9	43.1	45.6	45.9	0.6%
Petroleum Systems	34.4	31.1	27.8	27.4	26.8	25.8	25.4	28.5	0.4%
HCFC-22 Production	35.0	27.0	29.8	19.8	19.8	12.3	15.6	16.5	0.2%
Ammonia Manufacture and Urea Application	19.3	20.5	19.6	16.7	17.8	16.2	16.9	16.3	0.2%
Nitric Acid Production	17.8	19.9	19.6	15.9	17.2	16.7	16.0	15.7	0.2%
Lime Manufacture	11.3	12.8	13.3	12.9	12.3	13.0	13.7	13.7	0.2%
Aluminum Production	25.4	17.5	14.7	7.8	9.7	8.3	7.1	7.2	0.1%
Adipic Acid Production	15.2	17.2	6.0	4.9	5.9	6.2	5.7	6.0	0.1%
Substitution of Ozone Depleting Substances	+	1.2	3.3	3.2	3.9	4.6	5.1	5.5	0.1%
Abandoned Underground Coal Mines	6.0	8.2	7.3	6.7	6.1	5.9	5.8	5.5	0.1%
Stationary Combustion	5.3	5.6	5.5	5.1	5.0	4.9	5.2	4.6	0.1%
Semiconductor Manufacture	2.9	5.0	6.3	4.5	4.4	4.3	4.7	4.3	0.1%
N_2O Product Usage	4.3	4.5	4.8	4.8	4.3	4.3	4.3	4.3	0.1%
Soda Ash Manufacture and Consumption	4.1	4.3	4.2	4.1	4.1	4.1	4.2	4.2	0.1%
Petrochemical Production	3.1	3.8	4.2	3.9	4.0	3.9	4.1	4.0	0.1%
Limestone and Dolomite Use	2.8	3.7	3.0	2.9	2.9	2.4	3.4	3.7	0.1%
Magnesium Production and Processing	5.4	5.6	3.0	2.4	2.4	2.9	2.6	2.7	+
Titanium Dioxide Production	1.3	1.7	1.9	1.9	2.0	2.0	2.3	1.9	+
Ferroalloy Production	2.2	2.0	1.9	1.5	1.4	1.3	1.4	1.4	+
Phosphoric Acid Production	1.5	1.5	1.4	1.3	1.3	1.4	1.4	1.4	+
Carbon Dioxide Consumption	1.4	1.4	1.4	0.8	1.0	1.3	1.2	1.3	+
Mobile Combustion	0.9	1.0	1.1	1.2	1.2	1.3	1.3	1.3	+
Zinc Production	0.9	1.0	1.1	1.0	0.9	0.5	0.5	0.5	+
Lead Production	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	+

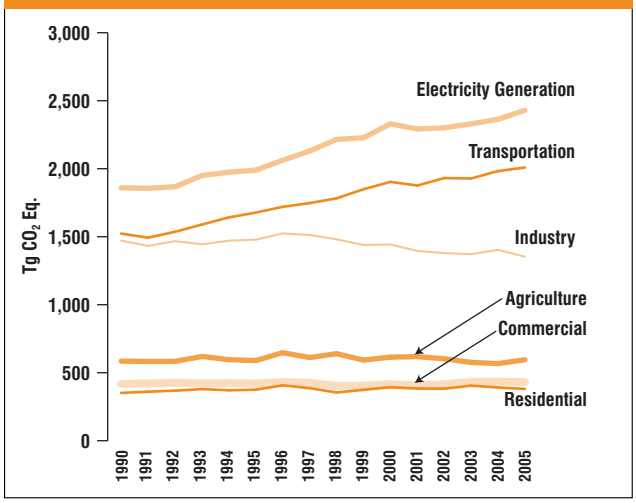
Table 2-14: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors (Tg CO_2 Eq. and Percent of Total in 2005) (continued)

Sector/Source	1990	1995	2000	2001	2002	2003	2004	2005	Percent[a]
Silicon Carbide Production and Consumption	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	+
Agriculture	**585.3**	**589.2**	**614.4**	**618.4**	**602.6**	**575.7**	**567.0**	**595.4**	**8.2%**
Agricultural Soil Management	366.9	353.4	376.8	389.0	366.1	350.2	338.8	365.1	5.0%
Enteric Fermentation	115.7	120.6	113.5	112.5	112.6	113.0	110.5	112.1	1.5%
Manure Management	39.5	44.1	48.3	50.0	50.8	49.8	49.2	50.8	0.7%
CO_2 from Fossil Fuel Combustion	46.8	57.3	50.9	50.7	52.9	45.0	51.1	45.5	0.6%
Forest Land Remaining Forest Land	7.9	4.5	15.7	6.9	11.8	9.2	8.0	13.1	0.2%
Rice Cultivation	7.1	7.6	7.5	7.6	6.8	6.9	7.6	6.9	0.1%
Field Burning of Agricultural Residues	1.1	1.0	1.3	1.2	1.1	1.2	1.4	1.4	+
Mobile Combustion	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.4	+
Stationary Combustion	+	+	+	+	+	+	+	+	+
Commercial	**417.8**	**420.5**	**415.5**	**406.6**	**413.7**	**433.5**	**432.6**	**431.4**	**5.9%**
CO_2 from Fossil Fuel Combustion	224.3	226.4	232.3	225.1	225.7	236.6	233.3	225.8	3.1%
Landfills	161.0	157.1	131.9	127.6	130.4	134.9	132.1	132.0	1.8%
Substitution of Ozone Depleting Substances	+	3.8	16.0	19.1	22.9	27.3	32.3	38.9	0.5%
Wastewater Treatment	31.2	32.0	34.0	33.5	33.5	33.4	33.6	33.4	0.5%
Stationary Combustion	1.3	1.3	1.3	1.2	1.2	1.3	1.3	1.2	+
Residential	**351.3**	**375.1**	**393.6**	**383.6**	**382.7**	**404.8**	**391.6**	**380.7**	**5.2%**
CO_2 from Fossil Fuel Combustion	340.3	356.4	373.5	363.9	362.4	383.8	369.9	358.7	4.9%
Substitution of Ozone Depleting Substances	0.3	8.1	10.1	10.4	10.7	11.0	11.5	11.9	0.2%
Settlement Soil Fertilization	5.1	5.5	5.6	5.5	5.6	5.8	6.0	5.8	0.1%
Stationary Combustion	5.5	5.0	4.4	3.9	4.0	4.2	4.3	4.3	0.1%
U.S. Territories	**34.1**	**41.1**	**47.3**	**54.5**	**53.6**	**60.0**	**63.2**	**61.5**	**0.8%**
CO_2 from Fossil Fuel Combustion	34.1	41.1	47.3	54.5	53.6	60.0	63.2	61.5	0.8%
Total Emissions	**6,242.0**	**6,571.0**	**7,147.2**	**7,027.0**	**7,064.6**	**7,104.2**	**7,203.7**	**7,260.4**	**100.0%**
Sinks	**(712.8)**	**(828.8)**	**(756.7)**	**(767.5)**	**(811.9)**	**(811.9)**	**(824.8)**	**(828.5)**	**-11.4%**
Forests	(598.5)	(717.5)	(638.7)	(645.7)	(688.1)	(687.0)	(697.3)	(698.7)	-9.6%
Urban Trees	(57.5)	(67.8)	(78.2)	(80.2)	(82.3)	(84.4)	(86.4)	(88.5)	-1.2%
CO_2 Flux from Agricultural Soils	(33.9)	(30.1)	(29.4)	(30.9)	(30.7)	(31.2)	(32.4)	(32.4)	-0.4%
Landfilled Yard Trimmings and Food Scraps	(22.8)	(13.3)	(10.5)	(10.6)	(10.8)	(9.3)	(8.7)	(8.8)	-0.1%
Net Emissions (Sources and Sinks)	**5,529.2**	**5,742.2**	**6,390.5**	**6,259.5**	**6,252.7**	**6,292.3**	**6,378.9**	**6,431.9**	**88.6%**

Note: Includes all emissions of CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. Parentheses indicate negative values or sequestration.
Totals may not sum due to independent rounding.
+ Does not exceed 0.05 Tg CO_2 Eq. or 0.05%.
[a] Percent of total emissions for year 2005.

Figure 2-13

Emissions Allocated to Economic Sectors



Emissions with Electricity Distributed to Economic Sectors

It can also be useful to view greenhouse gas emissions from economic sectors with emissions related to electricity generation distributed into end-use categories (i.e., emissions from electricity generation are allocated to the economic sectors in which the electricity is consumed). The generation, transmission, and distribution of electricity, which is the largest economic sector in the United States, accounted for 34 percent of total U.S. greenhouse gas emissions in 2005. Emissions increased by 31 percent since 1990, as electricity demand grew and fossil fuels remained the dominant energy source for generation. The electricity generation sector in the United States is composed of traditional electric utilities as

well as other entities, such as power marketers and nonutility power producers. The majority of electricity generated by these entities was through the combustion of coal in boilers to produce high-pressure steam that is passed through a turbine. Table 2-15 provides a detailed summary of emissions from electricity generation-related activities.

To distribute electricity emissions among economic end-use sectors, emissions from the source categories assigned to the electricity generation sector were allocated to the residential, commercial, industry, transportation, and agriculture economic sectors according to retail sales of electricity (EIA 2006c and Duffield 2006). These three source categories include CO_2 from Fossil Fuel Combustion, CH_4 and N_2O from Stationary Combustion, and SF_6 from Electrical Transmission and Distribution Systems.[6]

When emissions from electricity are distributed among these sectors, industry accounts for the largest share of U.S. greenhouse gas emissions (28 percent), followed closely by emissions from transportation activities, which also account for 28 percent of total emissions. Emissions from the residential and commercial sectors also increase substantially when emissions from electricity are included, due to their relatively large share of electricity consumption. In all sectors except agriculture, CO_2 accounts for more than 80 percent of greenhouse gas emissions, primarily from the combustion of fossil fuels.

Table 2-16 presents a detailed breakdown of emissions from each of these economic sectors, with emissions from electricity generation distributed to them. Figure 2-14 shows the trend in these emissions by sector from 1990 to 2005.

Figure 2-14

Emissions with Electricity Distributed to Economic Sectors

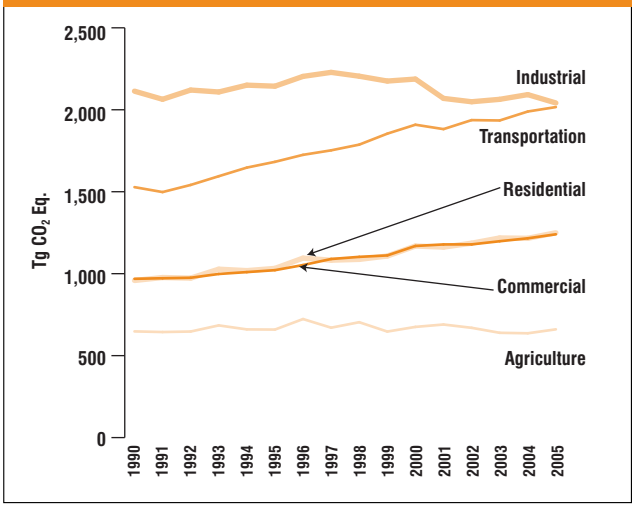


Table 2-15: Electricity Generation-Related Greenhouse Gas Emissions (Tg CO_2 Eq.)

Gas/Fuel Type or Source	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**1,823.9**	**1,958.7**	**2,304.3**	**2,266.7**	**2,276.2**	**2,305.8**	**2,339.2**	**2,405.8**
CO_2 from Fossil Fuel Combustion	1,810.2	1,939.3	2,283.5	2,245.5	2,254.7	2,284.0	2,315.8	2,381.2
Coal	*1,531.3*	*1,648.7*	*1,909.6*	*1,852.3*	*1,868.3*	*1,906.2*	*1,917.6*	*1,958.4*
Natural Gas	*176.8*	*229.5*	*282.0*	*290.8*	*307.0*	*279.3*	*297.7*	*320.1*
Petroleum	*101.8*	*60.7*	*91.5*	*102.0*	*79.1*	*98.1*	*100.1*	*102.3*
Geothermal	*0.4*	*0.3*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*
Municipal Solid Waste Combustion	10.9	15.7	17.9	18.3	18.5	19.5	20.1	20.9
Limestone and Dolomite Use	2.8	3.7	3.0	2.9	2.9	2.4	3.4	3.7
CH_4	**0.6**	**0.6**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**
Stationary Combustion*	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7
N_2O	**8.0**	**8.5**	**9.7**	**9.5**	**9.5**	**9.8**	**9.8**	**10.0**
Stationary Combustion*	7.6	8.0	9.3	9.1	9.1	9.4	9.4	9.6
Municipal Solid Waste Combustion	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
SF_6	**27.1**	**21.8**	**15.2**	**15.1**	**14.3**	**13.8**	**13.6**	**13.2**
Electrical Transmission and Distribution	27.1	21.8	15.2	15.1	14.3	13.8	13.6	13.2
Total	**1,859.7**	**1,989.5**	**2,329.9**	**2,292.0**	**2,300.7**	**2,330.2**	**2,363.4**	**2,429.8**

Note: Totals may not sum due to independent rounding.
* Includes only stationary combustion emissions related to the generation of electricity.

[6] Emissions were not distributed to U.S. territories, since the electricity generation sector only includes emissions related to the generation of electricity in the 50 states and the District of Columbia.

Table 2-16: U.S Greenhouse Gas Emissions by Economic Sector and Gas with Electricity-Related Emissions Distributed (Tg CO_2 Eq. and Percent of Total in 2005)

Sector/Gas	1990	1995	2000	2001	2002	2003	2004	2005	Percent[a]
Industry	**2,111.1**	**2,141.5**	**2,185.0**	**2,067.1**	**2,046.6**	**2,061.4**	**2,090.1**	**2,039.2**	**28.1%**
Direct Emissions	1,470.9	1,478.4	1,443.3	1,395.4	1,380.0	1,371.8	1,403.3	1,352.8	18.6%
CO_2	1,082.8	1,109.5	1,105.9	1,084.2	1,069.2	1,072.5	1,104.9	1,061.2	14.6%
CH_4	284.9	272.5	251.8	248.1	243.8	240.2	237.4	229.8	3.2%
N_2O	41.3	45.8	34.6	29.7	31.4	31.2	30.3	29.9	0.4%
HFCs, PFCs, and SF_6	61.9	50.6	50.9	33.4	35.6	27.9	30.8	32.0	0.4%
Electricity-Related	640.2	663.1	741.7	671.6	666.6	689.6	686.7	686.5	9.5%
CO_2	627.9	652.8	733.6	664.2	659.5	682.4	679.7	679.7	9.4%
CH_4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	+
N_2O	2.8	2.8	3.1	2.8	2.8	2.9	2.9	2.8	+
SF_6	9.3	7.3	4.8	4.4	4.2	4.1	4.0	3.7	0.1%
Transportation	**1,526.1**	**1,680.3**	**1,906.7**	**1,879.8**	**1,934.7**	**1,932.5**	**1,987.1**	**2,014.2**	**27.7%**
Direct Emissions	1,523.0	1,677.2	1,903.2	1,876.4	1,931.2	1,928.2	1,982.6	2,008.9	27.7%
CO_2	1,475.8	1,601.5	1,796.5	1,769.3	1,823.3	1,820.6	1,874.7	1,903.0	26.2%
CH_4	4.5	4.1	3.2	2.9	2.8	2.6	2.5	2.3	+
N_2O	42.7	52.5	52.0	48.4	45.8	42.4	39.8	36.5	0.5%
HFCs[b]	+	19.2	51.6	55.8	59.4	62.5	65.7	67.1	0.9%
Electricity-Related	3.1	3.1	3.5	3.4	3.5	4.3	4.5	5.3	0.1%
CO_2	3.1	3.1	3.5	3.3	3.4	4.3	4.4	5.2	0.1%
CH_4	+	+	+	+	+	+	+	+	+
N_2O	+	+	+	+	+	+	+	+	+
SF_6	+	+	+	+	+	+	+	+	+
Commercial	**967.2**	**1,019.8**	**1,167.4**	**1,176.8**	**1,177.0**	**1,196.2**	**1,214.1**	**1,238.5**	**17.1%**
Direct Emissions	417.8	420.5	415.5	406.6	413.7	433.5	432.6	431.4	5.9%
CO_2	224.3	226.4	232.3	225.1	225.7	236.6	233.3	225.8	3.1%
CH_4	186.7	183.1	159.2	154.4	157.1	161.5	158.7	158.3	2.2%
N_2O	6.8	7.2	7.9	7.9	8.0	8.2	8.3	8.4	0.1%
HFCs	+	3.8	16.0	19.1	22.9	27.3	32.3	38.9	0.5%
Electricity-Related	549.5	599.3	751.9	770.2	763.3	762.7	781.5	807.1	11.1%
CO_2	538.9	590.0	743.7	761.7	755.2	754.8	773.5	799.2	11.0%
CH_4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	+
N_2O	2.4	2.6	3.1	3.2	3.2	3.2	3.2	3.3	+
SF_6	8.0	6.6	4.9	5.1	4.8	4.5	4.5	4.4	0.1%
Residential	**956.9**	**1,030.6**	**1,167.0**	**1,160.3**	**1,184.3**	**1,216.2**	**1,214.2**	**1,248.0**	**17.2%**
Direct Emissions	351.3	375.1	393.6	383.6	382.7	404.8	391.6	380.7	5.2%
CO_2	340.3	356.4	373.5	363.9	362.4	383.8	369.9	358.7	4.9%
CH_4	4.4	4.0	3.5	3.1	3.1	3.3	3.3	3.4	+
N_2O	6.2	6.5	6.5	6.3	6.5	6.7	6.9	6.7	0.1%
HFCs	0.3	8.1	10.1	10.4	10.7	11.0	11.5	11.9	0.2%
Electricity-Related	605.7	655.5	773.4	776.6	801.5	811.4	822.6	867.3	11.9%
CO_2	594.0	645.4	764.9	768.1	793.0	802.9	814.2	858.7	11.8%
CH_4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	+
N_2O	2.6	2.8	3.2	3.2	3.3	3.4	3.4	3.6	+
SF_6	8.8	7.2	5.0	5.1	5.0	4.8	4.7	4.7	0.1%
Agriculture	**646.5**	**657.6**	**673.9**	**688.5**	**668.4**	**637.9**	**635.0**	**659.1**	**9.1%**
Direct Emissions	585.3	589.2	614.4	618.4	602.6	575.7	567.0	595.4	8.2%
CO_2	46.8	57.3	50.9	50.7	52.9	45.0	51.1	45.5	0.6%
CH_4	161.6	168.2	174.6	167.2	171.8	169.3	165.8	172.9	2.4%
N_2O	377.0	363.7	388.9	400.5	377.9	361.4	350.1	377.0	5.2%
Electricity-Related	61.2	68.5	59.4	70.1	65.8	62.1	68.0	63.7	0.9%
CO_2	60.0	67.4	58.8	69.3	65.1	61.5	67.4	63.0	0.9%
CH_4	+	+	+	+	+	+	+	+	+
N_2O	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	+
SF_6	0.9	0.8	0.4	0.5	0.4	0.4	0.4	0.3	+
U.S. Territories	**34.1**	**41.1**	**47.3**	**54.5**	**53.6**	**60.0**	**63.2**	**61.5**	**0.8%**
Total	**6,242.0**	**6,571.0**	**7,147.2**	**7,027.0**	**7,064.6**	**7,104.2**	**7,203.7**	**7,260.4**	**100.0%**

Note: Emissions from electricity generation are allocated based on aggregate electricity consumption in each end-use sector.
Totals may not sum due to independent rounding.
+ Does not exceed 0.05 Tg CO_2 Eq. or 0.05 percent.
[a] Percent of total emissions for year 2005.
[b] Includes primarily HFC-134a.

Transportation

Transportation activities accounted for 28 percent of U.S. greenhouse gas emissions in 2005. Table 2-17 provides a detailed summary of greenhouse gas emissions from transportation-related activities. Total emissions in Table 2-17 differ slightly from those shown in Table 2-16 primarily because the table below excludes a few minor non-transportation mobile sources, such as construction and industrial equipment.

From 1990 to 2005, transportation emissions rose by 32 percent due, in part, to increased demand for travel and the stagnation of fuel efficiency across the U.S. vehicle fleet. Since the 1970s, the number of highway vehicles registered in the United States has increased faster than the overall population, according to the Federal Highway Administration (FHWA). Likewise, the number of miles driven (up 21 percent from 1990 to 2005) and the gallons of gasoline consumed each year in the United States have increased steadily since the 1980s, according to the FHWA and Energy Information Administration, respectively. These increases in motor vehicle usage are the result of a confluence of factors including population growth, economic growth, urban sprawl, low fuel prices, and increasing popularity of sport utility vehicles and other light-duty trucks that tend to have lower fuel efficiency. A similar set of social and economic trends has led to a significant increase in air travel

Table 2-17: Transportation-Related Greenhouse Gas Emissions (Tg CO_2 Eq.)

Gas/Vehicle Type	1990	1995	2000	2001	2002	2003	2004	2005
CO_2	**1,478.8**	**1,604.6**	**1,799.9**	**1,772.6**	**1,826.7**	**1,824.9**	**1,879.1**	**1,908.1**
Passenger Cars	615.1	599.6	632.0	634.7	649.6	629.1	628.7	614.9
Light-Duty Trucks	314.0	401.6	459.2	462.7	476.6	510.7	533.6	550.3
Other Trucks	227.0	270.9	343.2	343.3	358.1	355.4	368.5	384.6
Buses	8.3	9.0	11.0	10.1	9.7	10.6	14.9	15.1
Aircraft[a]	180.0	174.6	196.4	186.6	178.0	174.7	179.7	186.1
Ships and Boats	46.8	55.4	63.8	43.0	60.6	53.3	61.1	63.7
Locomotives	38.1	42.2	45.1	45.1	44.9	46.6	49.2	50.3
Other[b]	49.6	51.3	49.1	47.2	49.2	44.4	43.5	43.1
International Bunker Fuels[c]	*113.7*	*100.6*	*101.1*	*97.6*	*89.1*	*83.7*	*97.2*	*97.2*
CH_4	**4.5**	**4.1**	**3.2**	**2.9**	**2.8**	**2.6**	**2.5**	**2.3**
Passenger Cars	2.6	2.1	1.6	1.5	1.4	1.3	1.2	1.1
Light-Duty Trucks	1.4	1.4	1.1	1.0	1.0	0.9	0.8	0.8
Other Trucks and Buses	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Aircraft	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Ships and Boats	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Locomotives	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Motorcycles	+	+	+	+	+	+	+	+
International Bunker Fuels[c]	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
N_2O	**42.7**	**52.5**	**52.0**	**48.4**	**45.8**	**42.4**	**39.7**	**36.5**
Passenger Cars	25.4	26.9	24.7	23.2	21.9	20.3	18.8	17.0
Light-Duty Trucks	14.1	22.1	23.3	21.4	20.1	18.3	17.0	15.6
Other Trucks and Buses	0.8	1.0	1.2	1.3	1.3	1.3	1.3	1.2
Aircraft	1.7	1.7	1.9	1.8	1.7	1.7	1.7	1.8
Ships and Boats	0.4	0.4	0.5	0.3	0.5	0.4	0.5	0.5
Locomotives	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Motorcycles	+	+	+	+	+	+	+	+
International Bunker Fuels[c]	*1.0*	*0.9*	*0.9*	*0.9*	*0.8*	*0.8*	*0.9*	*0.9*
HFCs	**+**	**19.2**	**51.6**	**55.8**	**59.4**	**62.5**	**65.6**	**67.1**
Mobile Air Conditioners[d]	+	16.8	41.6	44.9	47.7	50.0	52.2	53.1
Comfort Cooling in Buses and Trains	+	+	0.2	0.2	0.2	0.2	0.3	0.3
Refrigerated Transport	+	2.3	9.8	10.8	11.5	12.3	13.1	13.6
Total	**1,526.1**	**1,680.4**	**1,906.7**	**1,879.7**	**1,934.6**	**1,932.4**	**1,986.9**	**2,014.0**

+ Does not exceed 0.05 Tg CO_2 Eq.
Note: Totals may not sum due to independent rounding.
[a] Aircraft emissions consist of emissions from all jet fuel (less bunker fuels) and aviation gas consumption.
[b] "Other" CO_2 emissions include motorcycles, pipelines, and lubricants.
[c] Emissions from International Bunker Fuels include emissions from both civilian and military activities, but are not included in totals.
[d] Includes primarily HFC-134a.

and freight transportation by both air and road modes during the time series.

Almost all of the energy consumed for transportation was supplied by petroleum-based products, with nearly two-thirds being related to gasoline consumption in automobiles and other highway vehicles. Other fuel uses, especially diesel fuel for freight trucks and jet fuel for aircraft, accounted for the remainder. The primary driver of transportation-related emissions was CO_2 from fossil fuel combustion, which increased by 29 percent from 1990 to 2005. This rise in CO_2 emissions, combined with an increase of 67.1 Tg CO_2 Eq. in HFC emissions over the same period, led to an increase in overall emissions from transportation activities of 32 percent.

