UPDATED BASIN PLAN
FOR THE
LOS OSOS GROUNDWATER BASIN

JANUARY 2015

[This page intentionally blank]

Table of Contents

1 EXECUTIVE SUMMARY 1

1.1 Introduction 1
1.2 Background 1
1.3 Basin Plan Programs 4
1.4 Recommended Programs 13
1.5 Funding the Basin Plan Programs 14
1.6 Organization of the Basin Plan 14
1.7 Institutional Implementation of the Basin Plan 15
1.8 Consistency with the Sustainable Groundwater Management Act of 2014 15

2 INTRODUCTION TO THE BASIN PLAN 17

2.1 Subject Matter 17
2.2 Parties 17
2.3 Background and Authority 20
2.4 Basin Plan Goals 21
2.5 Water Management Principles 22
2.6 Environmental Review 23

3 THE LOS OSOS COMMUNITY 25

3.1 Communities and Plan Area 25
3.2 Land Use Planning Authority 25
3.3 Land Use Categories 26
3.4 Historical Population Growth 28
3.5 Future Population Growth 30
3.6 Environmental Resources 30

4 USE OF BASIN GROUNDWATER RESOURCES 33

4.1 Introduction 33
4.2 Production by the Purveyors 33
4.3 Production by Private Domestic Wells 39
4.4 Production by Community Facilities 41
4.5 Production by Agricultural Water Users 42
4.6 Total Groundwater Production 47
4.7 Production by Aquifer Layer and Basin Area 50

5 DESCRIPTION OF THE BASIN 53

5.1 Introduction 53
5.2 Geologic Setting 53
5.3 Surface Water Resources 57
5.4 Aquifer Zone Characterization 60
5.5 Recharge and Movement of Groundwater in the Basin 67

5.6 Historical Water Resource Studies and Management ... 69
5.7 Regulation of the Basin ... 81
5.8 Nitrate Impacts to the Basin ... 84
5.9 Seawater Intrusion into the Basin ... 85
5.10 Groundwater Storage ... 91
5.11 Groundwater Wells in the Basin ... 91

6 DEVELOPING A STRATEGY FOR THE BASIN ... 93

6.1 Introduction ... 93
6.2 Degradation of the Upper Aquifer ... 94
6.3 Seawater Intrusion into the Lower Aquifer ... 100
6.4 The Challenge of Uncertainty ... 110

7 GROUNDWATER MONITORING PROGRAM ... 115

7.1 Introduction ... 115
7.2 Purpose and Objectives ... 116
7.3 Coordination with Other Monitoring Programs ... 116
7.4 Groundwater Level and Quality Monitoring ... 123
7.5 Groundwater Production Monitoring ... 137
7.6 Reporting ... 139
7.7 Conclusion ... 140

8 URBAN WATER USE EFFICIENCY PROGRAM ... 141

8.1 Introduction ... 141
8.2 Water Use Efficiency Law and Policy ... 142
8.3 Defining the State of the Art ... 149
8.4 Los Osos Urban Water Use Baseline ... 169
8.5 Water Use Efficiency Measures and Programs ... 174
8.6 Basin Plan Actions ... 196
8.7 Impact of Basin Plan Actions ... 204

9 WATER REINVESTMENT PROGRAM ... 207

9.1 Policy and Purpose ... 207
9.2 Los Osos Wastewater Project ... 209
9.3 Urban Water Reinvestment Program ... 217
9.4 Agricultural Water Reinvestment Program ... 218
9.5 Coastal Commission Permit Conditions ... 220

10 BASIN INFRASTRUCTURE PROGRAM ... 227

10.1 Introduction ... 227
10.2 Program A ... 231
10.3 Program B ... 236
10.4 Program C ... 239

10.5 Program D ... 243
10.6 Conclusion ... 244
11 SUPPLEMENTAL WATER PROGRAM ... 247
11.1 Introduction ... 247
11.2 Rainwater Harvesting ... 247
11.3 Stormwater Capture ... 250
11.4 Greywater Reuse ... 250
11.5 Groundwater Desalination ... 252
11.6 Supplemental Water Conclusions ... 259
12 IMPORTED WATER PROGRAM ... 261
12.1 Introduction ... 261
12.2 Overview of Water Importation ... 262
12.3 State Water Project ... 263
12.4 Nacimiento Water Project ... 268
12.5 Other Imported Water Sources ... 271
12.6 Summary of Imported Water Options ... 272
13 WELLHEAD PROTECTION PROGRAM ... 275
13.1 Introduction ... 275
13.2 DWSAP Program ... 275
13.3 Other Wellhead Protection Measures ... 277
14 SOLUTIONS FOR THE BASIN ... 281
14.1 Introduction ... 281
14.2 Water Supply Programs ... 282
14.3 Water Demand Programs ... 287
14.4 Balancing Water Supplies and Demands ... 291
14.5 Selection of Basin Programs ... 293
14.6 Long-Term Water Balance ... 300
15 FUNDING OF THE BASIN PLAN ... 307
15.1 Introduction ... 307
15.2 Existing Population Scenario ... 307
15.3 Buildout Population Scenario ... 312
15.4 Community Decision-Making ... 313
16 IMPLEMENTATION OF THE BASIN PLAN ... 315
16.1 Introduction ... 315
16.2 The Basin Plan Process ... 315
16.3 Plan Implementation Timeline ... 317
16.4 Conclusion ... 323

17 BIBLIOGRAPHY 327
17.1 Introduction 327
17.2 Geologic Studies of the Basin 327
17.3 Water Resource Studies of the Basin 327
17.4 Studies of Water Use in the Basin 329
17.5 Planning Documents Related to the Los Osos Wastewater Project 329

TABLES

Table 1. Urban Water Use Efficiency Measures 8
Table 2. Recycled Water Uses in the Water Reinvestment Program 9
Table 3. Basin Infrastructure Program Improvements 11
Table 4. Land Use Categories in the Plan Area 26
Table 5. Categories of Groundwater Use 33
Table 6. Municipal Service Connections and Groundwater Production (1955-1972) 36
Table 7. Municipal Groundwater Production (1970-1988) 36
Table 8. Municipal Groundwater Production (1970-2013) 37
Table 9. Survey of Rural Residential Parcels by Water Usage 40
Table 10. Water Use on Rural Residential Parcels 41
Table 11. Agricultural Irrigation Groundwater Production (1970-1988) 43
Table 12. Agricultural Cropping Data (2008-2009) 45
Table 13. Agricultural Irrigation Water Demands (2008-2009) 46
Table 14. Total Groundwater Production (1970-2013) 48
Table 15. Timeline of Basin Studies and Management Actions 69
Table 16. Water Quality Monitoring Constituents 125
Table 17. Initial CEC Monitoring Constituents 126
Table 18. Distribution of Monitoring Wells 128
Table 19. First Water Monitoring Network 131
Table 20. Upper Aquifer Monitoring Network 133
Table 21. Lower Aquifer Monitoring Network 135
Table 22. CUWCC Best Management Practices 144
Table 23. Los Osos Population Projections (2010-2035) 172
Table 24. Purveyor Implementation of Water Efficiency BMPs 176
Table 25. Urban Water Efficiency Measures 178
Table 26. Measure 1A Rebates 179
Table 27. Measure 2A Rebates 182
Table 28. Urban Water Use Efficiency Programs 186
Table 29. Urban Water Use Efficiency Measures (2013-2018) 200
Table 30. Urban Water Use Efficiency Measures (2019-2035) 202
Table 31. Potential Recycled Water Demands 213
Table 32. Urban Water Reinvestment Program Recycled Water Uses 217
Table 33. Costs of the Urban Water Reinvestment Program 218
Table 34. Basin Infrastructure Program A Improvements 231
Table 35. Basin Infrastructure Program A Schedule 235
Table 36. Basin Infrastructure Program B Improvements 236
Table 37. Basin Infrastructure Program C Improvements 240
Table 38. Basin Infrastructure Program D Improvements 243

Table 39. Summary of the Basin Infrastructure Programs 245
Table 40. Costs for Selected Seawater Desalination Projects 255
Table 41. Imported Water Options 273
Table 42. Abbreviations for Basin Plan Programs 282
Table 43. Summary of Water Supply Program Combinations 285
Table 44. Summary of Water Demand Program Combinations 289
Table 45. Basin Yield Metrics for Supply/Demand Combinations 291
Table 46. Most Likely Program Combinations 292
Table 47. Projected Costs of Basin Plan Programs 295
Table 48. Projected Costs of Program Combinations 295
Table 49. Marginal Sustainable Population for Combinations 298
Table 50. Features of the Combinations 300
Table 51. Long-Term Water Balance, Los Osos Basin 302
Table 52. Basin Plan Programs for Existing Population Scenario 308
Table 53. Purveyors' Costs for Basin Infrastructure Program A 308
Table 54. Programs Financed by Basin CFD 309
Table 55. Comparative Costs to be Financed 310
Table 56. Basin Plan Programs for Buildout Population Scenario 312
Table 57. Additional Programs To Be Financed 313
Table 58. Groundwater Monitoring Program Schedule 318
Table 59. Water Reinvestment Program Schedule 320
Table 60. Basin Infrastructure Program Schedule 322
Table 61. Wellhead Protection Program Schedule 323
Table 62. Implementation Schedule for EPS Programs 324
Table 63. Implementation Schedule for BPS Programs 324

FIGURES

Figure 1. The Los Osos Groundwater Basin 2
Figure 2. Total Groundwater Production (1970-2013) 3
Figure 3. Historical Tracking of the Basin Yield Metric (1970-2013) 6
Figure 4. Los Osos Water Purveyor Service Areas 18
Figure 5. Land Uses in the Plan Area 27
Figure 6. Distribution of Land Uses in the Plan Area 28
Figure 7. Historical Plan Area Population 29
Figure 8. Decadal Contributions to Los Osos Population at Buildout 30
Figure 9. Environmental Resources in the Los Osos Area 32
Figure 10. Water Use Areas 34
Figure 11. Historical Groundwater Production by Purveyors (1955-2013) 38
Figure 12. Five-Year Running Average of Production by Purveyors (1960-2013) 39
Figure 13. Irrigated Fields in the Plan Area 44
Figure 14. Total Groundwater Production (1970-2013) 47
Figure 15. Five-Year Running Average of Production from the Basin (1970-2013) 49
Figure 16. Relative Use of Water Resources in Los Osos (2008-2013) 50
Figure 17. Sample Groundwater Distribution Graphic 51
Figure 18. Groundwater Distribution (1970-2013) 52
Figure 19. Conceptual Model of the Los Osos Groundwater Basin 54
Figure 20. Geology and Boundaries of the Los Osos Groundwater Basin 55
Figure 21. Surface Water Resources of the Basin 58
Figure 22. North-South Cross-Section of the Basin 61
Figure 23. West-East Cross-Section of the Basin 62
Figure 24. Recharge Areas of the Basin 68
Figure 25. Nitrate Levels in the Upper Aquifer 86
Figure 26. Historical Progression of Seawater Intrusion in the Lower Aquifer 89
Figure 27. Seawater Intrusion Wedge (2014) 90
Figure 28. Historical Nitrate Levels for Wells FW10 and UA4 (1960-2005) 94
Figure 29. Key Wells for the Nitrate Metric 96
Figure 30. Historical Tracking of the Nitrate Metric (2002-2012) 97
Figure 31. Nitrate Metric Target Trendline 99
Figure 32. Water Levels in the Lower Aquifer 101
Figure 33. Historical Tracking of the Basin Yield Metric (1970-2013) 103
Figure 34. The Basin Development Metric (2013) 105
Figure 35. Historical Tracking of the Water Level and Chloride Metrics (1975-2010) 106
Figure 36. Key Wells for the Water Level Metric and Chloride Metric 107
Figure 37. Water Level and Chloride Metric Target Trendlines 110
Figure 38. Predicted Seawater Intrusion for Basin Metric Targets 111

Figure 39. First Water Monitoring Network Locations 132
Figure 40. Upper Aquifer Monitoring Network Locations 134
Figure 41. Lower Aquifer Monitoring Network Locations 136
Figure 42. Distribution of Urban Water Uses in California 151
Figure 43. Potential for Urban Water Savings in California 152
Figure 44. Distribution of Residential Indoor Water Uses 153
Figure 45. Historical Development of Toilet Efficiency Standards in California (1975-2012) 154
Figure 46. Proportion of Water Uses in the CII Sectors 164
Figure 47. Los Osos Urban Per Capita Water Use (1975-2013) 170
Figure 48. Los Osos URL Population Projections (2010-2035) 173
Figure 49. Distribution of Urban Water Uses in Los Osos 174
Figure 50. Urban Water Demands Under Existing Population Scenario (2010-2035) 190
Figure 51. Urban Water Demands Under Buildout Population Scenario (2010-2035) 191
Figure 52. Per Capita Indoor Water Use in Buildout Population Scenario (2010-2035) 192
Figure 53. Projected Urban Water Demands on the Basin (2010-2035) 205
Figure 54. Los Osos Wastewater Project Map 211
Figure 55. Basin Infrastructure Program Map 229
Figure 56. Baseline Distribution of Groundwater Production 230
Figure 57. Distribution of Groundwater Production (2006-2013) 231
Figure 58. Distribution of Groundwater Production for Program A 235
Figure 59. Distribution of Groundwater Production for Program AB 239
Figure 60. Distribution of Groundwater Production for Program AC 241
Figure 61. Distribution of Groundwater Production for Program ABC 242
Figure 62. Distribution of Groundwater Production for Program ABCD 244
Figure 63. Typical Rainwater Harvesting System 249
Figure 64. Selected Water Importation Projects in California 263
Figure 65. SWP Coastal Branch Facilities 264
Figure 66. Potential Route of Los Osos Connection to the SWP 265
Figure 67. SWP Delivery Reliability 267
Figure 68. Nacimiento Water Project Facilities 269
Figure 69. Potential Route of Los Osos Connection to the NWP 270
Figure 70. Comparative Sustainable Yield of Water Supply Combinations 286
Figure 71. Summary of Water Demand Programs 290
Figure 72. Sustainable Population of Program Combinations 299
Figure 73. Water Balance: 2012 Baseline 303
Figure 74. Water Balance: No Further Development 304
Figure 75. Water Balance: Buildout Development 305
Figure 76. Developed Properties Subject to Bond Repayment 311
Figure 77. Projected Urban Water Demands on the Basin (2010-2035) 319

Figure 78. Timeline of Recycled Water Deliveries........321
Figure 79. Historical and Projected Basin Yield Metric (1970-2045)........326

ABBREVIATIONS

AF	acre-feet
AFY	acre-feet per year
APN	Assessor Parcel Number
ARSR	Annual Resource Summary Report
AWWA	American Water Works Association
B&C	Brown and Caldwell
Basin	Los Osos Groundwater Basin
Basin CFD	Basin Community Facilities District
BDCP	Bay Delta Conservation Plan
BMPs	best management practices
CASGEM	California Statewide Groundwater Elevation Monitoring Program
CCR	California Code of Regulations
CCWA	Central Coast Water Authority
CDP	Coastal Development Permit
CDPH	California Department of Public Health
CECs	Constituents of Emerging Concern
CEE	Consortium for Energy Efficiency
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CHG	Cleath-Harris Geologists, Inc., *née* Cleath & Associates
CII	commercial, industrial and institutional
County	County of San Luis Obispo
Court	San Luis Obispo County Superior Court
CPC	California Plumbing Code
CPUC	California Public Utilities Commission
CSA 9	County Service Area 9
CT	Contact Time
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
DBOOT	design-build-own-operate-transfer
Delta	Sacramento-San Joaquin River Delta
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection
EAP	Estero Area Plan
EFH	equivalent freshwater head
EIR	environmental impact report
EPS	Existing Population Scenario

ES	Engineering Science
Estuary	Morro Bay National Estuary
ETAW	evapotranspiration of applied water
gpcd	gallons per capita per day
gpd/ft	gallons per day per square foot
gpm	gallons per minute
GSWC	Golden State Water Company
HECW	high-efficiency clothes washing machine
HET	high efficiency toilet
ISJ	Interlocutory Stipulated Judgment
LA	Lower Aquifer
LOCP	Los Osos Community Plan
LOCSD	Los Osos Community Services District
LOHCP	Los Osos Habitat Conservation Plan
LOS	Level of Severity
LOWMP	Los Osos Water Management Plan
LOWTP	Los Osos Wastewater Treatment Plant
LOWWP	Los Osos Wastewater Project
MB	Michael Brandman Associates
MCL	maximum contaminant level
MGD	million gallons per day
mg/l	milligrams per liter
mL/L	milliliters per liter
µmhos/cm	µmhos per centimeter
Model	Model of the Basin, developed by CHG on behalf of the Parties
MODFLOW	Groundwater Modeling Software
MOU	CUWCC Memorandum of Understanding
MPN	most probable number
MRP	Monitoring and Reporting Program Order No. R3-2011-0001
msl	mean sea level
MTBE	methyl tertiary butyl ether
MWM	Maddaus Water Management
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
NDMA	N-Nitrosodimethylamine
NEPA	The National Energy Policy Act of 1992
NPDES	National Pollutant Discharge Elimination System
NWP	Nacimiento Water Project
Parties	County, LOCSD, GSWC, and S&T

PBE	Physical Barrier Effectiveness
PCA	Possible Contaminating Activity
Purveyors	LOCSD, GSWC, and S&T
RCS	Resource Capacity Study
RMS	Resource Management System
RO	reverse osmosis
RWMP	Recycled Water Management Plan
RWQCB	Central Coast Regional Water Quality Control Board
S&T	S&T Mutual Water Company
SCADA	Supervisory Control and Data Acquisition
SGMA	Sustainable Groundwater Management Act
SLOCFCWD	San Luis Obispo County Flood Control and Water Conservation District
Stetson	Stetson Engineers, Inc.
SWAP	Small Wilderness Area Preservation
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plans
SWRCB	California State Water Resources Control Board
TDS	total dissolved solids
TM	Technical Memorandum
UA	Upper Aquifer
ULFT	ultra low flush toilet
URL	Urban Reserve Line
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WG	Wallace Group
WDR	Waste Discharge/Recycled Water Requirements Order No. R3-011-0001
WELW	Water Efficient Landscape Worksheet
WWSA	Wastewater Service Area

1

EXECUTIVE SUMMARY

1.1 Introduction

This Basin Plan concerns the Los Osos Groundwater Basin (Basin), which underlies the unincorporated communities of Los Osos, Baywood Park and Cuesta-by-the-Sea in San Luis Obispo County, California, as shown in Figure 1. The Basin Plan has been prepared by the three water purveyors in Los Osos—Los Osos Community Services District (LOCSD), Golden State Water Company (GSWC) and S&T Mutual Water Company (S&T)—and the County of San Luis Obispo (County), as part of the adjudication of groundwater resources in the Basin (Adjudication).

The Basin is the only source of water for residential, commercial, institutional and agricultural development in Los Osos and a valuable resource for the community, region and state. Its continuing use for those purposes faces two challenges:

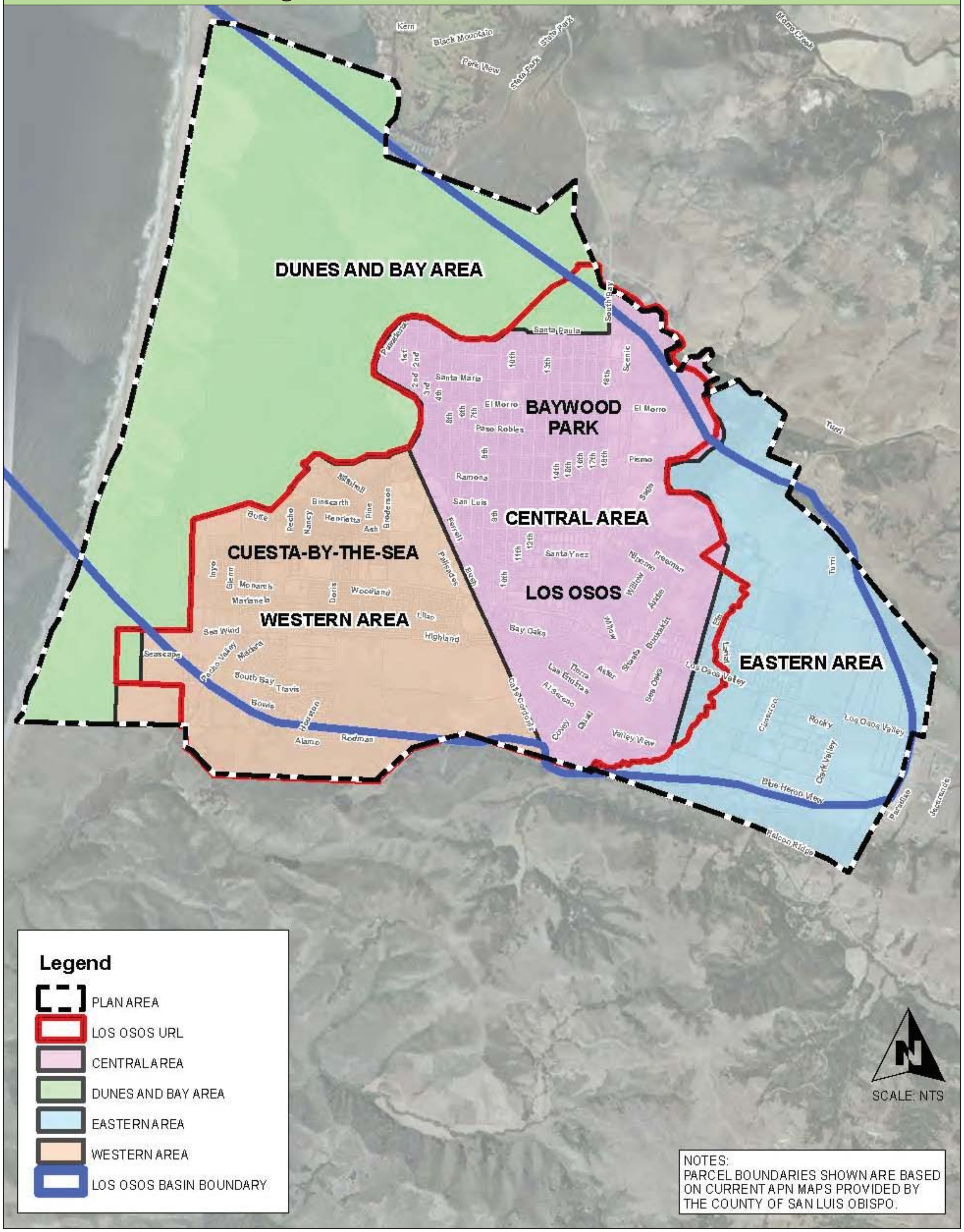
- Water quality degradation of the Upper Aquifer (UA), primarily by nitrate; and
- Seawater intrusion into the Lower Aquifer.

It is vital that bold, decisive and immediate actions be taken to solve these twin challenges and protect the sustainability of the Basin. This Basin Plan establishes several immediate and continuing goals for management of the water resources of the Basin. The most important goals are to halt seawater intrusion into the Basin and to provide sustainable water supplies for existing and future residential, commercial, institutional, recreational and agricultural development within Los Osos. Outside of this Basin Plan, the County is addressing water quality degradation through construction and operation of the Los Osos Wastewater Project (LOWWP), a community wastewater collection, treatment and reinvestment project in Los Osos.

1.2 Background

The Basin is composed of several aquifer layers underlying the Los Osos community and surrounding rural areas. In this Basin Plan, attention is focused on four aquifer layers known as First Water, the Upper Aquifer, the Lower Aquifer, and the Alluvial Aquifer underlying Los Osos Creek. The Upper and Lower Aquifers are the main

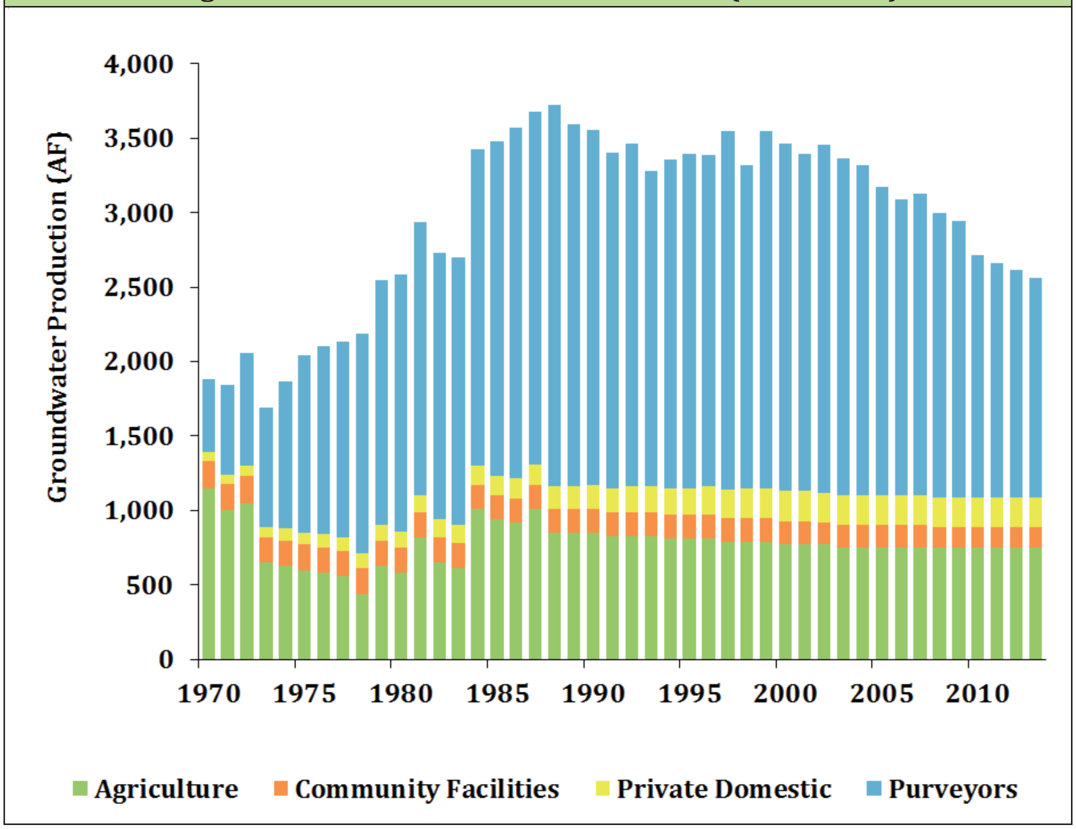
Figure 1. The Los Osos Groundwater Basin



sources of municipal and domestic water supplies in the Basin, while First Water and the Alluvial Aquifer are also used for irrigation water supplies.

The Los Osos community has been developed based on water supplies from Basin aquifers. As the only source of water, residents, businesses and agriculturalists have always relied on extractions from the Basin. As shown in Figure 2, community groundwater production increased dramatically during the 1970s and 1980s, primarily to serve fast-growing residential, commercial and institutional development. By the late 1970s, groundwater extractions exceeded the sustainable yield of the Basin. This was especially true in the Lower Aquifer in the Western Area, where falling groundwater levels induced intrusion of seawater into the Basin.

Figure 2. Total Groundwater Production (1970-2013)



Seawater intrusion has the potential to irreparably damage the Lower Aquifer as a source of water supplies for Los Osos. Saline groundwater would not be usable for municipal, domestic or irrigation purposes without desalination treatment. As described in Sections 11.5 and 14.5, desalination of saline groundwater would be relatively expensive as a supplemental water supply of between 250 and 750 acre-feet per year (AFY). Filling of the Lower Aquifer with seawater would require the replacement of approximately 2,000 AFY of water supplies for Los Osos, which would likely cost the community in excess of $100 million for the first 30 years, based on either desalination or importation of water from outside the Basin. It is the intent of this Basin Plan to halt seawater intrusion and protect the Basin as a source of sustainable water supplies, rather than abandon the Basin to seawater.

That is the desire of all the Parties and the community, based on comments received from the public as part of this planning effort.

To halt seawater intrusion, the Purveyors must largely discontinue production of groundwater from the Lower Aquifer in the Western Area. To stop producing groundwater from that portion of the Basin, the Los Osos community will need to decrease its water demands and increase water supplies available from the Upper Aquifer and from the Lower Aquifer in the Central and Eastern Areas. Accessing those supplies requires the construction of new infrastructure, including groundwater production wells, distribution pipelines and a community nitrate removal facility.

The current population of the Plan Area is approximately 14,600. Future levels of groundwater production from the Basin are tied to land use policies. Land development in the community is currently governed by the Estero Area Plan (EAP), which projects that population at buildout could be as high as 28,700. The County is currently in the process of drafting a new Los Osos Community Plan (LOCP) and Los Osos Habitat Conservation Plan (LOHCP), which are expected to limit the future population to no more than 19,850. This Basin Plan does not express a preference for the level of development in Los Osos, but contains actions that would support development at whatever level is deemed appropriate by the County and California Coastal Commission. In order to analyze water supplies and demands, this Basin Plan uses an Existing Population Scenario (EPS) to model current conditions, and a Buildout Population Scenario to model potential future growth up to the buildout population of 19,850.

1.3 Basin Plan Programs

This Basin Plan analyzes seven potential programs of action, each of which focuses on a different aspect of Basin management. Some programs—such as the Urban Water Use Efficiency Program—are directed at reducing the demand for water from the Basin, while other programs—such as the Basin Infrastructure Program—focus on increasing the sustainable yield of the Basin. Several programs—including the Water Reinvestment Program and Supplemental Water Program—are hybrids, with both demand- and supply-side impacts. Implementation of an identified combination of programs is expected to achieve a sustainable Basin.

Most Basin Plan actions will be undertaken by the Parties. This Basin Plan also anticipates the establishment of a Basin Management Committee to coordinate various management actions related to the Basin and implementation of the Basin Plan. The Basin Management Committee will be an entity created by the Court in the Adjudication, and will be governed by the Parties. In addition, certain actions will require active participation by the residents, businesses and institutions of Los Osos.

1.3.1 *Basin Metrics*

To measure nitrate impacts to the Upper Aquifer and seawater intrusion into the Lower Aquifer, this Basin Plan creates several metrics. The metrics will allow the

Parties, Basin Management Committee, regulatory agencies and the public to evaluate the status of nitrate levels and seawater intrusion in the Basin through objective, numerical criteria that can be tracked over time.

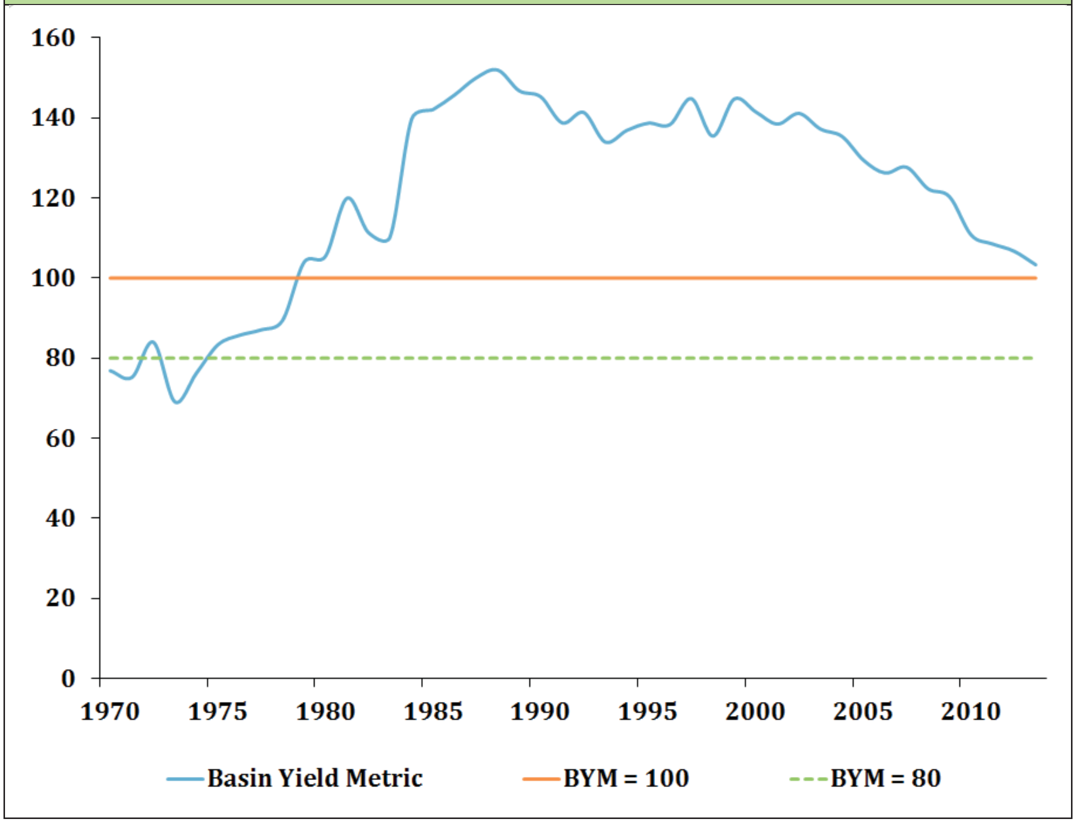
The Nitrate Metric is based on the average measurement of nitrate concentrations in five key wells in the Upper Aquifer. In order to clearly measure positive and negative movements in the Nitrate Metric, five wells were selected from those that have been historically impacted by nitrate. While extensive historical data does not exist for the key wells, data from 2002 through 2006 and 2012 set the current value for the Nitrate Metric at approximately 18 milligrams per liter (mg/l). This Basin Plan sets a goal of reducing the Nitrate Metric to below 10 mg/l. It is expected to take approximately 30 years for nitrate levels to reach that goal, based on the cessation of septic tank discharges with the operation of the LOWWP and the construction of a community nitrate removal facility.

To measure seawater intrusion, this Basin Plan establishes two metrics: the Water Level Metric, and the Chloride Metric. The Water Level Metric measures freshwater levels in five wells in the Lower Aquifer and currently has a value of approximately 2 feet above mean sea level (msl). This Basin Plan sets a Water Level Metric goal of 8 feet msl in order to provide sufficient freshwater head to keep seawater out of the Western and Central Areas of the Basin. The Chloride Level Metric is based on the weighted average of chloride concentrations in four wells in the Lower Aquifer. The current level of the Chloride Metric is approximately 130 mg/l, and the goal of this Basin Plan is to lower the metric below 100 mg/l.

In addition to the three metrics that measure specific circumstances of the Basin, this Basin Plan establishes several metrics relating to management of the Basin by the Purveyors and other groundwater producers. The Basin Yield Metric compares the total amount of groundwater production in a given year (Annual Groundwater Production_X) with the maximum sustainable yield of the Basin under then-current conditions, as determined by the Model (Sustainable Yield_X). The ratio generates a percentage of the Sustainable Yield_X that is utilized during the relevant Year X. A Basin Yield Metric under 100 would mean that current production is sustainable, while a value over 100 would indicate that the Los Osos community is extracting too much groundwater from the Basin. Figure 3 depicts historical values for the Basin Yield Metric from 1970 through 2013.

As is apparent from Figure 3, groundwater production from the Basin has been unsustainable from the late 1970s through the present. While the Basin Yield Metric has decreased in recent years from its highest value of 152 in 1988, groundwater production remains at an unsustainable level at the time of publication of this Basin Plan. The goal of this Basin Plan is to reduce the Basin Yield Metric to a permanent level below 80. Maintaining the Basin Yield Metric at least 20 points below the maximum sustainable yield of 100 will provide a margin of safety for the Los Osos community.

Figure 3. Historical Tracking of the Basin Yield Metric (1970-2013)



1.3.2 *Groundwater Monitoring Program*

This Basin Plan establishes a comprehensive Groundwater Monitoring Program to collect, organize and report data regarding the health of the Basin. That data will be used to calculate the metrics discussed above and to provide information needed to manage the Basin for long-term sustainability. The Groundwater Monitoring Program will satisfy various external monitoring requirements as well, such as the California Statewide Groundwater Elevation Monitoring Program (CASGEM) and waste discharge and recycled water permits for the LOWWP.

The Groundwater Monitoring Program establishes a network of 73 wells to be tested for water levels or quality. The wells are distributed laterally across the Western, Central and Eastern Areas and vertically among First Water and the Upper and Lower Aquifers. Monitoring will occur in the spring and fall of each year when water levels are typically at their highest and lowest, and will start in 2014.

In addition to measuring water levels and quality, the Purveyors will report their groundwater production to the Basin Management Committee in order to allow accurate calculation of the Basin Yield Metric. Information regarding other production from the Basin will be gained by estimates, until such time as accurate information can be acquired through voluntary participation by well owners, or a potential County groundwater ordinance that could require registration and reporting for all wells in the Basin.

The Basin Management Committee will coordinate the collection and analysis of data under the Groundwater Monitoring Program. On an annual basis, the Basin Management Committee will report the values for all Basin metrics and other relevant, non-proprietary data to the Parties, the Court and the public. Over 30 years, the Groundwater Monitoring Program is expected to cost approximately $650,000.[1]

1.3.3 *Urban Water Use Efficiency Program*

Improving urban water use efficiency is the highest priority program of this Basin Plan for balancing the Basin and preventing further seawater intrusion. During the 25-year period from 1988 through 2013, urban water use in Los Osos declined by almost 40 percent, but additional efficiencies are possible and will be implemented pursuant to this Basin Plan. The goal of the Urban Water Use Efficiency Program is to limit urban water use in Los Osos to 1,450 AFY for the current population and 2,100 AFY at buildout. Achieving that goal will make Los Osos one of the most water-efficient communities in California, exceeding the standards of the California Urban Water Conservation Council, the state *20 x 2020 Water Conservation Plan*, and the California Green Building Standards Code.

The Urban Water Use Efficiency Program is based on a comprehensive review of potential water conservation measures in the residential, commercial and institutional sectors. It has been and will continue to be coordinated with the water conservation efforts undertaken by the County for the LOWWP. The measures that were analyzed and will be implemented are listed in Table 1.

Subject to funding, the County will administer the Urban Water Use Efficiency Program from 2013 through 2018, with the Purveyors assuming that responsibility in 2019 and later years. Many actions will also require the cooperation and action of the residents, businesses and institutions of Los Osos. The Urban Water Use Efficiency Program is expected to cost $5,500,000 to implement through 2018.

[1] All costs set forth in this Basin Plan are in 2013 USD.

Table 1. Urban Water Use Efficiency Measures			
No.	**Water Efficiency Measure**	**2013-2018**	**2019-Ongoing**
Category 1. Residential Measures			
1A	Subsidized Community Retrofit (Partial)	■	
1B	Residential Clothes Washer Rebate	■	■
1C	Alternatives for Fully Retrofitted Residences	■	
1D	Retrofit on Resale	■	■
1E	High Efficiency Toilet Rebate		■
1F	Fixture Replacement by Deadline		
1G	Subsidized Community Retrofit (Full)		
1H	Retrofit Kit Distribution	■	■
1I	Purveyor Service Meters		■
1J	Purveyor Conservation Pricing		■
1K	Greywater Retrofit		
1L	Cisterns/Rain Catchment		
1M	Rain Sensors Rebate	■	■
1N	Rotating Sprinkler Nozzle Rebate		
1O	Water Waste Ordinance		
1P	Turf Removal		
Category 2. Commercial and Institutional Measures			
2A	Subsidized Community Retrofit (Partial)	■	
2B	Replace Pre-Rinse Spray Nozzles	■	
2C	Institutional Building Retrofit	■	
2D	Commercial Clothes Washer Rebate	■	■
Category 3. Education and Outreach Measures			
3A	Residential Water Survey	■	■
3B	CII Water Survey	■	■
3C	Public Information Program	■	■
3D	Media Campaign	■	■
3E	Efficient Outdoor Use Education Program	■	■
Category 4. New Development Measures			
4A	High Efficiency Dishwasher Requirement	■	■
4B	High Efficiency Clothes Washer Requirement	■	■
4C	Hot Water On Demand	■	■
4D	Greywater Plumbing	■	■
4E	Landscape and Irrigation Standards	■	■
4F	Smart Irrigation Controllers & Rain Sensors	■	■
4G	Multi-Family Submetering	■	■
4H	Efficient Fixtures Requirement	■	■

1.3.4 *Water Reinvestment Program*

In order to maximize the use of Basin water resources, it is imperative that water which has been used by urban residents and businesses in Los Osos be reinvested in the hydrologic cycle in an appropriate manner. The Water Reinvestment Program will accomplish that imperative by reinvesting all water collected and treated by the LOWWP in the Basin, either through direct percolation to the aquifers or reuse.

Water treated by the LOWWP will be of a sufficient quality to directly percolate into the Basin or to reuse for landscape or agricultural irrigation purposes. The LOWWP is expected to produce approximately 780 AFY under current conditions and 1,120 AFY at buildout. The planned uses of that water are listed in Table 2. Actions to be taken under current conditions are known as the Urban Water Reinvestment Program, while additional water may be delivered to agricultural users in the future under an Agricultural Water Reinvestment Program.

Table 2. Recycled Water Uses in the Water Reinvestment Program

Potential Use	Current Conditions	Buildout
Broderson Leach Fields	448	448
Bayridge Estates Leach Fields	33	33
Urban Reuse	63	63
Sea Pines Golf Course	40	40
Los Osos Valley Memorial Park	50	50
Agricultural Reuse	146	486
Total	780	1,120

All figures in AFY.

The County will deliver recycled water directly to the Broderson and Bayridge Estates leach fields, Sea Pines Golf Course, Los Osos Valley Memorial Park and agricultural users in the Eastern Area, on terms and conditions negotiated between the County and each user. Within the service areas of the Purveyors, the County will deliver recycled water to the Purveyors for resale to users, pursuant to an agreement between the County and each Purveyor. The Purveyors will deliver recycled water to users within their respective service areas based on rules adopted by them and, in the case of GSWC, approved by the California Public Utilities Commission (CPUC). Currently identified recycled water users include several schools, the community park and roadway median landscapes, with other users potentially being connected in the future.

The costs for the Urban Water Reinvestment Program are projected to be $18,290,000, with an additional $3,120,000 for the Agricultural Water Reinvestment Program in the future. These costs are currently included in the rates and charges for the LOWWP, but will be paid for under this Basin Plan if approved by Los Osos voters as explained below.

1.3.5 *Basin Infrastructure Program*

The level of sustainable production from the Basin is affected by the location of that production, both laterally and vertically. In particular, the Lower Aquifer is subject to seawater intrusion that can be controlled only by reducing extractions from that layer, especially from the Western Area. This Basin Plan establishes a Basin Infrastructure Program that will construct additional infrastructure to allow the Purveyors to transfer some production from the Lower Aquifer to the Upper Aquifer and shift some production from the Western Area landward into the Central and Eastern Areas.

The Basin Infrastructure Program is divided into four parts, designated Programs A through D. The potential projects and their expected costs are listed in Table 3. Each of the improvements is discussed in detail in Chapter 10.

Program A consists of actions that have already been taken by the Purveyors or for which the Purveyors have funding. Those actions are designed to allow the Purveyors to increase groundwater production from the Upper Aquifer to the greatest extent practicable without construction of large-scale nitrate removal facilities.

Program B improvements would allow the Purveyors to maximize production from the Upper Aquifer. To allow increased use of groundwater from the Upper Aquifer, the Purveyors would need to remove nitrate from water produced by new Upper Aquifer wells, including two for LOCSD, one for GSWC and, potentially, one or two for S&T. The Parties have determined that the necessary quantity of groundwater would be treated most economically and effectively through construction of a single, community nitrate facility rather than two or more separate facilities. Accordingly, Program B includes the construction of a shared nitrate removal facility. The technology for such a facility has not been finally determined, but for purposes of this Basin Plan it is assumed to be ion exchange. It is possible that an improved technology will emerge before design and construction of the nitrate removal facility, and the Parties will consider all appropriate technologies at that time.

Program C includes a set of infrastructure improvements that would allow the Purveyors to shift some groundwater production within the Lower Aquifer from the Western Area to the Central Area. Program D includes three additional wells that would allow the Purveyors to shift some groundwater production into the Eastern Area. Since groundwater production from the Central and Eastern Areas induces less seawater intrusion than the same amount of production from the Western Area, this landward shift increases the Sustainable Yield_X of the Basin.

Table 3. Basin Infrastructure Program Improvements		
Improvement	**Capital Cost**	**Parties Involved**
Program A		
Water Systems Interconnection	$100,000	LOCSD/GSWC
Upper Aquifer Well	$600,000	LOCSD
South Bay Well Nitrate Removal	$640,000	LOCSD
Palisades Well Modifications	$15,000	LOCSD
Blending Project	$1,110,000	GSWC
Water Meters	$370,000	S&T
Subtotal	$2,835,000	Purveyors
Program B		
LOCSD Wells	$2,700,000	LOCSD
GSWC Wells	$3,200,000	GSWC
Community Nitrate Removal Facility	$11,350,000	LOCSD/GSWC
Subtotal	$17,250,000	Purveyors
Program C		
Expansion Well No. 1	$1,400,000	GSWC
Expansion Well No. 2	$2,000,000	GSWC
Expansion Well No. 3	$1,600,000	LOCSD
Water Systems Interconnection	$30,000	S&T/GSWC
Los Osos Valley Road Main Upgrade	$1,530,000	GSWC
Subtotal	$6,530,000	Purveyors
Program D		
Expansion Well No. 4	$1,100,000	LOCSD/GSWC
Expansion Well No. 5	$1,875,000	LOCSD/GSWC
Expansion Well No. 6	$1,225,000	LOCSD/GSWC
Subtotal	$4,200,000	Purveyors

Basin Infrastructure Programs A through D can be combined in several ways, allowing incrementally greater production from the Upper Aquifer and the Central and Eastern Areas with implementation of each program. If Programs A through D were all implemented, that would increase the Sustainable Yield$_X$ of the Basin from its current level of 2,450 AFY to 3,500 AFY.[2] As discussed below, this Basin Plan recommends phased implementation of the Basin Infrastructure Programs in order to halt seawater intrusion and achieve a sustainable Basin.

[2] These figures also assume implementation of the Urban Water Reinvestment Program.

1.3.6 *Supplemental Water Program*

The Supplemental Water Program analyzes several alternatives for the development of supplemental water supplies for the Basin. For purposes of this Basin Plan, “supplemental water” is defined as water within the Plan Area that does not derive from potable water supplies within the Upper Aquifer or Lower Aquifer of the Basin. Supplemental water supplies analyzed in this Basin Plan include rainwater harvesting, stormwater capture, greywater reuse and groundwater desalination.

This Basin Plan concludes that rainwater harvesting, stormwater capture and greywater reuse would be difficult for the Parties to implement, because all three would require extensive, intrusive actions on private residential, commercial or institutional properties. In addition, none of the three are expected to produce sufficient quantities of water to justify attention by the Parties, when compared to other programs of this Basin Plan. Nevertheless, the Parties encourage residents, businesses and institutions in Los Osos to consider implementing these practices on their own properties.

The only action with the potential to generate large quantities of supplemental water is groundwater desalination. Based on an analysis of other water supplies in the Basin, the optimal quantities of desalinated groundwater would be either 250 AFY under current conditions or 750 AFY at buildout. A groundwater desalination facility would most likely use a reverse osmosis (RO) process. The greatest challenge for a successful desalination project in Los Osos would be disposal of the brine wastewater. Potential disposal methods include construction of an ocean outfall, evaporation ponds and zero-liquid discharge. Each of those methods is expected to be expensive and difficult to permit with the Coastal Commission and Regional Water Quality Control Board (RWQCB). Total costs for groundwater desalination are expected to be $16,750,000 for a capacity of 250 AFY and $40,250,000 for a capacity of 750 AFY. Based on those costs, the Parties do not recommend implementation of a groundwater desalination project.

1.3.7 *Imported Water Program*

This Basin Plan sets forth several alternatives for the development of an Imported Water Program for the Basin. For purposes of this Basin Plan, “imported water” is defined as water made available for use within the Plan Area from a source located outside the Plan Area. The purposes of identifying and analyzing potential imported water supplies are to ensure that the Basin Plan does not neglect any potential solution for the Basin and to provide a comparator for other Basin Plan programs. Nonetheless, the Parties do not recommend any implementation of the Imported Water Program, based on a water management principle that water supplies and demands in the Basin be balanced to avoid the need for imported water supplies in the Plan Area, to the extent possible, the relative reliability and cost of imported water, and past public antipathy.

1.3.8 *Wellhead Protection Program*

The Wellhead Protection Program is designed to protect water quality in the Basin by managing activities within a delineated source area or protection zone around drinking water wells. This program consists primarily of the Purveyors conducting Drinking Water Source Assessment and Protection surveys for each of their wells, as well as construction and operation of the LOWWP. The Basin Management Committee will take further actions to protect water quality in the Basin as deemed appropriate in the future.

1.4 Recommended Programs

The Basin Plan programs address the twin challenges of nitrate degradation of the Upper Aquifer and seawater intrusion into the Lower Aquifer. Each program focuses on a different aspect of water management, such as collecting and organizing groundwater data (Groundwater Monitoring Program), improving water use efficiency (the Urban Water Use Efficiency Program), or shifting the location of groundwater production within the Basin (Basin Infrastructure Program). Collectively, the programs are designed to achieve all goals of this Basin Plan.

While this Basin Plan has identified a number of potential programs, not all the programs are necessary or desirable for implementation in Los Osos. The Parties have analyzed the impacts of implementing various combinations of programs on the Basin through use of the Model. In particular, the Parties modeled the impact of each combination on the Basin Yield Metric, Water Level Metric and Chloride Metric.

Based on that analysis, the Parties recommend the following programs for immediate implementation:

- Groundwater Monitoring Program;
- Urban Water Use Efficiency Program;
- Urban Water Reinvestment Program;
- Basin Infrastructure Programs A and C; and
- Wellhead Protection Program.

The Parties also recommend the following programs for potential implementation, if the County and the Coastal Commission were to allow future development in Los Osos as part of the LOCP and LOHCP:

- Basin Infrastructure Program B; and
- Either Basin Infrastructure Program D or the Agricultural Water Reinvestment Program.

Of course, the County and Coastal Commission could approve a level of development less than that contained in the Buildout Population Scenario, in which case the Parties might be able to avoid implementing certain Basin Plan programs

1.5 Funding the Basin Plan Programs

The expected total cost for Basin Plan programs to be implemented under the Existing Population Scenario is estimated to be $33,775,000. Implementing the additional programs required for the Buildout Population Scenario is estimated to be an additional $19,450,000.

The Basin Plan applies two principles for the equitable allocation of costs. First, all water-using properties within the Basin should pay for the cost of achieving a sustainable Basin under current conditions, because all such properties contributed to the overall decline in Basin conditions. Second, properties that may be developed in the future should pay for the costs of achieving and maintaining a sustainable Basin in light of future water demand associated with the development of those properties.

1.6 Organization of the Basin Plan

This Basin Plan is divided into two parts. Part I sets forth the background of the Basin and the Basin Plan. Specifically, Chapter 2 provides an introduction to the Basin Plan, including the parties to the Basin Plan, the history and status of the court adjudication, and the goals and water management principles that are established in the Basin Plan. Chapter 3 describes the historical, present and future land uses within the Los Osos community, including urban and agricultural development and environmental resources. Chapter 4 summarizes the use of Basin water resources, including production and use of groundwater by the Purveyors (LOCSD, GSWC and S&T), private domestic landowners, community facilities and agriculturalists.

Chapter 5 concludes Part I with a description of the physical parameters of the Basin and the evolving history of human understanding about the Basin. That includes information about the geologic setting and structure of the Basin, surface water resources within the watershed and various aquifer layers within the Basin. The chapter closes with a description of the dual challenges facing the Basin: water quality degradation of the Upper Aquifer and seawater intrusion into the Lower Aquifer.

Part II sets forth the various Basin Plan programs. Chapter 6 establishes and defines the several Basin metrics. Chapters 7 through 13 describe each of the various programs, including the Groundwater Monitoring Program (Chapter 7), the Urban Water Use Efficiency Program (Chapter 8), the Water Reinvestment Program (Chapter 9), the Basin Infrastructure Program (Chapter 10), the Supplemental Water Program (Chapter 11), the Imported Water Program (Chapter 12) and the Wellhead Protection Program (Chapter 13). Chapter 14 analyzes various combinations of the programs and recommends a course of action for the Basin. Chapter 15 proposes the methods for funding various actions recommended in the Basin Plan. Chapter 16 describes the timeline for implementing the various Basin Plan programs.

Certain management actions within the scope of the Adjudication are not contained within this Basin Plan—for example, the determination of water rights of the Parties and establishment of rules for the governance of the Basin Management Committee. Those topics will be set forth in a final stipulated judgment to resolve the Adjudication to be presented to the Court.

1.7 Institutional Implementation of the Basin Plan

This Basin Plan is one of three key components of the institutional framework for the program to restore and ensure the long term integrity and reliability of water resources in the Basin. As noted above, this process was, in part, initiated through litigation (the Adjudication). As a resolution to the Adjudication, the Parties intend to obtain court approval to a Stipulated Judgment. The Stipulated Judgment will create the framework for the allocation and management of the water resources within the Basin, including ongoing court oversight of the Parties and their Basin management activities. The Basin Plan will be adopted and incorporated in its entirety in the Stipulated Judgment as the cornerstone of the "physical solution," articulating the program for restoration of Basin water resources. The Parties also intend to create a joint powers authority -- the Los Osos Groundwater Basin Management Committee (Basin Management Committee). The Basin Management Committee will be responsible for implementation of the Basin Plan through its dual roles as the entity responsible for implementation of the Stipulated Judgment (oftentimes referred to as a Watermaster in other adjudicated groundwater basins) and in creating and implementing the Los Osos Groundwater Basin Community Facilities District (Basin CFD). The Basin CFD will be responsible for financing the implementation of the Basin Plan and the Stipulated Judgment.

1.8 Consistency with the Sustainable Groundwater Management Act of 2014

In late 2014, the California legislature adopted three bills that are collectively referred to as the Sustainable Groundwater Management Act (SGMA) of 2014. The three bills are Senate Bill 1168 (Pavley), Senate Bill 1319 (Pavley) and Assembly Bill 1739 (Dickinson). The SGMA imposes a comprehensive framework for water resource management at a local level – that is, for each groundwater basin as designated by the California Department of Water Resources (DWR). The Parties intend their efforts to be fully compliant with the substantive requirements of the SGMA. The Parties may elect to take advantage of certain aspects of the SGMA as the implementation of the Basin Plan proceeds.

[This page intentionally blank]

2

INTRODUCTION TO THE BASIN PLAN

2.1 Subject Matter

2.1.1 *The Basin*

This Basin Plan concerns the Los Osos Groundwater Basin (Basin), which underlies the unincorporated communities of Los Osos, Baywood Park and Cuesta-by-the-Sea in San Luis Obispo County, California. For convenience, the various communities overlying the Basin are generally referred to as "Los Osos" in this Basin Plan.

The area covered by this Basin Plan (Plan Area) is outlined on Figure 1. For purposes of convenient discussion (but not necessarily hydrogeology), the Plan Area has been divided into four subareas—the Dunes and Bay Area, Western Area, Central Area and Eastern Area—as shown on Figure 1.

2.1.2 *Purpose*

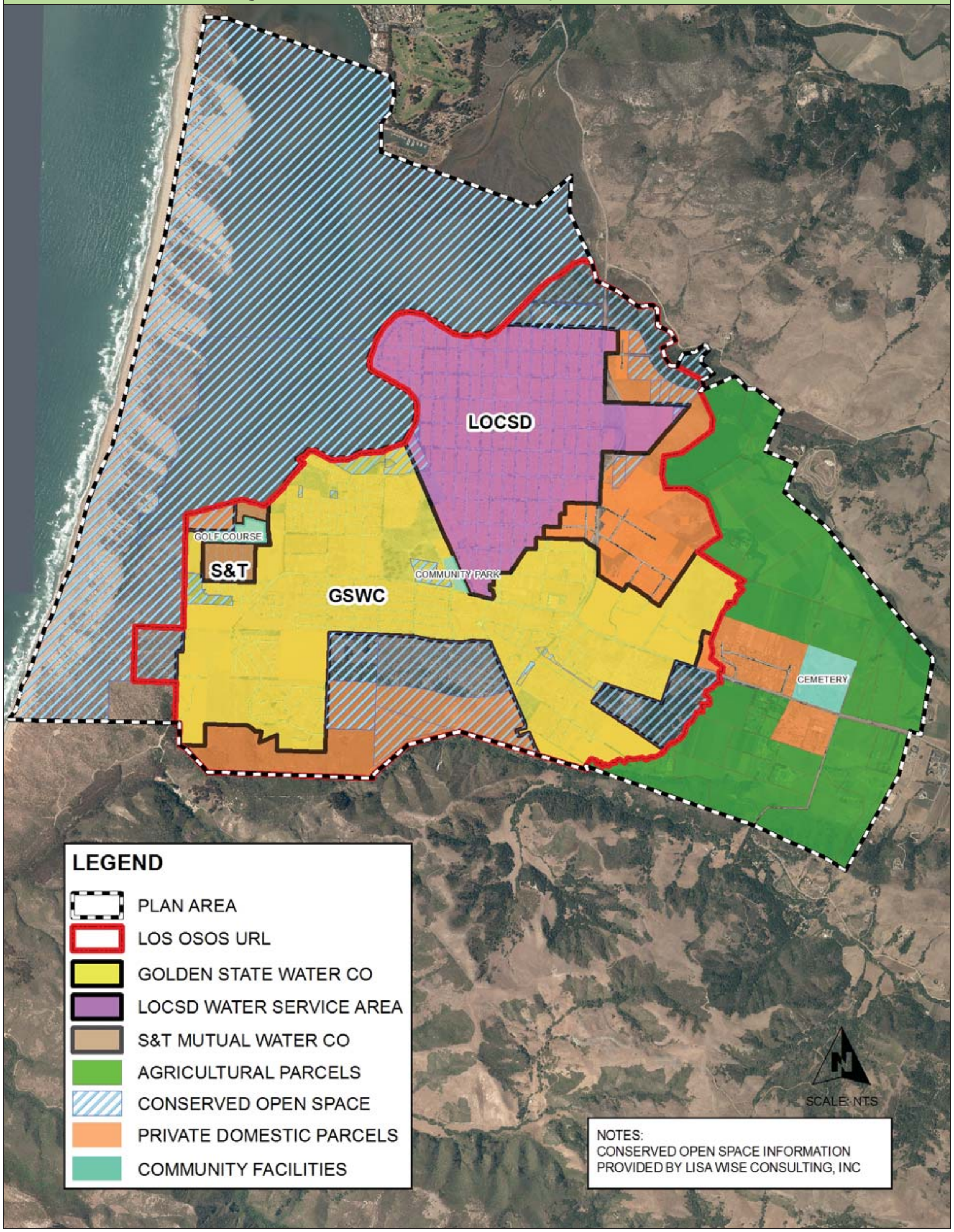
This Basin Plan was developed within the scope of the adjudication of the Basin in the case of *Los Osos Community Services District v. Golden State Water Company, et al.*, Civil Case No. GIN 040126 (San Luis Obispo County Superior Court) (the Adjudication and the Court). The Basin Plan will be incorporated into a final stipulated judgment in the Adjudication, for adoption by the Parties and approval by the Court.

2.2 Parties

2.2.1 *Parties*

This Basin Plan has been prepared and is being adopted by LOCSD, GSWC, S&T and the County, as the parties to the Adjudication. The water service areas of the three purveyors (LOCSD, GSWC and S&T) are shown in Figure 4.

Figure 4. Los Osos Water Purveyor Service Areas



2.2.2 *Los Osos Community Services District*

LOCSD is a community services district formed pursuant to California Government Code sections 61000 *et seq.* and operates a municipal water utility system within a specified zone located within its boundaries. LOCSD's water service area is shown in Figure 4.

2.2.3 *Golden State Water Company*

GSWC is a California corporation and a public utility, as defined in California Public Utilities Code section 216, and owns and operates a municipal water utility system in Los Osos. GSWC's water service area is shown in Figure 4. GSWC provides water service pursuant to a certificate of public convenience and necessity issued by the CPUC and is subject to comprehensive regulation by that agency. Among other areas, the CPUC regulates GSWC's water supplies, infrastructure standards, service quality and customer rates. GSWC formerly operated under the names Southern California Water Company and Cal Cities Water Company.

2.2.4 *S&T Mutual Water Company*

S&T is a California corporation and a mutual water company, as defined in California Public Utilities Code section 2705 and California Corporations Code section 14300(b). S&T owns and operates a municipal water utility system in Los Osos, through which it delivers water exclusively to its shareholders at cost. S&T's water service area is shown in Figure 4.

2.2.5 *County of San Luis Obispo*

The County is a California general law county that utilizes water from the Basin for irrigation of a park in Los Osos. The County, subject to certification of the local coastal plan by the California Coastal Commission (Coastal Commission), is the agency that has land use authority within the unincorporated Los Osos communities, including all those lands that overlie the Basin or otherwise receive water from the Basin.

Additionally, the County is authorized pursuant to California Government Code section 25825.5 to undertake efforts necessary to construct and operate a community wastewater collection and treatment system within Los Osos, including programs and projects for prevention of seawater intrusion and management of groundwater resources, to the extent that they are related to the construction and operation of the community wastewater collection and treatment system. Further discussion of the County's LOWWP is contained in Chapter 9 of this Basin Plan.

2.2.6 *Party References*

LOCSD, GSWC, S&T and the County are each sometimes referenced in this Basin Plan as a "Party," and collectively they are referenced as the "Parties." LOCSD, GSWC and S&T are collectively referenced as the "Purveyors."

2.2.7 *Non-Parties*

There are numerous other persons who extract groundwater from the Basin, primarily for private domestic, community facility or agricultural irrigation purposes. Unless those producers intervene in the Adjudication and stipulate to participation in this Basin Plan, they are not considered to be parties and have no rights or obligations arising out of or related to this Basin Plan. There may, however, be indirect impacts on non-parties from, and non-parties may be participants in, the various programs described in Part II of this Basin Plan.

2.2.8 *Basin Management Committee*

In the Adjudication, the Parties intend to enter into a stipulation that will establish a Basin Management Committee to perform certain tasks for management of the Basin. The Basin Management Committee will be an entity with governance by the Parties pursuant to the provisions of the stipulation.

2.3 Background and Authority

2.3.1 *Adjudication Complaint*

On February 13, 2004, LOCSD initiated the Adjudication by filing a Complaint for Declaratory and Injunctive Relief and Adjudication of Water Rights (Complaint) against Southern California Water Company (the prior name of GSWC), S&T, the County, Sea Pines Golf Course and Does 1 through 500, inclusive. According to the Complaint, paragraph 1, LOCSD brought the action "for the purposes of protecting the valuable resources of the [Basin], protecting its own rights and interests with respect to the Basin, and to facilitate efforts to cooperatively manage the Basin."

2.3.2 *Standstill Agreement*

The parties to the Adjudication entered into a Stipulation of Parties As to Standstill Agreement, which was approved by the Court on May 25, 2004 and stayed all pleadings in the Adjudication to allow the parties to hold settlement discussions. The standstill agreement was extended on several occasions. Sea Pines Golf Course was subsequently dismissed from the Adjudication on or about December 19, 2006.

2.3.3 *Interlocutory Stipulated Judgment*

On August 5, 2008, the Court approved an Interlocutory Stipulated Judgment (ISJ) between LOCSD, GSWC, S&T and the County. The ISJ provided that the Parties would form a Working Group to undertake technical studies of the Basin's water resources and to adopt a Basin management plan that resolves conflicting claims related to those resources. This Basin Plan is the result of those efforts and, together with the stipulated judgment, is intended to fulfill the obligations of the Parties pursuant to the ISJ.

2.3.4 *Legal, Financial and Political Considerations*

In the Basin, as in other parts of California, water resources management is governed by a complex system of local, state and federal laws. Water use, development and allocation are controlled by legal contracts and agreements, common law principles, statutes, constitutional provisions and court decisions. These legal considerations, in combination with the jurisdictional powers of the various local governing agencies and the private property rights of groundwater users, form the framework that governs water resources management in the Basin.

2.4 Basin Plan Goals

As established in the ISJ, Section II, and further detailed by the Parties based on the condition of the Basin, the goals of this Basin Plan are divided into two categories: Immediate and Continuing. Immediate Goals are designed to balance supplies and demands in the Basin in the immediate future and will be pursued at the commencement of Basin Plan implementation, to the extent they have not already been pursued by the Parties and other stakeholders in the Basin. Continuing Goals will be implemented over time in order to promote and maintain the long-term balance and health of the Basin. The goals are as follows.

<u>Immediate Goals</u>

1. Halt or, to the extent possible, reverse seawater intrusion into the Basin.

2. Provide sustainable water supplies for existing residential, commercial, community and agricultural development overlying the Basin.

3. Set water conservation goals and establish mandatory standards and policies that promote water use efficiency and innovation for residential, commercial and institutional water users for both indoor and outdoor usage.

<u>Continuing Goals</u>

- Provide for a continuously updated hydrologic assessment of the Basin, its water resources and sustainable yield.

- Create a water resource accounting which is able to meet the information needs for planning, monitoring, trading, environmental management, utility operations, land development and agricultural operations.

- Establish a strategy for maximizing the reasonable and beneficial use of Basin water resources.

- Provide sustainable water supplies for future development within Los Osos, consistent with local land use planning policies.

- Set water conservation goals and establish strategies to promote water use efficiency and innovation for agricultural water users, including use of recycled water.
- Clarify the assignment of risk arising from future changes in the availability of groundwater for extraction.
- Allocate costs equitably among all who benefit from the Basin's water resources.
- Protect water quality in the Basin.
- Protect environmentally sensitive areas within the Basin or influenced by Basin hydrology.
- Develop strategies to maximize grant and other funding and financing opportunities for ongoing Basin Plan implementation.

2.5 Water Management Principles

2.5.1 *General Principles*

Basin groundwater is a part of the natural capital of Los Osos, serving a number of important economic, environmental and social objectives. Decisions about water management involve balancing sets of economic, environmental and social interests.

The Parties agree to implement this Basin Plan in recognition of the continuing local and state imperative to increase the productivity and efficiency of water use in the Basin, the need to service the Los Osos community and to ensure the health of the Basin by establishing environmentally sustainable levels of extraction. For purposes of this Basin Plan, sustainable use of the Basin means that:

- Groundwater will be available to meet all reasonable, beneficial water demands within the Plan Area;
- Groundwater elevations will remain sufficiently high to prevent seawater intrusion, land subsidence or other negative impacts of falling groundwater levels;
- Groundwater quality will be protected for use as a source of drinking water with reasonable treatment;
- Groundwater levels and quality will support or enhance groundwater-dependent ecosystems in the Plan Area based on conditions in existence as of adoption of the Basin Plan;
- Water-related costs for Purveyor customers, private domestic well owners, community facilities and agricultural water users in the Plan Area will be reasonable in light of the economic value of Basin groundwater resources;

- Groundwater resources are managed for the long term, considering climatic and hydrologic variability and potential change and the limits to human understanding of the Basin; and

- Water supplies and demands of the Basin will be managed to avoid the need for imported water supplies in the Plan Area, to the extent possible.

The objective of the Parties in implementing this Basin Plan is to provide greater certainty for the Los Osos community and the environment, and underpin the capacity of the Basin's water management regime to deal with competing water demands and change responsively and equitably.

2.5.2 *Rights and Responsibilities of Water Users and the Basin Management Committee*

While this Basin Plan has been prepared by the Parties, Basin groundwater is beneficially used by residents, businesses and institutions in the Los Osos community. Proper water management attaches both rights and responsibilities to water users: a right to a share of the water made available for use at any particular time, and a responsibility to use this water in accordance with the needs of other water users, as determined by the Court and the Basin Management Committee. Likewise, the Basin Management Committee and all water users have a responsibility to ensure that water is allocated and used in a manner that is economically, environmentally and socially sustainable.

2.5.3 *Other Management Initiatives*

Other natural resource management initiatives for the Plan Area will have significant water impacts and will be subject to separate planning processes by one or more of the Parties. These initiatives include, but are not limited to, the LOCP and LOHCP being developed by the County. While the Basin Plan will be the primary guide for water management practices in the Basin, it is anticipated that the Basin Plan may need to be amended over time in order to remain consistent with those separate resource management initiatives, where such consistency is required by law.

