

OPTIMUM BASIN MANAGEMENT PROGRAM

Chino Basin Dry-Year Yield Program Modeling Report

Volume III

Prepared for

Chino Basin Watermaster
Inland Empire Utilities Agency

under a Subcontract Agreement with
Black & Veatch Corp.

Prepared by

Wildermuth Environmental, Inc.

July 2003



TABLE OF CONTENTS

1. INTRODUCTION	1-1
1.1 Background and Purpose.....	1-1
1.2 Report Organization	1-1
2. GEOLOGY AND HYDROGEOLOGY	2-1
2.1 Geologic Setting.....	2-1
2.2 Stratigraphy.....	2-1
2.2.1 Consolidated Bedrock.....	2-1
2.2.1.1 Basement Complex	2-2
2.2.1.2 Undifferentiated Pre-Pliocene Formations	2-2
2.2.1.3 Plio-Pleistocene Formations	2-3
2.2.2 Water-Bearing Sediments	2-3
2.2.2.1 Older Alluvium	2-3
2.2.2.2 Younger Alluvium.....	2-3
2.3 Groundwater Occurrence and Movement	2-4
2.3.1 Chino Basin Boundaries	2-4
2.3.2 Groundwater Recharge, Flow, and Discharge.....	2-5
2.3.3 Aquifer Systems	2-6
2.3.4 Hydrostratigraphy.....	2-8
2.3.5 Aquifer Properties	2-9
2.3.5.1 Effective Porosity	2-9
2.3.5.2 Hydraulic Conductivity	2-9
2.3.6 Internal Faults	2-10
2.4 Groundwater Levels	2-10
2.4.1 Groundwater Level Monitoring.....	2-10
2.4.2 Historical Groundwater Levels	2-11
3. GROUNDWATER QUALITY	3-1
3.1 Background.....	3-1
3.2 Water Quality Monitoring Programs	3-1
3.2.1 Title 22 Compliance Monitoring	3-1
3.2.2 Historical Water Quality Monitoring Programs for Private Wells.....	3-2
3.2.3 Comprehensive Water Quality Monitoring Program (1999 – 2001).....	3-2
3.2.4 205(j) Groundwater Monitoring Program	3-3
3.2.5 Chino Basin Groundwater Quality Monitoring Program (2002/2003)	3-3
3.3 Information Management	3-4
3.4 Groundwater Quality in Chino Basin	3-4



3.4.1 Total Dissolved Solids.....	3-6
3.4.2 Nitrate-Nitrogen.....	3-8
3.4.3 Water Character Index.....	3-10
3.4.4 Other Constituents of Concern.....	3-10
3.4.4.1 VOCs.....	3-10
3.4.4.2 Arsenic.....	3-11
3.4.4.4 Manganese.....	3-12
3.4.4.5 Perchlorate.....	3-12
3.4.4.6 Radon and Gross Alpha.....	3-14
3.5 Point Sources of Concern.....	3-15
3.5.1 Chino Airport.....	3-15
3.5.2 California Institute for Men.....	3-15
3.5.3 General Electric Flatiron Facility.....	3-16
3.5.4 General Electric Test Cell Facility.....	3-16
3.5.5 Kaiser Steel Fontana Steel Site.....	3-17
3.5.6 Mid-Valley Sanitary Landfill.....	3-17
3.5.7 Milliken Sanitary Landfill.....	3-17
3.5.8 Municipal Wastewater Disposal Ponds.....	3-18
3.5.9 Upland Sanitary Landfill.....	3-18
3.5.10 Un-named VOC Plume – South of the Ontario Airport.....	3-19
3.5.11 Stringfellow NPL Site.....	3-19
3.6 Current State of Groundwater Quality in Chino Basin.....	3-19
4. CONCEPTUAL MODEL.....	4-1
4.1 Model Domain and Hydrostratigraphic Units.....	4-1
4.2 Specification of Boundary Conditions.....	4-1
4.2.1 External Boundaries.....	4-1
4.2.2 Internal Boundaries.....	4-1
4.3 Preparation of Hydrologic Budget.....	4-2
4.3.1 Recharge Components.....	4-2
4.3.1.1 Subsurface Inflow.....	4-2
4.3.1.2 Streambed Recharge.....	4-3
4.3.1.3 Deep Percolation of Precipitation and Applied Water.....	4-3
4.3.1.4 Supplemental Water Recharge.....	4-4
4.3.2 Discharge.....	4-4
4.3.2.1 Subsurface Outflow.....	4-4
4.3.2.2 Rising Groundwater.....	4-4
4.3.2.3 Evapotranspiration by Riparian Vegetation.....	4-5
4.3.2.4 Pumping.....	4-5
4.3.3 Balance of Recharge and Discharge.....	4-6
4.4 Definition of Flow Systems.....	4-6
4.4.1 Vadose Zone.....	4-6
4.4.2 Saturated Zone.....	4-7
5. MODEL DESCRIPTION.....	5-1
5.1 MODFLOW.....	5-1
5.2 Groundwater Vistas.....	5-1
5.3 Relationship of MODFLOW, Other Models and Data.....	5-1
5.4 Implementation of Conceptual Model.....	5-2