2.3. Indirect Greenhouse Gas Emissions (CO, NO_x, NMVOCs, and SO_2)

The reporting requirements of the UNFCCC[7] request that information be provided on indirect greenhouse gases, which include CO, NO_x, NMVOCs, and SO_2. These gases do not have a direct global warming effect, but indirectly affect terrestrial radiation absorption by influencing the formation and destruction of tropospheric and stratospheric ozone, or, in the case of SO_2, by affecting the absorptive characteristics of the atmosphere. Additionally, some of these gases may react with other chemical compounds in the

Box 2-2: Methodology for Aggregating Emissions by Economic Sector

In order to aggregate emissions by economic sector, source category emission estimates were generated according to the methodologies outlined in the appropriate sections of this report. Those emissions were then simply reallocated into economic sectors. In most cases, the IPCC subcategories distinctly fit into an apparent economic sector category. Several exceptions exist, and the methodologies used to disaggregate these subcategories are described below:

- *Agricultural CO_2 Emissions from Fossil Fuel Combustion, and Non-CO_2 Emissions from Stationary and Mobile Combustion.* Emissions from on-farm energy use were accounted for in the Energy chapter as part of the industrial and transportation end-use sectors. To calculate agricultural emissions related to fossil fuel combustion, energy consumption estimates were obtained from economic survey data from the U.S. Department of Agriculture (Duffield 2006) and fuel sales data (EIA 1991 through 2005). To avoid double-counting, emission estimates of CO_2 from fossil fuel combustion and non-CO_2 from stationary and mobile combustion were subtracted from the industrial economic sector, although some of these fuels may have been originally accounted for under the transportation end-use sector.
- *Landfills and Wastewater Treatment.* CH_4 emissions from landfills and CH_4 and N_2O emissions from wastewater treatment were allocated to the commercial sector.
- *Municipal Solid Waste Combustion.* CO_2 and N_2O emissions from waste combustion were allocated completely to the electricity generation sector since nearly all waste combustion occurs in waste-to-energy facilities.
- *Limestone and Dolomite Use.* CO_2 emissions from limestone and dolomite use are allocated to the electricity generation (50 percent) and industrial (50 percent) sectors, because 50 percent of the total emissions for this source are due to flue gas desulfurization.
- *Substitution of Ozone Depleting Substances.* All greenhouse gas emissions resulting from the substitution of ozone depleting substances were placed in the industrial economic sector, with the exception of emissions from domestic, commercial, and mobile and transport refrigeration/air-conditioning systems, which were placed in the residential, commercial, and transportation sectors, respectively. Emissions from non-MDI aerosols were attributed to the residential economic sector.
- *Settlement Soil Fertilization, Forest Soil Fertilization.* Emissions from settlement soil fertilization were allocated to the residential economic sector; forest soil fertilization was allocated to the agriculture economic sector.
- *Forest Fires.* N_2O and CH_4 emissions from forest fires were allocated to the agriculture economic sector.

[7] See <http://unfccc.int/resource/docs/cop8/08.pdf>.

atmosphere to form compounds that are greenhouse gases. Carbon monoxide is produced when carbon-containing fuels are combusted incompletely. Nitrogen oxides (i.e., NO and NO_2) are created by lightning, fires, fossil fuel combustion, and in the stratosphere from N_2O. Non-CH_4 volatile organic compounds—(which include hundreds of organic compounds that participate in atmospheric chemical reactions (i.e., propane, butane, xylene, toluene, ethane, and many others)—are emitted primarily from transportation, industrial processes, and non-industrial consumption of organic solvents. In the United States, SO_2 is primarily emitted from coal combustion for electric power generation and the metals industry. Sulfur-containing compounds emitted into the atmosphere tend to exert a negative radiative forcing (i.e., cooling) and therefore are discussed separately.

One important indirect climate change effect of NMVOCs and NO_x is their role as precursors for tropospheric ozone formation. They can also alter the atmospheric lifetimes of other greenhouse gases. Another example of indirect greenhouse gas formation into greenhouse gases is CO's interaction with the hydroxyl radical—the major atmospheric sink for CH_4 emissions—to form CO_2. Therefore, increased atmospheric concentrations of CO limit the number of hydroxyl molecules (OH) available to destroy CH_4.

Since 1970, the United States has published estimates of annual emissions of CO, NO_x, NMVOCs, and SO_2 (EPA 2005),[8] which are regulated under the Clean Air Act. Table 2-18 shows that fuel combustion accounts for the majority of emissions of these indirect greenhouse gases. Industrial processes—such as the manufacture of chemical and allied products, metals processing, and industrial uses of solvents—are also significant sources of CO, NO_x, and NMVOCs.

Box 2-3: Sources and Effects of Sulfur Dioxide

Sulfur dioxide (SO_2) emitted into the atmosphere through natural and anthropogenic processes affects the earth's radiative budget through its photochemical transformation into sulfate aerosols that can (1) scatter radiation from the sun back to space, thereby reducing the radiation reaching the earth's surface; (2) affect cloud formation; and (3) affect atmospheric chemical composition (e.g., by providing surfaces for heterogeneous chemical reactions). The indirect effect of sulfur-derived aerosols on radiative forcing can be considered in two parts. The first indirect effect is the aerosols' tendency to decrease water droplet size and increase water droplet concentration in the atmosphere. The second indirect effect is the tendency of the reduction in cloud droplet size to affect precipitation by increasing cloud lifetime and thickness. Although still highly uncertain, the radiative forcing estimates from both the first and the second indirect effect are believed to be negative, as is the combined radiative forcing of the two (IPCC 2001). However, because SO_2 is short-lived and unevenly distributed in the atmosphere, its radiative forcing impacts are highly uncertain.

Sulfur dioxide is also a major contributor to the formation of regional haze, which can cause significant increases in acute and chronic respiratory diseases. Once SO_2 is emitted, it is chemically transformed in the atmosphere and returns to the earth as the primary source of acid rain. Because of these harmful effects, the United States has regulated SO_2 emissions in the Clean Air Act.

Electricity generation is the largest anthropogenic source of SO_2 emissions in the United States, accounting for 88 percent in 2005. Coal combustion contributes nearly all of those emissions (approximately 92 percent). Sulfur dioxide emissions have decreased in recent years, primarily as a result of electric power generators switching from high-sulfur to low-sulfur coal and installing flue gas desulfurization equipment.

[8] NO_x and CO emission estimates from field burning of agricultural residues were estimated separately, and therefore not taken from EPA (2005).

Table 2-18: Emissions of NO_x, CO, NMVOCs, and SO_2 (Gg)

Gas/Activity	1990	1995	2000	2001	2002	2003	2004	2005
NO_x	**21,645**	**21,272**	**19,203**	**18,410**	**18,141**	**17,327**	**16,466**	**15,965**
Mobile Fossil Fuel Combustion	10,920	10,622	10,310	9,819	10,319	9,911	9,520	9,145
Stationary Fossil Fuel Combustion	9,883	9,821	8,002	7,667	6,837	6,428	5,952	5,824
Industrial Processes	591	607	626	656	532	533	534	535
Oil and Gas Activities	139	100	111	113	316	317	317	318
Municipal Solid Waste Combustion	82	88	114	114	97	98	98	98
Agricultural Burning	28	29	35	35	33	34	39	39
Solvent Use	1	3	3	3	5	5	5	5
Waste	0	1	2	2	2	2	2	2
CO	**130,581**	**109,157**	**92,897**	**89,333**	**86,796**	**84,370**	**82,073**	**79,811**
Mobile Fossil Fuel Combustion	119,480	97,755	83,680	79,972	77,382	74,756	72,269	69,915
Stationary Fossil Fuel Combustion	5,000	5,383	4,340	4,377	5,224	5,292	5,361	5,431
Industrial Processes	4,125	3,959	2,217	2,339	1,710	1,730	1,751	1,772
Municipal Solid Waste Combustion	978	1,073	1,670	1,672	1,440	1,457	1,475	1,493
Agricultural Burning	691	663	792	774	709	800	879	858
Oil and Gas Activities	302	316	146	147	323	327	331	335
Waste	1	2	8	8	7	7	7	7
Solvent Use	5	5	46	45	1	1	1	1
NMVOCs	**20,930**	**19,520**	**15,228**	**15,048**	**14,968**	**14,672**	**14,391**	**14,123**
Mobile Fossil Fuel Combustion	10,932	8,745	7,230	6,872	6,608	6,302	6,011	5,734
Solvent Use	5,216	5,609	4,384	4,547	3,911	3,916	3,921	3,926
Industrial Processes	2,422	2,642	1,773	1,769	1,811	1,813	1,815	1,818
Stationary Fossil Fuel Combustion	912	973	1,077	1,080	1,733	1,734	1,735	1,736
Oil and Gas Activities	554	582	389	400	546	547	547	548
Municipal Solid Waste Combustion	222	237	257	258	244	244	244	245
Waste	673	731	119	122	116	116	116	116
Agricultural Burning	NA	NA	NA	NA	NA	NA	NA	NA
SO_2	**20,935**	**16,891**	**14,829**	**14,452**	**13,541**	**13,648**	**13,328**	**13,271**
Stationary Fossil Fuel Combustion	18,407	14,724	12,848	12,461	11,852	12,002	11,721	11,698
Industrial Processes	1,307	1,117	1,031	1,047	752	759	766	774
Mobile Fossil Fuel Combustion	793	672	632	624	681	628	579	535
Oil and Gas Activities	390	335	286	289	233	235	238	240
Municipal Solid Waste Combustion	38	42	29	30	23	23	23	23
Waste	0	1	1	1	1	1	1	1
Solvent Use	0	1	1	1	0	0	0	0
Agricultural Burning	NA	NA	NA	NA	NA	NA	NA	NA

Source: (EPA 2005) except for estimates from field burning of agricultural residues.
NA (Not Available)
Note: Totals may not sum due to independent rounding.

DRAFT California Greenhouse Gas Inventory (millions of metric tonnes of CO2 equivalent) — By IPCC Category

Last Updated: 8/22/2007 12:40:14 PM

Categories Included in the Inventory.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1 - ENERGY	**394.88**	**386.31**	**389.08**	**381.24**	**402.81**	**381.91**	**388.49**	**401.19**	**418.86**	**424.99**	**426.67**	**437.56**	**429.15**	**413.01**	**437.11**
1A - Fuel Combustion Activities	**391.56**	**383.11**	**386.24**	**378.22**	**399.87**	**379.08**	**385.60**	**398.36**	**416.10**	**422.24**	**423.93**	**434.74**	**426.35**	**410.18**	**434.23**
1A1 - Energy Industries	**146.86**	**146.94**	**150.43**	**146.09**	**159.28**	**140.45**	**148.31**	**158.28**	**162.66**	**162.66**	**157.62**	**171.77**	**154.50**	**156.23**	**170.56**
1A1a - Main Activity Electricity and Heat Production	107.243	106.150	111.463	104.589	118.576	102.516	104.738	110.616	115.770	120.734	112.187	123.802	109.723	114.104	124.934
1A1ai - Electricity Generation	82.121	81.339	84.987	77.867	91.039	74.628	75.914	81.435	93.626	99.096	90.895	102.775	86.184	92.745	100.095
1A1aii - Combined Heat and Power Generation (CHP)	25.122	24.811	26.475	26.722	27.537	27.888	28.824	29.181	22.144	21.638	21.291	21.027	23.539	21.359	24.838
1A1b - Petroleum Refining	28.187	28.646	28.518	31.676	31.333	26.185	31.462	30.995	29.176	26.207	29.275	31.013	30.530	26.027	30.148
1A1c - Manufacture of Solid Fuels and Other Energy Industries	11.433	12.139	10.447	9.824	9.367	11.754	12.106	16.673	17.710	15.718	16.155	16.957	14.249	16.094	15.478
1A1cii - Other Energy Industries	11.433	12.139	10.447	9.824	9.367	11.754	12.106	16.673	17.710	15.718	16.155	16.957	14.249	16.094	15.478
1A2 - Manufacturing Industries and Construction	**24.51**	**21.73**	**19.85**	**19.49**	**21.10**	**21.36**	**19.74**	**20.32**	**21.88**	**22.34**	**24.14**	**25.89**	**22.38**	**18.89**	**19.20**
1A2c - Chemicals	0.963	0.859	0.661	0.530	0.616	0.606	0.634	0.538	0.717	0.577	0.704	0.582	1.082	0.638	0.660
1A2d - Pulp, Paper and Print	1.918	1.655	1.161	1.284	1.691	1.735	1.995	1.636	1.944	1.551	1.742	1.629	1.100	1.098	1.086
1A2e - Food Processing, Beverages and Tobacco	3.076	3.272	3.238	3.287	3.274	3.179	3.129	3.163	3.590	3.770	3.743	3.194	3.497	3.172	3.365
1A2f - Non-Metallic Minerals	4.786	4.378	4.041	4.306	4.798	5.361	4.968	5.017	4.897	5.358	5.468	5.064	5.294	5.108	5.201
1A2g - Transport Equipment	0.534	0.533	0.530	0.514	0.517	0.478	0.435	0.448	0.482	0.515	0.504	0.441	0.408	0.282	0.252
1A2h - Machinery	1.336	1.246	1.172	1.174	1.150	1.168	1.200	1.239	1.303	1.305	1.254	1.108	1.155	0.990	1.058
1A2i - Mining (excluding fuels) and Quarrying	0.028	0.031	0.041	0.036	0.038	0.311	0.345	0.327	0.398	0.324	0.333	0.298	0.400	0.414	0.128
1A2j - Wood and Wood Products	0.236	0.219	0.233	0.255	0.263	0.399	0.351	0.307	0.309	0.305	0.304	0.325	0.159	0.133	0.106
1A2k - Construction	0.667	0.653	0.628	0.635	0.638	0.636	0.642	0.657	0.676	0.652	0.644	0.577	0.602	0.619	0.758
1A2l - Textile and Leather	0.379	0.350	0.355	0.391	0.430	0.435	0.451	0.481	0.510	0.565	0.574	0.464	0.561	0.544	0.549
1A2m - Non-specified Industry.	9.645	7.638	7.038	6.311	6.827	6.256	4.768	5.654	6.181	6.531	7.952	11.449	7.447	5.213	5.570
1A3 - Transport	**170.57**	**165.90**	**170.80**	**167.48**	**172.49**	**174.20**	**174.22**	**175.98**	**178.89**	**181.57**	**186.89**	**188.25**	**195.93**	**186.46**	**194.58**
1A3a - Civil Aviation	24.488	23.255	22.367	22.912	25.294	24.396	26.517	26.382	26.875	25.251	26.338	24.819	26.185	21.237	22.513
1A3aii - Domestic Aviation	24.470	23.236	22.353	22.899	25.280	24.386	26.507	26.372	26.845	25.238	26.296	24.810	26.122	21.174	22.449
1A3b - Road Transportation	139.808	136.313	143.211	141.079	142.215	144.753	142.907	144.973	147.643	151.938	155.357	158.158	164.417	161.073	166.747
1A3bi - Cars	0.471	0.449	0.393	0.384	0.373	0.359	0.322	0.310	0.300	0.287	0.282	0.260	0.232	0.209	0.195
1A3bii - Light-duty Trucks	0.297	0.285	0.245	0.242	0.235	0.227	0.205	0.198	0.196	0.189	0.184	0.172	0.153	0.147	0.139
1A3biii - Heavy-duty Trucks and Buses	0.222	0.200	0.152	0.147	0.138	0.133	0.122	0.116	0.113	0.110	0.104	0.105	0.101	0.105	0.100
1A3biv - Motorcycles	0.019	0.019	0.012	0.011	0.010	0.010	0.009	0.007	0.006	0.006	0.006	0.008	0.009	0.014	0.015
1A3c - Railways	2.334	2.465	2.239	1.972	2.133	2.431	2.596	2.570	2.702	2.801	3.071	2.903	3.044	2.787	3.192
1A3d - Water-borne Navigation	1.598	1.770	1.161	0.867	1.323	1.087	1.046	1.691	1.234	1.351	1.643	1.496	1.463	0.649	1.304
1A3dii - Domestic Water-borne Navigation	1.598	1.770	1.161	0.867	1.323	1.087	1.046	1.691	1.234	1.351	1.643	1.496	1.463	0.649	1.304
1A4 - Other Sectors	**48.22**	**47.76**	**44.44**	**44.42**	**46.18**	**42.35**	**42.62**	**43.14**	**52.28**	**54.76**	**54.27**	**47.93**	**47.99**	**45.98**	**47.68**
1A4a - Commercial/Institutional	14.030	13.612	11.484	11.115	11.756	11.249	11.168	11.333	16.452	16.865	17.940	14.929	15.264	14.979	14.469
1A4b - Residential	29.684	30.282	28.623	29.103	29.940	27.365	27.315	26.836	31.098	32.434	30.772	27.670	27.829	26.897	28.369
1A4c - Agriculture/Forestry/Fishing/Fish Farms	4.509	3.864	4.335	4.200	4.483	3.738	4.135	4.966	4.727	5.456	5.563	5.328	4.897	4.101	4.844
1A5 - Non-Specified	**1.39**	**0.79**	**0.71**	**0.75**	**0.83**	**0.73**	**0.71**	**0.64**	**0.40**	**0.91**	**1.01**	**0.89**	**5.55**	**2.63**	**2.21**
1B - Fugitive Emissions from Fuels	**3.32**	**3.20**	**2.85**	**3.02**	**2.94**	**2.83**	**2.90**	**2.83**	**2.76**	**2.76**	**2.74**	**2.83**	**2.81**	**2.83**	**2.88**
1B2 - Oil and Natural Gas	**2.94**	**2.82**	**2.47**	**2.64**	**2.59**	**2.53**	**2.58**	**2.51**	**2.43**	**2.42**	**2.42**	**2.52**	**2.48**	**2.50**	**2.54**
1B2a - Oil	0.139	0.078	0.072	0.067	0.067	0.071	0.055	0.044	0.045	0.058	0.053	0.025	0.029	0.029	0.029
1B2aiii - All Other	0.139	0.078	0.072	0.067	0.067	0.071	0.055	0.044	0.045	0.058	0.053	0.025	0.029	0.029	0.029
1B2b - Natural Gas	1.505	1.481	1.454	1.438	1.420	1.396	1.354	1.319	1.284	1.255	1.263	1.288	1.304	1.330	1.354
1B3 - Other Emissions from Energy Production	**0.37**	**0.38**	**0.38**	**0.38**	**0.35**	**0.29**	**0.32**	**0.33**	**0.33**	**0.34**	**0.32**	**0.31**	**0.33**	**0.33**	**0.33**
2 - INDUSTRIAL PROCESSES AND PRODUCT USE	**17.36**	**15.94**	**15.82**	**15.80**	**17.83**	**18.98**	**22.04**	**23.17**	**24.93**	**25.60**	**26.02**	**25.25**	**25.98**	**30.30**	**27.65**
2A - Mineral Industry	**5.33**	**4.91**	**4.68**	**4.33**	**4.91**	**4.98**	**5.13**	**5.27**	**5.33**	**5.68**	**5.67**	**5.43**	**5.96**	**6.01**	**6.17**
2A1 - Cement Production	**5.10**	**4.70**	**4.49**	**4.18**	**4.76**	**4.81**	**4.97**	**5.12**	**5.19**	**5.55**	**5.53**	**5.29**	**5.83**	**5.88**	**6.04**

DRAFT California Greenhouse Gas Inventory (millions of metric tonnes of CO2 equivalent) — By IPCC Category

Last Updated: 8/22/2007 12:40:14 PM

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
2A2 - Lime Production	**0.23**	**0.21**	**0.19**	**0.14**	**0.15**	**0.17**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**
2B - Chemical Industry	**3.95**	**3.55**	**3.47**	**3.38**	**3.60**	**3.52**	**3.46**	**3.48**	**3.64**	**3.40**	**3.47**	**2.88**	**3.08**	**3.05**	**3.11**
2B2 - Nitric Acid Production	**2.14**	**2.15**	**2.22**	**2.24**	**2.36**	**2.38**	**2.48**	**2.55**	**2.53**	**2.45**	**2.36**	**1.93**	**2.09**	**2.04**	**2.03**
2D - Non-Energy Products from Fuels and Solvent Use	**2.29**	**1.92**	**2.03**	**2.04**	**1.90**	**1.78**	**1.58**	**1.63**	**1.92**	**2.18**	**1.85**	**1.64**	**1.78**	**1.56**	**1.37**
2D1 - Lubricant Use	**1.13**	**1.01**	**1.03**	**1.05**	**1.10**	**1.08**	**1.05**	**1.11**	**1.16**	**1.17**	**1.15**	**1.06**	**1.04**	**0.96**	**0.98**
2D2 - Paraffin Wax Use	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2D4 - Other (please specify)	**1.16**	**0.91**	**1.00**	**0.99**	**0.80**	**0.70**	**0.53**	**0.52**	**0.76**	**1.01**	**0.70**	**0.58**	**0.74**	**0.59**	**0.39**
2E - Electronics Industry	**0.59**	**0.59**	**0.59**	**0.74**	**0.82**	**1.02**	**1.12**	**1.29**	**1.43**	**1.43**	**1.23**	**0.86**	**0.83**	**0.81**	**0.88**
2F - Product Uses as Substitutes for Ozone Depleting Substances	**0.04**	**0.07**	**0.35**	**0.92**	**1.82**	**3.86**	**5.38**	**6.91**	**7.92**	**8.89**	**9.75**	**10.73**	**11.78**	**12.87**	**13.98**
2G - Other Product Manufacture and Use	**3.04**	**2.78**	**2.57**	**2.82**	**2.62**	**2.25**	**2.48**	**2.27**	**1.88**	**1.89**	**1.76**	**1.67**	**1.66**	**1.58**	**1.61**
2G1 - Electrical Equipment	**2.43**	**2.21**	**2.02**	**2.27**	**2.03**	**1.60**	**1.82**	**1.65**	**1.26**	**1.23**	**1.17**	**1.14**	**1.06**	**1.03**	**1.03**
2G1b - Use of Electrical Equipment	2.429	2.209	2.018	2.267	2.029	1.600	1.819	1.649	1.257	1.234	1.169	1.142	1.059	1.035	1.029
2G4 - Other (Please specify)	**0.61**	**0.58**	**0.56**	**0.56**	**0.59**	**0.65**	**0.66**	**0.62**	**0.62**	**0.66**	**0.60**	**0.53**	**0.60**	**0.54**	**0.58**
2H - Other	**2.12**	**2.12**	**2.12**	**1.58**	**2.17**	**1.56**	**2.89**	**2.32**	**2.80**	**2.13**	**2.28**	**2.05**	**0.89**	**4.43**	**0.53**
2H3 - Other (please specify)	**2.12**	**2.12**	**2.12**	**1.58**	**2.17**	**1.56**	**2.89**	**2.32**	**2.80**	**2.13**	**2.28**	**2.05**	**0.89**	**4.43**	**0.53**
3 - AGRICULTURE, FORESTRY, AND OTHER LAND USE	**22.17**	**20.94**	**21.40**	**21.50**	**21.83**	**23.36**	**22.35**	**21.94**	**21.89**	**22.91**	**24.23**	**24.03**	**27.39**	**27.59**	**27.45**
3A - Livestock	**11.67**	**11.56**	**11.75**	**11.21**	**11.80**	**12.14**	**11.36**	**11.89**	**11.78**	**12.56**	**12.80**	**13.28**	**13.73**	**14.06**	**13.92**
3A1 - Enteric Fermentation	**6.67**	**6.47**	**6.57**	**6.22**	**6.49**	**6.58**	**6.15**	**6.30**	**6.29**	**6.60**	**6.68**	**6.80**	**6.99**	**7.08**	**7.01**
3A1a - Cattle	6.250	6.051	6.147	5.819	6.051	6.157	5.737	5.895	5.898	6.203	6.282	6.402	6.597	6.691	6.637
3A1ai - Dairy Cows	3.632	3.716	3.823	3.546	3.812	3.871	3.554	3.754	3.779	4.050	4.204	4.364	4.566	4.662	4.685
3A1aii - Other Cattle	2.618	2.335	2.324	2.273	2.240	2.286	2.182	2.141	2.119	2.153	2.078	2.038	2.031	2.030	1.952
3A1c - Sheep	0.168	0.171	0.167	0.150	0.181	0.171	0.155	0.148	0.134	0.139	0.136	0.135	0.127	0.123	0.114
3A1d - Goats	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.007	0.008	0.009	0.010	0.011	0.011	0.011
3A1f - Horses	0.240	0.241	0.242	0.243	0.242	0.243	0.244	0.244	0.245	0.248	0.248	0.248	0.248	0.248	0.248
3A1h - Swine	0.006	0.007	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.005	0.003	0.005	0.004	0.004
3A2 - Manure Management	**5.00**	**5.09**	**5.18**	**4.99**	**5.31**	**5.56**	**5.21**	**5.59**	**5.49**	**5.96**	**6.12**	**6.49**	**6.74**	**6.98**	**6.91**
3A2a - Cattle	4.683	4.767	4.856	4.679	5.002	5.258	4.932	5.302	5.237	5.704	5.886	6.266	6.515	6.763	6.703
3A2ai - Dairy Cows	4.359	4.482	4.595	4.395	4.752	4.990	4.701	5.056	4.984	5.443	5.618	5.979	6.219	6.462	6.405
3A2aii - Other Cattle	0.324	0.285	0.261	0.284	0.250	0.268	0.231	0.246	0.253	0.261	0.268	0.287	0.295	0.302	0.298
3A2c - Sheep	0.018	0.019	0.018	0.017	0.020	0.019	0.017	0.016	0.015	0.015	0.015	0.015	0.014	0.013	0.013
3A2d - Goats	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
3A2f - Horses	0.035	0.035	0.035	0.035	0.035	0.027	0.027	0.027	0.028	0.027	0.021	0.022	0.022	0.022	0.022
3A2h - Swine	0.068	0.076	0.095	0.092	0.091	0.090	0.079	0.079	0.071	0.067	0.053	0.040	0.055	0.052	0.052
3A2i - Poultry	0.195	0.190	0.179	0.164	0.165	0.162	0.160	0.163	0.140	0.146	0.143	0.142	0.137	0.129	0.116
3B - Land	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**
3B1 - Forest Land	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**
3C - Aggregate Sources and Non-CO2 Emissions Sources on Land	**10.31**	**9.19**	**9.45**	**10.10**	**9.84**	**11.04**	**10.80**	**9.86**	**9.92**	**10.16**	**11.25**	**10.56**	**13.47**	**13.35**	**13.34**
3C1 - Emissions from Biomass Burning	**0.31**	**0.27**	**0.30**	**0.31**	**0.33**	**0.32**	**0.34**	**0.33**	**0.33**	**0.30**	**0.31**	**0.28**	**0.29**	**0.31**	**0.30**
3C1b - Biomass Burning in Croplands	0.312	0.267	0.303	0.311	0.325	0.320	0.341	0.333	0.328	0.297	0.308	0.281	0.293	0.312	0.298
3C2 - Liming	**0.07**	**0.10**	**0.11**	**0.07**	**0.16**	**0.27**	**0.27**	**0.35**	**0.25**	**0.30**	**0.27**	**0.16**	**0.23**	**0.24**	**0.24**
3C4 - Direct N2O Emissions from Managed Soils	**6.07**	**5.42**	**5.47**	**5.81**	**5.62**	**6.17**	**6.00**	**5.39**	**5.50**	**5.62**	**6.18**	**5.88**	**7.57**	**7.46**	**7.40**
3C5 - Indirect N2O Emissions from Managed Soils	**3.45**	**3.04**	**3.16**	**3.46**	**3.24**	**3.79**	**3.68**	**3.26**	**3.36**	**3.42**	**3.92**	**3.75**	**4.83**	**4.81**	**4.79**
3C7 - Rice Cultivations	**0.41**	**0.36**	**0.41**	**0.45**	**0.50**	**0.48**	**0.52**	**0.54**	**0.47**	**0.52**	**0.57**	**0.49**	**0.55**	**0.53**	**0.61**