2.6 Environmental Review

As a management plan developed in the context of the Adjudication and expected to be adopted by the Court as the basis for a stipulated judgment in that proceeding, this Basin Plan is not subject to the environmental review requirements of the California Environmental Quality Act (CEQA).[3] Nonetheless, particular actions to be undertaken by the Parties and others under this Basin Plan may require compliance with CEQA. The Parties and other entities will undertake CEQA review for any such actions at the appropriate time.

[3] *See* Cal. Pub. Res. Code §§ 21000 *et seq*.

[This page intentionally blank]

3

THE LOS OSOS COMMUNITY

3.1 Communities and Plan Area

This Basin Plan concerns the Los Osos Groundwater Basin, which is located in and around the unincorporated community of Los Osos. Figure 1 shows the boundaries of the Basin and the Plan Area. The onshore portion of the Plan Area covers approximately 12 square miles, of which approximately four square miles underlie the bay and sand spit, and eight square miles underlie the Los Osos communities.

3.2 Land Use Planning Authority

The County is the primary land use planning authority for the area covered by the Coastal Commission-certified EAP, which includes the Plan Area. The Coastal Commission has jurisdiction over some County planning measures and may hear appeals of certain County actions under the EAP. The entire Plan Area is located within the coastal zone.

The EAP was certified by the Coastal Commission in February 1988, and was approved by the County Board of Supervisors in March 1988. The planning area covers about 71.5 square miles and includes the unincorporated communities of Los Osos and Cayucos as well as surrounding rural areas. The EAP covers an area larger than the Plan Area, but all of the Plan Area lies within the EAP planning area. The EAP is the official land use planning document for the covered areas and governs future development of those areas. In 1988, the EAP projected that the population of Los Osos at buildout would be approximately 28,688.

In 2005, County staff prepared a comprehensive draft update to the EAP. In 2009, the Coastal Commission approved the update, excluding the portions relating to Los Osos. The Coastal Commission rejected the portion of the EAP within the Los Osos Urban Reserve Line (URL) due in part to the pending nature of plans for a community wastewater collection and treatment system. In December 2012, the County began an effort to prepare a new update of the EAP for Los Osos that will undergo Coastal Commission review. That update will be called the Los Osos Community Plan (LOCP).

The Parties recognize the information regarding Los Osos contained in the 2005 draft update of the EAP has not been certified by the Coastal Commission.

Nonetheless, the Parties rely on the draft for certain purposes, including projecting the likely maximum future level of development within the Los Osos community and the Plan Area. In particular, the projected level of development and population in the 1988 EAP is widely considered to be unrealistic and is likely to be revised downward as part of the LOCP and LOHCP efforts.

3.3 Land Use Categories

The Plan Area includes approximately 7,530 acres, of which 80 percent (5,985 acres) are on land and the remaining 20 percent are underwater beneath Morro Bay.

Development within the Los Osos community consists largely of residences, with limited commercial development that serves the bedroom community. Residential and commercial development within Los Osos is generally bounded by the URL as established in the EAP. There are approximately 3,514 acres within that area, containing 6,022 assessor parcels as of December 31, 2010. The area within the URL represents slightly less than half of the Plan Area, but almost all of the residential and commercial development. Outside the URL are 104 assessor parcels, most of which are used for agricultural or recreational purposes.

Land use categories for properties within the Plan Area, as designated in the EAP, are listed in Table 4 and shown on the map in Figure 5. The relative distribution of land uses within the Plan Area is shown in Figure 6, excluding Morro Bay and with several commercial and residential categories combined for better perspective.

Table 4. Land Use Categories in the Plan Area

Name	Abbreviation	Acreage
Agriculture	AG	1,089.1
Commercial Retail	CR	92.2
Commercial Service	CS	27.4
Industrial	IN	0.0
Office and Professional	OP	31.6
Open Space	OS	378.1
Recreation	RC	1,123.4
Residential Rural	RR	148.5
Residential Multi-Family	RM	135.1
Residential Single-Family	RF	1,640.0
Residential Suburban	RS	1,086.8
Rural Lands	RL	0.0
Public Facilities	PF	121.7
Uncategorized	UN	109.7
Waterbody	WA	1,545.0
Total		7,528.6

Figure 5. Land Uses in the Plan Area

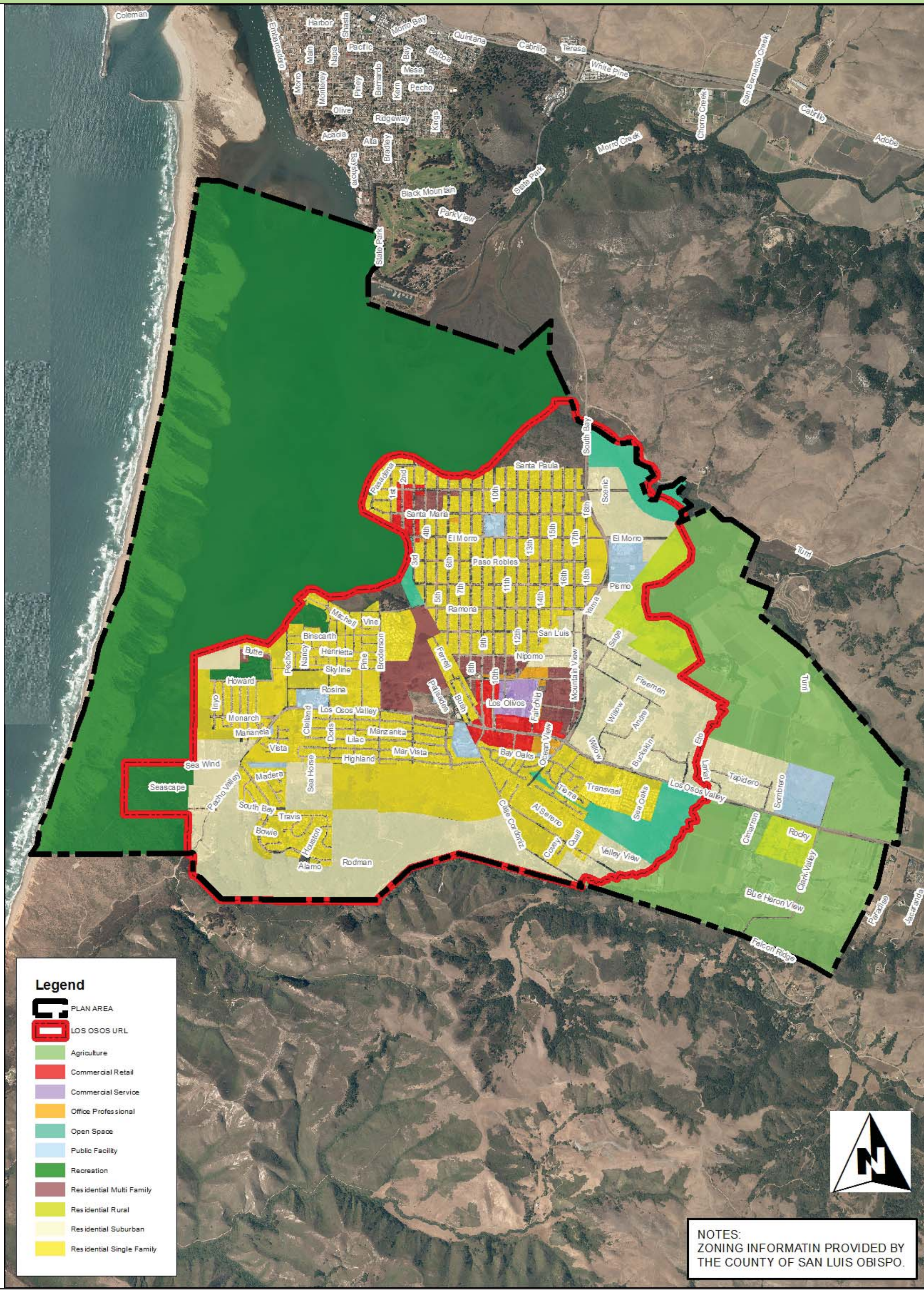
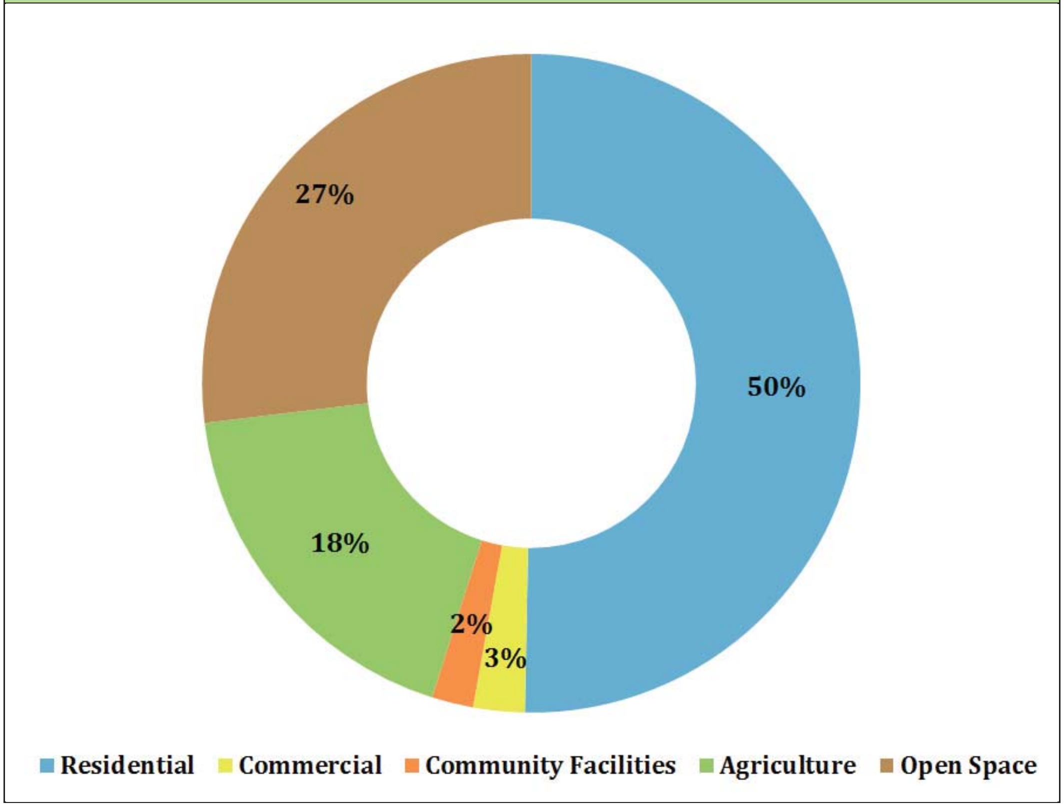


Figure 6. Distribution of Land Uses in the Plan Area



3.4 Historical Population Growth

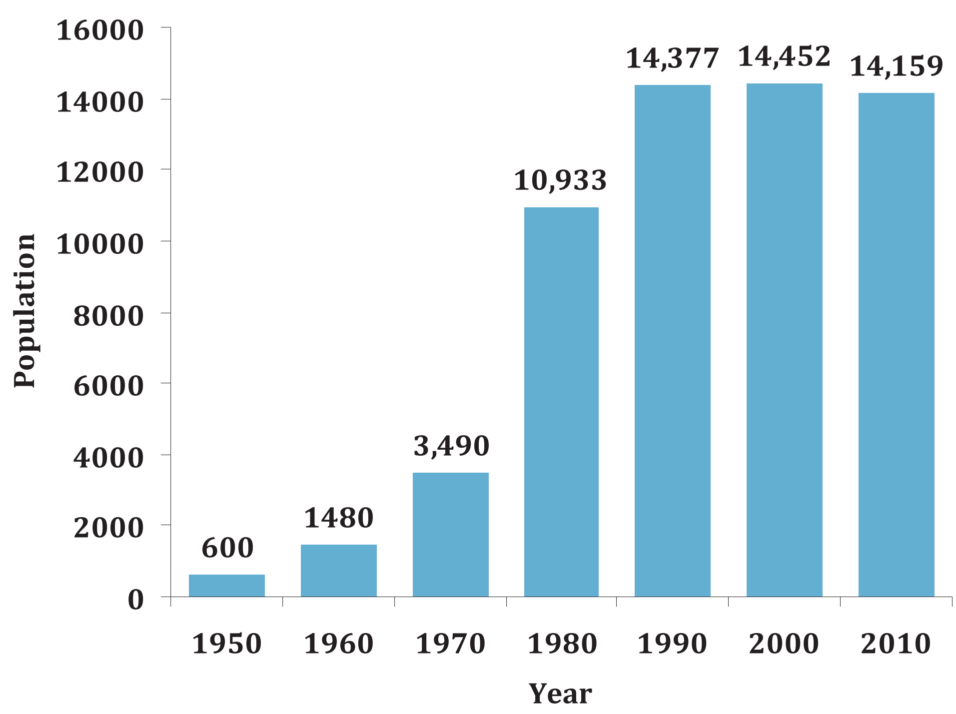
The community of Los Osos shares much of its history with the surrounding area in the County. As reported in various historical studies, the area was settled by Chumash Indians for centuries, and Chumash hunters, fishermen and foragers harvested local marine, coastal and river resources. Along the coast they collected abalone and mussels, and the Chumash trade network passed raw marine materials such as fish, whale bones and oils to the interior. Although the Portuguese conquistador Juan Rodriguez Cabrillo first encountered the Chumash while exploring for the Spanish government in 1542, it was not until 1772 that five Catholic missions were established within the Chumash Nation. After the secularization of the missions in 1833, the Chumash population fell into severe decline.

As noted above, Spanish explorers first entered the territory in 1542, but the period of initial exploration lasted more than 200 years. An expedition led by Gaspar de Portola explored the area in 1769 and allegedly encountered grizzly bears in the Los Osos Valley, gaining the community its name. With the explorers came Franciscan friars who began missions in the vicinity of Los Osos. In 1822, California came under the jurisdiction of Mexico when it gained independence from Spain and land grants were made to settlers in the area until, in 1848, California became a territory of the United States.

At the time of its formation as one of the original California counties in 1850, the County was reported to have a non-Indian population of 336. Development occurred slowly in Los Osos due to its distance from the population centers of Los Angeles and San Francisco. Early development was mostly limited to farms and low density residences. The first residential subdivisions were developed in Los Osos in the late 1950s. Population growth in Los Osos was moderate during the 1950s and 1960s, increasing an average of about 7.6 percent per year.

During the 1970s and early 1980s, growth was rapid, with growth rates as high as 18 percent per year. Such growth led the County to project future population figures as high as 28,688 residents by the mid-1990s.[4] Instead, population growth slowed during the 1980s, and virtually stopped following the *de facto* development moratorium that went into effect on November 1, 1988. The historical population of the Plan Area is shown in Figure 7, while Figure 8 depicts the percentage of expected buildout population that arrived in the Plan Area during each historical decade. The majority of population growth occurred during the 1970s and 1980s. As of 2010, Los Osos had developed approximately 72.6 percent of its expected population at buildout.

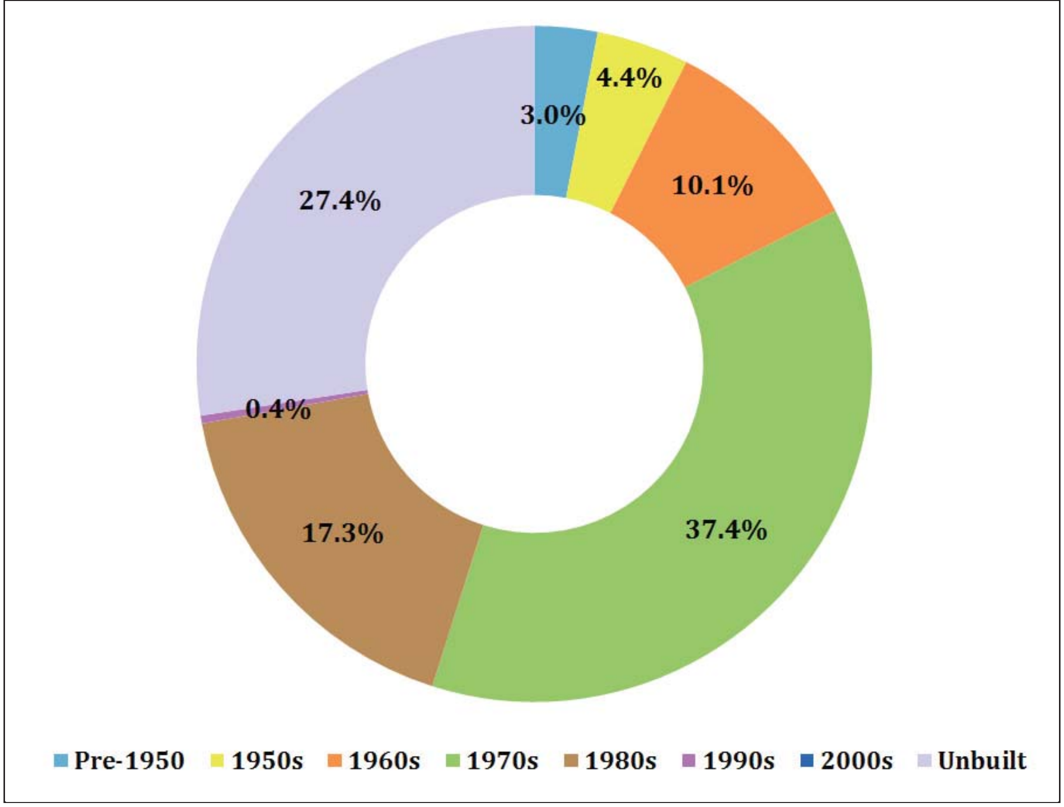
Figure 7. Historical Plan Area Population



[4] Brown & Caldwell, *Preliminary Groundwater Basin Management Study*, at 11-12 (1974).

Sources: Estero Area Plan; U.S. Census; California State Department of Finance.

Figure 8. Decadal Contributions to Los Osos Population at Buildout



3.5 Future Population Growth

This Basin Plan contemplates that additional development may occur within the Basin, leading to population growth within the Plan Area. The acceptable level of future development will be determined by other planning processes, including the LOCP and LOHCP. The level of projected development contained in this Basin Plan is based upon the draft EAP prepared by County staff in 2005, as updated in the current LOCP and LOHCP planning processes. The draft EAP would have allowed population up to approximately 19,700. This Basin Plan uses 19,850 as the potential population within the Plan Area in order to capture limited population outside the URL. In the event that the Basin Plan is adopted prior to completion of these processes, and projected future development figures generated during those processes are inconsistent with Basin Plan assumptions, it is contemplated that the Basin Plan will be amended to reflect actual projected future development.

3.6 Environmental Resources

Development in Los Osos is surrounded by significant environmental, park and open space areas, as shown in Figure 9. These areas generally limit development within the Plan Area to those areas within the URL and also serve as valuable community and state environmental resources. This Basin Plan includes among its goals the protection of environmentally sensitive areas within the Plan Area or influenced by Basin water resources. Specific environmental areas include the following.

- The Morro Bay National Estuary (Estuary) is a 2,300-acre semi-enclosed body of water where freshwater flowing from the land mixes with saltwater of the sea, supporting a unique ecosystem containing numerous plants and animals that are not found in either totally freshwater systems or the ocean. The Estuary supports the most important wetland system on California's central coast, and includes a wide variety of habitats and numerous sensitive and endangered species of plants and animals. The Estuary and its watershed support many beneficial human uses, such as agriculture, commercial and recreational fishing, recreational boating, tourist attractions which support a large business community, oyster farming, diverse water-oriented recreational opportunities and electric utility power generation. In April 1994, the Governor established the Estuary as California's first state estuary. This designation formally recognized the importance of preserving and enhancing the Estuary and its watershed as one of the state's rare natural treasures and the special need for a multi-jurisdictional planning effort. The Estuary has also been designated as a national estuary.

- Montaña de Oro State Park was created in 1965 and includes historic Spooner Ranch and house. The park was expanded to 7,828 acres by 1988, which made it the largest state park in California. It contains 7.3 miles of ocean frontage and 3.8 miles of bay frontage, as well as sensitive habitat.

- Morro Bay State Park features lagoon and natural bay habitat. The bay's most prominent landmark is Morro Rock. The park has opportunities for sailing, fishing, hiking and bird watching. The park museum has exhibits that cover natural features and cultural history, Native American life, geology and oceanography. On the bay's northeast edge is a pristine saltwater marsh that supports a thriving bird population.

- Los Osos Oaks State Natural Reserve features ancient sand dunes covered with centuries-old coast live oak trees. A series of trails wind their way through several types of plant communities.

- The El Moro Elfin Forest is a 97-acre preserve located on the southeastern shore of Morro Bay, south of Los Osos Creek along the west side of South Bay Boulevard. The name "Elfin Forest" comes from the stunted character of the California Live Oaks that range from only four to 20 feet in height in spite of being centuries old, due to soil and climate conditions. The preserve is owned by the County, California State Parks and California State Lands Commission, and is operated and managed by the Los Osos/Morro Bay chapter of the Small Wilderness Area Preservation (SWAP).

- The Sweet Springs Nature Preserve, located on Ramona Avenue in Los Osos, is a 24-acre preserve with excellent views of Morro Bay and Morro Rock. The preserve was established in 1981 and deeded to the Morro Coast

Audubon Society in June 1992. The site is home to more than 400 mature trees and offers birding, habitat restoration, nature study and community outreach efforts and events. An additional 8-acre property to the east may be added in the future.

Figure 9. Environmental Resources in the Los Osos Area

4

USE OF BASIN GROUNDWATER RESOURCES

4.1 Introduction

Basin groundwater resources are extracted and used exclusively by residents, businesses, institutions and agriculturalists within the Plan Area. This chapter describes the historical and existing uses of Basin groundwater resources as a baseline for other elements of the Basin Plan.

Consistent with the land uses described in Section 3.3, groundwater is used within the Plan Area for residential, commercial, community and agricultural purposes. The largest proportion of groundwater is extracted for residential, commercial and community uses by the three Purveyors within Los Osos, although there are a number of private domestic and agricultural well owners in the Basin. The specific areas served by the three Purveyors and by private domestic, community facility and agricultural wells are shown in Figure 10. Each of the four categories are summarized in Table 5 and described in the following sections.

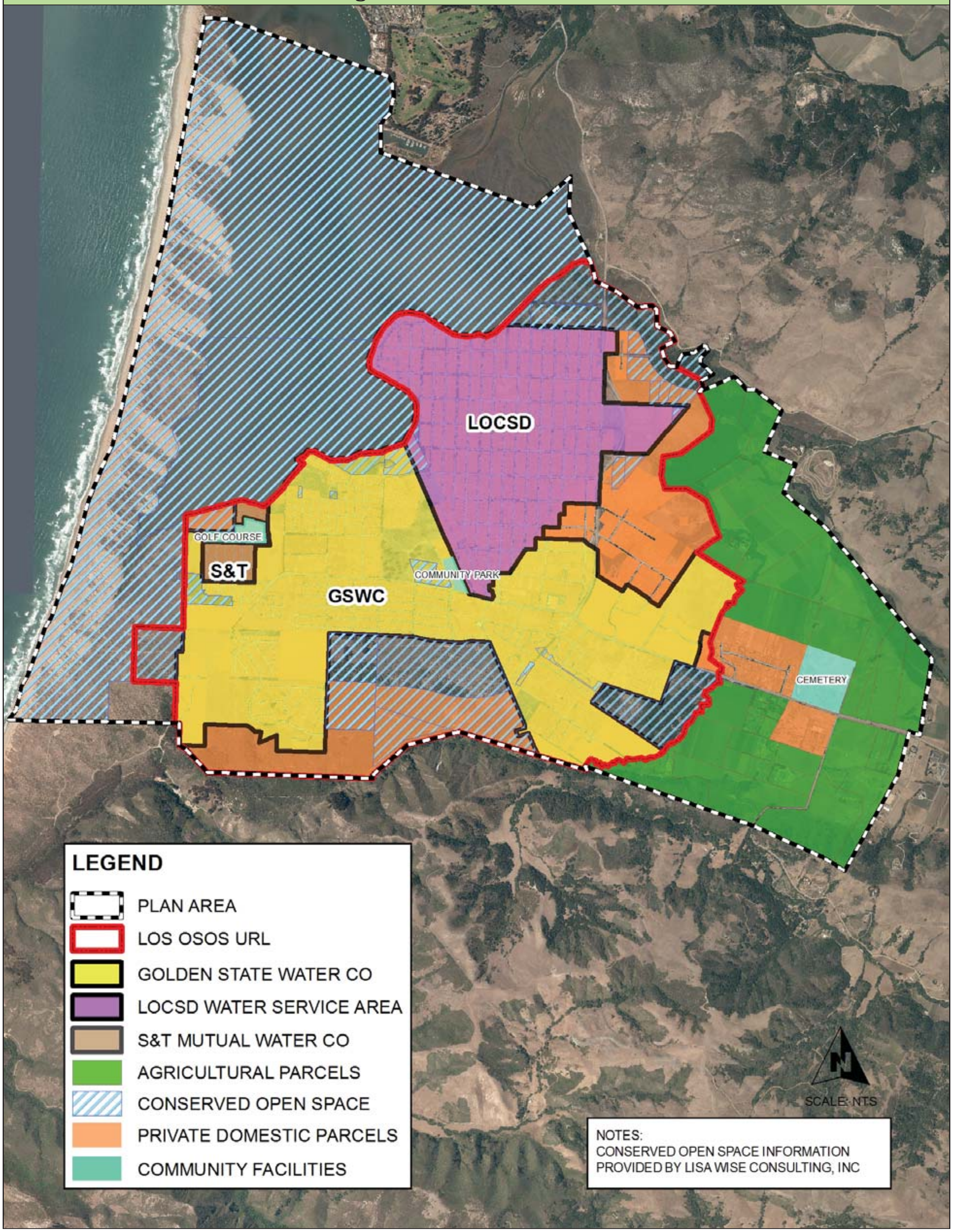
Table 5. Categories of Groundwater Use

Category	Area (acres)	Share of Total Area
Purveyors	2,365	52%
Private Domestic Wells	968	22%
Community Facilities	84	2%
Agriculture	1,090	24%
Total	4,507	100%

4.2 Production by the Purveyors

The majority of Basin groundwater is extracted and used by the Purveyors for service to their residential, business and institutional customers. Each of the Purveyors has an exclusive water service area as shown in Figure 10. The GSWC water service area covers 1,469 acres, the LOCSD water service area covers 826 acres, and the S&T water service area covers 70 acres, for a total of 2,365 acres. Those areas include both developed and undeveloped parcels.

Figure 10. Water Use Areas



Prior to the 1950s, residences, businesses and farms within Los Osos produced groundwater from the Basin strictly through the operation of private wells. The public water systems now owned and operated by LOCSD, GSWC and S&T were not created until the development of the first subdivisions in the 1950s. Since that time, the Purveyors have steadily added service connections through both main extensions and acquisition of smaller utilities. That consolidation is advantageous for management of the Basin, because it: (i) equips the Purveyors with an extensive network of wells and water distribution pipelines that enable the lateral and vertical movement of groundwater production within the Basin; (ii) limits the number of parties who produce groundwater and thus need to be directly involved in management actions; (iii) allows for economies of scale for certain actions recommended in this Basin Plan; and (iv) allows projects funded by the Purveyors to capture the majority of residential, commercial and institutional users of groundwater from the Basin.

The water system now owned and operated by LOCSD was started in 1951 under the ownership of San Luis Obispo County Water Works District No. 9, also known as Baywood Park County Water District. That district drilled the first municipal well in the Basin, the Third Street Well in Baywood Park. By 1958, the system had 200 service connections and three wells. The water system was later renamed County Service Area 9 (CSA 9), Zone A. The establishment of LOCSD was approved by local voters in November 1998, and the district was formed in 1999. LOCSD operates and manages the water system for the benefit of its customers.

The water system now owned and operated by GSWC was started by J.E. McClure in 1954 with the drilling of the Highland Well. Mr. McClure sold the system to W.H. Lambert in 1955, who in turn formed the Los Osos Valley Water Company in 1958. California Consolidated Water Company, Inc. purchased the water system in 1967, as well as the system of Los Osos Highlands Water Company at an unknown date. Since that time the system has been held by several different water utility companies resulting from corporate mergers, including California Consolidated (1967-1972), California Cities Water Company (1972-1978) and Southern California Water Company (1978-2005). Southern California Water Company changed its name to Golden State Water Company in 2005. Like LOCSD, GSWC operates and manages its water system for the benefit of its customers.

S&T was formed in 1961 and has served the neighborhood known as Sunset Terrace since that time. Historically, it has sometimes been referred to as Sunset Terrace Mutual Water Company. S&T operates and manages its water system for the benefit of its shareholders, who are also its customers.

Precise groundwater pumping records are not available for the Purveyors prior to 1970. The DWR estimated municipal water production and service connections from 1955-1972, as shown in Table 6, and from 1970-1988, as shown in Table 7. DWR estimates for 1955-1972 only included those properties connected to municipal water systems, while the estimates for 1970-1988 included all residential and commercial properties, including those served by private wells. Some of the apparent increase in production during the former period likely represented a shift in production from private domestic wells to public water system wells as existing residents and businesses connected to the three water systems in Los Osos and may not represent the change in overall urban production from the Basin. Because of the uncertainty of data before 1970, this Basin Plan uses the period from 1970 through 2013 as the basis for most analyses. Earlier periods are used only for understanding the overall development of Los Osos and the Basin.

Table 6. Municipal Service Connections and Groundwater Production (1955-1972)

Year	Connections	Production (AFY)	Year	Connections	Production (AFY)
1955	N/A	65	1964	840	275
1956	250	75	1965	920	325
1957	300	85	1966	930	375
1958	360	110	1967	1,000	360
1959	430	140	1968	1,050	425
1960	500	175	1969	1,120	390
1961	580	225	1970	1,230	450
1962	680	240	1971	1,520	600
1963	780	260	1972	1,970	800

Source: DWR, *Los Osos-Baywood Ground Water Protection Study*, Southern District Report (1973).

Table 7. Municipal Groundwater Production (1970-1988)

Year	Production (AFY)	Year	Production (AFY)	Year	Production (AFY)
1970	780	1977	1,530	1984	2,270
1971	890	1978	1,600	1985	2,340
1972	970	1979	1,840	1986	2,430
1973	940	1980	1,950	1987	2,510
1974	1,150	1981	2,090	1988	2,640
1975	1,440	1982	1,990		
1976	1,580	1983	1,990		

Source: DWR, *Geohydrology and Management of Los Osos Valley Ground Water Basin, San Luis Obispo County*, Southern District Report (1989).

Since 1970, the Purveyors or their predecessors have metered and maintained records of their production from the Basin, as shown in Table 8. Unlike the estimates available for earlier time periods, this data is highly accurate and reliable and provides a solid basis for evaluating recent groundwater usage by the Purveyors and their customers in Los Osos. The Purveyors have voluntarily provided this data as part of their contribution toward achieving sustainable water supplies for existing and future residential, commercial, community and agricultural development within Los Osos.

Table 8. Municipal Groundwater Production (1970-2013)				
Year	CSA 9/LOCSD	GSWC	S&T	Total
1970	200	270	20	490
1971	240	340	20	600
1972	320	370	70	760
1973	320	440	50	800
1974	420	500	70	990
1975	520	580	90	1,190
1976	560	620	80	1,260
1977	620	620	80	1,310
1978	690	700	90	1,480
1979	760	800	90	1,650
1980	770	840	110	1,720
1981	840	910	100	1,850
1982	820	870	100	1,790
1983	790	910	100	1,800
1984	1,000	1,000	120	2,120
1985	1,090	1,050	110	2,250
1986	1,170	1,070	110	2,350
1987	1,160	1,100	110	2,370
1988	1,260	1,180	120	2,560
1989	1,180	1,150	110	2,440
1990	1,160	1,120	110	2,390
1991	1,100	1,050	100	2,250
1992	1,160	1,040	110	2,310
1993	1,000	1,020	100	2,120
1994	1,110	1,000	100	2,210
1995	1,160	990	100	2,250
1996	1,100	1,030	100	2,230
1997	1,190	1,110	110	2,410
1998	1,070	990	110	2,170
1999	1,170	1,100	130	2,400
2000	1,150	1,090	110	2,350
2001	1,100	1,070	100	2,270
2002	1,160	1,060	120	2,340
2003	1,130	1,040	100	2,270
2004	1,050	1,070	100	2,220
2005	960	1,020	90	2,070
2006	940	970	90	2,000
2007	940	990	100	2,030
2008	870	950	90	1,910
2009	880	890	80	1,850
2010	770	770	80	1,620
2011	760	740	70	1,570
2012	760	700	60	1,520
2013	730	690	50	1,470

Note: All figures are expressed in AF and rounded to the nearest 10 AF.

Groundwater production by all municipal water Purveyors from 1955 through 2013 is shown in Figure 11, based on the best available data from Table 6, Table 7 and Table 8. In addition, a five-year running average of Purveyor production from 1960 through 2013 is shown in Figure 12. As is apparent from those figures, groundwater production increased quickly during the 1970s and 1980s, but has decreased by approximately 30 percent since that time.

The increase in water production stopped in the late 1980s largely due to the *de facto* building moratorium that has covered much of the community since 1988 based on regulatory actions by the Central Coast RWQCB, as discussed in Section 5.7.1.

Reduced groundwater production since 1988 is the result of a shrinking and aging population and water conservation efforts undertaken by the Purveyors and citizens of Los Osos. That trend is not expected to be reversed, especially in light of the water conservation measures set forth in Chapter 8. As can be seen in Figure 12, water usage in the municipal area of Los Osos decreased most clearly during the years immediately following the 1987-1992 drought, when water conservation measures were first seriously introduced in California, and since 2002, when water utility rates in the community began rising. This reduction in urban water demands has lessened some of the potential negative impacts from seawater intrusion into the Basin, but further urban water efficiency improvements will be necessary to halt seawater intrusion for long-term sustainable management of the Basin.

Figure 11. Historical Groundwater Production by Purveyors (1955-2013)

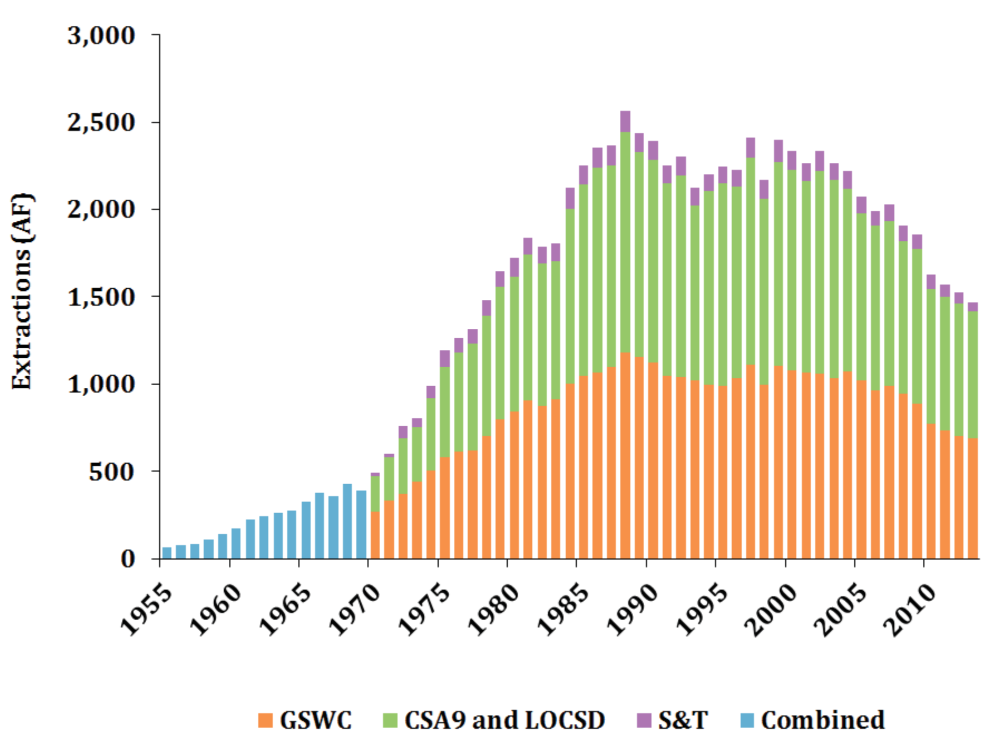
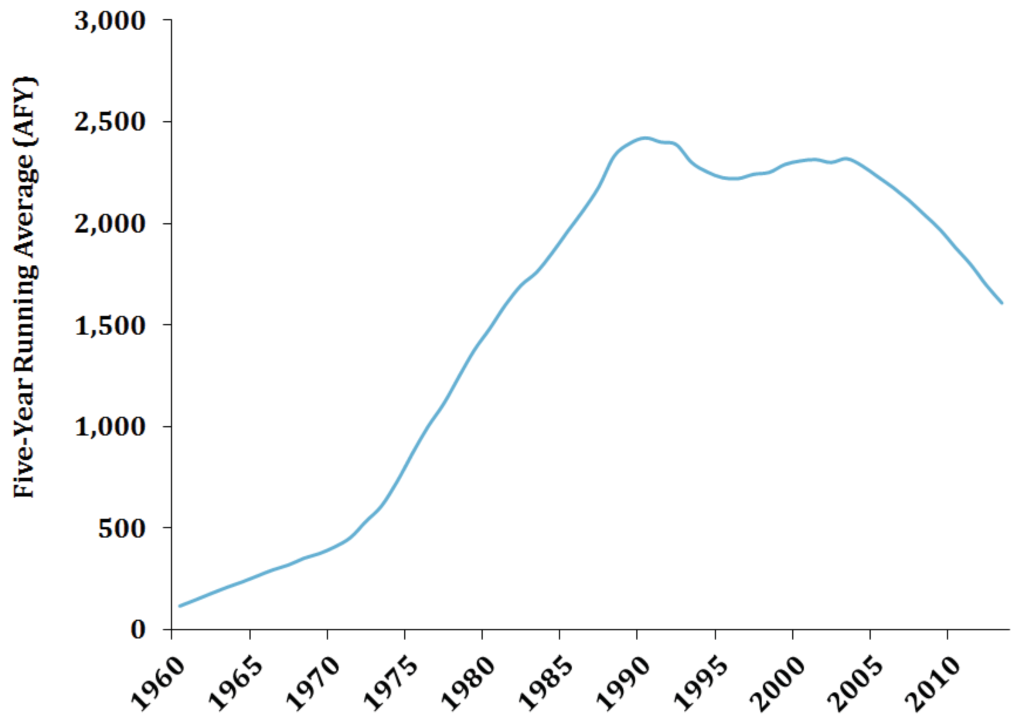


Figure 12. Five-Year Running Average of Production by Purveyors (1960-2013)



During the period from 1988 through 2013, groundwater production by the Purveyors ranged from 1,520 to 2,560 AFY, while the five-year average ranged from 1,700 to 2,390 AFY. Both measures show a generally downward trend. Based on those historical production figures and trends, for purposes of this Basin Plan, current groundwater demands of the Purveyors are determined to range from approximately 1,500 to 1,800 AFY. Within that range, annual production depends primarily on hydrologic conditions and the resulting water demands for landscape irrigation.

4.3 Production by Private Domestic Wells

While the Purveyors produce and provide groundwater to their respective service areas covering a total of approximately 2,365 acres, another 968 acres of the Plan Area rely on groundwater produced from private domestic wells. Groundwater production from domestic wells overlying the Basin has not historically been metered or publicly reported. In addition, use of some domestic wells has been discontinued over time as the properties served by those wells have been connected to municipal water systems, thus shifting their associated water use from one category to another.

This section estimates total domestic well production at the current time based on a survey of rural residential parcels.[5] The approach is useful for estimating total production from all domestic wells in the Basin, but does not provide information regarding any particular well or parcel. The parcel survey consisted of determining the number of existing residences on rural residential parcels within the Plan Area and classifying the irrigation demands on those parcels into three categories of water use: low, medium or high. The initial survey was completed using aerial photography from July 2007. Field reconnaissance was performed in February 2009 to check for any significant changes and to inspect areas that were not clear in the aerial photos. The parcels included within the survey are shown on Figure 10.

Rural residential parcels were initially classified as low, medium or high outdoor water use lots based on comparing irrigated turf areas. Low water use parcels have less than 1,000 square feet of turf. Medium water use parcels have between 1,000 and 3,000 square feet of turf, and high water use parcels have more than 3,000 square feet of turf. Low and medium water use parcels with additional major irrigated landscaping features, such as orchards, vegetable gardens or greenhouses, were moved up one classification. A few non-residential parcels—e.g., churches—were included in the survey. Results of the survey are summarized in Table 9.

Table 9. Survey of Rural Residential Parcels by Water Usage

Area	Parcels	Houses	Outdoor Water Use		
			Low	Medium	High
Central Urban Area	131	138	26	45	46
Eastern Area	68	76	13	16	38
Total	199	214	39	61	84

Data provided by GSWC was used to estimate the water demands for residences indoors and for each outdoor water use classification. The data consisted of bi-monthly demand figures over four years (2005-2008) for three one-acre parcels adjacent to the area served by private domestic wells. Most of the rural residential parcels in the study area are approximately one acre in size. GSWC staff reviewed their system data and selected three parcels as representative of low, medium and high residential water demands for the area.

Each data set was analyzed to separate indoor and outdoor use components. The indoor components were averaged into a single indoor water use factor, while the outdoor use components were kept separate to use with the parcel survey data. The estimated indoor use averaged 0.33 AFY per residence. This is consistent with indoor use estimates for GSWC and LOCSD. Outdoor use was estimated at 1.05 AFY for high-use parcels, 0.44 AFY for medium-use parcels and 0.23 AFY for low-use parcels.

[5] This survey was previously reported in Cleath-Harris Geologists, Inc., *Technical Memorandum: Water Use Estimates for Private Domestic Wells* (July 29, 2009).

Data from the parcel classification survey and the GSWC water system was combined to estimate the gross water use for domestic wells, as shown in Table 10. There are a total of 184 developed rural residential parcels (with 214 residences) and 15 undeveloped parcels that are estimated not to have any current water usage. The total water use is estimated at 195 AFY, or 1.06 AFY per parcel, which is rounded up to 200 AFY for purposes of this Basin Plan. Of that amount, 75 AFY is estimated to occur in the Eastern Area, and 125 AFY in the Central Area.

Table 10. Water Use on Rural Residential Parcels

Component	Units	Water Use Factor (AFY)	Water Use (AFY)
Residences Indoor Use	214	0.33	71
Low-Use Outdoor Use	39	0.23	9
Medium-Use Outdoor Use	61	0.44	27
High-Use Outdoor Use	84	1.05	88
Total			195

In order to estimate groundwater production by private domestic wells at earlier times, the same method was used in conjunction with historical aerial photographs from 1977 and 1994. That method yielded production of 90 AFY in 1977 and 180 AFY in 1994. Those calculations, along with the 2009 estimate and early 1970s estimates from the consulting firm Brown and Caldwell (B&C), indicate a steady increase in private well production through approximately 1998, when current demand levels were reached. Those figures are used for purposes of Table 14, which reports total groundwater production across all categories. The Parties will update the estimates made in this section as actual data become available in the future based on the Groundwater Monitoring Plan set forth in Chapter 7.

4.4 Production by Community Facilities

There are several community and recreational facilities in Los Osos that rely on water pumped from the Basin. Together, those facilities cover 84 acres of the Basin.

Sea Pines Golf Course is a nine-hole golf course constructed in 1954 and located in the Western Area of the Basin. The golf course owns three wells, which draw from both the Upper and Lower Aquifers. It currently uses Upper Aquifer groundwater and has used recycled water from the Monarch Grove Wastewater Treatment Plant since 1999. Between approximately 1985 and 2011, the golf course also used groundwater from the Lower Aquifer. An early study estimated that the golf course used approximately 110 AFY for turf irrigation. It currently uses approximately 20 AFY of recycled water and 80 AFY of groundwater.[6]

[6] County, *Recycled Water Management Plan for the Los Osos Wastewater Project*, at 5 (May 2012); B&C, *Los Osos-Baywood Park Phase I Water Quality Management Study*, Vol. II, at Table III-5 (1983).

The County owns and operates a community park in Los Osos. The park obtains groundwater through a single well, which is estimated to withdraw approximately 5 AFY for turf and other irrigation.

The Los Osos Valley Memorial Park (Memorial Park) was established in 1962 and covers approximately 50 acres, of which 18 acres are irrigated and 32 acres are not irrigated, and features a crematory and funeral home. The facility relies on groundwater from the Basin, using two wells, which produce an estimated 50 AFY for turf irrigation and other facility uses. The Memorial Park irrigation well is located off-site, near Los Osos Creek, and produces groundwater from the Lower Aquifer.

Total groundwater production for community facilities in the Basin is estimated to have been approximately 100 AFY from 1954 through 1961, and between 140 and 180 AFY since 1962. Those figures are used in Table 14 below. Future groundwater production for community facilities is expected to decline significantly following the availability of recycled water in the Plan Area as part of the Water Reinvestment Program set forth in Chapter 9.

4.5 Production by Agricultural Water Users

Approximately 1,090 acres of the Plan Area are zoned for agricultural use, as shown in Figure 10. Since agricultural wells in the Basin are privately owned and not metered, precise data for agricultural irrigation water use is not available. Various historical studies have made estimates, however, based on common irrigation practices in the area and known cropping patterns.

A 1973 study by DWR estimated agricultural water use to average 1,100 AFY for an area that extended east of the Basin boundary.[7] A study by B&C also estimated that irrigation water demands were approximately 1,100 AFY as of 1972, based on a similar area.[8] B&C revised that estimate slightly downward to 1,070 AFY in its 1983 study, based on irrigation of fewer acres.[9]

Based on those studies, the EAP adopted by the County in 1988 reserved 800 AFY of Basin groundwater supplies for agricultural use. The EAP specifically cited the 1974 B&C study and equated the 1,100 AFY of agricultural well production with 800 AFY of consumptive use. The EAP noted that the reservation of groundwater for agricultural use was intended to apply "[p]rior to completion of a Resource Capacity Study."[10] As described in Section 5.7.2, the County has conducted such a Resource Capacity Study (RCS), and the EAP reservation has no binding effect at this time.

In 1989, DWR estimated total agricultural irrigation water use from 1970 to 1988 as shown in Table 11.[11] The estimates were based on information related to land use,

---

7 DWR, *Los Osos-Baywood Ground Water Protection Study*, Southern District Report, at 7 (1973).
8 B&C, *Preliminary Groundwater Basin Management Study*, at 17 (1974).
9 B&C, *Los Osos-Baywood Park Phase I Water Quality Management Study*, at 3-4 (1983).
10 County, *Estero Area Plan*, at 8-16 (1988).
11 DWR, *Geohydrology and Management of Los Osos Valley Ground Water Basin, San Luis Obispo County*,

evapotranspiration of applied water (ETAW), expected irrigation efficiencies and monthly precipitation. DWR relied upon crop surveys in 1959, 1968, 1977 and 1984. Between 1968 and 1977, there was a significant shift from irrigated to non-irrigated crops, with a shift back again between 1977 and 1984. DWR assumed that the changes occurred gradually on a straight-line basis.

Table 11. Agricultural Irrigation Groundwater Production (1970-1988)

Year	Production (AFY)	Year	Production (AFY)	Year	Production (AFY)
1970	1,200	1977	610	1984	1,060
1971	1,050	1978	490	1985	990
1972	1,100	1979	680	1986	970
1973	700	1980	630	1987	1,060
1974	680	1981	870	1988	900
1975	650	1982	700		
1976	630	1983	660		

The agricultural use estimates presented in Table 11 appear to have included turf irrigation at Los Osos Memorial Park, based on a review of the source documents. For the Basin Plan, the Memorial Park has been reclassified as a community facility, so that the figures in Table 11 are reduced by 50 AFY when reporting total groundwater production from the Basin.

On behalf of the Parties, Cleath-Harris Geologists, Inc. (CHG) estimated agricultural well production based on analysis of cropping patterns and irrigation water demands in 2008 and 2009.[12] According to that study, total irrigated field area in the Plan Area was approximately 400 acres, with 375 acres irrigated and 25 acres fallow in any given year. That area was divided into 10 specific fields, as shown in Figure 13.

Cropping data for irrigated fields with pesticide use are available from the County's Department of Agriculture, including all fields identified in the Plan Area except portions of Fields A and E, which were possibly used for organic farming. Crop data from 2006 through 2008 was correlated with specific fields using permit location codes. For each location code, farmers report their crop types, planted acreage and pesticide use on an annual basis. Compiled crop data for each field is shown in Table 12.

Southern District Report (July 1989).

[12] *See* CHG, *Technical Memorandum: Water Use Estimates for Los Osos Creek Valley Irrigation Wells* (July 29, 2009); Cleath & Associates, *Basin Hydrologic Budget with Simulated Groundwater Elevation Contour Maps* (August 7, 2008).

Figure 13. Irrigated Fields in the Plan Area

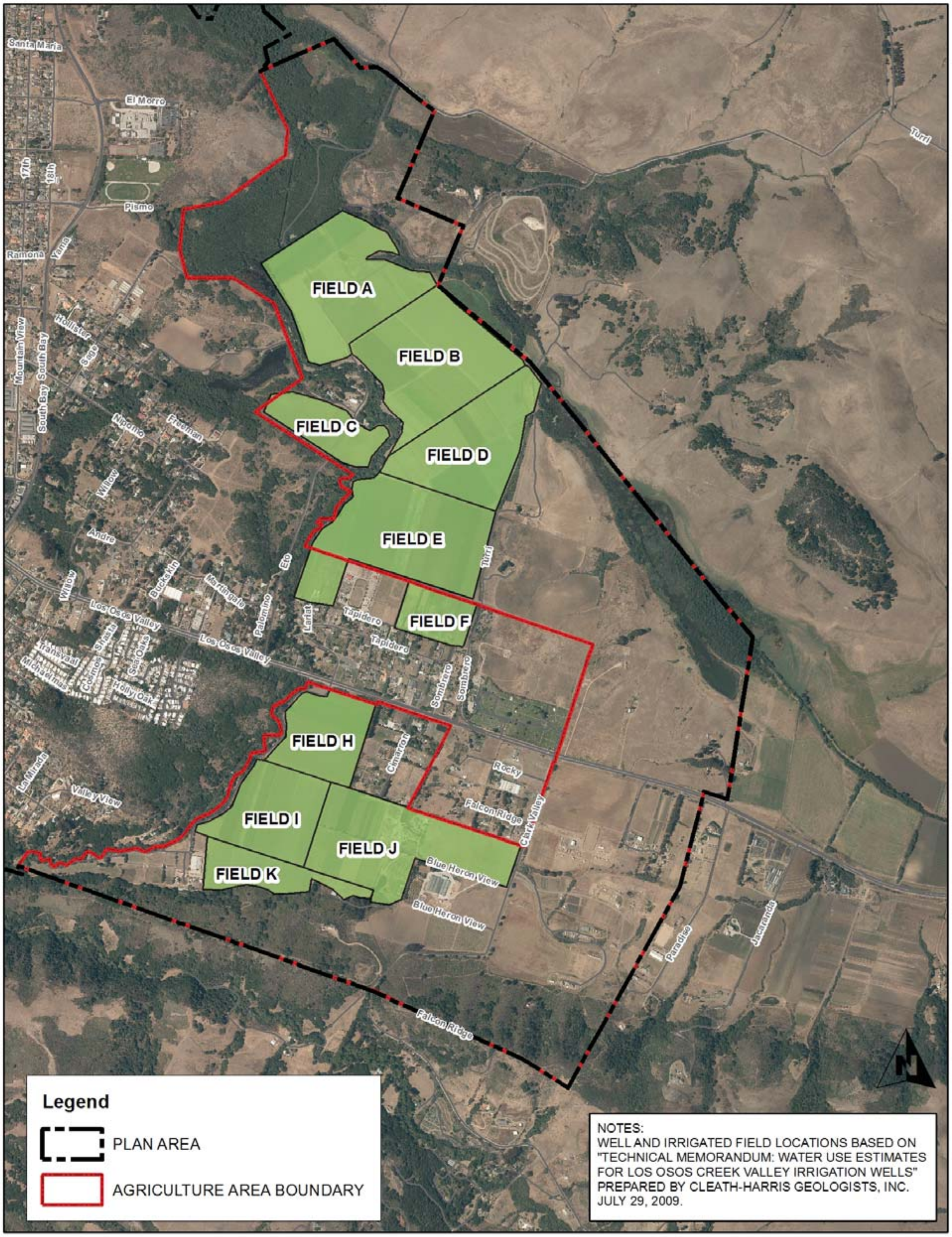


Table 12. Agricultural Cropping Data (2008-2009)					
Field	Location Code	Irrigated Acres	Cropping Data	Crops	Harvested Acres
A	140001	4.0	Cabbage	1	4.0
A	140006	20.0	Miscellaneous truck	1	20.0
A	N/A	30.0	Miscellaneous truck	1	30.0
B	140002	0.0	Fallow	0	0.0
B	140003	22.5	Celery	1	22.5
B	140004	15.0	Lettuce head	1	15.0
B	140005	16.0	Cabbage	1	16.0
C	140008	12.5	Broccoli, cilantro	2	25.0
C	140009	6.0	Parsley	1	6.0
D	100002	6.5	Broccoli, cabbage	2	13.0
D	100003	15.5	Broccoli, cabbage	2	31.0
D	100004	8.0	Broccoli, bok choy	2	16.0
D	100005	10.0	Broccoli, cabbage	2	20.0
D	100006	6.0	Broccoli	1	6.0
E	110001	55.0	Broccoli, cabbage, parsley, leaf lettuce, bok choy, celery	3	165.0
E	220002	5.0	Cauliflower	2	10.0
E	220002	5.0	Cauliflower	2	10.0
E	N/A	10.0	Miscellaneous truck	1	10.0
F	N/A	14.0	Miscellaneous truck	1	14.0
H	20001	30.0	Peas	1	30.0
I	60001	28.0	Squash, pepper, tomato	2	56.0
I	60002	0.0	Fallow	0	0.0
J	10001	8.3	Turf	1	8.3
J	10002	0.0	Fallow	0	0.0
J	10003	0.0	Fallow	0	0.0
J	10004	0.0	Fallow	0	0.0
J	10005	10.0	Turf	1	10.0
K	60003	0.0	Fallow	0	20.0
K	10003	20.0	Peas	1	20.0
Total		357.3			557.8

To determine the intensity of cropping in each field, the planted acreage for each crop was added together and divided by the actual land area. The results show that approximately 576 planted acres were proposed on 375 acres of land, for an average of 1.6 crops per field per year. Where the proposed planted acreage was significantly less than the land area, e.g., Field J, the unplanted acreage was assumed to be fallow.

Each crop type was assigned a nominal gross irrigation requirement factor. Turf was assigned a value of 2.7 AFY, and truck crops were assigned a value of 1.3 AFY, which are the average values for the Los Osos/Morro Bay area as listed in the 1998 County Master Water Plan Update. The resulting agricultural irrigation water demand for the Basin was estimated at 750 AFY, as shown in Table 13. Because there have been no significant changes in agricultural patterns since 2009, that estimate is used to represent current irrigation water demands in this Basin Plan.

In addition to irrigated fields, there are a few greenhouses in Los Osos. Combined greenhouse operations were assigned a nominal five AFY total water use, based on communications with growers in 2006.[13] Because that five AFY is within the margin of error for irrigated fields, this Basin Plan does not add greenhouse production to the agricultural water total.

Table 13. Agricultural Irrigation Water Demands (2008-2009)

Field	Irrigated Area (acres)	Crop Multiplier	Harvested Acres (acres)	Duty Factor (AF/acre)	Applied Water (AF)
A	54.0	1	54.0	1.3	70
B	53.5	1	53.5	1.3	70
C	18.5	1.7	31.0	1.3	40
D	46.0	1.9	86.0	1.3	112
E	75.0	2.6	195.0	1.3	254
F	14.0	1	14.0	1.3	18
H	30.0	1	30.0	1.3	39
I	28.0	2	56.0	1.3	73
J	18.3	1	18.3	2.7	49
K	20.0	1	20.0	1.3	26
Total	357.3	1.6	557.8	1.4	750

This Basin Plan uses 750 AFY as the best estimate for current agricultural water demands. This level of production is within the historical range (490-1,200 AFY) and appears reasonable, considering some of the higher historical estimates included crop irrigation in areas outside of the Basin, and there has likely been an increase in irrigation efficiency. Importantly, the Parties will update the estimates made in this section as actual data become available in the future based on the comprehensive Groundwater Monitoring Program set forth in Chapter 7.

[13] Ripley Pacific Team, *Technical Memorandum No. 5, Recycled Water Reuse Potential* (July 5, 2006).

4.6 Total Groundwater Production

Combined groundwater production by all users—Purveyors, private domestic, community facilities and agriculture—is shown in Figure 14 and Table 14 for the period from 1970 through 2013. The data was compiled from the best sources available, with missing data assumed to be consistent with nearby years.

Because of the use of estimates for groundwater production for private domestic, community facility and agricultural uses, the figures in Table 14 are likely to be accurate only within 100 AF, which is approximately 10 percent of the estimated groundwater production in those categories in recent years. As explained in Part II, a margin of error of 100 AF represents almost five percent of the Sustainable Yield$_{2012}$ of the Basin.

This Basin Plan seeks to mitigate the potential impact of uncertainties associated with estimated production from the Basin in two ways: (1) by reducing uncertainty in the future through collection of accurate groundwater production data through the Groundwater Monitoring Program in Chapter 7; and (2) by cautious planning approaches, e.g., use of a 20 percent buffer between actual production and the modeled yield of the Basin when setting goals for the Basin metrics set forth in Chapter 6.

Figure 14. Total Groundwater Production (1970-2013)

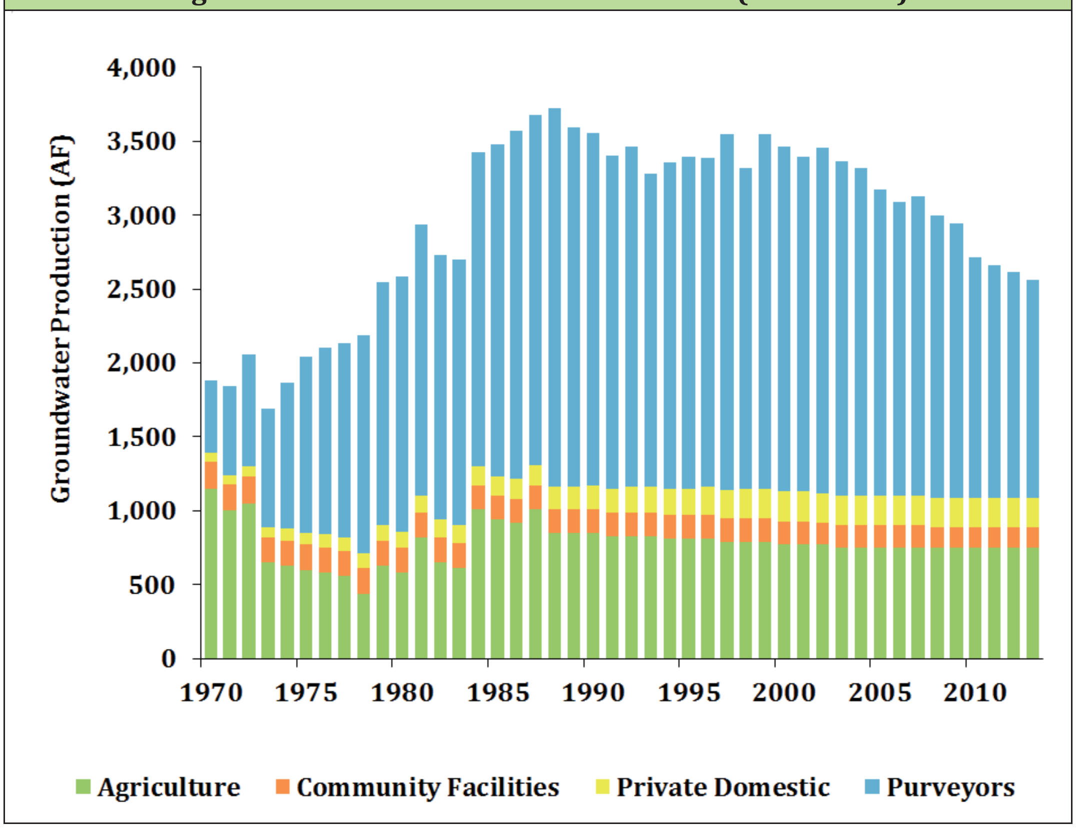
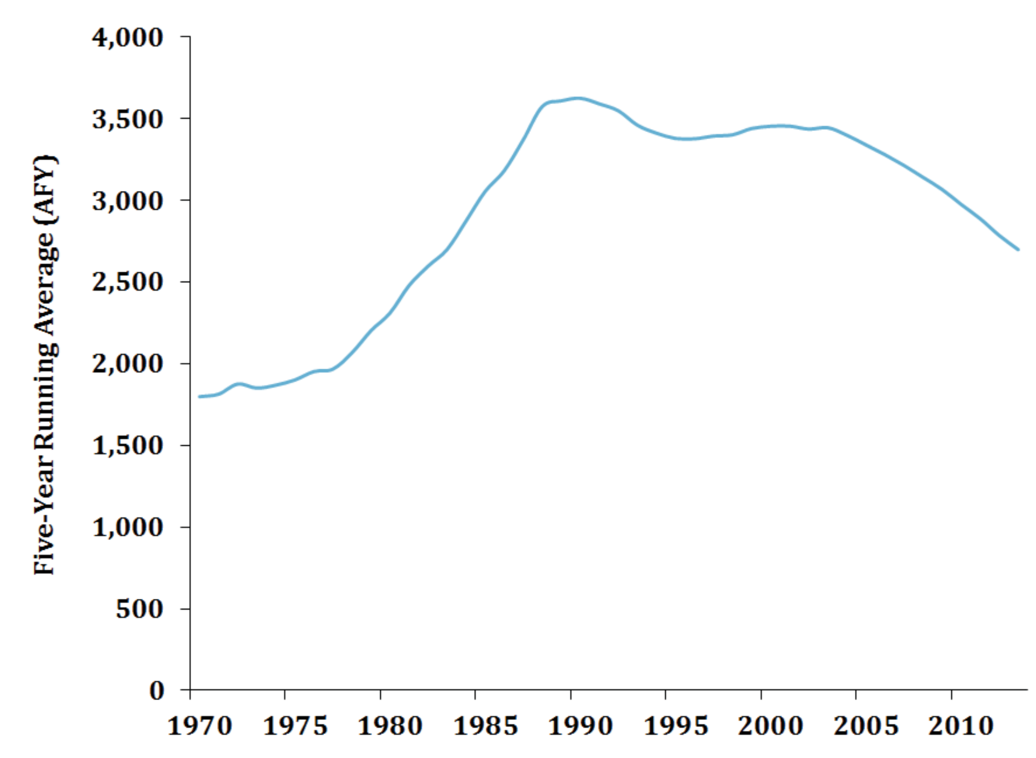


Table 14. Total Groundwater Production (1970-2013)					
Year	**Purveyors**	**Domestic**	**Community**	**Agriculture**	**Total**
1970	490	60	180	1,150	1,880
1971	600	60	180	1,000	1,840
1972	760	70	180	1,050	2,060
1973	800	70	170	650	1,690
1974	990	80	170	630	1,870
1975	1,190	80	170	600	2,040
1976	1,260	90	170	580	2,100
1977	1,310	90	170	560	2,130
1978	1,480	100	170	440	2,190
1979	1,650	100	170	630	2,550
1980	1,720	110	170	580	2,580
1981	1,850	110	170	820	2,950
1982	1,790	120	170	650	2,730
1983	1,800	120	170	610	2,700
1984	2,120	130	160	1,010	3,420
1985	2,250	130	160	940	3,480
1986	2,350	140	160	920	3,570
1987	2,370	140	160	1,010	3,680
1988	2,560	150	160	850	3,720
1989	2,440	150	160	850	3,600
1990	2,390	160	160	850	3,560
1991	2,250	160	160	830	3,400
1992	2,310	170	160	830	3,470
1993	2,120	170	160	830	3,280
1994	2,210	180	160	810	3,360
1995	2,250	180	160	810	3,400
1996	2,230	190	160	810	3,390
1997	2,410	190	160	790	3,550
1998	2,170	200	160	790	3,320
1999	2,400	200	160	790	3,550
2000	2,350	200	160	770	3,480
2001	2,270	200	160	770	3,400
2002	2,340	200	150	770	3,460
2003	2,270	200	150	750	3,370
2004	2,220	200	150	750	3,320
2005	2,070	200	150	750	3,170
2006	2,000	200	150	750	3,100
2007	2,030	200	150	750	3,130
2008	1,910	200	140	750	3,000
2009	1,850	200	140	750	2,940
2010	1,620	200	140	750	2,710
2011	1,570	200	140	750	2,660
2012	1,520	200	140	750	2,610
2013	1,470	200	140	750	2,560

Note: All figures are expressed in AF and rounded to the nearest 10 AF.

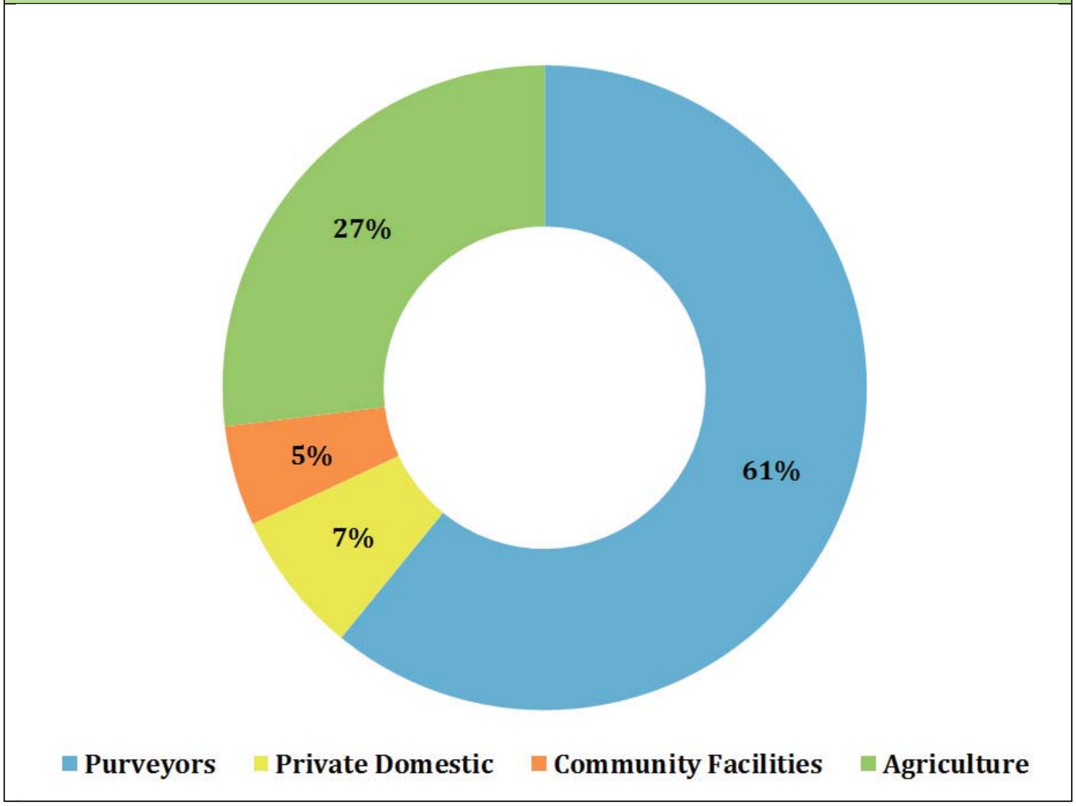
Groundwater production has generally followed population levels in Los Osos. Thus, total groundwater production increased from 1970 through 1988, with rapid acceleration during the late 1970s and early 1980s. Since 1988, total groundwater production has been trending downward, based on urban water use efficiency improvements and slightly declining population during the 2000s. This trend is clearly seen in Figure 15, which depicts the five-year running average of all groundwater production from the Basin from 1970 through 2013. Despite past success at reducing groundwater withdrawals from the Basin, one of the actions adopted in this Basin Plan is an aggressive Urban Water Use Efficiency Program, set forth in Chapter 8.