5.4.1 Calibration Period and Time Step	5-2
5.4.2 Geometry	5-3
5.4.2.1 Grid Size and Layout	5-3
5.4.2.2 Effective and Ineffective Cells	5-3
5.4.2.3 Stream Representation	5-4
5.4.2.4 Initial Aquifer Properties	5-4
5.4.3 Recharge and Discharge	5-4
5.4.4 Initial Conditions	5-5
6. MODEL CALIBRATION	6-1
6.1 Calibration Strategy	6-1
6.1.1 Matching Groundwater Levels at Wells	6-1
6.1.2 Matching Santa Ana River Discharge at Prado Dam	6-2
6.2. Calibration Results	6-2
6.2.1 Groundwater Levels at Wells	6-2
6.2.2 End of Calibration Groundwater Levels	6-3
6.2.3 Santa Ana River Discharge at Prado Dam	6-4
6.2.4 Final Aquifer Properties	6-4
6.2.5 Hydrologic Balance	6-4
7. DRY-YEAR YIELD PROGRAM IMPACTS	7-1
7.1 Dry-Year Yield Evaluation Criteria	7-1
7.2 Scenario Descriptions	7-1
7.2.1 Recharge Hydrology for the Planning Period	7-1
7.2.1.1 Subsurface Inflow	7-1
7.2.1.2 Streambed Recharge	7-1
7.2.1.3 Deep Percolation of Precipitation and Applied Water	7-2
7.2.1.4 Supplemental Water Recharge	7-2
7.2.2 Baseline OBMP Scenario	7-3
7.2.3 Dry-Year Yield Scenario	7-4
7.3 Evaluation of the Baseline OBMP Scenario	7-4
7.3.1 Groundwater Levels	7-4
7.3.2 Movement of Water Quality Anomalies	7-4
7.3.3 Hydrologic Balance and Storage	7-6
7.4 Evaluation of the Dry-Year Yield Program Impacts	7-7
7.4.1 Change in Groundwater Levels	7-7
7.4.2 Change in Movement of Water Quality Anomalies	7-8
7.4.3 Changes in Hydrologic Balance and Storage	7-8
7.4.4 Material Physical Injury	7-9
7.4.4.1 Groundwater Level Problems	7-9
7.4.4.2 Redirection and Transport of Known Water Quality Anomalies	7-10
7.4.4.3 Losses from Storage	7-10
8. REFERENCES	8-1



APPENDIX A COMPARISON OF GROUNDWATER MODEL PROJECTED TIME HISTORIES AT WELLS FOR THE CALIBRATION PERIOD

APPENDIX B GROUNDWATER MODEL PROJECTED TIME HISTORIES AT WELLS FOR BASELINE SCENARIO

APPENDIX C GROUNDWATER MODEL PROJECTED TIME HISTORIES AT WELLS FOR THE DRY-YEAR YIELD SCENARIO

APPENDIX D PLANNING INFORMATION PREPARED BY BLACK & VEATCH – ASSET INVENTORY AND WATER SUPPLY PLANS FOR PRODUCERS PARTICIPATING IN THE DRY YEAR YIELD PROGRAM