DRAFT California Greenhouse Gas Inventory (millions of metric tonnes of CO2 equivalent) — By IPCC Category

Last Updated: 8/22/2007 12:40:14 PM

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
4 - WASTE	7.41	7.15	7.42	7.43	7.46	7.01	6.90	6.86	7.07	7.05	6.82	6.91	6.79	6.87	6.88
4A - Solid Waste Disposal	6.58	6.29	6.54	6.54	6.55	6.10	5.98	5.92	6.12	6.06	5.82	5.89	5.78	5.83	5.83
4A1 - Managed Waste Disposal Sites	6.58	6.29	6.54	6.54	6.55	6.10	5.98	5.92	6.12	6.06	5.82	5.89	5.78	5.83	5.83
4D - Wastewater Treatment and Discharge	0.83	0.86	0.87	0.89	0.91	0.91	0.92	0.94	0.95	0.99	1.00	1.02	1.01	1.04	1.05
4D1 - Domestic Wastewater Treatment and Discharge	0.83	0.86	0.87	0.89	0.91	0.91	0.92	0.94	0.95	0.99	1.00	1.02	1.01	1.03	1.05
4D2 - Industrial Wastewater Treatment and Discharge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Summary of Categories Included in the Inventory.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gross California Emissions	441.81	430.34	433.72	425.97	449.95	431.26	439.79	453.15	472.75	480.54	483.74	493.76	489.31	477.77	499.08
Sinks and Sequestrations	-5.62	-5.43	-3.97	-5.99	-4.51	-4.18	-3.94	-3.76	-1.63	-4.55	-3.96	-1.38	-4.17	-2.39	-2.14
Net California Emissions	436.19	424.91	429.75	419.98	445.44	427.08	435.85	449.39	471.12	475.99	479.78	492.39	485.15	475.39	496.95

DRAFT California Greenhouse Gas Inventory (millions of metric tonnes of CO2 equivalent) — By IPCC Category

Last Updated: 8/22/2007 12:40:14 PM

Categories Excluded from the Inventory.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1 - ENERGY	**40.25**	**34.89**	**28.16**	**28.09**	**32.57**	**36.00**	**35.53**	**27.06**	**26.86**	**30.42**	**33.98**	**31.94**	**31.95**	**24.55**	**26.56**
1A - Fuel Combustion Activities	**40.25**	**34.89**	**28.16**	**28.09**	**32.57**	**36.00**	**35.53**	**27.06**	**26.86**	**30.42**	**33.98**	**31.94**	**31.95**	**24.55**	**26.56**
1A3 - Transport	**40.25**	**34.89**	**28.16**	**28.09**	**32.57**	**36.00**	**35.53**	**27.06**	**26.86**	**30.42**	**33.98**	**31.94**	**31.95**	**24.55**	**26.56**
1A3a - Civil Aviation	14.597	13.852	13.324	13.707	15.156	14.611	15.905	15.809	16.152	15.124	15.787	14.900	15.681	12.680	13.483
1A3ai - International Aviation (International Bunkers)	14.597	13.852	13.324	13.707	15.156	14.611	15.905	15.809	16.152	15.124	15.787	14.900	15.681	12.680	13.483
1A3d - Water-borne Navigation	25.649	21.038	14.839	14.380	17.412	21.386	19.629	11.251	10.709	15.292	18.196	17.043	16.272	11.870	13.080
1A3di - International Water-borne Navigation (International Bunkers)	25.649	21.038	14.839	14.380	17.412	21.386	19.629	11.251	10.709	15.292	18.196	17.043	16.272	11.870	13.080

Summary of Categories Excluded from the Inventory.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gross California Emissions	**40.25**	**34.89**	**28.16**	**28.09**	**32.57**	**36.00**	**35.53**	**27.06**	**26.86**	**30.42**	**33.98**	**31.94**	**31.95**	**24.55**	**26.56**
Net California Emissions	**40.25**	**34.89**	**28.16**	**28.09**	**32.57**	**36.00**	**35.53**	**27.06**	**26.86**	**30.42**	**33.98**	**31.94**	**31.95**	**24.55**	**26.56**

CALIFORNIA
ENERGY
COMMISSION

INVENTORY OF CALIFORNIA GREENHOUSE GAS EMISSIONS AND SINKS: 1990 TO 2004

STAFF FINAL REPORT

December 2006
CEC-600-2006-013-SF

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ABSTRACT

This report provides estimates of California's greenhouse gas emissions over the 1990 to 2004 time period. Emissions estimates in the report are derived from data provided by the U.S. Energy Information Administration and additional data collected by the California Energy Commission. Analysis in the report uses protocols established for country-level greenhouse gas emissions inventory reporting as established by the Intergovernmental Panel on Climate Change and the U. S. Environmental Protection Agency. The report includes both in-state emissions and emissions from electricity imported into California. These emissions and emissions from international fuel uses are shown at the bottom of the inventory to allow the reader to decide whether to include them.

California's greenhouse gas emissions are large in a world-scale context and growing over time. If California was considered to be an independent country, its emissions would rank seventeenth largest.

This report also includes projections of California greenhouse gas emissions to 2020. These projections are based upon forecasts adopted by the Energy Commission in its *2005 Integrated Energy Policy Report*. This report also includes an estimate of reductions needed to meet 2010 and 2020 greenhouse gas emissions reduction targets established by California's Governor, Arnold Schwarzenegger.

KEYWORDS

Greenhouse gas emissions inventory, climate change, carbon dioxide, methane, nitrous oxide, high global-warming potential gases

TABLE OF CONTENTS

EXECUTIVE SUMMARY i

INTRODUCTION 1

EARLY CALIFORNIA GHG INVENTORIES 2
LEGISLATIVE REQUIREMENTS FOR INVENTORY UPDATES 4
SUMMARY OF CALIFORNIA'S 2004 GHG EMISSIONS 5
Composition of California's GHG Emissions 5
End-Use Sectors Contributing to California's GHG Emissions 7
HISTORICAL GHG EMISSIONS TRENDS 8
Trends in California GHG Composition 9
Trends in California's GHG Emissions End-Use Categories 9
GHG Emissions Intensity Trends 12
California's GHG Emissions In a World-Scale Context 17
Future GHG Emissions Trends 22
CURRENT GHG EMISSIONS INVENTORY COMPARED TO CALIFORNIA CLIMATE ACTION TEAM REPORT VALUES 23

GHG INVENTORY UPDATE 24

FUTURE GHG INVENTORY IMPROVEMENTS 27

GWP WEIGHTING FACTORS FOR NON-CO_2 GASES 27
DATA IMPROVEMENTS OR REFINEMENTS 27

APPENDIX A--DETAILED DOCUMENTATION OF CALIFORNIA GREENHOUSE GAS EMISSIONS 33

CALCULATION METHODOLOGY 35

CO_2 EMISSIONS 35
CO_2 Emissions from Fossil Fuel Combustion 35
CO_2 Emissions from Non-Fossil Fuel Emissions Sources 42
METHANE EMISSIONS 48
NITROUS OXIDE EMISSIONS 54
HIGH GWP GAS EMISSIONS 57

APPENDIX B--FUEL USED IN CALIFORNIA (TRILLION BTUS) 69

APPENDIX C--DISCUSSION OF ALTERNATIVE METHODS OF ESTIMATING CO_2 EMISSIONS FROM ELECTRICITY IMPORTED TO CALIFORNIA 75

INTRODUCTION 77
CURRENT GHG INVENTORY 77
JOSEPH LOYER METHOD 77
1990-1999 INVENTORY METHOD 78
SUMMARY OF OPTIONS TO ESTIMATE CO_2 EMISSIONS FROM ELECTRIC IMPORTS 78

APPENDIX D--DIFFERENCES BETWEEN CURRENT INVENTORY AND JUNE 2005 INVENTORY 81

INTRODUCTION 83
NATURAL GAS COMBUSTION CO_2 EMISSIONS 83
Residential 83
Commercial 83
Industrial 83
Electricity Generation 84

Non-Sector Specific *84*
COAL COMBUSTION CO_2 EMISSIONS 84
Electricity Generation *84*
NON-FOSSIL FUEL CO_2 EMISSIONS 84
Agricultural Soils; Woody Crops *84*
METHANE EMISSIONS 85
Petroleum & Natural Gas Supply System *85*
Natural Gas Supply System (Gas Transmission Subcategory) *85*
Landfills *85*
Enteric Fermentation *85*
Manure Management *85*
N_2O EMISSIONS 85
Agricultural Soil Management (Direct Fertilizers and Indirect Fertilizers & Crop Residues) *85*
HIGH GWP EMISSIONS 86

APPENDIX E--METHANE SPECIATION PROFILE PROVIDED BY CALIFORNIA AIR RESOURCES BOARD 91

APPENDIX F--COMPARING THE CURRENT 1990 TO 2004 GHG EMISSIONS INVENTORY AND 2005 INTEGRATED ENERGY POLICY REPORT TO CORRESPOINDING VALUES USED BY THE CALIFORNIA CLIMATE ACTION TEAM..... 95

INTRODUCTION 97
PROJECTIONS BASED UPON *2003 IEPR* 97
PROJECTIONS BASED UPON *2005 IEPR* 98

APPENDIX G--CHANGES AFTER THE NOVEMBER 30, 2006 WORKSHOP..... 105

SUBMITTED COMMENTS AND REPLIES 107
Steven Brink, California Forestry Association *107*
Bud Hoekstra, BerryBlest Organic Farm *107*
David Coale, Palo Alto/Stanford Green Ribbon Task Force *107*
Randy S. Howard, Los Angeles Department of Water and Power *108*
ERRATA 108

Endnotes number 10 & 55 were updated from a draft report on the California Energy Balance to the final report. The bibliography was also updated.BIBLIOGRAPHY ... 108

BIBLIOGRAPHY 109

ENDNOTES..... 111

EXECUTIVE SUMMARY

This report updates California's statewide inventory of greenhouse gas (GHG) emissions to support evaluation of state policies that address climate change and climate variability or more commonly known as global warming. Information in this report extends the inventory period through 2004, which is the most recent year that data are available from the California Energy Commission (Energy Commission) or the United States Department of Energy's (DOE's) Energy Information Administration. This inventory reports GHG emissions from out-of-state electricity used in California along with in-state generation GHG emissions and estimates future emissions trends using fuel demand and other forecast data from the Energy Commission's *2005 Integrated Energy Policy Report*.

California's economy experienced the second largest percentage growth in terms of gross state product (in dollars, not adjusted for inflation) of any state in the country from 1990 to 2003.[1] During that period, California's GSP grew 83 percent while its GHG emissions grew more slowly at 12 percent. This demonstrates the potential for uncoupling economic trends from GHG emissions trends.

Nonetheless, California's GHG emissions are large and growing. As the second largest emitter of GHG emissions in the United States and twelfth to sixteenth largest in the world,[2] the state contributes a significant quantity of GHGs to the atmosphere.

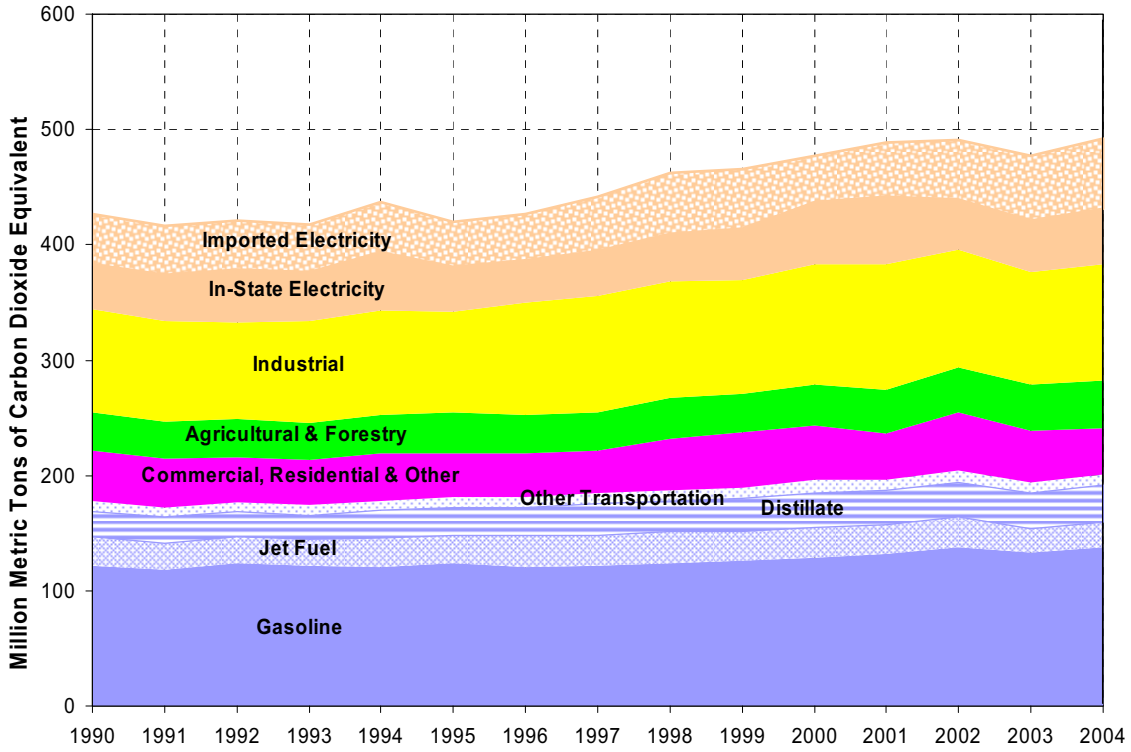
California's ability to slow the rate of growth of GHG emissions is largely due to the success of its energy efficiency and renewable energy programs and a commitment to clean air and clean energy. In fact, the state's programs and commitments lowered its GHG emissions rate of growth by more than half of what it would have been otherwise.[3] Moreover, California's energy programs and policies have had multiple benefits that include not only reducing GHG emissions, but reducing energy demand and improving air quality and public health.

Although California's total GHG emissions are larger than every state but Texas, California has relatively low carbon emission intensity. In 2001, California ranked fourth lowest of the 50 states in carbon dioxide emissions per capita from fossil fuel combustion and fifth lowest of the 50 states in carbon dioxide emissions from fossil fuel combustion per unit of gross state product. Emission trends per unit of gross state product are encouraging; most states have reduced their emissions per unit of gross state product over the 1990 to 2001 period.

In 2004, California produced 492 million gross metric tons of carbon dioxide-equivalent[4] GHG emissions, including imported electricity and excluding combustion of international fuels and carbon sinks or storage.

Figure 1 shows year-by-year trends in GHG emissions for the major energy sectors. Values differ yearly due to changes in fuel uses, meteorological variations, and other factors.

Figure 1 -- California's Gross GHG Emissions Trends



Source: California Energy Commission

The transportation sector is the single largest category of California's GHG emissions, producing 41 percent of the state's total emissions in 2004. Most of California's emissions, 81 percent, are carbon dioxide produced from fossil fuel combustion.

This California GHG emissions inventory excludes all international fuel uses, reporting them separately. Including these international emissions would increase total emissions by 27 to 40 million metric tons of carbon dioxide–equivalent GHG emissions, depending on the year.

Electricity generation is the second largest category of GHG emissions (behind transportation). In particular, out-of-state electricity generation has higher carbon intensity than in-state generation. While imported electricity is a relatively small

share of California's electricity mix (ranging from 22 to 32 percent of total electrical energy used), out-of-state electricity generation sources contribute 39 to 57 percent of the GHG emissions associated with electricity consumption in California. Electricity imported to California from the Southwest has a significant percentage that is coal-based generation, while imports from the Pacific Northwest have a significant portion that is hydroelectricity.

Because GHGs affect the entire planet, not just the location where they are emitted, policies developed to address climate change should include an evaluation of emissions from the entire fuel cycle whenever possible.

Staff recommends the following steps to further improve the accuracy and utility of the California GHG emissions inventory:

- Update fuel use and other emissions-related activity data.

- Perform a more detailed review of industrial uses of fossil fuels to classify when they are used as fuel versus when they are used as a process input and not released into the atmosphere at that step in their usage chain.

- Add industrial wastewater emissions. These occur from processing fruits and vegetables, red meat and poultry, and pulp and paper. Methane and nitrous oxide emissions from these activities are not yet included in this inventory and should be added since California is a major producer of these products.

- Study in more detail landfill methane emissions. Values in this inventory represent a facility-by-facility review of emissions by local air quality district staff; as of July 2006, local air quality districts are updating their data but have yet to finish this work. Also, landfill emissions are being studied by the Energy Commission's Public Interest Energy Research Program but results are not expected before 2008. Improved data for landfill emissions are expected to result from both of these efforts.

- Develop California-specific data for sulfur hexafluoride emissions from electric utilities for the 1990-to-present time period.

- Develop California-specific emission factors for methane and nitrous oxide from enteric fermentation and manure management.

The U.S. Inventory of Greenhouse Gas Emissions and Sinks: Fast Facts

U.S. Greenhouse Gas Emissions and Sinks (Tg CO_2 Equivalents)

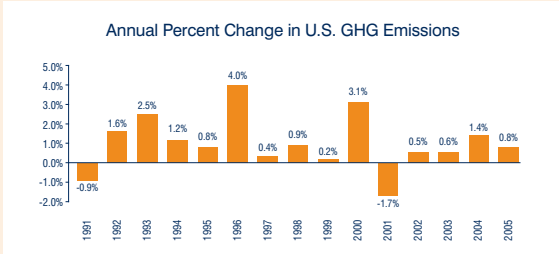
Gas/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Change from 1990 to 2005: Absolute	Change from 1990 to 2005: Percent
CO_2	**5,061.6**	**5,016.2**	**5,111.3**	**5,240.3**	**5,333.5**	**5,384.6**	**5,566.8**	**5,640.6**	**5,678.5**	**5,754.8**	**5,940.0**	**5,843.0**	**5,892.7**	**5,952.5**	**6,064.3**	**6,089.5**	**1,027.9**	**20.3%**
Fossil Fuel Combustion	4,724.1	4,682.9	4,786.3	4,912.9	4,986.7	5,030.0	5,218.1	5,277.5	5,306.3	5,377.9	5,584.9	5,511.7	5,557.2	5,624.5	5,713.0	5,751.2	1,027.1	21.7%
Non-Energy Use of Fuels	117.3	123.5	116.5	119.5	130.9	133.2	132.7	140.5	153.5	161.2	141.0	131.4	135.3	131.3	150.2	142.4	25.1	21.4%
Cement Manufacture	33.3	32.5	32.8	34.6	36.1	36.8	37.1	38.3	39.2	40.0	41.2	41.4	42.9	43.1	45.6	45.9	12.6	38.0%
Iron and Steel Production	84.9	75.9	73.4	69.0	73.2	73.3	67.4	71.7	67.4	63.5	65.1	57.9	54.6	53.4	51.3	45.2	(39.7)	(46.7)%
Natural Gas Systems	33.7	32.8	32.2	33.4	33.5	33.8	31.5	31.3	29.3	30.3	29.4	28.8	29.6	28.4	28.2	28.2	(5.5)	(16.4)%
Municipal Solid Waste Combustion	10.9	12.5	12.6	13.4	14.0	15.7	17.0	17.6	17.0	17.5	17.9	18.3	18.5	19.5	20.1	20.9	10.0	91.0%
Ammonia Manufacture and Urea Application	19.3	19.2	20.0	20.4	21.1	20.5	20.3	20.7	21.9	20.6	19.6	16.7	17.8	16.2	16.9	16.3	(3.0)	(15.5)%
Lime Manufacture	11.3	11.1	11.4	11.7	12.1	12.8	13.5	13.7	14.0	13.5	13.3	12.9	12.3	13.0	13.7	13.7	2.4	21.2%
Limestone and Dolomite Use	5.5	5.0	4.9	4.9	5.5	7.4	7.8	7.2	7.4	8.1	6.0	5.7	5.9	4.7	6.7	7.4	1.9	33.7%
Soda Ash Manufacture and Consumption	4.1	4.0	4.1	4.0	4.0	4.3	4.2	4.4	4.3	4.2	4.2	4.1	4.1	4.1	4.2	4.2	0.1	2.1%
Aluminum Production	6.8	6.9	6.8	6.2	5.5	5.7	6.0	6.0	6.2	6.3	6.1	4.4	4.5	4.5	4.2	4.2	(2.6)	(38.4)%
Petrochemical Production	2.2	2.3	2.4	2.6	2.7	2.8	2.8	2.9	3.0	3.1	3.0	2.8	2.9	2.8	2.9	2.9	0.7	30.5%
Titanium Dioxide Production	1.3	1.3	1.5	1.6	1.7	1.7	1.7	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.3	1.9	0.6	46.9%
Ferroalloy Production	2.2	1.9	2.0	1.9	2.0	2.0	2.1	2.2	2.2	2.2	1.9	1.5	1.3	1.3	1.4	1.4	(0.8)	(35.3)%
Phosphoric Acid Production	1.5	1.4	1.5	1.3	1.5	1.5	1.6	1.5	1.6	1.5	1.4	1.3	1.3	1.4	1.4	1.4	(0.1)	(9.5)%
Carbon Dioxide Consumption	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.8	1.0	1.3	1.2	1.3	(0.1)	(6.5)%
Zinc Production	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.1	1.1	1.0	0.9	0.5	0.5	0.5	(0.5)	(51.0)%
Lead Production	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	(0.0)	(7.2)%
Silicon Carbide Production and Consumption	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	(0.2)	(41.6)%
Land Use, Land-Use Change, and Forestry (Sink)[a]	*(712.8)*	*(793.0)*	*(794.5)*	*(765.3)*	*(833.9)*	*(828.8)*	*(832.9)*	*(862.3)*	*(808.6)*	*(782.2)*	*(756.7)*	*(767.5)*	*(811.9)*	*(811.9)*	*(824.8)*	*(828.5)*	*(115.7)*	*16.2%*
International Bunker Fuels[b]	*113.7*	*120.1*	*109.9*	*99.8*	*97.7*	*100.6*	*102.2*	*109.8*	*114.5*	*105.1*	*101.1*	*97.6*	*89.1*	*83.7*	*97.2*	*97.2*	*(16.5)*	*(14.5)%*
Wood Biomass and Ethanol Consumption[b]	*219.3*	*220.1*	*230.5*	*225.7*	*232.2*	*236.8*	*241.2*	*236.5*	*218.1*	*222.4*	*228.3*	*203.2*	*204.4*	*209.6*	*224.8*	*206.5*	*(12.9)*	*(5.9)%*
CH_4	**609.1**	**604.4**	**611.0**	**597.1**	**606.6**	**598.7**	**597.3**	**580.7**	**569.6**	**562.0**	**563.7**	**547.7**	**549.7**	**549.2**	**540.3**	**539.3**	**(69.8)**	**(11.5)%**
Landfills	161.0	161.6	166.1	165.3	163.4	157.1	153.4	146.5	138.9	135.4	131.9	127.6	130.4	134.9	132.1	132.0	(29.0)	(18.0)%
Enteric Fermentation	115.7	114.9	117.2	116.6	118.1	120.6	118.2	116.1	114.5	114.6	113.5	112.5	112.6	113.0	110.5	112.1	(3.6)	(3.1)%
Natural Gas Systems	124.5	125.7	126.1	127.5	128.8	128.1	130.2	128.5	125.8	121.7	126.6	125.4	125.0	123.7	119.0	111.1	(13.3)	(10.7)%
Coal Mining	81.9	79.0	77.0	65.1	65.2	66.5	63.4	62.8	62.8	58.7	55.9	55.5	52.0	52.1	54.5	52.4	(29.5)	(36.0)%
Manure Management	30.9	32.2	31.1	31.8	34.1	35.1	33.7	35.4	38.7	38.3	38.7	40.1	41.1	40.5	39.7	41.3	10.4	33.7%
Petroleum Systems	34.4	34.4	33.2	32.2	31.7	31.1	30.8	30.3	29.7	28.5	27.8	27.4	26.8	25.8	25.4	28.5	(6.0)	(17.3)%
Wastewater Treatment	24.8	25.2	25.7	25.7	25.5	25.1	25.7	26.5	26.5	26.6	26.4	25.9	25.8	25.6	25.7	25.4	0.6	2.5%
Forest Land Remaining Forest Land	7.1	2.6	4.1	3.5	8.0	4.0	11.1	4.9	3.9	9.0	14.0	6.0	10.4	8.1	6.9	11.6	4.5	63.7%
Stationary Combustion	8.0	8.2	8.4	8.0	7.8	7.8	8.1	7.5	6.9	7.0	7.4	6.8	6.8	7.0	7.1	6.9	(1.1)	(13.5)%
Rice Cultivation	7.1	7.0	7.9	7.0	8.2	7.6	7.0	7.5	7.9	8.3	7.5	7.6	6.8	6.9	7.6	6.9	(0.2)	(3.2%)
Abandoned Underground Coal Mines	6.0	6.1	6.6	6.9	8.1	8.2	8.4	7.5	6.9	7.0	7.3	6.7	6.1	5.9	5.8	5.5	(0.5)	(8.0)%
Mobile Combustion	4.7	4.6	4.6	4.5	4.5	4.3	4.2	4.0	3.8	3.6	3.5	3.2	3.1	2.9	2.8	2.6	(2.1)	(44.7)%
Petrochemical Production	0.9	0.9	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.2	1.1	1.1	1.1	1.2	1.1	0.2	25.1%
Iron and Steel Production	1.3	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.0	1.0	1.0	1.0	(0.4)	(28.0)%
Field Burning of Agricultural Residues	0.7	0.6	0.8	0.6	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.9	0.9	0.2	24.2%
Silicon Carbide Production and Consumption	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	(0.0)	(66.7)%
Ferroalloy Production	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	(0.0)	(43.0)%
International Bunker Fuels[b]	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*(0.1)*	*(34.9)%*
N_2O	**482.0**	**484.0**	**477.3**	**519.6**	**487.2**	**484.2**	**546.8**	**506.0**	**528.8**	**472.7**	**499.8**	**502.5**	**479.2**	**459.8**	**445.2**	**468.6**	**(13.4)**	**(2.8)%**
Agricultural Soil Management	366.9	367.2	358.8	396.5	359.2	353.4	413.1	377.6	405.0	350.0	376.8	389.0	366.1	350.2	338.8	365.1	(1.8)	(0.5)%
Mobile Combustion	43.7	45.8	48.8	50.9	52.6	53.7	54.4	55.1	55.1	54.3	53.2	49.7	47.1	43.8	41.2	38.0	(5.7)	(13.1)%
Nitric Acid Production	17.8	17.8	18.3	18.6	19.6	19.9	20.7	21.2	20.9	20.1	19.6	15.9	17.2	16.7	16.0	15.7	(2.2)	(12.1)%
Stationary Combustion	12.3	12.2	12.4	12.7	12.8	12.8	13.4	13.5	13.4	13.4	14.0	13.5	13.4	13.7	13.9	13.8	1.5	12.2%
Manure Management	8.6	9.0	8.7	9.1	9.0	9.0	8.7	9.0	9.2	9.2	9.6	9.8	9.7	9.3	9.4	9.5	0.9	10.3%
Wastewater Treatment	6.4	6.5	6.6	6.7	7.0	6.9	7.0	7.1	7.3	7.5	7.6	7.6	7.7	7.8	7.9	8.0	1.6	25.6%
Adipic Acid Production	15.2	14.8	13.1	14.0	15.0	17.2	17.0	10.3	6.0	5.5	6.0	4.9	5.9	6.2	5.7	6.0	(9.2)	(60.7)%
Settlements Remaining Settlements	5.1	5.2	5.3	5.5	5.7	5.5	5.7	5.7	5.7	5.8	5.6	5.5	5.6	5.8	6.0	5.8	0.7	13.1%
N_2O Product Usage	4.3	4.2	3.9	4.5	4.5	4.5	4.5	4.8	4.8	4.8	4.8	4.8	4.3	4.3	4.3	4.3	(0.0)	(0.4)%
Forest Land Remaining Forest Land	0.8	0.3	0.5	0.5	0.9	0.6	1.3	0.8	0.7	1.3	1.7	1.0	1.4	1.2	1.1	1.5	0.8	97.6%
Field Burning of Agricultural Residues	0.4	0.4	0.4	0.3	0.5	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.4	0.4	0.5	0.5	0.1	36.2%
Municipal Solid Waste Combustion	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	(0.1)	(15.0)%
International Bunker Fuels[b]	*1.0*	*1.0*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*1.0*	*1.0*	*0.9*	*0.9*	*0.9*	*0.8*	*0.8*	*0.9*	*0.9*	*(0.1)*	*(8.5)%*
HFCs, PFCs, and SF_6	**89.3**	**81.0**	**86.3**	**87.5**	**91.9**	**103.5**	**120.5**	**129.2**	**142.7**	**141.0**	**143.8**	**133.8**	**143.0**	**142.7**	**153.9**	**163.0**	**73.7**	**82.5%**
Substitution of Ozone Depleting Substances	0.3	0.6	2.9	7.6	15.1	32.2	44.9	57.4	65.5	73.1	80.9	88.6	96.9	105.5	114.5	123.3	123.0	36,899.1%
HCFC-22 Production	35.0	30.8	34.9	31.8	31.6	27.0	31.1	30.0	40.1	30.4	29.8	19.8	19.8	12.3	15.6	16.5	(18.4)	(52.7)%
Electrical Transmission and Distribution	27.1	26.0	25.9	25.1	23.7	21.8	19.9	18.3	15.5	15.9	15.2	15.1	14.3	13.8	13.6	13.2	(13.9)	(51.3)%
Semiconductor Manufacture	2.9	2.9	2.9	3.6	4.0	5.0	5.5	6.3	7.1	7.2	6.3	4.5	4.4	4.3	4.7	4.3	1.4	47.7%
Aluminum Production	18.5	15.6	14.3	13.7	12.1	11.8	12.4	10.8	8.6	8.5	8.6	3.5	5.2	3.8	2.8	3.0	(15.6)	(84.1)%
Magnesium Production and Processing	5.4	5.1	5.4	5.5	5.4	5.6	6.6	6.4	5.8	5.9	3.0	2.4	2.4	2.9	2.6	2.7	(2.8)	(50.9)%
Total	**6,242.0**	**6,185.6**	**6,286.0**	**6,444.4**	**6,519.2**	**6,571.0**	**6,831.4**	**6,856.4**	**6,919.6**	**6,930.5**	**7,147.2**	**7,027.0**	**7,064.6**	**7,104.2**	**7,203.7**	**7,260.4**	**1,018.4**	**16.3%**
Net Emissions (Sources and Sinks)	**5,529.2**	**5,392.6**	**5,491.5**	**5,679.1**	**5,685.3**	**5,742.2**	**5,998.5**	**5,994.1**	**6,111.0**	**6,148.2**	**6,390.5**	**6,259.5**	**6,252.7**	**6,292.3**	**6,378.9**	**6,431.9**	**902.7**	**16.3%**