Figure 15. Five-Year Running Average of Production from the Basin (1970-2013)



The relative use of water resources in Los Osos across the four categories—Purveyors, private domestic, community facilities and agriculture—is shown in Figure 16. Use of water in all categories supports the entire Los Osos community, and many individuals may regularly use water across categories. For example, a resident who purchases water from LOCSD at home may work at a business served by GSWC and may spend his or her weekend enjoying recreation at the community park or Sea Pines Golf Course. Similarly, a resident family with a private domestic well may send its children to Los Osos Middle School served by LOCSD, frequent businesses and restaurants served by GSWC, and consume produce grown on local agricultural parcels. All residents and businesses in Los Osos benefit directly or indirectly from water use in all four categories.

Figure 16. Relative Use of Water Resources in Los Osos (2008-2013)



4.7 Production by Aquifer Layer and Basin Area

As described in Section 5.4, the Basin is divided vertically into three layers: First Water, Upper Aquifer and Lower Aquifer. In addition, there is also an Alluvial Aquifer present in the Eastern Area. Historical groundwater production has originated from the Upper, Lower and Alluvial Aquifers, although relative pumping between the aquifers has varied over time and is based on a water user's location in the Basin. For example, the Purveyors have historically relied upon the Lower Aquifer in the Western and Central Areas as the primary source of municipal water supplies for Los Osos, while the Upper Aquifer has been tapped by Purveyor wells on a more limited basis. The majority of private domestic wells are shallow and draw from the Upper Aquifer, and community facility wells use water from both the Upper and Lower Aquifers. Agricultural wells have generally been limited to the Alluvial and Lower Aquifers.

As described in later sections of this Basin Plan, the sustainable yield of the Basin is impacted not only by total groundwater production, but also by which aquifer zone is the source of production, and where in the Basin the well is located. Thus, there is value gained for management of the Basin by determining the amount of water historically extracted from each aquifer layer and Basin area. In order to visually represent the distribution of groundwater production, this Basin Plan uses the sample graphic shown in Figure 17. In that graphic, groundwater production is divided by aquifer layer, with the Upper Aquifer shown in blue, the Lower Aquifer in green, and the Alluvial Aquifer in yellow. In addition, production is divided by area, with the Western Area on the left, the Central Area in the middle, and the Eastern Area on the right. This graphic is used throughout the Basin Plan to demonstrate the distribution of groundwater production across the aquifer layers and areas.

Figure 17. Sample Groundwater Distribution Graphic

While exact historical production from each aquifer layer and area is difficult to determine, Figure 18 depicts best available estimates of such production based on the location of each well and known information regarding the depths from which each well draws. The graphics in Figure 18 depict the distribution of groundwater production over several historical periods from 1970 through 2013, which were chosen based on changes in production patterns that occurred between each period.

As shown in Figure 18, groundwater production in the Eastern Area has remained largely constant since 1970. In the Western and Central Areas, two trends have been noticeable. First, the overall quantity of groundwater production increased through the period of 1983 through 1995, which is consistent with earlier analysis in this chapter. Second, most of the increase in groundwater production from 1970 through 1995 occurred in the Lower Aquifer. Since 1996, when nitrate levels became too high for use of Upper Aquifer water as a drinking water source, without treatment, groundwater production has shifted from the Upper Aquifer to the Lower Aquifer. From 1996 through 2005, much of that production was in the Western Area, but the Purveyors shifted their production to the Central Area starting in 2006, in order to alleviate seawater intrusion.

As explained in Section 5.9, seawater intrusion is particularly sensitive to groundwater production in the Lower Aquifer and Western Area. Thus, the historical increase in groundwater production from that sector was accompanied by an acceleration of seawater intrusion into the Basin, and in particular the Lower Aquifer in the Western Area. The programs of action set forth in Part II of this Basin Plan focus on reducing groundwater production in the Lower Aquifer and Western Area as the primary method to halt or reverse seawater intrusion.

Figure 18. Groundwater Distribution (1970-2013)

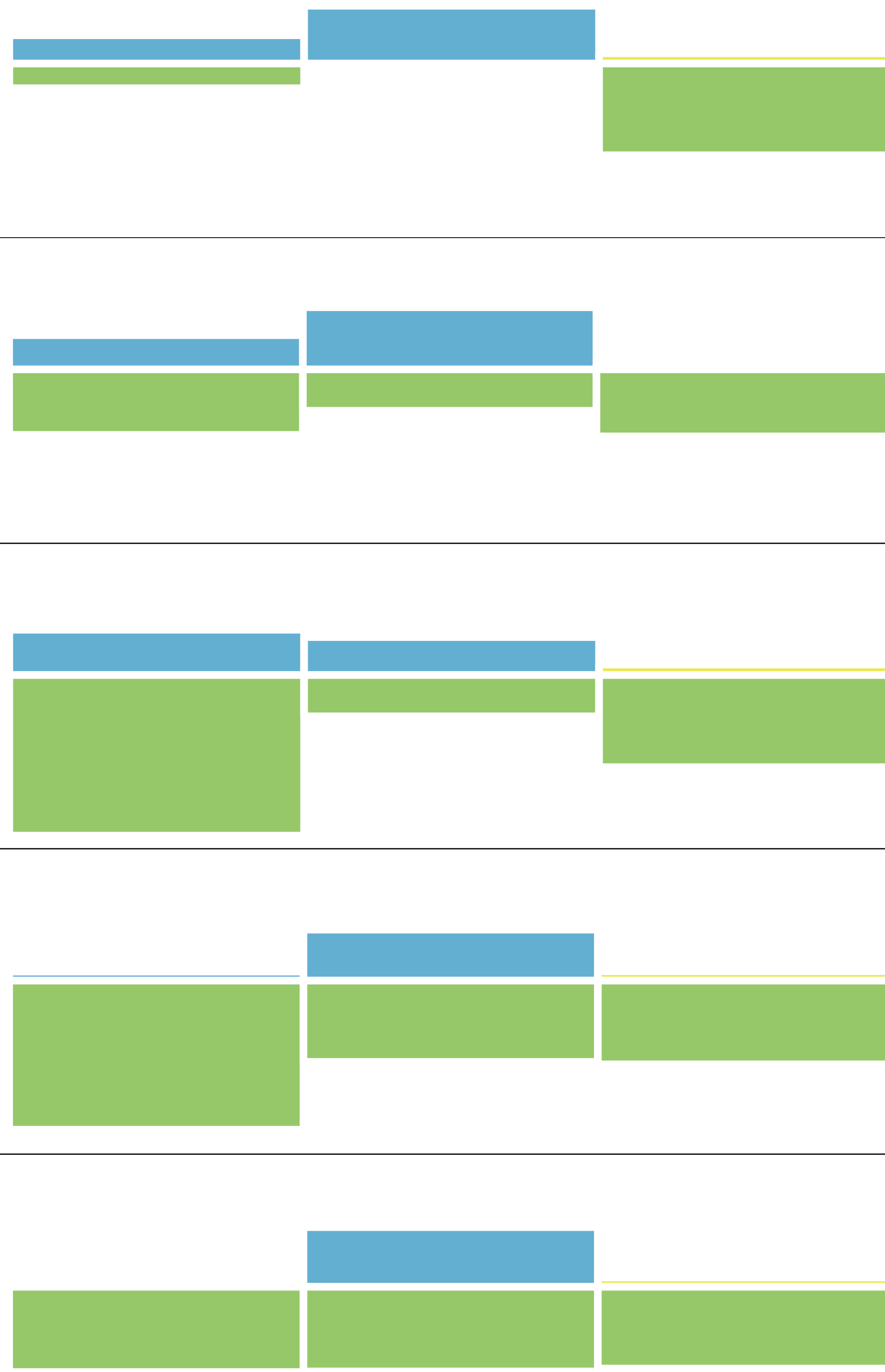
1970-1975 Average Production: 2,000 AFY

1976-1982 Average Production: 2,650 AFY

1983-1995 Average Production: 3,450 AFY

1996-2005 Average Production: 3,350 AFY

2006-2012 Average Production: 2,850 AFY



5

DESCRIPTION OF THE BASIN

5.1 Introduction

This chapter describes the boundaries, geologic structure and water resources of the Basin. It summarizes the development of understanding of the Basin by the Parties and others over the past several decades and the creation and refinement of both conceptual and numerical models of the Basin. Those models are critical for use in later chapters to assess the status and challenges of the Basin, as well as potential solutions. The largest body of technical work in recent years has been performed by Cleath-Harris Geologists, Inc. (CHG).[14] Portions of text in this chapter are excerpted from the *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Groundwater Basin* by CHG in 2005.

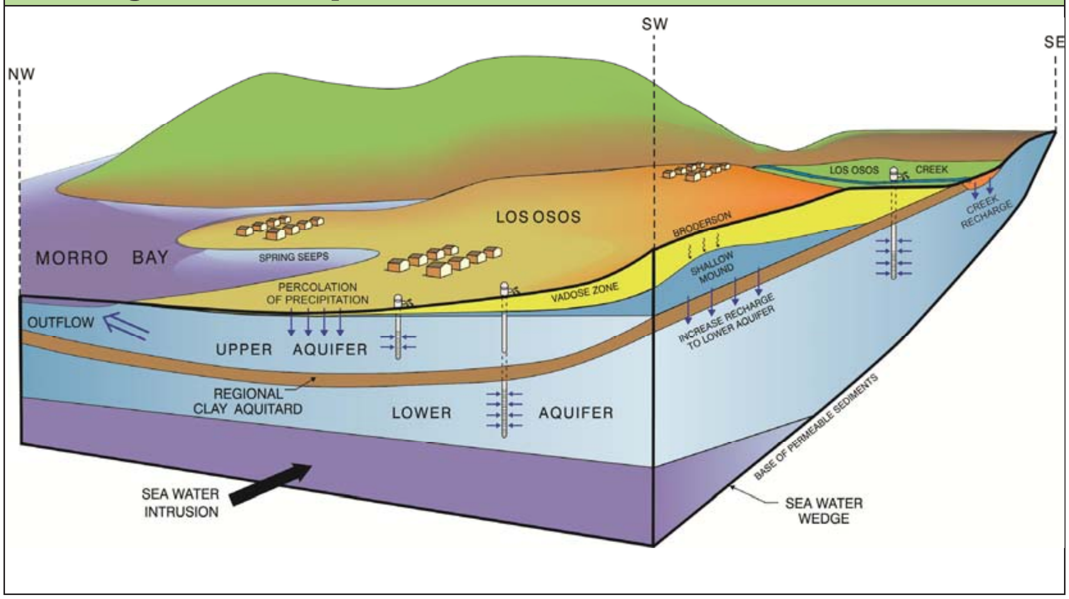
5.2 Geologic Setting

The Basin is located in the Coast Ranges geomorphic province along the California coast in San Luis Obispo County, as shown in Figure 1. It underlies the Los Osos Valley, which is a relatively flat alluvial plain with a northwest-southeast orientation lying between two parallel ridges of hills to the north and south. The southern boundary of the Basin is formed by the Los Osos Fault, south of which the Irish Hills rise to an elevation between 1,300 and 1,500 feet. Park Ridge on the northern boundary of the Basin is lower, reaching elevations of 800 to 900 feet. The Basin area is characterized at ground surface by dune sands, Morro Bay Estuary tidal flats, Los Osos Creek alluvial deposits, and Paso Robles Formation alluvial deposits. The eastern end of the Basin is located near a gradual rise in the surface topography that is accompanied by subsurface thinning of the water-bearing formation that makes up the Basin. The Basin extends westward under Morro Bay and an estimated three miles beneath the Pacific Ocean, although groundwater in the western portion of the Basin is brackish and not usable as a source of drinking water for the Los Osos community.

Figure 19 is a three-dimensional depiction of the Basin, showing the general location, aquifer layers, recharge sources and outflows of the Basin. Each of those features is discussed in later sections of this chapter.

[14] For convenience, CHG is used to reference both Cleath & Associates and Cleath-Harris Geologists, Inc.

Figure 19. Conceptual Model of the Los Osos Groundwater Basin



5.2.1 *Area*

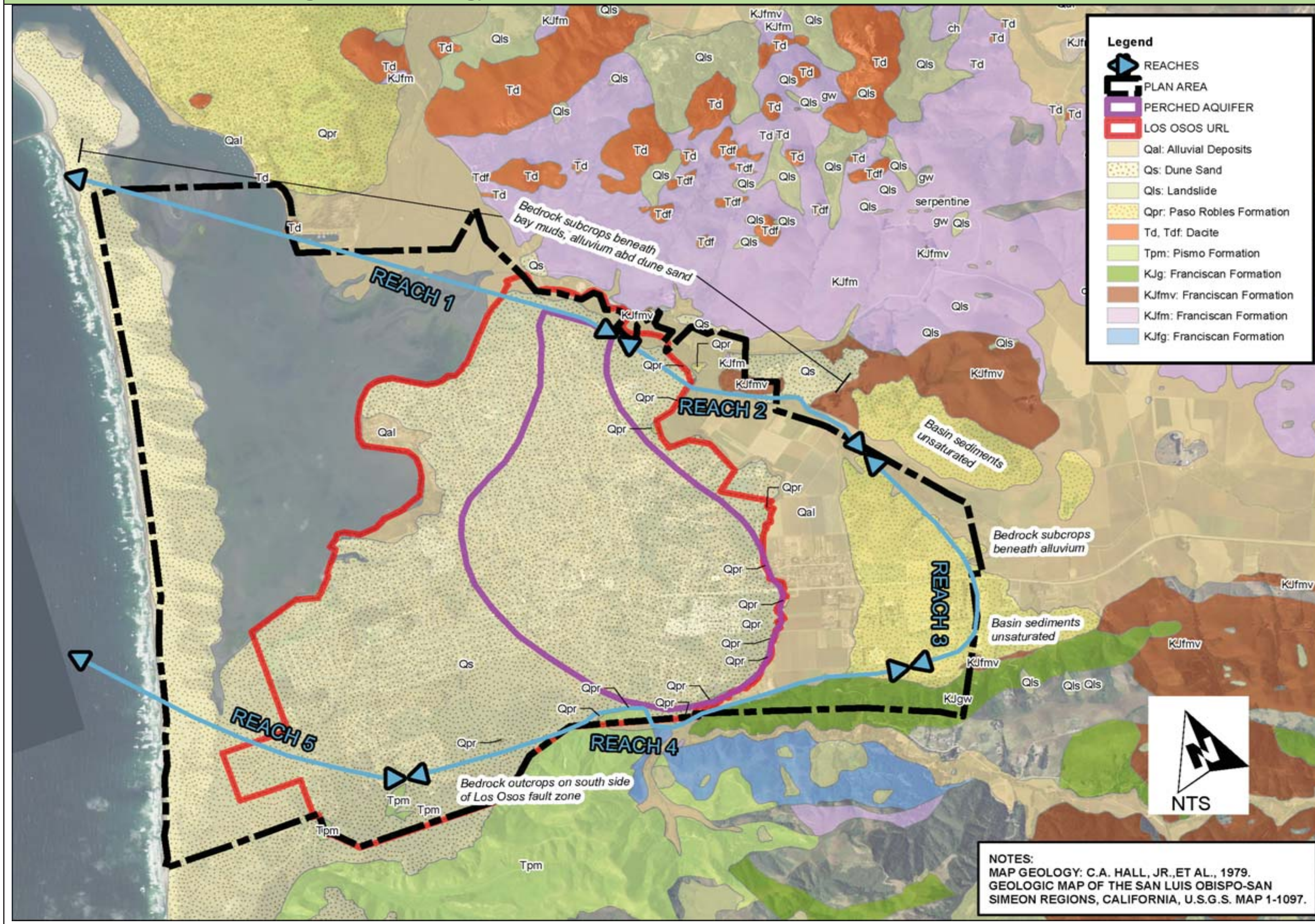
The onshore portion of the Basin covers approximately 10 square miles, of which approximately 3.3 square miles underlie the Morro Bay and sand spit, and 6.7 square miles underlie the communities of Los Osos, Baywood Park and Cuesta-by-the-Sea. The Basin is underlain and bounded by relatively impermeable rocks on the north, east and south. To the west, the Basin is effectively bounded by the seawater-freshwater interface, although Basin sediments extend close to three miles offshore. Unconsolidated sediments forming the Basin include alluvial deposits, dune sands, the Paso Robles Formation and the Careaga Formation. The geology of the Basin is shown in Figure 20.

The boundary of the Plan Area, as set forth in Section 2.1.1, encloses an area at ground surface beneath which the Paso Robles Formation is interpreted to be present and saturated. The boundary lies where the Paso Robles Formation abuts basement rocks or its base rises above the water table. Within this boundary is a contiguous groundwater reservoir capable of furnishing a significant supply of groundwater to wells or storing a significant amount of water. The Plan Area excludes alluvial deposits and dune sands that are directly underlain by bedrock, which have a restricted subsurface hydraulic connection to the Basin.

The shape of the Plan Area was developed through a series of nine geologic cross-sections of the Basin.[15] A detailed description of the onshore portion of the Basin boundary at ground surface is presented below. The reaches are shown on Figure 20.

[15] CHG, *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Groundwater Basin* (2005); CHG, *Geologic Structure of the Los Osos Valley Groundwater Basin* (November 2003).

Figure 20. Geology and Boundaries of the Los Osos Groundwater Basin



- *Reach 1: North Sandspit to Santa Ysabel Avenue*. Information from test holes drilled on the Morro Bay sandspit, together with dacite bedrock cropping out at White Point and on the seafloor offshore, indicates the northern Basin boundary likely crosses the sandspit between the township line and the south jetty.[16] From White Point, the Basin boundary continues across the Estuary along a southeast trend toward Scenic Way. Subsurface control along South Bay Boulevard, Scenic Way, and Santa Ysabel Avenue is interpreted from test holes drilled for the Scenic Way investigation and Basin cross-sections.[17]

- *Reach 2: Santa Ysabel Avenue to Warden Creek*. Beginning at the east end of Santa Ysabel Avenue, the boundary turns south toward a Franciscan Formation metavolcanics outcrop on the west side of the Los Osos Creek valley. After crossing the creek valley at this narrows, the boundary follows metavolcanic outcrops along the valley edge to the confluence with Warden Creek alluvial deposits. Shallow Franciscan Formation bedrock is interpreted to restrict subsurface flow into the Basin from the watershed drained by Warden Creek. Basin cross-sections, along with perennial surface water and wetlands in Warden Creek upstream of the Los Osos Creek valley confluence, are consistent with this interpretation.

- *Reach 3: Warden Creek to Clark Valley Road*. From Warden Creek, the Basin boundary follows a southerly, curved alignment to meet the Los Osos fault zone at Clark Road. The boundary is curved through this reach to represent where the base of permeable sediments rises to the water table. A mapped spring is interpreted to be along the Basin boundary.

- *Reach 4: Clark Valley Road to Rodman Drive*. At Clark Valley Road, the Basin boundary is the main strand of the Los Osos fault zone, which separates the Basin synclinal structure on the north from uplifted Pismo Formation and Franciscan Formation bedrock on the south. The boundary follows the main fault strand west to Rodman Drive.

- *Reach 5: Rodman Drive to South Sandspit*. Bedrock mapped on the ocean floor west of the sandspit at approximately 50 feet below sea level indicates that the Basin boundary turns to the northwest from its east-west alignment along the Los Osos fault zone. The specific location and orientation of this final reach has not been established in the field.

5.2.2 *Geologic Structure*

The Basin is a synclinal trough, with a southeast-northwest trending fold axis. Dips along stratigraphic horizons on the limbs of the syncline reach approximately four degrees, although dips of up to eight degrees are present near the Los Osos fault zone at the southeast end of the Basin. The contact between Basin sediments and

[16] DWR, *Morro Bay Sandspit Investigation* (August 1979).
[17] CHG, *Scenic Way Investigation with East Side Wastewater Disposal [Draft Report]* (July 2003).

bedrock is an unconformity, and the synclinal nature of the Basin sediments are only partially developed on the surface. Faulting along the south Basin boundary has encroached into the Basin and offset bedrock along at least three planes. The United States Geological Survey (USGS) proposed two parallel faults trending north-northeast and extending into the Basin from previously mapped faults in basement rocks south of Bayview Heights.[18] These parallel faults uplift Basin sediments on the east and create a groundwater barrier between upper Los Osos Creek and downtown Los Osos.

Formation of the Basin was tectonically controlled by the main strand of the Los Osos fault, which forms part of the southern Basin boundary. This reverse fault trends east-west and is considered active near the westerly limits of the City of San Luis Obispo, approximately 10 miles east of Los Osos. The fault offsets Basin sediments on the Cambria structural block to the north, with Pismo Formation and Franciscan Formation bedrock of the San Luis/Pismo structural block to the south. Detailed mapping and age-dating of emergent marine terraces disrupted by the Los Osos fault near Montaña de Oro State Park has led to an estimate of coastal uplift of the Irish Hills sub-block (San Luis/Pismo block) at a rate of 0.2 to 0.23 millimeters per year. Uplift of the Irish Hills sub-block relative to the Cambria block is responsible, along with subsidence and erosion in the Los Osos valley, for the orientation and structural configuration of the Basin. Maximum subsidence rates in the Basin have been estimated at 0.1 millimeters per year.[19]

5.3 Surface Water Resources

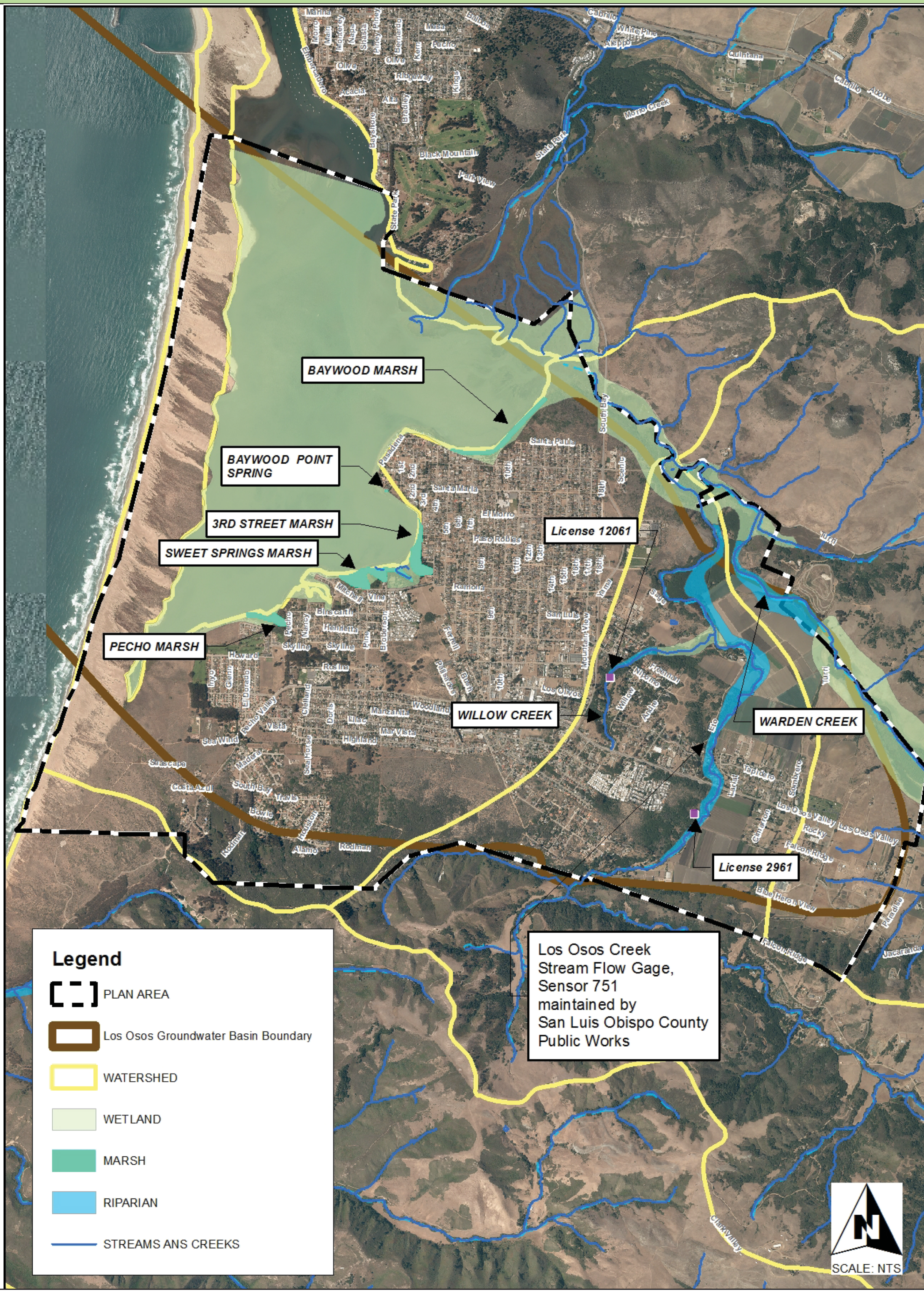
The most significant sources of recharge for the Basin are direct percolation of precipitation and percolation of surface runoff. Surface water drainage areas within the Basin and its watershed are shown in Figure 21. Precipitation that falls on non-overlying lands may reach the Basin either as runoff into stream channels that eventually run across the Basin surface or as groundwater inflow at the Basin boundary.

The primary stream overlying the Basin is Los Osos Creek and its tributaries, including Willow Creek and Warden Creek, which flows through Warden Lake, a marshy depression located just outside the Basin boundary to the east. Los Osos Creek originates in the Irish Hills to the south of the Basin and flows through Clark Valley, a small alluvial valley, before debouching through a small notch into the Basin area. From that location, Los Osos Creek flows northeast and then northwest into Morro Bay. Willow Creek is a short watercourse through the dune sands and drains into Eto Lake and then Los Osos Creek.

---

[18] Yates and Wiese, *Hydrogeology and Water Resources of Los Osos Valley Groundwater Basin*, USGS Water-Resources Investigations Report 88-4081 (1988).
[19] Lettis and Hall, "Los Osos Fault Zone, San Luis Obispo County, California," in *Seismotectonics of the Central California Coast Ranges*, Geologic Society of America Special Paper 292 (Alterman, et al., ed. 1994).

Figure 21. Surface Water Resources of the Basin



There is minimal surface water runoff into defined stream channels from other lands overlying the Basin because the sandy soils allow high infiltration rates. Thus, although those lands do not contribute to streams that recharge the Basin, precipitation that falls on those lands recharges the Basin both directly and from local drainage basins or natural depressions within the dune sands.

Flow in Los Osos Creek is highly variable by season, due to the steep topography of hills surrounding the Basin and soils that do not hold significant quantities of water. Rainfall tends to reach the stream channel quickly following precipitation events. Peak flows can be as high as 1,000 cubic feet per second (cfs), subsiding to less than 40 cfs within a few days. Baseflow on Los Osos Creek typically flows on the surface during most of the year upstream of the Basin boundary and downstream of the Willow Creek confluence, but dries up seasonally in the summer and fall between the mouth of Clark Valley and Eto Lake. There is one permanent streamflow gage in Los Osos Creek, as shown on Figure 21.

There are two existing permitted surface water rights in the Plan Area, with their points of diversion shown on Figure 21.

First, License 2961 (Application 10279, Permit 6125) allows the diversion of water from Los Osos Creek just upstream of its intersection with Los Osos Valley Road. Records of the California State Water Resources Control Board (SWRCB) indicate that License 2961 was granted to Frank Machado in 1948 based on an application dated September 2, 1941, recognizing a right to appropriate from the waters of Los Osos Creek up to 140 gallons per minute (gpm) from April 1 to May 15 for irrigation and domestic uses. The place of use on the license is described as 25 acres within a 40-acre parcel located east of Los Osos Creek and southwest of the intersection of Los Osos Valley Road and Clark Valley Road. The place of use is shown as Field H on the map in Figure 13.

In 1960, License 2961 was partially assigned to Rosa S. Machado. In 1967, the name of the license holder was changed to the Estate of Frank Machado & Estate of Rosa S. Machado. In 1971, the license was assigned to Masaji and Margaret Eto. Current SWRCB records indicate that the license is held by Masaji Eto. From 2008 to 2010, the license holder reported no diversions, with 50 AFY of groundwater production in lieu of the use of surface water.

Second, License 12061 (Application 2565, Permit 17831) allows the diversion of water from Willow Creek near its intersection with Nipomo Avenue. SWRCB records show that License 12061 was issued to Thomas M. Corr, Freeman Estate, Mrs. Del Bates, Bumpus Estate, Robert E. White, John Lindemans and Jean Lindemans in 1987, based on an application dated May 13, 1977.

License 12061 confers the right to divert 3.2 AFY from the waters of an unnamed stream (Willow Creek) tributary to Los Osos Creek from December 1 to April 1 of the succeeding year for the purpose of recreational and fish and wildlife enhancement uses. The license does not authorize collection of water to storage outside of the specified season to offset evaporation and seepage losses or for any other purpose. After the initial filling of the reservoir, the right extends only to water necessary to keep the storage reservoir full by replacing water lost by evaporation and seepage and to refill the reservoir if emptied for necessary maintenance and repair. The place of use is a reservoir located on open space property south of Nipomo Avenue between South Bay Boulevard and Willow Avenue. Current SWRCB records indicate that the license is held by Michael Tutt, and approximately 3.2 AFY was diverted annually during 2010 and 2011.

5.4 Aquifer Zone Characterization

The Basin is made up of several sub-horizontal aquifer layers, each of which has distinct characteristics. Those layers are described in the following sections. For ease of reference, the aquifer layers are described as Zones A through E, and the Alluvial Aquifer, as shown on the north-south cross-section in Figure 22 and the west-east cross-section in Figure 23. For most purposes in this Basin Plan, Zones A and B are also referred to as the perched aquifers, Zone C is referred to as the Upper Aquifer, and Zones D and E are referred to collectively as the Lower Aquifer. As discussed in Chapter 7, First Water refers to the shallowest groundwater zones and includes the Alluvial Aquifer, the perched aquifer, and the top portion of the Upper Aquifer (Zone C) where not overlain by the alluvial or perched aquifer.

The hydrogeology of the Basin has been subject to a number of technical studies, leading to progressively better understanding over time. The vertical differentiation of aquifer zones began in 1989, when The Morro Group prepared a series of geologic cross-sections interpreting Basin structure, based on correlating three discrete horizons—i.e., aquitards—separating four zones across the Basin in a series of cross-sections. The three horizons correlated in the cross-sections were selected for their significance in restricting movement of groundwater within the Basin. The three horizons, designated AT2 through AT4, separated four aquifer zones, designated AF1 through AF4. This terminology was used until further investigations of the upper part of the Basin in 2001.

In 2001, Weber Hayes & Associates subdivided AF1 into three units, designated Zones A, B and C, as a part of a service station site investigation report in downtown Los Osos.[20] In 2003, CHG adapted this nomenclature for the Basin and expanded it to include Zones D and E which were previously designated AF2 and AF3 in The Morro Group terminology. A sixth aquifer zone, also identified by CHG, is the Alluvial Aquifer, which lies along Los Osos Creek valley.[21] This characterization of the aquifer zones was confirmed in a peer review conducted by Stetson Engineers, Inc. (Stetson) in 2010, as further described in Section 5.6.6.

[20] Weber, Hayes & Associates, *Site Investigation Report, Bear Valley Chevron, 1099 Los Osos Valley Road, Los Osos, California* (2001).
[21] CHG, *Geologic Structure of the Los Osos Valley Ground Water Basin* (November 2003).

Figure 22. North-South Cross-Section of the Basin

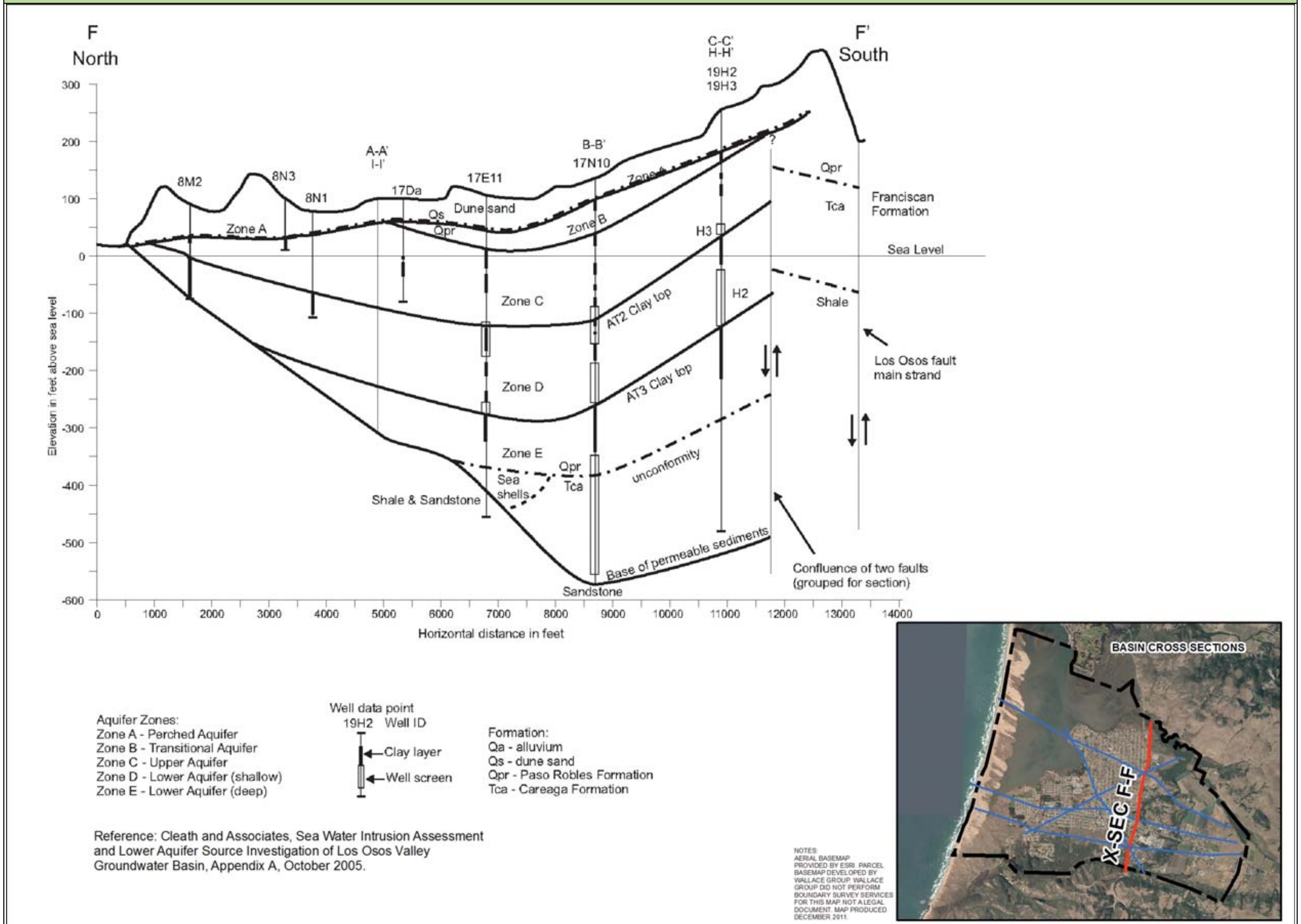
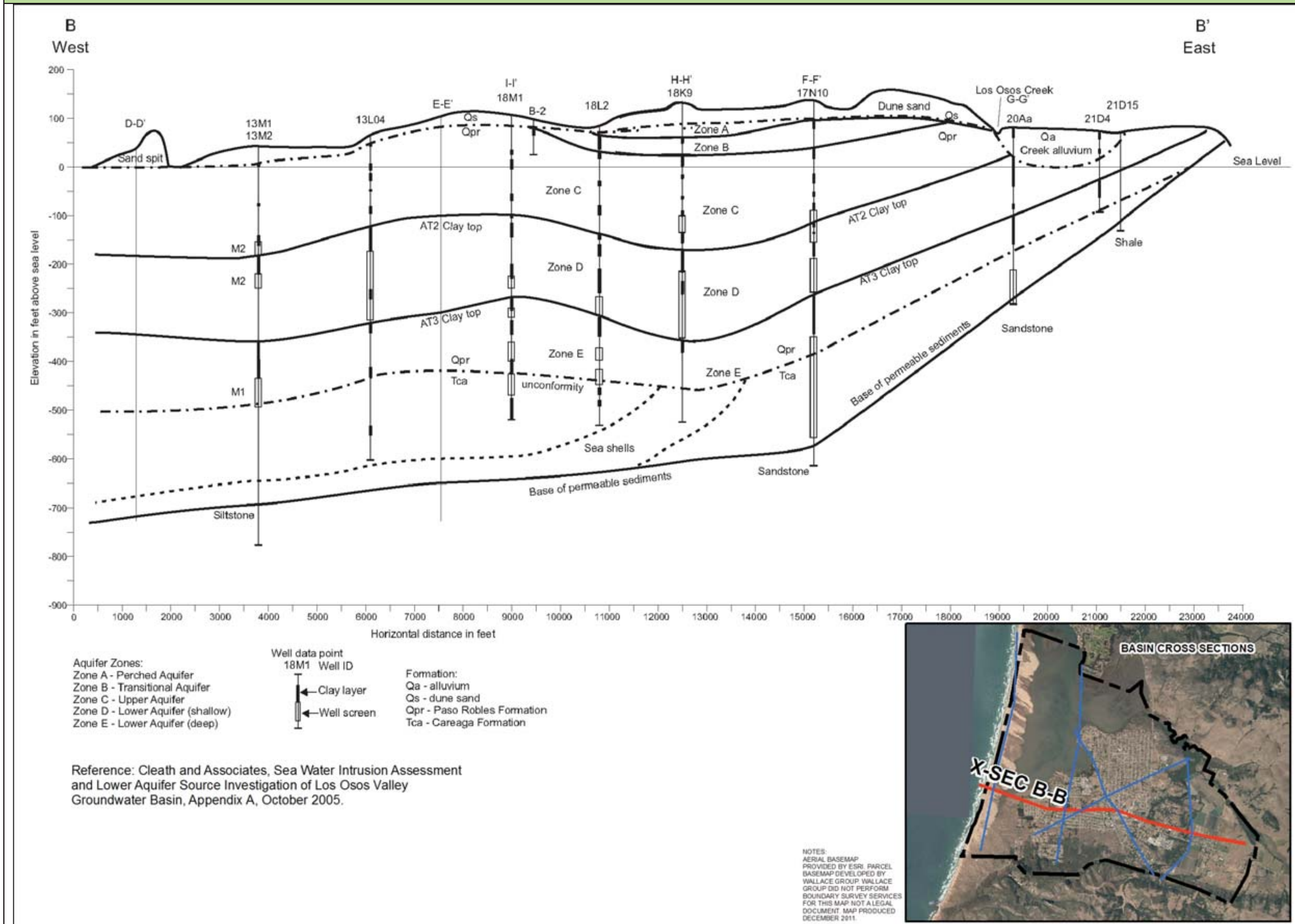


Figure 23. West-East Cross-Section of the Basin



5.4.1 *Zone A - Perched Aquifer*

Zone A is a perched aquifer that overlies a clay layer at the base of the older dune sands, beneath a large portion of the Central Area, including Bayridge Estates and Bayview Heights (where it is truly perched), downtown Los Osos, and through portions of Baywood Park. The lateral extent of the perched aquifer is shown on Figure 20. Zone A is not generally used as a source of water supply for Los Osos.

The perched aquifer is unconfined and completely within dune sands, although there are also many areas with saturated dune sands that are not specifically in Zone A. The perching clay outcrops along the banks of Los Osos Creek above an elevation of approximately 80 feet, although more than one perching clay may be involved. Dune sands are wind-blown deposits. Also referred to as the Baywood fine sand, these deposits typically comprise poorly graded fine- to medium-grained clean sand and reach a maximum estimated thickness of close to 100 feet along the dune ridges in Baywood Park.[22]

The average transmissivity of the older dune sand in Zone A is estimated to range from 70 to 230 gallons per day per square foot (gpd/ft^2), based on the first and third quartile of 50 laboratory and field tests from various locations across the Basin.[23]

Zone A receives recharge from direct percolation of precipitation and return flows from anthropogenic activities. Groundwater movement in Zone A is within dune sand and flow directions are generally northwest and northeast, with relatively steep hydraulic gradients of up to 0.06 ft/ft between Bayview Heights and downtown Los Osos (parallel to the topographic slope). Flow in Zone A drains to Willow Creek and issues from seeps in the Los Osos Oaks Preserve and along the banks of Los Osos Creek. To the north and west, the perching clay pinches out and groundwater spills into Zone A. A groundwater high between downtown Los Osos and eastern Baywood Park separates water moving to the east toward Los Osos Creek from water moving to the west toward the Estuary.

The perched aquifer results from groundwater resting on a relatively extensive shallow clay layer, as shown in Figure 20. South of Los Osos Valley Road, an unsaturated zone occurs between the bottom of the perching clay layer and the top of the regional water table. North of Los Osos Valley Road, aquifer Zone A is semi-perched, with a steep vertical head gradient that extends into Zone B. The perched aquifer drains into Willow Creek.

5.4.2 *Zone B - Transitional Aquifer*

Zone B, the transitional aquifer, is composed of fine sands and silty sands with occasional clayey and gravelly lenses. Zone B is separated from Zone A by a clay and clayey sand aquitard up to 30 feet thick beneath downtown Los Osos. The

[22] *Id*.

[23] CHG, *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Ground Water Basin, San Luis Obispo County, California*, Appendix C (2005).

piezometric head in Zone B lies between the Zone A perched aquifer and the uppermost community water supply aquifer, which is Zone C. Water levels in Zone B have been measured up to 16 feet lower than Zone A, and close to 60 feet higher than Zone C at multi-level monitoring wells.[24] These water level differences, along with differences in general mineral water quality, led to the identification of saturated Zone B as a separate aquifer layer. Subsequent lithologic correlations between downtown Los Osos and wells to the north and east placed Zone B within the Paso Robles Formation.[25] No pumping tests specific to Zone B are available. Zone B is not generally used as a source of water supply for Los Osos.

5.4.3 *Zone C - Upper Aquifer*

Zone C, which is the shallowest aquifer used as a source of water supply for the Los Osos community, overlies the regional aquitard and extends up to the water table, except where overlain by Zones A or B. Zone C is predominantly within Paso Robles Formation deposits, except at lower topographic elevations where dune sands are saturated. The Paso Robles Formation is composed of unconsolidated sands, gravels and clays. Gravel clasts are generally composed of Franciscan assemblage rocks, including cherts, metavolcanics and hard sandstone. Shales, quartz and diabase/dacite are also commonly logged. The depositional environment has included beach and near-shore marine conditions. As a result, sea shells are occasionally present in the Paso Robles Formation. West of downtown Los Osos, Zone C is generally composed of fine- to medium-grained sands, with relatively few clays or gravels, except one notable basal gravel. In the downtown area, Zone C sediments coarsen, with more fine gravels noted in logs, although interbedded clays are also common.

Recharge to Zone C occurs via direct percolation of precipitation, return flow from irrigation and septic system discharges, stream seepage from Los Osos Creek, subsurface inflows across Basin boundaries, and through leakage from Zones A and B. Movement of groundwater in Zone C is variable, but generally flows north and west toward Morro Bay, with some easterly flow from Baywood toward Los Osos Creek. There is a pumping depression in Zone C near downtown Los Osos that draws water from surrounding areas.

5.4.4 *Regional Aquitard*

Individual clay beds in the Paso Robles Formation are generally discontinuous across the Basin, with one important exception. A regional aquitard has been recognized since the early 1980s, when B&C noted differences in water quality above and below the clay.[26] The regional aquitard ranges from approximately 20 to 80 feet thick, and averages 50 feet thick over 27 locations.[27] The regional aquitard is

---

[24] Weber, Hayes & Associates, *Site Investigation Report, Bear Valley Chevron, 1099 Los Osos Valley Road, Los Osos, California* (2001).
[25] CHG, *Geologic Structure of the Los Osos Valley Ground Water Basin* (November 2003).
[26] B&C, *Los Osos-Baywood Park Phase 1 Water Quality Management Study* (1983).
[27] CHG, *Geologic Structure of the Los Osos Valley Ground Water Basin* (November 2003).

one of the most significant geologic features in the Basin and separates the Upper and Lower Aquifers in Zones C and D, respectively. Hydraulic communication between the Upper (Zone C) and Lower (Zones D and E) Aquifers is restricted by the regional aquitard, although the large areal extent and vertical hydraulic gradient across this layer, along with open wellbore flows, results in several hundred AF of leakage through the aquitard each year.[28]

5.4.5 *Zone D - Lower Aquifer*

Below the regional aquitard is Lower Aquifer Zone D. This is currently the primary source of community water supplies, as discussed in Section 4.7.

Zone D is a Paso Robles Formation aquifer zone composed predominantly of sands and gravels. The lithologic description of Zone D, consisting of interbedded sand, gravel and clay, does not appear to vary as much as Zone C or Zone E across the Basin. Gravel clast composition is predominantly Franciscan Formation detritus (sandstone, chert, metavolcanics) along with siliceous shales and claystones. Shell fragments are noted in Zone D lithology at wells on the sand spit and in Baywood Park. The structure of Zone D is generally conformable with the overlying aquitard, except where displaced by Quaternary faulting in the Bayview Heights area. The aquifer zone averages close to 100 feet thick over the central portions of the Basin, thinning toward the east. Pumping tests indicate a confined aquifer condition in Zone D. The hydraulic conductivity of Zone D is estimated at 129-140 gpd/ft^2.

Groundwater is generally moving toward downtown Los Osos from surrounding areas in Zone D. Water levels have declined over time in most areas, except in the Eastern Area. Much of this decline took place during the 1970s and early 1980s, in concert with growing population and groundwater withdrawal.

The principal sources of recharge to the Lower Aquifer (Zones D and E) are leakage through the regional aquitard from the Upper Aquifer and Los Osos Creek stream seepage. Subsurface inflow from bedrock sources is believed to be a minor source of recharge. Seawater intrusion is a source of recharge that until recently has increased on the western edge of the Basin.

5.4.6 *Zone E - Lower Aquifer*

An aquitard separates Zone D from Zone E in the Lower Aquifer. This aquitard is typically thinner than the regional aquitard and possibly discontinuous. The two Lower Aquifer zones differ with respect to salinity near the coast and with respect to permeability in inland areas, warranting the hydrogeologic aquifer distinction. The contact between the Plio-Pleistocene Paso Robles Formation and the Pliocene Careaga Formation occurs in the middle of Zone E. The Careaga Formation is the lowermost Basin hydrostratigraphic unit and has been included for practical purposes with Zone E. Zone E reaches depths up to 1,000 feet in the Western Area.

[28] CHG, *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Ground Water Basin, San Luis Obispo County, California* (2005).

Zone E contains a mixture of sands and gravels that are associated with Paso Robles Formation and Careaga Formation. The Careaga Formation has not been mapped regionally in outcrop, however, there is considerable variation in what has been tentatively identified as Careaga Formation, including coarser grained and finer grained zones. The deep Basin sediments in the western portion of the Basin include much coarser sands and gravel, compared to the finer sands and silty sands in the eastern portion of the Basin. Coarsening of the deep Basin sediments to the west could be associated with upper Careaga Formation conglomerate but could also be part of the overlying Paso Robles Formation.

At wells along South Bay Boulevard east of downtown Los Osos, the fine-grained silty sandstone attributable to the Careaga Formation is estimated to have a hydraulic conductivity of approximately 7 gpd/ft^2. Adjusting for differences in permeability and screened intervals between Zone D and Zone E aquifers, the hydraulic conductivity of Zone E in the vicinity of the Los Osos Community Park is estimated at 60-90 gpd/ft^2.

Groundwater is generally moving toward downtown Los Osos from surrounding areas in Zone E. As in Zone D, water levels have declined over time in most areas, except the Eastern Area.

5.4.7 *Alluvial Aquifer*

There is a unique aquifer presented in the Eastern Area, formed from alluvial deposits of Los Osos Creek. Recent alluvial deposits are interpreted to overlie Paso Robles and Careaga Formation sediments in the Los Osos Creek valley. These alluvial deposits are typically close to 70 feet thick. The base of the alluvial deposits extends to approximately 40 feet below sea level where Los Osos Creek exits the Basin through a narrows in the lower creek valley.

The Los Osos Creek valley alluvium typically consists of mostly clay with interbedded sand and gravel lenses. A basal sand and gravel unit is also inferred from inspection of well drilling logs, although the similarities in lithology with underlying Paso Robles Formation deposits make alluvial sediment interpretation difficult. Active irrigation or private domestic wells may tap the basal gravel in the alluvium, but typically also extend into deeper aquifer zones.

Groundwater in the Alluvial Aquifer of the Los Osos Creek valley moves down the valley toward the Estuary. Recharge occurs from a variety of sources: direct percolation of precipitation; return flow from irrigation and septic system discharges; stream seepage from Los Osos Creek; and subsurface inflows across Basin boundaries.

During drought years, water levels decline in excess of 10 feet between spring and fall, but typical seasonal fluctuations are closer to five feet. Many agricultural wells in the creek valley tap the Lower Aquifer below the alluvium, where water level fluctuations are greater due to seasonal production to meet irrigation demands.

5.5 Recharge and Movement of Groundwater in the Basin

The majority of recharge to the Basin consists of the following elements:

- Direct percolation of precipitation, including localized runoff into percolation basins and natural depressions;
- Stream seepage from Los Osos Creek;
- Return flow from irrigation and septic system discharges; and
- Subsurface inflow across Basin boundaries, including seawater intrusion.

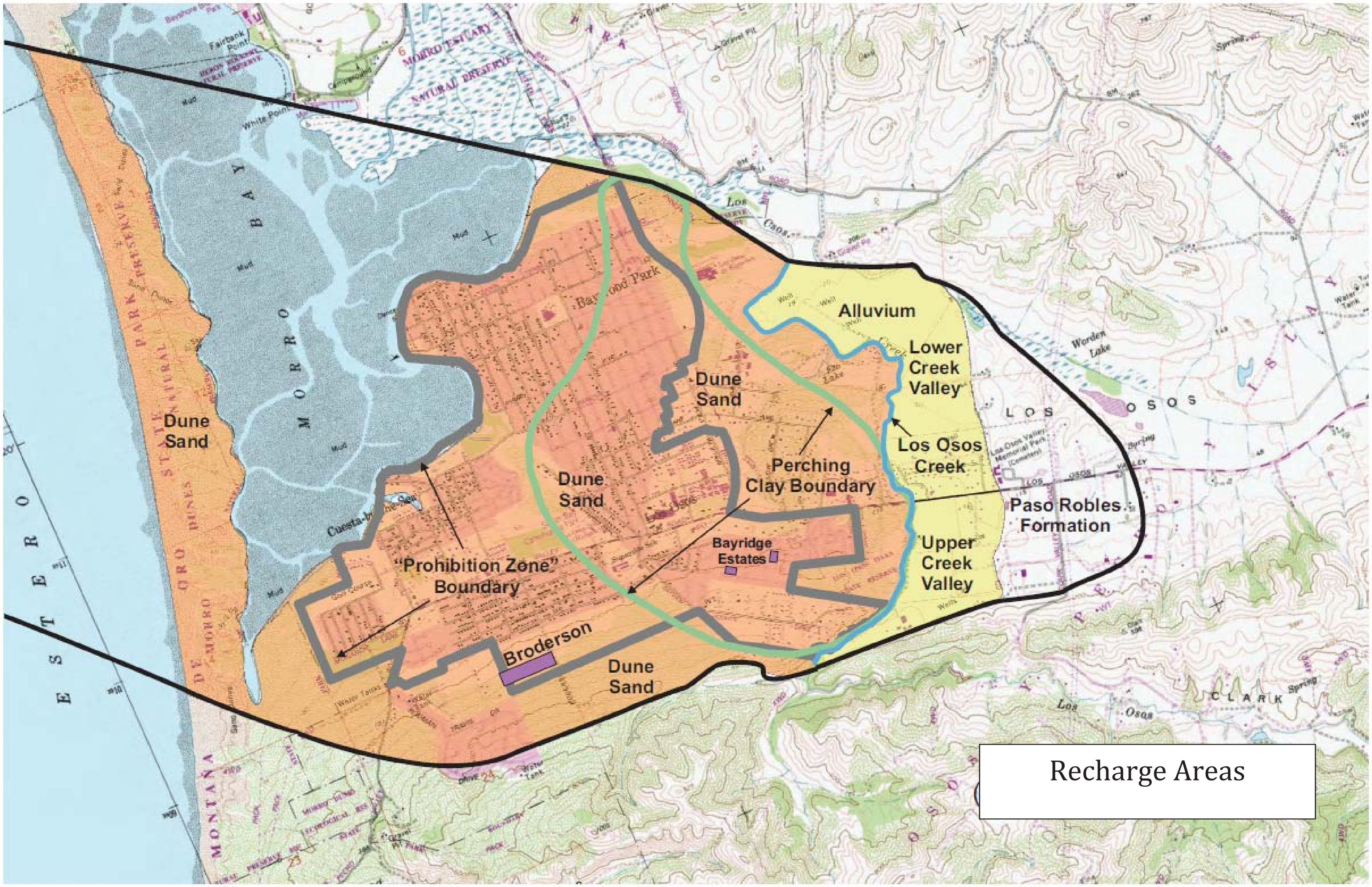
Figure 25 presents the primary recharge areas in the Basin. Percolation of precipitation is greatest within the dune sands, which cover the basin west of Los Osos Creek. Deep percolation of precipitation to the Upper Aquifer is restricted where overlain by the perching clay layer. The perching clay layer supports the Perched Aquifer, results in base flow to Willow Creek (Figure 22), and allows both subsurface leakage and lateral spilling to the Upper Aquifer. The majority of stream flow percolation occurs in the upper Los Osos Creek valley, where recharge to the Lower Aquifer is not restricted by the regional clay aquitard. Agricultural irrigation return flows occur throughout Los Osos Creek valley. Septic and landscape irrigation return flows are concentrated in the "Prohibition Zone". A portion of the treated wastewater from the LOWWP will be returned to the basin at the Broderson and Bayridge Estates disposal areas.

As discussed above, within the Basin, individual aquifer zones may receive recharge directly from those sources, or indirectly through inflow (leakage) from an overlying or underlying aquifer zone. Recharge to First Water and the Upper Aquifer is primarily from direct precipitation (including localized runoff) and return flows from irrigation and septic systems. Recharge to the Lower Aquifer is primarily from leakage through the regional aquitard, stream seepage in Los Osos Creek and subsurface inflow across Basin boundaries, particularly seawater intrusion until recent years.

Recharge from Los Osos Creek creates a prominent groundwater mound, as does recharge over the perching clay. There are pumping depressions in both the Upper and Lower Aquifers in the downtown Los Osos area, with the Lower Aquifer pumping depression extending throughout the Central and Western Areas.

Once percolating water reaches the saturated zones of the Basin, it moves through the water-bearing formations in a variety of pathways. Groundwater flow in the Upper Aquifer moves westerly toward the Pacific Ocean, easterly toward Los Osos Creek, and also downward into the Lower Aquifer. First Water and Upper Aquifer flows may emanate as springs and seeps in sand deposits along the southern margin of Morro Bay, drain into Willow Creek and Los Osos Creek and discharge where the aquifer subcrops beneath Morro Bay mud flats. Historically, groundwater in the Lower Aquifer also moved generally westward, to where it interfaced with seawater occupying the brackish portion of the aquifer underlying the Pacific Ocean. Following Basin development, groundwater flow in the Lower Aquifer began moving toward production wells and into the pumping depression present in the Central and Western Areas.

Figure 24. Recharge Areas of the Basin



Source: CHG.

5.6 Historical Water Resource Studies and Management

5.6.1 *Introduction*

Numerous studies of water resources have been performed for the Basin, leading over time to progressively greater knowledge regarding the Basin aquifers, water supplies and demands. Water management in the Basin has proceeded iteratively, both following and leading technical studies. The following sections of the Basin Plan review the major historical steps in the understanding and management of the Basin. Table 15 summarizes those studies.

Table 15. Timeline of Basin Studies and Management Actions

Date	Party	Summary
1958	DWR	▪ First study of Basin ▪ Determined sustainable yield to be 800 AFY (based on history of use)
1972	DWR	▪ Found groundwater levels in Basin to be steady since 1950s, no evidence of seawater intrusion except in dune sands adjacent to Morro Bay ▪ First artesian well drilled into Zone E
1973	DWR	▪ Found a groundwater depression near commercial center of Los Osos ▪ Compilation of historical water quality data ▪ Identified seawater intrusion and domestic waste discharges as potential threats ▪ Found urgent need for management of the Basin, including monitoring, treated wastewater reuse, blending for water quality and optimum placement of production wells
1974	Brown & Caldwell (B&C)	▪ Created first computer model of Basin ▪ Aquifer testing ▪ Estimated sustainable yield to be 1,800 AFY (consumptive use), annual recharge 3,100 AFY ▪ Projected that Basin demands would exceed supplies by mid-1980s at current growth rate
1979	DWR	▪ Upper and Lower Aquifers identified on sand spit ▪ Installed monitoring wells on sand spit and found aquifers to be impacted by seawater intrusion ▪ Recommended seawater intrusion barrier, treated wastewater reuse, water conservation and importation of new supplies

Table 15 (continued)		
Date	**Party**	**Summary**
1983	B&C	▪ Extend Upper and Lower Aquifers across Basin ▪ Found no seawater intrusion, but noted that population growth could cause intrusion in future ▪ Recommended active management of water quality, including seawater intrusion ▪ Nitrate monitoring well network established with Upper Aquifer nitrate characterization
1986	Engineering Science (ES)	▪ Recognized potential for seawater intrusion into Lower Aquifer ▪ Recommended percolation of treated wastewater into Lower Aquifer through Los Osos Creek discharge and into Upper Aquifer in vicinity of Broderson site
1987	Morro Group	▪ First hydrologic budget for Upper and Lower Aquifers ▪ Refined Broderson disposal site
1988	United States Geological Surveys (USGS)	▪ Installed several deep monitoring wells ▪ First MODFLOW Basin model ▪ Simulated seven management alternatives
1989	DWR	▪ Groundwater in storage calculations ▪ Found safe yield of 3,900 AFY ▪ Recommended wastewater collection and tertiary treatment, Basin disposal sites, 600 AFY imported water, maximize safe yield through positioning of deep wells east of recharge sites and shallow wells west of sites
1989	Morro Group	▪ Detailed Basin structural interpretation including e-log correlations and elevation contour on top of regional aquitard ▪ New alignment of Los Osos Fault Zone Strand B
1990	Morro Group	▪ Freshwater springs identification and analysis ▪ Stream flow analysis
1993	Black & Veatch	▪ Nitrogen study ▪ Original report rewritten with revised conclusions by County Technical Advisory Committee formed by County in 1994
1995 to 1997	Metcalf & Eddy	▪ Various studies related to wastewater project ▪ New monitoring wells ▪ Depth-to-water contour map ▪ Broderson disposal site investigations including pilot testing and neutron probe logging

Table 15 (continued)		
Date	**Party**	**Summary**
1997	Solution Group	▪ Solution Group introduces alternative management plan based on partial area wastewater collection, septic tank effluent pumps and treatments ponds
2000	Cleath-Harris Geologists (CHG)	▪ Broderson site drilling program ▪ Groundwater mounding analysis ▪ MODFLOW model
2000	URS Corp.	▪ Used MODFLOW model for Basin management ▪ Basin balanced at 4,000 AFY well production with wastewater project and Broderson site disposal
2001	Weber Hayes & Associates	▪ MTBE study for Bear Valley Chevron ▪ Well logs ▪ First identification of Zones A, B and C
2003	CHG	▪ Current definition of Zones A through E and Alluvial Aquifer ▪ Nine Basin cross-sections ▪ Strand B removed from Model
2003	Yates	▪ Current MODFLOW model initial construction ▪ Groundwater in storage calculations
2005	CHG	▪ Seawater intrusion investigation ▪ Lower Aquifer recharge study ▪ Basin water quality characterization
2006	CHG	▪ Upper Aquifer water quality characterization ▪ Sampled for Constituents of Emerging Concern (CECs)
2006	Ripley Pacific (RP)	▪ Eight technical memoranda covering water and wastewater management ▪ Promoted zero discharge and full beneficial use of wastewater
2008	Michael Brandman (MB)	▪ Prepared EIR for LOWWP ▪ Included analysis of hydrogeology, water quality, surface water resources, hydrologic budget, impact of LOWWP on Basin water resources
2008 to present	CHG	▪ Various studies in support of Basin Plan development, including Basin metrics and analysis of potential programs and combinations

5.6.2 *Studies Through 1983*

In 1958, DWR published a study on the County's water resources, which found that the sustainable yield of the Basin was approximately 800 AFY based on historical extractions that had not caused negative impacts up to that time.[29] The County subsequently estimated that the sustainable yield of the Basin was 1,000 AFY on the same basis.[30]

The earliest evidence of seawater intrusion into the Basin and other coastal aquifers in the Morro Bay area was found in the early 1950s.[31] Recognizing the growing threat of seawater intrusion to coastal water resources throughout the state, DWR initiated a series of studies in 1970 to acquire knowledge of the extent of seawater intrusion and potential impacts on the Basin.

In the first study, published in 1972, DWR found that documented seawater intrusion had occurred in the Basin in only one well located in shallow dune sands near the southern shoreline of Morro Bay. The remainder of the Basin aquifers appeared unimpacted with deeper zones under artesian conditions. Groundwater level elevations remained about the same as they had been since the 1950s. Despite these positive findings, the report acknowledged that the hydrogeologic regime of the Paso Robles Formation freshwater-bearing sediments was not known, and warned that increased groundwater extractions from Zones C, D and E could induce migration of seawater into those aquifers.

In 1973, the SWRCB contracted with DWR to conduct a study focusing on the Los Osos area, in support of SWRCB efforts to create a water quality management plan for the Basin. The SWRCB was particularly interested in potential impacts to the Basin from collection and export of wastewater that was being discharged to individual septic tanks.[32]

DWR found that groundwater production at the time was predominantly from the "old dune sands", which roughly correlated to Zone C as set forth in this Basin Plan. Groundwater elevations recorded in May and June 1973 showed a groundwater depression below sea level roughly in the vicinity of the commercial area to the north of Los Osos Valley Road. The report concluded that the sustainable yield of the Basin might be greater than the 800 to 1,000 AFY estimated by previous studies. Primary threats to the Basin were described as seawater intrusion and degradation of water quality from domestic waste discharges. In analyzing groundwater production, the report concluded that:

> *If groundwater extraction continues and/or increases in the center of [Los Osos], the threat of sea-water intrusion will continue, due to the large pumping trough. [T]here will be a need to disperse the location and amounts of extraction from wells to minimize the threat of sea-water intrusion and the volume of underflow toward the ocean that is lost to the Basin unless some way can be found to recover it. It will*

[29] DWR, *San Luis Obispo County Investigation*, Bulletin No. 18, at 61 (May 1958).
[30] County, *Master Water and Sewerage Plan* (May 1972).
[31] DWR, *Sea Water Intrusion: Morro Bay Area, San Luis Obispo County*, Bulletin 63-6, at 1 (1972).
[32] DWR, *Los Osos-Baywood Ground Water Protection Study*, Southern District Report (1973).

> *also be necessary to blend the pumped ground water from this area with water of better quality extracted from other parts of the Basin.*[33]

By 1973, use of septic systems for discharge of domestic waste had started to degrade water quality in Zone C, especially with nitrates, although water quality varied from year to year based on the amount of diluting precipitation. The report estimated that approximately 300 AFY of domestic waste was discharged to the Basin. Potential plans for disposing of domestic wastes included: (1) continuing the existing method; (2) treating and disposing at a different area of the Basin; and (3) exporting waste for treatment and disposal outside the Basin. DWR noted that plans (2) and (3) would have the potential to exacerbate seawater intrusion, especially in light of projected future increases in groundwater production from the Basin.

The 1973 report concluded that there was an "urgent need for complete management of the Los Osos Basin's water resources: its water supply; conservation; use and treatment and disposal of waste water." Important elements of the suggested management plan included: increased conservation and use of water from Los Osos Creek; maintenance of watershed cover to enhance infiltration; dispersion of extraction wells on a comprehensive, coordinated basis to control groundwater levels; blending of poorer with better quality water; optimum disposal of domestic wastewater effluent; and establishment of a groundwater monitoring program. Many of these elements continue to be relevant and are included within this Basin Plan.

In 1974, B&C was hired to evaluate the Basin on behalf of CSA 9.[34] B&C developed the first computer model of the Basin, although its accuracy was limited.[35] Using the model, B&C estimated the sustainable yield of the Basin to be approximately 1,800 AFY as consumptive use, estimating that average annual recharge was about 3,100 AFY, which it identified as an upper limit to consumptive use of Basin groundwater. B&C noted that the RWQCB was then studying the feasibility of a centralized sewage treatment facility for Los Osos and abandonment of septic tank disposal systems.

In light of projected significant increases in water demands for the Los Osos community, B&C concluded that Basin water demands would exceed supplies by the mid-1980s, and at buildout would exceed supplies by as much as 3,530 AFY. B&C recommended that several management actions be taken, including: appointment of a watermaster; spacing of new wells away from existing pumping centers; vertical spacing of new wells to increase the use of lower aquifer layers; use of treated wastewater for irrigation within the Basin (because export of wastewater would significantly reduce the sustainable yield of the Basin); and development of an imported water supply for the Basin, specifically water supplies from the Nacimiento Water Project.

---

[33] *Id.* at 43.
[34] Brown & Caldwell, *Preliminary Groundwater Basin Management Study* (1974).
[35] For example, the cells used in the B&C model were 2,000 feet square, and the model contained only one aquifer layer.

In 1979, DWR conducted a study on the Morro Bay sand spit, including well construction, to determine whether new water supplies could be developed from the offshore portion of the Basin.[36] Instead, DWR found that both Upper and Lower Aquifers underlying the sand spit had been impacted by seawater intrusion. Although the landward rate of movement and position of the seawater wedge was not known, the report recommended a groundwater management plan for the Basin that would consider "altering the pumping pattern and amount, installation of a seawater intrusion barrier, reuse of treated waste water for groundwater recharge and for a barrier, water conservation, and importation of additional supplies," as well as potential seawater desalination.[37]

No evidence of seawater intrusion was reported in a 1983 study by B&C, which documented nitrate impacts in the Upper Aquifer. Hydrographs taken from several wells in the Basin indicated that groundwater elevation had remained steady through 1979. The report did note, however, that population growth in the Basin, including increased pumping from the Lower Aquifer zones, could create seawater intrusion in the future, and if seawater intrusion were allowed to occur, the usability of the Basin would be impaired and wells located near the coast would need to be moved inland or abandoned. The study recommended that the County and other interested parties establish a strict program for managing water quality in the Basin, including seawater intrusion.[38]

5.6.3 *Studies from 1986 to 2000*

From the late 1980s through the early 2000s, Basin studies largely focused on investigation of nitrate impacts on the Basin and a potential wastewater project, with less attention paid to seawater intrusion. The last seawater intrusion-specific investigation prior to 2005 was completed in 1979 by DWR, as described above.

While seawater intrusion was not the focus of studies during this period, the potential for inducement of seawater intrusion by groundwater production from the Lower Aquifer was incorporated into a 1986 study by Engineering Science (ES) related to the design of a community wastewater collection and treatment system. This possibility of induced seawater intrusion was the basis for an ES recommendation that the wastewater project dispose of a portion of the treated effluent through percolation to the Lower Aquifer.[39]

Following that recommendation, Basin management options using strategic disposal of treated effluent from a future wastewater project were introduced by the Morro Group in the 1987 EIR for the CSA 9 wastewater treatment facilities. Through the 1983 B&C study, the Basin was generally treated as a single aquifer unit, rather than a two- or three-aquifer system, as became clear in later investigations. The 1987

[36] DWR, *Morro Bay Sandspit Investigation*, Southern District Report (1979).
[37] *Id.* at 3, 39.
[38] B&C, *Los Osos-Baywood Park Phase I Water Quality Management Study*, at 2-4, 4-8 (1983).
[39] ES, *Phase One—Sewerage Planning Study, CSA No. 9 – Los Osos, Baywood Park, Cuesta-by-the-Sea*, at 5-2, 5-6 (1986).