LIST OF TABLES

- 4-1 Subsurface Inflow Boundary Conditions for 2003 Watermaster Model
- 4-2 Time History of Annual Stormwater Recharge in Chino Basin Recharge Facilities, 1989/90 to 2000/01
- 4-3 Time History of Deep Percolation of Precipitation and Applied Water by 2003 Basin Plan Management Zones, 1989/90 to 2000/01
- 4-4 Time History of Supplemental Water Recharge in the Chino Basin, 1989/90 to 2000/01
- 4-5a Estimate of Annual Evapotranspiration by Riparian Vegetation in the Lower Chino Basin
- 4-5b Estimate of Monthly Distribution of Evapotranspiration by Riparian Vegetation in the Lower Chino Basin
- 4-6 Time History of Chino Basin and Temescal Basin Groundwater Production
- 6-1 Comparison of Model-Predicted and Observed Santa Ana River Discharge at Prado Dam, 1989/90 to 2000/01
- 6-2a Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino North, 1989/90 to 2000/01
- 6-2b Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino East, 1989/90 to 2000/01
- 6-2c Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino South, 1989/90 to 2000/01
- 6-2d Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Prado Basin, 1989/90 to 2000/01
- 6-2e Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Temescal, 1989/90 to 2000/01
- 6-3 Model-Estimated Inflows, Outflows and Rising Water Contributions to the Santa Ana River for the Prado Basin Management Zone 1989/90 to 2000/01
- 7-1 Recycled Water Discharge Projections Used in Baseline and Dry-Year Yield Scenarios
- 7-2 Total Chino Basin Production, Watermaster Replenishment Requirement, and Replenishment Plan that Balances Recharge and Discharge for Baseline Scenario
- 7-3a Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino North, Baseline Period 2004/05 to 2028/29
- 7-3b Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino East, Baseline Period 2004/05 to 2028/29
- 7-3c Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino South, Baseline Period 2004/05 to 2028/29
- 7-3d Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Prado Basin, Baseline Period 2004/05 to 2028/29



- 7-3e Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Temescal, Baseline Period 2004/05 to 2028/29
- 7-4 Model-Estimated Inflows, Outflows and Rising Water Contributions to the Santa Ana River for the Prado Basin Management Zone 2004/05 to 2028/29
- 7-5 Comparison of Projected Annual Time Histories of Santa Ana River Discharge at Prado Dam for Baseline and Dry-Year Yield Scenarios



LIST OF FIGURES

- 2-1 Chino Basin – and Other Surrounding Groundwater Basins
- 2-2 Base of Freshwater Aquifer – Including Bedrock Type
- 2-3 Groundwater Elevation Map – Fall 2000
- 2-4 Chino Basin Hydrogeology – Areas of Subsidence and Historical Artesian Conditions
- 2-5 Water-Level Time Histories (Non-Pumping) at City of Chino Hills Wells 1A and 1B
- 2-6 Map View of Geologic Cross-Sections – Chino Basin
- 2-7 Cross-Section A-A’
- 2-8 Cross-Section B-B’
- 2-9 Cross-Section C-C’
- 2-10 Cross-Section D-D’
- 2-11 Cross-Section E-E’
- 2-12 Cross-Section F-F’
- 2-13 Cross-Section H-H’
- 2-14 Cross-Section J-J’
- 2-15 Average Specific Yield of Sediments – Layer 1
- 2-16 Average Specific Yield of Sediments – Layer 2
- 2-17 Average Specific Yield of Sediments – Layer 3
- 2-18 Well Index Map – Water-Level Time Histories
- 2-19 Water-Level Time Histories at Wells in Management Zone 1
- 2-20 Water-Level Time Histories at Wells in Management Zone 2
- 2-21 Water-Level Time Histories at Wells in Management Zone 3
- 2-22 Water-Level Time Histories at Wells in Management Zone 4
- 2-23 Water-Level Time Histories at Wells in Management Zone 5