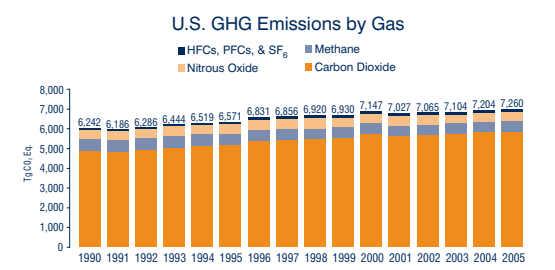
+ Does not exceed 0.05 Tg CO_2 Eq
[a] Sinks are only included in net emissions total.
[b] Emissions from International Bunker Fuels and Wood Biomass and Ethanol Consumption are not included in totals.

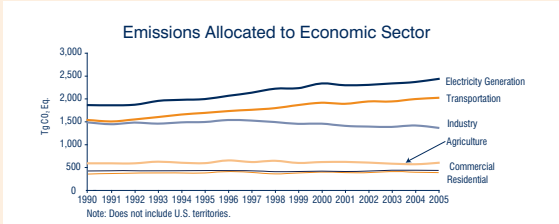
Note: Totals may not sum due to independent rounding. Emissions weighted using GWP values from IPCC Second Assessment Report (1996) in keeping with UNFCCC reporting guidelines.

1990-2005 Trends

- Total GHG emissions rose 16 percent since 1990 (increasing 1.6 percent since 2000)
- Dominant gas emitted was CO_2, mostly from fossil fuel combustion
- Methane emissions decreased by 11 percent
- Nitrous oxide emissions decreased by 3 percent
- HFC, PFC, and SF_6 emissions have grown by 83 percent







EPA United States Environmental Protection Agency

Office of Atmospheric Programs (6207J) • April 2007
EPA 430-F-07-004

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The U.S. Inventory of Greenhouse Gas Emissions and Sinks:
Reference Tables and Conversions

Global Warming Potentials (100 Year Time Horizon)

Gas	GWP	
	SAR[a]	TAR[b]
Carbon dioxide (CO_2)	1	1
Methane (CH_4)*	21	23
Nitrous oxide (N_2O)	310	296
HFC-23	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
HFC-4310mee	1,300	1,500
CF_4	6,500	5,700
C_2F_6	9,200	11,900
C_4F_{10}	7,000	8,600
C_6F_{14}	7,400	9,000
SF_6	23,900	22,200

[a] *IPCC Second Assessment Report* (1996)
[b] *IPCC Third Assessment Report* (2001)

* The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included.

Note: GWP values from the *IPCC Second Assessment Report* are used in accordance with UNFCCC guidelines.

Global Warming Potential (GWP) is defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. Inventory are presented in terms of equivalent emissions of carbon dioxide (CO_2), using units of teragrams of carbon dioxide equivalents (Tg CO_2 Eq.).

Conversion:

$$\text{Tg} = 10^9 \text{ kg} = 10^6 \text{ metric tons}$$
$$= 1 \text{ million metric tons}$$

The molecular weight of carbon is 12, and the molecular weight of oxygen is 16; therefore, the molecular weight of CO_2 is 44 (i.e., $12+[16\times2]$), as compared to 12 for carbon alone. Thus, the weight ratio of carbon to carbon dioxide is 12/44.

Conversion from gigagrams of gas to teragrams of carbon dioxide equivalents:

$$\text{Tg } CO_2 \text{ Eq.} = \left(\frac{\text{Gg}}{\text{of gas}}\right) \times (\text{GWP}) \times \left(\frac{\text{Tg}}{1{,}000 \text{ Gg}}\right)$$

Guide to Metric Unit Prefixes

Prefix/Symbol	Factor	
Tera (T)	10^{12}	1,000,000,000,000
Giga (G)	10^9	1,000,000,000
Mega (M)	10^6	1,000,000
Kilo (k)	10^3	1,000
Hecto (h)	10^2	100
Deca (da)	10^1	10
—	10^0	1
Deci (d)	10^{-1}	.1
Centi (c)	10^{-2}	.01
Milli (m)	10^{-3}	.001
Micro (μ)	10^{-6}	.000001
Nano (n)	10^{-9}	.000000001
Pico (p)	10^{-12}	.000000000001

Unit Conversions

1 pound	= 0.454 kilograms	= 16 ounces	
1 kilogram	= 2.205 pounds	= 35.27 ounces	
1 short ton	= 0.9072 metric tons	= 2,000 pounds	
1 metric ton	= 1.1023 short tons	= 1,000 kilograms	
1 cubic foot	= 0.02832 cubic meters	= 28.3168 liters	
1 cubic meter	= 35.315 cubic feet	= 1,000 liters	
1 U.S. gallon	= 3.78541 liters	= 0.03175 barrels	= 0.02381 barrels petroleum
1 liter	= 0.2642 U.S. gallons	= 0.0084 barrels	= 0.0063 barrels petroleum
1 barrel	= 31.5 U.S. gallons	= 119 liters	= 0.75 barrels petroleum
1 barrel petroleum	= 42 U.S. gallons	= 159 liters	
1 foot	= 0.3048 meters	= 12 inches	
1 meter	= 3.28 feet	= 39.37 inches	
1 mile	= 1.609 kilometers	= 5,280 feet	
1 kilometer	= 0.6214 miles	= 3,280.84 feet	
1 square mile	= 2.590 square kilometers	= 640 acres	
1 square kilometer	= 0.386 square miles	= 100 hectares	
1 acre	= 43,560 square feet	= 0.4047 hectares	= 4,047 square meters

Energy Conversions

The common energy unit used in international reports of greenhouse gas emissions is the joule. A joule is the energy required to move an object one meter with the force of one Newton. A terajoule (TJ) is one trillion (10^{12}) joules. A British thermal unit (Btu, the customary U.S. energy unit) is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 Fahrenheit.

1 TJ =
- 2.388×10^{11} calories
- 23.88 metric tons of crude oil equivalent
- 9.478×10^8 Btu
- 277,800 kilowatt-hours

Energy Units

Btu	British thermal unit	1 Btu
MBtu	Thousand Btu	1×10^3 Btu
MMBtu	Million Btu	1×10^6 Btu
BBtu	Billion Btu	1×10^9 Btu
TBtu	Trillion Btu	1×10^{12} Btu
QBtu	Quadrillion Btu	1×10^{15} Btu

Source for all data: *U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990-2005* (EPA 2007)

CO_2 Emissions from Fossil Fuel Combustion = Fuel Combusted x Carbon Content Coefficient x Fraction Oxidized x (44/12)

May include adjustments for carbon stored in fossil fuel-based products, emissions from international bunker fuels, or emissions from territories.

Carbon Intensity of Different Fuel Types

The amount of carbon in fossil fuels per unit of energy content varies significantly by fuel type. For example, coal contains the highest amount of carbon per unit of energy, while petroleum has about 25 percent less carbon than coal, and natural gas about 45 percent less.

Converting Various Physical Units to Energy Units

The values in the following table provide conversion factors from physical units to energy equivalent units and from energy units to carbon contents. These factors can be used as default factors, if local data are not available.

Conversion Factors to Energy Units (Heat Equivalents) Heat Contents and Carbon Content Coefficients of Various Fuel Types

Fuel Type	Heat Content	Carbon (C) Content Coefficients	Carbon Dioxide (CO_2) per Physical Unit
Solid Fuels	**Million Btu/Metric Ton**	**kg C/Million Btu**	**kg CO_2/Metric Ton**
Anthracite Coal	20.48	28.26	2,122.0
Bituminous Coal	21.67	25.49	2,025.6
Sub-bituminous Coal	15.55	26.48	1,509.7
Lignite	11.67	26.30	1,125.6
Coke	22.50	31.00	2,557.0
Unspecified Coal	22.68	25.34	2,106.9
Gas Fuels	**Btu/Cubic Foot**	**kg C/Million Btu**	**kg CO_2/Cubic Foot**
Natural Gas	1,030	14.47	0.0546
Liquid Fuels	**Million Btu/Petroleum Barrel**	**kg C/Million Btu**	**kg CO_2/Petroleum Barrel**
Crude Oil	5.80	20.33	432.3
Natural Gas Liquids and LRGs	3.72	16.99	231.9
Motor Gasoline	5.22	19.33	369.8
Aviation Gasoline	5.05	18.87	349.3
Kerosene	5.67	19.72	410.0
Jet Fuel	5.67	19.33	401.9
Distillate Fuel Oil	5.83	19.95	426.1
Residual Fuel Oil	6.29	21.49	495.4
Naphtha for Feedstock	5.25	18.14	349.1
Petroleum Coke	6.02	27.85	615.2
Other Oil for Feedstock	5.83	19.95	426.1
Special Naphthas	5.25	19.86	382.2
Lubricants	6.07	20.24	450.1
Waxes	5.54	19.81	402.2
Asphalt & Road Oil	6.64	20.62	501.7
Still Gas	6.00	17.51	385.2
Misc. Products	5.80	20.33	432.0

Note: For fuels with variable heat contents and carbon content coefficients, 2005 U.S. average values are presented. All factors are presented in gross calorific values (GCV) (i.e., higher heating values). LRG = Liquid Refinery Gas. Miscellaneous products includes all finished products not otherwise classified, (e.g., aromatic extracts and tars, absorption oils, ram-jet fuel, synthetic natural gas, naptha-type jet fuel, and specialty oils).

Density Conversions

Methane (Natural Gas)	1 cubic meter	=	35.32 cubic feet	=	0.676 kilograms
Carbon dioxide	1 cubic meter	=	35.32 cubic feet	=	1.854 kilograms
Natural gas liquids	1 metric ton	=	11.60 barrels	=	1,844.20 liters
Unfinished oils	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Alcohol	1 metric ton	=	7.94 barrels	=	1,262.36 liters
Liquefied petroleum gas	1 metric ton	=	11.60 barrels	=	1,844.20 liters
Aviation gasoline	1 metric ton	=	8.90 barrels	=	1,415.00 liters
Naphtha jet fuel	1 metric ton	=	8.27 barrels	=	1,314.82 liters
Kerosene jet fuel	1 metric ton	=	7.93 barrels	=	1,260.72 liters
Motor gasoline	1 metric ton	=	8.53 barrels	=	1,356.16 liters
Kerosene	1 metric ton	=	7.73 barrels	=	1,228.97 liters
Naphtha	1 metric ton	=	8.22 barrels	=	1,306.87 liters
Distillate	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Residual oil	1 metric ton	=	6.66 barrels	=	1,058.85 liters
Lubricants	1 metric ton	=	7.06 barrels	=	1,122.45 liters
Bitumen	1 metric ton	=	6.06 barrels	=	963.46 liters
Waxes	1 metric ton	=	7.87 barrels	=	1,251.23 liters
Petroleum coke	1 metric ton	=	5.51 barrels	=	876.02 liters
Petrochemical feedstocks	1 metric ton	=	7.46 barrels	=	1,186.04 liters
Special naphtha	1 metric ton	=	8.53 barrels	=	1,356.16 liters
Miscellaneous products	1 metric ton	=	8.00 barrels	=	1,271.90 liters

Note: Gas densities are at room temperature and pressure.

For more information on calculating CO_2 emissions per kWh, download eGRID at: **http://www.epa.gov/cleanenergy/egrid**

For other related information, see: **http://www.epa.gov/climatechange** **http://unfccc.int**

Download the Inventory at: http://www.epa.gov/climatechange/emissions/usinventoryreport.html

11

Regional Climate Projections

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This chapter should be cited as:

Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, R. Jones, R.K. Kolli, W.-T. Kwon, R. Laprise, V. Magaña Rueda, L. Mearns, C.G. Menéndez, J. Räisänen, A. Rinke, A. Sarr and P. Whetton, 2007: Regional Climate Projections. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Table of Contents

Executive Summary 849

11.1 Introduction 852

11.1.1 Summary of the Third Assessment Report 852

11.1.2 Introduction to Regional Projections 852

Box 11.1: Summary of Regional Responses 858

11.1.3 Some Unifying Themes 860

11.2 Africa 866

11.2.1 Key Processes 866

11.2.2 Skill of Models in Simulating Present and Past Climates 867

11.2.3 Climate Projections 867

11.3 Europe and the Mediterranean 872

11.3.1 Key Processes 872

11.3.2 Skill of Models in Simulating Present Climate 872

Box 11.2: The PRUDENCE Project 873

11.3.3 Climate Projections 873

11.4 Asia 879

11.4.1 Key Processes 879

11.4.2 Skill of Models in Simulating Present Climate 880

11.4.3 Climate Projections 881

Box 11.3: Climatic Change in Mountain Regions 886

11.5 North America 887

11.5.1 Key Processes 887

11.5.2 Skill of Models in Simulating Present Climate 888

11.5.3 Climate Projections 889

11.6 Central and South America 892

11.6.1 Key Processes 892

11.6.2 Skill of Models in Simulating Present Climate 893

11.6.3 Climate Projections 894

11.6.4 Extremes 896

11.7 Australia – New Zealand 896

Box 11.4: Land Use and Land Cover Change Experiments Related to Climate Change 897

11.7.1 Key Processes 898

11.7.2 Skill of Models in Simulating Present Climate 898

11.7.3 Climate Projections 899

11.8 Polar Regions 902

11.8.1 Arctic 903

11.8.2 Antarctic 907

11.9 Small Islands 909

11.9.1 Key Processes 910

11.9.2 Skill of Models in Simulating Present Climate 911

11.9.3 Temperature and Precipitation Projections 911

11.9.4 Sea Level Rise 914

11.9.5 Tropical Cyclones 915

Box 11.5: Coastal Zone Climate Change 916

11.10 Assessment of Regional Climate Projection Methods 918

11.10.1 Methods for Generating Regional Climate Information 918

11.10.2 Quantifying Uncertainties 921

Frequently Asked Question

FAQ 11.1: *Do Projected Changes in Climate Vary from Region to Region?* 865

References 926

Supplementary Material

The following supplementary material is available on CD-ROM and in on-line versions of this report.

Supplementary Figures S11.1–S11.37

Supplementary Tables S1.1 and S1.2

Supplementary References

Executive Summary

Increasingly reliable regional climate change projections are now available for many regions of the world due to advances in modelling and understanding of the physical processes of the climate system. A number of important themes have emerged:

- Warming over many land areas is greater than global annual mean warming due to less water availability for evaporative cooling and a smaller thermal inertia as compared to the oceans.
- Warming generally increases the spatial variability of precipitation, contributing to a reduction of rainfall in the subtropics and an increase at higher latitudes and in parts of the tropics. The precise location of boundaries between regions of robust increase and decrease remains uncertain and this is commonly where Atmosphere-Ocean General Circulation Model (AOGCM) projections disagree.
- The poleward expansion of the subtropical highs, combined with the general tendency towards reductions in subtropical precipitation, creates especially robust projections of a reduction in precipitation at the poleward edges of the subtropics. Most of the regional projections of reductions in precipitation in the 21st century are associated with areas adjacent to these subtropical highs.
- There is a tendency for monsoonal circulations to result in increased precipitation due to enhanced moisture convergence, despite a tendency towards weakening of the monsoonal flows themselves. However, many aspects of tropical climatic responses remain uncertain.

Atmosphere-Ocean General Circulation Models remain the primary source of regional information on the range of possible future climates. A clearer picture of the robust aspects of regional climate change is emerging due to improvement in model resolution, the simulation of processes of importance for regional change and the expanding set of available simulations. Advances have been made in developing probabilistic information at regional scales from the AOGCM simulations, but these methods remain in the exploratory phase. There has been less development extending this to downscaled regional information. However, downscaling methods have matured since the Third Assessment Report (TAR; IPCC, 2001) and have been more widely applied, although only in some regions has large-scale coordination of multi-model downscaling of climate change simulations been achieved.

Regional climate change projections presented here are assessed drawing on information from four potential sources: AOGCM simulations; downscaling of AOGCM-simulated data using techniques to enhance regional detail; physical understanding of the processes governing regional responses; and recent historical climate change.

Previous chapters describe observed climate change on regional scales (Chapter 3) and compare global model simulations with these changes (Chapter 9). Comparisons of model simulations of temperature change with observations can be used to help constrain future regional temperature projections. Regional assessments of precipitation change rely primarily on convergence in both global and downscaling models along with physical insights. Where there is near unanimity among models with good supporting physical arguments, as is more typical for middle and higher latitudes, these factors encourage stronger statements as to the likelihood of a regional climate change. In some circumstances, physical insights alone clearly indicate the direction of future change.

The summary likelihood statements on projected regional climate are as follows:

- ***Temperature projections:*** These are comparable in magnitude to those of the TAR and confidence in the regional projections is now higher due to a larger number and variety of simulations, improved models, a better understanding of the role of model deficiencies and more detailed analyses of the results. Warming, often greater than the global mean, is *very likely* over all landmasses.
- ***Precipitation projections:*** Overall patterns of change are comparable to those of TAR, with greater confidence in the projections for some regions. Model agreement is seen over more and larger regions. For some regions, there are grounds for stating that the projected precipitation changes are *likely* or *very likely*. For other regions, confidence in the projected change remains weak.
- ***Extremes:*** There has been a large increase in the available analyses of changes in extremes. This allows for a more comprehensive assessment for most regions. The general findings are in line with the assessment made in TAR and now have a higher level of confidence derived from multiple sources of information. The most notable improvements in confidence relate to the regional statements concerning heat waves, heavy precipitation and droughts. Despite these advances, specific analyses of models are not available for some regions, which is reflected in the robust statements on extremes. In particular, projections concerning extreme events in the tropics remain uncertain. The difficulty in projecting the distribution of tropical cyclones adds to this uncertainty. Changes in extra-tropical cyclones are dependent on details of regional atmospheric circulation response, some of which remain uncertain.

The following summarises the robust findings of the projected regional change over the 21st century. Supporting narratives are provided in Sections 11.2 to 11.9. These changes are assessed as *likely* to *very likely* taking into account the uncertainties in climate sensitivity and emission trajectories (in the Special Report on Emission Scenarios (SRES) B1/A1B/B2 scenario range) discussed in earlier chapters.

All land regions:

It is *very likely* that all land regions will warm in the 21st century.

Africa:

Warming is *very likely* to be larger than the global annual mean warming throughout the continent and in all seasons, with drier subtropical regions warming more than the moister tropics. Annual rainfall is *likely* to decrease in much of Mediterranean Africa and the northern Sahara, with a greater likelihood of decreasing rainfall as the Mediterranean coast is approached. Rainfall in southern Africa is *likely* to decrease in much of the winter rainfall region and western margins. There is *likely* to be an increase in annual mean rainfall in East Africa. It is unclear how rainfall in the Sahel, the Guinean Coast and the southern Sahara will evolve.