EIR was the first study to prepare separate hydrologic budgets for the Upper and Lower Aquifers. The Morro Group also produced a Supplemental EIR for the CSA 9 wastewater treatment facilities in 1989, which included detailed Basin cross-sections based on e-log correlations. That report introduced a new alignment for the Los Osos fault zone Strand B, which was interpreted to affect groundwater movement in the Basin and was subsequently incorporated into flow models and groundwater contour maps.

In 1988, USGS conducted a major study of the Basin, installing a network of deep monitoring wells and publishing a report that summarized the geology of the Basin and evaluated the hydrologic effects of several alternatives for reuse of treated wastewater in the Basin Area.[40] The study found that groundwater elevations in municipal production wells owned by the Purveyors were frequently below sea level, and salinity had increased in some wells near the coast. The first MODFLOW groundwater flow model was constructed for the Basin with three layers.[41]

DWR, working concurrently with USGS during the late 1980s, produced a report on Basin management in 1989 using the results of the USGS study. The DWR report charted water importation, groundwater extraction and groundwater outflow to identify the recommended management alternative that would provide for buildout demand without seawater intrusion. The final recommendation was an alternative that included Broderson site wastewater disposal, 600 AFY of imported water and repositioning of well facilities to meet total Basin water demands at buildout of 4,500 AFY. This is the first report which specifically recommended moving deep well production eastward and developing shallow wells in the Central and Western Areas of the Basin.

Between 1993 and 1997, several reports were prepared for wastewater project development which included nitrate fate and transport studies, wastewater project alternatives studies and pilot studies for wastewater disposal at Broderson. Different conclusions were sometimes reached, and in late 1997 the Solution Group produced a wastewater project alternative that included partial community wastewater collection, septic tank effluent pumps and a pond-based wastewater treatment facility. This management plan helped lead to the formation of the LOCSD in 1998. Although the Solution Group plan would be significantly altered to meet regulatory requirements and ultimately abandoned, LOCSD remained the lead agency for the wastewater project until 2006.

5.6.4 *Studies After 2000*

Basin hydrogeologic definition and management efforts continued to develop during the 2000s. The Broderson site was re-evaluated for wastewater disposal in two phases, first though a drilling program, followed by a site-specific flow model and

[40] USGS, *Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County California*, Water-Resources Investigations Report 88-4081 (1988).
[41] *Id.* at 1.

mounding analysis.[42] That same year, URS Corporation finished construction of a Basin flow model to investigate the threat of seawater intrusion under community buildout scenarios, with the wastewater project and Broderson site disposal in place. URS reported that pumping patterns, assisted by purveyor system interties, could be managed to meet buildout demand without seawater intrusion.

In 2001, Weber Hayes & Associates identified two distinct zones within the perched aquifer while investigating methyl tertiary butyl ether (MTBE) contamination in groundwater beneath downtown Los Osos. These perched zones were labeled Zone A and Zone B, with a third zone labeled Zone C that correlated with the upper water supply aquifer.

In 2003, the current geologic structural interpretation of the principal aquifers and aquitards was completed through a series of nine cross-sections across the Basin that built upon prior work by investigators, with revisions.[43] Strand B was removed from the Basin interpretation and replaced by the western edge of the perching clay, and an uplifted area relative to the main Basin was identified in Bayview Heights. This revised structural interpretation provided the conceptual model for concurrent development of a steady-state basin model by USGS.[44] This MODFLOW/MT3D model was initially used for evaluating nitrate loading and the effects of a wastewater project, and subsequently converted by CHG to also evaluate seawater intrusion using equivalent freshwater head (EFH) methods.

The first comprehensive seawater intrusion study in 25 years was conducted by CHG in 2005, and included Basin hydrologic definition, Basin water quality characterization, estimation of the historical rate of movement and current position of the seawater intrusion front, and an investigation of the sources of recharge to the Lower Aquifer.[45] The study included field investigation and data interpretation through water sampling, aquifer testing, borehole geophysics, tritium and carbon age-dating, source water mixing calculations and groundwater modeling. Findings of the 2005 study showed no evidence of seawater intrusion into the Upper Aquifer (Zone C), but significant intrusion in the Lower Aquifer, which had moved inland 50 to 60 feet per year for at least 28 years, and was threatening supply wells as far inland as Palisades Avenue. The primary source of recharge to the Lower Aquifer in the urban service area was confirmed to be leakage through the regional aquitard, followed by subsurface inflow from the Los Osos Creek valley and seawater intrusion.

In 2006, as a preliminary task to redevelopment of the Upper Aquifer by the Purveyors after years of relying primarily on the Lower Aquifer for supply, CHG collected water samples at five locations across the Basin for comprehensive

[42] CHG, *Hydrogeologic Investigation of Broderson Phase I* and *Hydrogeologc Investigation of Broderson Phase II, Impact Analysis* (2000).
[43] CHG, *Geologic Structure of the Los Osos Valley Ground Water Basin* (2003).
[44] Yates and Williams, *Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin* (2003).
[45] CHG, *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Ground Water Basin, San Luis Obispo County, California* (2005).

drinking water quality characterization, including organic wastewater compounds. This study found that nitrates were the primary constituent of concern, and were the only constituent detected in excess of primary drinking water standards. Wastewater influence was confirmed through detections of organic wastewater compounds and emerging contaminants, one of which (N-Nitrosodimethylamine, called NDMA, a byproduct of water treatment) was detected at levels above the consumer notification level.

During the 2000s, Basin management was being pursued along with the technical studies discussed above. LOCSD commissioned an Urban Water Management Plan in 2000, a Water Master Plan in 2002, a draft Water Management Plan in 2005 and the Los Osos Wastewater Management Plan Update in 2006. The 2006 report by Ripley Pacific was the last wastewater project study completed before project authority was transferred to the County. A series of eight technical memoranda presented background and detailed conceptual project components for wastewater collection, treatment, storage and recycling. Two panels from the National Water Research Institute were convened to review and discuss the Ripley Pacific report in 2006 and 2008.

Under direction of the County, Michael Brandman Associates completed the EIR for the County wastewater project in 2008. Appendix D updates and includes analyses of Basin hydrogeology, water quality, surface water resources, the hydrologic budget and impacts analyses.

5.6.5 *Development of the Model*

Groundwater models have been used in the Basin since the early 1970s. The original MODFLOW model of the Basin was developed as part of a USGS study in the mid-1980s and calibrated to the 1970-1977 and 1986 periods. It was updated during the 1990s by URS and calibrated to the 1986-1996 period. Since 2000, the model has primarily been maintained and operated by CHG.

The current Basin model (Model) was first developed in 2003. The following list of references contains information on the conceptual basis for the Model, aquifer parameters, calibration, applications, modifications, sensitivity analyses and peer review recommendations:

- CHG, *Geologic Structure of the Los Osos Valley Groundwater Basin* (2003);
- Yates and Williams, *Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin* (2003);
- CHG, *Report Addendum and Response to Comments* (2004);
- CHG, *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Groundwater Basin* (2005);
- CHG, *Basin Hydrologic Budget with Simulated Groundwater Elevation Contour Maps* (2008);

- CHG, *Flow Model Conversion and Urban Area Yield Update* (2009);
- CHG, *Los Osos Creek Valley Yield Evaluation* (2009);
- Hydrofocus, *Review of Cleath-Harris Geologists' July 2009 Memorandum "Flow Model Conversion and Urban Area Yield Update"* (2010); and
- Stetson, *Peer Review of the Los Osos Groundwater Model* (2010).

The Model utilizes USGS's SEAWAT program, which was developed to simulate three-dimensional, variable-density, transient groundwater flow in porous media. SEAWAT combines MODFLOW (modular flow) and MT3D (mass transport) code, and adds variable fluid density capability for seawater intrusion simulations.[46] Model construction and development was performed using Groundwater Vistas, a commercial software package that couples an advanced model design system with comprehensive graphical analysis tools. The Model has been developed and is owned by the Parties.

A conceptual model is a compilation and interpretation of available information on the physical system being modeled. It includes a characterization of basin structure, boundary conditions, aquifer geometry and physical parameters, and components of inflow and outflow. Basin structure and aquifer geometry for the Model was developed through a network of geologic cross-sections, with deep well control points used to contour elevations on the base of four layers. The Model layers correspond to the Upper Aquifer (Layer 1) the regional aquitard (Layer 2), and two divisions of the Lower Aquifer (Layers 3 and 4). The physical parameters for Basin sediments (hydraulic conductivity, porosity, specific yield and storativity) are based on field tests or adjusted through calibration within a plausible range of values.

The basic components of inflow to the Model include percolation of precipitation, leakage from the perched aquifer (through a recharge pre-processor), stream seepage, septic return flows, irrigation return flows and subsurface inflow (including seawater intrusion). The Model simulates seawater intrusion and mixing with fresh groundwater by tracking total dissolved solids (TDS) concentrations within the Basin. Components of outflow from the Model include evapotranspiration (through the recharge pre-processor), well production, creek outflow and subsurface outflow. Wastewater collection and distribution after treatment are incorporated into wastewater project scenarios.

The Model has been used to evaluate seawater intrusion and sustainable yield. Hydrologic budget information derived from the Model, along with TDS isoconcentration maps, have been used to compare the effects of existing and alternative groundwater pumping and wastewater disposal scenarios on seawater intrusion and sustainable yield. Control of seawater intrusion is a prerequisite for

---

[46] Gou and Langevin, *User's Guide to SEAWAT: A Computer Program for Simulation of Three-Dimensional Variable-Density Ground-Water Flow*, USGS Techniques of Water-Resources Investigations 6-A7 (2002).

any long-term Basin management that provides a sustainable groundwater resource.

The methodology developed for determining Basin sustainable yield and evaluating seawater intrusion mitigation measures in support of Basin management involves the application of the Model. The process of preparing, running and using the results of a Model scenario is outlined as follows:

- Input parameters for individual Model scenarios include adjusting well production, septic/wastewater return flow, and perched aquifer leakage. Percolation of precipitation and sea level are also adjusted when defining climate change scenarios. Starting heads and initial salt concentrations are imported from the current condition scenario.

- Model scenarios are run to steady-state using the SEAWAT program. To achieve steady-state (Basin equilibrium), the ending heads and final concentrations of each Model run are imported into the Model as initial heads and starting concentrations for the next Model run until there is no significant difference between Model inflow and outflow (mass balance error approaching zero), and there is no further movement of the seawater intrusion front within the Basin.

- A scenario is considered sustainable if none of the active wells in the Basin are producing water with chloride concentrations in excess of 250 milligrams per liter (mg/l), which is the recommended limit for drinking water (one-half of the Maximum Contaminant Level (MCL) upper limit).

- Information extracted from the Model for comparison with other scenarios includes the quantity of seawater intrusion, Los Osos Creek recharge, and subsurface outflow. Other components of flow have also been extracted to create Basin hydrologic budgets.

The flow portion of the Model was originally constructed and calibrated for steady-state operation; there are no seasonal fluctuations or cycles of drought and wet periods. The main aquifers are represented by three model layers, which precludes modeling seawater intrusion through individual sand and gravel zones (preferential pathways). In addition, there will be significant changes to the groundwater system under wastewater project conditions, compared to the historical conditions under which the Model was calibrated.

While there are limitations and associated uncertainty in all models, the current Model provides a reasonable estimate for long-term yield and useable results for developing the Basin Plan, provided there are ongoing monitoring and analysis.

5.6.6 *Peer Review*

In 2010, Stetson was retained to conduct a peer review of the Model and related technical studies to determine the validity of the Model and its assumptions. Stetson was tasked with providing an opinion on the sustainable yield estimates using the Model for the Upper Aquifer and the Lower Aquifer in the Eastern Area. Stetson reviewed key reports produced by CHG and other consultants regarding the Basin and the County's LOWWP as part of the peer review process. Stetson also discussed the development and assumptions of the Model with CHG.

Stetson concluded that the SEAWAT-based Model, and its results regarding seawater intrusion and sustainable yield, provides usable results on which to base near-term changes in pumping distribution to mitigate seawater intrusion. Stetson further concluded that SEAWAT is an appropriate model code for the Basin for evaluation of the average groundwater Basin budget (including the Basin and subarea yields), the extent of seawater intrusion, and for use in evaluating the relative effects of development and changes in Basin management.

Stetson also concluded that the Model scenario regarding redistribution of pumping in the Basin with an increase in pumping in the Eastern Area is reasonable and could be initiated without further modeling or analysis, provided the change is gradual, with continued water level and water quality monitoring and analysis. The Model could be updated as the effects of that strategy become more fully understood. Stetson recommended phased redistribution of pumping with contingency plans in place to make adjustments as needed and as ongoing monitoring data indicate.

Stetson also noted that the structure of the Model was sound and able to effectively simulate hydrologic processes in the Basin, particularly as regards to the different characteristics and extent of seawater intrusion in each of the main water-bearing units (Zones C, D and E). The Eastern Area has a slightly different structure which the Model also suitably represents. Stetson also determined that the Model grid is reasonable for the Basin given the scale, density of data and resolution required of Model results.

Stetson made several recommendations for improvements to the Model:

- Creation of additional model documentation, including definition of the Model's limitations and uncertainty in the results and technical basis for input data;
- Model refinement and additional scenarios, including evaluation of climactic variability other than sea level rise; and
- Development of a monthly transient flow model.

The Parties will consider making those improvements to the Model as implementation of actions under this Basin Plan are underway, particularly if grant funding becomes available from the federal or state governments.

5.6.7 *Technical Evaluations for the Basin Plan*

The Model has been used extensively to assist with development of this Basin Plan. Specific improvements to the Model have been made during the process, such as a stream seepage study performed on Los Osos Creek, which validated the range of stream seepage being simulated by the Model. Water quality monitoring for seawater intrusion was also conducted between November 2009 and January 2010. The most recent technical evaluation of the Basin was the characterization of seawater intrusion at the LOCSD Palisades well which identified Lower Aquifer Zone E as the source of locally elevated chlorides.[47] This is consistent with Model performance.

The Model scenarios used to develop the Basin Plan cover a wide range of objectives. These have included:

- Evaluate current conditions (2013);
- Evaluate current well facilities yield;
- Evaluate several combinations of possible future well facilities yield;
- Evaluate effects of wastewater collection and recycling on yield;
- Evaluate effects of agricultural reuse on yield;
- Evaluate nitrate blending and nitrate removal facilities; and
- Evaluate salt loading from wastewater recycling.

Pertinent results of these scenarios are discussed in or have been incorporated into the Basin Plan. These efforts have identified scenarios that meet the resource development goals established in this plan.

5.7 Regulation of the Basin

5.7.1 *Regulation of Wastewater Treatment by the RWQCB*

Beginning as early as 1971, the RWQCB and other health agencies became concerned with the safety of the Los Osos community sanitary system. Concern arose from the high level of variance in depth to groundwater, which in certain areas is shallow enough to flood leach fields during wet weather. Additionally, many smaller lots do not contain sufficient land area to accommodate leach fields. As a result, these areas depend solely on deeper seepage pits which may discharge directly into groundwater. To compound matters, the Los Osos community draws its potable water supply from the same groundwater. The RWQCB responded in June 1971, by adopting an interim basin plan that contained a provision prohibiting septic system discharges in the area after 1974.

In 1983, the RWQCB determined that nitrates in excess of state standards had impacted First Water and the Upper Aquifer, with a substantial effect from the use of septic systems throughout the community. The RWQCB issued Resolution No. 83-13 and made the following findings:

- Previous studies indicated that the quality of water derived from the shallow aquifer underlying the community was deteriorating, particularly as it related to increasing concentrations of nitrates in excess of state standards;

[47] CHG, Technical Memorandum, *Palisades Well chloride source testing and mitigation plan* (January 16, 2013).

- The current method of wastewater disposal by individual septic tank systems located in areas of high groundwater was a major contributing factor to this degradation of water quality; and

- Continuation of this method of waste disposal could result in health hazards to the community and the continued degradation of groundwater quality in violation of the Porter-Cologne Act.

Based on those findings, the RWQCB resolution established discharge prohibitions for a portion of Los Osos that became known as the "Prohibition Zone." The action set a deadline of November 1, 1988, beyond which most new septic system discharges from new construction or remodels were prohibited. These regulatory actions created a *de facto* moratorium, effectively halting new construction or major expansions of existing development until a community wastewater collection and treatment was constructed.

Due to the predominately residential and agricultural character of overlying land uses, the Basin has not been significantly affected by industrial or hazardous wastes.[48] During the late 1990s and early 2000s, First Water was impacted by MTBE from a gasoline service station, but that impact was largely contained and mitigated following an enforcement action by the RWQCB.

5.7.2 *The County Resource Management System*

The County Board of Supervisors created the Resource Management System (RMS) in 1990 with the purpose of establishing a process whereby development could be sustained through planned resource management. The RMS focuses on collecting data, identifying issues and recommending solutions with respect to a number of resources, including water and sewage disposal. As part of the RMS, the County Planning and Building Department produces Annual Resource Summary Reports (ARSRs) and, under certain circumstances, Resource Capacity Studies (RCSs). ARSRs contain updated resource data, data evaluation and level of severity (LOS) recommendations. RCSs include a determination of the capacity of the resource being studied, an identification of alternate measures for avoiding a predicted resource deficiency and an estimated timetable for funding and completion of public works projects to correct the resource deficiency.

The RMS classifies resource deficiencies using three alert levels known as levels of severity (LOS). The criteria for each LOS in the context of water supply are as follows:

- LOS I is reached when water demand projected over nine years equals or exceeds the estimated dependable supply.

[48] *Id.* at 2-3.

- LOS II occurs when water demand projected over seven years (or other lead time determined by an RCS) equals or exceeds the estimated dependable supply.

- LOS III is reached when water demand equals the available resource, i.e., the amount of consumption has reached the dependable water supply.

If the County Board of Supervisors concludes that a potential resource problem exists based on information contained within an ARSR, it initiates the preparation of an RCS that is subject to a public hearing before the County Planning Commission and Board of Supervisors. If the Board adopts an RCS and certifies an LOS, then it implements the action requirements set forth in the County Land Use Plan.

The County Department of Planning and Building has prepared more than 20 ARSRs since the inception of the RMS, all of which discuss water supply in the Los Osos community. The first ARSR (issued in 1990) recommended completion of an RCS and adoption of an LOS II for water supply in the Basin based on the results of the 1988 USGS study discussed in Section 5.6.3 of this Basin Plan. Pursuant to the 1990 ARSR, the Board of Supervisors directed the Department of Planning and Building to prepare an RCS. Completed in 1992, that RCS contained the following findings:

- An LOS II exists for water supply in the Basin;

- The interim service capacity allocation in the EAP should be revised to acknowledge that there is no excess system capacity to be allocated;

- The water system should be modified to eliminate the factors causing seawater intrusion;

- The area's water purveyors should jointly undertake a regular monitoring program to determine the ongoing status of seawater intrusion;

- Measures for increasing the water supply should be evaluated and pursued, as appropriate;

- A moratorium on new subdivisions should be enacted, to include the area within the boundaries of the URL; and

- When new information about the Basin's water supply becomes available, it should be promptly reviewed to determine whether the moratorium should be extended to include building permits in addition to subdivisions.

Although the County Planning Commission recommended adoption of the RCS with some modifications, the Board of Supervisors declined to adopt it on August 18, 1992.

From 1993 to 2005, the ARSRs generally refrained from recommending a particular LOS for water supply in the Basin pending the completion of a number of studies, including a Los Osos Water Management Plan (LOWMP) that was instituted by LOCSD.

Based on the results of the LOWMP, in 2005, the ARSR recommended the preparation of an RCS and adoption of an LOS III. The LOWMP concluded that the demand in 2005 (then estimated to be approximately 3,400 AFY) exceeded the safe yield (3,250 AFY). Pursuant to the 2005 ARSR, the County Board of Supervisors directed the Planning and Building Department to prepare an RCS, which was completed in 2007. In preparing the RCS, the County Department of Planning and Building relied on reports commissioned by LOCSD and completed by CHG. The RCS contained the following findings:

- The Basin was in overdraft and an LOS III was recommended for water resources in Los Osos;
- Seawater intrusion was occurring and had already progressed to the point where certain community wells needed to be replaced;
- Aggressive conservation measures must be put into place;
- GSWC and LOCSD had responded to seawater intrusion by changing well locations;
- S&T did not meter water use;
- GSWC and LOCSD customers used a relatively small amount of water per connection; and
- A supplemental water supply would eventually be required for buildout.

Consistent with the action requirements set forth in the County Land Use Plan, the RCS also contained a number of recommended implementation measures, many of which have already been completed. Following adoption and implementation of the various programs in this Basin Plan, the County will revisit its RCS to ensure that all information in the RMS is updated and all actions are appropriate.

5.8 Nitrate Impacts to the Basin

As discussed in prior sections, the Basin has experienced increasing levels of nitrates in First Water and the Upper Aquifer due to the discharge of municipal wastewater to septic tanks across the Plan Area. Previous technical studies have analyzed the source of nitrate in the Upper Aquifer and determined that the majority is derived from septic discharge of municipal wastewater. Other origins include natural sources (soil organic matter, vegetation and inflowing groundwater), agricultural and residential fertilizers, waste products from horses, dogs and cats, and soil disturbance from construction and weed abatement activities. This conclusion was drawn from a general understanding of nitrate sources and physical behavior, a strong statistical correlation between increasing nitrate levels and population growth in Los Osos, and a mass loading analysis of various potential sources of nitrates.[49]

The trend of nitrate levels can be seen clearly in Figure 25, which shows the historical development of nitrate levels in the Upper Aquifer. As is clear from that figure, while nitrate levels have increased in many parts of the Basin, those levels are not uniform across the Basin, but vary substantially based on local subsurface conditions, density of historical septic discharges, the location of sources of recharge and production well locations. Nonetheless, the Upper Aquifer has been broadly degraded as a suitable source of water for the Los Osos community.

This Basin Plan addresses nitrate degradation of the Upper Aquifer in two ways:

- Construction of a community wastewater collection and treatment facility by the County, as the LOWWP set forth in Chapter 9; and

- Construction and operation of one or more nitrate removal facilities that will allow impacted Upper Aquifer water to be safely and reliably treated to potable water standards, as described in Chapter 10.

5.9 Seawater Intrusion into the Basin

The second challenge to the Basin is seawater intrusion. The following description of seawater intrusion by USGS is helpful in understanding how intrusion occurs and what is necessary to prevent further intrusion into the Basin:

> *In coastal aquifers containing both freshwater and seawater, the two tend not to mix. Seawater is denser, and it tends to underlie the freshwater and extend inland as a "toe" or "wedge" near the bottom of the basin. Freshwater is less dense and tends to float on top of the seawater, flowing seaward and then rising as seepage through the ocean floor. Although some mixing does occur, the interface between the two types of water is commonly distinct, so that it constitutes a boundary to the flow of fresh ground water. In a complexly layered aquifer system like the Los Osos Valley ground-water basin, the interface can be at different locations in different layers, depending on their relative hydraulic connection to pumping wells and the ocean or bay.*

[49] Metcalf & Eddy, Inc., *Los Osos Wastewater Study Task F – Report on Sanitary Survey and Nitrate Source Study* (1995).

Figure 25. Nitrate Levels in the Upper Aquifer

Note: All nitrate concentrations are expressed in mg/L.

> *Because seawater is 2.5 percent denser than freshwater, the potentiometric head on the freshwater side of the interface must be 2.5 percent greater than the depth of the interface below sea level, if the interface is to remain stationary. For example, in order to balance the interface in an unconfined aquifer at a depth of 400 feet below sea level, a freshwater head of 10 feet above sea level would be needed. In this steady-state situation, the seawater remains stationary while freshwater flows seaward above the interface at a constant rate. Seawater intrudes when the freshwater head is insufficient to counterbalance the greater density of seawater, even when the freshwater head is above sea level.*[50]

These differences in density between freshwater and seawater are built into the SEAWAT module of the Model. The seawater wedge is simulated in the Model for each aquifer zone, but not for sub-horizons of varying permeability within the zones.

The Ghyben-Herzberg relation, which states that for every foot of freshwater above sea level there are 40 feet of freshwater below sea level, is useful for estimating the approximate groundwater elevations needed inland of the coast to prevent seawater intrusion. Along the axis of the Basin syncline between the sand spit and Sea Pines Golf course, Upper Aquifer Zone C is 180 feet deep, and would need a freshwater head of five feet to prevent seawater intrusion. Zone D is 230-350 feet below sea level, so a freshwater head of nine feet would be needed. Zone E is 430-670 feet below sea level so a freshwater head of 17 feet is needed. Along the Bay at Pasadena Drive in Baywood Park one would need 2.5 feet of head for Zone C, 5.5 feet in Zone D, and 9.5 feet in Zone E. Given that Lower Aquifer groundwater elevations inland of the coast have been below sea level or within a few feet of sea level for many years, seawater intrusion was inevitable. Upper Aquifer groundwater elevations have remained above the elevation needed to preclude intrusion.

Between 1985 and 2005, the average annual rate of intrusion in Lower Aquifer Zone D was estimated at 60 feet per year for the 250 mg/l isochlor line. Zone E intrusion was estimated at 54 feet per year. Data from the 2005 study also showed the rate of intrusion for precursor trends (early-detection at lower chloride concentrations based on ion ratios) at approximately 200 feet per year between GSWC wells Pecho and Rosina, and approximately 600 feet per year between GSWC's Rosina well and LOCSD's Palisades well.

Since the 2005 study, two water quality monitoring surveys for seawater intrusion have been conducted, the first between November 2009 and January 2010, and recently in July and August 2014. These surveys were used to update estimates concerning the rate and extent of sea water intrusion and indicate the rate of intrusion is accelerating. Diagrams of the seawater intrusion in 2014 are shown in

[50] USGS, *Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County California*, Water-Resources Investigations Report 88-4081, at 17 (1988).

Figure 26 and Figure 27. Rates of sea water intrusion are affected primarily by water levels (pressure gradients) and aquifer permeability. The rate of intrusion is typically not uniform over time, but varies seasonally according to pumping cycles, and is accelerated during drought periods. Intrusion may also not be uniform within the aquifer zones, but may follow preferential pathways along discrete sand and gravel layers being tapped by pumping wells.

In 2013, work at the LOCSD Palisades Well confirmed that intrusion at the well was occurring in Zone E, while Zone D water quality at the well was close to historical (pre-intrusion) quality. Using the recent information on the flow and salt loading contributions of each Lower aquifer zone, a back-calculation of historical water quality data shows that the intrusion front in Zone E had already reached Palisades by 2005.

The estimated rate of seawater intrusion in Zone D has increased from an average of 60 feet per year between 1985 and 2005, to approximately 200-250 feet per year since 2005. Zone E intrusion has increased from an estimated 54 feet per year between 1977 and 2005, to approximately 100-125 feet per year since 2005. A separate, accelerated intrusion rate in Zone E along a preferential pathway toward Palisades well 18L2 is estimated to have averaged 170 feet per year between 1977 and 2004. The 250 mg/l isochlor is interpreted to have advanced west of Broderson Avenue in Zone D (Figure 26), and is approaching 10th Street in Zone E (Figure 27).

Figure 26. Historical Progression of Seawater Intrusion in the Lower Aquifer

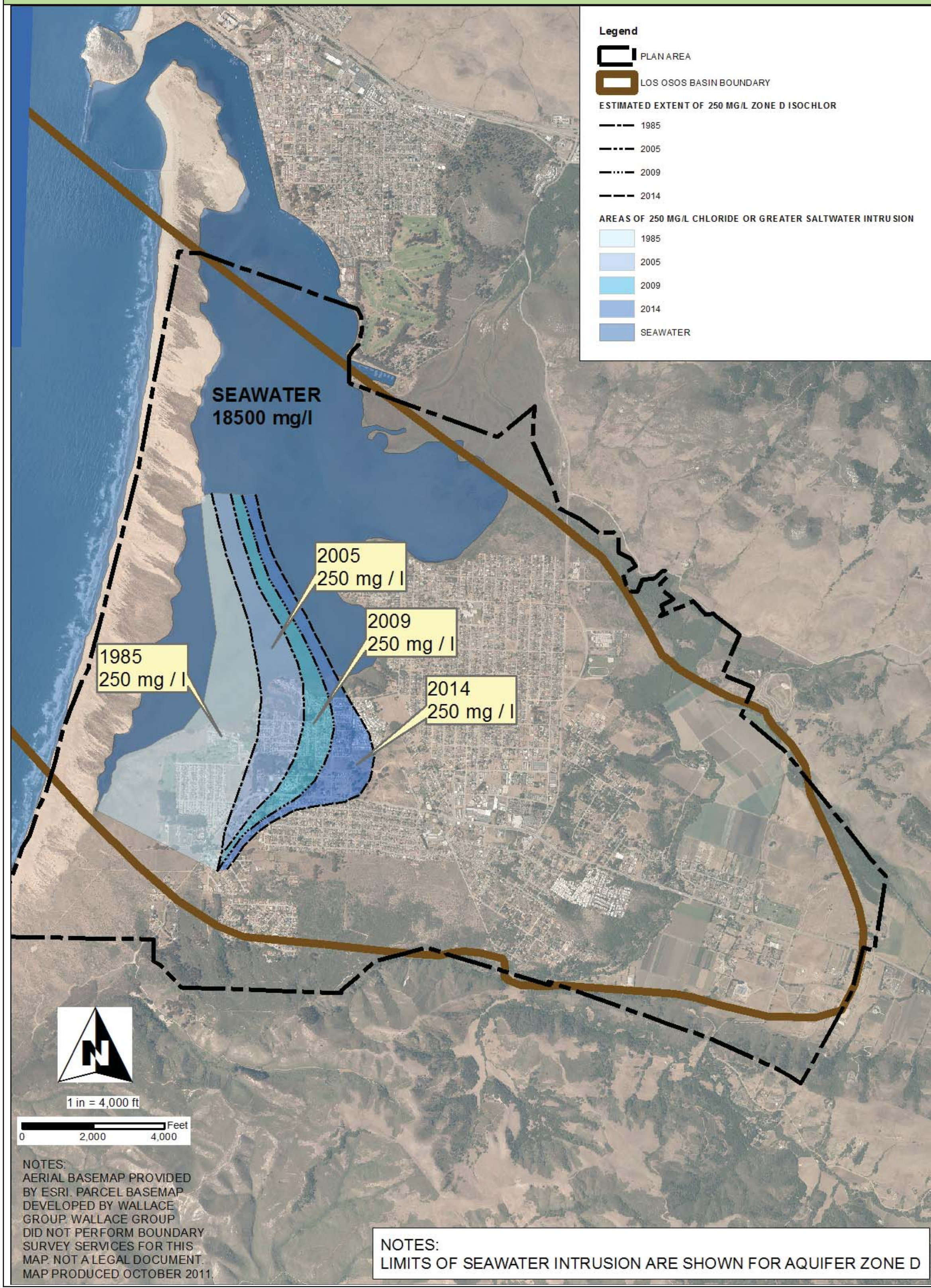
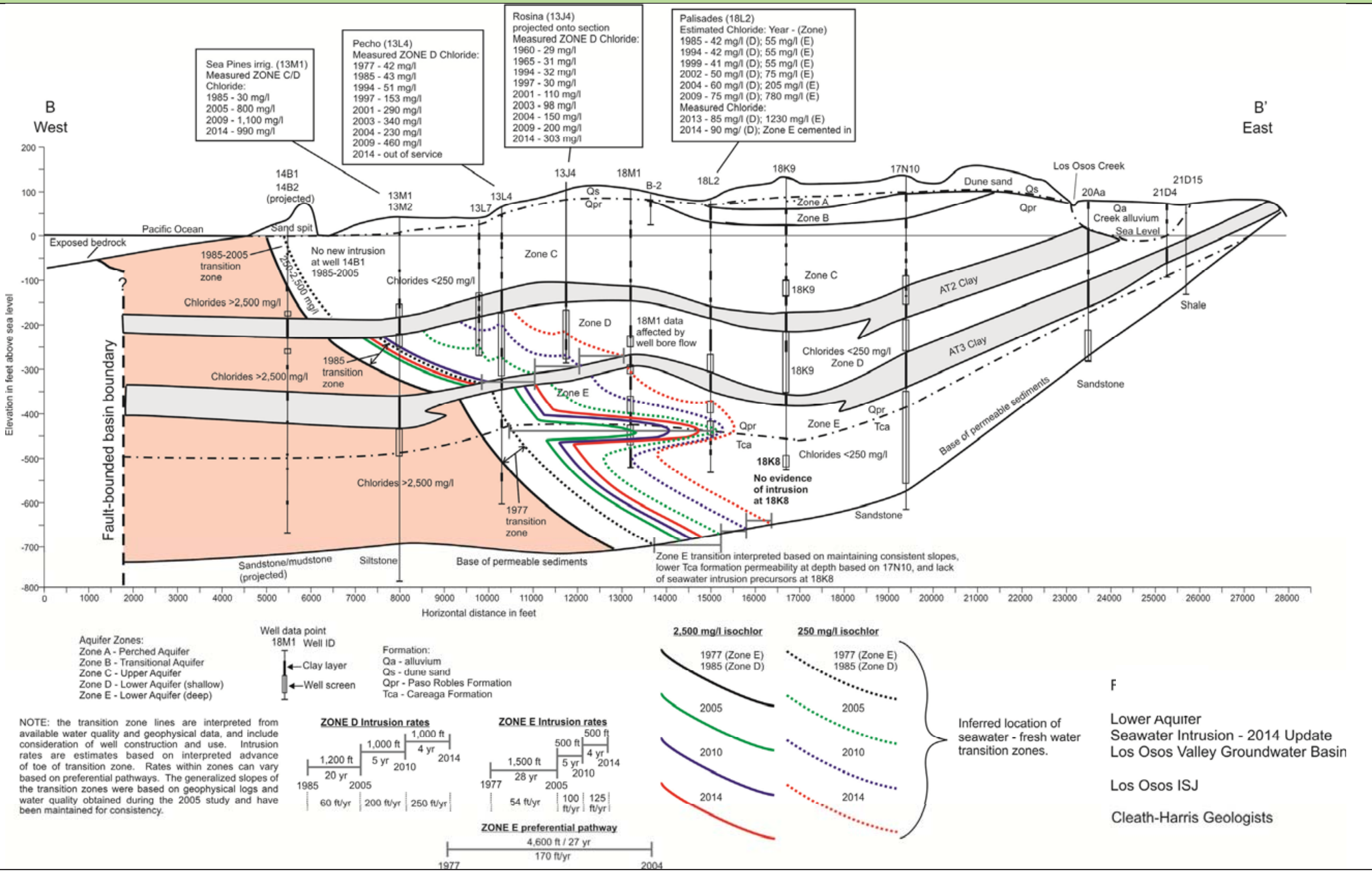


Figure 27. Seawater Intrusion Wedge (2014)



Source: CHG.

5.10 Groundwater Storage

The Basin reaches depths of several hundred feet below sea level in the Western Area and holds a considerable volume of groundwater in storage. Estimates for groundwater in storage have been developed based on the structural interpretation of the Basin, nominal values of aquifer porosity, position of the seawater intrusion front, and water level contour maps presented in the 2005 seawater intrusion study.

Reported groundwater storage values may represent different types of storage. Once the volume of saturated Basin sediments has been calculated, a porosity factor is applied to isolate the volume of pore space, which contains the actual groundwater. Sometimes the porosity factor used may be the specific yield,[51] which is the amount of stored water that would be available to flow into wells, leaving some pore water behind due to capillary forces. Other investigators may use an effective porosity factor, which estimates that portion of the water in pores that moves as groundwater flow.[52] For the Basin, the nominal values for the various porosity factors are estimated at 0.3 total porosity, 0.2 effective porosity, and 0.1 specific yield.

The following volumes of groundwater in storage have been estimated for freshwater inland of the seawater intrusion front using the DWR methodology with an average specific yield factor of 0.1:

- First Water and Upper Aquifer: 65,000 acre-feet (AF);
- Lower Aquifer: 140,000 AF; and
- Basin storage above sea level: 20,000 AF

In many shallow coastal basins, as well as inland basins that are not subject to seawater intrusion, adequate storage capacity can be an important buffer during drought. The depth of the Basin provides adequate storage as shown above (compared to annual Basin demands), but also requires higher water levels to prevent seawater intrusion. Only a portion of groundwater in storage above sea level can be used without causing seawater intrusion, and almost all of that groundwater is currently within the Upper Aquifer. Useable storage in the Lower Aquifer has been mined over time and is slowly being replaced with seawater.

5.11 Groundwater Wells in the Basin

There are approximately 240 water supply wells in the Basin, and at least another 30 monitoring wells. The Basin Management Committee will maintain a database of wells in the Basin, along with their characteristics such as date of construction, depth, screened intervals, equipment, owner, purpose, location and historical production. This database will be maintained as confidential proprietary data, with only aggregate data published to the public.

---

[51] *See*, *e.g.*, DWR, *Geohydrology and Management of the Los Osos Basin* (1989).
[52] *See*, *e.g.*, Yates and Williams, *Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin* (2003).

California has adopted a uniform system for numbering wells based on their geographic location. The components of the well number refer to the township, range, section and 40-acre subdivision of a section. The township and range are separated by a slash, the range and section by a hyphen, with no separation between the section and section subdivision designation. Finally, each well in the subdivision is individually numbered. For example, Well 30S/11E-7N1 is in Township 30 South, Range 11 East, Section 7, subdivision N, and was the first well to receive a state number in that 40-acre area. The township and range lines in Los Osos are from the Mount Diablo base and meridian system.

For purposes of this Basin Plan, the location of a well is less important than the aquifer layer from which the well produces groundwater. Therefore, this Basin Plan uses a different well numbering system consisting of the primary aquifer layer and a sequential number. For example, Well 30S/11E-7N1 under the state's numbering system is named Well UA5 in this Basin Plan, which stands for Upper Aquifer Well No. 5. The prefix FW for First Water, UA for Upper Aquifer, and LA for Lower Aquifer are preceded by a unique well number. This numbering system provides a simple means of organizing the wells for data reporting and interpretation, such as water quality and water elevation contour maps. The Basin Management Committee will include both state and Basin Plan well numbers in its database of Basin wells.

6

DEVELOPING A STRATEGY FOR THE BASIN

6.1 Introduction

Based on the information presented in Chapters 1 through 5, it is clear that the Basin faces two significant threats requiring immediate action: nitrate impacts to the Upper Aquifer and seawater intrusion into the Lower Aquifer.

Water quality in the Upper Aquifer has been degraded through use of septic systems for disposal of municipal wastewater in the Los Osos community for more than 60 years. Those impacts, which primarily take the form of nitrates, have made the Upper Aquifer unsuitable as a source of drinking water without nitrate treatment. While future degradation of the Upper Aquifer should be prevented by construction and operation of a community wastewater collection and treatment system, as planned by the LOWWP described in Chapter 9, natural attenuation of existing nitrate levels will require decades. During the attenuation period, this Basin Plan provides for the potential construction and operation of one or more nitrate removal facilities to allow use of Upper Aquifer water for municipal purposes. Those facilities are part of the Basin Infrastructure Program set forth in Chapter 10.

Withdrawal of groundwater from the Lower Aquifer has caused a general decline in water levels, leading to seawater intrusion from that portion of the Basin which underlies the Pacific Ocean. Seawater intrusion has caused some municipal wells in Los Osos to become unsuitable as sources of drinking water due to high levels of salts, and threatens to affect many other wells in the community. Currently, and for the foreseeable future, seawater intrusion is the most serious challenge facing the Basin.

This Chapter defines the nitrate and seawater intrusion threats facing the Basin, sets goals for resolution of those problems, suggests the general approach for action by the Parties and others, and creates metrics to measure success in reaching Basin goals. This chapter thus serves as a bridge between Part I of the Basin Plan, which describes the past and present conditions of the Basin, and Part II, which identifies future actions for management of the Basin.

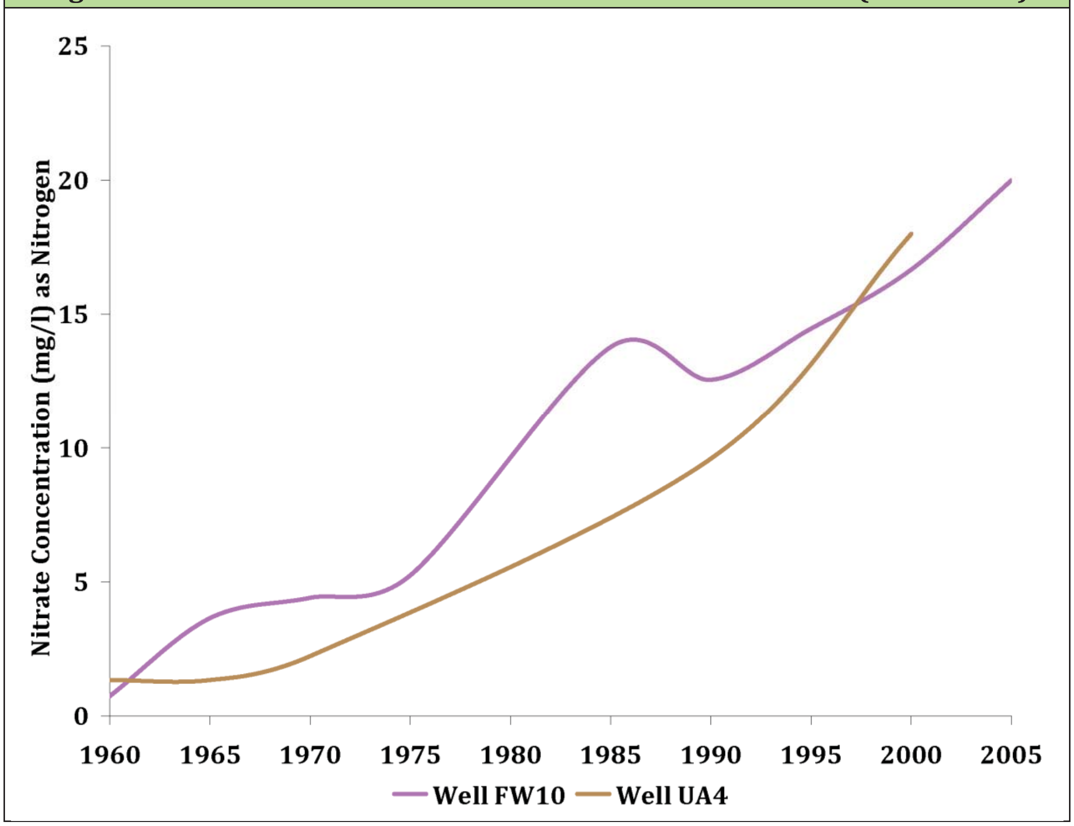
6.2 Degradation of the Upper Aquifer

6.2.1 *The Nature and Development of Degradation*

The most significant threat facing the Upper Aquifer is a degradation of groundwater quality caused by approximately 60 years of septic disposal of municipal wastewater in the Los Osos community. The most significant impact to the Basin is from nitrate. The level of nitrate in Upper Aquifer groundwater has increased steadily in past decades along with the rise in population and accompanying volumes of municipal wastewater discharged to the Basin.

The general trend of increasing nitrate levels may be seen in the historical water quality measurements in two wells located in different parts of the Basin—Well FW10 in Baywood Park and Well UA4 near Sea Pines Golf Course—as depicted in Figure 28. The increase in nitrate levels in those two wells followed population growth, starting in the 1970s with significant residential development in Los Osos, and continuing since that time as a result of continued nitrate loading. Population growth slowed toward the end of the 1980s, but nitrate concentrations continued rising through the early 2000s in response to nitrate loading.

Figure 28. Historical Nitrate Levels for Wells FW10 and UA4 (1960-2005)



Source: CHG.

As explained in Sections 5.7.1 and 5.8, the primary source of excess nitrate in Upper Aquifer groundwater supplies is municipal wastewater discharged into high-density septic systems. Other sources include natural materials (soil organic matter, vegetation and inflowing groundwater), agricultural and residential fertilizers, waste products from horses, dogs and cats, soil disturbance from construction and weed abatement activities.

For sources of drinking water, nitrates are regulated by the U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) under the federal and state Safe Drinking Water Acts. Nitrates in drinking water have been linked to methemoglobinemia, a blood disorder that primarily affects infants up to six months old, causing shortness of breath and blue baby syndrome, including death. The current federal and state MCL for nitrate in drinking water is 10 mg/l.[53] Nitrates may be removed from water through several proven technologies, including ion exchange, RO, and electrodialysis.

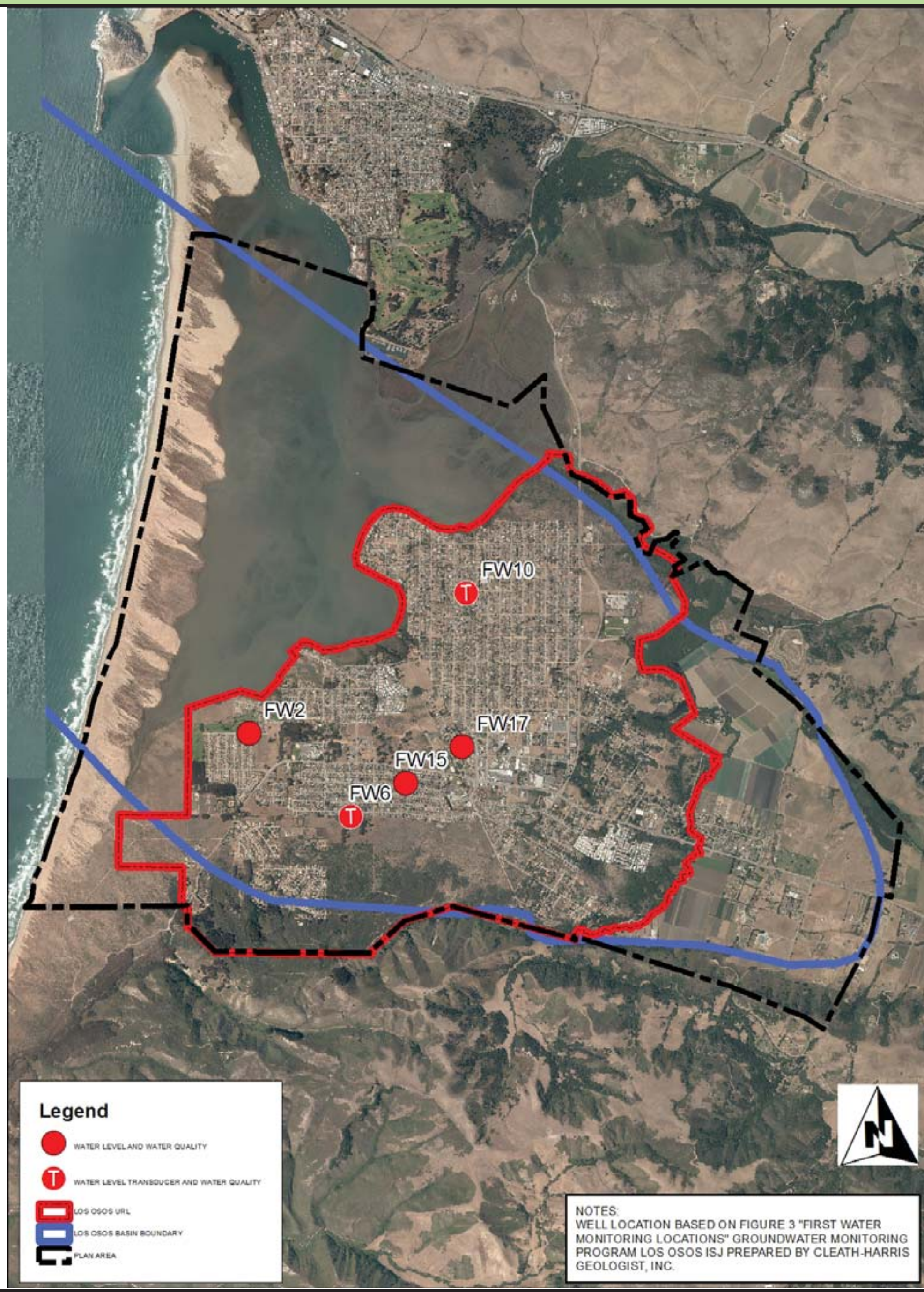
6.2.2 *Nitrate Metric*

In order to measure the status of nitrate impacts to the Upper Aquifer, this Basin Plan establishes a Nitrate Metric that can be used to track nitrate levels across a period of years. Nitrate is considered to be the best constituent to measure as a proxy for overall degradation of groundwater quality in the Upper Aquifer. The Nitrate Metric is based on monitoring data that will be collected on an annual basis under the Groundwater Monitoring Program set forth in Chapter 7, and thus is objective and quantitative in nature. The Nitrate Metric will be published in periodic reports generated by the Basin Management Committee and will be available to the Parties, governmental agencies and the residents, businesses and institutions of Los Osos.

The Nitrate Metric is based on the average measurement of nitrate concentrations in five key wells in the Upper Aquifer. In order to clearly measure positive and negative movements in the Nitrate Metric, five wells were selected from those that have been historically impacted by nitrate, as shown in Figure 29. In selecting the key wells, areas of the Upper Aquifer that have been less impacted by nitrate were avoided, so that the Nitrate Metric has the highest possible degree of sensitivity to changes in nitrate levels. Accordingly, the Nitrate Metric is valuable for tracking the presence of nitrate in the Upper Aquifer over time, but does not represent an average of nitrate levels across the Basin.

[53] All nitrate concentrations in this Basin Plan are expressed in nitrate as nitrogen, unless otherwise noted.

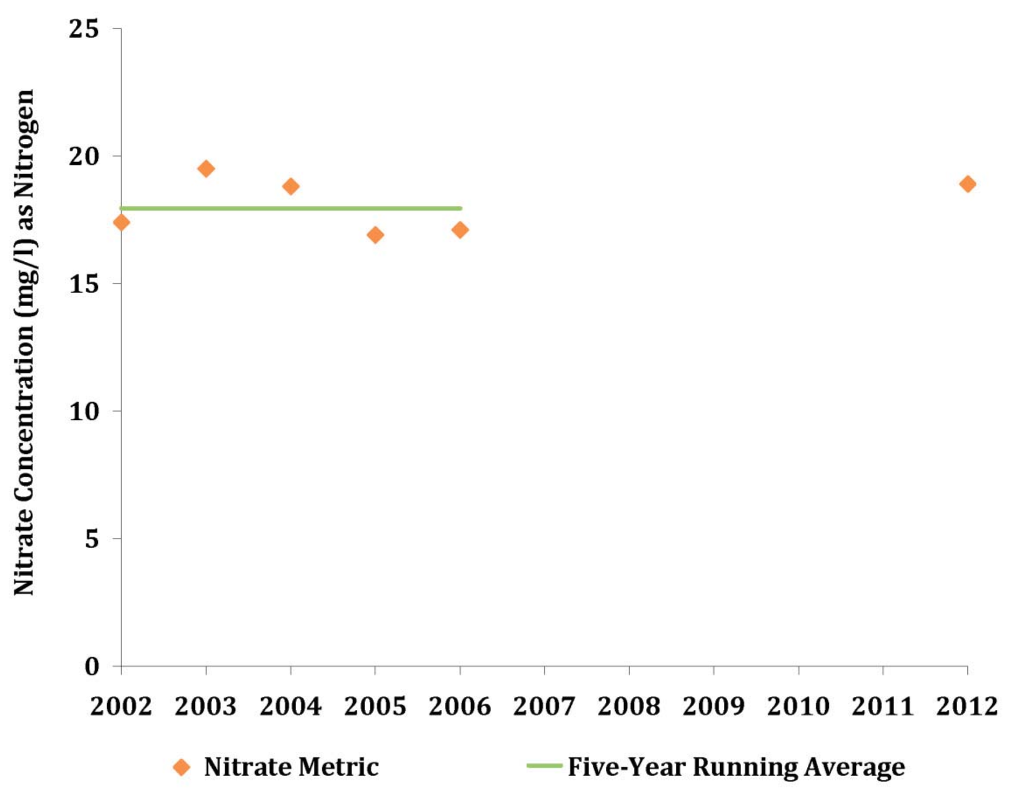
Figure 29. Key Wells for the Nitrate Metric



The five key wells for the Nitrate Metric monitor First Water, where nitrate loading to the Basin takes place. These five key wells are located along the western edge of the perched aquifer (FW10, FW17) and across the Western Area (FW2, FW6 and FW15). Data exists for the key wells for the period from 2002 through 2006 and for 2013. Depths to water range from less than four feet at FW10 to over 150 feet at FW6. The Nitrate Metric wells characterize First Water quality in areas of high-density septic systems where the greatest nitrate impacts have occurred, but also where significant declines in nitrate levels are expected. If a key well were to become unsuitable for nitrate testing in the future, a new well would be selected or constructed for that purpose, and the Nitrate Metric would be recalibrated.

The Nitrate Metric will be calculated each year based on the measurement of nitrate in the key wells. In order to track changes in the Nitrate Metric over time, a five-year running average will be used, because such an approach largely avoids year-to-year variations that do not represent long-term trends. Figure 30 shows data collected for the key wells from 2002 through 2006 as part of an LOCSD monitoring program associated with its wastewater collection and treatment project; the average during those five years was 17.9 mg/l. Collection of new data for the key wells began in 2012 with commencement of groundwater monitoring associated with the LOWWP. While data is missing from 2007 through 2011, the measurement for 2012 (18.9 mg/L) was generally consistent with the previously established five-year running average. A new five-year average will be available in 2016, but any trends may be apparent before then.

Figure 30. Historical Tracking of the Nitrate Metric (2002-2012)



6.2.3 *Nitrate Metric Target*

Independent of this Basin Plan, construction and operation of the LOWWP will largely stop nitrate loading into the Upper Aquifer by septic disposal of municipal wastewater within the Wastewater Service Area, which will include approximately

90 percent of the population of Los Osos. Building on the successful termination of new nitrate loading of the Basin, the goal of this Basin Plan is for nitrate levels in the Upper Aquifer to decrease across the Basin, so that groundwater from all Upper Aquifer wells is below the MCL for drinking water of 10 mg/l. That level for nitrate in Upper Aquifer groundwater is used because the Basin is the exclusive source of drinking water for the Los Osos community, and the community will need to increase and maintain its reliance on the Upper Aquifer in order to halt seawater intrusion into the Lower Aquifer.

While the Nitrate Metric was measured between 2002 and 2006 at approximately 18 mg/l, as noted above, that measurement does not represent a consistent level of nitrate present across the entire Upper Aquifer. The Nitrate Metric serves as an appropriate method for evaluating the goal of this Basin Plan, because the key wells were chosen to represent areas with the highest levels of nitrate impacts. If the Nitrate Metric decreases below 10 mg/l, it may be reasonably inferred that nitrate levels are generally lower across the Upper Aquifer, or will be in the reasonably foreseeable future. Thus, the Nitrate Metric Target is set at 10 mg/l.

In order to achieve the Nitrate Metric Target of 10 mg/l, the Parties intend to take several actions. First, the County will design, construct and operate a community wastewater collection and treatment system to prevent further nitrate impacts to the Upper Aquifer. The County's LOWWP is described in Chapter 9. Although the focus of Chapter 9 is on reinvestment of treated wastewater in the Basin, it should not be overlooked that the LOWWP itself is expected to play a vital role in ending nitrate impacts to the Upper Aquifer. Implementation of the LOWWP will allow the discontinuance of use of high-density septic disposal systems for approximately 90 percent of the population overlying the Basin.

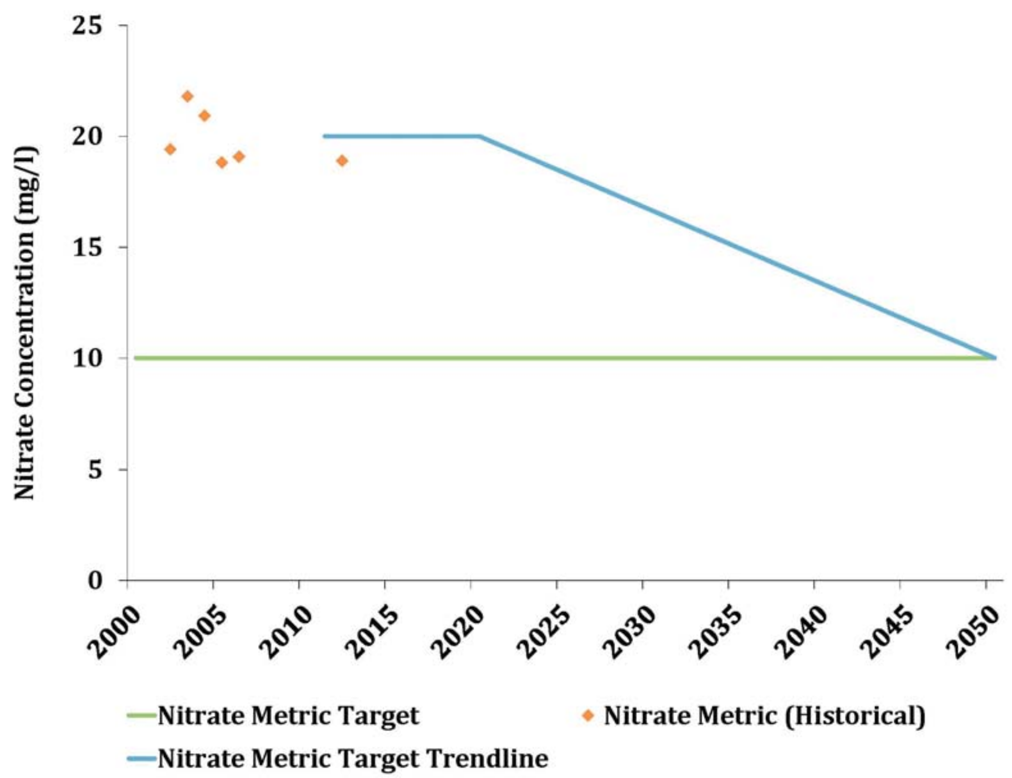
Once the entry of nitrate into the Basin through septic system discharges has ended, the natural flow of groundwater in the Upper Aquifer towards the northwest into Morro Bay, or northeast into Los Osos Creek, is expected to reduce nitrate levels over time, as precipitation recharges and flushes nitrate out of the Basin. Once the sources of excess nitrate are stopped with the collection of municipal wastewater from the Wastewater Service Area by the LOWWP, First Water is expected to be naturally flushed based on recharge of precipitation and return flow from treated municipal wastewater at the Broderson site, with total nitrogen concentration that is expected to average 7 mg/l or less. Groundwater in the Upper Aquifer will be flushed more slowly, but nitrate level trends in the Upper Aquifer directly follow those in First Water, so that the Nitrate Metric will act as an early indicator of water quality trends in the Upper Aquifer.

Second, the Purveyors may design, construct and operate one or more nitrate removal facilities to allow use of the Upper Aquifer as a source of safe drinking water for Los Osos. Use of such facilities would allow the Purveyors to withdraw a greater quantity of groundwater from the Upper Aquifer in lieu of pumping from the Lower Aquifer, thus avoiding seawater intrusion. Over time, use of such facilities will also withdraw nitrate-impacted water from the Upper Aquifer and remove the nitrate before use. The nitrate will be exported from the Basin for disposal, reducing the overall quantity of nitrate in the Basin. Nitrate removal facilities are components of the Basin Infrastructure Program set forth in Chapter 10.

Lastly, through the Basin Management Committee, the Parties will implement the Wellhead Protection Program set forth in Chapter 13. That program will ensure proper construction of new wells and abandonment of existing wells to prevent further impacts to either the Upper Aquifer or Lower Aquifer.

It is likely to take approximately 30 years for the Upper Aquifer to equilibrate to a change in nitrate loading, although the Nitrate Metric Target can potentially be achieved within a shorter time frame.[54] In the intervening years, nitrate removal or blending with other sources with lower nitrate levels will be required for extensive use of the Upper Aquifer as a source of drinking water. Figure 31 depicts a Nitrate Metric Target Trendline that will be used to measure progress toward the ultimate Nitrate Metric Target of 10 mg/l. The Parties will periodically evaluate the progress of the Nitrate Metric in relation to the trendline in Figure 31 in order to determine whether actions taken in the Basin are having the desired impacts on nitrate levels.

Figure 31. Nitrate Metric Target Trendline



[54] *See* Yates & Williams, *Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin* (2003).

The Target Trendline starts at the current approximate level of 20 mg/l and then slopes downward beginning in 2020 on a straight line until it reaches the Nitrate Metric Target of 10 mg/l in 2050. It should be noted that while the Target Trendline is straight, the actual trend of nitrate levels in the Upper Aquifer will not be consistent across all areas or years. Nitrate levels will change across years based on precipitation and groundwater withdrawals from the Upper Aquifer and will vary across the Basin based on local subsurface conditions, density of historical septic discharges, the location of sources of recharge and well locations. Groundwater in the vicinity of Upper Aquifer production wells may be cleaned at a different rate than in the vicinity of monitoring wells used for the Nitrate Metric. Thus, while the Nitrate Metric will serve as the reference for measuring progress in reducing nitrate impacts to the Basin, the Parties will also keep the broader context of nitrate attenuation in mind for purposes of Basin analysis and management.

6.3 Seawater Intrusion into the Lower Aquifer

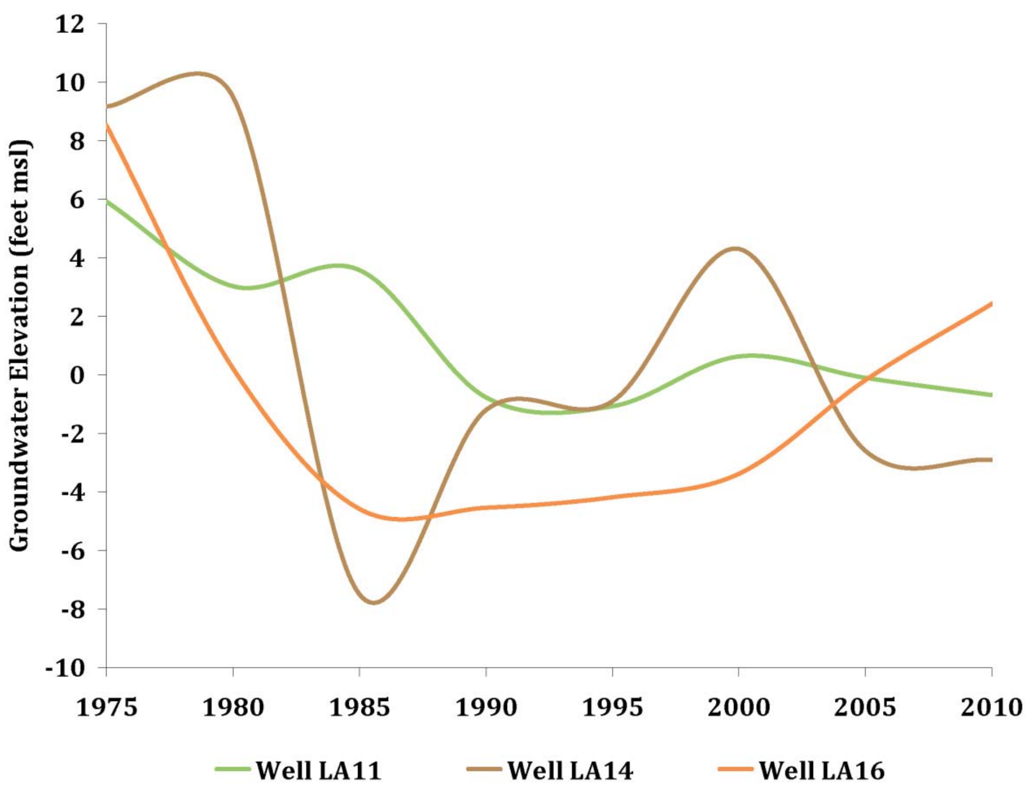
6.3.1 *The Nature and Development of Seawater Intrusion*

As discussed in Section 5.9, the Basin is continually susceptible to seawater intrusion due to its coastal location and the fact that it extends offshore for several miles, with the offshore portion of the Basin naturally filled with seawater or brackish water. In order to maintain the freshwater-seawater interface at a defined location in the Basin, average static groundwater levels in the freshwater portion of the aquifer must be held higher than sea level. If freshwater levels fall below a certain level (defined in more detail below), then seawater will progress inland in order to equilibrate the pressures between seawater and freshwater portions of the aquifer.

Historical groundwater production from the Basin, and particularly the Lower Aquifer, has caused groundwater levels in the Lower Aquifer to decline to an extent that seawater has intruded into areas that were formerly occupied by freshwater. Based on historical data, it appears that the initial decline in groundwater levels occurred during the 1970s along with increasing population and accompanying production of groundwater from the Basin to meet municipal and agricultural water demands. The general trend of decreasing groundwater levels may be seen in the historical water level measurements in three wells located in different parts of the Basin—Well LA11 in Baywood Park near Morro Bay, Well LA14 near the community park, and Well LA16 near the corner of Los Osos Valley Road and Broderson Avenue—as depicted in Figure 32.

Groundwater levels in the Lower Aquifer fell steadily from the 1970s through the late 1980s, when they rose slightly and assumed a relatively constant value. Since the late 1980s, seawater intrusion has not stopped, but rather groundwater levels have been maintained through recharge of the Basin with seawater. Thus, Figure 32 does not show continually falling groundwater levels only because freshwater has been replaced with seawater. Stabilization of groundwater levels in that manner does not represent a sustainable condition.

Figure 32. Water Levels in the Lower Aquifer



Source: CHG.

Figure 26 depicts the lateral progression of seawater into the Lower Aquifer over the past several decades. The sustainable yield of the Basin under current conditions has been calculated by the Model to be approximately 2,450 AFY. Historical groundwater production from all wells in the Basin has consistently exceeded that figure since the late 1970s, resulting in the drawdown of freshwater pressures and seawater intrusion into the Basin. That sequence of events has been particularly focused in the Lower Aquifer, where the Purveyors have concentrated their groundwater production in order to avoid increasing nitrate levels in the Upper Aquifer.

In order to control seawater intrusion in the Basin, the Purveyors and other groundwater users need to reduce their production from the Lower Aquifer in the Western Area. That action will allow freshwater levels to rise, thereby preventing further seawater intrusion and pushing the freshwater-seawater interface seaward and away from the Los Osos community. The key measurements of Basin conditions for this purpose are groundwater elevation in the freshwater portion of the Lower Aquifer and chloride levels. This data can be used to assess the current location of the freshwater-seawater interface and its expected future location.

6.3.2 *Seawater Intrusion Metrics*

This Basin Plan establishes two methods for measuring progress in the management of seawater intrusion, one based on comparing groundwater extractions with the sustainable yield of the Basin as calculated by the Model, and one based on monitoring data from the Groundwater Monitoring Program set forth in Chapter 7.

(A) *Basin Yield Metric*

The first method of measuring progress in the fight against seawater intrusion is based on comparing the actual amount of groundwater extractions in a given year with the maximum sustainable yield of the Basin under then-current conditions. This ratio, called the Basin Yield Metric, may be expressed as a fraction:

$$\frac{\text{Annual Groundwater Production}_X}{\text{Sustainable Yield}_X} * 100$$

where Annual Groundwater Production$_X$ equals the total quantity of groundwater extracted from the Basin in Year X, and Sustainable Yield$_X$ equals the maximum amount of groundwater that may be extracted from the Basin in Year X without causing seawater to advance further inland and with no active well producing water with chloride concentrations above 250 mg/l.

As noted in Section 5.9, the sustainable yield of the Basin effectively changes based on infrastructure in place at the time due to the freshwater-seawater interface in the western portion of the Basin. The sustainable yield of the Basin as of December 31, 2012 (Sustainable Yield$_{2012}$) has been determined to be approximately 2,450 AFY. The Sustainable Yield$_X$ is determined for a given set of infrastructure in place by using the Model to determine the maximum amount of groundwater extractions that may occur with a stable seawater intrusion front, and no active well producing water with chloride concentrations above 250 mg/l.