- 3-1 Well Location Map, Chino Basin and Vicinity: Wells with Water Quality Data from 1997 through 2002
- 3-2 TDS in Groundwater, Average Concentration (pre-1980)
- 3-3 TDS in Groundwater, Average Concentration (1981 to 1996)
- 3-4 TDS in Groundwater, Average Concentration (1997 to 2002)
- 3-5 Nitrate-N in Groundwater, Average Concentration (pre-1980)



LIST OF FIGURES

- 3-6 Nitrate-N in Groundwater, Average Concentration (1981 to 1996)
 - 3-7 Nitrate-N in Groundwater, Average Concentration (1997 to 2002)
 - 3-8 Water Character Index in Groundwater (1997 to 2002)
 - 3-9 Tetrachloroethene (PCE) in Groundwater, Average Concentration (1997 to 2002)
 - 3-10 Trichloroethene (TCE) in Groundwater, Average Concentration (1997 to 2002)
 - 3-11 1,1-Dichloroethene in Groundwater, Average Concentration (1997 to 2002)
 - 3-12 1,2-Dichloroethane in Groundwater, Average Concentration (1997 to 2002)
 - 3-13 *cis*-1, 2-Dichloroethene in Groundwater, Average Concentration (1997 to 2002)
 - 3-14 1,2,3-Trichloropropane in Groundwater, Average Concentration (1997 to 2002)
 - 3-15 1,2,3-Trichloropropane in Groundwater, Average Concentration (1997 to 2002), Expanded Class Intervals
 - 3-16 Arsenic in Groundwater, Average Concentration (1997 to 2002)
 - 3-17 Manganese in Groundwater, Average Concentration (1997 to 2002)
 - 3-18 Perchlorate in Groundwater, Average Concentration (1997 to 2002)
 - 3-19 Radon in Groundwater, Average Concentration (1997 to 2002)
 - 3-20 Gross Alpha in Groundwater, Average Concentration (1997 to 2002)
 - 3-21 Location of Known Contamination Sources and Related Water Quality Anomalies
-
- 4-1 Location of Subsurface Boundary Inflows and Stream Segments that Are Dynamically Linked to the Groundwater System
 - 4-2 Management Zones Used in the 2003 Basin Plan
 - 4-3 Location of Precipitation Stations and Drainage Area Configuration in the Chino Area Used in the Chino Basin Model
 - 4-4 SCS Hydrologic Soil Types in the Chino Area Used in the Chino Basin Model
 - 4-5 1993 Land Uses in the Chino Area Used in the Chino Basin Model
 - 4-6 Water Service Area Boundaries for the Chino Basin Area
 - 4-7 Distribution of Riparian Vegetation in the Lower Chino Basin
 - 4-8 Location of Wells that Produced Water During the Period 1989/90 to 2000/01
-
- 5-1 Relationship of Models, Input Data and Output Data
 - 5-2 Characterization of Calibration Period to Long-term Climatic Trends
 - 5-3 Model Grid



LIST OF FIGURES

- 5-4 Location of Effective and Ineffective Cells for Layer 1
- 5-5 Location of Effective and Ineffective Cells for Layer 2
- 5-6 Location of Effective and Ineffective Cells for Layer 3
- 5-7 Stream Representation in MODFLOW and WLAM
- 5-8 Initial Groundwater Elevations at Start of Calibration Period – Fall 1989

- 6-1 Location of Wells and Prado Dam Gaging Station Used in Model Calibration
- 6-2 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Fontana Water Company No. 3A
- 6-3 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Cucamonga County Water District No. 30
- 6-4 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Ontario No. 17
- 6-5 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Upland No. 3
- 6-6 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Monte Vista No. 10
- 6-7 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Pomona No. 11
- 6-8 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Chino No. 9
- 6-9 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Chino Hills No. 18A
- 6-10 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for CIM No. 4
- 6-11 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for JCSD No. 16
- 6-12 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for Norco No. 11
- 6-13 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for a Private Well Parente ARC
- 6-14 Comparison of Model Predicted Groundwater Level and Observed Groundwater Level for a Private Well Excelsior
- 6-15a Model Projected Groundwater Elevations at End of Calibration Period for Layer 1 – Fall 2001
- 6-15b Model Projected Groundwater Elevations at End of Calibration Period for Layer 2 – Fall 2001