Mediterranean and Europe:

Annual mean temperatures in Europe are *likely* to increase more than the global mean. Seasonally, the largest warming is *likely* to be in northern Europe in winter and in the Mediterranean area in summer. Minimum winter temperatures are *likely* to increase more than the average in northern Europe. Maximum summer temperatures are *likely* to increase more than the average in southern and central Europe. Annual precipitation is *very likely* to increase in most of northern Europe and decrease in most of the Mediterranean area. In central Europe, precipitation is *likely* to increase in winter but decrease in summer. Extremes of daily precipitation are *very likely* to increase in northern Europe. The annual number of precipitation days is *very likely* to decrease in the Mediterranean area. Risk of summer drought is *likely* to increase in central Europe and in the Mediterranean area. The duration of the snow season is *very likely* to shorten, and snow depth is *likely* to decrease in most of Europe.

Asia:

Warming is *likely* to be well above the global mean in central Asia, the Tibetan Plateau and northern Asia, above the global mean in eastern Asia and South Asia, and similar to the global mean in Southeast Asia. Precipitation in boreal winter is *very likely* to increase in northern Asia and the Tibetan Plateau, and *likely* to increase in eastern Asia and the southern parts of Southeast Asia. Precipitation in summer is *likely* to increase in northern Asia, East Asia, South Asia and most of Southeast Asia, but is *likely* to decrease in central Asia. It is *very likely* that heat waves/hot spells in summer will be of longer duration, more intense and more frequent in East Asia. Fewer very cold days are *very likely* in East Asia and South Asia. There is *very likely* to be an increase in the frequency of intense precipitation events in parts of South Asia, and in East Asia. Extreme rainfall and winds associated with tropical cyclones are *likely* to increase in East Asia, Southeast Asia and South Asia.

North America:

The annual mean warming is *likely* to exceed the global mean warming in most areas. Seasonally, warming is *likely* to be largest in winter in northern regions and in summer in the southwest. Minimum winter temperatures are *likely* to increase more than the average in northern North America. Maximum summer temperatures are *likely* to increase more than the average in the southwest. Annual mean precipitation is *very likely* to increase in Canada and the northeast USA, and *likely* to decrease in the southwest. In southern Canada, precipitation is *likely* to increase in winter and spring but decrease in summer. Snow season length and snow depth are *very likely* to decrease in most of North America except in the northernmost part of Canada where maximum snow depth is *likely* to increase.

Central and South America:

The annual mean warming is *likely* to be similar to the global mean warming in southern South America but larger than the global mean warming in the rest of the area. Annual precipitation is *likely* to decrease in most of Central America and in the southern Andes, although changes in atmospheric circulation may induce large local variability in precipitation response in mountainous areas. Winter precipitation in Tierra del Fuego and summer precipitation in south-eastern South America is *likely* to increase. It is uncertain how annual and seasonal mean rainfall will change over northern South America, including the Amazon forest. However, there is qualitative consistency among the simulations in some areas (rainfall increasing in Ecuador and northern Peru, and decreasing at the northern tip of the continent and in southern northeast Brazil).

Australia and New Zealand:

Warming is *likely* to be larger than that of the surrounding oceans, but comparable to the global mean. The warming is less in the south, especially in winter, with the warming in the South Island of New Zealand *likely* to remain less than the global mean. Precipitation is *likely* to decrease in southern Australia in winter and spring. Precipitation is *very likely* to decrease in south-western Australia in winter. Precipitation is *likely* to increase in the west of the South Island of New Zealand. Changes in rainfall in northern and central Australia are uncertain. Increased mean wind speed is *likely* across the South Island of New Zealand, particularly in winter. Increased frequency of extreme high daily temperatures in Australia and New Zealand, and a decrease in the frequency of cold extremes is *very likely*. Extremes of daily precipitation are *very likely* to increase, except possibly in areas of significant decrease in mean rainfall (southern Australia in winter and spring). Increased risk of drought in southern areas of Australia is *likely*.

Polar regions:

The Arctic is *very likely* to warm during this century more than the global mean. Warming is projected to be largest in winter and smallest in summer. Annual arctic precipitation is *very likely* to increase. It is *very likely* that the relative precipitation increase will be largest in winter and smallest in summer. Arctic sea ice is *very likely* to decrease in its extent and thickness. It is uncertain how the Arctic Ocean circulation will change. The Antarctic is *likely* to warm and the precipitation is *likely* to increase over the continent. It is uncertain to what extent the frequency of extreme temperature and precipitation events will change in the polar regions.

Small Islands:

Sea levels are *likely* to rise on average during the century around the small islands of the Caribbean Sea, Indian Ocean and northern and southern Pacific Oceans. The rise will *likely* not be geographically uniform but large deviations among models make regional estimates across the Caribbean, Indian and Pacific Oceans uncertain. All Caribbean, Indian Ocean and North and South Pacific islands are *very likely* to warm during this century. The warming is *likely* to be somewhat smaller than the global annual mean. Summer rainfall in the Caribbean is *likely* to decrease in the vicinity of the Greater Antilles but changes elsewhere and in winter are uncertain. Annual rainfall is *likely* to increase in the northern Indian Ocean with increases *likely* in the vicinity of the Seychelles in December, January and February, and in the vicinity of the Maldives in June, July and August, while decreases are *likely* in the vicinity of Mauritius in June, July and August. Annual rainfall is *likely* to increase in the equatorial Pacific, while decreases are projected by most models for just east of French Polynesia in December, January and February.

11.1 Introduction

Increasingly reliable regional climate change projections are now available for many regions of the world due to advances in modelling and understanding of the physical processes of the climate system. Atmosphere-Ocean General Circulation Models (AOGCMs) remain the foundation for projections while downscaling techniques now provide valuable additional detail. Atmosphere-Ocean General Circulation Models cannot provide information at scales finer than their computational grid (typically of the order of 200 km) and processes at the unresolved scales are important. Providing information at finer scales can be achieved through using high resolution in dynamical models or empirical statistical downscaling. Development of downscaling methodologies remains an important focus. Downscaled climate change projections tailored to specific needs are only now starting to become available.

11.1.1 Summary of the Third Assessment Report

The assessment of regional climate projections in the Third Assessment Report (TAR; Chapter 10 of IPCC, 2001) was largely restricted to General Circulation Model (GCM)-derived temperature with limited precipitation statements. The major assessment of temperature change was that it is very likely all land areas will warm more than the global average (with the exception of Southeast Asia and South America in June, July and August; JJA), with amplification at high latitudes. The changes in precipitation assessed to be likely were: an increase over northern mid-latitude regions in winter and over high-latitude regions in both winter and summer; in December, January and February (DJF), an increase in tropical Africa, little change in Southeast Asia, and a decrease in Central America; an increase or little change in JJA over South Asia and a decrease over Australia and the Mediterranean region. These projections were almost entirely based on analysis of nine coarse-resolution AOGCMs that had performed transient experiments for the 20th century with the specifications for the A2 and B2 emission scenarios. Chapter 10 of the TAR noted that studies with regional models indicate that changes at finer scales may be substantially different in magnitude from these large sub-continental findings.

Information available for assessment regarding climate variability and extremes at the regional scale was too sparse for it to be meaningfully drawn together in a systematic manner. However, some statements of a more generic nature were made. It was assessed that the variability of daily to interannual temperatures is likely to decrease in winter and increase in summer for mid-latitude Northern Hemisphere (NH) land areas, daily high temperature extremes are likely to increase and future increases in mean precipitation are very likely to lead to an increase in variability. In some specifically analysed regions, it was assessed that extreme precipitation may increase and there were indications that droughts or dry spells may increase in occurrence in Europe, North America and Australia.

11.1.2 Introduction to Regional Projections

Assessments of climate change projections are provided here on a region-by-region basis. The discussion is organised according to the same continental-scale regions used by Working Group II (WGII) in the Fourth Assessment Report (AR4) and in earlier assessments: Africa, Europe and Mediterranean, Asia, North America, Central and South America, Australia-New Zealand, Polar Regions and Small Islands. While the topics covered vary somewhat from region to region, each section includes a discussion of key processes of importance for climate change in that region, relevant aspects of model skill in simulating current climate, and projections of future regional climate change based on global models and downscaling techniques.

Each of these continental-scale regions encompasses a broad range of climates and is too large to be used as a basis for conveying quantitative regional climate change information. Therefore, each is subdivided into a number of sub-continental or oceanic regions. The sub-continental regions as defined in Table 11.1 are the framework for developing specific regional or sub-continental robust statements of projected change.

Area-averaged temperature and precipitation changes are presented from the coordinated set of climate model simulations archived at the Program for Climate Model Diagnosis and Intercomparison (PCMDI; subsequently called the multi-model data set or MMD). The regions are very close to those initially devised by Giorgi and Francesco (2000) with some minor modifications similar to those of Ruosteenoja et al. (2003). They have simple shapes and are no smaller than the horizontal scales on which current AOGCMs are useful for climate simulations (typically judged to be roughly 1,000 km).

These regional averages have some deficiencies for discussion of the AOGCM projections. In several instances, the simple definition of these boxes results in spatial averaging over regions in which precipitation is projected to increase and decrease. There are also sub-regions where the case can be made for a robust and physically plausible hydrological response, information about which is lost in the regional averages. Partially to help in discussing these features, this chapter also uses maps of temperature and precipitation responses, interpolated to a grid with 128 longitudes by 64 latitudes which is typical of many of the lower-resolution atmospheric models in the MMD.

In the regional discussion to follow, the starting points are temperature and precipitation. Changes in temperature are introduced in each continental section by plotting for each of the regions the evolution of the range of projected decadal mean change for the A1B scenario through the 21st century (simulations hereafter referred to as MMD-A1B). These are put into the context of observed changes in the 20th century by plotting the observed changes and how well the models reproduce these. This summary information is displayed for continental regions in Box 11.1, which also contains details of how the figures were constructed. The equivalent figures for the individual regions of each continental-scale region are displayed in the following sections. These are constructed in

the same way as Box 11.1, Figure 1. The 20th-century parts of these figures are also displayed in Section 9.4, where more details on their construction are provided. The discussion on precipitation provides a limited view of hydrological changes. Supplementary Material Figure S11.1 expands on this issue by comparing the annual mean responses in precipitation and in precipitation minus evaporation over the 21st century in the MMD-A1B projections. Over North America and Europe, for example, the region of drying in the sense of precipitation minus evaporation is shifted poleward compared to the region of reduced precipitation. A summary of the more significant hydrological cycle changes from the regional discussions is presented in Box 11.1.

Table 11.1 provides detailed information for each region generated from the MMD-A1B models focusing on the change in climate between the 1980 to 1999 period in the 20th-century integrations and the 2080 to 2099 period. The distribution of the annual and seasonal mean surface air temperature response and percentage change in precipitation are described by the median, the 25 and 75% values (half of the models lie between these two values) and the maximum and minimum values in the model ensemble. Information on model biases in these regional averages for the 1980 to 1999 simulations is provided in Supplementary Material Table S11.1 in a similar format. Maps of biases are referred to in some of the following and are included in the Supplementary Material as well. Data sources used in these comparisons are listed in the table and figure captions where these biases are displayed.

Most of the discussion focuses on the A1B scenario. The global mean near-surface temperature responses (between the period 1980 to 1999 of the 20th-century integrations and the period 2080 to 2099) in the ensemble mean of the MMD models are in the ratio 0.69:1:1.17 for the B1:A1B:A2 scenarios. The local temperature responses in nearly all regions closely follow the same ratio, as discussed in Chapter 10 and as illustrated in Supplementary Material Figures S11.2 to S11.4. Therefore, little is gained by repeating the discussion of the A1B scenario for the other scenarios. The ensemble mean local precipitation responses also approximately scale with the global mean temperature response, although not as precisely as the temperature itself. Given the substantial uncertainties in hydrological responses, the generally smaller signal/noise ratio and the similarities in the basic structure of the AOGCM precipitation responses in the different scenarios, a focus on A1B seems justified for the precipitation as well. The overall regional assessments, however, do rely on all available scenario information.

Given the dominantly linear response of the models, the 2080 to 2099 period allows the greatest clarity of the background climate change underlying the interannual and decadal variability. In the ensemble mean AOGCM projections there is no indication of abrupt climate change, nor does the literature on individual models provide any strong suggestions of robust nonlinearities. Some local temporal nonlinearities are to be expected, for example as the sea ice boundary retreats from a particular location in the Arctic. While the possibility exists that changes of more abrupt character could happen, such as major ocean circulation or land surface/vegetation change, there is little basis to judge the plausibility of these factors (see Chapter 10). Therefore, this discussion is based on this linear picture.

Table 11.1 also provides some simple estimates of the signal-to-noise ratio. The signal is the change in 20-year means of seasonal or annual mean temperature or precipitation. The noise is an estimate of the internal variability of 20-year means of seasonal or annual mean temperature or precipitation, as generated by the models. The signal-to-noise ratio is converted into the time interval that is required before the signal is clearly discernible, assuming that the signal grows linearly over the century at the average rate in the ensemble mean A1B projection. 'Clearly discernible' is defined in this context as distinguishable with 95% confidence. As an example, the annual mean precipitation increase in northern Europe (NEU) (Table 11.1) is clearly discernible in these models after 45 years, meaning that the 20-year average from 2025 to 2044 will be greater than the 20-year mean over 1980 to 1999 with 95% confidence, accounting only for the internal variability in the models and no other sources of uncertainty. In contrast, the annual temperature response in Southeast Asia (SEA) rises above the noise by this measure after only 10 years, implying that the average temperature over the period 1990 to 2009 is clearly discernible in the models from the average over the control period 1980 to 1999. This measure is likely an overestimate of the time of emergence of the signal as compared to that obtained with more refined detection strategies (of the kind discussed in Chapter 9). This noise estimate is solely based on the models and must be treated with caution, but it would be wrong to assume that models always underestimate this internal variability. Some models overestimate and some underestimate the amplitude of the El Niño-Southern Oscillation (ENSO), for example, thereby over- or underestimating the most important source of interannual variability in the tropics. On the other hand, few models capture the range of decadal variability of rainfall in West Africa, for example (Hoerling, et al., 2006; Section 8.4).

Also included in Table 11.1 is an estimate of the probability of extremely warm, extremely wet and extremely dry seasons, for the A1B scenario and for the time period 2080 to 2099. An 'extremely warm' summer is defined as follows. Examining all of the summers simulated in a particular realisation of a model in the 1980 to 1999 control period, the warmest of these 20 summers can be computed as an estimate of the temperature of the warmest 5% of all summers in the control climate. The period 2080 to 2099 is then examined, and the fraction of the summers exceeding this warmth determined. This is referred to as the probability of extremely warm summers. The results are tabulated after averaging over models, and similarly for both extremely low and extremely high seasonal precipitation amounts. Values smaller (larger) than 5% indicate a decrease (increase) in the frequency of extremes. This follows the approach in Weisheimer and Palmer (2005) except that this chapter compares each model's future with its own 20th century to help avoid distortions due to differing biases in the different

Table 11.1. *Regional averages of temperature and precipitation projections from a set of 21 global models in the MMD for the A1B scenario. The mean temperature and precipitation responses are first averaged for each model over all available realisations of the 1980 to 1999 period from the 20th Century Climate in Coupled Models (20C3M) simulations and the 2080 to 2099 period of A1B. Computing the difference between these two periods, the table shows the minimum, maximum, median (50%), and 25 and 75% quartile values among the 21 models, for temperature (°C) and precipitation (%) change. Regions in which the middle half (25–75%) of this distribution is all of the same sign in the precipitation response are coloured light brown for decreasing and light blue for increasing precipitation. Signal-to-noise ratios for these 20-year mean responses is indicated by first computing a consensus standard deviation of 20-year means, using those models that have at least three realisations of the 20C3M simulations and using all 20-year periods in the 20th century. The signal is assumed to increase linearly in time, and the time required for the median signal to reach 2.83 ($2 \times \sqrt{2}$) times the standard deviation is displayed as an estimate of when this signal is significant at the 95% level. These estimates of the times for emergence of a clearly discernible signal are only shown for precipitation when the models are in general agreement on the sign of the response, as indicated by the colouring. The frequency (%) of extremely warm, wet and dry seasons, averaged over the models, is also presented, as described in Section 11.2.1. Values are only shown when at least 14 out of the 21 models agree on an increase (bold) or a decrease in the extremes. A value of 5% indicates no change, as this is the nominal value for the control period by construction. The regions are defined by rectangular latitude/longitude boxes and the coordinates of the bottom left-hand and top right-hand corners of these are given in degrees in the first column under the region acronym (see table notes for full names of regions). Information is provided for land areas contained in the boxes except for the Small Islands regions where sea areas are used and for Antarctica where both land and sea areas are used.*

		Temperature Response (°C)						Precipitation Response (%)						Extreme Seasons (%)		
Region[a]	Season	Min	25	50	75	Max	T yrs	Min	25	50	75	Max	T yrs	Warm	Wet	Dry
AFRICA																
WAF	DJF	2.3	2.7	3.0	3.5	4.6	10	-16	-2	6	13	23		**100**	**21**	4
	MAM	1.7	2.8	3.5	3.6	4.8	10	-11	-7	-3	5	11		**100**		
12S,20W	JJA	1.5	2.7	3.2	3.7	4.7	10	-18	-2	2	7	16		**100**	**19**	
to	SON	1.9	2.5	3.3	3.7	4.7	10	-12	0	1	10	15		**100**	**15**	
22N,18E	Annual	1.8	2.7	3.3	3.6	4.7	10	-9	-2	2	7	13		**100**	**22**	
EAF	DJF	2.0	2.6	3.1	3.4	4.2	10	-3	6	13	16	33	55	**100**	**25**	1
	MAM	1.7	2.7	3.2	3.5	4.5	10	-9	2	6	9	20	>100	**100**	**15**	4
12S,22E	JJA	1.6	2.7	3.4	3.6	4.7	10	-18	-2	4	7	16		**100**		
to	SON	1.9	2.6	3.1	3.6	4.3	10	-10	3	7	13	38	95	**100**	**21**	3
18N,52E	Annual	1.8	2.5	3.2	3.4	4.3	10	-3	2	7	11	25	60	**100**	**30**	1
SAF	DJF	1.8	2.7	3.1	3.4	4.7	10	-6	-3	0	5	10		**100**	**11**	
	MAM	1.7	2.9	3.1	3.8	4.7	10	-25	-8	0	4	12		**98**		
35S,10E	JJA	1.9	3.0	3.4	3.6	4.8	10	-43	-27	-23	-7	-3	70	**100**	1	**23**
to	SON	2.1	3.0	3.7	4.0	5.0	10	-43	-20	-13	-8	3	90	**100**	1	**20**
12S,52E	Annual	1.9	2.9	3.4	3.7	4.8	10	-12	-9	-4	2	6		**100**	4	**13**
SAH	DJF	2.4	2.9	3.2	3.5	5.0	15	-47	-31	-18	-12	31	>100	**97**		**12**
	MAM	2.3	3.3	3.6	3.8	5.2	10	-42	-37	-18	-10	13	>100	**100**	2	**21**
18N,20E	JJA	2.6	3.6	4.1	4.4	5.8	10	-53	-28	-4	16	74		**100**		
to	SON	2.8	3.4	3.7	4.3	5.4	10	-52	-15	6	23	64		**100**		
30N,65E	Annual	2.6	3.2	3.6	4.0	5.4	10	-44	-24	-6	3	57		**100**		
EUROPE																
NEU	DJF	2.6	3.6	4.3	5.5	8.2	40	9	13	15	22	25	50	**82**	**43**	0
	MAM	2.1	2.4	3.1	4.3	5.3	35	0	8	12	15	21	60	**79**	**28**	2
48N,10W	JJA	1.4	1.9	2.7	3.3	5.0	25	-21	-5	2	7	16		**88**	**11**	
to	SON	1.9	2.6	2.9	4.2	5.4	30	-5	4	8	11	13	80	**87**	**20**	2
75N,40E	Annual	2.3	2.7	3.2	4.5	5.3	25	0	6	9	11	16	45	**96**	**48**	2
SEM	DJF	1.7	2.5	2.6	3.3	4.6	25	-16	-10	-6	-1	6	>100	**93**	3	**12**
	MAM	2.0	3.0	3.2	3.5	4.5	20	-24	-17	-16	-8	-2	60	**98**	1	**31**
30N,10W	JJA	2.7	3.7	4.1	5.0	6.5	15	-53	-35	-24	-14	-3	55	**100**	1	**42**
to	SON	2.3	2.8	3.3	4.0	5.2	15	-29	-15	-12	-9	-2	90	**100**	1	**21**
48N,40E	Annual	2.2	3.0	3.5	4.0	5.1	15	-27	-16	-12	-9	-4	45	**100**	0	**46**

Table 11.1 (continued)

		Temperature Response (°C)						Precipitation Response (%)						Extreme Seasons (%)		
Region[a]	Season	Min	25	50	75	Max	T yrs	Min	25	50	75	Max	T yrs	Warm	Wet	Dry
ASIA																
NAS	DJF	2.9	4.8	6.0	6.6	8.7	20	12	20	26	37	55	30	**93**	**68**	0
	MAM	2.0	2.9	3.7	5.0	6.8	25	2	16	18	24	26	30	**89**	**66**	1
50N,40E	JJA	2.0	2.7	3.0	4.9	5.6	15	-1	6	9	12	16	40	**100**	**51**	2
to	SON	2.8	3.6	4.8	5.8	6.9	15	7	15	17	19	29	30	**99**	**65**	0
70N,180E	Annual	2.7	3.4	4.3	5.3	6.4	15	10	12	15	19	25	20	**100**	**92**	0
CAS	DJF	2.2	2.6	3.2	3.9	5.2	25	-11	0	4	9	22		**84**	**8**	
	MAM	2.3	3.1	3.9	4.5	4.9	20	-26	-14	-9	-4	3	>100	**94**		**16**
30N,40E	JJA	2.7	3.7	4.1	4.9	5.7	10	-58	-28	-13	-4	21	>100	**100**	3	**20**
to	SON	2.5	3.2	3.8	4.1	4.9	15	-18	-4	3	9	24		**99**		
50N,75E	Annual	2.6	3.2	3.7	4.4	5.2	10	-18	-6	-3	2	6		**100**		**12**
TIB	DJF	2.8	3.7	4.1	4.9	6.9	20	1	12	19	26	36	45	**95**	**40**	0
	MAM	2.5	2.9	3.6	4.3	6.3	15	-3	4	10	14	34	70	**96**	**34**	2
30N,50E	JJA	2.7	3.2	4.0	4.7	5.4	10	-11	0	4	10	28		**100**	**24**	
to	SON	2.7	3.3	3.8	4.6	6.2	15	-8	-4	8	14	21		**100**	**20**	
75N,100E	Annual	2.8	3.2	3.8	4.5	6.1	10	-1	2	10	13	28	45	**100**	**46**	1
EAS	DJF	2.1	3.1	3.6	4.4	5.4	20	-4	6	10	17	42	>100	**96**	**18**	2
	MAM	2.1	2.6	3.3	3.8	4.6	15	0	7	11	14	20	55	**98**	**35**	2
20N,100E	JJA	1.9	2.5	3.0	3.9	5.0	10	-2	5	9	11	17	45	**100**	**32**	1
to	SON	2.2	2.7	3.3	4.2	5.0	15	-13	-1	9	15	29		**100**	**20**	3
50N,145E	Annual	2.3	2.8	3.3	4.1	4.9	10	2	4	9	14	20	40	**100**	**47**	1
SAS	DJF	2.7	3.2	3.6	3.9	4.8	10	-35	-9	-5	1	15		**99**		
	MAM	2.1	3.0	3.5	3.8	5.3	10	-30	-2	9	18	26		**100**	**14**	
5N,64E	JJA	1.2	2.2	2.7	3.2	4.4	15	-3	4	11	16	23	45	**96**	**32**	1
to	SON	2.0	2.5	3.1	3.5	4.4	10	-12	8	15	20	26	50	**100**	**29**	3
50N,100E	Annual	2.0	2.7	3.3	3.6	4.7	10	-15	4	11	15	20	40	**100**	**39**	3
SEA	DJF	1.6	2.1	2.5	2.9	3.6	10	-4	3	6	10	12	80	**99**	**23**	2
	MAM	1.5	2.2	2.7	3.1	3.9	10	-4	2	7	9	17	75	**100**	**27**	1
11S,95E	JJA	1.5	2.2	2.4	2.9	3.8	10	-3	3	7	9	17	70	**100**	**24**	2
to	SON	1.6	2.2	2.4	2.9	3.6	10	-2	2	6	10	21	85	**99**	**26**	3
20N,115E	Annual	1.5	2.2	2.5	3.0	3.7	10	-2	3	7	8	15	40	**100**	**44**	1
NORTH AMERICA																
ALA	DJF	4.4	5.6	6.3	7.5	11.0	30	6	20	28	34	56	40	**80**	**39**	0
	MAM	2.3	3.2	3.5	4.7	7.7	35	2	13	17	23	38	40	**69**	**45**	0
60N,170W	JJA	1.3	1.8	2.4	3.8	5.7	25	1	8	14	20	30	45	**86**	**51**	1
to	SON	2.3	3.6	4.5	5.3	7.4	25	6	14	19	31	36	40	**86**	**51**	0
72N,103W	Annual	3.0	3.7	4.5	5.2	7.4	20	6	13	21	24	32	25	**97**	**80**	0
CGI	DJF	3.3	5.2	5.9	7.2	8.5	20	6	15	26	32	42	30	**95**	**58**	0
	MAM	2.4	3.2	3.8	4.6	7.2	20	4	13	17	20	34	35	**94**	**49**	1
50N,103W	JJA	1.5	2.1	2.8	3.7	5.6	15	0	8	11	12	19	35	**99**	**46**	1
to	SON	2.7	3.4	4.0	5.7	7.3	20	7	14	16	22	37	35	**99**	**62**	0
85N,10W	Annual	2.8	3.5	4.3	5.0	7.1	15	8	12	15	20	31	25	**100**	**90**	0