The Basin Yield Metric creates a useful comparison between actual groundwater production in a given year and the maximum amount of groundwater that could have been produced for long-term sustainability of the Basin. For example, if the Sustainable Yield$_X$ were 3,000 AF and the Annual Groundwater Production$_X$ were 2,250 AF, then the Basin Yield Metric would equal 2,250/3,000 or 75. In that scenario, the Los Osos community would be utilizing 75 percent of the available resource, which would leave a 25 percent buffer against seawater intrusion. On the other hand, if the Sustainable Yield$_X$ were 3,000 AF and the Annual Groundwater Production$_X$ were 3,750 AF, then the Basin Yield Metric would equal 3,750/3,000 or 125. In that scenario, the Los Osos community would be overutilizing the available resource by 25 percent. A Basin Yield Metric of 100 would represent a Basin in which groundwater production is perfectly maximized, without any facility producing water with greater than 250 mg/l of chlorides. The optimal level for the Basin Yield Metric is discussed below.

In order to calculate the Basin Yield Metric for any given year, it is necessary to know the quantity of groundwater extracted from the Basin in that year. Accurate information about groundwater extractions will also be necessary to refine the Model for calculation of the Sustainable $Yield_X$. This Basin Plan relies on estimates of historical and current groundwater extractions by private domestic, community facility and agricultural water users. In the future, it will be critical to base management of the Basin on accurate extraction data rather than estimates. The measurement and collection of data are covered in the Groundwater Monitoring Program in Chapter 7.

Figure 33. Historical Tracking of the Basin Yield Metric (1970-2013)

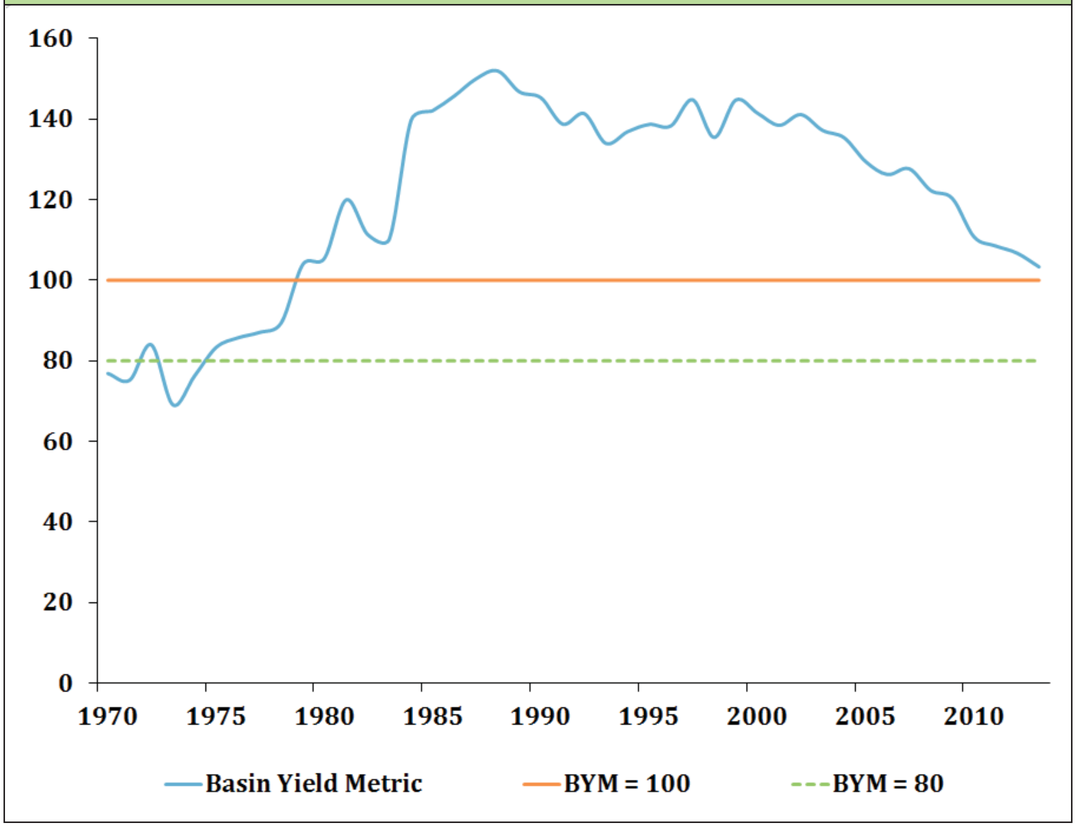


Figure 33 depicts the Basin Yield Metric from 1970 to 2013, based on the best estimates available for groundwater production and the facilities used to produce groundwater from the Basin.[55] The Basin Yield Metric hovered between 75 and 90 from 1970 through 1978, except for 1973, when it fell to 69. The Basin Yield Metric exceeded 100 for the first time in 1979, and rose as high as 152 in 1988, when it began falling. In 2013, the Basin Yield Metric was the lowest it had been since 1979, due primarily to water conservation efforts of the Purveyors and their customers in Los Osos. Despite the significant decrease from 152 to 103 during the period from

[55] It should be noted that Figure 33 assumes a denominator for the Basin Yield Metric equal to Sustainable $Yield_{2013}$ for all years from 1970 to 2013. While there may be some variations in historical values for Sustainable $Yield_X$ that would change the shape of the curve in Figure 33, there is insufficient information about historical infrastructure to justify further investigation and analysis. It is anticipated that any unanalyzed changes would tend to produce a Basin Yield Metric higher than that shown in Figure 33.

1988 to 2013, the Basin Yield Metric remains in excess of 100, which represents maximum sustainable production from the Basin.

(B) *Basin Development Metric*

In addition to the Basin Yield Metric, the Model can be used to generate a comparison between the current sustainable yield of the Basin and its potential. Chapters 9 through 11 of this Basin Plan discuss a number of potential projects that have been identified to increase the sustainable yield of the Basin, and if all those projects were implemented, then the resulting sustainable yield would represent the maximum potential yield of the Basin. This ratio, called the Basin Development Metric, may be expressed as a fraction:

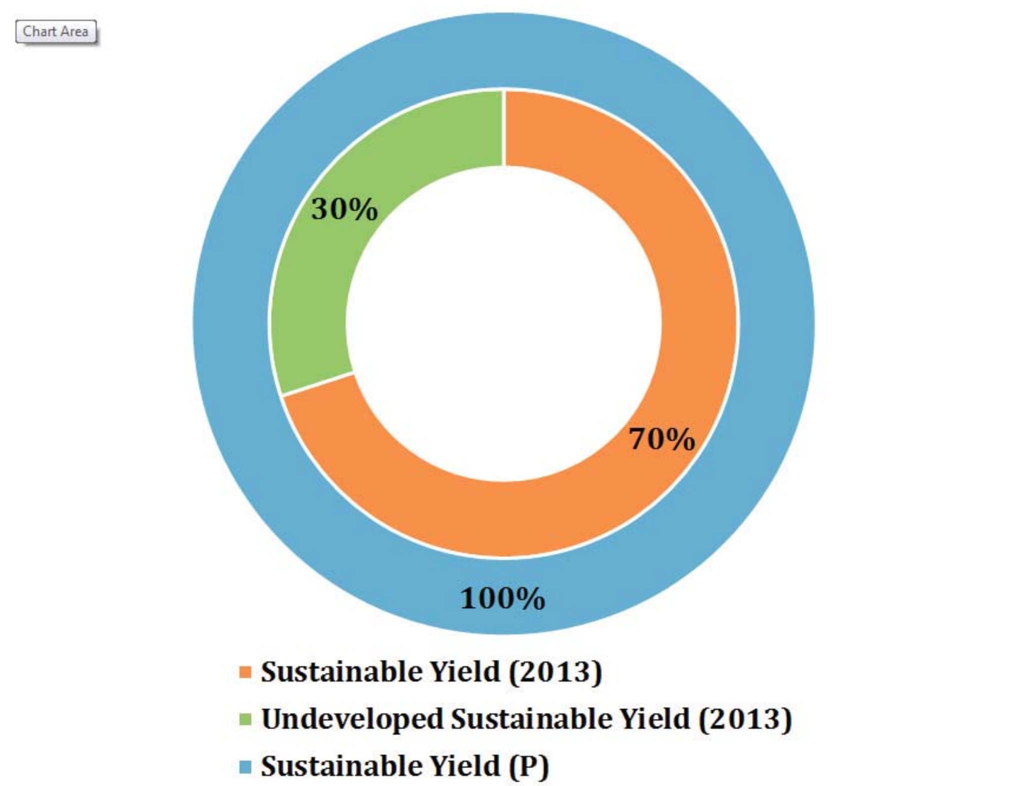
$$\frac{\text{Sustainable Yield}_X}{\text{Sustainable Yield}_P} * 100$$

where Sustainable Yield$_X$ equals the maximum amount of groundwater that may be extracted from the Basin in Year X without causing seawater to advance further inland and with no active well producing water with chloride concentrations above 250 mg/l, and Sustainable Yield$_P$ equals the maximum amount of groundwater that could be extracted from the Basin with the same impacts if all potential projects identified in this Basin Plan were implemented. Thus, Sustainable Yield$_P$ represents the maximum potential sustainable yield of the Basin and the Basin Development Metric represents the percentage of that potential yield that has been developed in Year X.

The Basin Development Metric is useful as a representation of the percentage of the Basin's maximum potential sustainable yield that has been developed. While the Basin Yield Metric represents the percent of current sustainable yield (Sustainable Yield$_X$) that is used in any given year, the Basin Development Metric demonstrates the degree to which the Parties and others have developed the full potential of the Basin. As the Basin Development Metric increases toward 100 percent, that condition will signal that the focus of future water management efforts in the Basin will need to turn to either improving water use efficiency, developing supplemental water supplies or limiting future residential growth. On the other hand, to the extent the Basin Development Metric is less than 100 percent, additional demands could be met within the Basin—or a greater seawater intrusion buffer created—through the development of additional water infrastructure up to Sustainable Yield$_P$.

While Sustainable Yield$_P$ does not conceptually change over time, it is possible that there are projects that would increase the maximum sustainable yield of the Basin but are not identified in this Basin Plan. In the event that such projects are identified in the future, the Parties may recalculate Sustainable Yield$_P$. The Sustainable Yield$_P$ might also be recalculated in the future based on improvements to the Model. As of the initial publication of this Basin Plan, Sustainable Yield$_P$ equals 3,500 AFY. The current Basin Development Metric is depicted in Figure 34.

Figure 34. The Basin Development Metric (2013)



(C) *Water Level and Chloride Metrics*

While the Basin Yield Metric and Basin Development Metric are useful for planning to balance water supplies and demands in the Basin, it is also important to measure the actual physical impact that actions set forth in this Basin Plan will have on seawater intrusion. In other words, it is prudent to affirm that operations with a theoretically acceptable Basin Yield Metric actually produce the desired results. Thus, the second method of measuring progress against seawater intrusion is based directly on data generated by the Groundwater Monitoring Program set forth in Chapter 7. This method is similar to the Nitrate Metric in that it is calculated by averaging data from multiple wells, but is different in that it is divided into two parts, known as the Water Level Metric and Chloride Metric.

The particular wells that comprise the Water Level Metric and Chloride Metric are shown in Figure 36. Note that Well LA11 is utilized for both the Water Level Metric and the Chloride Metric.

The Water Level Metric is defined as the average elevation of the piezometric surface measured in feet above msl in five Lower Aquifer wells. Two of the wells are piezometers located on the Morro Bay sand spit (LA2 and LA3), where monitoring will help evaluate whether Basin management programs are producing desired regional effects, rather than just localized water level rebound. Water in these wells ranges from 25 to 45 percent seawater, and density corrections are made to provide levels of EFH in the metric. Water samples for chloride will be collected every five years from wells LA2 and LA3 to make the necessary density corrections.

Inland, two Water Level Metric wells are positioned on the west side of the current pumping depression (LA14 and LA16) and one well on the bay front (LA11). Development of a pumping depression is a normal response to Basin groundwater development, but currently extends too far to the west and draws seawater into the Basin. As Basin production is redistributed through the Basin Infrastructure Program set forth in Chapter 10, the inland Water Level Metric wells will monitor Lower Aquifer pressures in critical areas at the leading edge of seawater intrusion.

All groundwater elevations used for the water level metric are adjusted to the National Geodetic Vertical Datum of 1929 (NGVD 29). Mean sea level in the Morro Bay area is approximately zero feet elevation using NGVD 29, whereas local elevations using the North American Vertical Datum of 1988 (NAVD 88) are 2.8 feet higher than NGVD 29. The Model was calibrated to NGVD 29 elevations.

Historical values for the Water Level Metric are shown in Figure 35. The Water Level Metric was approximately 6.5 feet msl during the mid-1970s, before seawater intrusion became a significant concern. After groundwater production in the Basin increased during the 1970s and early 1980s, the Water Level Metric declined, so that by 2012 it was at -1.0 feet msl.

Figure 35. Historical Tracking of the Water Level and Chloride Metrics (1975-2010)

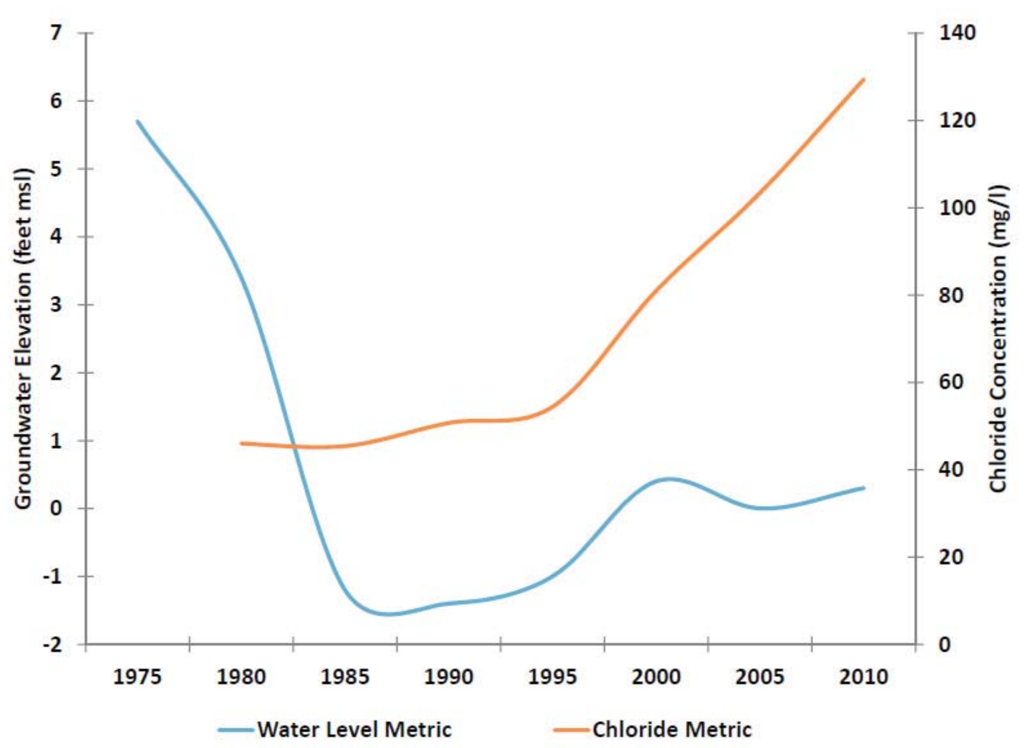


Figure 36. Key Wells for the Water Level Metric and Chloride Metric

The Chloride Metric is defined as the weighted average concentration of chlorides in the four Lower Aquifer wells shown in Figure 36. Key wells for the Chloride Metric include one production well in the Western Area (LA10) that is within the historical path of seawater intrusion, which parallels the synclinal axis of the Basin. Reductions in pumping from the Lower Aquifer should result in measurable declines in chloride concentrations at this well. There are also three key wells on the perimeter of the seawater intrusion front (LA8, LA11 and LA12). These perimeter wells are likely to be less sensitive to management actions that involve wells along the historical intrusion pathway, but will be key monitoring locations as the Basin pumping pattern shifts. Wells LA11 and LA12 monitor Lower Aquifer chloride concentrations on the broad north limb of the Basin syncline, while LA8 monitors chloride concentrations on the steeper south limb. When calculating the Chloride Metric, the concentration at Well LA10 is given twice the weight of the other three wells, in order to increase the sensitivity of the metric to management actions.

As depicted on Figure 35, chloride concentrations for these four key wells averaged approximately 50 mg/l between 1980 and 1995 (a background value), increasing to 100 mg/l in 2005 and 130 mg/l in 2010 due to seawater intrusion. That figure also shows a comparison between the historical Water Level Metric and Chloride Metric. The chart demonstrates that there was an approximately 15-year lag between when the Water Level Metric fell below 8 feet msl and when the Chloride Metric began to rise above prior historical levels.

6.3.3 *Seawater Intrusion Targets*

The primary goal of this Basin Plan is to halt or, to the extent possible, reverse seawater intrusion into the Basin, as established in Section 2.4, Immediate Goal No. 1. Related Immediate Goal No. 2 is to provide sustainable water supplies for existing residential, commercial, community and agricultural development within Los Osos.

In order to achieve those goals, this Basin Plan proposes to balance water demands within the Plan Area, including an appropriate buffer, so that the Parties and other persons who extract groundwater from the Basin do not overuse the valuable water resources of the Basin. This Basin Plan adopts a buffer of 20 percent, so that the Basin Yield Metric should not exceed 80 percent on a long-term basis. The results of such a buffer are discussed below. Such balance can be achieved by either reducing the amount of Annual Groundwater Production$_X$ or by increasing the Sustainable Yield$_X$.

This Basin Plan adopts a Water Level Metric Target of 8 feet msl and a Chloride Metric Target of 100 mg/l. Both targets were developed based on historical metric values and Model results. As with the Nitrate Metric, it is not expected that the Water Level Metric or Chloride Metric can reach their respective targets within a short time frame. The Water Level Metric is expected to reach the Target level within approximately 10 years of achieving the targeted Basin Yield Metric, while the Chloride Metric is likely to follow the Water Level Metric response by approximately 20 years. The Chloride Metric may rise above current levels before falling.

Target trendlines for achieving the Water Level Metric Target of 8 feet msl and Chloride Metric Target of 100 mg/l are shown in Figure 37. As with the Nitrate Metric, the Water Level Metric and Chloride Metric are not expected to follow straight lines, but the trendlines are useful to depict the general nature of the trend. The Parties will evaluate the Water Level Metric and Chloride Metric periodically during the implementation period to determine whether adequate progress is being made to achieve the Basin Plan goals.

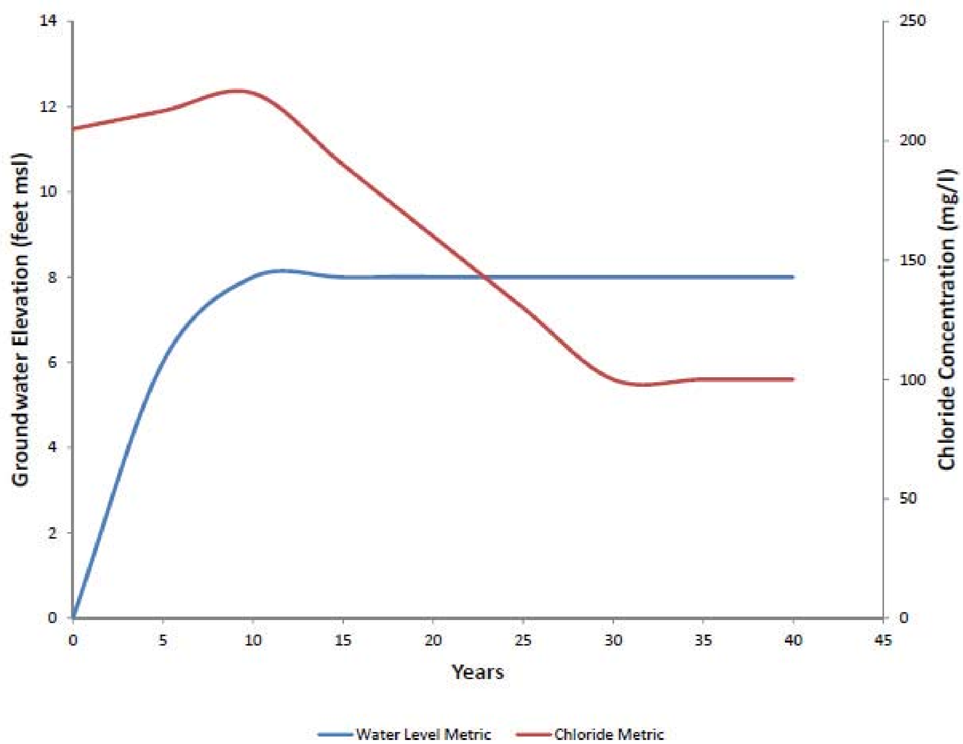
A water level metric of 8 feet msl (NGVD 29) is consistent with the pressures needed to mitigate seawater intrusion under the Ghyben-Herzberg relation (introduced in Basin Plan Section 5.9). The Model predicts inland pressures at the metric wells between 8.5 feet and 13 feet elevation for Basin Yield Metric 80 scenarios, as required by the Ghyben-Herzberg relation. The predicted metric levels at the two sandspit wells, however, are 3 to 5 feet elevation, because intrusion will persist at those locations, which bring the overall metric average down to 8 feet.

This Basin Plan includes several strategies to reach the metric targets and stop seawater intrusion. In order to allow calculation of the metrics with a higher degree of accuracy, the Parties and Basin Management Committee will implement the Groundwater Monitoring Program set forth in Chapter 7.

In order to reduce Annual Groundwater Production$_X$ required in any given year and thus reduce the Basin Yield Metric, this Basin Plan includes an Urban Water Use Efficiency Program in Chapter 8. That program includes a number of efficiency improvements that are expected to reduce urban water demands in Los Osos significantly, in addition to the 30 percent reduction in groundwater production by the Purveyors since 1988. Many elements of the Urban Water Use Efficiency Program will be led by the County and Purveyors, but this Basin Plan also encourages residents, businesses and institutions within Los Osos to undertake additional actions.

In order to increase the Sustainable Yield$_X$ of the Basin, this Basin Plan includes a Water Reinvestment Program in Chapter 9 and a Basin Infrastructure Program in Chapter 10. The Water Reinvestment Program promotes the reuse of all treated wastewater from the LOWWP for the benefit of the Basin, specifically for discharge at the Broderson and Bayridge Estates leach fields, urban reuse at various locations that may include school athletic and playing fields, the Los Osos Valley Cemetery and Sea Pines Golf Course, and agricultural reuse in the Eastern Area. The Basin Infrastructure Program is designed to reduce Purveyor groundwater production from the Lower Aquifer in the Western Area and replace it with additional pumping from the Upper Aquifer and Central and Eastern Areas.

Figure 37. Water Level and Chloride Metric Target Trendlines

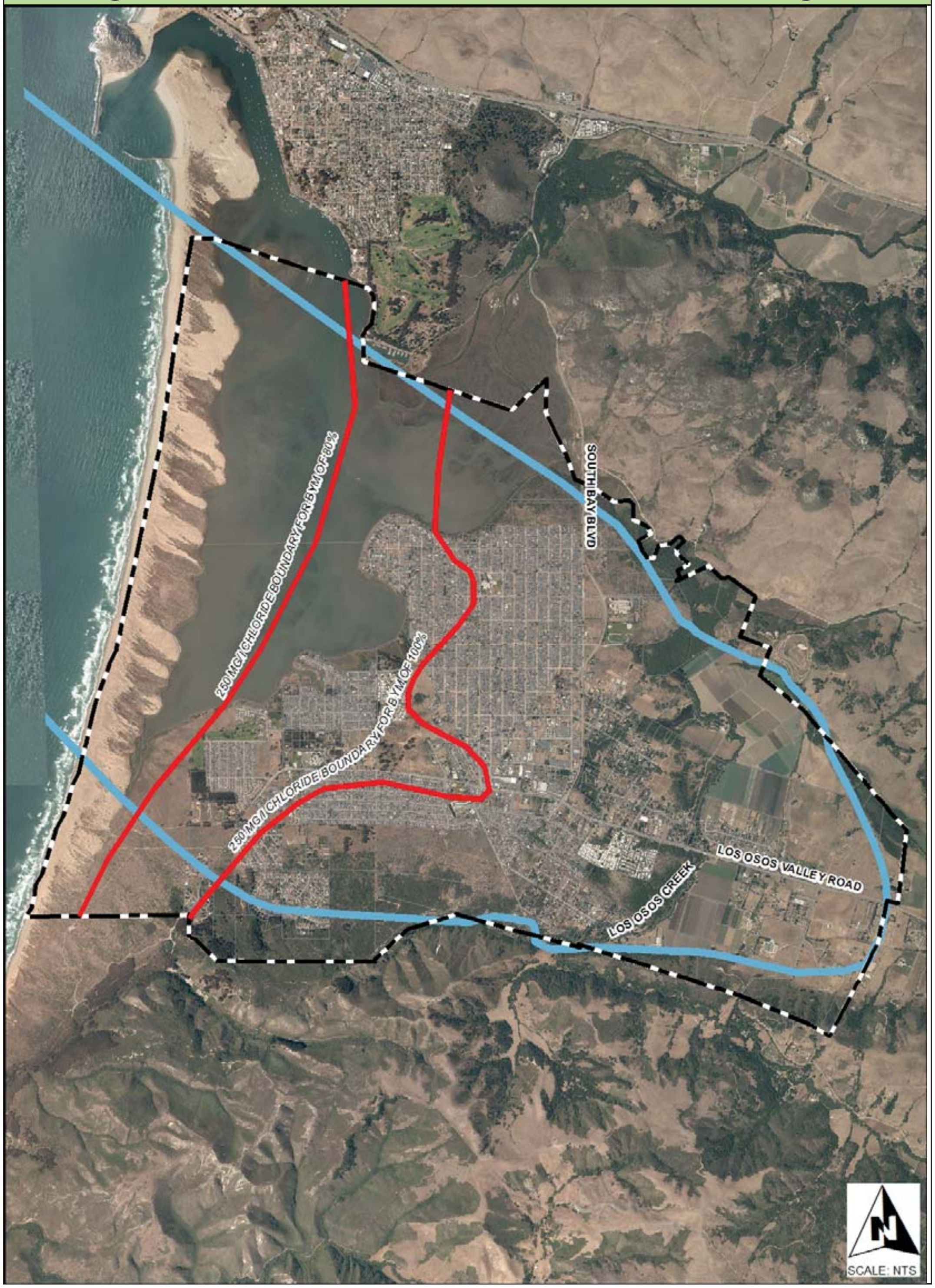


Based on the actions recommended in this Basin Plan, the Model predicts that the freshwater-seawater interface will be pushed seaward from its current location to that shown in Figure 38. As seen on that map, a Basin Yield Metric of 100 would maintain seawater intrusion (250 mg/l) at an equilibrium line underneath the landed portion of the Basin. This Basin Plan does not recommend allowing seawater intrusion to remain in the Basin to that extent, but rather to reverse the present location of seawater in the Basin (see Figure 26) to a position further seaward. In order to attain seawater intrusion at the seaward position, the Parties would need to achieve a Basin Yield Metric of 80 or below. Maintaining a buffer of 20 percent would shift seawater intrusion to a more favorable location than simply achieving a Basin Yield Metric of 100.

6.4 The Challenge of Uncertainty

The prior sections of this chapter have addressed the two greatest threats to the Basin, namely, nitrate impacts to the Upper Aquifer and seawater intrusion into the Lower Aquifer. Those sections establish metrics for evaluating the twin threats and actions that will be taken to defend against them. In addition to past and present threats, however, there are also potential future threats. Future threats are particularly challenging to address because of their inherent uncertainty. Because these threats share that common condition, they are analyzed together as the single threat of uncertainty. Several sources of uncertainty are discussed below.

Figure 38. Predicted Seawater Intrusion for Basin Metric Targets



- *The Model*. Despite the Parties' best efforts to build a reliable, scientifically sound Model of the Basin and to obtain credible predictions about the impacts of conservation and various water production scenarios, a degree of uncertainty persists. Some of the uncertainty exists now, and some is unforeseen. In large part, this uncertainty is driven by factors outside the control of the Parties but could potentially have significant impacts on future Basin water supply. The primary existing sources of uncertainty are: (1) the assumptions imbedded in the Model about the physical characteristics of and hydrogeologic relationships within the Basin, which partially determine recharge rates; and (2) the assumptions regarding the quantity of non-Purveyor pumping currently occurring within the Basin. The Basin Model predictions are premised on estimated levels of pumping by the non-Purveyor groundwater users—private domestic, community facility and agricultural water users—because data on the actual pumping by those users is not available.

- *Modeling Limitations*. The Model is operated as a steady-state, non-transient model. Accordingly, it is not used to depict changes in groundwater flow or levels across time. That means the Model assumes that a given set of conditions persists over time, without changing. This obscures potential drought impacts and precludes evaluating seasonal Basin management strategies. Use of the steady state model may also lead to a more limited understanding of the advance or retreat of the seawater-freshwater interface.

- *Increase in Agricultural Production*. The Plan Area encompasses approximately 1,090 acres of land that is zoned for agricultural uses. Approximately 35 percent, or 375 acres, of that land is currently used for irrigated agriculture. To the extent additional parcels zoned for agricultural production are put into production, or dry-farmed parcels are irrigated, agricultural water demands could increase, which would affect water supply availability for other purposes in the Basin.

- *Effectiveness of Urban Water Use Efficiency Program*. The Urban Water Use Efficiency Program set forth in Chapter 8 makes a series of assumptions about the effectiveness of the conservation measures to be implemented in the Basin. To the extent user behaviors, market penetration of certain measures and the actual effectiveness of the measures at reducing water use differ from those assumptions, the amount of water conserved could be more or less. Another source of uncertainty is the potential effect of "demand hardening," which occurs when customers lose the ability to easily institute emergency conservation during drought or other crises because all conservation savings have been captured. In Los Osos, implementation of the Urban Water Use Efficiency Program could lead to demand hardening because the measures are designed to make aggressive, significant reductions in water demand.

- *Unexpected Population Growth or Decline*. Future population growth or decline represents another source of uncertainty. In Los Osos, population is a significant factor driving water demands, so population changes have a significant effect on Basin water demand. The population in Los Osos is expected to increase gradually after 2015, provided that vacant parcels are permitted to develop by the County and Coastal Commission. If Los Osos were to experience a drastic increase in birth rates, water demand could increase more quickly even without additional land development, which would cause actual demand to be greater than the demand reflected in the Model predictions. Conversely, if the population were to drop quickly due to an unexpected outflux from the Los Osos community, water demands in the community might drop significantly, thereby impacting Model predictions.

- *Climate Variability*. Climate variability, including climate change, has the potential to significantly impact the Basin and future water supply by affecting the Basin's water demands, available groundwater supply and infrastructure. Climate change presents a significant source of uncertainty because it is unclear which of the predicted climate change scenarios, if any, will occur. Climate variability as reflected in the array of predicted climate change scenarios presents many potential issues and impacts. For example, an increase in temperature would increase Basin demand by creating drier conditions for plants and humans. An increase or decrease in precipitation would impact recharge rates. Increased frequency of high flow events could threaten water infrastructure due to flooding. Sea level rise could increase the rate or quantity of seawater intrusion into the Basin, which could in turn prevent groundwater production in certain parts of the Basin. The potential worst case impacts of climate change were studied by the Parties using the Model, and appropriate management actions will be taken by the Parties and Basin Management Committee to track and respond to climate changes that may occur.[56]

- *Natural Hazards*. Unexpected natural changes could impact Basin water supply or demand and result in a reality much different than that predicted by the Basin Model. For example, natural disasters such as earthquakes, droughts, tsunamis, extreme flooding or heat waves could affect water supply or demand. Any change caused by such natural occurrences has the potential to increase or decrease supply or demand in a way that will impact the Basin.

Changes in any of the underlying assumptions or variables highlighted above, individually or together, could impact Basin water supplies or demands in the future. Depending on the severity of any inaccuracies regarding underlying assumptions or unexpected conditions, the impacts on future Basin management could range from minimal to significant.

---

[56] *See* USEPA, *Climate Resilience Evaluation and Awareness Tool Exercise with Los Osos Water Purveyors and the Morro Bay National Estuary Program* (June 2013) [http://water.epa.gov/infrastructure/watersecurity/-climate/upload/epa817b13003.pdf].

This Basin Plan includes several strategies to address these and other currently unidentified uncertainties. The Basin Plan uses both Model-generated and measured metrics to evaluate the condition of the Basin, as explained in Sections 6.2 and 6.3. Where practicable, the Basin Plan uses reasonably cautious assumptions in evaluating the current status of the Basin and planning for future actions. As discussed above, one of the most important elements of this Basin Plan is establishing metrics, especially related to halting seawater intrusion into the Lower Aquifer. This Basin Plan establishes the Basin Yield Metric Target at 80 percent, meaning that 20 percent of the yield of the Basin will be used as a buffer against uncertainty. The metric targets and timelines are estimates based on reversing the historical trends. As the Basin Plan and the Los Osos Wastewater Project are implemented, the Monitoring Program will provide actual data trends, which can then be used to update the metric targets and time required for mitigating basin nitrate loading and seawater intrusion.

Depending on the extent to which any of the uncertainties described above are realized and impact Basin supply and demand, additional actions may need to be taken in the future to secure a reliable water supply for the Basin.

7

GROUNDWATER MONITORING PROGRAM

7.1 Introduction

This chapter establishes a comprehensive Groundwater Monitoring Program to complete and consolidate data collection on groundwater resources in the Basin, beginning in 2014. Information that will be collected under the program includes groundwater level, quality and production data. The Groundwater Monitoring Program will provide the Basin Management Committee, Parties, private Basin water users and public agencies with continuously updated information on groundwater resources in the Basin.

This Groundwater Monitoring Program is necessary to accomplish the following Continuing Goals set forth in Section 2.4 of the Basin Plan:

1. *Provide for a continuously updated hydrologic assessment of the Basin, its water resources and sustainable yield.*

2. *Create a water resource accounting which is able to meet the information needs for planning, monitoring, trading, environmental management, utility operations, land development and agricultural operations.*

This Groundwater Monitoring Program is also necessary to support other goals of the Basin Plan, including prevention of seawater intrusion, establishing a long-term environmentally and economically sustainable and beneficial use of the Basin, quantification of water rights in the Basin, and the equitable allocation of costs associated with Basin management. The program will provide significant overlap with several regulatory requirements, including: Assembly Bill 3030, a California statute regarding adoption by local agencies of groundwater management plans; the California Statewide Groundwater Elevation Monitoring Program (CASGEM); the SWRCB's salt and nutrient monitoring guidelines as adopted in the state Recycled Water Policy; and the Recycled Water Management Plan requirements for the LOWWP.

7.2 Purpose and Objectives

The purpose of the Groundwater Monitoring Program is to collect and organize groundwater data on a regular basis for use in management of the Basin. The program will utilize ongoing monitoring efforts by the County Department of Public Works and the Purveyors, expand the scope of monitoring where needed, and organize the data to improve access, reporting and data analysis efficiency. The program will be managed by the Basin Management Committee.

Groundwater monitoring is essential for addressing many issues related to groundwater resources in the Basin, including determination of the sustainable yield of the Basin, seawater intrusion, salt loading, nitrate impacts and future dynamic changes to the Basin, including those resulting from the LOWWP. The Groundwater Monitoring Program will provide continually updated data that will be used to calculate the various Basin metrics set forth in Chapter 6. The basic Groundwater Monitoring Program elements are as follows.

- Monitor long-term groundwater level trends in a network of wells for three monitoring groups within the Basin: First Water, Upper Aquifer, and Lower Aquifer.

- Monitor seasonal fluctuations and long-term water quality trends at selected wells in each of the three monitoring groups.

- Compile hydrologic data pertinent to Basin management, including groundwater production from the two principal water supply aquifers (Upper Aquifer and Lower Aquifer), wastewater disposal and recycled water use, local precipitation data and County stream gage records for Los Osos Creek.

- Organize historical and ongoing water production, water level and water quality monitoring data into three comprehensive databases, facilitating access and analysis.

- Collect data sufficient to evaluate the effectiveness of Basin management strategies adopted in this Basin Plan via the metrics established in Chapter 6. It will be crucial for long-term management to test the predicted effect of various strategies on Basin resources against actual data collected as part of this Groundwater Monitoring Program. Such data can be used to confirm and calibrate management actions.

7.3 Coordination with Other Monitoring Programs

The Groundwater Monitoring Program in this Basin Plan will provide significant overlap with monitoring requirements of groundwater management plans adopted pursuant to state law, with the CASGEM, with the SWRCB Recycled Water Policy and with the Recycled Water Management Plan for the LOWWP. The program managed by the Basin Management Committee pursuant to the Basin Plan, however, is intended to be the primary groundwater monitoring program for the Basin, and other groundwater monitoring efforts undertaken by the Parties shall be made consistent with the Basin Plan to the extent possible.

7.3.1 *Groundwater Management Plans*

California law authorizes certain types of local agencies to develop, adopt and implement groundwater management plans.[57] The law was originally adopted in Assembly Bill 3030 (1992) and was significantly amended in Senate Bill 1938 (2002). While this Basin Plan is being developed by the Parties pursuant to the Adjudication rather than the groundwater management plan statute, that law contains groundwater monitoring requirements that are helpful in designing a program for the Basin.

The act requires any public agency seeking state funds administered through DWR for the construction of groundwater projects to prepare and implement a groundwater management plan with certain specified components. Requirements include establishing Basin management objectives, involving other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management. These requirements apply to agencies that have already adopted groundwater management plans as well as agencies that do not overlie groundwater basins identified in Bulletin 118 and its updates.[58]

As part of any groundwater management plan, the law requires local agencies to adopt monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins in which subsidence has been identified as a potential problem, and flow and quality of surface waters that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin. The monitoring protocols must be designed to generate information that promotes efficient and effective groundwater management.[59]

The Groundwater Monitoring Program contained in the Basin Plan meets the intent of these monitoring protocols by collecting, compiling and organizing water level, surface flow and water quality data for efficient and effective groundwater management. Subsidence has not been identified as a potential problem in the Basin and is not part of the Groundwater Monitoring Program. Surface water quality monitoring is also not part of the Groundwater Monitoring Program, because successful monitoring efforts are ongoing by the County and the Estuary. The primary surface water inflow to the Basin is Los Osos Creek. Surface water quality in upper Los Osos Creek has not changed significantly between 1983 and 2005, and is similar to existing groundwater quality in the area of the stream, which will be monitored.

---

[57] Cal. Water Code §§ 10750 *et seq*.
[58] *See* DWR, *California's Groundwater*, Bulletin 118 (Update 2003).
[59] Cal. Water Code § 10753.7(a)(1), (4).

7.3.2 *Senate Bill 6*

In 2009, the California Legislature passed SBx7 6, which for the first time in California required collaboration between local monitoring parties and DWR to collect groundwater elevations statewide and to make this information available to the public. This legislation led to DWR's formation of the CASGEM.

SBX7 6 provides that:

- Local parties, called "Monitoring Entities," may assume responsibility for monitoring and reporting groundwater elevations.
- DWR will work cooperatively with local Monitoring Entities to achieve monitoring programs that demonstrate seasonal and long-term trends in groundwater elevations.
- DWR will accept and review prospective Monitoring Entity submittals, then determine the designated Monitoring Entity for each groundwater basin, notify the Monitoring Entity and make that information available to the public.
- DWR will perform groundwater elevation monitoring in basins where no local party has agreed to perform the monitoring functions.
- If local parties do not volunteer to perform the groundwater monitoring functions, and DWR assumes those functions, then those parties become ineligible for water grants or loans from the state.

The major deadlines for the CASGEM are:

- On or before January 1, 2011: Parties seeking to become Monitoring Entities were required to notify DWR. The Parties adopting this Basin Plan sought and received recognition by DWR as the Monitoring Entity for the Basin, until the finalization of the Basin Plan and formal establishment of the Basin Management Committee, at which time the Basin Management Committee will assume the duties of the Monitoring Entity.
- On or before January 1, 2012: Monitoring Entities were required to begin reporting seasonal groundwater elevation measurements. The Parties began implementing relevant portions of the Groundwater Monitoring Program before completion of this Basin Plan in order to meet the deadline.

Not all of the wells in the Groundwater Monitoring Program contained in the Basin Plan would be eligible for entry into the CASGEM. Currently, municipal supply wells are excluded from CASGEM due to infrastructure security concerns from CDPH. The Groundwater Monitoring Program in the Basin Plan includes these municipal supply wells because of their location in key areas of the Basin and the ability to maintain consistent monitoring through the Purveyors, but will omit from reporting under CASGEM any sensitive information needed to protect vital infrastructure.

It is anticipated that all the data needs of the CASGEM program will be met by the Groundwater Monitoring Program. DWR field log sheets or equivalent forms will be used in the program, and water level data from eligible wells will be made available to the Parties for CASGEM program use.

7.3.3 *Salt and Nutrient Management Plans*

In May 2009, the SWRCB adopted a Recycled Water Policy to encourage the safe use of recycled and storm waters in California. The policy requires a salt and nutrient management plan to be prepared for each groundwater basin in the state. Salts and nutrients from all sources are to be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses. By 2014, interested parties are required to prepare salt and nutrient management plans and submit them to the applicable RWQCB for the basin. These implementation plans are to be developed by local water and wastewater entities, together with local salt/nutrient contributing stakeholders. The final plans will be adopted by the RWQCB as amendments to the region's water quality plans.

One of the components of salt and nutrient management plans is a basin-wide monitoring plan. The Recycled Water Policy specifies that such monitoring plans should include the following:

- A network of monitoring locations adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salt, nutrients and other constituents of concern as identified in the salt and nutrient management plan are consistent with applicable water quality objectives.

- A determination of water quality in the basin. The plan must focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects. Monitoring locations shall, where appropriate, target groundwater and surface waters where groundwater has connectivity with adjacent surface waters.

- The preferred approach to monitoring plan development is to collect samples from existing wells, if feasible, as long as existing wells are located appropriately to determine water quality throughout the most critical areas of the basin.

- The identification of those stakeholders responsible for conducting, compiling and reporting the monitoring data. The data must be reported to the RWQCB at least once every three years.

A provision for annual monitoring of CECs is also required in salt and nutrient management plans. The SWRCB assembled a panel of experts to provide recommendations and guide future action relating to CECs. These experts produced a final report to the SWRCB in June 2010.[60]

It is anticipated that the data needs of the salt and nutrient management plan monitoring program will be met by the Groundwater Monitoring Program in this Basin Plan. The program includes salt, nutrient and initial CECs monitoring that covers critical areas of the Basin. The groundwater monitoring element of this Basin Plan will be submitted by the Parties to the RWQCB for peer review and approval, and any required modifications will be made through amendment of this Basin Plan.

7.3.4 *Monitoring and Reporting Program for the LOWWP*

The Central Coast RWQCB adopted Waste Discharge and Recycled Water Requirements Order No. R3-2011-0001 (Order) for the LOWWP on May 5, 2011. The Order requires the LOWWP to comply with Monitoring and Reporting Program Order No. R3-2011-0001 (MRP) for assessment of discharges of recycled water in the Basin Area and its impacts on Basin groundwater resources. Pursuant to the Order, the County will apply for a master reclamation permit prior to using or providing recycled water, which may modify its current monitoring obligations under the MRP.

Consistent with the MRP, the County will engage in the following monitoring activities:

- *Influent Monitoring*. The County will collect and analyze representative samples of influent to the LOWWP in accordance with the standards and specifications set forth in Table 1 of the MRP.

- *Effluent Monitoring*. The County will collect representative samples of the effluent downstream of any return flows and analyze them in accordance with the standards and specifications set forth in Table 2 of the MRP.

- *Recycled Water Monitoring*. The County will collect and analyze representative samples of water provided for reuse in accordance with the standards and specifications set forth in Table 3 of the MRP. Monitoring activities will be consistent with the Engineering Report on the Production, Distribution and Use of Recycled Water (Engineering Report) that the County adopts pursuant to the Order. The County submitted the draft Engineering Report to the CDPH in the fall of 2012, and expects a final draft to be approved in 2013. The Engineering Report must be completed at least six (6) months prior to the proposed reuse of water. It is anticipated that the Engineering Report will contain provisions requiring the County to periodically inspect the various components of the recycled water conveyance system as well as each reuse site.

[60] State Water Resources Control Board Science Advisory Panel, *Final Report: Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water* (June 25, 2010).

- *Groundwater Monitoring*. On a semiannual basis, the County will collect and analyze representative samples of groundwater from the fourteen (14) wells identified in Section (D)(1) of the MRP (and any other wells added by the Executive Director of the RWQCB) in accordance with the standards and specifications set forth in Table 4 of the MRP. Annually, the County will collect representative samples of groundwater from the wells identified in Section (D)(2) of the MRP and analyze them for priority pollutants, total organic carbon and total coliform. Once every other year, the County will collect representative samples of groundwater from the wells identified in Section (D)(3) (and from any other wells added by the Executive Director of the RWQCB) in accordance with the standards and specifications set forth in Table 5 of the MRP.

- *Disposal Area Monitoring*. The County will inspect the disposal areas daily for indications of actual or threatened overflow, seepage, surfacing or other problems, and will maintain an inspection log documenting its observations. The County will include a summary of the log in its monthly monitoring report.

- *Biosolids Monitoring*. The County will collect and analyze representative samples of biosolids removed from the LOWTP in accordance with the standards and specifications set forth in Table 6 of the MRP.

The County will submit monthly reports to the RWQCB and CDPH summarizing monitoring data, noncompliance, reasons for noncompliance, corrective action, disposal area monitoring, and any other significant events relating to compliance with the Order. The County will also submit annual summary reports consistent with Condition No. 23 of the Order. The County will send a copy of all reports to the Basin Management Committee.

7.3.5 *Recycled Water Management Plan*

The Coastal Commission has directed the County to prepare a Recycled Water Management Plan (RWMP) as a condition of approval for the LOWWP. The following monitoring program is required within the RWMP:

> *The Monitoring Program shall be designed to quantitatively and qualitatively assess the effectiveness of the Los Osos Basin Recycled Water Management Plan over time to ensure its objectives are achieved, and shall include: a baseline physical and ecological assessment of ground and surface water and related resources to be monitored; measurable goals and interim and long-term success criteria for those resources, including at a minimum clear criteria that demonstrate that the health and sustainability of Plan area resources are steadily improving over time, including with respect to seawater intrusion; monitoring provisions, including identification of appropriate representative resource monitoring locations and data types (e.g., groundwater levels and quality; wetland, stream, creek, riparian, and marsh plant and animal abundance, hydrology, and*

> *water quality; etc.) and a schedule for proposed monitoring activities. The Monitoring Program shall also include measures to clearly document the manner in which recycled water is being reused and water is being conserved pursuant to the Recycled Water Reuse and Water Conservation Programs.* [61]

The Groundwater Monitoring Program contained in this Basin Plan has significant overlap with data requirements of the recycled water monitoring program required by the Coastal Commission, and some key differences. The Groundwater Monitoring Program objectives are to collect and organize groundwater level, quality and production data, along with future wastewater disposal/recycled water use data. The monitoring program contained in this Basin Plan does not provide for collecting ecological monitoring data, and surface water monitoring data is limited to monitoring flow on Los Osos Creek.

The recycled water monitoring program will rely heavily on the Groundwater Monitoring Program as a source of data for annual reports, as well as baseline assessment, establishing success criteria, and ensuring that its objectives are achieved. The RWMP will also need to be supplemented with other types of resource monitoring. As the ownership and operations entity for the LOWWP, the County will be solely responsible for collection, compilation and reporting of any data to meet any Coastal Commission requirements that exceed the Groundwater Monitoring Program contained in this Basin Plan. The County will provide copies of all reports from the RWMP to the Basin Management Committee for use in the Groundwater Monitoring Program contained in this Basin Plan and for other relevant purposes.

7.3.6 *Additional Monitoring Programs*

There are many other historical, existing or proposed environmental monitoring programs within the Morro Bay watershed and the Basin region. These programs are summarized below for reference.

- San Luis Obispo County Water Level Monitoring Program: the County Department of Public Works monitors water levels in approximately 45 wells throughout the County on a semi-annual basis.

- Los Osos Nitrate Monitoring Program: this program operated from 1982 through 1998 under County staff, was reorganized in 2002 and was operated from 2002 through 2006 by LOCSD. The program consisted of quarterly water level and water quality monitoring at 25 shallow groundwater wells across the Basin. Water quality parameters included all forms of nitrogen, along with minerals. This program will be replaced by monitoring required in the RWMP for the LOWWP.

[61] Coastal Commission, CDP A-3-SLO-09-055/069 (LOWWP), Special Condition 5.c. (September 7, 2010).

- Purveyor Supply Well Monitoring: the Purveyors regularly monitor groundwater levels and production from their wells in the Basin.
- The Estuary Program/Friends of the Estuary Monitoring
- USEPA National Monitoring Program
- RWQCB Ambient Monitoring
- RWQCB Storm Water Runoff Monitoring
- RWQCB Total Maximum Daily Load Monitoring (Future)
- LOHCP Monitoring (Future)

The Groundwater Monitoring Program for this Basin Plan will incorporate data collected in these other monitoring programs to the extent useful and feasible. This Basin Plan monitoring program will be sufficient to accomplish its goals, however, without the necessity of reliance on other programs.

7.4 Groundwater Level and Quality Monitoring

Groundwater level and quality monitoring in the Basin has historically been performed by the Purveyors and the County, and to a lesser degree by permitted waste dischargers, consultants and state agencies. Production data is collected by the Purveyors. While withdrawals from private domestic, community facilities and agricultural irrigation wells have not been metered, the withdrawals are estimated from land use data in Sections 4.3, 4.4 and 4.5, respectively. There have been many historical monitoring programs and studies regarding groundwater in the Basin which can contribute data to the Groundwater Monitoring Program.

Groundwater resources data currently being collected by the Parties has been incorporated into the Groundwater Monitoring Program. Additional monitoring requirements identified in this program will be performed under the auspices of this Basin Plan. For determination of the persons or entities responsible for each monitoring activity, including data collection, see Section 7.4.6.

7.4.1 *Groundwater Levels*

Groundwater elevations are measures of hydraulic head in an aquifer. Groundwater moves in the direction of declining pressure head, and groundwater elevation contours are used to show the direction and hydraulic gradient of groundwater movement. Changes to groundwater in storage within an aquifer can also be estimated by changes in the hydraulic head. Groundwater level monitoring is a fundamental tool in characterizing basin hydrology, and will be performed at all 73 Groundwater Monitoring Program locations. Eight key monitoring locations will be equipped with water level transducers, which will provide an efficient and high level of resolution for tracking the dynamic changes in aquifer head.

As set forth in more detail below, water levels will be measured at wells that are distributed both laterally and vertically across the Basin. Of the 73 wells in the groundwater monitoring network, 28 are in First Water, 15 are in the Upper Aquifer, and 30 are in the Lower Aquifer. Laterally, 31 water level monitoring wells are in the Western Area, 30 are in the Central Area, and 12 are in the Eastern Area. This extensive network of water level monitoring wells will allow the Basin Management Committee, Parties and others to more fully understand water level trends within the Basin. If the Basin Management Committee or Parties determine that this network does not fully achieve the goals of the Groundwater Monitoring Program, then additional wells may be added in the future.

7.4.2 *Water Quality*

Groundwater quality monitoring requirements are highly variable, depending on the purpose of monitoring. General minerals and nitrate are common water quality constituents of analysis for groundwater basin investigations. There are many other classes of water quality constituents of concern, however, such as volatile organic compounds, inorganic compounds (metals), petroleum hydrocarbons or emerging contaminants. Many of these are regulated and have drinking water standards. The Purveyors monitor many of these constituents on a schedule determined by CDPH, and data from those monitoring efforts will be incorporated into the Groundwater Monitoring Program.

(A) *Water Quality Monitoring Constituents*

Constituents of analysis for the Groundwater Monitoring Program have been selected to focus on salt loading and associated nitrate impacts, seawater intrusion and wastewater disposal. Table 16 lists the general mineral constituents, including nitrate, which will be monitored as part of the program. TDS and specific conductance are standard measures for groundwater mineralization and salinity. Temperature and pH are parameters that are routinely measured during sampling to verify that the groundwater samples represent the actual aquifer conditions. All of these constituents will be tested in the 23 wells designated for water quality monitoring, which are distributed laterally and vertically across the Basin.

In addition to the general water quality monitoring constituents tested in all wells, one key well in the Lower Aquifer (Well LA4 in Table 21 below) will be monitored using downhole geophysics (natural gamma and induction logs) to provide a unique measure of vertical seawater intrusion over time. The well is located near the Sea Pines Golf Course in the Western Area. Stopping or reversing the vertical movement of seawater at this location would be a clear measure of effectiveness for seawater intrusion mitigation efforts.

Table 16. Water Quality Monitoring Constituents		
Constituent	**Reporting Limit**	**Units**
Specific Conductance	1	umhos/cm
pH	0.01	pH units
TDS	1	mg/L
Carbonate Alkalinity	1	mg/L
Bicarbonate Alkalinity	1	mg/L
Total Alkalinity	1	mg/L
Chloride	1	mg/L
Nitrate	0.1	mg/L
Sulfate	0.5	mg/L
Boron	0.05	mg/L
Calcium	0.03	mg/L
Magnesium	0.03	mg/L
Potassium	0.1	mg/L
Sodium	0.05	mg/L
Temperature	N/A	°F

(B) *Constituents of Emerging Concern*

Monitoring CECs is a requirement of salt and nutrient management plans adopted pursuant to the SWRCB's Recycled Water Policy. Such monitoring will measure potential dilution and soil-aquifer treatment of recycled water constituents, and travel time and movement of recycled water. Since recycled water will be generated by the LOWWP for use within the Basin, as described in Chapter 9, the Parties intend that the Groundwater Monitoring Program in this Basin Plan address CECs. The monitoring data established on CECs will be useful in various aspects of Basin management, including groundwater model calibration and recycled water management.

As part of the LOWWP, the County will be required by the RWQCB to monitor representative samples of water produced for reuse for CECs. The RWQCB Monitoring and Reporting Program Order No. R3-2011-0001 (MRP) requires monitoring for CECs on an annual basis.[62] The County will monitor for CECs in accordance with the MRP and any other waste discharge requirements imposed by the RWQCB and will provide all monitoring data to the Basin Management Committee for inclusion in its annual report.

The initial CECs to be monitored are listed in Table 17, and were selected based on the SWRCB Recycled Water Policy.[63] There are three types of CECs, each of which

[62] Order, at Table 3.
[63]SWRCB, *Recycled Water Policy, Attachment A: Requirements for Monitoring Constituents of Emerging Concern*

has a different function: health-based indicators directly monitor the presence of classes of constituents in groundwater; and performance-based and surrogate indicators measure the effectiveness of the treatment process. The list of CECs is not intended to be comprehensive but representative. Additional CECs may be added to, or removed from, the monitoring list once data has been collected and analyzed, subject to approval by the Basin Management Committee.

Table 17. Initial CEC Monitoring Constituents

Constituent or Parameter	Type of Constituent	Type of Indicator	Reporting Limit (µg/L)
17β-estradiol	Steroid Hormones	Health	0.001
Triclosan	Antimicrobial	Health	0.050
Caffeine	Stimulant	Health	0.050
NDMA	Disinfection Byproduct	Health	0.002
Gemfibrozil	Pharmaceutical Residue	Performance	0.010
DEET	Personal Care Product	Performance	0.050
Iopromide	Pharmaceutical Residue	Performance	0.050
Sucralose	Food additive	Performance	0.100
Ammonia	N/A	Surrogate	N/A
Nitrate	N/A	Surrogate	N/A
Total Organic Carbon	N/A	Surrogate	N/A
UV Light Absorption	N/A	Surrogate	N/A
Conductivity	N/A	Surrogate	N/A

7.4.3 *Precipitation and Streamflow Data*

Precipitation and stream flow data will be gathered from available sources for inclusion in the Groundwater Monitoring Program. This information is useful for evaluating the Basin status and planning for potential drought conditions.

Precipitation data is currently available from private stations, and from a County gage at the former Los Osos landfill. Historically, precipitation was recorded at the LOCSD maintenance yard (at 8th Street) and at the Los Osos fire station (at 9th Street). Daily precipitation from the County-maintained gage will be included in the Groundwater Monitoring Program, and the Parties will consider re-establishing a precipitation gage at either the maintenance yard or the fire station if it appears that currently monitored stations are not sufficient to measure inputs to the Basin.

for Recycled Water, SWRCB Resolution No. 2013-0003 (January 22, 2013). *See also* State Water Resources Control Board Science Advisory Panel, *Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water* (June 25, 2010).

Stream flow on Los Osos Creek is monitored by a County gage at the Los Osos Valley Road bridge. Daily stream flow data from this stream gage will be included in the Groundwater Monitoring Program.

7.4.4 *Monitoring Frequency*

Implementation of the Groundwater Monitoring Program commenced on January 1, 2014. Monitoring frequency is the time interval between data collection. Seasonal fluctuations relating to groundwater are typically on semi-annual cycles in coastal California, correlating with precipitation, recharge, water levels and often well production. The monitoring schedule for groundwater levels will coincide with seasonal water level fluctuations, in October (low) and April (high). A semi-annual monitoring frequency provides a measure of these seasonal cycles, which can then be distinguishable from the long-term trends. At the transducer-monitored locations, water level measurements will be recorded automatically on a daily basis and downloaded during the regular semi-annual water level monitoring events.

The monitoring schedule for Basin-wide groundwater quality monitoring will be once per year in October, when groundwater levels are seasonally low and many water quality constituents are at their highest concentrations. Lower Aquifer seawater intrusion would typically be at a seasonal maximum in October, while nitrate concentrations in the First Water group would be close to average annual levels, based on past monitoring data.

Monitoring for CECs in the product water of the LOWWP will be conducted by the County quarterly for the first three years of operations, and annually (in October) thereafter. Water quality monitoring for general minerals will be conducted every five years at Lower Aquifer Wells LA2 and LA3 on the Morro Bay sand spit. Results will be used to calibrate their EFH for use in the Water Level Metric.

In the future, the Basin Management Committee may decide to conduct geophysical logging of Lower Aquifer Well LA4 located near the Sea Pines Golf Course. Such monitoring may be useful for measuring seawater intrusion.

7.4.5 *Monitoring Locations*

There are a total of 73 wells in the Groundwater Monitoring Program, including 37 monitoring wells, 15 municipal wells (active and inactive) and 21 private wells. As described in Section 5.4, the Basin has been divided into three vertically discrete layers: First Water, Upper Aquifer and Lower Aquifer. The Basin is further separated into four geographic areas: Dunes and Bay, Western, Central and Eastern, as depicted in Figure 1. Groundwater monitoring wells were chosen for their specific characteristics and to achieve horizontal and vertical distribution across the Basin. That distribution is shown in Table 18.

Table 18. Distribution of Monitoring Wells			
	Western Area	**Central Area**	**Eastern Area**
First Water	11	12	5
Upper Aquifer	6	9	*0
Lower Aquifer	14	9	7

* There are no monitoring wells in the Upper Aquifer in the Eastern Area because that aquifer layer does not exist separately from First Water east of Los Osos Creek.

A brief discussion of each aquifer layer and its characteristics related to the Groundwater Monitoring Program follows.

(A) *First Water*

The First Water group refers to the shallowest groundwater zones, and includes the alluvial aquifer, perched aquifer (Zones A and B) and the top portion of the Upper Aquifer (Zone C) where not overlain by the alluvial or perched aquifers or tidal flats. This group will be routinely monitored as part of the wastewater discharge permit for the LOWWP and was the primary focus of two historical monitoring programs, the 1982-1998 County monitoring program and the 2002-2006 LOCSD nitrate monitoring program.

First Water is the interface where percolating waters, including precipitation and return flows from irrigation and wastewater, mix with Basin waters. Where First Water rises to the surface, it also impacts drainage and is associated with flooding issues in low-lying areas. First Water extends across the Basin, and may be present in dune sands, Paso Robles Formation deposits or Los Osos Creek alluvium. In downtown Los Osos, First Water is semi-perched above shallow clay horizons.

(B) *Upper Aquifer*

The Upper Aquifer refers to the non-perched water supply aquifer (Zone C) above the regional aquitard. As noted above, the top portion of the Upper Aquifer may also be considered First Water in certain Basin areas. Historically, the Upper Aquifer was the main water supply for the community, and is still the main source of water for private domestic wells. As part of the Basin Plan, a significant increase in Upper Aquifer production is planned; monitoring the Upper Aquifer is important to the Purveyors and to other water users.

(C) *Lower Aquifer*

The Lower Aquifer refers to water bearing zones below the regional aquitard. There are both Paso Robles Formation and Careaga Formation deposits in the Lower Aquifer. The base of the Lower Aquifer is claystone and sandstone bedrock of the Pismo and Franciscan Formations, although the effective base of freshwater lies above bedrock at the western edge of the Basin. The rising axis of the regional syncline is interpreted to cause the regional aquitard to crop out along the west banks of Los Osos Creek, and brings the Lower Aquifer in contact with the Los Osos Creek alluvium. As described in Sections 5.4.5 and 5.4.6, there are two generalized aquifer zones within the Lower Aquifer: Zone D lies between a regional aquitard and a deeper aquitard, and Zone E is below the deeper aquitard.

Lower Aquifer Zone D is currently the main water supply for the Los Osos community. Seawater intrusion has been advancing at increasing rates over time, and a significant reduction in Lower Aquifer production in the Western Area is necessary to halt intrusion. The Groundwater Monitoring Program continues Lower Aquifer monitoring across the Basin, with an expanded scope that focuses on seawater intrusion monitoring.

(D) *Specific Wells*

Some groundwater wells are better suited for meeting program objectives than others. Well construction, type of use and location are all factors in selecting qualifying wells. At a minimum, sufficient well construction information must be available to assign wells to the correct aquifers. Wells that are not pumped are often better suited for groundwater level monitoring, while wells that are pumped regularly are better suited for water quality testing. A well with an historical monitoring record is generally more useful than one with little or no prior monitoring record.

The monitoring locations and proposed monitoring activities are compiled in Table 19, Table 20 and Table 21, and shown in Figure 39, Figure 40 and Figure 41. The tables and figures are organized according to aquifer group, i.e., First Water, Upper Aquifer and Lower Aquifer.

Some of the wells identified for potential inclusion in the monitoring network are privately owned and will need to be confirmed. Those wells are located in all three aquifer layers. Only one of those wells, LA16, will be used to calculate any of the Basin metrics; that well will be used in the Water Level Metric. It is expected that employees or contractors of the Basin Management Committee or the Parties would perform monitoring activities for those wells, with each respective owner's permission. Any information gathered would be shared with the well owner. If the Basin Management Committee or Parties cannot gain access to a well, it may be removed from the Groundwater Monitoring Plan or replaced with another well, as determined by the Basin Management Committee.

(E) *Data Gaps*

The Basin Plan monitoring program has excellent spatial coverage over the basin area. Nevertheless, data gaps may exist or may appear as the monitoring program is implemented. Over time, some existing monitoring wells may also become unavailable or unsuitable for the monitoring program, due to access issues, damage, or other causes.

An existing data gap has been identified for both upper and lower aquifer monitoring in Cuesta-by-the-Sea. This is where the axis of the basin syncline comes on-shore from the bay, and is a critical location for monitoring seawater intrusion. A deep test hole (660 feet total depth) was completed in the area during the 2005 seawater intrusion study that penetrated the seawater wedge and helped defined the intrusion front. New Upper and Lower monitoring wells will be completed to close this data gap, which is between wells UA3 and UA5 in the upper aquifer (Figure 40) and between wells LA4 and LA11 in the Lower aquifer (Figure 41).

7.4.6 *Program Implementation*

Implementation of the Groundwater Monitoring Program will require coordination between the Basin Management Committee, the County, Purveyors and private well owners. Basic tasks are outlined as follows:

- The Basin Management Committee will perform wellhead surveys to establish reference point elevations and locations as needed. A licensed land surveyor will be required.
- The Basin Management Committee will establish well monitoring protocols and data quality objectives.
- The Basin Management Committee will assign water level monitoring responsibilities to the Parties or other stakeholders. This may consist of supplementing the existing County semi-annual water level monitoring program with monitoring by local Purveyor staff.
- Appropriate representatives of the Basin Management Committee will contact private well owners to request permission for participation in the groundwater elevation and water quality portions of the Groundwater Monitoring Program. A final list of monitoring locations will be prepared following this task.
- The Basin Management Committee will assign water quality monitoring responsibilities. The Basin Management Committee will adopt a set of procedures for recording groundwater elevations and sampling for water quality.
- The Basin Management Committee will assign data compilation, organization and reporting duties.

Costs associated with the Groundwater Monitoring Program are expected to be approximately $30,000 for initial setup and $25,000 per year thereafter. Over 30 years, those costs would equal a present value of approximately $500,000. These costs include water level recording and sampling at private domestic and dedicated monitoring wells, water quality laboratory testing, data collection and analysis and reporting, but do not include groundwater level recording or water quality sampling at community supply wells, which will be performed by the Purveyors and their staff. Costs related to the Groundwater Monitoring Program will be funded as described in Chapter 15.

Table 19. First Water Monitoring Network				
Program ID	**Well Number**	**Area**	**Well Type**	**Monitoring***
FW1	Private	Western	Private	L
FW2	30S/10E-13L8	Western	Monitoring	L, G
FW3	30S/10E-13G	Western	Monitoring	L
FW4	30S/10E-13H	Western	Monitoring	L
FW5	30S/10E-13Q2	Western	Monitoring	L
FW6	30S/10E-24A	Western	Monitoring	TL, G, CEC
FW7	30S/10E-24Ab	Western	Monitoring	L
FW8	30S/11E-7L4	Central	Monitoring	L
FW9	30S/11E-7K3	Central	Monitoring	L
FW10	30S/11E-7Q1	Central	Monitoring	TL, G
FW11	30S/11E-7R2	Central	Monitoring	L
FW12	30S/11E-18C2	Central	Monitoring	L
FW13	30S/11E-18B2	Central	Monitoring	L
FW14	Private	Western	Private	L
FW15	30S/11E-18N2	Western	Monitoring	L, G
FW16	30S/11E-18L11	Western	Monitoring	L
FW17	30S/11E-18L12	Central	Monitoring	L, G
FW18	30S/11E-18P	Western	Monitoring	L
FW19	30S/11E-18J7	Central	Monitoring	L
FW20	30S/11E-8M	Central	Monitoring	L, G
FW21	30S/11E-8N4	Central	Monitoring	L
FW22	Private	Central	Private	L, G
FW23	Private	Central	Private	L
FW24	Private	Eastern	Private	L
FW25	Private	Eastern	Private	L
FW26	Private	Eastern	Private	L, G, CEC
FW27	Private	Eastern	Private	TL
FW28	Private	Eastern	Private	L, G

Legend: L = groundwater level; TL = transducer site for groundwater level;
G = groundwater quality: general mineral suite; CEC = constituents of emerging concern.