LIST OF FIGURES

- 6-15c Model Projected Groundwater Elevations at End of Calibration Period for Layer 3 – Fall 2001
- 6-16a Change in Groundwater Level from Start to End of Calibration Period for Layer 1 – Fall 1988 to Fall 2001
- 6-16b Change in Groundwater Level from Start to End of Calibration Period for Layer 2 – Fall 1988 to Fall 2001
- 6-16c Change in Groundwater Level from Start to End of Calibration Period for Layer 3 – Fall 1988 to Fall 2001
- 6-17a Comparison of Model-Projected and Observed Santa Ana River Discharge Time Histories at Prado Dam – Histogram
- 6-17b Comparison of Model-Projected and Observed Santa Ana River Discharge Time Histories at Prado Dam – Regression Plot
- 6-18a Final Aquifer Properties, Hydraulic Conductivity in Layer 1
- 6-18b Final Aquifer Properties, Hydraulic Conductivity in Layer 2
- 6-18c Final Aquifer Properties, Hydraulic Conductivity in Layer 3
- 6-19a Final Aquifer Properties, Vertical Hydraulic Conductivity in Layer 1
- 6-19b Final Aquifer Properties, Vertical Hydraulic Conductivity in Layer 2
- 6-19c Final Aquifer Properties, Vertical Hydraulic Conductivity in Layer 3
- 6-20a Final Aquifer Properties, Specific Yield in Layer 1
- 6-20b Final Aquifer Properties, Specific Yield in Layer 2
- 6-20c Final Aquifer Properties, Specific Yield in Layer 3
- 6-21 Time History of Total Storage in the Chino Basin, Fall 1989 to Fall 2001
- 6-22 Comparison of Model Projected and Observed Santa Ana River Discharge at Prado
-
- 7-1 Comparison of Annual Groundwater Pumping for Baseline and Dry-Year Yield Scenarios
- 7-2a Groundwater Levels at End of Baseline Scenario for Layer 1 – Fall 2028
- 7-2b Groundwater Levels at End of Baseline Scenario for Layer 2 – Fall 2028
- 7-2c Groundwater Levels at End of Baseline Scenario for Layer 3 – Fall 2028
- 7-3a Change in Groundwater Level from Start to End of Baseline Scenario for Layer 1 – 2004 to 2028
- 7-3b Change in Groundwater Level from Start to End of Baseline Scenario for Layer 1 – 2004 to 2028
- 7-3c Change in Groundwater Level from Start to End of Baseline Scenario for Layer 2 – 2004 to 2028



LIST OF FIGURES

- 7-4 Estimated Location of Water Quality Anomalies in 2004 and their Projected Locations in 2028 for Baseline and Dry-Year Yield Scenarios
- 7-5 Projected Annual Time History of Santa Ana River Discharge at Prado Dam for the Baseline Scenario
- 7-6 Location of New Wells in the Dry-Year Yield Program and OBMP Desalter Wells
- 7-7a Groundwater Levels at End of the Dry-Year Yield Scenario for Layer 1 – Fall 2028
- 7-7b Groundwater Levels at End of the Dry-Year Yield Scenario for Layer 2 – Fall 2028
- 7-7c Groundwater Levels at End of the Dry-Year Yield Scenario for Layer 3 – Fall 2028
- 7-8a Change in Groundwater Level from Start to End of the Dry-Year Yield Scenario for Layer 1 – 2004 to 2028
- 7-8b Change in Groundwater Level from Start to End of the Dry-Year Yield Scenario for Layer 2 – 2004 to 2028
- 7-8c Change in Groundwater Level from Start to End of the Dry-Year Yield Scenario for Layer 3 – 2004 to 2028
- 7-9a Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 1 at 2028
- 7-9b Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 2 at 2028
- 7-9c Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 2 at 2028
- 7-10a Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 1 at Point of Maximum Storage – 2007
- 7-10b Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 2 at Point of Maximum Storage – 2007
- 7-10c Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 3 at Point of Maximum Storage – 2007
- 7-11a Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 1 after three-Year Extraction period – 2018
- 7-11b Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 2 after three-Year Extraction period – 2018
- 7-11c Difference in Groundwater Levels Between Baseline and Dry-Year Yield Scenarios for Layer 3 after three-Year Extraction period – 2018
- 7-12 Projected Time History of Total Storage in the Chino Basin for Baseline and Dry-Year Yield Scenarios