Table 11.1 (continued)

		Temperature Response (°C)						Precipitation Response (%)						Extreme Seasons (%)		
Region[a]	Season	Min	25	50	75	Max	T yrs	Min	25	50	75	Max	T yrs	Warm	Wet	Dry
NORTH AMERICA (continued)																
WNA	DJF	1.6	3.1	3.6	4.4	5.8	25	-4	2	7	11	36	>100	**80**	**18**	3
	MAM	1.5	2.4	3.1	3.4	6.0	20	-7	2	5	8	14	>100	**87**	**14**	
30N,50E	JJA	2.3	3.2	3.8	4.7	5.7	10	-18	-10	-1	2	10		**100**	3	
to	SON	2.0	2.8	3.1	4.5	5.3	20	-3	3	6	12	18	>100	**95**	**17**	2
75N,100E	Annual	2.1	2.9	3.4	4.1	5.7	15	-3	0	5	9	14	70	**100**	**21**	2
CNA	DJF	2.0	2.9	3.5	4.2	6.1	30	-18	0	5	8	14		**71**	**7**	
	MAM	1.9	2.8	3.3	3.9	5.7	25	-17	2	7	12	17	>100	**81**	**19**	4
30N,103W	JJA	2.4	3.1	4.1	5.1	6.4	20	-31	-15	-3	4	20	>100	**93**		**15**
to	SON	2.4	3.0	3.5	4.6	5.8	20	-17	-4	4	11	24		**91**	**11**	
50N,85W	Annual	2.3	3.0	3.5	4.4	5.8	15	-16	-3	3	7	15		**98**		
ENA	DJF	2.1	3.1	3.8	4.6	6.0	25	2	9	11	19	28	85	**78**	**24**	
	MAM	2.3	2.7	3.5	3.9	5.9	20	-4	7	12	16	23	60	**86**	**23**	2
25N,85W	JJA	2.1	2.6	3.3	4.3	5.4	15	-17	-3	1	6	13		**98**		
to	SON	2.2	2.8	3.5	4.4	5.7	20	-7	4	7	11	17	>100	**97**	**19**	
50N,50W	Annual	2.3	2.8	3.6	4.3	5.6	15	-3	5	7	10	15	55	**100**	**29**	1
CENTRAL AND SOUTH AMERICA																
CAM	DJF	1.4	2.2	2.6	3.5	4.6	15	-57	-18	-14	-9	0	>100	**96**	2	**25**
	MAM	1.9	2.7	3.6	3.8	5.2	10	-46	-25	-16	-10	15	75	**100**	2	**18**
10N,116W	JJA	1.8	2.7	3.4	3.6	5.5	10	-44	-25	-9	-4	12	90	**100**		**24**
to	SON	2.0	2.7	3.2	3.7	4.6	10	-45	-10	-4	7	24		**100**		**15**
30N,83W	Annual	1.8	2.6	3.2	3.6	5.0	10	-48	-16	-9	-5	9	65	**100**	2	**33**
AMZ	DJF	1.7	2.4	3.0	3.7	4.6	10	-13	0	4	11	17	>100	**93**	**27**	4
	MAM	1.7	2.5	3.0	3.7	4.6	10	-13	-1	1	4	14		**100**	**18**	
20S,82W	JJA	2.0	2.7	3.5	3.9	5.6	10	-38	-10	-3	2	13		**100**		
to	SON	1.8	2.8	3.5	4.1	5.4	10	-35	-12	-2	8	21		**100**		
12N,34W	Annual	1.8	2.6	3.3	3.7	5.1	10	-21	-3	0	6	14		**100**		
SSA	DJF	1.5	2.5	2.7	3.3	4.3	10	-16	-2	1	7	10		**100**		
	MAM	1.8	2.3	2.6	3.0	4.2	15	-11	-2	1	5	7		**98**	8	
56S,76W	JJA	1.7	2.1	2.4	2.8	3.6	15	-20	-7	0	3	17		**95**		
to	SON	1.8	2.2	2.7	3.2	4.0	15	-20	-12	1	6	11		**99**		
20S,40W	Annual	1.7	2.3	2.5	3.1	3.9	10	-12	-1	3	5	7		**100**		
AUSTRALIA AND NEW ZEALAND																
NAU	DJF	2.2	2.6	3.1	3.7	4.6	20	-20	-8	1	8	27		**89**		
	MAM	2.1	2.7	3.1	3.3	4.3	20	-24	-12	1	15	40		**92**		3
30S,110E	JJA	2.0	2.7	3.0	3.3	4.3	25	-54	-20	-14	3	26		**94**	3	
to	SON	2.5	3.0	3.2	3.8	5.0	20	-58	-32	-12	2	20		**98**		
11S,155E	Annual	2.2	2.8	3.0	3.5	4.5	15	-25	-8	-4	8	23		**99**		
SAU	DJF	2.0	2.4	2.7	3.2	4.2	20	-23	-12	-2	12	30		**95**		
	MAM	2.0	2.2	2.5	2.8	3.9	20	-31	-9	-5	13	32		**90**		**6**
45S,110E	JJA	1.7	2.0	2.3	2.5	3.5	15	-37	-20	-11	-4	9	>100	**95**		**17**
to	SON	2.0	2.6	2.8	3.0	4.1	20	-42	-27	-14	-5	4	>100	**95**		**15**
30S,155E	Annual	1.9	2.4	2.6	2.8	3.9	15	-27	-13	-4	3	12		**100**		

Table 11.1 (continued)

		Temperature Response (°C)						Precipitation Response (%)						Extreme Seasons (%)		
Region[a]	Season	Min	25	50	75	Max	T yrs	Min	25	50	75	Max	T yrs	Warm	Wet	Dry
POLAR REGIONS																
ARC[b]	DJF	4.3	6.0	6.9	8.4	11.4	15	11	19	26	29	39	25	**100**	**90**	0
	MAM	2.4	3.7	4.4	4.9	7.3	15	9	14	16	21	32	25	**100**	**79**	0
60N,180E	JJA	1.2	1.6	2.1	3.0	5.3	15	4	10	14	17	20	25	**100**	**85**	0
to	SON	2.9	4.8	6.0	7.2	8.9	15	9	17	21	26	35	20	**100**	**96**	0
90N,180W	Annual	2.8	4.0	4.9	5.6	7.8	15	10	15	18	22	28	20	**100**	**100**	0
ANT[c]	DJF	0.8	2.2	2.6	2.8	4.6	20	-11	5	9	14	31	50	**85**	**34**	3
	MAM	1.3	2.2	2.6	3.3	5.3	20	1	8	12	19	40	40	**88**	**54**	0
90S,180E	JJA	1.4	2.3	2.8	3.3	5.2	25	5	14	19	24	41	30	**83**	**59**	0
to	SON	1.3	2.1	2.3	3.2	4.8	25	-2	9	12	18	36	45	**79**	**42**	1
60S,180W	Annual	1.4	2.3	2.6	3.0	5.0	15	-2	9	14	17	35	25	**99**	**81**	1
SMALL ISLANDS																
CAR	DJF	1.4	1.8	2.1	2.4	3.2	10	-21	-11	-6	0	10		**100**	2	
	MAM	1.3	1.8	2.2	2.4	3.2	10	-28	-20	-13	-6	6	>100	**100**	3	**18**
10N,85W	JJA	1.3	1.8	2.0	2.4	3.2	10	-57	-35	-20	-6	8	60	**100**	2	**40**
to	SON	1.6	1.9	2.0	2.5	3.4	10	-38	-18	-6	1	19		**100**		**22**
25N,60W	Annual	1.4	1.8	2.0	2.4	3.2	10	-39	-19	-12	-3	11	60	**100**	3	**39**
IND	DJF	1.4	2.0	2.1	2.4	3.8	10	-4	2	4	9	20	>100	**100**	**19**	1
	MAM	1.5	2.0	2.2	2.5	3.8	10	0	3	5	6	20	80	**100**	**22**	1
35S,50E	JJA	1.4	1.9	2.1	2.4	3.7	10	-3	-1	3	5	20		**100**	**17**	
to	SON	1.4	1.9	2.0	2.3	3.6	10	-5	2	4	7	21	>100	**100**	**17**	2
17.5N,100E	Annual	1.4	1.9	2.1	2.4	3.7	10	-2	3	4	5	20	65	**100**	**30**	2
MED	DJF	1.5	2.0	2.3	2.7	4.2	25	-25	-16	-14	-10	-2	85	**96**	1	**18**
	MAM	1.5	2.1	2.4	2.7	3.7	20	-32	-23	-19	-16	-6	65	**99**	0	**32**
30N,5W	JJA	2.0	2.6	3.1	3.7	4.7	15	-64	-34	-29	-20	-3	60	**100**	1	**36**
to	SON	1.9	2.3	2.7	3.2	4.4	20	-33	-16	-10	-5	9	>100	**99**	2	**21**
45N,35E	Annual	1.7	2.2	2.7	3.0	4.2	15	-30	-16	-15	-10	-6	45	**100**	0	**50**
TNE	DJF	1.4	1.9	2.1	2.3	3.3	10	-35	-8	-6	3	10	>100	**100**		
	MAM	1.5	1.9	2.0	2.2	3.1	15	-16	-7	-2	6	39	>100	**100**		
0,30W	JJA	1.4	1.9	2.1	2.4	3.6	15	-8	-2	2	7	13	>100	**100**		
to	SON	1.5	2.0	2.2	2.6	3.7	15	-16	-5	-1	3	9	>100	**100**		
40N,10W	Annual	1.4	1.9	2.1	2.4	3.5	15	-7	-3	1	3	7	>100	**100**		
NPA	DJF	1.5	1.9	2.4	2.5	3.6	10	-5	1	3	6	17	>100	**100**	**20**	2
	MAM	1.4	1.9	2.3	2.5	3.5	10	-17	-1	1	3	17		**100**	**14**	
0,150E	JJA	1.4	1.9	2.3	2.7	3.9	10	1	5	8	14	25	55	**100**	**43**	1
to	SON	1.6	1.9	2.4	2.9	3.9	10	1	5	6	13	22	50	**100**	**31**	1
40N,120W	Annual	1.5	1.9	2.3	2.6	3.7	10	0	3	5	10	19	60	**100**	**35**	1
SPA	DJF	1.4	1.7	1.8	2.1	3.2	10	-6	1	4	7	15	80	**100**	**19**	4
	MAM	1.4	1.8	1.9	2.1	3.2	10	-3	3	6	8	17	35	**100**	**35**	1
55S,150E	JJA	1.4	1.7	1.8	2.0	3.1	10	-2	1	3	5	12	70	**100**	**27**	3
to	SON	1.4	1.6	1.8	2.0	3.0	10	-8	-2	2	4	5		**100**		
0,80W	Annual	1.4	1.7	1.8	2.0	3.1	10	-4	3	3	6	11	40	**100**	**40**	3

Notes: [a] Regions are: West Africa (WAF), East Africa (EAF), South Africa (SAF), Sahara (SAH), Northern Europe (NEU), Southern Europe and Mediterranean (SEM), Northern Asia (NAS), Central Asia (CAS), Tibetan Plateau (TIB), East Asia (EAS), South Asia (SAS), Southeast Asia (SEA), Alaska (ALA), East Canada, Greenland and Iceland (CGI), Western North America (WNA), Central North America (CNA), Eastern North America (ENA), Central America (CAM), Amazonia (AMZ), Southern South America (SSA), North Australia (NAU), South Australia (SAU), Arctic (ARC), Antarctic (ANT), Caribbean (CAR), Indian Ocean (IND), Mediterrranean Basin (MED), Tropical Northeast Atlantic (TNE), North Pacific Ocean (NPA), and South Pacific Ocean (SPA).

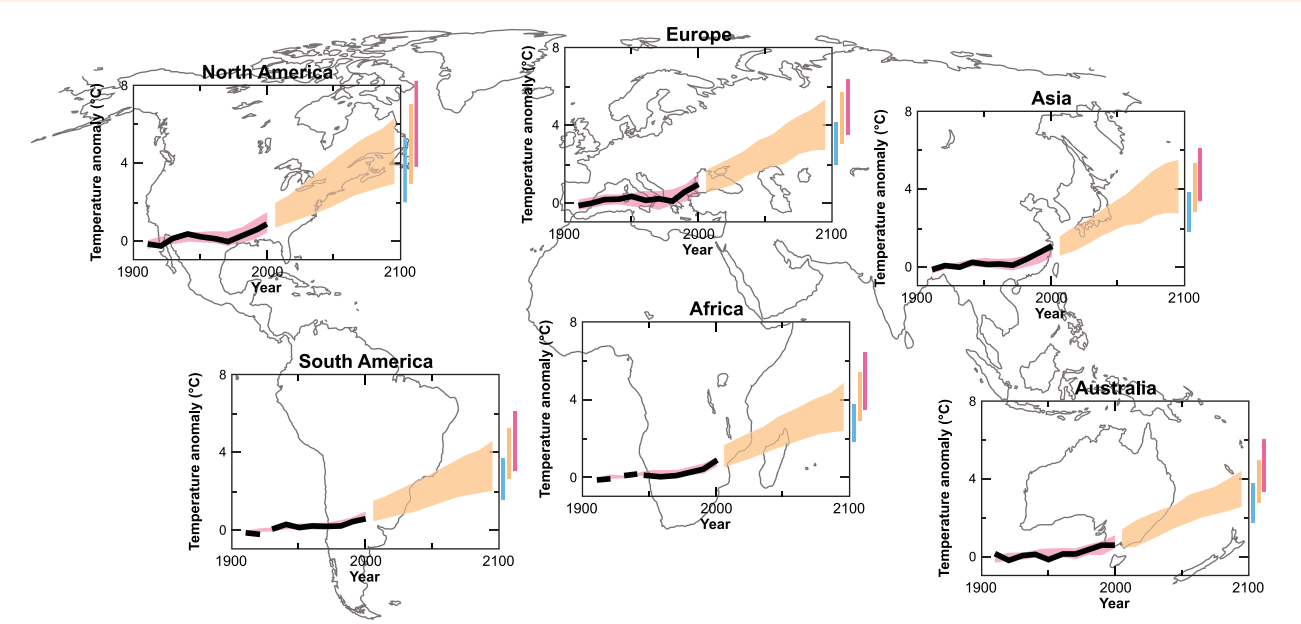
[b] land and ocean

[c] land only

Box 11.1: Summary of Regional Responses

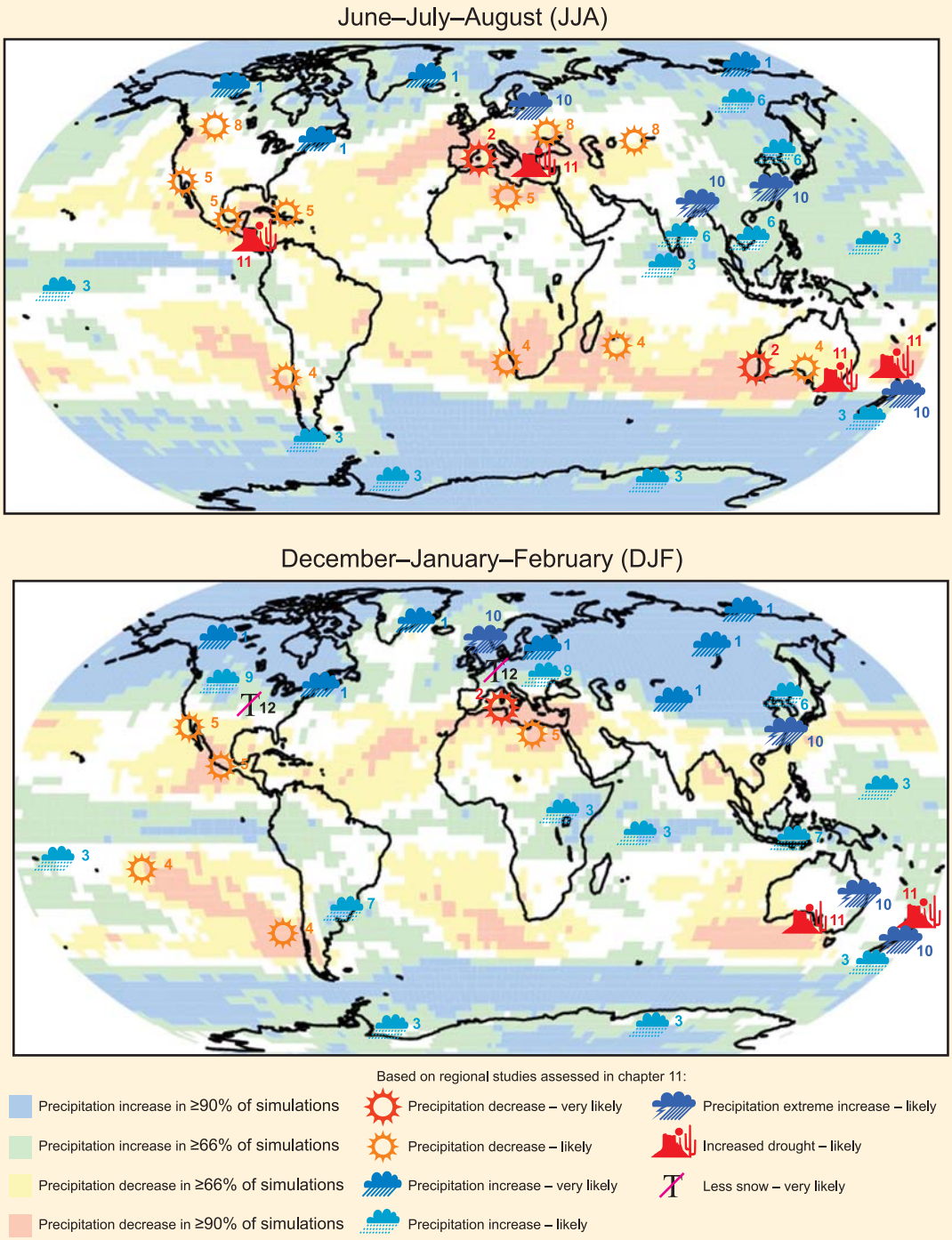
As an introduction to the more detailed regional analysis presented in this chapter, Box 11.1, Figure 1 illustrates how continental-scale warming is projected to evolve in the 21st century using the MMD models. This warming is also put into the context of the observed warming during the 20th century by comparing results from that subset of the models incorporating a representation of all known forcings with the observed evolution (see Section 9.4 for more details). Thus for the six continental regions, the figure displays: 1) the observed time series of the evolution of decadally averaged surface air temperature from 1906 to 2005 as an anomaly from the 1901 to 1950 average; 2) the range of the equivalent anomalies derived from 20th-century simulations by the MMD models that contain a full set of historical forcings; 3) the evolution of the range of this anomaly in MMD-A1B projections between 2000 and 2100; and 4) the range of the projected anomaly for the last decade of the 21st century for the B1, A1B, and A2 scenarios. For the observed part of these graphs, the decadal averages are centred on the decade boundaries (i.e., the last point is for 1996 to 2005), whereas for the future period they are centred on the decade mid-points (i.e., the first point is for 2001 to 2010). The width of the shading and the bars represents the 5 to 95% range of the model results. To construct the ranges, all simulations from the set of models involved were considered independent realisations of the possible evolution of the climate given the forcings applied. This involved 58 simulations from 14 models for the observed period and 47 simulations from 18 models for the future. Important in this representation is that the models' estimate of natural climate variability is included and thus the ranges include both the potential mitigating and amplifying effects of variability on the underlying signal. In contrast, the bars representing the range of projected change at the end of the century are constructed from ensemble mean changes from the models and thus provide a measure of the forced response. These bars were constructed from decadal mean anomalies from 21 models using A1B scenario forcings, from the 20 of these models that used the B1 forcings and the 17 that used the A2 forcings. The bars for the B1 and A2 scenarios were scaled to approximate ranges for the full set of models. The scaling factor for B1 was derived from the ratio between its range and the A1B range of the corresponding 20 models. The same procedure was used to obtain the A2 scaling factor. Only 18 models were used to display the ranges of projected temperature evolution as the control simulations for the other 3 had a drift of >0.2°C per century, which precludes clearly defining the decadal anomalies from these models. However, anomalies from all 21 models were included in calculating the bars in order to provide the fullest possible representation of projected changes in the MMD. Comparison of these different representations shows that the main messages from the MMD about projected continental temperature change are insensitive to the choices made. Finally, results are not shown here for Antarctica because the observational record is not long enough to provide the relevant information for the first part of the 20th century. Results of a similar nature to those shown here using the observations that are available are presented in Section 11.8. *(continued)*

Box 11.1, Figure 1. *Temperature anomalies with respect to 1901 to 1950 for six continental-scale regions for 1906 to 2005 (black line) and as simulated (red envelope) by MMD models incorporating known forcings; and as projected for 2001 to 2100 by MMD models for the A1B scenario (orange envelope). The bars at the end of the orange envelope represent the range of projected changes for 2091 to 2100 for the B1 scenario (blue), the A1B scenario (orange) and the A2 scenario (red). The black line is dashed where observations are present for less than 50% of the area in the decade concerned. More details on the construction of these figures are given in Section 11.1.2.*



Box 11.1, Figure 2 serves to illustrate some of the more significant hydrological changes, with the two panels corresponding to DJF and JJA. The backdrop to these figures is the fraction of the AOGCMs (out of the 21 considered for this purpose) that predict an increase in mean precipitation in that grid cell (using the A1B scenario and comparing the period 2080 to 2099 with the control period 1980 to 1999). Aspects of this pattern are examined more closely in the separate regional discussions.

Robust findings on regional climate change for mean and extreme precipitation, drought and snow are highlighted in the figure with further detail in the accompanying notes. *(continued)*



Box 11.1, Figure 2. *Robust findings on regional climate change for mean and extreme precipitation, drought, and snow. This regional assessment is based upon AOGCM based studies, Regional Climate Models, statistical downscaling and process understanding. More detail on these findings may be found in the notes below, and their full description, including sources is given in the text. The background map indicates the degree of consistency between AR4 AOGCM simulations (21 simulations used) in the direction of simulated precipitation change.*

(1) Very likely annual mean increase in most of northern Europe and the Arctic (largest in cold season), Canada, and the North-East USA; and winter (DJF) mean increase in Northern Asia and the Tibetan Plateau.
(2) Very likely annual mean decrease in most of the Mediterranean area, and winter (JJA) decrease in southwestern Australia.
(3) Likely annual mean increase in tropical and East Africa, Northern Pacific, the northern Indian Ocean, the South Pacific (slight, mainly equatorial regions), the west of the South Island of New Zealand, Antarctica and winter (JJA) increase in Tierra del Fuego.
(4) Likely annual mean decrease in and along the southern Andes, summer (DJF) decrease in eastern French Polynesia, winter (JJA) decrease for Southern Africa and in the vicinity of Mauritius, and winter and spring decrease in southern Australia.
(5) Likely annual mean decrease in North Africa, northern Sahara, Central America (and in the vicinity of the Greater Antilles in JJA) and in South-West USA.
(6) Likely summer (JJA) mean increase in Northern Asia, East Asia, South Asia and most of Southeast Asia, and likely winter (DJF) increase in East Asia.
(7) Likely summer (DJF) mean increase in southern Southeast Asia and southeastern South America
(8) Likely summer (JJA) mean decrease in Central Asia, Central Europe and Southern Canada.
(9) Likely winter (DJF) mean increase in central Europe, and southern Canada
(10) Likely increase in extremes of daily precipitation in northern Europe, South Asia, East Asia, Australia and New Zealand.
(11) Likely increase in risk of drought in Australia and eastern New Zealand; the Mediterranean, central Europe (summer drought); in Central America (boreal spring and dry periods of the annual cycle).
(12) Very likely decrease in snow season length and likely to very likely decrease in snow depth in most of Europe and North America.

models. The results are shown in Table 11.1 only when 14 out of the 21 models agree as to the sign of the change in frequency of extremes. For example, in Central North America (CNA), 15% of the summers in 2080 to 2099 in the A1B scenario are projected to be extremely dry, corresponding to a factor of three increase in the frequency of these events. In contrast, in many regions and seasons, the frequency of extreme warmth is 100%, implying that all seasons in 2080 to 2099 are warmer than the warmest season in 1980 to 1999, according to every model in this ensemble.

In each continental section, a figure is provided summarising the temperature and precipitation responses in the MMD-A1B projection for the last two decades of the 21st century. These figures portray a multi-model mean comprising individual models or model ensemble means where ensembles exist. Also shown is the simple statistic of the number of these models that show agreement in the sign of the precipitation change. The annual mean temperature and precipitation responses in each of the 21 separate AOGCMs are provided in Supplementary Material Figures S11.5 to 11.12 and S11.13 to 11.20, respectively.

Recent explorations of multi-model ensemble projections seek to develop probabilistic estimates of uncertainties and are provided in the Supplementary Material Table S11.2. This information is based on the approach of Tebaldi et al. (2004a,b; see also section 11.10.2).

11.1.3 Some Unifying Themes

The basic pattern of the projected warming as described in Chapter 10 is little changed from previous assessments. Examining the spread across the MMD models, temperature projections in many regions are strongly correlated with the global mean projections, with the most sensitive models in global mean temperature often the most sensitive locally. Differing treatments of regional processes and the dynamical interactions between a given region and the rest of the climate system are responsible for some spread. However, a substantial part of the spread in regional temperature projections is due to differences in the sum of the feedbacks that control transient climate sensitivity (see also Chapter 10).