Figure 39. First Water Monitoring Network Locations

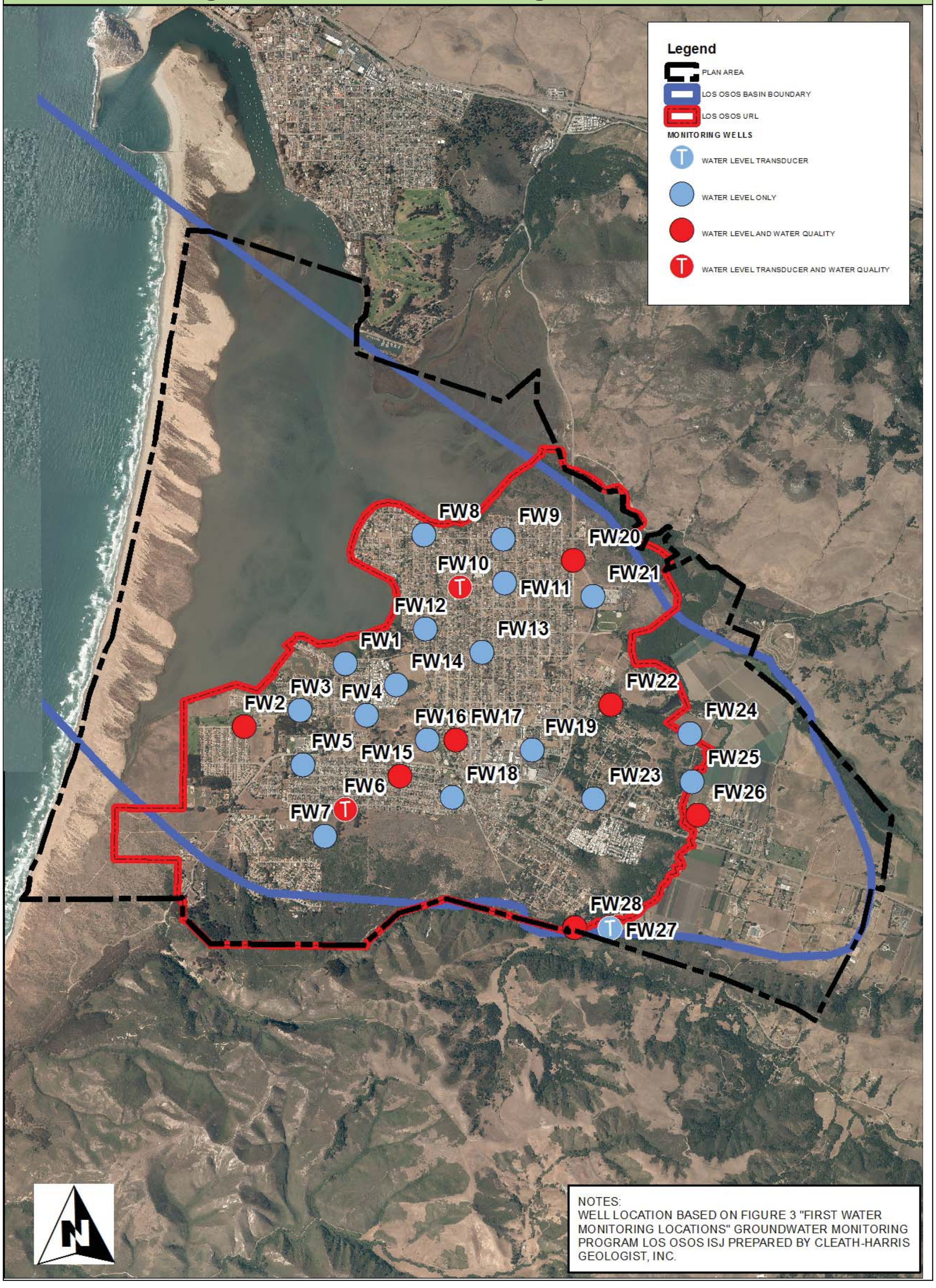


Table 20. Upper Aquifer Monitoring Network				
Program ID	**Well Number**	**Area**	**Type**	**Monitoring***
UA1	30S/10E-11A1	Dunes and Bay	Monitoring	L
UA2	30S/10E-14B1	Dunes and Bay	Monitoring	L
UA3	30S/10E-13F1	Western	Municipal	L, G
UA4	30S/10E-13L1	Western	Municipal	TL
UA5	30S/11E-7N1	Central	Municipal	L
UA6	30S/11E-18L8	Western	Monitoring	L
UA7	30S/11E-18L7	Western	Monitoring	L
UA8	30S/11E-18K7	Central	Monitoring	L
UA9	30S/11E-18K3	Central	Municipal	L, G
UA10	30S/11E-18H1	Central	Municipal	TL
UA11	Private	Central	Private	L
UA12	30S/11E-17E9	Central	Monitoring	L
UA13	30S/11E-17E10	Central	Municipal	L, G
UA14	Private	Central	Private	L
UA15	Private	Central	Private	L

Legend: L = groundwater level; TL = transducer site for groundwater level;
G = groundwater quality: general mineral suite.

Figure 40. Upper Aquifer Monitoring Network Locations

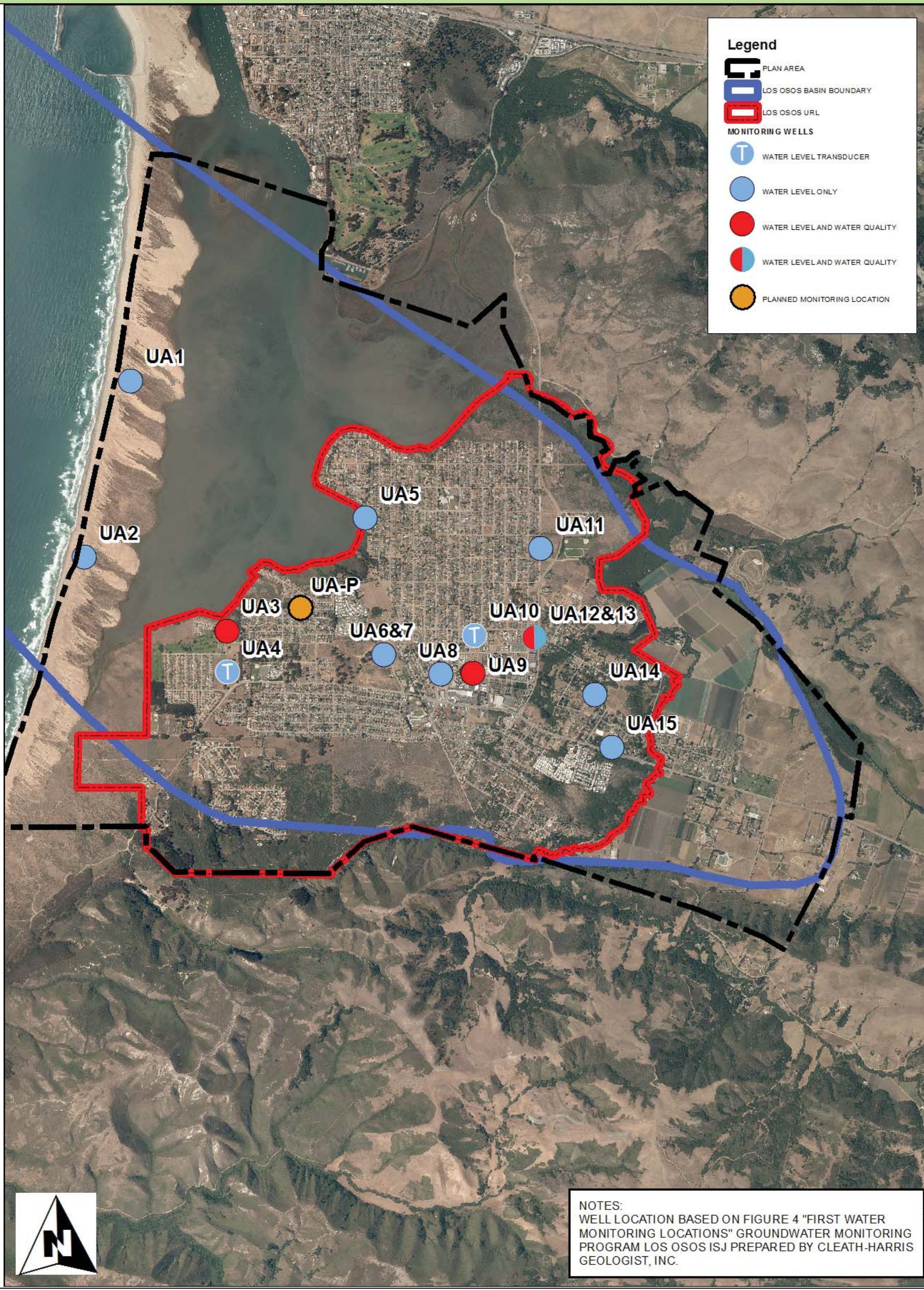
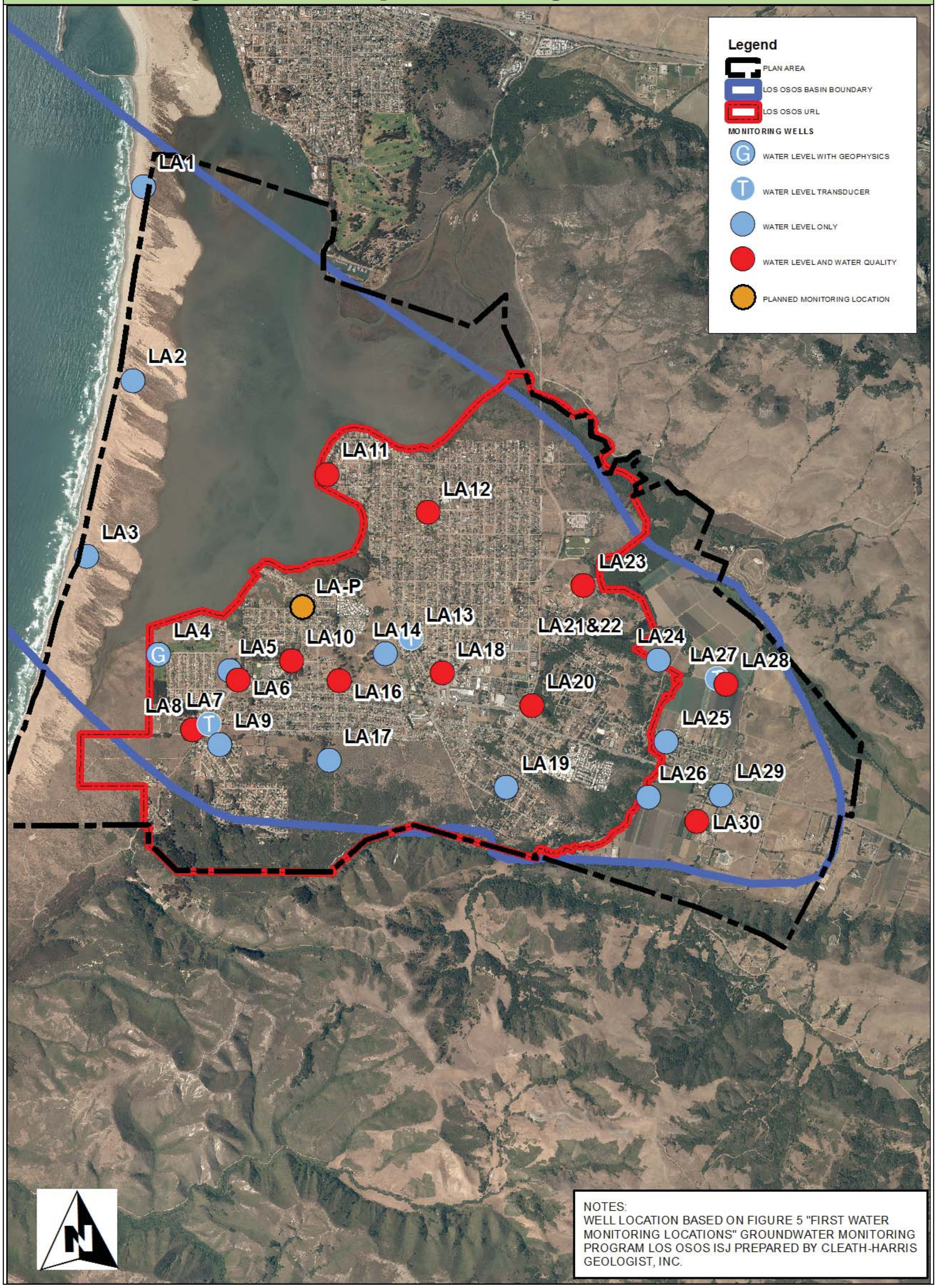


Table 21. Lower Aquifer Monitoring Network				
Program ID	**Well Number**	**Area**	**Well Type**	**Monitoring***
LA1	30S/10E-2A1	Dunes and Bay	Monitoring	L
LA2	30S/10E-11A2	Dunes and Bay	Monitoring	L
LA3	30S/10E-14B2	Dunes and Bay	Monitoring	L
LA4	30S/10E-13M1	Western	Monitoring	L, GL
LA5	30S/10E-13L7	Western	Municipal	L
LA6	30S/10E-13L4	Western	Municipal	L , G
LA7	Private	Western	Private	TL
LA8	30S/10E-13N	Western	Municipal	L, G
LA9	30S/10E-24C1	Western	Municipal	L
LA10	30S/10E-13J4	Western	Municipal	L, G
LA11	30S/10E-12J1	Central	Monitoring	L, G
LA12	30S/11E-7Q3	Central	Municipal	L, G
LA13	30S/11E-18F2	Central	Municipal	TL
LA14	30S/11E-18L6	Western	Monitoring	L
LA15	30S/11E-18L2	Western	Municipal	L, G
LA16	Private	Western	Private	L
LA17	30S/11E-24A2	Western	Monitoring	L
LA18	30S/11E-18K8	Central	Monitoring	L, G
LA19	30S/11E-19H2	Central	Monitoring	L
LA20	30S/11E-17N10	Central	Municipal	L, G
LA21	30S/11E-17E7	Central	Monitoring	L
LA22	30S/11E-17E8	Central	Monitoring	L
LA23	30S/11E-17C1	Central	Monitoring	L, G
LA24	Private	Eastern	Private	L
LA25	Private	Eastern	Private	L
LA26	Private	Eastern	Private	L
LA27	Private	Eastern	Private	TL
LA28	Private	Eastern	Private	L, G
LA29	Private	Eastern	Private	L
LA30	Private	Eastern	Private	L, G

Legend: L = groundwater level; GL = geophysical logging; G = groundwater quality: general mineral suite; TL = transducer site for groundwater level.

Figure 41. Lower Aquifer Monitoring Network Locations



7.5 Groundwater Production Monitoring

Accurate data regarding groundwater production is necessary for the Parties to assess Basin water resources and implement this Basin Plan. It will be particularly helpful with respect to ensuring accurate calculation of the Basin Yield Metric. While the Purveyors have historically metered and reported their groundwater production figures to the County and other government agencies, such as the California Public Utilities Commission (CPUC), as well as for purposes of joint technical analyses of the Basin including construction of the Model, that reporting will be formalized in this Groundwater Monitoring Program. Similar data does not exist for other water users in the Basin. In order to cure that information gap, this Groundwater Monitoring Program includes several ways to measure and collect groundwater production data from wells in the Basin.

7.5.1 *Reporting by the Purveyors*

The Purveyors, as Parties to the Adjudication and the ISJ, have for several years shared groundwater production data as part of the process leading to development of the Basin Plan. Detailed groundwater production data was used in construction of the Model and for evaluation of past, current and potential future Basin conditions. The Purveyors have shared their groundwater production data with each other and the County based on the urgent need to manage the Basin for prevention of seawater intrusion and long-term sustainability.

Pursuant to this Basin Plan, the Purveyors will report monthly groundwater production from each of their wells in the Basin to the Basin Management Committee. That reporting will be made by January 31 of each year for the immediately preceding calendar year. The Basin Management Committee will incorporate this data into its annual report and use the data to calculate relevant Basin metrics.

7.5.2 *Reporting by Other Producers*

While reporting of groundwater production by the Purveyors is necessary, the Basin Management Committee and Parties will face significant challenges to successful management of the Basin without the collection and use of data from non-Purveyors. In particular, with over 40 percent of Basin production based on estimates, the Basin Management Committee and Parties may not be able to accurately predict or measure the effect of their actions to stop seawater intrusion, using the Basin Yield Metric and other metrics. Because there is a substantial time lag between potential over-extractions from the Basin, as calculated through the Basin Yield Metric, and measurement of actual impacts on the Basin in the Water Level Metric and Chloride Metric, any errors resulting from use of estimated rather than actual production figures will not be known for as long as 15 years, when it will be too late to correct. It is vitally important for the Basin Yield Metric to be as accurate as possible in order to ensure that the proper actions are being taken to stop seawater intrusion as early as possible.

The failure of this Basin Plan to stop seawater intrusion would harm the public interest in use of the Basin as a sustainable source of water for all purposes, including residential, commercial, institutional and agricultural uses. Because all residents, businesses and institutions of Los Osos benefit from a sustainable Basin, it is appropriate that all contribute to responsible management of the Basin, including this Groundwater Monitoring Program.

Non-Purveyor producers of groundwater from the Basin are not currently Parties to the Adjudication or this Basin Plan. There are two potential ways in which they could measure and report their groundwater production for use in management of the Basin.

- Non-Purveyors may voluntarily measure and report their groundwater production through a program administered by the Basin Management Committee. Such a program would be operated on the same schedule as Purveyor reporting, i.e., for each calendar year with reporting by January 31 of the following year. The Basin Management Committee would solicit non-Purveyors to measure and report their groundwater production, through directed mailings and a public information campaign. The Basin Management Committee would treat any production data as confidential proprietary information of the reporting person or entity, would only make such data publicly available on an aggregated basis, and would limit use of the data to Basin management purposes.

  It is unknown how many non-Purveyors would be willing to participate in a voluntary production monitoring program. The Parties are hopeful that many non-Purveyors will be willing to measure and report their groundwater production in order to contribute to community efforts to combat seawater intrusion.

- The County could adopt an ordinance requiring registration of groundwater wells and monitoring and reporting of groundwater production in the Basin. Such an ordinance would require all persons who own groundwater wells in the Plan Area to register such wells with the County, which would establish a form for registration of wells in the Basin, to include at least the following information: the name and mailing address of the well owner; the GIS coordinates of the well and the Assessor Parcel Number (APN) of the parcel on which the well is located; the date of drilling, construction or redrilling of the well; the well drilling log, if available; the depth of the well and the depths of all seals and screened intervals; a description of all equipment on the well, including pumps; and the purpose and place of use for all groundwater produced from the well.

  All persons would be required to register their wells with the County no later than a certain date. By the same date, all well owners would be required to install totalizing flow meters capable of measuring the total quantity of groundwater produced from each well on a periodic basis. After the deadline for registration and metering of wells, the ordinance would require each well owner to report all metered production annually, with the report due to the County no later than January 31 for the immediately preceding calendar year.

The County would share all data supplied pursuant to the ordinance with the Basin Management Committee for inclusion in the annual groundwater monitoring report. Such data would be published only in aggregate form, without any identification of data for individual producers from the Basin. All individual groundwater monitoring data would be held by the County and Basin Management Committee in confidence and would not be made available for public review, as such information is exempt from disclosure under the California Public Records Act.

The cost of implementing such a County ordinance is expected to be approximately $150,000, including the purchase and installation of meters on all private domestic and agricultural wells in the Basin. Costs associated with procuring and installing meters would be paid for as part of this Groundwater Monitoring Program, to be funded as described in Chapter 15.

7.6 Reporting

7.6.1 *Electronic Databases*

Historical groundwater level and quality data for wells included in the Groundwater Monitoring Program network will be consolidated into electronic databases. The Groundwater Monitoring Program databases can be organized to facilitate data reporting for the future CASGEM program, salt and nutrient management plan, and the RWMP for the LOWWP.

7.6.2 *Annual Report*

A Groundwater Monitoring Program report will be prepared annually. The report will be completed by the Basin Management Committee, in cooperation with the Parties, on or before April 30 of each year, and will include data reporting for the period from January 1 through December 31 of the preceding year. The following outline provides an example of the content for the Groundwater Monitoring Program annual report:

- Introduction: purpose, objectives;
- Background: program history and design;
- Conduct of work: services performed, methods, equipment, personnel affiliations;
- Monitoring results: monitoring results, well location maps, data maps, data tables;
- Data interpretation: calculation of Basin metrics and trends as set forth in Chapter 6 of this Basin Plan, water level contour maps, hydrographs, chemographs, ion ratio graphs, change in storage calculations;

- Basin status: seawater intrusion, drought alerts, supply issues, changes from prior year's report;

- Groundwater monitoring program recommendations: recommended changes, if any, to the monitoring program.

The annual Groundwater Monitoring Program report will be made available to the Parties and the public and posted in electronic form on a website maintained by the Basin Management Committee.

7.7 Conclusion

The Groundwater Monitoring Program set forth in this chapter will provide valuable information about the condition of the Basin, including the Basin metrics established in Chapter 6. The Groundwater Monitoring Program will satisfy Continuing Goals Nos. 1 and 2 set forth in Section 2.4 of this Basin Plan, as well as other monitoring requirements based on DWR's CASGEM program, the SWRCB's Recycled Water Policy and the Coastal Commission's RWMP for the LOWWP. The Groundwater Monitoring Program will consolidate all existing and future data into a single database. This effort will assist the Parties, other water users within the Basin and governmental agencies to make intelligent decisions regarding management of the Basin, in order to provide long-term sustainable water supplies for residential, commercial, institutional, recreational and agricultural users within the Basin.

8

URBAN WATER USE EFFICIENCY PROGRAM

8.1 Introduction

Improving urban water use efficiency is the highest priority program of this Basin Plan for balancing the Basin and preventing further seawater intrusion. More efficient urban water use will allow the Purveyors and private domestic well owners to decrease the amount of groundwater extracted from the Basin to meet water demands of residents, businesses and institutions in Los Osos, thus ensuring that a sufficient amount of water remains in the Basin to stabilize the freshwater-seawater interface at an acceptable location.

The Urban Water Use Efficiency Program set forth in this chapter is consistent with the purposes and principles of the Basin Plan as a whole. It is intended to directly achieve the goal set forth in Section 2.4 of this Basin Plan to:

(3) *Set water conservation goals and establish mandatory standards and policies that promote water use efficiency and innovation for residential, commercial and institutional water users for both indoor and outdoor usage.*

In order to utilize water resources of the Basin in a sustainable manner and supply the Los Osos community with a reliable long-term water supply, the Parties agree that all urban water use within the Plan Area must meet the highest standards for efficiency. Because the benefits of maintaining sustainable use of the Basin will be enjoyed by all residents, businesses and institutions of Los Osos, and because water efficiency improvements can be implemented by all urban water users in the Basin, across and outside of Purveyor service areas, this program is highly equitable. Improved water use efficiency is also consistent with the principles of this Basin Plan to protect environmental resources and avoid imported water supplies.

This chapter summarizes the law and policy of water conservation as it applies to the Basin (Section 8.2), describes the "state of the art" as a goal for urban water efficiency in Los Osos (Section 8.3), establishes a baseline for understanding past, current and future urban water use in Los Osos (Section 8.4), identifies and evaluates potential measures and programs to improve urban water use efficiency (Section 8.5), sets forth the planned actions of the Parties (Section 8.6), and analyzes the impact of those actions on the Basin (Section 8.7).

At the outset, it is important to note that urban water users in Los Osos have already made significant improvements in water use efficiency. During the 25-year period from 1988 through 2013, urban water use in Los Osos declined by almost 40 percent, from 2,760 AF to 1,720 AF.[64] Numerous actions led to that result, including some by the Purveyors—for example, leak reduction programs, utility incentives for replacing inefficient fixtures and appliances, and increased water rates—and some by individual water users in Los Osos based on increased awareness of water scarcity in the Basin. Building on past successes, the goal of this Urban Water Use Efficiency Program is to limit urban water use in Los Osos to 1,450 AFY for the current population and 2,100 AFY at buildout, or less than 95 gallons per capita per day (gpcd).

For purposes of this Urban Water Use Efficiency Program, Los Osos is divided into two parts, one made up of that area which will be served by the LOWWP, known as the Wastewater Service Area, and the other made up of urban water use areas located outside the Wastewater Service Area. The two areas are treated differently because of the indoor water conservation requirements imposed on the LOWWP, which has an effect on the manner of implementing the Urban Water Use Efficiency Program. There are also less significant differences in implementation between those areas within the service areas of the Purveyors, and those areas served by private domestic wells.

Water use efficiency, or water conservation, is often used as a temporary strategy in response to a water shortage emergency. In contrast, improving urban water use efficiency in Los Osos is necessary to achieve a sustainable Basin for the long term, and thus all improvements will be permanent.

For purposes of this Basin Plan, improving water use efficiency refers to reducing the amount of water needed to accomplish a given goal or task. This definition excludes actions that might limit accomplishment of the goal or task through deprivation or cutbacks in economic production.[65]

8.2 Water Use Efficiency Law and Policy

8.2.1 *California Legal Background*

Under the fundamental water law of California, all persons in the state must avoid the waste of water.[66] The California Water Code also provides that the water resources of the state should be conserved with a view to water's reasonable and beneficial use.[67] California courts have held that all persons must use water

---

[64] For purposes of this program, urban water use is defined as all water demands met by the Purveyors and private domestic wells. Historical groundwater use by those two groups is discussed in Sections 4.2 and 4.3.

[65] *See* Pacific Institute, *Waste Not, Want Not: The Potential for Urban Water Conservation in California*, at 24-25 (November 2003) (hereinafter "Pacific Institute Report").

[66] Cal. Const., Art. X, § 2; *Peabody v. Vallejo*, 2 Cal.2d 351 (1935); *Gin Chow v. City of Santa Barbara*, 217 Cal. 673 (1933). *See generally* Wells A. Hutchins, *The California Law of Water Rights* 11-20 (1956).

[67] Cal. Water Code § 100.

according to the evolving customary efficiency standards developed by the community.[68]

As a result, certain conservation customs have emerged and developed over time. In places like Los Osos, where the community's water source and location are unique and water is in some senses scarcer than elsewhere in the state, broad customary water conservation measures may not be sufficient to meet the needs of water users and protect the health of the Basin. Therefore it is the intent of the Parties to intentionally establish new local water use customs that promote the sustainable use of Basin resources and exceed the water use efficiency customs that apply across the state, nation or globe generally.

8.2.2 *California Urban Water Conservation Council*

In California, a common standard for urban water conservation programs is the set of best management practices (BMPs) articulated by the California Urban Water Conservation Council (CUWCC) in its conservation Memorandum of Understanding (MOU). The CUWCC was created to increase efficient water use statewide through partnerships among urban water purveyors, public interest organizations and private entities and to integrate urban water conservation BMPs into the planning and management of California's water resources. The BMPs focus on programs that can be undertaken by urban water purveyors to improve water use efficiency within their service areas.

Signatories to the MOU pledge to develop and implement 14 conservation BMPs. Since 1991, over 225 water purveyors have signed the MOU, representing 80 percent of all the urban water supplied in California.[69] The MOU is amended periodically, most recently in June 2010. GSWC was an original signatory to the MOU in 1991 and has participated since then. LOCSD is not currently a signatory to the MOU but has adopted some of the BMPs set forth in the MOU. As part of this Urban Water Use Efficiency Program, LOCSD agrees to join the CUWCC and execute the MOU for improved engagement and accountability related to water use efficiency. Due to its small size, S&T will not become a signatory to the MOU, but will implement key water use efficiency improvements within its service area.

The CUWCC BMPs are listed in Table 22, along with the sector and end use of water that are targeted. BMPs cover both the residential and commercial, industrial and institutional (CII) sectors, although there is an emphasis on the residential sector. The MOU requires that a water purveyor implement only the BMPs that are economically feasible. The CUWCC provides an analytical framework to guide agencies in conducting cost-benefit analyses to determine whether a particular BMP is economically feasible.

---

[68] *City of Lodi v. East Bay Municipal Utility District*, 7 Cal.2d 316 (1936).

[69] *See* CUWCC Website [http://www.cuwcc.org];DWR, *California Water Plan*, Bulletin 160-09, at 3-13 (Update 2009).

Table 22. CUWCC Best Management Practices			
	Best Management Practice	**Target Sector**	**Target End Use**
1	Water survey programs for residential customers	Residential	All
2	Residential plumbing retrofit	Residential	Showers / faucets
3	System water audits, leak detection and repair	Utility	System losses
4	Metering with commodity rates for all connections	Residential, CII	All
5	Large landscape conservation programs and incentives	CII	Irrigation
6	High-efficiency clothes washing machine financial incentive programs	Residential	Washing machines
7	Public information programs	All	All
8	School education programs	All	All
9	Conservation programs for CII accounts	CII	All
10	Wholesale agency assistance programs	All	All
11	Retail conservation pricing	All	All
12	Conservation coordinator	All	All
13	Water waste prohibition	All	All
14	Residential ultra-low-flow toilet replacement programs	Residential	Toilets

In 2006, a review of the CUWCC effort estimated that the first 13 years of BMP implementation had successfully reduced urban water use by only about two percent statewide. The review also found that water savings have been driven primarily by BMPs 5, 9 and 14. Together, these three measures resulted in 90 percent of annual water efficiency gains. BMP 14 has clearly had the greatest impact on urban water use, accounting for almost half of all reported water savings.[70]

Unfortunately, the performance of the BMPs has been disappointing. The 2006 review noted that, "[w]hile growth in BMP water savings has been steady, the magnitude of these savings has not caused a substantial change in daily per capita urban water use" in California.[71] Because of the voluntary nature of the MOU process and lack of any enforcement mechanism, most MOU signatories are out of compliance with the majority of BMPs, leading the review to conclude that "MOU

[70] CALFED Bay-Delta Program, *Water Use Efficiency Comprehensive Evaluation Final Report*, at 89 (August 2006) (hereinafter "CALFED Report").
[71] *Id*.

non-compliance is pervasive."[72] Subsequent efforts to invigorate the MOU through establishment of a certification process and federal and state funding have also failed.[73]

Implementation of the BMPs by the Purveyors is discussed in Section 8.5.1. Because the MOU is largely perfunctory, however, it is the intention of the Parties for this Urban Water Use Efficiency Program to go beyond the CUWCC process and, as a result, achieve more substantial urban water savings in Los Osos.

8.2.3 *Urban Water Management Planning*

The Urban Water Management Planning Act[74] requires urban water suppliers of a certain size to prepare and submit to the DWR an urban water management plan once every five years. Such management plans are required to analyze, *inter alia*, water efficiency programs implemented by the urban water supplier.[75] In practice, most management plans simply discuss the supplier's implementation of the CUWCC BMPs.

The threshold size for urban water suppliers subject to the Act is that they serve 3,000 connections or 3,000 AFY, and none of the Purveyors is large enough to meet that test. Thus, none of the Purveyors is required to prepare an urban water management plan. This Basin Plan is intended to be a comprehensive water resources planning effort in the Plan Area and to perform many of the same functions as an urban water management plan.

8.2.4 *The 20x2020 Plan*

Based in part on the underwhelming performance of the efforts described above, in early 2008, then-Governor Arnold Schwarzenegger called for a plan to achieve a 20 percent reduction in per capita water use statewide by 2020.[76] To help develop the 20x2020 Water Conservation Plan, DWR assembled a "20x2020 Team" of state agencies that play a role in the management of California's water, including DWR, the SWRCB, the California Energy Commission, the CDPH, the CPUC and the U.S. Bureau of Reclamation.

In November 2009, the Legislature passed SBX7 7, which requires California urban water users to achieve Governor Schwarzenegger's proposed 20 percent reduction by December 31, 2020. The law requires the state to make incremental progress toward this goal by reducing per capita water use at least 10 percent on or before December 31, 2015. SBX7 7 also requires urban retail water purveyors to develop interim and ultimate urban water use targets. The urban water purveyors must report to DWR on their progress in achieving these targets as part of their urban

[72] *Id.* at 93-94.
[73] *Id.* at 95-97.
[74] Cal. Water Code §§ 10610 *et seq*.
[75] Cal. Water Code § 10631(f).
[76] *See* Letter of Governor Arnold Schwarzenegger to California Legislature, at 2 (February 28, 2008) [http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/docs/govltr_to_legislature022808.pdf].

water management plans.[77] With certain exceptions, the law provides that after July 1, 2016, urban water purveyors are not eligible for state grants or loans unless they comply with the water conservation requirements established by the law. It is the intent of the Parties that the Urban Water Use Efficiency Program meet or exceed the efficiency standards of the 20x2020 Plan and SBX7 7.

8.2.5 *Requirements on the LOWWP*

The County is developing the LOWWP as a community wastewater collection and treatment project for a portion of the Basin Area, as described in detail in Chapter 9. In order to proceed with the LOWWP, the County required a coastal development permit. In issuing the permit, the County imposed Condition 99 on the project, which requires that:

> *Within one year of adoption of a due diligence resolution by the Board of Supervisors, electing to proceed with a wastewater project, a water conservation program shall be developed by the applicant in consultation with the local water purveyors within the prohibition zone for the community of Los Osos, that meets the goal of 50 gallons per day / per person for indoor use. The applicant shall provide 5 (five) million dollars of funding towards a water conservation program for indoor water conservation. Incentives shall be provided to homeowners and other property owners who install conservation measures within the first year.*

In addition, the Coastal Commission imposed Special Condition 5.b on the LOWWP, as follows:

> ***Water Conservation Program.*** *The Water Conservation Program required by the County project, which limits indoor water use to no more than 50 gallons per person per day on average within the Basin, shall be incorporated into the Recycled Water Management Plan. The Program shall be designed to help Basin residents to reduce their potable water use as much as possible through measures including but not limited to retrofit and installation of low water use fixtures, and grey water systems. The Program shall include enforceable mechanisms designed to achieve its identified goals, including the 50 gallons per person per day target, and shall include provisions for use of the $5 million committed by the Permittee to initiate water conservation measures pursuant to the Basin Plan as soon as possible following CDP approval. The Permittee shall coordinate with water purveyors to the maximum extent feasible to integrate this conservation program with purveyor implemented outdoor water use reduction measures.*

[77] As noted in Section 8.2.3, the Purveyors fall under the customer threshold for being required to prepare such management plans, so this legal requirement does not apply to them.

Pursuant to those conditions, the County must design and implement a water conservation program that expends $5 million to reduce indoor water use within the Wastewater Service Area as much as possible, with a target of lowering water use below 50 gpcd. In October 2012, the County adopted a *Water Conservation Implementation Plan for the Los Osos Wastewater Project* in order to fulfill Condition 99 and Special Condition 5.b. That water conservation plan is incorporated into the Urban Water Use Efficiency Program contained in this chapter, although the County will remain solely responsible for compliance with the separate, independent legal requirements imposed on the LOWWP in its coastal development permit.

8.2.6 *Other Policies and Principles*

Water resource experts and practitioners have found that, in many circumstances, improved efficiency and increased conservation are the least costly, easiest and least destructive ways to meet water needs in a constrained environment.[78] In addition, water efficiency improvements may have collateral benefits, such as reducing energy demands and decreasing the amount of wastewater generated.[79] This last reason led the Coastal Commission to require water use efficiency improvements as part of the LOWWP, as mentioned above.

The CPUC has adopted policies encouraging improvements in water use efficiency for the water utilities subject to its jurisdiction, including GSWC. In its Water Action Plan, the CPUC has placed "water conservation at the top of the loading order as the best, lowest-cost supply" and established efficient use of water as one of four "key principles" for its regulation of water utilities.[80] The CPUC committed itself to strengthening water efficiency measures through education, consumer price signals and utility incentives, each of which are contained in the Basin Plan.[81]

This Basin Plan follows the principle of treating water use efficiency improvements as one of the first actions to be taken within the Basin. In developing programs contained in Part II of the Basin Plan, the Parties first analyzed the benefits that are achievable through the Urban Water Use Efficiency Program, and only then designed the Water Reinvestment, Basin Infrastructure, Supplemental Water and Imported Water Programs to satisfy any remaining need to balance the Basin and halt seawater intrusion.[82] The Parties believe this approach is consistent with the principles of the Basin Plan.

---

[78] *See*, *e.g.*, CPUC, *Water Action Plan*, at 3 (October 2010) (hereinafter "Water Action Plan"); Pacific Institute, *California's Next Million Acre-Feet: Saving Water, Energy, and Money*, at 6-7 (September 2010); State of California, *20x2020 Water Conservation Plan*, at 1 (February 2010) (hereinafter "20x2020 Plan"); DWR, *California Water Plan, Volume 2 – Resource Management Strategies*, Bulletin 160-09, at 3-5 (2009); CALFED Report, at 86; Pacific Institute Report, at 1, 117.
[79] 20x2020 Plan, at ix, 1; Pacific Institute Report, at 6.
[80] Water Action Plan, at 1-2.
[81] *Id.* at 3.
[82] As noted in Chapter 12, the Imported Water Program is prioritized last among all programs in this Basin Plan.

8.2.7 *Responsible Parties*

There are critical roles for a wide range of parties in the improvement of urban water use efficiency in Los Osos. Federal, state and local governments can encourage efficient use of water resources within their respective jurisdictions. The Purveyors can implement programs to encourage and facilitate efficient water use within their respective service areas. The greatest responsibility for efficient water use, however, lies with the parties that use water from the Basin, namely, the residents, businesses and institutions of Los Osos.

The Urban Water Use Efficiency Program includes actions that have been and will be undertaken by the federal, state and local governments and the Purveyors to improve water use efficiency in Los Osos. This chapter describes the impact of those actions on projected urban water demands, which are then used in planning and evaluating overall management of the Basin in other chapters of this Basin Plan. The Parties need the active involvement of the citizens of Los Osos in order to make the actions set forth in this chapter effective.

One of the primary ways in which the Purveyors can encourage efficient use of water resources in the Basin is through their water rates. Appropriate pricing of water is a recognized method to ensure use of the correct amount of the resource. Numerous water policy experts have adopted full-cost pricing and economic incentives as fundamental principles for water efficiency, as reflected in the statements below.

> *Water use efficiency is a policy goal that can be facilitated by economic incentives.*[83]
>
> *Utility and system managers as well as regulators and governing boards should ensure that the price of water services fairly charges ratepayers or customers the total cost of meeting service and sustainable water infrastructure requirements, subject to concerns about affordability. Funding for water utilities should generally rely on cost-based rates and charges, and these revenues should not be diverted to unrelated purposes. Full-cost pricing is a sound business practice that is helpful in obtaining debt financing. The resulting price signal to consumers is also good practice from the perspective of promoting wise water use. Where it is necessary to undertake actions to avoid, mitigate and compensate for environmental impacts, these additional out-of-pocket costs should be considered in the full cost of providing service.*[84]
>
> *When water is not properly priced, it is frequently wasted. In all urban uses, pricing water at appropriate levels encourages conservation and*

[83] DWR, *California Water Plan*, Bulletin 160-09, at 21-8 (Update 2009).
[84] Aspen Institute, *Sustainable Water Systems: Step One – Redefining the Nation's Infrastructure Challenge*, at 28 (2009).

> *efficiency actions and investments. All water use and wastewater discharges should be charged at rates (and with rate structures) that encourage efficiency.*[85]

It is the intention of the Parties that the principle of using economic incentives and full-cost pricing to promote efficiency be applied within the Basin to the extent possible. For the Purveyors, this means setting water service rates based on the cost of providing service, including those actions needed to achieve sustainable management of the Basin, such as the water use efficiency improvements set forth in this chapter. Implementation of full-cost pricing will have the additional effect of incentivizing residents and businesses of Los Osos to use water efficiently.

Economic signals to water users can be accentuated by using conservation rate structures, in which per unit water rates increase with larger volumes of use. As would be expected, implementation of conservation rate structures by LOCSD and GSWC since approximately 2000 has resulted in declining levels of water use in Los Osos. Reduction in groundwater withdrawals by the Purveyors during the 2000s by approximately 30 percent was primarily caused by the response of Los Osos residents, businesses and institutions to increasing water utility rates, with lesser contributions from other water use efficiency improvements.

Despite the gains in water use efficiency that are expected from economic signals and other actions set forth in this chapter, water utility customers in Los Osos must realize that many of the costs associated with management of the Basin and delivery of high-quality water utility services are fixed. In other words, those costs do not vary by the amount of water used, and improvements in water use efficiency do not allow a reduction in water utility revenues. Individual water utility customers can reduce their utility bills by conserving water relative to average usage levels, but over time, per unit water rates are likely to rise based on general economic inflation, water infrastructure investments and the impact of spreading fixed costs across a smaller quantity of water. The overall amount that water utility customers will pay to the Purveyors is likely to rise, even as they use less water. This is not intended to punish utility customers for their good deeds, but simply reflects the reality of utility economics.

8.3 Defining the State of the Art

It is the intent of the Parties for this Urban Water Use Efficiency Program to help urban water users in the Basin achieve the highest standards for efficiency. This section provides a context for understanding those standards in light of water use patterns in California, the United States and globally. Although some may see Los Osos as a quiet, coastal bedroom community that is far from the center of global innovation, it is the intent of the Parties to implement a "state of the art" water use efficiency program in the Plan Area.

[85] Pacific Institute Report, at 14.

Various studies have attempted to calculate urban water use in California and its hydrologic regions. Most recently, the *20x2020 Plan* estimated that statewide urban per capita use of water is approximately 192 gpcd. The Central Coast hydrologic region, where the Plan Area is located, has the lowest regional urban water use in the state, at 154 gpcd, although its water use is very close to other coastal hydrologic regions.[86]

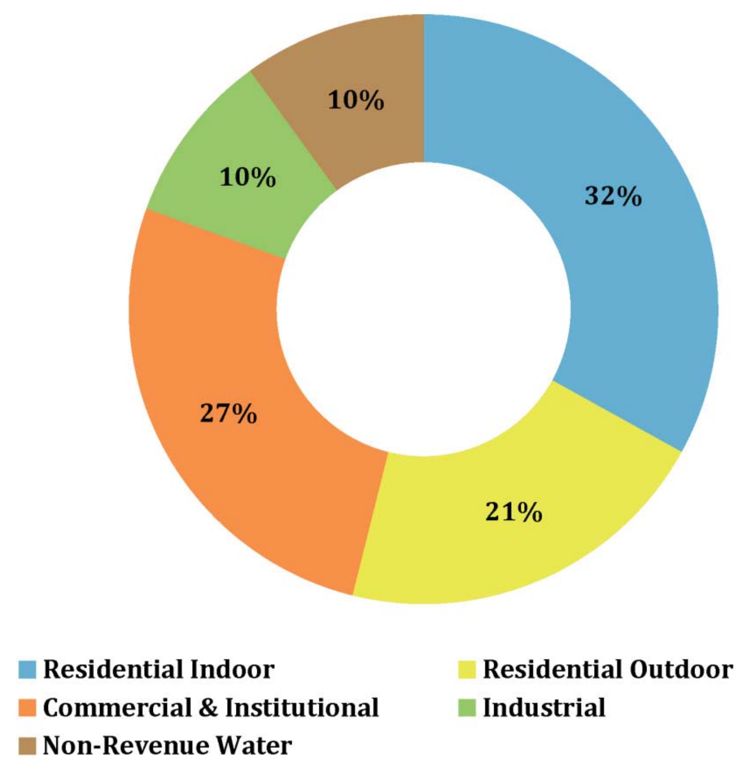
Despite gains achieved by water conservation efforts since the early 1990s (following the 1987-1992 drought), a comprehensive report by the Pacific Institute in 2003 estimated that indoor residential water use in California could be reduced by an additional 40 percent by replacing remaining inefficient toilets, washing machines, showerheads and dishwashers, and by reducing the level of leaks, even without improvements in technology. With respect to outdoor residential water use, the report estimates that reductions of 25 to 40 percent could be made with improved management practices and better application of available technology. The report projected similar reductions in water use for the CII sectors.

In 2006, the CALFED Bay-Delta Program released a *Water Use Efficiency Comprehensive Evaluation Report* which also estimated the potential for future urban water conservation in California. The study evaluated urban water savings potential from four sources: (1) requiring water-using appliances and fixtures to meet specified levels of efficiency; (2) local water agency implementation of urban conservation BMPs, as well as other locally cost-effective conservation measures; (3) additional urban conservation measures funded through CALFED grant programs; and (4) 100 percent saturation of the urban water conservation devices and activities included in the analysis. Assuming 100 percent adoption of all measures statewide and existing technology, the report estimated the total water savings potential of identified conservation measures to be approximately 25 percent by 2030.[87]

An urban water use efficiency improvement program must not look only at the overall level of water use, but at the specific areas where water is used. Figure 42 depicts the distribution of urban water uses in California, by the residential and CII sectors. The residential sector is commonly broken down further into indoor and outdoor use components. In addition, some water supplies are not delivered to customers but are used for system and fire hydrant flushing to maintain water quality, used for well flushing or other treatment maintenance activities, lost through distribution system leaks or theft, or simply not measured due to inaccurate meters. These amounts are referred to as non-revenue water.

[86] 20x2020 Plan, at x, 14.
[87] CALFED Report, at 103-132.

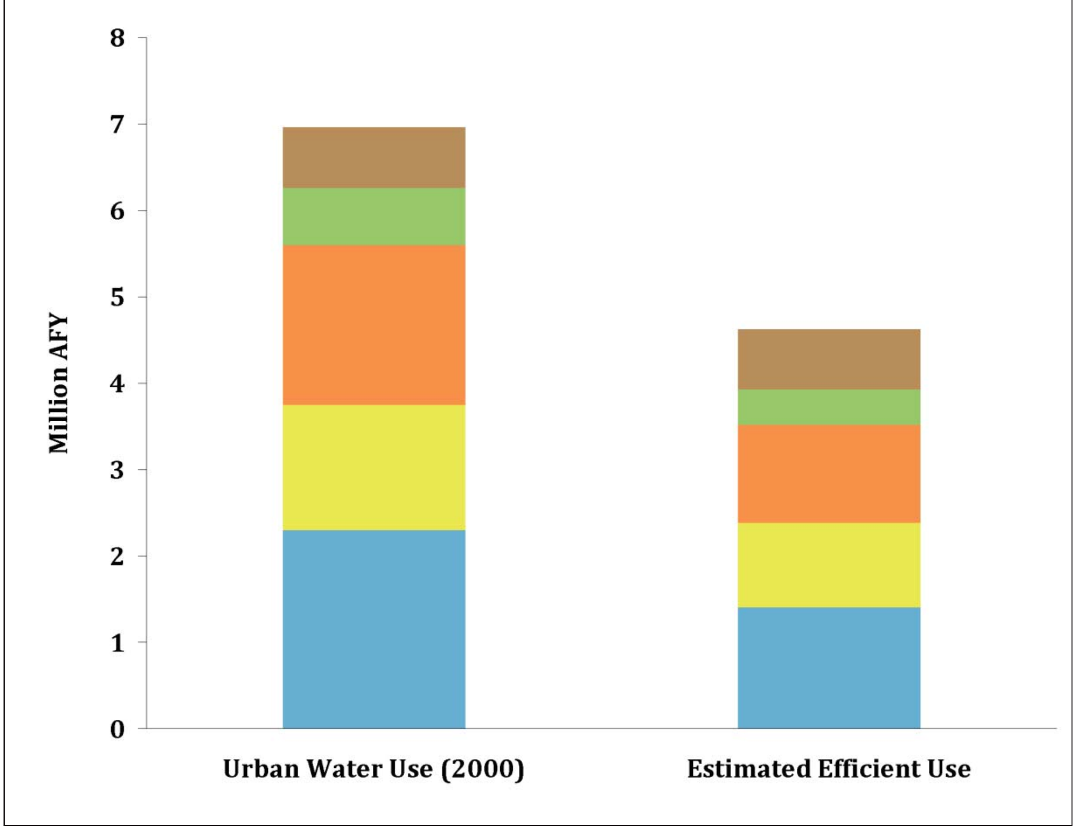
Figure 42. Distribution of Urban Water Uses in California



Source: Pacific Institute (2003), at 2. Data represent 2000 conditions.

The focus of water use efficiency improvements in California is typically on the residential sector, since that sector represents the largest share of urban water use and offers the largest volume of potential savings compared with other sectors. Certain commercial, institutional and industrial uses and non-revenue water are targeted also. Figure 43 shows the results of an analysis by the Pacific Institute of the magnitude of potential urban water savings in California. As seen in that figure, potential water savings from water use efficiency improvements are significant. The potential savings for Los Osos are analyzed in Section 8.5, and are expected to be roughly parallel to those that are achievable across California for similar types of development.

Figure 43. Potential for Urban Water Savings in California



Source: Pacific Institute Report, at 2-3. Data represent 2000 conditions. Colors represent the same water use categories depicted in Figure 42.

8.3.1 *Indoor Residential Use*

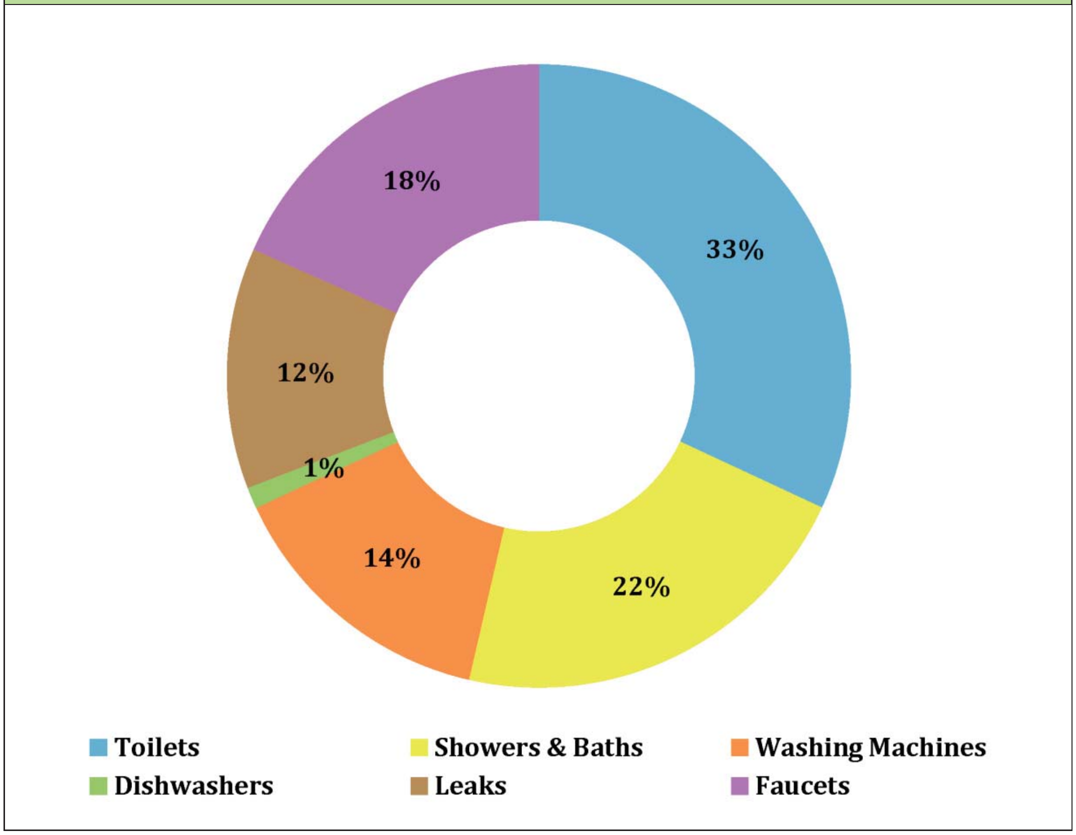
Indoor water uses in the residential sector are focused in the bathroom, kitchen and laundry room. Figure 44 shows the distribution of indoor residential water uses in California. The vast majority of water use involves toilets, showers, baths, faucets and washing machines, which combined represent an estimated 87 percent of all indoor residential water use. Most water efficiency programs understandably focus on those uses. Dishwashers account for only 1 percent of indoor residential use, and so they are not normally a priority target for water efficiency improvements. Residential leaks are a significant 12 percent of indoor residential use, but are prevented by actions than other efficiency improvement measures, which can be addressed through new equipment and education.

There is broad agreement among experts that significant water savings can be achieved by replacing older residential water fixtures and appliances with more efficient models. Estimates of potential savings in this sector are as high as 40 percent, although actual savings may be less depending on local circumstances.[88]

[88] Pacific Institute Report, at 6.

The following sections describe each of the indoor water uses and actions that can be taken to improve the efficiency of each use.

Figure 44. Distribution of Residential Indoor Water Uses



Source: Pacific Institute Report, at 5. Data represent 2000 conditions.

(A) *Toilets*

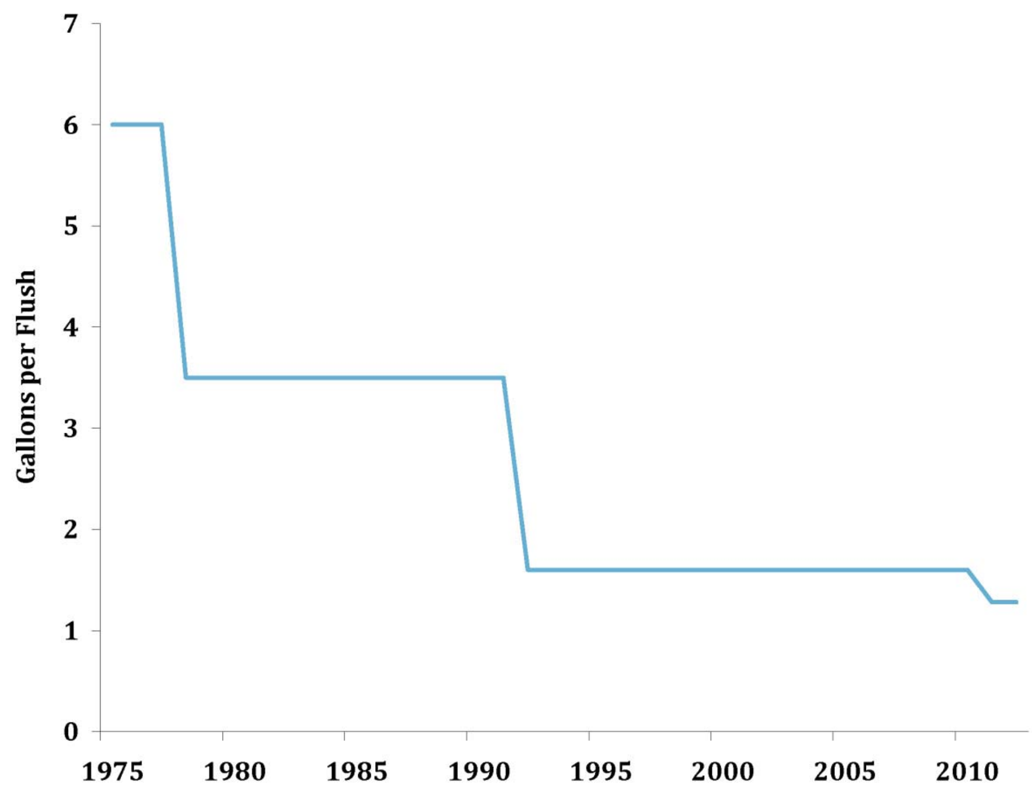
More water is used to flush toilets than for any other indoor use.[89] Flushing toilets is the largest single use of water inside the home; estimates for toilet use range from 28 percent to almost 40 percent of total indoor use.[90] Thus, significant savings can be achieved by targeting toilet water use. Since human sanitation requires regular flushing of toilets,[91] the primary method of improving the water use efficiency of toilets is replacement of older, less-efficient models with newer ones. In this way, toilets can use water more efficiently without any negative impacts on quality of life.

Prior to 1978, toilets in the United States typically used six gallons per flush. In response to the 1977-1978 drought in California, state law was changed to require

[89] *Id.* at 37.
[90] *Id.* at 42.
[91] See, e.g., World Health Organization, *Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) Report* (2012); United Nations Development Programme, *The Millennial Development Goals Report*, at 54-56 (2012).

that new toilets use no more than 3.5 gallons per flush. In 1992, the federal National Energy Policy Act mandated that new toilets sold nationwide use no more than 1.6 gallons per flush. Today, consumers can purchase toilets that use as little as 0.8 gallons per flush, or dual flush toilets that use varying amounts of water based on demand. Toilets that use 1.6 gallons per flush are often called ultra-low flush toilets (ULFTs), and those that use 1.28 gallons per flush or have dual flush capability are referred to as high efficiency toilets (HETs). The CalGreen building standards adopted in 2010 require that all new residential construction install HETs beginning January 1, 2011, and the California Plumbing Code (CPC) requires that all toilets sold in California be HETs after January 1, 2014. The historical development of toilet efficiency standards in California is shown in Figure 45.[92]

Figure 45. Historical Development of Toilet Efficiency Standards in California (1975-2012)



The key to improving water use efficiency for toilets is replacing older toilets with HETs. Public programs to promote water efficiency normally focus on incentivizing residential property owners to purchase ULFTs or HETs at the time of normal toilet replacement, by providing a subsidy to make those toilets equal or less in price than less efficient models. These subsidies can vary considerably, with predictable

[92] *See* Maddaus Water Management, *Final 2010 Water Demand Analysis and Water Conservation Evaluation*, at 24 (March 18, 2011); California Building Standards Commission, *2010 California Green Building Standards Code*, 24 Cal. Code of Regs. § 4.303; CALFED Report, at 114; Pacific Institute Report, at 42-47.

consequences. For example, the CUWCC's BMP 14 states that a water agency will provide incentives or adopt an ordinance that requires the replacement of toilets using 3.5 gallons or more per flush with toilets meeting WaterSense specifications, i.e., HETs.[93] According to BMP 14, toilets that use between 1.28 and 3.5 gallons per flush do not need to be replaced through an active water agency program, although when they are replaced, the CPC will govern the efficiency of toilets in the consumer marketplace.

As described below, the water efficiency improvement programs to be adopted by the County and Purveyors in this Basin Plan include significant subsidies and requirements for the replacement of less efficient toilets with HETs in the near term. While many programs in California allow replacement with ULFTs, this Basin Plan requires more efficient HETs.[94] Thus, in terms of BMP 14, this Basin Plan is more aggressive than most public programs in seeking improvements in the water use efficiency of toilets. It is the goal of this Basin Plan for every residential toilet in the Wastewater Service Area to be an HET by 2015, and every residential toilet in the Plan Area to be an HET by 2035. Given the water use efficiency measures that will be implemented by the Parties pursuant to this Basin Plan, those goals will be met or exceeded.

(B) *Showers and Baths*

Showers and baths account for roughly 22 percent of indoor residential water use in California. Similar to toilets, human sanitation and quality of life depend on access to showers and baths on a level roughly equal to current cultural practices. Thus, improvements in water use efficiency are mostly technological, with some education efforts focusing on behavior.

Since the rate of flow in bathtub fixtures does not have a significant effect on the volume of water used, the emphasis for water use efficiency is on showers. Residential showerheads have become more water efficient over time, shifting from 5.0 to 3.5 to 2.5 and now to 2.0 gpm. The National Energy Policy Act of 1992 (NEPA) required new showerheads to use at most 2.5 gpm, and the USEPA WaterSense program includes only showerheads with no more than 2.0 gpm flows. The Pacific Institute Report concluded that replacing all less efficient showerheads in California with 2.5 gpm models would reduce water used for showers and baths by about 24 percent. The savings achieved by installing lower flow showerheads would be even greater.[95]

As with toilets, water efficiency programs operated by most utilities focus on subsidizing or otherwise incentivizing homeowners to replace older showerheads with newer, low-flow models. The CUWCC's BMP 2 states that a water agency must provide showerheads that meet current water efficiency standards set by the WaterSense program, i.e., maximum flow of 2.0 gpm. The programs to be adopted

[93] *See* USEPA, WaterSense Website [http://www.epa.gov/WaterSense/products/toilets.html].
[94] *See* CALFED Report, at 114 n.6.
[95] *See* CALFED Report, at 114; Pacific Institute Report, at 48-50.

by the County and Purveyors take the same approach, while being more aggressive due to the challenges facing the Basin. It is the goal of this Basin Plan for every showerhead in the Los Osos community to be a high-efficiency model with flows no more than 1.5 gpm by 2015.

(C) *Faucets*

Past studies have widely varying estimates about the extent to which retrofitting faucets or installing aerators saves water. Faucet flow rates are not directly linked to water use, because many faucet uses are largely based on volume, e.g., filling a sink or pot of water will require the same volume of water regardless of flow rate. One of the most aggressive studies, by the Pacific Institute, did not model any savings from installing low-flow faucets. The report noted, however, that technological options combined with changes in user behavior can significantly affect faucet water use over time.[96]

Historical faucet flows ranged from 2.75 to 7.0 gpm prior to 1992. The CPC required all bathroom faucets to have a maximum flow rate of 2.2 gpm beginning in 1992, although that standard was replaced by 2.5 gpm under federal law in 1994. Federal law was modified in 2005 to revert back to the 2.2 gpm standard. The WaterSense specification for bathroom faucets was set at 1.5 gpm in 2007. The CUWCC's BMP 2 states that a water agency must distribute retrofit kits that include faucet aerators meeting the current water efficiency standard established in the WaterSense program.

This Basin Plan establishes a goal of installing aerators on all residential bathroom faucets to allow flows of no more than 1.5 gpm by 2015. Such aerators are included in the water use efficiency program of the Parties, as set forth in the following sections.

(D) *Washing Machines*

Washing machines are a significant source of residential indoor water use, representing about 14 percent of the total. As with other indoor water uses, there is not an expectation that clothes washing will decrease on a per capita basis in California (or Los Osos), and the focus of public programs is on improving the efficiency of washing machines.

Residential washing machines currently use around 330,000 AFY in California. Most residential models in use today are top-loading, immersion machines, and very few have been replaced with more efficient front-loading, non-immersion models. Front-loading washers reduce water use on average by about 15 gallons per wash and may save a typical household 7,000 to 9,000 gallons of water per year.

[96] *Id.* at 58-59.

Replacement of top-loading with front-loading washers statewide could reduce water use by 30 percent.[97]

In 2004 the California Energy Commission adopted state water efficiency standards for clothes washers. It is a tiered standard based on the "water factor" of each clothes washer, which is the number of gallons per cubic foot of drum capacity. In 2007, the maximum water factor allowed was 8.5 per machine. In 2010, the standard would have been further reduced to 6.0 per machine. Conventional clothes washers have a factor of about 13.3, thus the standards would have reduced per-load water use 36 percent by 2007 and 55 percent by 2010.

Federal approval of the California Energy Commission standard was required, because the federal Energy Policy Act of 1992 allows only the federal government to regulate residential clothes washers unless a state waiver is approved. The U.S. Department of Energy denied California's request for waiver of federal preemption for the state water efficiency standards for residential clothes washers. California appealed the denial to the Ninth Circuit Court of Appeals. The Ninth Circuit found that the denial was arbitrary and capricious and directed the district court to determine whether the Department of Energy should be directed to approve the waiver. The district court proceedings have not yet commenced. The standards are not yet in effect in California, but the 20x2020 Plan calls for the state to continue its efforts for washing machine standards.[98]

The CUWCC's BMP 6 states that a water agency must provide incentives or adopt ordinances requiring the purchase of high-efficiency clothes washing machines (HECWs) that meet an average water factor value of 5.0. If the WaterSense specification is less than 5.0, then the average water factor value will decrease to that amount. WaterSense has not yet adopted specifications for clothes washers, so that the standard under BMP 6 remains a water factor value of 5.0.

There are few public programs in California focusing on replacement of clothes washing machines. Most programs offer limited rebates for qualifying models. It is the goal of this Basin Plan to replace all less efficient washing machines with HECWs with a water factor of 4.0 or less by 2025, which is the expected life span of current washing machines in the community. This goal will be accomplished by the residents of Los Osos, with rebates from the County and Purveyors as described below.

(E) *Dishwashers*

Dishwashers account for approximately one percent of total residential water use. The Pacific Institute Report estimated that dishwashers used almost 28,000 AFY of water in 2000 across California. It indicated that efficient machines use about 5.3 gallons per load. Applying this to the number of dishwashers in California, if all

[97] *Id.* at 50-55.

[98] *See* 20x2020 Plan, at xii, 21; *California Energy Commission v. Department of Energy*, 585 F.3d 1143 (9th Cir. 2009); CALFED Report, at 114-115.

dishwashers were replaced with efficient 5.3 gallons-per-load models, use in 2000 would have been reduced to under 15,000 AFY, a savings of approximately 46 percent. In addition, improving the water efficiency of dishwashers reduces energy usage, since over half of energy usage in the appliances goes to water heating.[99]

Because dishwashers represent a relatively low percentage of all indoor residential water use, public programs typically do not focus on water efficiency in these appliances. It is assumed that consumers will replace less efficient with more efficient models on a normal replacement schedule, based on those models that are available in the consumer marketplace. The CUWCC does not currently have a BMP for dishwashers, and there are no governmental standards or WaterSense specifications.

This Basin Plan does not set a community-wide goal for water use efficiency in dishwashers, although it does anticipate a County mandate for installation of high efficiency dishwashers in new development, through the CPC. As part of the LOWWP, the County is offering a rebate for high efficiency dishwashers to those residents within the Wastewater Service Area who have already installed other high efficiency appliances and fixtures. The installation of such appliances by residents of Los Osos is highly encouraged.

(F) *Leaks*

Leaks within a home are responsible for significant water losses. However, leak rates are highly variable – various studies have estimated that leakage ranges from 5 to 13 percent of indoor water use. Water losses from leakage are concentrated in a small number of houses; one study found that 10 percent of homes were responsible for 58 percent of water losses. Assuming a 10 gpcd average leak rate, the Pacific Institute concluded that if all homes reduced leakage rates to the average rate of 4.2 gpcd (the median leakage rate), the total savings statewide would be 240,000 AFY. This could be significant for California as a whole and for Los Osos specifically.[100]

The CUWCC's BMP 1 requires water purveyors to survey single-family and multi-family residential customers, including site-specific leak detection assistance. The variability of leak rates suggests that leakage reduction programs are most effective if they are targeted at homes with the highest leakage rates. Targeting high-end water users makes an audit program more cost-effective for a utility and, ultimately, its customers.

This Basin Plan does not adopt a metrical goal for reducing residential water leaks, because there is no data regarding the specific amount of leaks in Los Osos. However, the water use efficiency programs set forth below do address household leaks through residential water use audits consistent with BMP 1.

[99] *Id.* at 55-58.
[100] *Id.* at 59-61.

8.3.2 *Outdoor Residential Use*

Substantial amounts of water are used outdoors in the residential sector, primarily for landscape irrigation but also for washing of cars and exterior spaces, such as patios and driveways, and filling of pools and other water features. There is a greater degree of uncertainty about the specifics of outdoor residential water use in California than for indoor use.[101]

It has been estimated that outdoor residential water use could be reduced by at least 32.5 percent relatively quickly with improved management and available irrigation technology.[102] Even so, implementing water use efficiency improvements in the outdoor residential sector is challenging, and there are few successful programs to emulate. Some of these challenges have been recognized by the Pacific Institute:

> *Efficient irrigation involves two things: proper design and proper landscape maintenance. Proper landscape maintenance requires that the homeowner be informed and diligent – difficult things for an agency to predict, control, or monitor. For example, planting a water-efficient landscape or installing a sophisticated irrigation system will not save water if the homeowner fails to match the irrigation schedule with plant needs. And a manual irrigation system on a traditional landscape can be efficient if it is properly maintained and used. In contrast, projecting the savings from an efficient toilet or showerhead program is relatively straightforward. When an agency decides whether to invest in a retrofit program, they can reliably calculate savings from switching their existing stock to ULFTs and from that determine the costs and benefits of such a program. A similar evaluation of landscape programs is more difficult and is constrained by lack of data and consistency.*
>
> *Farmers and, increasingly, large-lot landscape managers have been taking advantage of tools such as improved irrigation technologies, rebates, audits, and weather station data in planning and designing irrigation systems and schedules. While these tools are often available in the residential sector, homeowners are less likely to have the time, inclination, incentive, or expertise to adopt them. One challenge thus lies in educating, motivating, and in some cases requiring residential homeowners and managers of smaller residential lots to adopt proper irrigation scheduling and techniques.*[103]

The Pacific Institute Report places available efficiency options for outdoor residential water conservation into four general categories: landscape design,

[101] *Id.* at 66.
[102] *Id.* at 7.
[103] Pacific Institute Report, at 64-65.

hardware improvement, management practices, and policy options.[104] Each is discussed below, along with the potential associated water savings.