ACRONYM AND ABBREVIATIONS LIST

µg/L	micrograms per liter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,2,3-TCP	1,2,3-trichloropropane
1,2-DCA	1,2-dichloroethane
AL	Action Level
ASTM	American Society for Testing and Materials
BNA	base/neutral/acid-extractable organic chemicals
CA	California
CBFIP	Chino Basin Facilities Improvement Project
CBWCD	Chino Basin Water Conservation District
Watermaster	Chino Basin Watermaster
CBWRMS	Chino Basin Water Resources Management Study
CCWD	Cucamonga County Water District
CDA	Chino Desalter Authority
CDFM	cumulative departure from the mean
CIM	California Institution for Men
CIMIS	California Irrigation Management Information System
<i>cis</i> -1,2-DCE	<i>cis</i> -1,2-dichloroethene
CMP	Comprehensive Water Quality Monitoring Program
CN	cyanide
COC	Constituents of Concern
DBCP	1,2-dibromo-3-chloropropane
DHS	California Department of Health Services
DLR	Detection Limit for Reporting
DOE	Department of Energy
DPt	deep percolation of precipitation and applied water
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EDB	1,2-dibromoethane
EMP	Evaluation Monitoring Program



ACRONYM AND ABBREVIATIONS LIST

EPA	US Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FC	field capacity
FWC	Fontana Water Company
GE	General Electric
GIS	Geographic Information System
GSS	Geosciences Support Services, Inc.
GV	Groundwater Vistas
IEUA	Inland Empire Utilities Agency
InSAR	Synthetic Aperture Radar Interferometry
JCSD	Jurupa Community Services District
JMM	James M. Montgomery, Consulting Engineers, Inc. now dba as MWH
MCL	maximum contaminant level
MCLG	Maximum Contaminant Level Goal
mg/L	milligrams per liter
mL	milliliter
MODFLOW	MODular three-dimensional finite-difference groundwater FLOW model
MSL	Milliken Sanitary Landfill
MTBE	methyl tertiary butyl ether
MVSL	Mid Valley Sanitary Landfill
MVWD	Monte Vista Water District
MW	Monitoring Well
MWD	Metropolitan Water District of Southern California
MWDSC	Metropolitan Water District of Southern California
MZ	management zone
ND	not detected
NDMA	N-nitrosodimethylamine
NO ₃	nitrate
NPL	National Priorities List
OBMP	Optimum Basin Management Program
PCB	Polychlorinated Biphenyls
PCE	tetrachloroethene
PWMP	Private Well Monitoring Program



ACRONYM AND ABBREVIATIONS LIST

QA	quality assurance
RfD	reference dose
RP1	Regional Plant 1
RP2	Regional Plant 2
RP3	Regional Plant 3
RP4	Regional Plant 4
RWQCB	Regional Water Quality Control Board
SARWC	Santa Ana River Water Company
SBCFCD	San Bernardino County Flood Control District
SCS	Soil Conservation Service
SM	Standard Methods
SM _t	SM _t is the soil moisture at the time t
SOILH2O	soil moisture accounting module for WLAM
SWQIS	State Water Quality Information System
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TDS	total dissolved solids
TIN	total inorganic nitrogen
TOC	total organic carbon
TON	threshold odor number
TVMWD	Three Valleys Municipal Water District
UCMR	Unregulated Chemicals Monitoring Requirements
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
USL	Upland Sanitary Landfill
VOC	Volatile Organic Chemicals
WCI	Water Character Index
WEI	Wildermuth Environmental, Inc.
WLAM	Wasteload Allocation Model
WMWD	Western Municipal Water District
WQS	water quality standard