The response of the hydrological cycle is controlled in part by fundamental consequences of warmer temperatures and the increase in water vapour in the atmosphere (Chapter 3). Water is transported horizontally by the atmosphere from regions of moisture divergence (particularly in the subtropics) to regions of convergence. Even if the circulation does not change, these transports will increase due to the increase in water vapour. The consequences of this increased moisture transport can be seen in the global response of precipitation, described in Chapter 10, where, on average, precipitation increases in the inter-tropical convergence zones, decreases in the subtropics, and increases in subpolar and polar regions. Over North America and Europe, the pattern of subpolar moistening and subtropical

drying dominates the 21st-century projections. This pattern is also described in Section 9.5.4, which assesses the extent to which this pattern is visible over land during the 20th century in precipitation observations and model simulations. Regions of large uncertainty often lie near the boundaries between these robust moistening and drying regions, with boundaries placed differently by each model.

High-resolution model results indicate that in regions with strong orographic forcing, some of these large-scale findings can be considerably altered locally. In some cases, this may result in changes in the opposite direction to the more general large-scale behaviour. In addition, large-area and grid-box average projections for precipitation are often very different from local changes within the area (Good and Lowe, 2006). These issues demonstrate the inadequacy of inferring the behaviour at fine scales from that of large-area averages.

Another important theme in the 21st-century projections is the poleward expansion of the subtropical highs, and the poleward displacement of the mid-latitude westerlies and associated storm tracks. This circulation response is often referred to as an enhanced positive phase of the Northern or Southern Annular Mode, or when focusing on the North Atlantic, the positive phase of the North Atlantic Oscillation (NAO). In regions without strong orographic forcing, superposition of the tendency towards subtropical drying and poleward expansion of the subtropical highs creates especially robust drying responses at the poleward boundaries of the five subtropical oceanic high centres in the South Indian, South Atlantic, South Pacific, North Atlantic and, less robustly, the North Pacific (where a tendency towards El-Niño like conditions in the Pacific in the models tends to counteract this expansion). Most of the regional projections of strong drying tendencies over land in the 21st century are immediately downstream of these centres (south-western Australia, the Western Cape Provinces of South Africa, the southern Andes, the Mediterranean and Mexico). The robustness of this large-scale circulation signal is discussed in Chapter 10, while Chapters 3, 8 and 9 describe the observed poleward shifts in the late 20th century and the ability of models to simulate these shifts.

The retreats of snow and ice cover are important for local climates. The difficulty of quantifying these effects in regions of substantial topographic relief is a significant limitation of global models (see Section 11.4.3.2, Box 11.3) and is improved with dynamical and statistical downscaling. The drying effect of an earlier spring snowmelt and, more generally, the earlier reduction in soil moisture (Manabe and Wetherald, 1987) is a continuing theme in discussion of summer continental climates.

The strong interactions between sea surface temperature gradients and tropical rainfall variability provides an important unifying theme for tropical climates. Models can differ in their projections of small changes in tropical ocean temperature gradients and in the simulation of the potentially large shifts in rainfall that are related to these oceanic changes. Chou and Neelin (2004) provide a guide to some of the complexity involved in diagnosing and evaluating hydrological responses in the tropics. With a few exceptions, the spread in projections of hydrological changes is still too large to make strong statements about the future of tropical climates at regional scales (see also Section 10.3). Many AOGCMs project large tropical precipitation changes, so uncertainty as to the regional pattern of these changes should not be taken as evidence that these changes are likely to be small.

Assessments of the regional and sub-regional climate change projections have primarily been based on the AOGCM projections summarised in Table 11.1 and an analysis of the biases in the AOGCM simulations, regional downscaling studies available for some regions with either physical or statistical models or both, and reference to plausible physical mechanisms.

To assist the reader in placing the various regional assessments in a global context, Box 11.1 displays many of the detailed assessments documented in the following regional sections. Likewise, an overview of projected changes in various types of extreme weather statistics is summarised in Table 11.2, which contains information from the assessments within this chapter and from Chapter 10. Thus, the details of the assessment that lead to each individual statement can all be found in either Chapter 10, or the respective regional sections, and links for each statement are identifiable from Table 11.2.

Table 11.2. *Projected changes in climate extremes. This table summarises key phenomena for which there is confidence in the direction of projected change based on the current scientific evidence. The included phenomena are those where confidence ranges between medium and very likely, and are listed with the notation of VL (very likely), L (likely), and M (medium confidence). maxTmax refers to the highest maximum temperature, maxTmin to the highest minimum temperature, minTmax to the lowest maximum temperature, and minTmin to the lowest minimum temperature. In addition to changes listed in the table, there are two phenomena of note for which there is little confidence. The issue of drying and associated risk of drought in the Sahel remains uncertain as discussed in Section 11.2.4.2. The change in mean duration of tropical cyclones cannot be assessed with confidence at this stage due to insufficient studies.*

Temperature-Related Phenomena	
Change in phenomenon	**Projected changes**
Higher monthly absolute maximum of daily maximum temperatures (maxTmax) more hot / warm summer days	**VL (consistent across model projections)** maxTmax increases at same rate as the mean or median[1] over northern Europe,[2] Australia and New Zealand[3] **L (fairly consistent across models, but sensitivity to land surface treatment)** maxTmax increases more than the median over southern and central Europe,[4] and southwest USA[5] **L (consistent with projected large increase in mean temperature)** Large increase in probability of extreme warm seasons over most parts of the world[6]
Longer duration, more intense, more frequent heat waves / hot spells in summer	**VL (consistent across model projections)** Over almost all continents[7], but particularly central Europe,[8] western USA,[9] East Asia[10] and Korea[11]
Higher monthly absolute maximum of daily minimum temperatures (maxTmin); more warm and fewer cold nights	**VL (consistent with higher mean temperatures)** Over most continents[12]
Higher monthly absolute minimum of daily minimum temperatures (minTmin)	**VL (consistent across model projections)** minTmin increases more than the mean in many mid- and high-latitude locations,[13] particularly in winter over most of Europe except the southwest[14]
Higher monthly absolute minimum of daily maximum temperatures (minTmax), fewer cold days	**L (consistent with warmer mean temperatures)** minTmin increases more than the mean in some areas[15]
Fewer frost days	**VL (consistent across model projections)** Decrease in number of days with below-freezing temperatures everywhere[16]
Fewer cold outbreaks; fewer, shorter, less intense cold spells / cold extremes in winter	**VL (consistent across model projections)** Northern Europe, South Asia, East Asia[17] **L (consistent with warmer mean temperatures)** Most other regions[18]
Reduced diurnal temperature range	**L (consistent across model projections)** Over most continental regions, night temperatures increase faster than the day temperatures[19]
Temperature variability on interannual and daily time scales	**L (general consensus across model projections)** Reduced in winter over most of Europe[20] Increase in central Europe in summer[21]

1 Kharin and Zwiers (2005)
2 §11.3.3.3, Supplementary Material Figure S11.23, PRUDENCE, Kjellström et al. (2007)
3 §11.7.3.5, CSIRO (2001)
4 §11.3.3.3, PRUDENCE, Kjellström et al. (2007)
5 §11.5.3.3, Bell et al. (2004),
6 Table 11.1
7 §11.3.3.3, Tebaldi et al. (2006), Meehl and Tebaldi (2004)
8 §11.5.3.3, Barnett et al. (2006), Clark et al. (2006), Tebaldi et al. (2006), Gregory and Mitchell (1995), Zwiers and Kharin (1998), Hegerl et al. (2004), Meehl and Tebaldi (2004)
9 §11.5.3.3, Bell et al. (2004), Leung et al. (2004)
10 §11.4.3.2, Gao et al. (2002)
11 §11.4.3.2, Kwon et al. (2005), Boo et al. (2006)
12 §11.3.3.2, §11.4.3.1
13 Kharin and Zwiers (2005)
14 §11.3.3.2, Fig. 11.3.3.3, PRUDENCE
15 §11.7.3.5, Whetton et al. (2002)
16 Tebaldi et al. (2006), Meehl and Tebaldi (2004), §11.3.3.2, PRUDENCE, §11.7.3.1, CSIRO (2001), Mullan et al. (2001b)
17 §11.3.3.2, PRUDENCE, Kjellström et al. (2007), §11.4.3.2, Gao et al. (2002), Rupa Kumar et al. (2006)
18 §11.1.3
19 §11.5.3.3, Bell et al. (2004), Leung et al. (2004), §11.4.3.2, Rupa Kumar et al. (2006), Mizuta et al. (2005)
20 §11.3.3.2, Räisänen (2001), Räisänen and Alexandersson (2003), Giorgi and Bi (2005), Zwiers and Kharin (1998), Hegerl et al. (2004), Kjellström et al. (2007)
21 §11.3.3.2, PRUDENCE, Schär et al. (2004), Vidale et al. (2007)

Table 11.2. (continued)

Moisture-Related Phenomena	
Phenomenon	**Projected changes**
Intense precipitation events	**VL (consistent across model projections; empirical evidence, generally higher precipitation extremes in warmer climates)** Much larger increase in the frequency than in the magnitude of precipitation extremes over most land areas in middle latitudes,[22] particularly over northern Europe,[23] Australia and New Zealand[24] Large increase during the Indian summer monsoon season over Arabian Sea, tropical Indian Ocean, South Asia[25] Increase in summer over south China, Korea and Japan[26]
Intense precipitation events	**L (some inconsistencies across model projections)** Increase over central Europe in winter[27] Increase associated with tropical cyclones over Southeast Asia, Japan[28] **Uncertain** Changes in summer over Mediterranean and central Europe[29] **L decrease (consistent across model projections)** Iberian Peninsula[30]
Wet days	**L (consistent across model projections)** Increase in number of days at high latitudes in winter, and over northwest China[31] Increase over the Inter-Tropical Convergence Zone[32] Decrease in South Asia[33] and the Mediterranean area[34]
Dry spells (periods of consecutive dry days)	**VL (consistent across model projections)** Increase in length and frequency over the Mediterranean area[35], southern areas of Australia, New Zealand[36] **L (consistent across model projections)** Increase in most subtropical areas[37] Little change over northern Europe[38]
Continental drying and associated risk of drought	**L (consistent across model projections; consistent change in precipitation minus evaporation, but sensitivity to formulation of land surface processes)** Increased in summer over many mid-latitude continental interiors, e.g., central[39] and southern Europe, Mediterranean area,[40] in boreal spring and dry periods of the annual cycle over Central America[41]

22 §11.3.3.4, Groisman et al. (2005), Kharin and Zwiers (2005), Hegerl et al. (2004), Semenov and Bengtsson (2002), Meehl et al. (2006)
23 §11.3.3.4, Räisänen (2002), Giorgi and Bi (2005), Räisänen (2005)
24 §11.1.3, §11.7.3.2, §11.3.3.4, Huntingford et al. (2003), Barnett et al. (2006), Frei et al. (2006), Hennessy et al. (1997), Whetton et al. (2002), Watterson and Dix (2003), Suppiah et al. (2004), McInnes et al. (2003), Hennessy et al. (2004b), Abbs (2004), Semenov and Bengtsson (2002)
25 §11.4.3.2, May (2004a), Rupa Kumar et al. (2006)
26 §11.4.3.2, Gao et al. (2002), Boo et al. (2006), Kimoto et al. (2005), Kitoh et al. (2005), Mizuta et al. (2005)
27 §11.3.3.4, PRUDENCE, Frei et al. (2006), Christensen and Christensen (2003, 2004)
28 §11.1.3, §11.4.3.2, Kimoto et al. (2005), Mizuta et al. (2005), Hasegawa and Emori (2005), Kanada et al. (2005)
29 §11.3.3.4, PRUDENCE, Frei et al. (2006), Christensen and Christensen (2004), Tebaldi et al. (2006)
30 §11.3.3.4, PRUDENCE, Frei et al. (2006)
31 §11.4.3.2, Gao et al. (2002), Hasegawa and Emori (2005)
32 Semenov and Bengtsson (2002)
33 §11.4.3.2 Krishna Kumar et al. (2003)
34 §11.3.3.4, Semenov and Bengtsson (2002), Voss et al. (2002); Räisänen et al. (2004); Frei et al. (2006)
35 §11.3.3.4, Semenov and Bengtsson, 2002; Voss et al., 2002; Hegerl et al., 2004; Wehner, 2004; Kharin and Zwiers, 2005; Tebaldi et al., 2006
36 §11.1.3, §11.7.3.2, §11.7.3.4, Whetton and Suppiah (2003), McInnes et al. (2003), Walsh et al. (2002), Hennessy et al. (2004c), Mullan et al. (2005)
37 §11.1.3
38 §11.3.3.4, Beniston et al. (2007), Tebaldi et al. (2006), Voss et al. (2002)
39 §11.3.3.2, Rowell and Jones (2006)
40 §11.1.3, §11.3.3.4, Voss et al. (2002)
41 §11.1.3

Table 11.2. (continued)

Tropical Cyclones (typhoons and hurricanes)	
Change in phenomenon	**Projected changes**
Increase in peak wind intensities	**L (high-resolution Atmospheric GCM (AGCM) and embedded hurricane model projections)** Over most tropical cyclone areas[42]
Increase in mean and peak precipitation intensities	**L (high-resolution AGCM projections and embedded hurricane model projections)** Over most tropical cyclone areas,[43] South,[44] East[45] and southeast Asia[46]
Changes in frequency of occurrence	**M (some high-resolution AGCM projections)** Decrease in number of weak storms, increase in number of strong storms[47] **M (several climate model projections)** Globally averaged decrease in number, but specific regional changes dependent on sea surface temperature change[48] Possible increase over the North Atlantic[49]
Extratropical Cyclones	
Change in phenomenon	**Projected changes**
Changes in frequency and position	**L (consistent in AOGCM projections)** Decrease in the total number of extratropical cyclones[50] Slight poleward shift of storm track and associated precipitation, particularly in winter[51]
Change in storm intensity and winds	**L (consistent in most AOGCM projections, but not explicitly analysed for all models)** Increased number of intense cyclones[52] and associated strong winds, particularly in winter over the North Atlantic,[53] central Europe[54] and Southern Island of New Zealand[55] **More likely than not** Increased windiness in northern Europe and reduced windiness in Mediterranean Europe[56]
Increased wave height	**L (based on projected changes in extratropical storms)** Increased occurrence of high waves in most mid-latitude areas analysed, particularly the North Sea[57]

42 Knutson and Tuleya (2004)
43 Knutson and Tuleya (2004)
44 §11.4.3.2, Unnikrishnan et al. (2006)
45 §11.3.4, Hasegawa and Emori (2005)
46 §11.3.4, Hasegawa and Emori (2005), Knutson and Tuleya (2004)
47 Oouchi et al. (2006)
48 Hasegawa and Emori (2005)
49 Sugi et al. (2002), Oouchi et al. (2006)
50 §11.3.3.6, Yin (2005), Lambert and Fyfe (2006), §11.3.3.5, Lionello et al. (2002), Leckebusch et al. (2006), Vérant (2004), Somot (2005)
51 §11.1.3, Yin (2005), Lambert and Fyfe (2006)
52 §11.1.2, §11.3.3.5, Yin (2005), Lambert and Fyfe (2006)
53 §11.3.3.5, Leckebusch and Ulbrich (2004)
54 §11.3.3.5, Zwiers and Kharin (1998), Knippertz et al. (2000), Leckebusch and Ulbrich (2004), Pryor et al. (2005a), Lionello et al. (2002), Leckebusch et al. (2006), Vérant (2004), Somot (2005)
55 §11.1.3, §11.7.3.7
56 §11.3.3.5, Lionello et al. (2002), Leckebusch et al. (2006), Vérant (2004), Somot (2005)
57 X.L. Wang et al. (2004)

Frequently Asked Question 11.1

Do Projected Changes in Climate Vary from Region to Region?

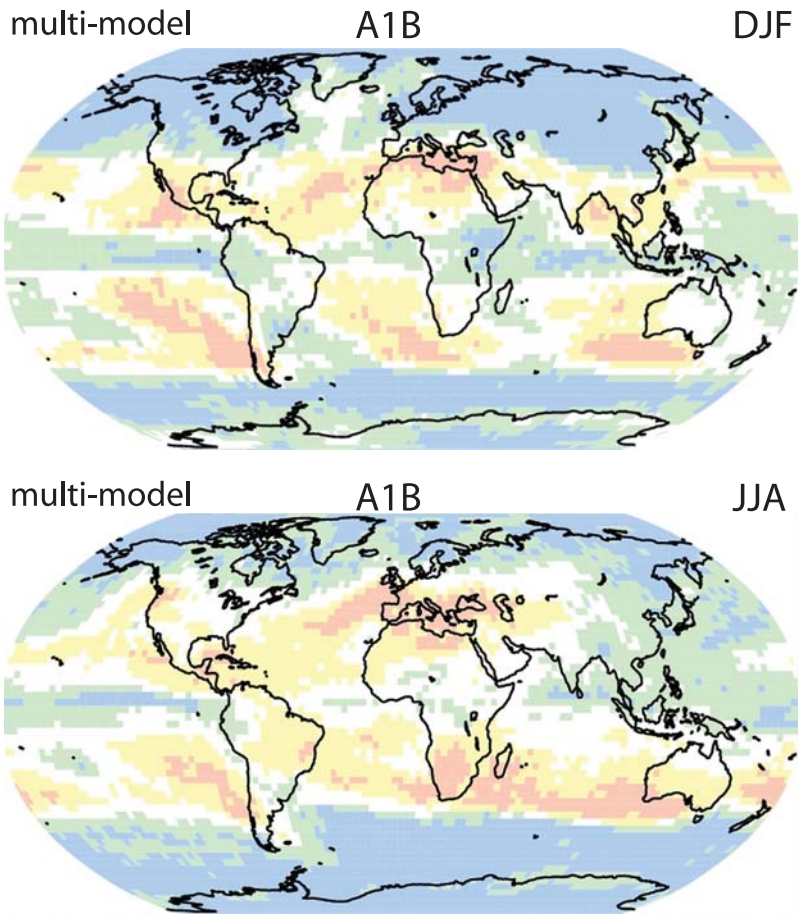
Climate varies from region to region. This variation is driven by the uneven distribution of solar heating, the individual responses of the atmosphere, oceans and land surface, the interactions between these, and the physical characteristics of the regions. The perturbations of the atmospheric constituents that lead to global changes affect certain aspects of these complex interactions. Some human-induced factors that affect climate ('forcings') are global in nature, while others differ from one region to another. For example, carbon dioxide, which causes warming, is distributed evenly around the globe, regardless of where the emissions originate, whereas sulphate aerosols (small particles) that offset some of the warming tend to be regional in their distribution. Furthermore, the response to forcings is partly governed by feedback processes that may operate in different regions from those in which the forcing is greatest. Thus, the projected changes in climate will also vary from region to region.

Latitude is a good starting point for considering how changes in climate will affect a region. For example, while warming is expected everywhere on Earth, the amount of projected warming generally increases from the tropics to the poles in the Northern Hemisphere. Precipitation is more complex, but also has some latitude-dependent features. At latitudes adjacent to the polar regions, precipitation is projected to increase, while decreases are projected in many regions adjacent to the tropics (see Figure 1). Increases in tropical precipitation are projected during rainy seasons (e.g., monsoons), and over the tropical Pacific in particular.

Location with respect to oceans and mountain ranges is also an important factor. Generally, the interiors of continents are projected to warm more than the coastal areas. Precipitation responses are especially sensitive not only to the continental geometry, but to the shape of nearby mountain ranges and wind flow direction. Monsoons, extratropical cyclones and hurricanes/typhoons are all influenced in different ways by these region-specific features.

Some of the most difficult aspects of understanding and projecting changes in regional climate relate to possible changes in the circulation of the atmosphere and oceans, and their patterns of variability. Although general statements covering a variety of regions with qualitatively similar climates can be made in some cases, nearly every region is idiosyncratic in some ways. This is true whether it is the coastal zones surrounding the subtropical Mediterranean Sea, the extreme weather in the North American interior that depends on moisture transport from the Gulf of Mexico, or the interactions between vegetation distribution, oceanic temperatures and atmospheric circulation that help control the southern limit of the Sahara Desert.

While developing an understanding of the correct balance of global and regional factors remains a challenge, the understanding of these factors is steadily growing, increasing our confidence in regional projections.



FAQ 11.1, Figure 1. *Blue and green areas on the map are by the end of the century projected to experience increases in precipitation, while areas in yellow and pink are projected to have decreases. The top panel shows projections for the period covering December, January and February, while the bottom panel shows projections for the period covering June, July and August.*

increase in intensity (precipitation and winds) is supported for the northwest Pacific (and other regions) by the recent modelling study of Knutson and Tuleya (2004). The high-resolution time-slice modelling experiment of Hasegawa and Emori (2005) also demonstrates an increase in tropical cyclone precipitation in the western North Pacific, but not an increase in tropical cyclone intensity. Wu and Wang (2004) examined possible changes in tracks in the northwest Pacific due to changes in steering flow in two Geophysical Fluid Dynamics Laboratory (GFDL) enhanced greenhouse gas experiments. Tracks moved more north-easterly, possibly reducing tropical cyclone frequency in the Southeast Asian region. Since most of the tropical cyclones form along the monsoon trough and are also influenced by ENSO, changes in the occurrence, intensity and characteristics of tropical cyclones and their interannual variability will be affected by changes in ENSO (see Section 10.3).

Central Asia and Tibet

Precipitation over central Asia increases in most MMD-A1B projections for DJF but decreases in the other seasons. The median change by the end of the 21st century is –3% in the annual mean, with +4% in DJF and –13% in JJA (the dry season) (Table 11.1). This seasonal variation in the changes is broadly consistent with the earlier multi-model study of Meleshko et al. (2004), although they find an increase in summer precipitation in the northern part of the area.

Over the Tibetan Plateau, all MMD-A1B models project increased precipitation in DJF (median 19%). Most but not all models also simulate increased precipitation in the other seasons (Table 11.1). Earlier studies both by AOGCMs and RCMs are consistent with these findings (Gao et al., 2003b; Y. Xu et al., 2003a,b, 2005).

11.5 North America

Assessment of projected climate change for North America:

All of North America is very likely to warm during this century, and the annual mean warming is likely to exceed the global mean warming in most areas. In northern regions, warming is likely to be largest in winter, and in the southwest USA largest in summer. The lowest winter temperatures are likely to increase more than the average winter temperature in northern North America, and the highest summer temperatures are likely to increase more than the average summer temperature in the southwest USA.

Annual mean precipitation is very likely to increase in Canada and the northeast USA, and likely to decrease in the southwest USA. In southern Canada, precipitation is likely to increase in winter and spring, but decrease in summer.

Snow season length and snow depth are very likely to decrease in most of North America, except in the northernmost part of Canada where maximum snow depth is likely to increase.

The uncertainties in regional climate changes over North America are strongly linked to the ability of AOGCMs to reproduce the dynamical features affecting the region (Chapter 10). Atmosphere-Ocean General Circulation Models exhibit large model-to-model differences in ENSO and NAO/Arctic Oscillation (AO) responses to climate changes. Changes in the Atlantic MOC are uncertain, and thus so is the magnitude of consequent reduced warming in the extreme north-eastern part of North America; cooling here cannot be totally excluded. The Hudson Bay and Canadian Archipelago are poorly resolved by AOGCMs, contributing to uncertainty in ocean circulation and sea ice changes and their influence on the climate of northern regions. Tropical cyclones are not resolved by the MMD models and inferred changes in the frequency, intensity and tracks of disturbances making landfall in southeast regions remain uncertain. At the coarse horizontal resolution of the MMD models, high-altitude terrain is poorly resolved, which likely results in an underestimation of warming associated with snow-albedo feedback at high elevations in western regions. Little is known about the dynamical consequences of the larger warming over land than over ocean, which may affect the northward displacement and intensification of the subtropical anticyclone off the West Coast. This could affect the subtropical North Pacific eastern boundary current, the offshore Ekman transport, the upwelling and its cooling effect on SST, the persistent marine stratus clouds and thus precipitation in the southwest USA.

The uncertainty associated with RCM projections of climate change over North America remains large despite the investments made in increasing horizontal resolution. All reported RCM projections were driven by earlier AOGCMs that exhibited larger biases than the MMD models. Coordinated ensemble RCM projections over North America are not yet available, making it difficult to compare results.

11.5.1 Key Processes

Central and northern regions of North America are under the influence of mid-latitude cyclones. Projections by AOGCMs (Chapter 10) generally indicate a slight poleward shift in storm tracks, an increase in the number of strong cyclones but a reduction in medium-strength cyclones over Canada and poleward of 70°N. Consequent with the projected warming, the atmospheric moisture transport and convergence is projected to increase, resulting in a widespread increase in annual precipitation over most of the continent except the south and south-western part of the USA and over Mexico.

The southwest region is very arid, under the general influence of a subtropical ridge of high pressure associated with the thermal contrast between land and adjacent ocean. The North American Monsoon System develops in early July (e.g., Higgins

and Mo, 1997); the prevailing winds over the Gulf of California undergo a seasonal reversal, from northerly in winter to southerly in summer, bringing a pronounced increase in rainfall over the southwest USA and ending the late spring wet period in the Great Plains (e.g., Bordoni et al., 2004). The projection of smaller warming over the Pacific Ocean than over the continent, and amplification and northward displacement of the subtropical anticyclone, is likely to induce a decrease in annual precipitation in the south-western USA and northern Mexico.

The Great Plains Low-Level Jet (LLJ) is a dynamical feature that transports considerable moisture from the Gulf of Mexico into the central USA, playing a critical role in the summer precipitation there. Several factors, including the land-sea thermal contrast, contribute to the strength of the moisture convergence during the night and early morning, resulting in prominent nocturnal maximum precipitation in the plains of the USA (such as Nebraska and Iowa; e.g., Augustine and Caracena, 1994). The projections of climate changes indicate an increased land-sea thermal contrast in summer, with anticipated repercussions on the LLJ.