(A) *Landscape Design*

One of the most reliable ways of improving outdoor water use efficiency is to modify the design of gardens and landscapes. There are two aspects to landscape design: the choice of plants and the physical layout of the landscaped area. This dichotomy is addressed in the Model Water Efficient Landscape Ordinance discussed below. Water requirements for vegetation based on type should be considered when choosing plant type for a landscape. Proper landscape layout involves controlling the area and perimeter of turf, minimizing narrow paths or steep areas that cannot be irrigated efficiently, and grouping plants with similar irrigation needs. Several studies have quantified water savings from xeriscapes, typically defined as water-efficient landscaping, and found that proper choice of plants and careful landscape design can reduce water use by up to 54 percent.[105]

(B) *Hardware Improvement*

Hardware improvement refers to devices that reduce water use in outdoor residential landscapes. Such devices range widely in price and sophistication. Savings from such devices also range widely, from about 10 percent for automatic rain shutoff devices, to 50 percent for drip-irrigation systems. The effectiveness of landscape devices depends in large part on the homeowner knowing how to use the device, whether it's an irrigation system or a handheld probe measuring soil moisture. Thus, conservation programs must also address behavioral variations with respect to hardware improvements. Some programs emphasize the proper use of the available tools through public education, outreach, rebates, loans and rate structures. Past programs in southern California resulted in water use reductions between 24 and 50 percent. As is typical for water use efficiency improvements, the greatest gains are achieved from the highest water users.[106]

(C) *Management Practices*

Efficient landscape management practices include irrigation scheduling based on evapotranspiration, regular system maintenance (such as checking for leaks and fixing broken or misaligned sprinkler heads) and proper horticultural practices (such as fertilization and soil aeration). These practices are highly dependent on individual behavior and thus are difficult to quantify, predict or control. One program resulted in water use dropping by 20 percent. A pilot study of residential weather-based irrigation scheduling in southern California suggests that by targeting the top third of homes with the highest use, evapotranspiration controllers

[104] While this categorization derives from the Pacific Institute Report, the same concepts are discussed in other reports. *See*, *e.g.*, 20x2020 Plan, at 23.
[105] *Id.* at 73.
[106] 20x2020 Plan, at 21-22; Pacific Institute Report, at 71-72.

might be expected to save roughly 57 gallons per household per day, a reduction of 10 percent in their total water use or 24 percent of outdoor use.[107]

(D) *Policy Options*

There are a number of government or water utility policies that can affect the behavior of residential water users. For example, properly designed rate structures can be a valuable tool to help homeowners improve the efficiency of their water use. As noted in Section 8.5.1, both LOCSD and GSWC have adopted increasing block rate structures to encourage conservation.

Another mechanism for achieving improved water use efficiency in the residential outdoor sector is through adoption of a local ordinance. The California Legislature endorsed this method through passage of Assembly Bill 325 (1990), which required DWR to develop a Model Water Efficient Landscape Ordinance to help improve landscape irrigation practices. Under Assembly Bill 325, cities and counties are required to adopt the model ordinance or a special local ordinance to achieve similar results.

DWR adopted the current Model Water Efficient Landscape Ordinance effective January 1, 2010.[108] The ordinance applies to landscape for new public agency projects and developer-installed landscapes of at least 2,500 square feet, as well as homeowner-installed landscapes of at least 5,000 square feet. The ordinance is enforced as part of the normal land development process by the applicable local agency (in Los Osos it is the County). The centerpiece of the ordinance is the preparation by a certified irrigation designer or landscape architect of a landscape documentation package, Water Efficient Landscape Worksheet (WELW), soil management report, landscape design plan, irrigation design plan and grading design plan, each of which is required to consider local conditions for efficient water use. The WELW is a standard form for describing landscape features and their expected water use.

Specific landscape and irrigation measures that must be implemented under the ordinance include:

- Installation of dedicated landscape irrigation meters;
- Selection of appropriate plants for the project site;
- Installation of irrigation systems to meet but not exceed applied water requirements;
- Installation of automatic irrigation controllers using either evapotranspiration or soil moisture sensor data to adjust irrigation quantities;

---

[107] Pacific Institute Report, at 69-71.
[108] The Model Water Efficient Landscape Ordinance can be found at 23 Cal. Code of Regs. §§ 490-494.

- Design of irrigation systems to prevent runoff, overspray or other conditions where water flows onto non-targeted areas, such as adjacent property, hardscapes, sidewalks or roadways;
- Scheduling of overhead irrigation between 8:00 p.m. and 10:00 a.m.;
- Mulching of all soil areas;
- Use of recycled water for water features where available; and
- Use of pool and spa covers.

The project applicant must have the landscape documentation package and WELW approved by the local land use authority, and must submit a certificate of completion that the landscaping has been installed according to the approved plans. The project applicant must submit and implement a regular maintenance schedule in order to ensure that the landscape continues to efficiently use irrigation water.

For existing landscapes, the local land use agency or water purveyors are encouraged to administer programs for irrigation audits, surveys and water use analyses. Local agencies are to adopt ordinance provisions that prohibit water waste through allowing runoff, overspray or other conditions where water flows onto non-targeted areas, such as adjacent property, hardscapes, sidewalks or roadways.

Under the CUWCC's BMP 1, a water utility must perform site-specific landscape water surveys that include, but are not limited to, the following: check irrigation system and timers for maintenance and repairs needed; estimate or measure landscaped area; develop customer irrigation schedule based on precipitation rate, local climate, irrigation system performance and landscape conditions; review the scheduling with customer; provide information packet to customer; and provide customer with evaluation results and water savings recommendations.

(E) *Potential Water Savings*

Implementation of the water use efficiency measures set forth above can significantly reduce outdoor water use in the residential sector. The Pacific Institute has estimated that adopting the measures that were technologically and economically available in 2003 would result in water use reduction of between 25 and 40 percent.

Due to uncertainties in outdoor water use, it will be helpful for the Parties to continue developing their programs for measuring and reducing water use in this sector. The Parties intend to implement residential survey and public information programs for reducing water use in the outdoor residential sector, as described below, although outdoor use in Los Osos represents a smaller proportion of overall use than in other areas of California, thus decreasing the impact of such programs.

8.3.3 *Commercial, Industrial and Institutional Use*

The CII sectors include schools, hotels, restaurants, retail stores, offices, laundries and other business or public properties. The CII sectors account for approximately one-third of all urban water use in California.[109] Significant water savings can be achieved by focusing on CII water use, both indoors and outdoors, with estimates of potential water savings as high as 40 percent.[110]

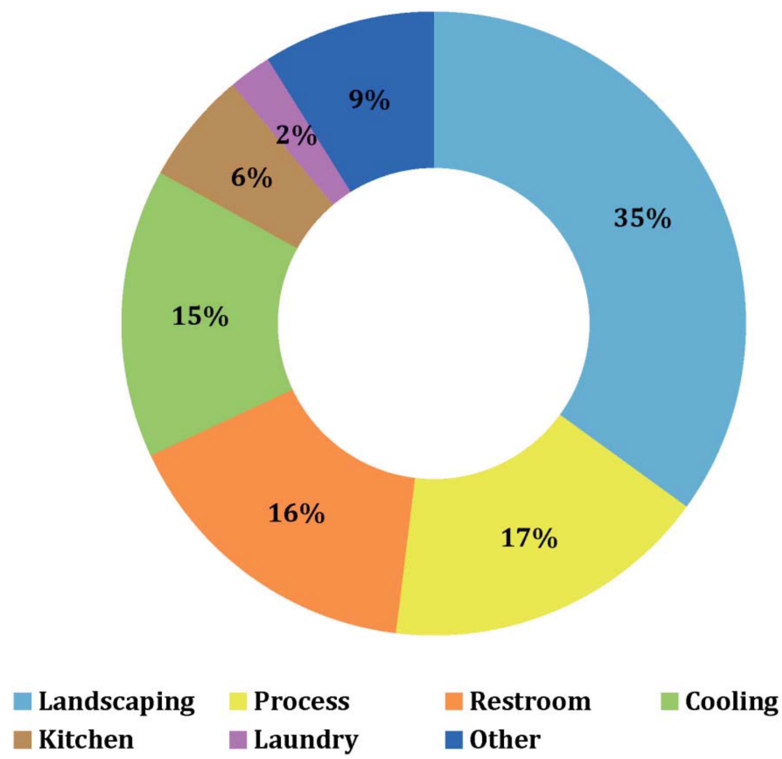
Many of the water uses in the CII sectors are the same as those in the residential sector. For example, in a typical office building the largest uses of water are for toilets, restroom faucets, kitchen faucets and landscape irrigation. Water use efficiency improvements are, thus, the same as those set forth above for residential properties. The difference lies primarily in the fact that most office buildings are owned and operated by professional management companies rather than the businesses that occupy them, so efficiency programs must incentivize building managers rather than residential property owners.

Industrial process water uses are, of course, quite different than residential water uses. Some industries use large quantities, while other industries use almost no water. Water use within the industrial sector varies among users in both quantity and purpose. Nonetheless, it is clear that implementing water efficiency improvements can create significant savings, especially through on-site reuse for cleaning and cooling. Each industry often has similar water uses across similar companies and facilities, and innovative water efficiency measures have been developed for many industries or processes. In many ways, industrial water users are more advanced in water use efficiency than residential, commercial or institutional users, due to a consistent focus on financial performance. One obstacle to industrial investments in water use efficiency is that companies often use a short time period when analyzing the benefit-cost ratio of capital investments.

Figure 46 depicts the estimated proportion of water uses in the CII sectors. This analysis divides water uses into seven categories, including landscaping, process, restroom, cooling, kitchen, laundry and other. Water uses in the landscaping, restroom, cooling, kitchen and laundry categories tend to be similar across industries, and similar water use efficiency improvements can be implemented. Many of the measures applicable to water savings in the CII sectors are the same as those described above for residential properties. For example, design and maintenance of CII landscaping can be improved through the same methods as residential landscaping, and replacement of less efficient toilets and faucets can reduce water use in CII restrooms as well as those in the residential sector.

[109] *Id.* at 8.
[110] *Id.* at 10.

Figure 46. Proportion of Water Uses in the CII Sectors



Source: Pacific Institute Report, at 83.

This Basin Plan encourages CII properties to reduce water usage where possible. A description of the actions that can be taken to reduce water use in the process, cooling and other categories is generally beyond the scope of this Basin Plan, given that the number of CII properties in the Plan Area is relatively small, and there are few programs that can be applied by the Parties. Broadly applicable measures in the landscaping, restroom, kitchen and laundry categories are described in the following paragraphs and set forth in Section 8.5.

(A) *Restrooms*

Starting around 1994, state and federal legislation prohibited the installation and sale of non-ULFTs in non-residential buildings. It has been estimated that by 2030 efficiency code requirements alone will reduce the stock of non-ULFTs in non-residential buildings to approximately 600,000 (from four million in 1991) in California. Nonetheless, a prompt replacement of low efficiency toilets and fixtures has the potential to increase the speed of water efficiency improvements. Thus, the rebate and subsidized retrofit programs set forth in Section 8.5 generally apply to CII uses as well as residential properties.

(B) *Landscaping*

The goal of CUWCC's BMP 5 for Large Landscape Conservation Programs and Incentives is that irrigators, with assistance from signatories, will achieve a higher level of water use efficiency consistent with the actual irrigation needs of plants. Reaching this goal would reduce overall demands for water, reduce demands during the peak summer months, and still result in a healthy and vibrant landscape for California. Implementing utilities will provide CII customers with support and incentives to improve their landscape water use efficiency. A utility must specifically address accounts with dedicated irrigation meters and CII accounts without meters or with mixed-use meters.

More specifically, Assembly Bill 1881 (2006), the Water Conservation in Landscaping Act of 2006, directed water purveyors that serve more than 15 connections, to require as a condition of new retail water service after January 1, 2008 the installation of separate water meters to measure the volume of water used for landscape purposes. The requirement applies to connections with 5000 square feet of landscape and does not apply to single family residential connections. The Purveyors will implement Assembly Bill 1881 within their respective service areas.

(C) *Other Water Uses*

The CUWCC's BMP 9—"Conservation Programs for CII Accounts"—was designed to implement comprehensive yet flexible BMPs, allowing each water utility to tailor its implementation to fit local needs and opportunities. An urban water purveyor must implement measures to achieve the water savings goal for CII accounts of 10 percent of the baseline water use over a 10-year period. Baseline water use is defined as the water consumed by CII accounts in the agency's service area in 2008. Implementation should consist of one of the two following approaches, or both: (i) implement measures on the CII "Demonstrated Savings Measure List" with well-documented savings that have been demonstrated for the purpose of documentation and reporting; or (ii) implement unique conservation measures to achieve the utility's water savings goals, such as industrial process water use reduction, industrial laundry retrofits, car wash recycling systems, water-efficient commercial dishwashers and wet cleaning. Water use reduction shall be calculated on a case-by-case basis.

(D) *Potential Water Savings*

Based on implementation of the measures described above and other industry-specific, reasonably achievable and cost-effective measures, it has been estimated that water use in the CII sectors in California could be reduced by between 28 and 52 percent, with a moderate estimate of 39 percent.[111] The impact of water use efficiency measures in any particular community would vary based on the types of industries located there. Because of the common uses of water in areas dominated

[111] Pacific Institute Report, at 89.

by commercial rather than industrial properties, such as Los Osos, in those locations water savings are generally lower, but more predictable.

8.3.4 *Other Water Efficiency Improvements*

In addition to the sector-specific water use efficiency measures set forth above, certain actions apply across multiple sectors and locations or are undertaken at the utility level. Common measures of this type are described in the following sections.

(A) *Non-Revenue Water Audits*

As noted above, non-revenue water comprises a significant portion of urban water use. That portion which is lost due to system leaks or is simply not measured due to inaccurate meters can be saved through auditing urban water systems.

The CUWCC's BMP 3 for System Water Audits, Leak Detection and Repair requires a water purveyor to, at a minimum, quantify its current volume of apparent and real water loss in its own water distribution system. Purveyors must complete the standard water audit and balance using the American Water Works Association (AWWA) Water Loss software to determine their current volume of apparent and real water loss and the cost impact of these losses on utility operations at no less than annual intervals. A purveyor must undertake a component analysis at least once every four years to provide a means to analyze apparent and real losses and their causes by quantity and type. The goal is to identify volumes of water loss, the cause, and the value of the water loss for each component. Purveyors shall advise customers whenever it appears possible that leaks exist on the customer's side of the meter.

The CPUC has recognized that leak detection can lead to significant water savings. Thus, it requires a report on leak detection as part of information presented in a water utility's general rate case. GSWC presents such a report to the CPUC at least once every three years, on its normal rate case cycle.[112] While they are not regulated by the CPUC, LOCSD and S&T will each undertake water system audits to minimize losses from their distribution systems at least once every three years pursuant to this Basin Plan.

(B) *Metering*

It has been consistently demonstrated that measuring the amount of water used by each utility customer or well owner tends to reduce water use, especially when combined with consumption-based utility rates.[113] In recognition of that principle, California has required the metering of urban water deliveries by water purveyors for new service connections since 1992.[114] In 2003, the Legislature adopted a requirement that all service connections be retrofitted with meters by 2013 if the

[112] Water Action Plan, at 17.
[113] *See*, *e.g.*, Cal. Water Code §§ 370, 521; Pacific Institute, *California's Next Million Acre-Feet: Saving Water, Energy, and Money*, at 14 (September 2010); 20x2020 Plan, at 38; Pacific Institute Report, at 13-15.
[114] Cal. Water Code § 525.

relevant water purveyor receives water from the federal Central Valley Project (CVP), and by 2025 regardless of water sources.[115]

Similarly, the CUWCC's BMP 4 requires water agencies to install meters for all new service connections and establish a program for retrofitting existing unmetered service connections, read meters and bill customers by volume of use, including implementation of billing intervals that are no longer than bi-monthly, and prepare a written plan, policy or program that includes a census of all meters and a schedule of meter testing, repair and replacement.

Each of the Purveyors currently meters all water deliveries to customers and charges for water service according to the volume of water delivered. Thus, all water systems are in full compliance with all laws and BMPs related to metering.

(C) *Smart Metering Systems*

A small number of utilities are currently experimenting with smart metering systems, which gather water use information several times a day or continuously. These systems can convey real-time water resource impact and use data to utilities and directly to consumers on dedicated in-home, wirelessly connected, ambient display devices. The information can be used to manage utility water resources and infrastructure and motivate consumers by actively comparing data gathered from automated meter reading systems to household water use goals. It provides an incentive to change behavior to reduce water use or to identify potential leaks in a household.

The Purveyors do not currently plan to install smart meters in their respective service areas, because the technology has not reached maturity. If the technology is developed for broad commercial use, and the Purveyors determine that additional urban water use efficiency improvements are necessary or convenient for management of the Basin in a sustainable manner, then the Purveyors will consider the installation of smart metering systems at that time.

(D) *Public Education Programs*

Many urban water purveyors have created public education programs in recent years. The CUWCC's BMP 7 requires an agency to implement a public information program to promote water conservation and water conservation-related benefits. The program may include, but is not limited to: providing speakers to employees, community groups and the media; using paid and public service advertising; using bill inserts; providing information on customers' bills showing use for the last billing period compared to the same period the year before; providing public information to promote water conservation measures; and coordinating with other government agencies, industry groups, public interest groups and the media. The program should also include, when possible, social marketing elements which are designed to change attitudes and influence behavior. This includes seeking input from the

[115] Cal. Water Code §§ 526, 527. *See* CALFED Report, at 115-116.

public to shape the water conservation message; training stakeholders outside the utility staff in water conservation priorities and techniques; and developing partnerships with stakeholders who carry the conservation message to their target markets.[116]

In addition, the CUWCC's BMP 8 focuses on education of the youth through school programs. Water agencies must implement school education programs to promote water conservation and water conservation-related benefits. This allows the water conservation message to reach the youngest water users at an early age and enforce the need to engage in water conservation as a lifelong behavior. Programs include working with school districts and private schools in the water suppliers' service area to provide instructional assistance, educational materials, and classroom presentations that identify urban, agricultural, and environmental issues and conditions in the local watershed. Educational materials must meet state education requirements and be grade-appropriate.

In order to coordinate public information and education programs, BMP 12 requires the hiring of a conservation coordinator. A water agency must designate a person as the agency's responsible conservation coordinator for program management, tracking, planning and reporting on BMP implementation.

As described in Section 8.5, the Parties intend to create and implement an active public information campaign on the value and methods of urban water use efficiency improvements. The Parties have been jointly conducting a youth educational program in Los Osos schools for the past several years and will continue to refine and carry out that program.

(E) *Economic Incentives*

As noted above, a number of experts have recognized the vital role that proper water pricing can play in promoting water use efficiency. This may be particularly true in the CII sectors.[117] This principle is reflected in the CUWCC's BMP 11 for retail conservation pricing. Under this BMP, an agency must try to implement retail conservation pricing for water sales. Because conservation pricing requires a volumetric rate, metered water service is a necessary condition of conservation pricing. Unmetered water service is inconsistent with the definition of conservation pricing. Conservation pricing provides economic signals to customers to use water efficiently. BMP 11 is not intended to supplant an agency's internal rate case process, but rather to reinforce the need for water agencies to establish a strong nexus between volume-related system costs and volumetric commodity rates.

As noted above, both LOCSD and GSWC have adopted increasing block rate structures for several years, which have led to substantial urban water demand

[116] *See* Pacific Institute, *California's Next Million Acre-Feet: Saving Water, Energy, and Money*, at 14-15 (September 2010).
[117] CALFED Report, at 104 (stating that the evidence of water pricing affecting urban water use is "overwhelming"); Pacific Institute Report, at 108.

reductions. In past years, S&T has not had the opportunity to charge conservation rates because its service connections were unmetered, but all S&T connections are now equipped with meters, and the company began charging customers by volume as of November 2012. These practices will continue under the Urban Water Use Efficiency Program.

(F) *Efficiencies in New Development*

While certain conservation efforts focus on retrofitting existing development, additional measures can be best implemented at the time of new development. For example, the CUWCC's BMP 13 prohibits certain uses of water for new development, including single-pass cooling systems; conveyer and in-bay vehicle wash and commercial laundry systems which do not reuse water; non-recirculating decorative water fountains; and address irrigation, landscape and industrial, commercial and other design inefficiencies.

Urban water use efficiency improvements connected to new development often reach beyond the development itself to require offset of new water use at existing developments. In a typical offset program, an urban water supplier will mandate that a developer, in order to obtain approval for a proposed project, must implement or financially contribute to actions that will save water at or above the demand level of the project. Such programs are sometimes called net-zero water impact programs. Specific measures have included developers installing or paying for the retrofit installation of dual flush toilets, low flush toilets, HECWs, xeriscape residential landscaping, water efficient landscaping in common areas and street medians, evapotranspiration controllers, artificial turf, use of recycled water for all large turf irrigation, hot water recirculation demand systems, pre-rinse spray valves, and even farm irrigation improvements. Offset programs in Cambria have included farm irrigation improvements such as drip irrigation.

This Basin Plan includes the adoption of stringent water use standards for new development within the Plan Area. In addition, the County has adopted a conservation offset ordinance for new development, as described in Section 8.5.1(A).

8.4 Los Osos Urban Water Use Baseline

8.4.1 *Current Water Demands*

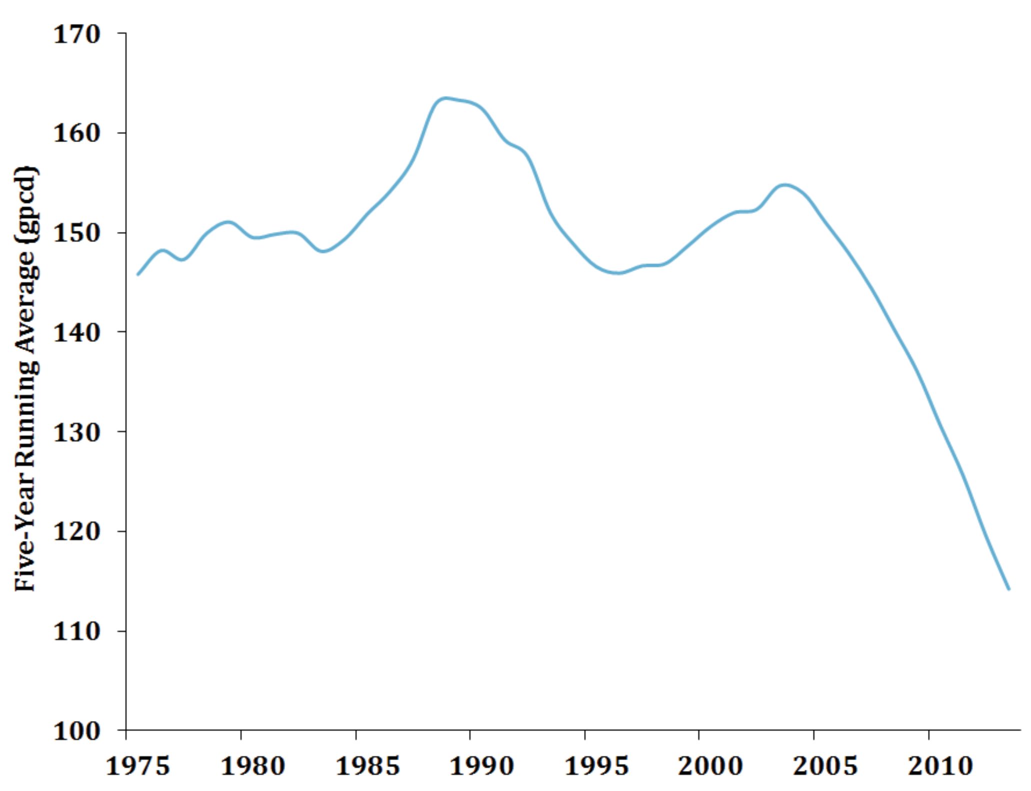
The Parties retained Maddaus Water Management (MWM) to assist them with analyzing potential efficiency improvements for urban water use in the Plan Area, resulting in preparation of a preliminary report in 2011.[118] This Urban Water Use Efficiency Program relies on that report and more recent developments in Los Osos, such as the continued decline in urban water usage through 2013.

[118]MWM, *2011 Water Demand Analysis and Water Conservation Evaluation* (April 5, 2011).

For purposes of the MWM analysis, the URL was used to approximate overall urban water use within the Plan Area. Although there is limited development outside the URL, the URL contains 97 percent of the population within the Basin Area, and parcels located outside the URL to the east are similar to parcels within the eastern boundary of the URL. Urbanized areas outside the URL are incorporated into the final conclusions and projections of urban water use within this chapter, based on the initial water demand estimate of 75 AFY from Section 4.3 and the efficiency improvements that are expected to be achievable in nearby areas of Los Osos within the URL, as analyzed by MWM and the Parties.

An initial task of this Urban Water Use Efficiency Program is to estimate current urban per capita water use in Los Osos. Because water use can vary from year to year as a result of normal hydrologic fluctuations, averages over longer periods of time are typically used to measure water use and detect trends. The results of such an analysis for the period from 1975 to 2013, using a five-year running average, are shown in Figure 47. The most noticeable trends during the past 35 years are a decline in per capita water use during the early 1990s and another decline during the late 2000s, leading to current water use being at the lowest point in the period. This is consistent with total groundwater production from the Basin by the Purveyors and private domestic well owners, as described in Sections 4.2 and 4.3.

Figure 47. Los Osos Urban Per Capita Water Use (1975-2013)



The noticeable decline in water usage during the early 1990s followed the 1987 to 1992 drought in California, which led to the passage of new laws regarding water efficient fixtures and appliances, and the formation of the CUWCC, as described in Section 8.2. Those factors likely led to the water use reductions in Los Osos, which were similar to the state-wide trend.

During the late 2000s, a number of factors contributed to declining water usage in Los Osos. Both LOCSD and GSWC adopted conservation rate structures, which created strong economic incentives for residents, businesses and institutions in Los Osos to be more efficient in their water use. In addition, it was widely known that the Basin was experiencing seawater intrusion and other challenges, that there was a dry period from 2008 through 2010, and that the decade closed with a significant economic recession, all of which tend to produce declining water use levels. It is noteworthy that most of this improvement in urban water use efficiency was implemented by the residents, businesses and institutions of Los Osos in response to changing economic and environmental conditions, rather than as a result of direct action by the Purveyors or the County.

The five-year average of urban per capita water use in Los Osos ending in 2013 was approximately 115 gpcd, which is significantly lower than the statewide average of 192 gpcd and the average in the Central Coast hydrologic region of 154 gpcd. In fact, that figure was lower than the 123 gpcd target set for the Central Coast hydrologic region by the 20x2020 Plan. Although Los Osos residents, businesses and institutions already use less water per capita than their fellow Californians, additional water use efficiency improvements will be critical to achieving a sustainable Basin.

8.4.2 *Future Water Demands*

In order to calculate future water demands within the URL, this Basin Plan uses historical water production and billing data from the Purveyors from 2006, 2007 and 2008 to create an urban per capita water use baseline of 135 gpcd. Those years were chosen because they represent a diverse hydrologic period under relatively strong economic conditions. This is a conservative planning approach because, as explained in Section 8.4.1, urban per capita water use declined from 2008 through 2012. The goal of this Basin Plan is for urban per capita water use to be reduced to a maximum of 95 gpcd.

Baseline per capita water use figures are combined with current and projected populations to arrive at estimates of overall future water demands on the Basin. This Basin Plan projects future water demands for the period from 2010 through 2035 under two scenarios for future development in the Basin Area, which represent low and high population estimates.

The Existing Population Scenario assumes that there is no future urban development in Los Osos beyond that which existed in 2010—the year of the most recent federal census. The purpose of this scenario is to determine the impact of water efficiency improvements on water use at current levels of development. This is particularly important in light of the *de facto* growth moratorium that has limited further urban development in Los Osos since 1988. Policies of the County, the Coastal Commission and the RWQCB will not allow future development to occur until the Basin is being managed on a sustainable basis. Thus, the occurrence of any future development in Los Osos is conditioned upon the successful implementation of this Basin Plan, including water use efficiency improvements. Because there will be no further development in Los Osos prior to the successful implementation of this Basin Plan, it is appropriate to begin analysis of future urban water demands in the Plan Area under the Existing Population Scenario.

The Buildout Population Scenario assumes that future development in Los Osos follows the projections made in the Draft EAP from 2005. Those projections anticipate the population within the URL increasing by roughly 35 percent through 2035, starting in 2016. Although the draft update for the portion of the EAP within the Los Osos URL was not approved by the Coastal Commission based on water supply and other concerns, some of those concerns are being addressed in this Basin Plan, and the projected level of development and population in the official 1988 EAP is widely considered to be unrealistic and likely to be revised downward as part of the current LOCP and LOHCP efforts. The 2005 draft update was based on a parcel-by-parcel evaluation of potential development in Los Osos and represents the most reasonable full buildout scenario available to the Parties for use in this Basin Plan.

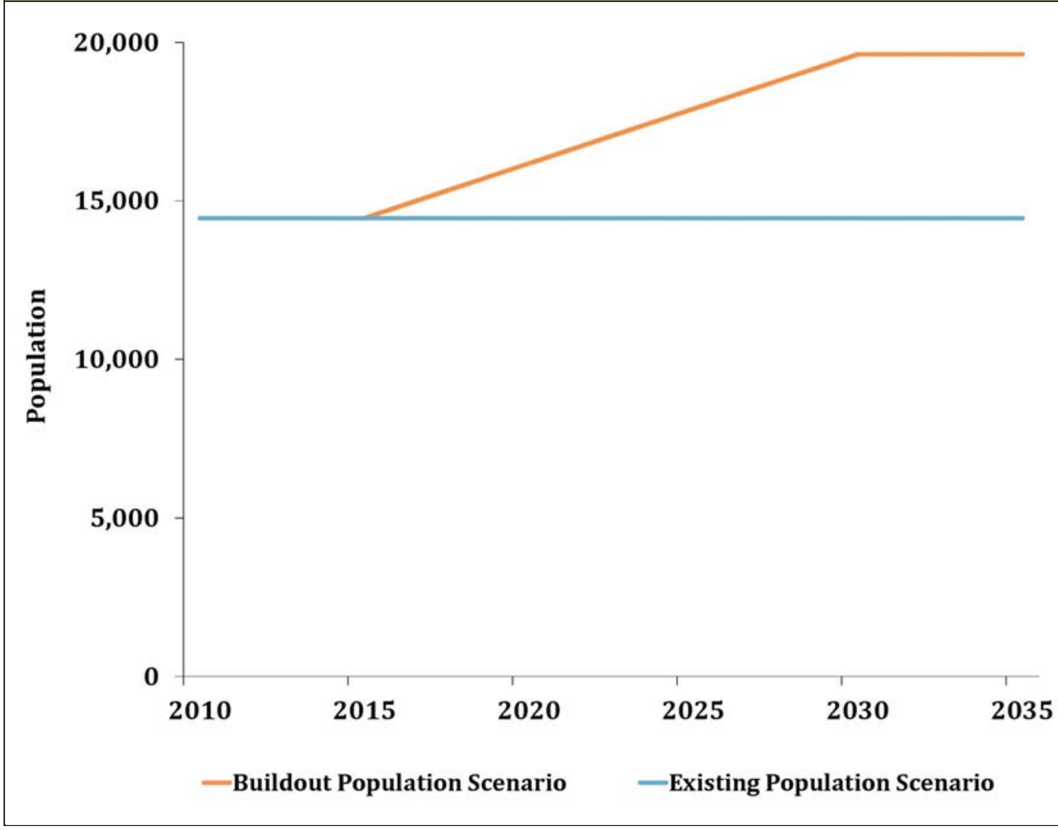
The Existing Population Scenario and Buildout Population Scenario represent low and high marks for future urban water demands, and actual future development within the URL may fall somewhere between those two scenarios. Additionally, population growth under the Buildout Population Scenario may be slower than the projection used in this Basin Plan. Projected population under the two scenarios is listed in Table 23 and depicted in Figure 48. The population figures are higher here than in the draft EAP Update because of the inclusion of the entire Plan Area, which covers some residential properties located outside the URL.

Table 23. Los Osos Population Projections (2010-2035)

	2010	2015	2020	2025	2030	2035
Existing Population Scenario	14,600	14,600	14,600	14,600	14,600	14,600
Buildout Population Scenario	14,600	14,600	16,350	18,100	19,850	19,850

The Parties initially analyzed the projected water demands of the Los Osos community under the Existing Population Scenario and Buildout Population Scenario without implementation of any water use efficiency improvements. Because certain improvements are required by the CPC, CalGreen building standards and other existing legal mandates, there will be some reduction in urban water use in the Basin Area even without any actions under the Basin Plan. Those legal mandates would reduce urban water use in Los Osos by approximately 12 percent over the next 25 years under the Existing Population Scenario, and by 19 percent under the Buildout Population Scenario. The Parties analyzed future water demands both with and without implementation of current legal mandates.

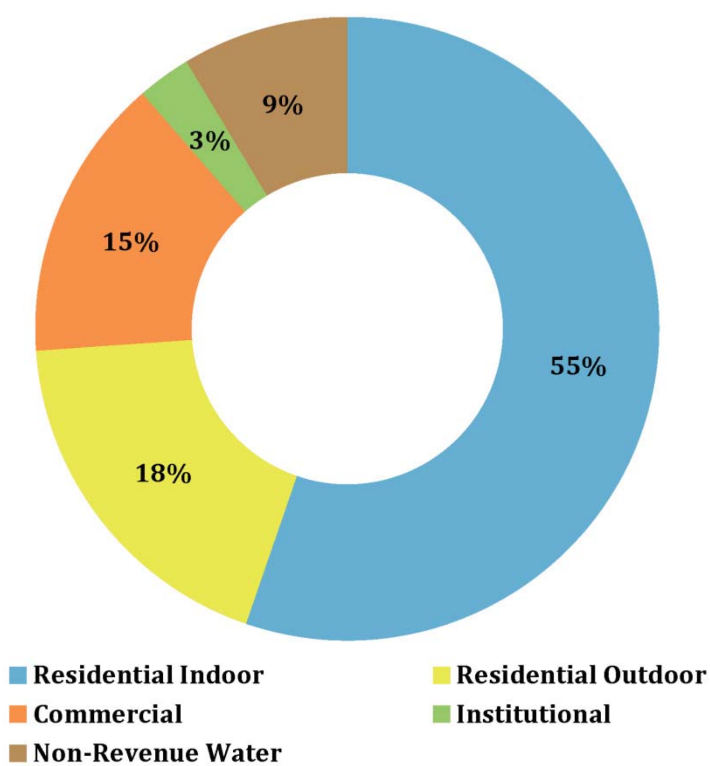
Figure 48. Los Osos URL Population Projections (2010-2035)



Urban water demands within Los Osos are broken down into three sectors: residential, commercial and institutional. Although water use in some geographic areas of California also includes substantial industrial use, the three sectors listed above are the most appropriate for Los Osos, due to the absence of substantial industrial development in the community.

The distribution of overall urban water use in Los Osos by sector is shown in Figure 49. The residential sector (combined indoor and outdoor) is by far the largest, representing almost 75 percent of all urban water use in Los Osos. When compared to the statewide proportions depicted in Figure 42, it is clear that Los Osos has substantially higher residential water use, lower commercial and institutional use, no industrial use, and slightly lower non-revenue water. If the community were to grow as projected under the Buildout Population Scenario, it is anticipated that the distribution of urban water uses would remain roughly the same, though it would be somewhat dependent on the types and mix of commercial activities present in the community at any given time.

Figure 49. Distribution of Urban Water Uses in Los Osos



8.5 Water Use Efficiency Measures and Programs

8.5.1 *Current Water Use Efficiency Measures*

Although this Basin Plan represents a comprehensive, community-wide effort to improve urban water use efficiency, the need for reducing water use has not been ignored in Los Osos in the past, and the Purveyors and County have implemented a number of urban water use efficiency measures. Those measures have affected the existing penetration of water efficiency improvements within the Plan Area, baseline water usage and the extent to which new water use efficiency programs may reduce future water demands. As noted above, based in part on the actions already taken by the Purveyors and County, urban water usage has consistently declined in recent years. Between 1988 and 2013, urban water usage in Los Osos declined by approximately 40 percent, and water usage in 2013 was at its lowest point during the period.

(A) *County*

The County promotes urban water use efficiency pursuant to its role as the land use planning agency for the Plan Area, and its actions focus on promoting efficiency in new development. By ordinance, the County requires the developer of any new structure that uses water from the Basin to install plumbing fixtures that meet certain requirements, including:

- HETs using no more than 1.28 gallons per flush;
- Showerheads using no more than 2.5 gpm;
- Bathroom faucet aerators with a volume of no more than 1.0 gpm;
- Hot water circulation systems for master bathrooms and kitchens if the furthest plumbing fixture unit in these rooms is greater than 20 pipe-feet from the hot water heater;
- Waterless urinals in all commercial structures;
- New residences plumbed for grey-water systems pursuant to Chapter 16 of the Uniform Plumbing Code.[119]

Before issuing a construction permit for a new structure with plumbing fixtures that use water from the Basin, the County requires the developer to retrofit fixtures in other existing structures within the Plan Area. Retrofits are each assigned a value, and must total an amount equal to at least two times the projected water use of the new structure.[120] In addition, before issuing a construction permit for certain remodels of an existing structure, the County requires that all fixtures within the structure be retrofitted to meet water efficiency standards.[121]

The County has also adopted an ordinance requiring the retrofit of inefficient toilets, showerheads and bathroom faucet aerators in existing residential and commercial structures upon the resale of those structures. Sellers are required to provide confirmation through a County-issued "water conservation certificate" prior to change in ownership. Compliance is monitored by escrow officers, who confirm that a water conservation certificate has been received prior to closing of the property sale transaction.[122]

(B) *Purveyors and Water Users*

Each of the three Purveyors in Los Osos has taken actions to promote efficient use of water by their customers. Most of their actions have taken the form prescribed by the CUWCC in its BMPs to provide public information or subsidies for replacement of older, less efficient fixtures with newer, more efficient ones. The participation of the Purveyors in each of the BMPs through 2013 are listed in Table 24. Several of the unimplemented BMPs are not applicable within Los Osos. For example, BMP 10 for wholesale agency assistance programs could not be implemented in Los Osos because there is no agency that provides wholesale water service.

[119] County Code § 19.07.042(e)(1).
[120] County Code § 19.07.042(e)(2), Appendix A.
[121] County Code § 19.07.042(e)(3), (4).
[122] County Code §§ 8.91.010 *et seq*.

Table 24. Purveyor Implementation of Water Efficiency BMPs				
	Best Management Practice	LOCSD	GSWC	S&T
1	Water survey programs for residential customers	■		
2	Residential plumbing retrofit	■	■	
3	System water audits, leak detection and repair	■	■	■
4	Metering with commodity rates for all connections	■	■	■
5	Large landscape conservation programs and incentives			
6	High-efficiency clothes washing machine financial incentive programs			
7	Public information programs	■	■	
8	School education programs	■	■	■
9	Conservation programs for CII accounts			
10	Wholesale agency assistance programs			
11	Retail conservation pricing	■	■	■
12	Conservation coordinator	■	■	
13	Water waste prohibition	■	■	■
14	Residential ultra-low-flow toilet replacement programs			

As noted throughout this chapter, while the Purveyors and County are empowered and intend to promote the efficient use of water via regulations and incentives, the ultimate responsibility for using water efficiently rests with the residents, businesses and institutions of Los Osos. Those water users have responded to past Purveyor water conservation programs in a variety of ways, from taking full advantage to ignoring them. The Urban Water Use Efficiency Program adopted in this Basin Plan will need to achieve more complete penetration of the community in order to achieve its goals.

8.5.2 *Future Efficiency Measures*

With the assistance of MWM, the Parties reviewed current urban water uses in Los Osos and developed a number of water efficiency improvement measures that could be used to meet the conservation goals set forth in Section 8.3. As a first step, the Parties screened a broad, initial list of 60 potential measures based on the following criteria:

- **Technology/Market Maturity.** Refers to whether the technology needed to implement the conservation measure is commercially available and supported by the local service industry. A measure was scored low if the technology was not commercially available or high if the technology was widely available in the service area. A device was screened out if it is not yet commercially available in the region.

- **Service Area Match.** Refers to whether the measure or related technology is appropriate for the area's climate, building stock or lifestyle. For example, promoting xeriscape gardens for multi-family or commercial sites may not be appropriate where water use analysis indicates little outdoor irrigation. Thus, a measure scored low if it was not well suited for the area's characteristics and could not save water. A measure scored high if it was well suited for the area and could save water.

- **Customer Acceptance/Equity.** Refers to whether retail customers within the community would be willing to implement and accept the conservation measure. For example, would retail customers attend homeowner irrigation classes and implement lessons learned from these classes? If not, then the water savings associated with this measure would not be achieved, and a measure with this characteristic would score low. This criterion also refers to retail customer equity, i.e., whether one category of retail customers receives the benefit while another pays the costs without receiving benefits. Retail customer acceptance may be based on convenience, economics, perceived fairness and aesthetics.

Measures with low scores were eliminated from further consideration by the Parties, while those with high scores passed into the next evaluation phase. This process reduced the number of measures to be evaluated to 33. Some of these measures would be applied to existing development, and some would be limited to new development because existing development cannot be retrofitted as a practical matter. The measures carried forward for analysis are listed in Table 25 and described in detail below.

For ease of reference, the measures set forth in this Urban Water Use Efficiency Program use the same numbering and features as in the County's Water Conservation Implementation Plan for the LOWWP. That plan is described in further detail in Section 8.6.2. The Water Conservation Implementation Plan includes a detailed description of the implementation of each efficiency measure.

Table 25. Urban Water Efficiency Measures		
No.	**Measure Name**	**Target**
Category 1. Residential Measures		
1A	Subsidized Community Retrofit (Partial)	Residential toilets, showerheads, faucets
1B	Residential Clothes Washer Rebate	Residential clothes washers
1C	Alternatives for Fully Retrofitted Residences	Residential dishwashers, faucets
1D	Retrofit on Resale	Residential toilets, showerheads
1E	High Efficiency Toilet Rebate	Residential toilets
1F	Fixture Replacement by Deadline	Residential toilets, fixtures
1G	Subsidized Community Retrofit (Full)	Residential toilets, fixtures, clothes washers
1H	Retrofit Kit Distribution	Residential fixtures
1I	Purveyor Service Meters	Residential intelligence
1J	Purveyor Conservation Pricing	Residential intelligence
1K	Greywater Retrofit	Residential irrigation
1L	Cisterns/Rain Catchment	Residential irrigation
1M	Rain Sensors Rebate	Residential irrigation
1N	Rotating Sprinkler Nozzle Rebate	Residential irrigation
1O	Water Waste Ordinance	Residential irrigation, leaks
1P	Turf Removal	Residential irrigation
Category 2. Commercial and Institutional Measures		
2A	Subsidized Community Retrofit (Partial)	Commercial
2B	Replace Pre-Rinse Spray Nozzles	Commercial spray nozzles
2C	Institutional Building Retrofit	Institutional toilets, fixtures
2D	Commercial Clothes Washer Rebate	Commercial clothes washers
Category 3. Education and Outreach Measures		
3A	Residential Water Survey	Residential
3B	Commercial and Institutional Water Survey	Institutional
3C	Public Information Program	All
3D	Media Campaign	All
3E	Efficient Outdoor Use Education Program	Residential irrigation
Category 4. New Development Measures		
4A	High Efficiency Dishwasher Requirement	Residential dishwashers
4B	High Efficiency Clothes Washer Requirement	Residential clothes washers
4C	Hot Water On Demand	Residential
4D	Greywater Plumbing	Residential irrigation
4E	Landscape and Irrigation Standards	Residential irrigation
4F	Smart Irrigation Controllers & Rain Sensors	Residential irrigation
4G	Multi-Family Submetering	Residential intelligence
4H	Efficient Fixtures Requirement	Commercial and institutional fixtures

The following measures would be implemented to retrofit existing residential development within the Plan Area, to the extent they have not already been retrofitted.

1A Subsidized Community Retrofit (Partial). This measure would fund the replacement of designated fixtures before residential properties connect to the LOWWP. As such, it would apply only in the Wastewater Service Area. Under this measure, all toilets flushing more than 1.6 gallons are required to be replaced with HETs. Toilets flushing between 1.28 and 1.6 gallons are not required to be replaced, but are eligible for a rebate if replaced with toilets flushing less than 1.0 gallons. All showerheads flowing greater than 2.0 gpm must be replaced with showerheads flowing 1.5 gpm or less. Showerheads flowing less than 2.0 gpm are not included in the measure and not eligible for a rebate. All faucet aerators flowing greater than 1.5 gpm must be replaced by aerators flowing 1.5 gpm or less. Only fixtures on the USEPA WaterSense list will qualify for the rebate.[123]

Retrofits required under this measure can be implemented in one of two ways, at the option of the property owner. First, the property owner can purchase and install approved fixtures and seek a rebate from the County, subject to inspection of the property before and after the installation. Second, the owner may obtain free fixtures purchased in bulk by the County for installation, followed by inspection. The amount of rebate depends on the option chosen and the timing of action, as shown in Table 26. Earlier implementation results in a larger rebate, in order to incentivize early compliance. Year 1 covers calendar year 2013, and Years 2 and 3 cover 2014 and 2015, respectively.

All properties within the Wastewater Service Area are expected to be connected to the wastewater collection system by June 2016, so Measure 1A would be completed by that date.

Table 26. Measure 1A Rebates

		Year 1	Years 2 and 3
Option 1: Customer Purchase	Toilet	$250	$160
	Showerhead	$40	$30
	Faucet Aerator	$5	$5
Option 2: Bulk Fixture Purchase	Toilet	$110	$0
	Showerhead	$10	$0
	Faucet Aerator	$0	$0

Rebate amounts are the maximum rebate, per fixture, for actual expenses for the purchase price and installation costs of each fixture. Installation costs are only eligible for rebates when installed and invoiced by a licensed contractor.

[123] The list can be found at http://www.epa.gov/watersense/product_search.html.

1B **Residential Clothes Washer Rebate.** Residential property owners would be eligible to receive a $150 rebate on an HECW. The rebates would require inspection and installation of a clothes washer that has a rating by the Consortium for Energy Efficiency (CEE) of Tier 3, currently a water factor of 4.0 or less. This measure would be less aggressive than the Subsidized Community Retrofit (Full), because it would offer a smaller subsidy for replacement of inefficient clothes washers. If both measures were adopted, this measure would apply primarily outside the Wastewater Service Area.

1C **Alternatives for Fully Retrofitted Residences.** For those residential properties equipped with water efficient toilets, showerheads and faucets before the start of the Urban Water Use Efficiency Program, this measure would provide up to $300 in rebates for additional water saving devices, including clothes washers, hot water on demand and high efficiency dishwashers approved by the USEPA Energy Star program. Rebates for clothes washers under Measure 1B could be combined with rebates under this measure, for a total rebate up to $450. This program would be available through June 30, 2015.

1D **Retrofit on Resale.** Pursuant to existing County ordinance, this measure would require the installation of HETs and showerheads before the sale of a residential property within the Plan Area.[124] The ordinance requires that a certificate of compliance be submitted to the County that verifies a licensed plumber has inspected the property and determined that HETs and low-flow showerheads were installed before close of escrow for any sale of residential property. This measure would coordinate with California law, but require fixture upgrades rather than notifying the purchaser of the presence of inefficient fixtures.[125]

This measure would result in replacing less efficient toilets and showerheads when a house is sold, which would result in the gradual conversion of fixtures throughout the Plan Area. It would likely result in a more aggressive toilet replacement schedule than the High Efficiency Toilet Rebate measure, but a less aggressive schedule than the Fixture Replacement by Deadline, Subsidized Community Retrofit (Partial) and Subsidized Community Retrofit (Full) measures.

1E **High Efficiency Toilet Rebate.** This measure would provide a $100 rebate or voucher for installation of an HET to residential customers. The rebate amount would reflect the incremental purchase cost between a ULFT and an HET. This measure would incentivize the purchase of HETs when customers replace toilets on a normal replacement schedule. More aggressive toilet replacement would occur as part of the Retrofit on Resale, Fixture Replacement by Deadline, Subsidized Community Retrofit (Partial) and Subsidized Community Retrofit (Full) measures.

[124] County Code §§ 8.91.010 *et seq*.
[125] *See* Cal. Civil Code §§ 1101.1 *et seq*.

1F **Fixture Replacement by Deadline.** In this potential measure, the County would adopt an ordinance requiring owners of residential properties to bring toilets, showerheads and faucets up to efficiency standards by a fixed date at their own expense. The deadline could be the date residences and businesses are required to connect to the LOWWP, since toilet replacement is already required as a condition for connection pursuant to the LOWWP. If Measure 1A were implemented also, this measure would primarily affect those properties that lie outside the Wastewater Service Area, since properties within that area would qualify for the subsidies of Measure 1A. This measure would result in replacement of inefficient toilets on a more aggressive schedule than the High Efficiency Toilet Rebate or Retrofit on Resale measures. It differs from the Subsidized Community Retrofit (Partial) and Subsidized Community Retrofit (Full) measures in that this measure does not include any subsidy to property owners, but requires each property owner to bear his own retrofit expenses.

1G **Subsidized Community Retrofit (Full).** This measure would add residential clothes washing machines to the list of fixtures replaced in the Subsidized Community Retrofit (Partial) measure. Clothes washers with a water factor or 4.0 or lower would be provided. The subsidy would cover the entire cost of fixtures, excluding installation labor. It would apply only in the Wastewater Service Area.

1H **Retrofit Kit Distribution.** This measure would provide owners of pre-1992 homes with retrofit kits that contain easy-to-install low flow showerheads, faucet aerators and toilet tank retrofit devices.

1I **Purveyor Service Meters.** This measure would install totalizing flow meters on all service accounts in the water service areas for each Purveyor. Metering of water usage has been demonstrated to raise awareness of water use and lead to lower levels of consumption.

1J **Purveyor Conservation Pricing.** The goal of this measure is to have the water rate structures of the Purveyors incentivize reduced discretionary water use. For example, with a single-family inclining block rate structure, the number of tiers, volume in each tier, or water rates within each tier could be changed so that more customers are encouraged to conserve. Because this measure requires the use of water meters, it would necessarily follow Measure 1I. Each of the Purveyors has adopted conservation rates.

1K **Greywater Retrofit.** This measure would provide rebates of up to $1,000 per year to assist a certain percentage of single-family homeowners to install greywater systems. More information on greywater use is set forth in Section 11.4.

1L **Cisterns/Rain Catchment.** This measure would provide a $100 rebate to assist a certain number of single-family homeowners per year with installation of rain barrels or cisterns. More information on rainwater harvesting is set forth in Section 11.2.

1M **Rain Sensors Rebate.** This measure would provide a free rain sensor shut-off device for existing irrigation controllers for residential property owners.

1N **Rotating Sprinkler Nozzle Rebate.** This measure would provide rebates for rotating spray nozzles for existing sprinkler irrigation systems for residential, commercial or institutional properties.

1O **Water Waste Ordinance.** Under this measure, the County would adopt or modify existing ordinances or regulations to prohibit the waste of water, which is defined as gutter flooding and failure to repair leaks in a timely manner.

1P **Turf Removal.** This measure would provide a 50¢ per square foot incentive for turf removal for residential properties. The replacement of irrigated vegetation with xeriscape or synthetic turf may significantly reduce outdoor watering needs.

The following measures would be implemented to retrofit existing commercial and institutional development within the Plan Area.

2A **Subsidized Community Retrofit (Partial).** This measure would apply the same actions as Measure 1A to commercial and institutional properties. It would add the replacement of urinals flushing more than 1.0 gallons with models that flush 0.5 gallons or less. The rebates for Measure 2A are shown in Table 27. Since almost all the commercial and institutional properties in the Plan Area are located within the Wastewater Service Area, this measure would result in the retrofitting of essentially all commercial and industrial properties with water efficient toilets, urinals, showerheads and faucets.

Table 27. Measure 2A Rebates

		Year 1	Years 2 and 3
Option 1: Customer Purchase	Toilet	$250	$160
	Showerhead	$40	$30
	Urinals	$500	$250
	Faucet Aerator	$5	$5
Option 2: Bulk Fixture Purchase	Toilet	$110	$0
	Showerhead	$10	$0
	Urinals	$400	$200
	Faucet Aerator	$0	$0

2B **Replace Pre-Rinse Spray Nozzles.** This measure would provide free installation of 1.15 gpm or lower flow spray nozzles for the rinse and clean operations in restaurants and other commercial kitchens or food establishments. The County would purchase qualifying low-flow spray nozzles in bulk and install or distribute them to businesses without charge, as part of the retrofit conducted under Measure 2A. Participation in Measure 2B would be mandatory before connection to the LOWWP.

2C **Institutional Building Retrofit.** This measure would replace inefficient toilets, showerheads and faucet aerators with new, higher efficiency models in schools and churches. The standards for this measure would be the same as in Measure 1A. The 11 properties to which this measure would be applied within the Wastewater Service Area are: Monarch Grove Elementary School, Baywood Elementary School, Sunnyside Elementary School, Bay Osos Montessori School, Los Osos Christian Fellowship, Baywood Park Community Church, Ocean Pacific Church, South Bay Christian Fellowship, Trinity Methodist Church, Village Children's Center and Sunnyside Head Start. Outside the Wastewater Service Area, five properties would be included: Los Osos Middle School, Sonshine Preschool, First Baptist Church of Los Osos, Los Osos Church of Christ and St. Benedict's Episcopal Church.

2D **Commercial Washer Rebate.** This measure would provide a $300 rebate for the installation of high efficiency washers in Laundromats, hotels and other businesses that have commercial washing machines in Los Osos. Rebate amounts would reflect the incremental purchase cost. The County would contact each owner of a commercial washing machine to determine the best method to incentivize the replacement of less efficient models with ones that meet the CEE Tier 3 criteria, currently a water factor of 4.5 or less.

The following educational and outreach measures would be implemented within the Plan Area. These measures would focus on the residential sector, but also provide information to commercial and institutional water users.

3A **Residential Water Survey.** This measure would provide indoor and outdoor water use surveys for existing residential properties. Normally homeowners with high water use are targeted and provided with a customized report on how to save water in their home. The effectiveness of this measure depends on the cooperation of residential water users, both for scheduling the survey and implementing recommended changes. Properties within the Wastewater Service Area would all be surveyed at the same time as inspections occur under Measure 1A.

3B **Commercial and Institutional Water Survey.** Commercial and institutional water users would be offered a free water survey to evaluate ways for their businesses to save water and money. The surveys would be for all commercial and institutional water users within the Wastewater Service Area, as well as other accounts such as hotels, restaurants, stores and schools that use significant amounts of water. The effectiveness of this measure depends on the cooperation of water users, both for scheduling the survey and implementing recommended changes. Measure 3B would be coordinated with Measures 2A, 2B, 2C and 2D.

3C **Public Information Program.** Public education would be used to raise awareness of conservation measures available to customers. The program would continue existing efforts, including school programs, poster contests, speakers to community groups, conservation hotline, website, social media, radio and television time and printed educational materials such as bill inserts. This program would continue indefinitely.

3D **Media Campaign.** This measure would design and run a concentrated media campaign promoting efficient water use. The responsible parties would create and distribute appropriate media campaign messages through website, flyers, banners, community groups, radio and television ads and social media. The campaign may include communications related to a metric of water efficiency, so that the community can understand its progress. This program would continue indefinitely.

3E **Efficient Outdoor Use Education Program.** Under this measure, the responsible party would offer, organize and sponsor a series of educational workshops or other means of educating homeowners in efficient landscaping and irrigation principles. The program would utilize guest speakers, xeriscape demonstration gardens and incentives, such as distribution of nursery plant coupons. The program would be focused on residential properties, but could be useful to commercial and institutional properties as well.

Each of the measures that would potentially be applied to new development is described below.

4A **High Efficiency Dishwasher Requirement.** Under this measure, the County would modify the Building Code to require that dishwashers meet water efficiency standards.

4B **High Efficiency Clothes Washer Requirement.** Under this measure, the County Planning and Building Department would ensure that an efficient clothes washer was installed before new home or multi-family residential building occupancy. The Purveyors would impose conditions of water service that include efficiency standards for washing machines.

4C **Hot Water on Demand.** This measure would require developers to equip new homes or buildings with efficient hot water on demand systems such as structured plumbing systems. These systems use a pump placed under the sink to recycle water from the hot water pipes to the water heater. This measure may also require developers to move the water heater into the center of the house and/or reduce hot water waiting times by having an on-demand pump on a recirculation line.

4D **Greywater Plumbing.** This measure would require that the drain lines in new single-family homes be plumbed for future installation of greywater systems.

4E **Landscape and Irrigation Standards.** This measure would enforce current County Landscape Design Standards for Water Conservation. Those standards specify that development projects subject to design review must be landscaped according to xeriscape principles, with appropriate turf ratios, plant selection, efficient irrigation systems and smart irrigation controllers.

4F **Smart Irrigation Controllers and Rain Sensors.** This measure would require developers for all properties of more than two residential units and all commercial and institutional developments to provide the latest state-of-the-art "smart" irrigation controllers and rain sensors. These smart controllers have on-site temperature sensors or rely on a signal from a central weather station that modifies irrigation times at least weekly.

4G **Multi-Family Submetering.** This measure would require the metering of individual units in new multi-family, condos, townhouses, mobile-home parks and business centers with fewer than four stories and with water heaters in the units.

4H **Efficient Fixtures Requirement.** This measure would revise the County Building Code requirements for new commercial and institutional buildings to require high efficiency commercial equipment such as ice machines, food steamers and conductivity controllers.

Cumulatively, the measures address all major water uses in the residential, commercial and institutional sectors in Los Osos, both indoors and outdoors. As noted above, some measures overlap, and if two overlapping measures are implemented, they would reinforce each other.

8.5.3 *Future Efficiency Programs*

Following identification of the water efficiency improvement measures set forth in Section 8.5.2, the Parties and MWM combined multiple measures into five incrementally aggressive water efficiency programs. The programs were designed to address each of the major water use sectors and locations, with each differing primarily in the time schedule for implementation and amount of subsidy provided to property owners. The specific measures contained in each program are shown in Table 28.

Table 28. Urban Water Use Efficiency Programs

No.	Water Efficiency Measure	A	B	C	D	E
Category 1. Residential Measures						
1A	Subsidized Community Retrofit (Partial)				■	
1B	Residential Clothes Washer Rebate	■	■	■	■	■
1C	Alternatives for Fully Retrofitted Residences					
1D	Retrofit on Resale	■	■	■	■	■
1E	High Efficiency Toilet Rebate	■	■	■	■	■
1F	Fixture Replacement by Deadline					
1G	Subsidized Community Retrofit (Full)					■
1H	Retrofit Kit Distribution		■	■	■	■
1I	Purveyor Service Meters			■	■	■
1J	Purveyor Conservation Pricing			■	■	■
1K	Greywater Retrofit					
1L	Cisterns/Rain Catchment					
1M	Rain Sensors Rebate		■	■	■	■
1N	Rotating Sprinkler Nozzle Rebate					
1O	Water Waste Ordinance					
1P	Turf Removal					
Category 2. Commercial and Institutional Measures						
2A	Subsidized Community Retrofit (Partial)				■	
2B	Replace Pre-Rinse Spray Nozzles		■	■	■	■
2C	Institutional Building Retrofit		■	■	■	■
2D	Commercial Clothes Washer Rebate	■	■	■	■	■
Category 3. Education and Outreach Measures						
3A	Residential Water Survey			■	■	■
3B	CII Water Survey		■	■	■	■
3C	Public Information Program	■	■	■	■	■
3D	Media Campaign		■	■	■	■
3E	Efficient Outdoor Use Education Program					
Category 4. New Development Measures						
4A	High Efficiency Dishwasher Requirement			■	■	■
4B	High Efficiency Clothes Washer Requirement		■	■	■	■
4C	Hot Water On Demand		■	■	■	■
4D	Greywater Plumbing		■	■	■	■
4E	Landscape and Irrigation Standards		■	■	■	■
4F	Smart Irrigation Controllers & Rain Sensors		■	■	■	■
4G	Multi-Family Submetering		■	■	■	■
4H	Efficient Fixtures Requirement		■	■	■	■

Program A was designed to contain the measures currently being implemented by the Purveyors, as a baseline for comparison purposes. Programs B and C are more aggressive than Program A. They contain many of the typical water efficiency improvement measures undertaken by urban retail water purveyors. Program B adds 13 measures, and Program C adds an additional four measures.

Programs D and E include all the measures of Programs B and C. In addition, Program D adds the Subsidized Community Retrofit (Partial) measure, and Program E adds the Subsidized Community Retrofit (Full) measure. Both of these measures provide subsidies for the replacement of inefficient toilets, showerheads and faucets, with Program E adding efficient clothes washers. Because the LOWWP requires all residential and commercial properties to be retrofitted before connection to the wastewater collection system, implementation of Programs D and E as part of the LOWWP would result in significantly faster and more complete implementation of water use efficiency improvements. While there is a cost associated with those improvements, the LOWWP is mandated to fund certain water efficiency measures under the terms of its Coastal Development Permit (CDP) from the Coastal Commission. Thus, funding is available for implementation of the measures.

A good example of the development of the programs involves the treatment of toilets. As described in Section 8.3.1, toilets represent the single largest use of water in the residential sector, and the residential sector is predominant in Los Osos. Therefore, toilets are a main focus of the five programs, each of which leads incrementally to faster and more complete replacement of toilets in the community.

- Program A includes the High Efficiency Toilet Rebate and Retrofit on Resale measures that focus on toilets, as well as the Public Information Program that includes public education about toilets. Implementation of these measures would ultimately result in the replacement of most inefficient toilets in Los Osos, but would need to wait on the normal toilet replacement or home sale cycles.

- Program B includes the same measures as Program A, but adds the Retrofit Kit Distribution, Institutional Building Retrofit, Commercial and Institutional Water Survey, Media Campaign, Greywater Plumbing and Efficient Fixtures Requirement measures. The effect of these measures would be to retrofit or replace toilets at a faster rate than Program A, especially in the commercial and institutional sectors.

- Program C includes the same measures as Program B, but adds the Residential Water Survey and Purveyor Service Meters measures to encourage faster toilet replacement in the residential sector.

- Programs D and E both add the Subsidized Community Retrofit measures, which would fully subsidize the purchase of HETs for every residential, commercial and institutional property. This would result in a significant portion of the Plan Area being fully retrofitted with HETs within the first three years of program implementation.

Seven of the water efficiency measures identified in Section 8.5.2 were not included in any of the five programs. Each of those measures are addressed below, including the reasons why they were not incorporated into the programs established in the Basin Plan.

1F **Fixture Replacement by Deadline.** This measure was not included in a water efficiency program because it compels private action without any corresponding financial assistance, and it would be extremely difficult to enforce while respecting residents' privacy. It was determined that the Basin Plan would focus on water efficiency measures that provide economic incentives for private action, or that are tied to an easily verifiable action. For example, it is relatively simple to confirm that residential fixtures have been replaced with efficient models upon sale of a property or connection to the LOWWP. It would be more difficult to enforce an independent requirement without invasive residential inspections.

1K **Greywater Retrofit.** This measure is discussed in more detail in Section 11.4. Implementation of this measure was determined to be relatively expensive relative to the benefits received and best implemented by individual property owners rather than the Parties to this Basin Plan.

1L **Cisterns/Rain Catchment.** This measure is discussed in more detail in Section 11.1. Implementation of this measure was determined to be relatively expensive relative to the benefits received and best implemented by individual property owners rather than the Parties to this Basin Plan.

1N **Rotating Sprinkler Nozzle Rebate.** Implementation of this measure was determined to be relatively expensive relative to the benefits received.

1O **Water Waste Ordinance.** This measure was not incorporated into the water efficiency programs because it would be difficult to enforce on a consistent basis, and the action to be prohibited can be addressed through the Public Information Program, Media Campaign, Residential Water Survey, Rain Sensors Rebate, S&T Service Meters and S&T Conservation Pricing measures. Each of those measures discourages the actions that would be prohibited under the potential ordinance, and collectively are likely to be as effective without the difficulty of enforcement.

1P **Turf Removal.** Implementation of this measure was determined to be relatively expensive relative to the benefits received. In addition, Los Osos already has relatively low acreage of turf compared to other California communities.

3E **Efficient Outdoor Use Education Program.** This measure was determined to be duplicative of the Public Information Program, Media Campaign and Residential Water Survey measures.

While the measures above are not incorporated into the water efficiency programs of this Basin Plan, residential, commercial and institutional property owners are encouraged to undertake those actions in their discretion. Based on the cautious planning approach used throughout this Basin Plan, the projections of urban water demands in the following section do not assume any implementation of the seven unincorporated efficiency measures.

8.5.4 *Impact of Future Water Efficiency Programs*

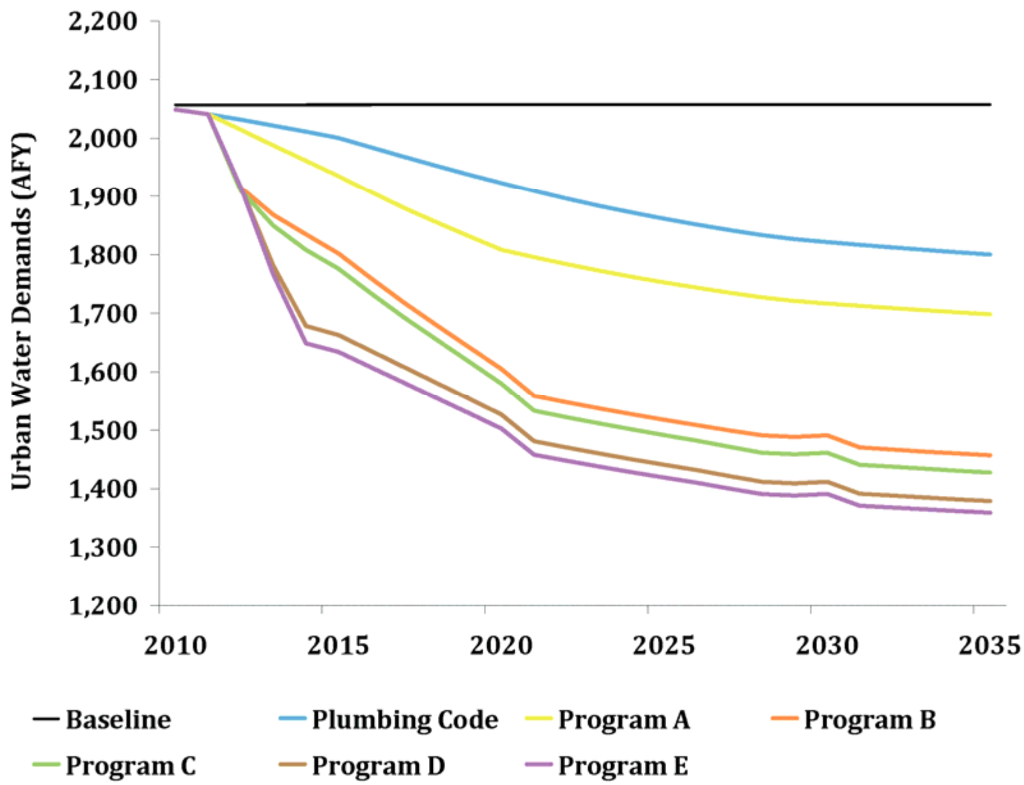
Following development of the water use efficiency measures and programs, the Parties and MWM analyzed the impact that those programs would have on urban water use in Los Osos. This analysis is intended to provide a general understanding of the impacts on urban water demands in the Basin if water efficiency measures were implemented. The measures and programs assembled by the Parties and MWM reflect the current intentions of the Parties, but do not confine water use efficiency actions to be undertaken by the Parties or individual water users in Los Osos. A slightly varied program might be implemented to achieve the desired level of water use efficiency within Los Osos. Such variations would be expected based on the response received by the Parties within the community, so that resources can be targeted at those measures that receive the highest interest in participation from water users. The implementation schedule may also be adjusted as necessary to reach the Purveyors' water efficiency goals. This evaluation is based upon the water efficiency programs rather than individual measures. Thus, the savings from overlapping measures are not counted more than once.

Figure 50 depicts the impacts of the water efficiency programs under the Existing Population Scenario. Figure 50 shows that urban water demands under the Existing Population Scenario would decrease incrementally with implementation of the CPC and each of the Programs A through E. The differences between the programs are demonstrated by an increasingly sharp decline in water demands in early years and lower total water demands at the end of the projected period in 2035. By the end of that period, implementation of the CPC would result in water use of approximately 1,800 AFY, and Program E would result in water use as low as 1,360 AFY.