Interannual variability over North America is connected to two large-scale oscillation patterns (see Chapter 3), ENSO and the NAO/AO. The MMD model projections indicate an intensification of the polar vortex and many models project a decrease in the arctic surface pressure, which contributes to an increase in the AO/NAO index; the uncertainty is large, however, due to the diverse responses of AOGCMs in simulating the Aleutian Low (Chapter 10). The MMD model projections indicate a shift towards mean El-Niño like conditions, with the eastern Pacific warming more than the western Pacific; there is a wide range of behaviour among the current models, with no clear indication of possible changes in the amplitude or period of El Niño (Chapter 10).

11.5.2 Skill of Models in Simulating Present Climate

Individual AOGCMs in the MMD vary in their ability to reproduce the observed patterns of pressure, surface air temperature and precipitation over North America (Chapter 8). The ensemble mean of MMD models reproduces very well the annual-mean mean sea level pressure distribution (Section 8.4). The maximum error is of the order of ±2 hPa, with the simulated Aleutian Low pressure extending somewhat too far north, probably due to the inability of coarse-resolution models to adequately resolve the high topography of the Rocky Mountains that blocks incoming cyclones in the Gulf of Alaska. Conversely, the pressure trough over the Labrador Sea is not deep enough. The depth of the thermal low pressure over the southwest region in summer is somewhat excessive.

The MMD models simulate successfully the overall pattern of surface air temperature over North America, with reduced biases compared to those reported in the TAR. Ensemble-mean regional mean bias ranges from –4.5°C to 1.9°C for the 25th to 75th percentile range, and medians vary from –2.4°C to +0.4°C depending on region and season (Supplementary Material Table S11.1). The ensemble mean of MMD models reproduces the overall distribution of annual mean precipitation (Supplementary Material Table S11.1), but almost all models overestimate precipitation for western and northern regions. The ensemble-mean regional mean precipitation bias medians vary from –16% to +93% depending on region and season. The ensemble-mean precipitation is excessive on the windward side of major mountain ranges, with the excess reaching 1 to 2 mm day^{-1} over high terrain in the west of the continent.

Regional Climate Models are quite successful in reproducing the overall climate of North America when driven by reanalyses. Over a 10° × 10° Southern Plains region, an ensemble of six RCMs in the North American Regional Climate Change Assessment Program (NARCCAP; Mearns et al., 2005) had 76% of all monthly temperature biases within ±2°C and 82% of all monthly precipitation biases within ±50%, based on preliminary results for a single year. RCM simulations over North America exhibit rather high sensitivity to parameters such as domain size (e.g., Juang and Hong, 2001; Pan et al., 2001; Vannitsem and Chomé, 2005) and the intensity of large-scale nudging (providing large-scale information to the interior of the model domain, see e.g., von Storch et al., 2000; Miguez-Macho et al., 2004) if used. In general, RCMs are more skilful at reproducing cold-season temperature and precipitation (e.g., Pan et al., 2001; Han and Roads, 2004; Plummer et al., 2006) because the warm-season climate is more controlled by mesoscale and convective-scale precipitation events, which are harder to simulate (Giorgi et al., 2001a; Leung et al., 2003; Liang et al., 2004; Jiao and Caya, 2006). On the other hand, Gutowski et al. (2004) find that spatial patterns of monthly precipitation for the USA, when viewed as a whole rather than broken into individual regions, are better simulated in summer than winter. Several studies point to the large sensitivity of RCMs to parametrization of moist convection, including the vertical transport of moisture from the boundary layer (Chaboureau et al., 2004; Jiao and Caya, 2006) and entrainment mixing between convective plumes and the local environment (Derbyshire et al., 2004). In a study of the simulation of the 1993 summer flood in the central USA by 13 RCMs, Anderson et al. (2003) find that all models produced a precipitation maximum that represented the flood, but most underestimated it to some degree, and 10 out of 13 of the models succeeded in reproducing the observed nocturnal maxima of precipitation. Leung et al. (2003) examined the 95th percentile of daily precipitation and find generally good agreement across many areas of the western USA.

A survey of recently published RCM current-climate simulations driven with AOGCMs data reveals that biases in surface air temperature and precipitation are two to three times larger than the simulations driven with reanalyses. The sensitivity of simulated surface air temperature to changing lateral boundary conditions from reanalyses to AOGCMs appears to be high in winter and low in summer (Han and Roads, 2004; Plummer et al., 2006). Most RCM simulations to date for North America have been made for time slices that are too short to properly sample natural variability. Some

RCMs have employed less than optimal formulations, such as outdated parametrizations (e.g., bucket land surface scheme), too few levels in the vertical (e.g., 14) or a too-low uppermost computational level (e.g., 100 hPa).

11.5.3 Climate Projections

11.5.3.1 Surface Air Temperature

The ensemble mean of the MMD models projects a generalised warming for the entire continent with the magnitude projected to increase almost linearly with time (Figure 11.11). On an annual-mean basis, projected surface air temperature warming varies from 2°C to 3°C along the western, southern and eastern continental edges (where at least 16 out of the 21 models project a warming in excess of 2°C) up to more than 5°C in the northern region (where 16 out of the 21 AOGCMs project a warming in excess of 4°C). This warming exceeds the spread among models by a factor of three to four over most of the continent. The warming in the USA is projected to exceed 2°C by nearly all the models, and to exceed 4°C by more than 5 AOGCMs out of 21. More regional and seasonal detail on ranges of projected warming is provided in Table 11.1 and Supplementary Table S11.2.

The largest warming is projected to occur in winter over northern parts of Alaska and Canada, reaching 10°C in the northernmost parts, due to the positive feedback from a reduced period of snow cover. The ensemble-mean northern warming varies from more than 7°C in winter (nearly all AOGCMs project a warming exceeding 4°C) to as little as 2°C in summer. In summer, ensemble-mean projected warming ranges between 3°C and 5°C over most of the continent, with smaller values near the coasts. In western, central and eastern regions, the projected warming has less seasonal variation and is more modest, especially near the coast, consistent with less warming over the oceans. The warming could be larger in winter over elevated areas as a result of snow-albedo feedback, an effect that is poorly modelled by AOGCMs due to insufficient horizontal resolution (see also Box 11.3). In winter, the northern part of the eastern region is projected to warm most while coastal areas are projected to warm by only 2°C to 3°C.

The climate change response of RCMs is sometimes different from that of the driving AOGCM. This appears to be the result of a combination of factors, including the use of different parametrizations (convection and land surface processes are particularly important over North America in summer) and resolution (different resolution may lead to differing behaviour of the same parametrization). For example, Chen et al. (2003) find that two RCMs project larger temperature changes in summer than their driving AOGCM. In contrast, the projected warming of an RCM compared to its driving AOGCM was found to be 1.5°C less in the central USA (Pan et al., 2004; Liang et al., 2006), a region where observations have shown a cooling trend in recent decades. This resulted in an area of little warming that may have been due to a changing pattern of the LLJ frequency and associated moisture convergence. It is argued that the improved simulation of the LLJ in the RCM is made possible owing to its increased horizontal and vertical resolution. However, other RCMs with similar resolution do not produce the same response.

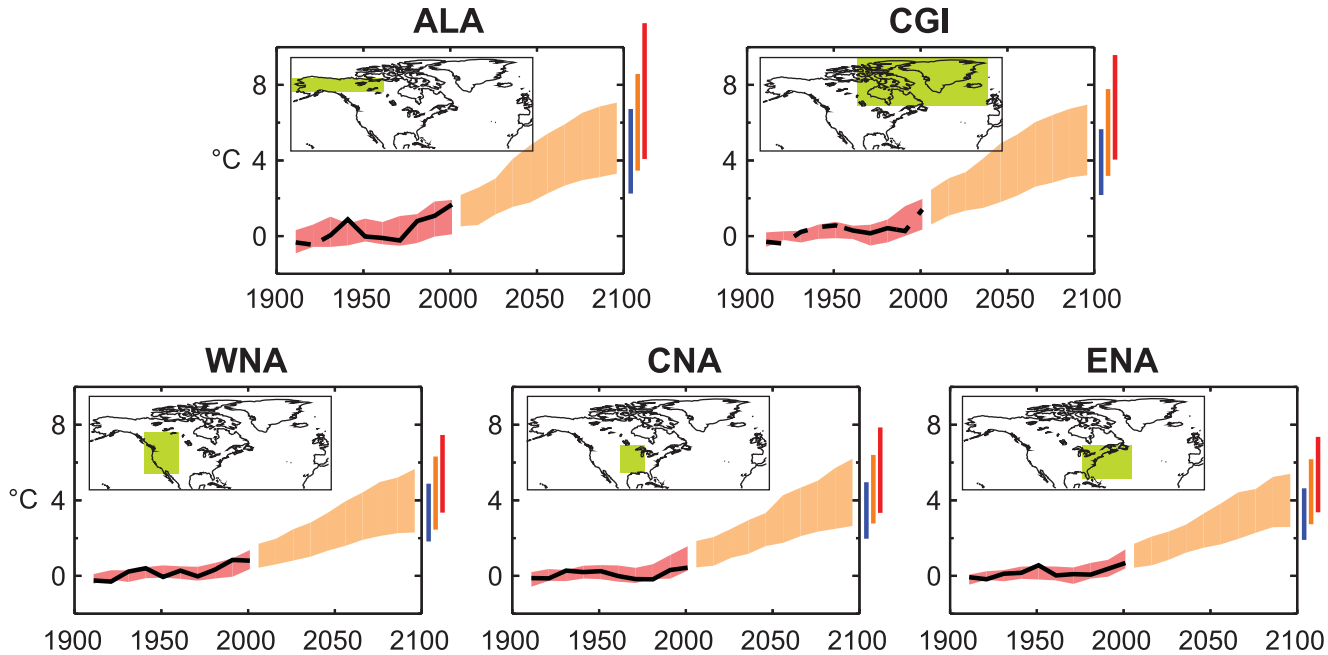


Figure 11.11. *Temperature anomalies with respect to 1901 to 1950 for five North American land regions for 1906 to 2005 (black line) and as simulated (red envelope) by MMD models incorporating known forcings; and as projected for 2001 to 2100 by MMD models for the A1B scenario (orange envelope). The bars at the end of the orange envelope represent the range of projected changes for 2091 to 2100 for the B1 scenario (blue), the A1B scenario (orange) and the A2 scenario (red). The black line is dashed where observations are present for less than 50% of the area in the decade concerned. More details on the construction of these figures are given in Box 11.1 and Section 11.1.2.*

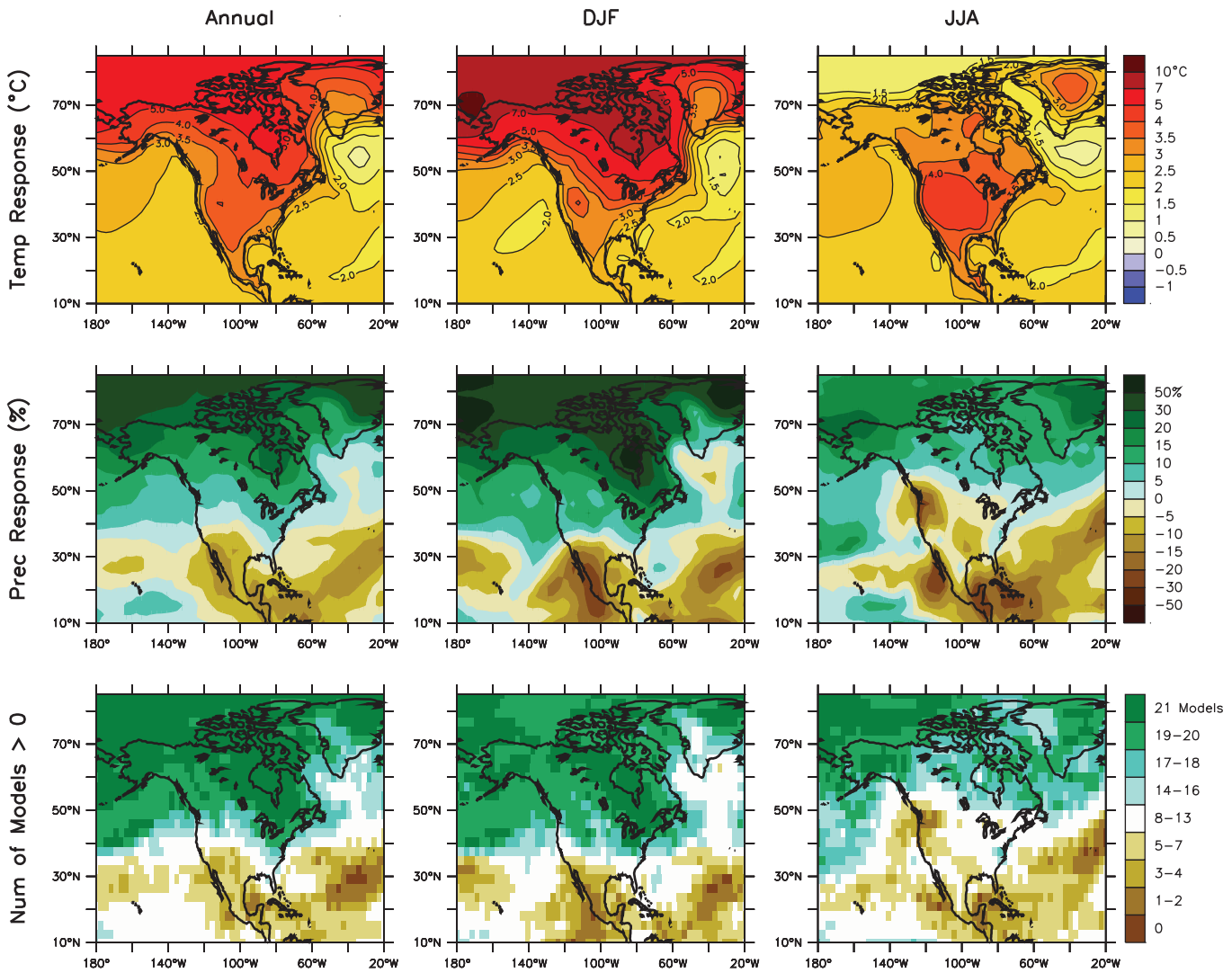


Figure 11.12. *Temperature and precipitation changes over North America from the MMD-A1B simulations. Top row: Annual mean, DJF and JJA temperature change between 1980 to 1999 and 2080 to 2099, averaged over 21 models. Middle row: same as top, but for fractional change in precipitation. Bottom row: number of models out of 21 that project increases in precipitation.*

11.5.3.2 Precipitation

As a consequence of the temperature dependence of the saturation vapour pressure in the atmosphere, the projected warming is expected to be accompanied by an increase in atmospheric moisture flux and its convergence/divergence intensity. This results in a general increase in precipitation over most of the continent except the most south-westerly part (Figure 11.12). The ensemble mean of MMD models projects an increase in annual mean precipitation in the north reaching +20%, which is twice the inter-model spread, so likely significant; the projected increase reaches as much as +30% in winter. Because the increased saturation vapour pressure can also yield greater evaporation, projected increases in annual precipitation are partially offset by increases in evaporation; regions in central North America may experience net surface drying as a result (see Supplementary Material Figure S11.1). See Table 11.1 and Supplementary Table S11.2 for more regional and seasonal details, noting that regional averaging hides important north-south differences.

In keeping with the projected northward displacement of the westerlies and the intensification of the Aleutian Low (Section 11.5.3.3), northern region precipitation is projected to increase, by the largest amount in autumn and by the largest fraction in winter. Due to the increased precipitable water, the increase in precipitation amount is likely to be larger on the windward slopes of the mountains in the west with orographic precipitation. In western regions, modest changes in annual mean precipitation are projected, but the majority of AOGCMs indicate an increase in winter and a decrease in summer. Models show greater consensus on winter increases (ensemble mean maximum of 15%) to the north and on summer decreases (ensemble mean maximum of –20%) to the south. These decreases are consistent with enhanced subsidence and flow of drier air masses in the southwest USA and northern Mexico resulting from an amplification of the subtropical anticyclone

off the West Coast due to the land-sea contrast in warming (e.g., Mote and Mantua, 2002). However, this reduction is close to the inter-model spread so it contains large uncertainty, an assessment that is reinforced by the fact that some AOGCMs project an increase in precipitation.

In central and eastern regions, projections from the MMD models show the same characteristics as in the west, with greater consensus for winter increases to the north and summer decreases to the south. The line of zero change is oriented more or less west-to-east and moves north from winter to summer. The line of zero change is also projected to lie further to the north under SRES scenarios with larger greenhouse gas amounts. However, uncertainty around the projected changes is large and the changes do not scale well across different SRES scenarios.

Govindasamy (2003) finds that, averaged over the USA, the few existing time-slice simulations with high-resolution AGCM results do not significantly differ from those obtained with AOGCMs. Available RCM simulations provide little extra information on average changes. Some RCMs project precipitation changes of different sign, either locally (Chen et al., 2003) or over the entire continental USA (Han and Roads, 2004, where in summer the AOGCM generally produced a small increase and the RCM a substantial decrease). In contrast, Plummer et al. (2006) find only small differences in precipitation responses using two sets of physical parametrizations in their RCM, despite the fact that one corrected significant summer precipitation excess present in the other.

11.5.3.3 Temperature and Precipitation Extremes

Several RCM studies focused particularly on changes in extreme temperature events. Bell et al. (2004) examine changes in temperature extremes in their simulations centred on California. They find increases in extreme temperature events, both as distribution percentiles and threshold events, prolonged hot spells and increased diurnal temperature range. Leung et al. (2004) examine changes in extremes in their RCM simulations of the western USA; in general, they find increases in diurnal temperature range in six sub-regions of their domain in summer. Diffenbaugh et al. (2005) find that the frequency and magnitude of extreme temperature events changes dramatically under SRES A2, with increases in extreme hot events and a decrease in extreme cold events.

In a study of precipitation extremes over California, Bell et al. (2004) find that changes in precipitation exceeding the 95th percentile followed changes in mean precipitation, with decreases in heavy precipitation in most areas. Leung et al. (2004) find that extremes in precipitation during the cold season increase in the northern Rockies, the Cascades, the Sierra Nevada and British Columbia by up to 10% for 2040 to 2060, although mean precipitation was mostly reduced, in accord with earlier studies (Giorgi et al., 2001a). In a large river basin in the Pacific Northwest, increases in rainfall over snowfall and rain-on-snow events increased extreme runoff by 11%, which would contribute to more severe flooding. In their 25-km RCM simulations covering the entire USA, Diffenbaugh et al. (2005) find widespread increases in extreme precipitation events under SRES A2, which they determine to be significant.

11.5.3.4 Atmospheric Circulation

In general, the projected climate changes over North America follow the overall features of those over the NH (Chapter 10). The MMD models project a northward displacement and strengthening of the mid-latitude westerly flow, most pronounced in autumn and winter. Surface pressure is projected to decrease in the north, with a northward displacement of the Aleutian low-pressure centre and a north-westward displacement of the Labrador Sea trough, and to decrease slightly in the south. The reductions in surface pressure in the north are projected to be strongest in winter, reaching –1.5 to –3 hPa, in part as a result of the warming of the continental arctic air mass. On an annual basis, the pressure decrease in the north exceeds the spread among models by a factor of 3 on an annual-mean basis and a factor of 1.5 in summer, so it is significant. The East Pacific subtropical anticyclone is projected to intensify in summer, particularly off the coast of California and Baja California, resulting in an increased air mass subsidence and drier airflow over south-western North America. The pressure increase (less than 0.5 hPa) is small compared to the spread among models, so this projection is rather uncertain.

11.5.3.5 Snowpack, Snowmelt and River Flow

The ensemble mean of the MMD models projects a general decrease in snow depth (Chapter 10) as a result of delayed autumn snowfall and earlier spring snowmelt. In some regions where winter precipitation is projected to increase, the increased snowfall can more than make up for the shorter snow season and yield increased snow accumulation. Snow depth increases are projected by some GCMs over some land around the Arctic Ocean (Figure S10.1) and by some RCMs in the northernmost part of the Northwest Territories (Figure 11.13). In principle a similar situation could arise at lower latitudes at high elevations in the Rocky Mountains, although most models project a widespread decrease of snow depth there (Kim et al., 2002; Snyder et al., 2003; Leung et al., 2004; see also Box 11.3).

Much SD research activity has focused on resolving future water resources in the complex terrain of the western USA. Studies typically point to a decline in winter snowpack and hastening of the onset of snowmelt caused by regional warming (Hayhoe et al., 2004; Salathé, 2005). Comparable trends towards increased annual mean river flows and earlier spring peak flows have also been projected by two SD techniques for the Saguenay watershed in northern Québec, Canada (Dibike and Coulibaly, 2005). Such changes in the flow regime also favour increased risk of winter flooding and lower summer soil moisture and river flows. However, differences in snowpack behaviour derived from AOGCMs depend critically on the realism of downscaled winter temperature variability and its

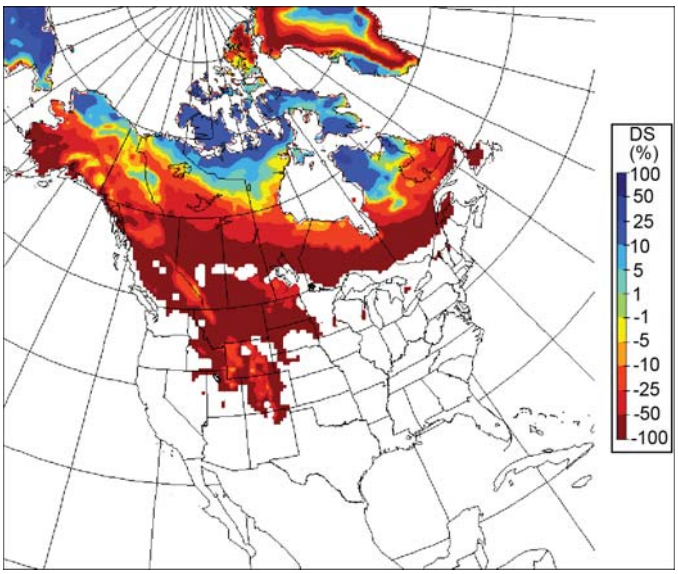


Figure 11.13. *Percent snow depth changes in March (only calculated where climatological snow amounts exceed 5 mm of water equivalent), as projected by the Canadian Regional Climate Model (CRCM; Plummer et al., 2006), driven by the Canadian General Circulation Model (CGCM), for 2041 to 2070 under SRES A2 compared to 1961 to 1990.*

interplay with precipitation and snowpack accumulation and melt (Salathé, 2005). Hayhoe et al. (2004) produced a standard set of statistically downscaled temperature and precipitation scenarios for California; under both the A1F1 and B1 scenarios, they find overall declines in snowpack.

11.6 Central and South America

Assessment of projected climate change for Central and South America:

All of Central and South America is very likely to warm during this century. The annual mean warming is likely to be similar to the global mean warming in southern South America but larger than the global mean warming in the rest of the area.

Annual precipitation is likely to decrease in most of Central America, with the relatively dry boreal spring becoming drier. Annual precipitation is likely to decrease in the southern Andes, with relative precipitation changes being largest in summer. A caveat at the local scale is that changes in atmospheric circulation may induce large local variability in precipitation changes in mountainous areas. Precipitation is likely to increase in Tierra del Fuego during winter and in south-eastern South America during summer.

It is uncertain how annual and seasonal mean rainfall will change over northern South America, including the Amazon forest. In some regions, there is qualitative consistency among the simulations (rainfall increasing in Ecuador and northern Peru, and decreasing at the northern tip of the continent and in southern northeast Brazil).

The systematic errors in simulating current mean tropical climate and its variability (Section 8.6) and the large inter-model differences in future changes in El Niño amplitude (Section10.3) preclude a conclusive assessment of the regional changes over large areas of Central and South America. Most MMD models are poor at reproducing the regional precipitation patterns in their control experiments and have a small signal-to-noise ratio, in particular over most of Amazonia (AMZ). The high and sharp Andes Mountains are unresolved in low-resolution models, affecting the assessment over much of the continent. As with all landmasses, the feedbacks from land use and land cover change are not well accommodated, and lend some degree of uncertainty. The potential for abrupt changes in biogeochemical systems in AMZ remains as a source of uncertainty (see Box 10.1). Large differences in the projected climate sensitivities in the climate models incorporating these processes and a lack of understanding of processes have been identified (Friedlingstein et al., 2003). Over Central America, tropical cyclones may become an additional source of uncertainty for regional scenarios of climate change, since the summer precipitation over this region may be affected by systematic changes in hurricane tracks and intensity.

11.6.1 Key Processes

Over much of Central and South America, changes in the intensity and location of tropical convection are the fundamental concern, but extratropical disturbances also play a role in Mexico's winter climate and throughout the year in southern South America. A continental barrier over Central America and along the Pacific coast in South America and the world's largest rainforest are unique geographical features that shape the climate in the area.

Climate over most of Mexico and Central America is characterised by a relatively dry winter and a well-defined rainy season from May through October (Magaña et al., 1999). The seasonal evolution of the rainy season is largely the result of air-sea interactions over the Americas' warm pools and the effects of topography over a dominant easterly flow, as well as the temporal evolution of the ITCZ. During the boreal winter, the atmospheric circulation over the Gulf of Mexico and the Caribbean Sea is dominated by the seasonal fluctuation of the Subtropical North Atlantic Anticyclone, with invasions of extratropical systems that affect mainly Mexico and the western portion of the Great Antilles.

A warm season precipitation maximum, associated with the South American Monsoon System (Vera et al., 2006), dominates the mean seasonal cycle of precipitation in tropical and subtropical latitudes over South America. Amazonia has had

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