The range of projected efficiency improvements under the CPC and Programs A through E is similar to, but slightly higher than, the results of the CALFED Report's evaluation of potential water savings in the Central Coast hydrologic region. That report included a range from 11 percent—assuming implementation of federal and state standards—to 28 percent—assuming that all cost-effective BMPs are implemented, and that there is substantial funding available. The CALFED Report estimated the technical potential of water savings to be 34 percent. A comparison demonstrates both that Los Osos has a greater potential for water use efficiency improvement and that this Basin Plan is relatively aggressive in its goals.[126]

[126] *See* CALFED Report, at 125.

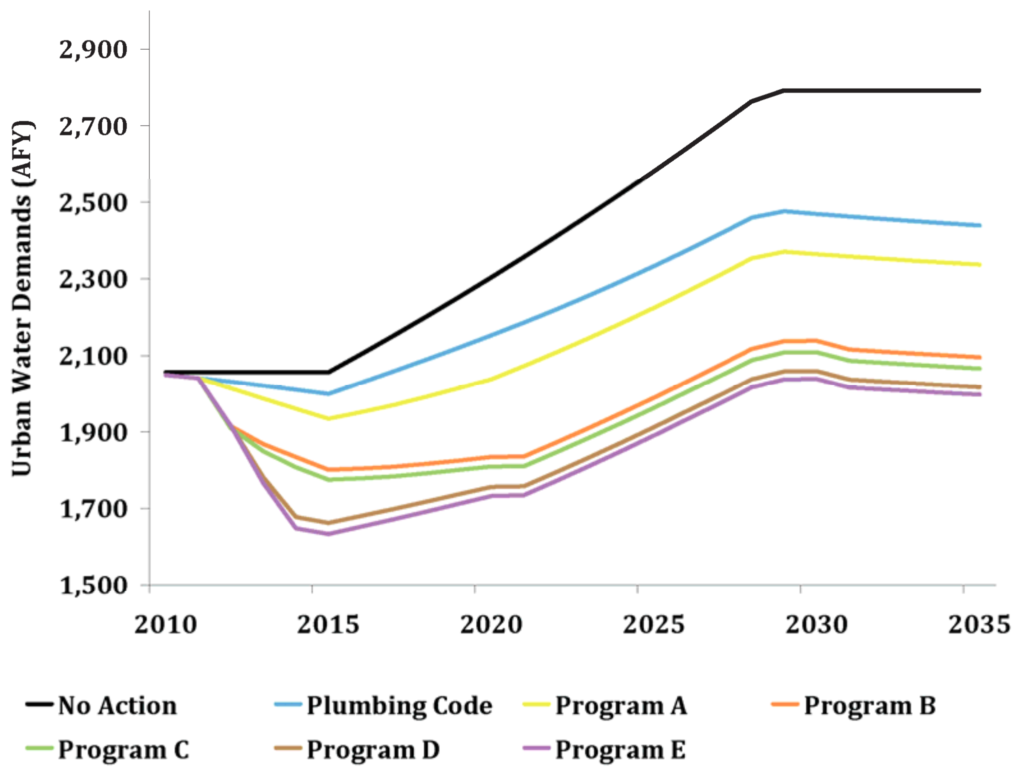
Figure 50. Urban Water Demands Under Existing Population Scenario (2010-2035)



In Figure 50, baseline water demands are depicted as being constant into the future. That baseline projection represents a hypothetical, but unrealistic view of future urban water use, because use would decline with the normal replacement of fixtures and appliances under existing federal and state standards. Water savings from the CPC would occur regardless of any actions taken under this Basin Plan, and thus represents a more realistic baseline. Nonetheless, the federal and state standards capture only 37 percent of the water savings potential for the Plan Area. Therefore, this Basin Plan does not rely on the CPC alone to improve urban water use efficiency in Los Osos.

The analysis above assumes that there is no further urban development in the Plan Area. As described in Section 3.5, however, it is anticipated that the County may allow some development if the LOWWP is constructed and the Basin is brought into a long-term sustainable condition. For purposes of this Basin Plan, it is assumed that such development would be limited by the Buildout Population Scenario. Figure 51 depicts the impact of the efficiency programs on urban water demands under the Buildout Population Scenario. The same water efficiency measures would be implemented under the Buildout Population Scenario as under the Existing Population Scenario, plus those measures that apply to new development.

Figure 51. Urban Water Demands Under Buildout Population Scenario (2010-2035)



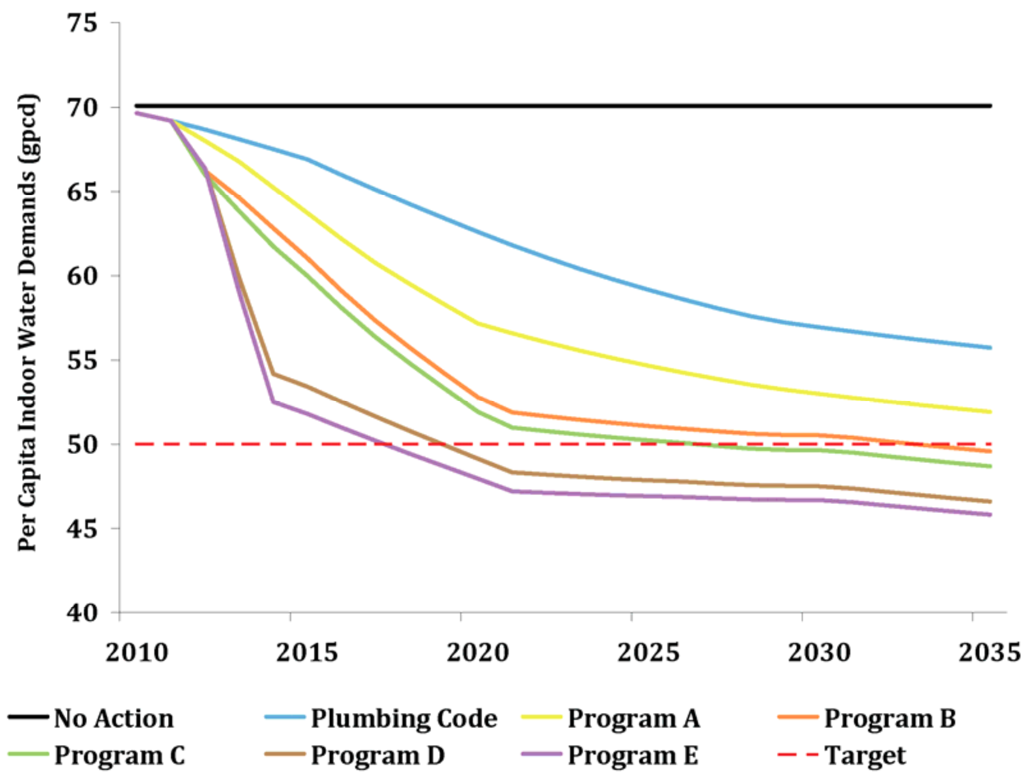
As a general rule, new development would be required to be more efficient than existing development. Projected water demands are greater in Figure 51 (Buildout Population Scenario) than in Figure 50 (Existing Population Scenario) because of the larger population in Los Osos, but per capita water use declines by a greater percentage in the Buildout Population Scenario, because new development would be subject to stricter water use standards.

Figure 51 is similar to Figure 50 except that it shows water usage declining in the early years, followed by an increase accompanying population growth under the Buildout Population Scenario beginning in 2016. Significantly, overall water demands at the end of the planning period would be lower based on implementation of Programs B, C, D or E than water demands are at the beginning of the period under current conditions, even with assumed population growth. That fact alone, however, does not justify the allowance of new development in the Plan Area, because current levels of groundwater extraction from the Basin are unsustainable without implementation of other elements of this Basin Plan. Approval of new development in Los Osos is within the authority of the County and the Coastal Commission, and is beyond the scope of the policies contained in this Basin Plan.

Urban water use may be broken down into indoor and outdoor components. Figure 52 shows changes over time of urban per capita indoor water use due to the water efficiency programs. The indoor water use goal imposed by the County and Coastal

Commission in connection with construction of the LOWWP is 50 gpcd by 2020. If only the CPC and Program A were implemented, the 50 gpcd goal would be not reached by 2035. If Program B were implemented, the goal would be reached in 2032, and if Program C were implemented, the goal would be reached in 2026. Only Programs D and E would allow Los Osos to meet the goal before 2020. Under Program D the goal would be reached in 2019, and under Program E it would be reached in 2018. Thus, in order to meet this external goal imposed by the County and the Coastal Commission, the Parties would need to adopt and implement either Program D or Program E.

Figure 52. Per Capita Indoor Water Use in Buildout Population Scenario (2010-2035)



As noted in Section 8.4.2, the baseline used to project future urban water demands is based on historical demands during 2006, 2007 and 2008. Between 2006-2008 and 2012, urban water demands fell by approximately 21 percent, from an average of 2,180 AFY to 1,720 AFY. This has led some in the community to question whether additional urban water use efficiency measures would be effective or necessary.

The most significant portion of the decrease in urban water demands from 2006-2008 to 2013 was likely caused by changes in the behavior of water users, tied to a broad decline in the economy, water rate increases by LOCSD and GSWC, and increasing awareness of the challenges facing the Basin by residents and businesses of Los Osos. Replacement of fixtures and appliances appears to have been a less significant factor, and therefore the potential water savings from the measures and programs identified in this Section 8.5 remain largely untapped. Without the replacement of fixtures and appliances, water demands might return to higher levels in the future as economic growth accelerates. For these reasons, the Parties agree that the measures and programs identified in this Urban Water Use Efficiency Program remain both viable and necessary to reduce urban water demands in Los Osos.

The decrease in urban water use between 2006-2008 and 2013 may serve to either dampen or amplify the effect of the measures and programs analyzed in this section. Implementation of those measures and programs might result in a reduction of either or both of the quantity and percentage of conserved water, so that the outcome is less advantageous than it would have been starting in 2006-2008. Nonetheless, there is no doubt that the measures and programs identified in this Section 8.5 will improve the efficiency of urban water use in Los Osos, regardless of the magnitude of that vector. That the Los Osos community is closer to the urban water efficiency goals set forth in this Basin Plan in 2013 than it was in 2006-2008 should be taken as supporting the MWM analysis, rather than excusing a course of no action.

8.5.5 *Financial Impacts of Water Conservation Measures*

This section analyzes costs associated with the potential water use efficiency programs, and the impact of water use efficiency on utility rates.

Many water use efficiency programs are independent, that is, they are not part of an integrated water resource management plan. Under those circumstances, water use efficiency measures are analyzed for their internal benefits and costs without regard to external benefits and costs related to use of water resources. When water efficiency programs are included in an integrated water resources management plan, such as this Basin Plan, the financial analysis of those programs must include the benefits and costs associated with other elements of the planning effort. For example, while an urban water efficiency improvement measure might not be cost-effective where water resources are unconstrained, that measure might be very financially beneficial in light of avoided costs associated with an alternative water management effort.

Pursuant to Condition 99 and Special Condition 5b of its CDP for the LOWWP, the County must expend $5 million on the Urban Water Use Efficiency Program within the Wastewater Service Area. It is anticipated that $5 million will enable the County to implement all actions under Program D. In order to implement Program D outside the Wastewater Service Area, it is projected that another $500,000 would be required. Therefore, this Basin Plan sets the projected cost of the Urban Water Use Efficiency Plan at $5.5 million for the entire Plan Area.

Funding options for this Basin Plan are set forth in Chapter 15. As discussed there and in Section 8.6, community-level funding for the water efficiency programs would be provided through either the County, as owner and operator of the LOWWP, or the Purveyors. The Parties could secure those funds in one or more of the following ways:

- Grant funding from the DWR, SWRCB or other source external to the Los Osos community;
- Funding by all properties within the Basin;
- Financing by each Party as a capital investment; or
- Payment by each Party on an annual basis as an expense.

Each method of securing funds has both positive and negative aspects. Grant funding reduces the economic burden of the programs on residents, businesses and institutions of Los Osos, but may not be available and violates the principle that costs of a program should be borne by the persons who benefit therefrom. Basin-wide property funding would be highly equitable in reaching the broadest potential range of payors and may achieve the lowest cost of capital, but would not provide economic incentives for efficient use. Financing by each Party as a capital investment would make use of existing organizational structures and provide substantial access to capital, but would impose differential costs across the Plan Area and would fail to impose any charge on private domestic well owners or other users of water from the Basin. Payment by each Party as an annual expense would reduce capital interest costs, but would limit the amount of money available and cause highly variable charges across program years. Choosing a method of payment for Urban Water Use Efficiency Program costs requires a careful balancing of factors, including equity across the Plan Area, availability of capital funds with various costs of capital, and creation of proper economic incentives.

It is also important to note potential impacts on the Purveyors' water rates from implementation of the Urban Water Use Efficiency Program. There are two potential ways that the program could affect each utility: an increase in costs to implement the program, and a decrease in revenue based on lower water sales.

First, any funding arranged through the Purveyors will add to their capital repayment or annual expenses, and therefore their revenue requirements. With all other rate inputs being equal, the Purveyors would need to increase their water rates to cover the increased revenue requirement associated with water efficiency programs. It seems strange from the typical business perspective that an enterprise would incur increased costs in order to sell less of its product, but that is true for water utilities that implement water efficiency programs.

Second, it is axiomatic that water efficiency programs are designed to decrease water consumption by utility customers, which in turn causes a decrease in the revenues collected by a water utility, if rates are held constant. Accordingly, as part of water use efficiency programs, water utilities often need to increase their per unit water rates to meet revenue requirements and pay all the costs of providing water. This is especially true in light of the fact that many costs, such as capital repayment and labor, are fixed and do not vary with the amount of water delivered to customers.

For example, if we assume that a hypothetical water utility charges an average of $100 for water per customer, which consists of a $25 fixed service charge and $75 variable commodity charge, and utility costs which are 75 percent fixed and 25 percent variable, a 25 percent reduction in water use would require a 22 percent increase in the commodity rate for the utility to balance its budget, without accounting for elasticity of demand. In reality, we know that increased water rates result in further reduced usage, so that the impact on rates would be greater still. Water rates and demands will eventually reach an equilibrium so that utility revenue requirements are met exactly, but it is often difficult to set rates that reach such equilibrium.

A further complication is that both LOCSD and GSWC use conservation rate designs, meaning that commodity costs increase as each customer uses more units. Such a rate design amplifies the difficulties of reaching equilibrium, because higher marginal water rates provide greater incentivizes to reduce water usage, and cause a greater change in revenue per unit. It will be important for the residents, businesses and institutions of Los Osos to be understanding of the difficulties faced by the Purveyors in setting rates at the proper level. Each of the Purveyors may experience the need to adjust its rates in response to the uncertainties associated with implementation of the water use efficiency programs.

The impact of rate increases that usually accompany implementation of water use efficiency measures are not uniform within a community. Residents who embrace water use efficiency measures and are conscientious about decreasing their water use will likely see a decrease in their total water utility bill compared to what it would have been without water efficiency improvements, because although the per unit rate is higher, the decrease in water consumption more than compensates for the impact of increased rates. Residents who are moderately committed to water conservation are expected, on the whole, to see little or no change in their water bill, even under increased rates, because the decrease in consumption offsets the increased rates. Residents who do not make an effort to conserve water—i.e., residents whose overall water use remains unchanged or increases—are expected to see an increase in their overall water bills due to increased rates combined with unchanged water consumption.

The impact of water use efficiency programs on utility revenue requirements must be determined separately for each of the Purveyors. Utility rates are also significantly affected by capital improvement plans and costs of critical supplies such as electricity, fuel, chemicals and labor, some of which are independent of water use efficiency. Each of the Purveyors will address the financial impacts of implementing the water use efficiency programs set forth in this Basin Plan through their typical ratesetting process. In the case of GSWC, those impacts will be evaluated by the CPUC as part of its review and approval of rates.

8.6 Basin Plan Actions

8.6.1 *Water Efficiency Goals*

As established in Section 8.1, it is the goal of this Basin Plan that Los Osos achieve the highest standards for water use efficiency. Improving urban water use efficiency is the highest priority program of this Basin Plan for balancing the Basin and preventing further seawater intrusion in the groundwater supply. In furtherance of those goals, this Basin Plan seeks to achieve maximum practical savings for those water uses that are common in the Plan Area, to meet or exceed the current and future state of the art for urban water use efficiency.

Accordingly, this Basin Plan sets the following specific goals:

- Every toilet in the Wastewater Service Area should be an HET by 2016, and every toilet in the Plan Area should be an HET by 2035;
- Every showerhead in the Plan Area should be a high efficiency model with flows no more than 1.5 gpm by 2016;
- Every bathroom faucet in the Plan Area should be equipped with an aerator to allow flows of no more than 1.5 gpm by 2016;
- Every residential, commercial and institutional clothes washing machine in the Plan Area should be replaced with an HECW by 2025;
- Every pre-rinse spray nozzle in the Plan Area should be replaced with a model that flows no more than 1.15 gpm by 2016;
- Surveys of indoor and outdoor water use should be conducted for all residential, commercial and institutional water users in the Wastewater Service Area by 2016;
- Surveys of indoor and outdoor water use should be conducted for the top 10 percent of all residential water users and the top 50 percent of commercial and institutional users outside the Wastewater Service Area but within the Plan Area by 2016;
- All new development should be equipped with the most water efficient fixtures and appliances available and plumbed for hot water on demand and potential future greywater use;
- A prominent public information and media campaign regarding the need for water use efficiency within the Plan Area should be established; and
- The Purveyors should meter all water delivered and bill customers by the amount of water used, preferably with a rate design that encourages water use efficiency to the extent practicable.

In order to achieve the goals of this Urban Water Use Efficiency Program, it is the intention of the Parties to implement water use efficiency measures equivalent to Program D as set forth in Section 8.5.3. Programs D and E are the only water efficiency programs that would achieve the above goals, based on the timing and completeness of the water efficiency measures included in those two programs. The only difference between Programs D and E is the subsidization of residential washing machine replacement within the Wastewater Service Area. Program D is expected to reduce water demands to approximately 1,380 AFY by 2035 under the Existing Population Scenario, while Program E would reduce water demands to approximately 1,360 AFY. Under the Buildout Population Scenario, water demands would be reduced to approximately 2,020 AFY for Program D and 2,000 AFY for Program E.

The difference in water savings between Program D and Program E is not considered to be significant. In practice, the only difference between the two programs is that under Program E, the LOWWP would collect wastewater utility rates from its customers and use a portion of those revenues to purchase new, efficient clothes washing machines to replace older machines owned by those same LOWWP customers. Under Program D, residents of the Wastewater Service Area will be able to choose whether to purchase new washing machines on an individual basis, rather than having the County make such purchases for them as a requirement for connection to the LOWWP. This approach is more fair to homeowners who have already invested in efficient washing machines and more protective of individual investments, since washing machines are relatively expensive compared to water fixtures such as toilets, showerheads and faucet aerators. The County would continue to offer rebates for efficiency clothes washers for those residents, businesses and institutions that choose to replace their less efficient appliances.

Implementation of Program D will exceed the requirements of the statewide 20x2020 Plan described in Section 8.2.4. By 2020, Program D is expected to decrease per capita urban water use within the Plan Area from a baseline of 135 gpcd in 2006-2008 to approximately 94 gpcd for the Existing Population Scenario and 97 gpcd for the Buildout Population Scenario. Those represent 30 percent and 28 percent reductions, respectively, both of which exceed the 20 percent mandate.[127]

Implementation of urban water use efficiency measures will involve active participation by the County, GSWC, LOCSD, S&T and the residents of Los Osos. The County will participate in its roles as land use planning agency and as the owner and operator of the LOWWP. GSWC, LOCSD and S&T will participate in their roles as water purveyors, who can use revenue from utility rates to provide education and financial incentives to residents. Individual residents of Los Osos will participate by accepting financial incentives, installing efficient fixtures and implementing water use efficiency measures that are not targeted by the County or Purveyors.

[127] See DWR, *Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use*, Methodology 3 (October 1, 2010).

The roles of the County and Purveyors will vary based on location in the Basin and time period. The County will assume primary responsibility for implementing the Urban Water Use Efficiency Program during the period from 2013 through 2018. The Purveyors will assume primary responsibility from the County beginning in 2019 within their respective service areas.

8.6.2 *Implementation Measures (2013-2018)*

The County will be the primary agency for implementation of the Urban Water Use Efficiency Program from 2013 through 2018. It will undertake actions pursuant to three different roles: as the general government exercising its land use planning authority and police power in the Plan Area; as the owner and operator of the LOWWP within the Wastewater Service Area; and as the administrator of efficiency measures outside the Wastewater Service Area based on convenience and program efficiency. The County will implement all the water efficiency measures set forth in Table 29, according to the area in which each measure applies, as each measure is described in Section 8.5.2 and the *Water Conservation Implementation Plan*.

As the local agency with land use authority within Los Osos, the County has adopted ordinances related to the retrofitting of properties on resale[128] (Measure 1D) and water efficiency standards for new development[129] (Measures 4A through 4H).

As the owner and operator of the LOWWP, the County will be responsible for administering multiple measures of this Urban Water Use Efficiency Program within the Wastewater Service Area. Those measures apply to the residential sector (Measures 1A, 1B, 1C and 3A), the commercial and institutional sectors (Measures 2A, 2B, 2C, 2D and 3B) and all water users through public information and media campaigns (Measures 3C and 3D). Collectively, these measures will generate the bulk of the water efficiency improvements within the Plan Area, especially in light of the fact that the Wastewater Service Area includes approximately 90 percent of the Los Osos population. Each of the residential, commercial and institutional measures will be implemented prior to connection of properties to the LOWWP.

In order to achieve consistent application and efficient administration, the County will also administer the Urban Water Use Efficiency Program outside the Wastewater Service Area from 2015 through 2018. Because properties located outside the Wastewater Service Area will not be connecting to the LOWWP, there is no definitive deadline by which they must implement water efficiency improvement measures. As set forth in Section 8.5.2, outside the Wastewater Service Area the County will provide economic incentives for property owners to voluntarily participate in the Urban Water Use Efficiency Program. Those incentives take the form of rebates for toilets (Measures 1E and 2C), showerheads and faucets (Measures 1H and 2C), clothes washers (Measures 1B and 2D), rain sensors (Measure 1M) and pre-rinse spray nozzles (Measure 2B), combined with public information and education campaigns that strongly encourage property owners to

[128] County Code §§ 8.91.010 *et seq*.
[129] County Code § 19.07.042(e)(1).

participate (Measures 3C and 3D). The County will also provide water surveys for all properties outside the Wastewater Service Area (Measures 3A and 3B) on an equal basis with those located within the Wastewater Service Area.

Because the focus of water efficiency improvements for the LOWWP is on indoor water use, the implementation of measures related to outdoor water use efficiency (Measures 1M and 3E) will apply equally across the Plan Area, based on the County's role as a convenient and efficiency administrator of the Urban Water Use Efficiency Program during the period from 2013 through 2018.

The County will consult with the Purveyors for design and implementation of the public information program (Measure 3C), media campaign (Measure 3D) and efficient outdoor use education program (Measure 3E). That consultation will take place as part of the Basin Management Committee's administration of Basin water resources. In addition, the Purveyors will share water consumption data with the County for use in evaluating the effectiveness of the Urban Water Use Efficiency Program. The Parties will consult at least once per year regarding the status and effectiveness of the program.

Pursuant to Condition 99 and Special Condition 5b of its CDP for the LOWWP, the County must expend $5 million on the Urban Water Use Efficiency Program within the Wastewater Service Area. Outside the Wastewater Service Area, the County will expend $500,000 on the Urban Water Use Efficiency Program. The analysis contained in this Basin Plan and the Water Conservation Implementation Plan indicates that $5.5 million will be sufficient for full implementation of the program across the Plan Area through 2018.

The County has included $5 million for the Urban Water Use Efficiency Program within the rates and charges for the LOWWP. Because water use efficiency improvements benefit the entire Basin, and because of the need to generate $500,000 in additional funds for the Urban Water Use Efficiency Program outside the Wastewater Service Area, the Parties propose that all costs of the Urban Water Use Efficiency Program be funded by all properties in the Basin (discussed in detail in Chapter 15), rather than through rates and charges for the LOWWP.

The proposed funding by properties in the Basin will be presented to property owners in the Plan Area for their approval. If that approach is approved, $5 million will be contributed from the assessment to the LOWWP in recognition of value provided by the LOWWP to Basin management efforts. That contribution will allow the County to reduce rates and charges for wastewater collection and treatment services by the LOWWP, and thus will benefit property owners within the Wastewater Service Area.

The remaining $500,000 of funding will be assigned to the County for implementation of the Urban Water Use Efficiency Program outside the Wastewater Service Area, and those outdoor efficiency measures that apply across the Plan Area. If any of these funds have not been expended by the end of 2018, they will be distributed among the Purveyors on a per connection basis for implementation of further water efficiency measures.

Table 29. Urban Water Use Efficiency Measures (2013-2018)

No.	Water Efficiency Measure	Inside WWSA	Outside WWSA
Category 1. Residential Measures			
1A	Subsidized Community Retrofit (Partial)	■ (orange)	
1B	Residential Clothes Washer Rebate	■ (orange)	■ (purple)
1C	Alternatives for Fully Retrofitted Residences	■ (orange)	
1D	Retrofit on Resale	■ (blue)	■ (blue)
1E	High Efficiency Toilet Rebate		■ (purple)
1F	Fixture Replacement by Deadline		
1G	Subsidized Community Retrofit (Full)		
1H	Retrofit Kit Distribution		■ (purple)
1I	Purveyor Service Meters	■ (brown)	■ (brown)
1J	Purveyor Conservation Pricing	■ (brown)	■ (brown)
1K	Greywater Retrofit		
1L	Cisterns/Rain Catchment		
1M	Rain Sensors Rebate	■ (purple)	■ (purple)
1N	Rotating Sprinkler Nozzle Rebate		
1O	Water Waste Ordinance		
1P	Turf Removal		
Category 2. Commercial and Institutional Measures			
2A	Subsidized Community Retrofit (Partial)	■ (orange)	
2B	Replace Pre-Rinse Spray Nozzles	■ (orange)	■ (purple)
2C	Institutional Building Retrofit	■ (orange)	■ (purple)
2D	Commercial Clothes Washer Rebate	■ (orange)	■ (purple)
Category 3. Education and Outreach Measures			
3A	Residential Water Survey	■ (orange)	■ (purple)
3B	CII Water Survey	■ (orange)	■ (purple)
3C	Public Information Program	■ (orange)	■ (purple)
3D	Media Campaign	■ (orange)	■ (purple)
3E	Efficient Outdoor Use Education Program	■ (purple)	■ (purple)
Category 4. New Development Measures			
4A	High Efficiency Dishwasher Requirement	■ (blue)	■ (blue)
4B	High Efficiency Clothes Washer Requirement	■ (blue)	■ (blue)
4C	Hot Water On Demand	■ (blue)	■ (blue)
4D	Greywater Plumbing	■ (blue)	■ (blue)
4E	Landscape and Irrigation Standards	■ (blue)	■ (blue)
4F	Smart Irrigation Controllers & Rain Sensors	■ (blue)	■ (blue)
4G	Multi-Family Submetering	■ (blue)	■ (blue)
4H	Efficient Fixtures Requirement	■ (blue)	■ (blue)

County Action: ■ (blue) ⇨ Police Power; ■ (orange) ⇨ LOWWP; ■ (purple) ⇨ Convenient & Efficient Administration. Purveyor Action: ■ (brown).

If property owners within the Plan Area were not to approve the proposed funding, the County would not be responsible for administering the Urban Water Use Efficiency Program outside the Wastewater Service Area unless other funds are provided for that purpose. The County would administer the Urban Water Use Efficiency Program within the Wastewater Service Area pursuant to its obligations under the LOWWP. In that event, the Parties will confer regarding the best method to equitably generate funds for the Urban Water Use Efficiency Program between 2013 and 2018.

8.6.3 *Implementation Measures (2019-2035)*

For the period from 2019 through 2035, the County will relinquish administration of the Urban Water Use Efficiency Program to the Purveyors. Each Purveyor will implement the water efficiency measures set forth in Table 30 within its respective service area, as each measure is described in Section 8.5.2. The County's role will be limited to enforcement of its urban water use efficiency ordinances.

By the end of 2018, many of the water efficiency measures will have been completed within the Wastewater Service Area and the broader Plan Area. For example, all toilets, showerheads and faucet aerators within the Wastewater Service Area will be high efficiency models. Remaining efforts will largely focus on providing rebates for high efficiency clothes washers, residential, commercial and institutional water surveys and the public information and media campaigns. The Purveyors will continue to offer rebates to replace the few low efficiency fixtures and appliances that remain, and will set the rebates at levels that provide adequate incentives for property owners to participate.

In addition, the Purveyors will administer those measures that apply to outdoor water use (Measures 1M and 3E). There is likely to be a continued need for actions to improve outdoor water efficiency during the period from 2019 through 2035 and beyond. LOCSD and GSWC will each commit at least $10,000 per year for implementation of urban water use efficiency measures during the period from 2019 through 2035. The obligation of GSWC will be subject to CPUC approval of rates that include such an amount.

Given the much smaller size of its service area, S&T will commit at least $1,000 per year for implementation of urban water use efficiency measures during the period from 2019 through 2035. As of December 31, 2011, S&T had installed water meters on all its service connections and begun billing its members based on the volume of water used. S&T will continue that billing practice as part of its obligations under this Urban Water Use Efficiency Program. S&T will also implement the same water efficiency measures as the other Purveyors, with the exception of those measures that apply to commercial and institutional properties, since no such properties exist within the S&T service area.

In coordination with the Basin Management Committee, the Parties will periodically revisit this Urban Water Use Efficiency Program to evaluate its effectiveness and determine whether additional measures should be added.

Table 30. Urban Water Use Efficiency Measures (2019-2035)					
No.	**Water Efficiency Measure**	**County**	**LOCSD**	**GSWC**	**S&T**
Category 1. Residential Measures					
1A	Subsidized Community Retrofit (Partial)				
1B	Residential Clothes Washer Rebate		■	■	■
1C	Alternatives for Fully Retrofitted Residences				
1D	Retrofit on Resale	■			
1E	High Efficiency Toilet Rebate		■	■	■
1F	Fixture Replacement by Deadline				
1G	Subsidized Community Retrofit (Full)				
1H	Retrofit Kit Distribution		■	■	■
1I	Purveyor Service Meters		■	■	■
1J	Purveyor Conservation Pricing		■	■	■
1K	Greywater Retrofit				
1L	Cisterns/Rain Catchment				
1M	Rain Sensors Rebate		■	■	■
1N	Rotating Sprinkler Nozzle Rebate				
1O	Water Waste Ordinance				
1P	Turf Removal				
Category 2. Commercial and Institutional Measures					
2A	Subsidized Community Retrofit (Partial)				
2B	Replace Pre-Rinse Spray Nozzles				
2C	Institutional Building Retrofit				
2D	Commercial Clothes Washer Rebate		■	■	
Category 3. Education and Outreach Measures					
3A	Residential Water Survey		■	■	■
3B	CII Water Survey		■	■	
3C	Public Information Program		■	■	■
3D	Media Campaign		■	■	■
3E	Efficient Outdoor Use Education Program		■	■	■
Category 4. New Development Measures					
4A	High Efficiency Dishwasher Requirement	■			
4B	High Efficiency Clothes Washer Requirement	■			
4C	Hot Water On Demand	■			
4D	Greywater Plumbing	■			
4E	Landscape and Irrigation Standards	■			
4F	Smart Irrigation Controllers & Rain Sensors	■			
4G	Multi-Family Submetering	■			
4H	Efficient Fixtures Requirement	■			

8.6.4 *Actions by Los Osos Residents, Businesses and Institutions*

Residents, businesses and institutions will need to actively participate in improving urban water use efficiency in the Plan Area. There are several ways in which these residents, businesses and institutions will participate.

Property owners within the Wastewater Service Area will need to cooperate with the retrofit of their residences, businesses and institutions by the County as part of connection to the LOWWP. The applicable measures include substantial subsidy for the purchase of high efficiency toilets, showerheads, faucet aerators and restaurant spray nozzles, but property owners will be responsible for installation. At the same time, the County will conduct residential, commercial and institutional water use surveys under Measures 3A and 3B. Any recommendations beyond replacement of inefficient fixtures will need to be implemented by the individual property owner.

Property owners outside the Wastewater Service Area will be able to benefit from water surveys and rebates through multiple ongoing measures implemented at first by the County, and then by the Purveyors. Each of these measures will be initiated by the property owner approaching the relevant entity. The County or Purveyor will offer subsidies for surveys and water efficient fixtures and appliances under these measures, but water users will be responsible for certain remaining costs, including installation.

Under County ordinance and Measure 1D, property owners will be responsible for replacing any less efficient toilets with HETs upon the sale of a property. This measure will apply across the Plan Area. All expenses for complying with this measure are the responsibility of the relevant property owner.

There are several measures that will not be implemented by the County or Purveyors, but could result in improved water efficiency. The Parties encourage residents, businesses and institutions within the Plan Area to consider implementing those measures based on their general duties as members of the Los Osos community. Recommended actions include:

- Retrofit of existing residences, businesses and institutions for use of greywater (Measure 1K), as further described in Section 11.4;
- Retrofit of existing residences, businesses and institutions for capture and use of rainwater (Measure 1L), as further described in Section 11.2;
- Replacement of irrigation sprinkler heads with rotating models (Measure 1N);
- Prevention of water waste by limiting gutter flooding and irrigation of sidewalks, driveways and roadways (Measure 1O); and
- Removal of high water-using turf (Measure 1P).

Finally, water users within the Plan Area will be responsible for altering their water use practices in ways that create long-term water savings. There are many ways water use can be reduced that do not detract from one's quality of life, including monitoring shower temperature so that the water does not run longer than necessary to warm up, turning off faucets while teeth brushing, using extra water from other activities to water plants, avoiding irrigation during peak evapotranspiration hours, not using water to wash sidewalks and driveways, etc. Residents, businesses and institutions should pay attention to and implement recommendations made by the County and Purveyors through the public information and media campaigns (Measures 3C and 3D). Success at improving urban water use efficiency will ultimately depend on the actions of all water users in Los Osos.

8.7 Impact of Basin Plan Actions

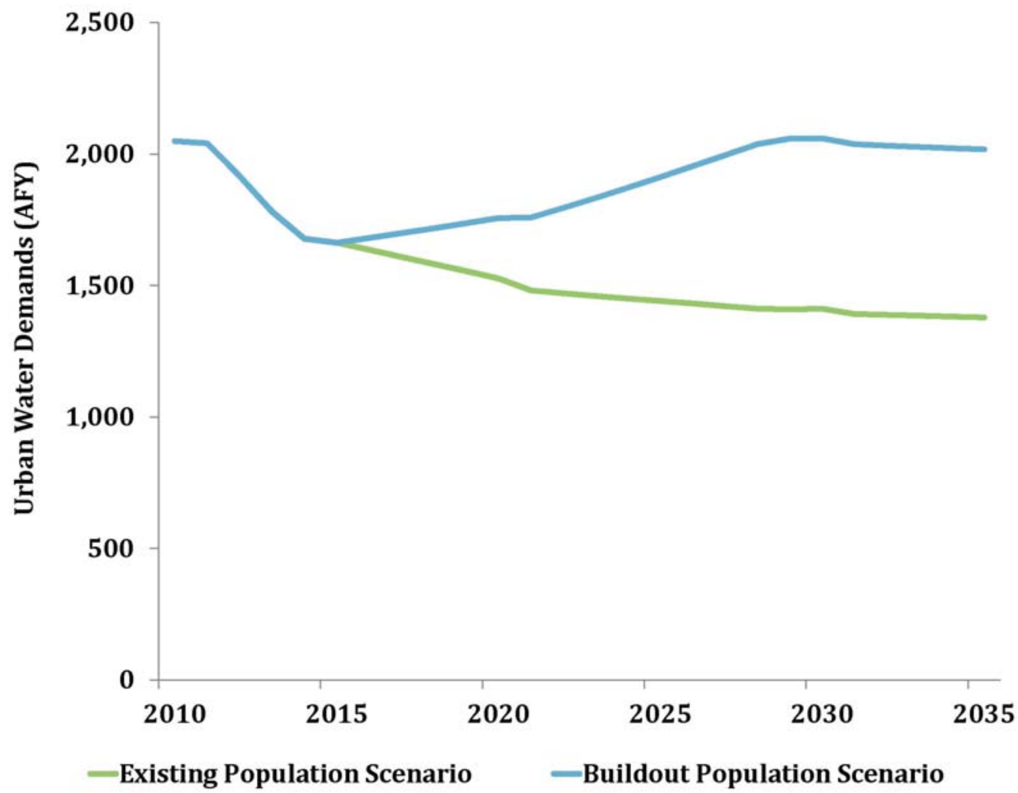
As described in Chapter 6, the purpose of this Basin Plan is to address two significant threats facing the Basin: water quality impacts to the Upper Aquifer and seawater intrusion into the Lower Aquifer. This Urban Water Use Efficiency Program will help to prevent seawater intrusion by reducing the amount of groundwater extracted from the Basin, especially the Lower Aquifer. This section evaluates the anticipated benefit of the Urban Water Use Efficiency Program for Basin management.

As noted in Section 8.1, improvements in urban water use efficiency will affect the Basin Yield Metric defined in Chapter 6 by reducing the urban component of its numerator, Annual Groundwater Production$_X$. This Basin Plan analyzes several potential programs, and to some extent, the programs build upon and are interconnected with each other, as described in Chapter 14. Nonetheless, some impacts on the Basin can be isolated for each program.

Baseline urban water demands in Los Osos have been calculated as 2,050 AFY and 135 gpcd. As shown in Figure 53, with implementation of the Urban Water Use Efficiency Program, it is anticipated that urban water demands will decrease by 2035 to below 1,450 AFY and 100 gpcd under the Existing Population Scenario. That projection of future water demands has been supported by a decrease in water demands between the 2006-2008 baseline and 2012, when water demands fell to 1,720 AF and 110 gpcd. When the comprehensive and state-of-the-art water efficiency improvements set forth in this chapter are implemented, it is reasonable to expect urban water demands to fall below the Basin Plan goals.

Under current conditions, the Sustainable Yield$_X$ of the Basin has been calculated by the Model to be 2,450 AFY. Baseline urban water demands of 2,050 AFY, when combined with community facility and agricultural water demands of 890 AFY, produce a Basin Yield Metric of 120. In other words, the 2006-2008 baseline period saw groundwater production exceeding the sustainable yield of the Basin by 20 percent. By 2013, the Basin Yield Metric had fallen to 103, and with full implementation of the Urban Water Use Efficiency Program under the Existing Population Scenario, the Basin Yield Metric is expected to decline further to 96, which would represent a sustainable Basin, albeit without a significant buffer.

Figure 53. Projected Urban Water Demands on the Basin (2010-2035)



Implementation of the Urban Water Use Efficiency Program is expected to allow full buildout of the Los Osos community, while maintaining urban water demands of no more than 2,100 AFY and 95 gpcd. (See Figure 53.) That compares favorably to the projection of 2,900 AFY and 132 gpcd without any efficiency improvements or 2,450 AFY and 112 gpcd with only implementation of the CPC. While implementation of the Urban Water Use Efficiency Program alone would not allow the Basin to reach balanced conditions, with a Basin Yield Metric of 122 at buildout, it would be appreciably better than the projected Basin Yield Metrics of 155 with no efficiency improvements.

This analysis shows the value of the Urban Water Use Efficiency Program for overall efforts to balance the Basin and prevent seawater intrusion. Nonetheless, it is also clear from this analysis that improving urban water efficiency will not by itself achieve a sustainable Basin. Even under the Existing Population Scenario with full implementation of the Urban Water Use Efficiency Program in 2035, the Basin Yield Metric is only reduced to 96. While that metric theoretically represents perfectly balanced conditions, it leaves no room for error due to uncertainty and allows seawater intrusion to occur as long as no well in the Basin produces water with chlorides greater than 250 mg/l. As set forth in Chapter 6, this Basin Plan has a goal of maintaining a buffer, or margin of safety, of 20 percent, so that the Basin Yield Metric does not exceed 80 in any given year.

Based on this analysis, the Urban Water Use Efficiency Program is a vital part of this Basin Plan, but additional actions from the other programs contained in this Basin Plan will be needed to prevent seawater intrusion. Those actions are set forth in other chapters of this Basin Plan.

9

WATER REINVESTMENT PROGRAM

9.1 Policy and Purpose

The purpose of this Basin Plan is to sustainably manage the valuable water resources of the Basin for the benefit of residents, businesses and institutions within Los Osos, the environment and the Parties. In order to maximize the use of Basin resources, it is imperative that water which has been used by urban residents and businesses be reinvested in the hydrologic cycle in an appropriate manner. The Water Reinvestment Program set forth in this chapter describes the actions of the Parties to further that goal.

The Water Reinvestment Program will directly contribute toward Immediate Goal No. 3 and Continuing Goal No. 5 of this Basin Plan, to promote water use efficiency for urban and agricultural water users, including use of recycled water. In addition, it will support Immediate Goals Nos. 1 and 2 and Continuing Goals Nos. 3 and 4 related to halting seawater intrusion and providing sustainable water supplies for existing and future development in the Plan Area.

There are a number of compelling reasons for the reinvestment of water in the Basin, including the policies contained in state law in favor of water reuse, the need for reuse of water to balance the Basin and prevent seawater intrusion (as reflected in the permit conditions imposed by the County and Coastal Commission on the LOWWP) and the financial efficiency of reusing water that has been treated to meet the requirements imposed on the LOWWP by the RWQCB.

The following provisions are representative of the legal and regulatory framework encouraging the use of recycled water:

- California Water Code §§ 13510-13512 declare that the "people of the state have a primary interest in the development of facilities to recycle water containing waste to supplement existing surface and underground water supplies" and provide that the state shall "undertake all possible steps to encourage development of water recycling facilities."

- California Water Code §§ 13550-13557 declare that the "use of potable domestic water for nonpotable uses […] is a waste or an unreasonable use […] if recycled water is available" and prohibit the use of water suitable for potable domestic use for nonpotable uses when recycled water is available.

- California Water Code §§ 13575-13583, commonly known as the Water Recycling Act of 1991, established "a statewide goal to recycle a total of 700,000 acre-feet of water per year by the year 2000 and 1,000,000 acre-feet per year by the year 2010" and required retail water suppliers to take certain actions in order to further that goal, including without limitation, identifying potential uses of recycled water within their service areas and entering into contracts to provide recycled water upon customer request when available at a rate comparable to, or less than, the retail water supplier's rate for potable water.

- California Code of Regulations (CCR), Titles 17 and 22, contain the standards established by CDPH for recycled water use and cross-control connections between potable and nonpotable water systems.

- SWRCB Statement of Policy (adopted as amended on January 22, 2013) calls for a significant increase in the use of recycled water and includes within its goals the substitution of local recycled water supplies for potable water as much as possible.

- California Public Utilities Code § 455.1 sets forth the procedures that the CPUC must follow when a water corporation files a schedule stating rates, classifications, contracts, practices or rules for the service of recycled water, and provides that the CPUC shall approve said schedule unless it is unjustified or a party submits a written protest.

- California Public Utilities Code §§ 1501 *et seq*. (commonly known as the Service Duplication Act) declare that "whenever a political subdivision constructs facilities to provide or extend water service, or provides or extends such service, to any service area of a private utility with the same type of service, such an act constitutes a taking" and "just compensation" shall be paid to the private utility.

- CPUC Water Action Plan (2010) provides that the CPUC will require the use of recycled water "[t]o the extent that [it] is available, when practicable and to the extent required by and consistent with Water Code Sections 13550-13557, as another supply source."

- CPUC Rulemaking 10-11-014, with a proposed decision anticipated in August 2013, is expected to establish a comprehensive policy framework for recycled water applicable to investor-owned water and sewer utilities with the goal of facilitating the use of cost-effective recycled water where it is or can be made available, reducing barriers to collaboration between public agency wholesalers and retail recycled water purveyors and creating guiding principles of rate design for determining recycled water rates.

9.2 Los Osos Wastewater Project

9.2.1 *History of the Project*

Although the Los Osos community's population grew steadily during the 1970s and early 1980s, as described in Section 3.4, sanitation needs continued to be met primarily by septic systems. As noted in Section 5.7.1, the RWQCB adopted an amendment to the Water Quality Control Plan for the Central Coast Basin in Resolution No. 83-13 that prohibited "[d]ischarges of waste from individual and community sewage disposal systems effective November 1, 1988" within the Prohibition Zone. The RWQCB adopted Resolution No. 83-13 based on its finding that the increase in population in Los Osos, and resultant increase in private waste disposal systems, was degrading water quality in the Upper Aquifer. More specifically, the disposal systems were causing nitrate concentrations in the groundwater to exceed safe drinking water standards.

Since the establishment of the Prohibition Zone by the RWQCB, both the County and LOCSD have made unsuccessful attempts to construct a community wastewater treatment system. After the attempt initiated by the LOCSD in 2005 was halted as a result of the recall of LOCSD board members, the state Legislature passed Assembly Bill 2701, codified in California Government Code § 25825.5 and effective January 1, 2007, which authorized the County to "design, construct, and operate a wastewater collection and treatment project that will eliminate […] discharges, particularly in the prohibition zone."

Following a successful Proposition 218 vote in 2007, the County completed an environmental review process that examined various project options. The Draft EIR was released in November 2008, and the Final EIR was adopted by the County Board of Supervisors on September 29, 2009. In June 2010, the Coastal Commission issued a CDP for the LOWWP subject to a number of conditions of approval, some of which are related to recycled water distribution and use and are discussed in this chapter.

9.2.2 *General Project Description*

The following governing mission statement was developed for the LOWWP to guide the overall County effort:

> *To evaluate and develop a wastewater treatment system for Los Osos, in cooperation with the community water purveyors, to solve the Level III water resource shortage and groundwater pollution, in an environmentally sustainable and cost effective manner, while respecting community preferences and promoting participatory government, and addressing individual affordability challenges to the greatest extent possible.*

The LOWWP will utilize a gravity wastewater collection system to serve all residential, commercial and institutional properties within the Prohibition Zone. Raw wastewater will be collected at a mid-town pump station and conveyed to a treatment plant located at the Giacomazzi Site. The Giacomazzi Site is a 38.2-acre parcel located north of Los Osos Valley Road and west of Clark Valley Road, as shown on Figure 54. All collected wastewater will undergo tertiary treatment and be available for reuse.

Construction on the LOWWP collection system began in mid-2012, and the entire project is projected to be completed by mid-2015. At that time, individual properties within the Prohibition Zone—thereafter called the "Wastewater Service Area"—will connect to the LOWWP, which will begin operations in late 2016.

9.2.3 *Impact of the LOWWP on the Basin*

The importance of reinvesting all treated wastewater within the Basin has been recognized for many years. For example, according to the USGS in 1988:

> *Results indicated that if wastewater is centrally treated and recharged to the ground-water basin, the entire projected municipal water demand can be met with locally pumped ground water without inducing seawater intrusion, even during droughts lasting 1 to 3 years. If wastewater is exported from the basin, however, large amounts of seawater intrusion are likely to occur even if nearly half of the municipal water demand is met with imported water.*[130]

That conclusion has been confirmed by later technical studies. In preparation for this Basin Plan, the Model was used to compare current conditions to a hypothetical scenario in which the LOWWP was operational and exporting all treated wastewater from the Basin. Sustainable Yield_{2012} was calculated to be 2,450 AFY, and the hypothetical Sustainable $\text{Yield}_{\text{EXPORT}}$ would be 2,250 AFY, a decrease of 200 AFY. Described differently, if no other actions were taken by the Parties, implementation of the LOWWP with export of all treated wastewater would induce an additional 200 AFY of seawater intrusion into the Basin, above current conditions.

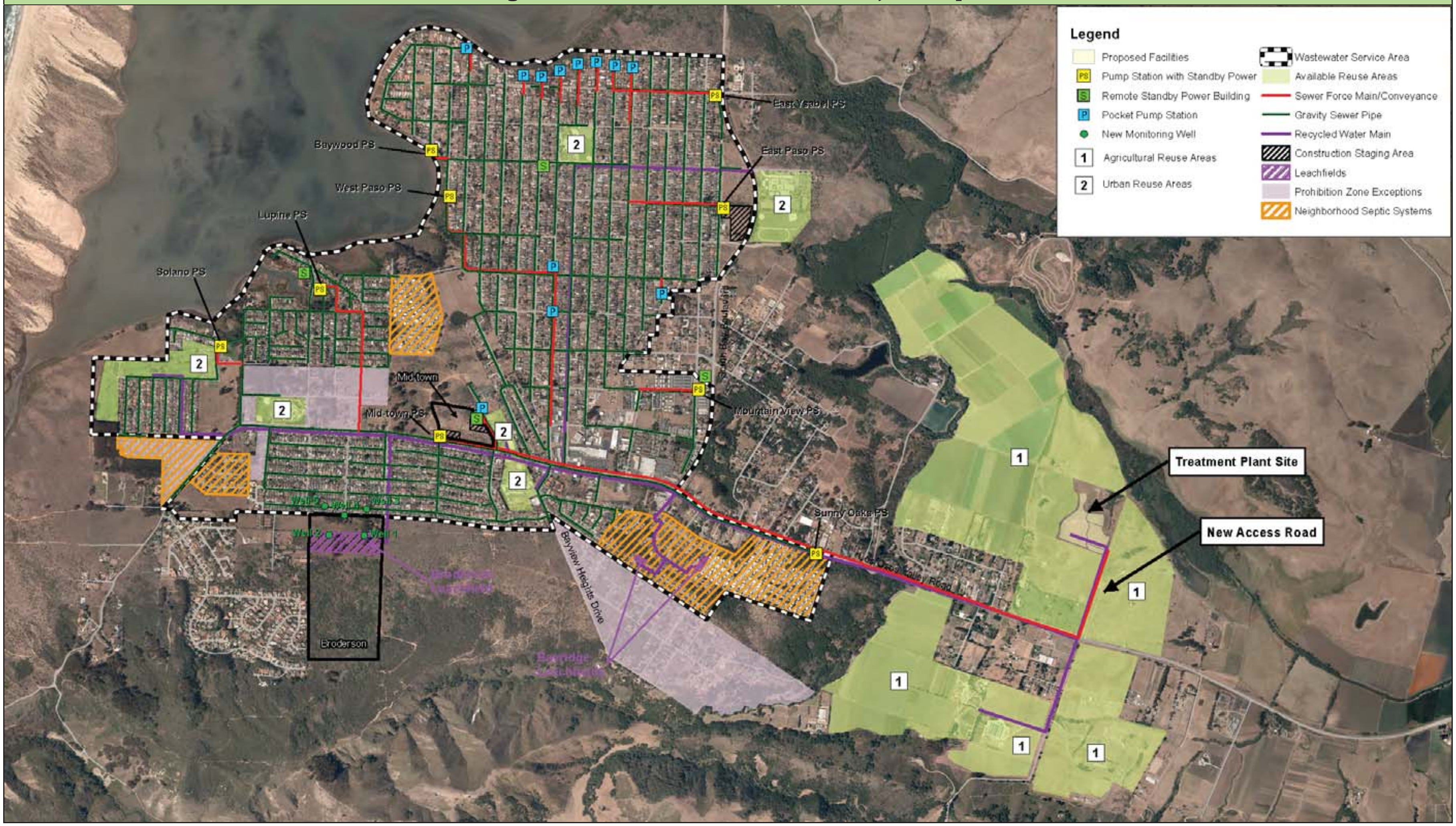
In order to prevent the LOWWP from harming the Basin through additional seawater intrusion, the Coastal Commission required the LOWWP to reinvest all treated wastewater from the project within the Basin by adopting Condition No. 97 of the CDP. That condition requires that all treated effluent be reserved for reinvestment into the Basin, including:

> a. *Broderson (not to exceed 448 AFY on an average annual basis);*
> b. *Urban re-use within the Urban Reserve Line (as identified in the Effluent Re-Use and Disposal Tech Memo, July 2008);*
> c. *Agricultural re-use overlying the Los Osos Groundwater Basin;*
> d. *Environmental reservations (not less than 10 percent of the total volume of treated effluent); and*
> e. *Other agricultural re-use within Los Osos Valley.*

---

[130] USGS, *Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County California*, Water-Resources Investigations Report 88-4081 (1988).

Figure 54. Los Osos Wastewater Project Map



Total agricultural re-use shall not be less than 10% of the total treated effluent. Disposal shall be prioritized to reduce seawater intrusion and return/retain water to/in the Los Osos groundwater basin. Highest priority shall be given to replacing potable water uses with tertiary treated effluent consistent with Water Code Section 13550.

No amount of treated effluent may be used to satisfy or offset water needs that result from non-agricultural development outside the Urban Reserve Line of the community of Los Osos.

Consistent with the above framework, the Coastal Commission included Special Condition No. 5 in the CDP issued for the LOWWP. That condition requires the preparation of a RWMP in coordination with this Basin Plan, as descried in Section 7.3.5. The purpose of the RWMP is to develop a comprehensive water resources management plan that includes water recycling and conservation to maximize the long-term health and sustainability of ground and surface waters and related resources. The RWMP must include information on the uses to which recycled water will be put and set forth a monitoring program for determining the effectiveness of the RWMP. Special Condition No. 5 also requires all tertiary treated recycled water to be disposed of in locations within the Basin.

9.2.4 *Effluent Generation*

During the initial year of LOWWP operations, flows to the system will be limited but will increase as private homeowners gradually abandon their septic systems and connect to the project. There will also be an initial start-up and commissioning period for the new treatment facility, in order to document the ability to reliably produce recycled water that meets California's standards for irrigation reuse. During the start-up period, the majority of the recycled water flows will be delivered to leach fields at Broderson and Bayridge Estates, and irrigation uses will be gradually increased.

Based on the current population of the Wastewater Service Area—approximately 12,500 with 4,800 connections—start-up flows are estimated to be approximately 0.7 to 0.9 MGD or 780 AFY, assuming that the water conservation measures to be implemented by the County pursuant to the Urban Water Use Efficiency Program reduce water consumption as expected. At the estimated buildout population of 18,500 within the Wastewater Service Area, the flow is anticipated to be 1.2 MGD or 1,120 AFY.

Given that the Los Osos community is primarily residential, except for a small commercial zone to provide day-to-day services to local residents, and that tourism is not prevalent, indoor water use will not fluctuate much throughout the year. Therefore, recycled water is anticipated to be available year round.

The effluent flows to each reuse/disposal component of the LOWWP will not be constant throughout the year. Recycled water demands from urban and agricultural reuse sites will be maximized during the irrigation season with peak reuse flows in the late summer. Agricultural reuse will only occur during the growing season, with peak flows in July. There will be little or no reuse between December and February. During this period, it is likely that most of the winter flows will be delivered to the leach fields at Broderson or Bayridge or stored in ponds at the wastewater treatment plant, which can hold up to 50 AF of recycled water. In wet years, there will be minimal agricultural reuse between December and February. Most of the winter flows can be accommodated at the Broderson site. However, since the maximum daily capacity of the Broderson site is less than the total effluent flow, winter storage will be necessary. Water that is stored during the winter will be sent to leach fields or used for other approved reuse purposes. Any excess effluent remaining after application to leach fields and delivery to recycled water customers will be stored.

9.2.5 *Disposal Sites*

The approvals and permits for the LOWWP provide that all treated effluent must be reused or disposed of inside the Basin. Consistent with those requirements, this Water Reinvestment Program includes the potential use of recycled water at the locations listed in Table 31. The sum of the quantities of recycled water that may be used at each location is greater than the amount of recycled water that is projected to be available, under either the Existing Population Scenario (780 AFY) or the Buildout Population Scenario (1,120 AFY). Thus, it is clear that recycled water will not be available to meet all potential demands within the Plan Area.

Table 31. Potential Recycled Water Demands

Potential Use	Quantity (AFY)	Percent of Total
Broderson Leach Fields	448	34.3
Bayridge Estates Leach Fields	33	2.5
Urban Reuse	63	4.8
Sea Pines Golf Course	40	3.4
Los Osos Valley Memorial Park	50	3.8
Agricultural Reuse	666	51.0
Total	1,300	100

As listed in Table 31, potential uses for recycled water include the following.

- *Broderson Leach Fields*. A portion of the treated effluent will be disposed of at leach fields to be installed on the Broderson site, a 40-acre parcel located south of Highland Drive in Los Osos. The site slopes to the north from the maximum elevation of 340 feet above msl to approximately 200 feet above msl along its northern boundary. The site is currently undeveloped and largely covered with scrub vegetation in its lower half and the upper half by chaparral-type vegetation that includes strands of Morro Manzanita. The leach fields will be constructed on approximately eight acres of the site; the rest of the site will be placed in permanent open space and added to the greenbelt surrounding the Los Osos community.

A 2000 hydrogeological study of the site recommended a wastewater disposal rate of 800,000 gpd (equivalent to 896 AFY). The study concluded that "[d]aylighting will not occur at this disposal rate between Highland Drive and Los Osos Valley Road due to mounding or lateral movement of perched water along the shallowest perching horizon." Wastewater particles will take at least one year to move offsite, and 14 years to reach the bay in the upper aquifer. Movement from the site to the Rosina well would take at least 16 years, of which an estimated 11 years would be spent moving through a regionally confining clay layer into the Lower Aquifer.[131]

Up to 448 AFY of effluent will be discharged at the Broderson leach fields. Discharge can occur during both wet and dry weather. The site will be fenced and five vadose zone monitoring wells will be installed to monitor groundwater quality.

- *Bayridge Estates Leach Fields*. The CDP and the County's approval of the LOWWP were conditioned on disposal of 33 AFY of treated effluent at the existing Bayridge Estates leach field to mitigate impacts to Willow Creek. Recycled water can be discharged at this leach field during both wet and dry weather.

- *Urban Reuse*. The County and Purveyors have identified several large users of water for landscape irrigation, who can receive and use recycled water in lieu of potable groundwater supplies. The largest sites for use of recycled water are landscaping and playing fields at the several schools operated by San Luis Coastal Unified School District: Los Osos Middle School (30 AFY); Monarch Grove Elementary School (10 AFY); Baywood Elementary School (9 AFY); and Sunnyside Elementary School (7 AFY). In addition, LOCSD currently provides water to the community park, which could use about 5 AFY of recycled water for landscape irrigation, and recycled water can be used to irrigate landscaping along certain streets, such as Los Osos Valley Road. Combined, those urban areas could use approximately 63 AFY.

  In addition to those existing water users, urban reuse could potentially be extended to landscape irrigation for future subdivisions within Los Osos. As stated in Section 8.5.2, future development would be subject to strict water efficiency requirements, and any future subdivision for which reuse would be practical may be required to accept recycled water for common area landscaping. The Parties will evaluate the potential for other urban reuse locations as may be beneficial in the future.

- *Sea Pines Golf Course*. As described in Section 4.4, Sea Pines Golf Course currently uses approximately 15-20 AFY of recycled water from the Monarch Grove Wastewater Treatment Plant and approximately 75 to 85 AFY of water from on-site Upper Aquifer wells. If the Monarch Grove subdivision is connected to the LOWWP, its wastewater treatment plant will

[131] CHG, *Hydrogeologic Investigation of the Broderson Site, Phase 2 – Impacts Assessment* (November 2000).

no longer be used, and it is proposed to serve Sea Pines Golf Course with recycled water from the LOWWP at a 1:1 blend with well water. The remaining water would continue to be supplied by existing wells. Sea Pines Golf Course could utilize an estimated 40 AFY of LOWWP recycled water.

- *Los Osos Valley Memorial Park*. The cemetery is located on Los Osos Valley Road, adjacent to the proposed LOWWP treatment plant site. The cemetery currently pumps groundwater from its own private well in the Eastern Area, as noted in Section 4.4. The County could supply the cemetery with recycled water, which would offset approximately 50 AFY of groundwater use, thus decreasing the demand on the Basin.

- *Agricultural Reuse*. As described in Section 4.5, agricultural water users produce an estimated 750 AFY of groundwater from the Basin. The County could deliver recycled water to those users in lieu of groundwater pumping, which would be especially advantageous if the Purveyors were to construct new municipal groundwater wells in or near the Eastern Area pursuant to Basin Infrastructure Programs C or D.

  Since the LOWWP is not expected to produce sufficient quantities of recycled water to meet all the demands above, plus 750 AFY for agricultural irrigation, this use will be limited by the production of recycled water. In addition, not all agriculturalists are expected to be comfortable with use of recycled water, even though the tertiary-treated water produced by the LOWWP qualifies under California law for irrigation of all the crops typically grown in Los Osos.

9.2.6 *Infrastructure Needs*

The recycled water conveyance system to the produced water reinvestment sites will be designed to accommodate seasonal fluctuations in demand in anticipation of peak irrigation demands of summer, while conveyance systems to leach fields will need to anticipate maximum design flows during the winter months.

A recycled water pump station at the treatment plant will provide adequate pressure to deliver water throughout the conveyance system. Booster pumps may be needed at irrigation sites near the ends of the conveyance route. Main line and branch lines will be sized for velocities at 5 to 7 cfs at peak flow. The County's Recycled Water engineering report will provide more detailed information regarding system delivery pressure, schedule, demand requirements and other relevant considerations.

As shown in Figure 54, the recycled water main will be routed south from the treatment plant site to Los Osos Valley Road, a major roadway through the town of Los Osos. A connection point from the recycled water main will be available to deliver recycled water to the Los Osos Valley Memorial Park. A branch will be constructed to serve Clark Valley Road agricultural reuse customers south of Los Osos Valley Road. Another connection point on Los Osos Valley Road will be provided for future agricultural reuse customers to both the north and south. The pipeline will continue west along Los Osos Valley Road with branches to the leach fields to the south and a branch to the south on 10th Street to serve reuse sites at Baywood Elementary School and Los Osos Middle School. The pipeline will terminate on the west side of town at the Sea Pines Golf Course. Approximately 35,000 feet of pipeline is required to supply recycled water to the various planned reuse sites.

Storage ponds will be available to accommodate excess winter flows that cannot be delivered to any of the reuse facilities and to meet peak summer demand. This is estimated to be 30 AF initially and up to 150 AF at buildout. Those storage ponds will be designed and constructed as part of the LOWWP.

Urban reuse sites with existing landscape irrigation systems would be retrofitted to allow recycled water to be the primary water source and potable water as a backup source on an emergency basis. Appropriate cross-connection control measures, including an air gap on any remaining potable water service line, would be used. The connection to either water source would be approved by the CDPH.

9.2.7 *Alternative Recycled Water Use – Creek Discharge*

In March 2014, CHG prepared a technical memorandum (TM) to review the potential water supply benefits of discharging recycled water to Los Osos Creek during the dry season to augment groundwater recharge. The TM reached the following conclusions:

1. The optimal creek discharge location for Basin recharge is between the southerly Basin boundary and the southern Los Osos Oaks State Reserve boundary, south of Los Osos Valley Road. Dry channel seepage rates of up to 10 cubic feet per second (6.5 MGD) have been documented in this reach of Los Osos Creek.

2. In terms of Basin yield, a dry season recycled water discharge in Los Osos Creek is generally less efficient compared to discharges at the Broderson effluent disposal site, urban reuse, and agricultural irrigation on crops that have historically been irrigated with groundwater.

3. Dry season creek discharge would increase Basin yield in comparison to use of recycled water for new irrigation uses within the Basin. In other words, using recycled water for irrigation of land that was previously dormant (not irrigated or using groundwater) does not result in any increase in Basin yield and results in a loss of that increment of augmented Basin yield that would have resulted from use of recycled water to recharge the Basin, or offset existing groundwater uses. In this case, seasonal creek discharge strategies could result in a recapture of 60 to 90 percent of the volume discharged to the creek.

The implementation of a creek discharge would require additional environmental review and permitting through the Regional Water Quality Control Board, and various other federal and state resource agencies. At this time, creek discharge has not been incorporated into any of the Basin Infrastructure Programs.

9.3 Urban Water Reinvestment Program

The Water Reinvestment Program set forth in this chapter is divided into two parts. The first part, known as the Urban Water Reinvestment Program, is intended to beneficially use all recycled water produced by the LOWWP under the Existing Population Scenario. The second part, known as the Agricultural Water Reinvestment Program, is intended to use all marginal recycled water produced under the Buildout Population Scenario. Although a limited quantity of agricultural reuse is planned as part of the Urban Water Reinvestment Program, the bulk of agricultural reuse will occur under the Agricultural Water Reinvestment Program.

The proposed uses of recycled water under the Urban Water Reinvestment Program are listed in Table 32. Not all potential uses will start at the commencement of LOWWP operations, or occur in their full quantities. For example, irrigation at Sea Pines Golf Course is likely to occur only if the Monarch Grove subdivision connects to the LOWWP. Any produced water that is not used for one of the potential uses listed in Table 32 will likely be reinvested in agricultural reuse. In addition, the quantity of water produced by the LOWWP may vary from 780 AFY, requiring reinvestment of either more or less recycled water for the various potential uses. Despite these uncertainties, the Urban Water Reinvestment Program is expected to deliver all recycled water produced by the LOWWP to one of the categories of reuse shown in Table 32.

Table 32. Urban Water Reinvestment Program Recycled Water Uses

Potential Use	Quantity (AFY)	Percent of Total
Broderson Leach Fields	448	57.4
Bayridge Estates Leach Fields	33	4.2
Urban Reuse	63	8.1
Sea Pines Golf Course	40	5.1
Los Osos Valley Memorial Park	50	6.4
Agricultural Reuse	146	18.7
Total	780	100

Some of the recycled water to be reinvested pursuant to the Urban Water Reinvestment Program—e.g., that delivered to the schools and community park—will offset water that would have otherwise been produced from the Basin and sold by the Purveyors to their potable water customers. The County will deliver recycled water to users within the LOCSD and GSWC service areas pursuant to agreements with the Purveyors, in order to prevent a loss of water utility revenue while still facilitating the reinvestment of recycled water in the Basin. The agreements between the County, LOCSD and GSWC will determine the respective obligations of the parties.

LOCSD and GSWC will each follow their required processes for the establishment of rates or tariffs for recycled water service. For LOCSD, that will involve commissioning a rate study and following the process of Proposition 218. For

GSWC, that will involve seeking CPUC approval of the terms, conditions and tariffs for provision of recycled water service.

In March 2012, the County and San Luis Coastal Unified School District entered into an agreement for the delivery of recycled water to the four schools in Los Osos. The Parties will work together to modify that agreement in order to accomplish the delivery of recycled water within the service areas of LOCSD and GSWC.

Implementation of the Urban Water Reinvestment Program will require the construction of certain infrastructure. Projected costs for that infrastructure, as well as for environmental mitigation measures of the LOWWP that benefit the entire Plan Area, are shown in Table 33. Because the Urban Water Reinvestment Program will provide benefits to everyone who produces or uses water from the Basin, this Basin Plan proposes that the costs identified in Table 33 be paid for by all properties in the Basin as set forth in detail in Chapter 15. Such funds would be transferred to the County to offset costs previously incurred by the LOWWP. In that way, costs associated with the Urban Water Reinvestment Program would be shifted from property owners within the Wastewater Service Area to all property owners in the Plan Area.

Table 33. Costs of the Urban Water Reinvestment Program

Infrastructure Component	Cost ($1000)
Wastewater Treatment Plant	9,320
Recycled Water Distribution System Areas A & D	1,280
Recycled Water Distribution System Areas B & C	6,370
Midtown Site Restoration	400
Archaeology Monitoring	920
Total	18,290

9.4 Agricultural Water Reinvestment Program

9.4.1 *Program Description*

As set forth in Section 9.2.7, a limited amount of recycled water produced by the LOWWP will be delivered for agricultural reuse as part of the Urban Water Reinvestment Program. The bulk of agricultural reuse will not occur, however, unless and until there is additional land development within Los Osos to generate additional flows into the LOWWP. Any recycled water produced by the LOWWP based on future land development will be delivered for agricultural reuse within the Plan Area.

Development in the Plan Area pursuant to the Buildout Population Scenario is likely to generate approximately 340 AFY of recycled water, above the quantity available under the Urban Water Reinvestment Program. In order to treat and distribute that recycled water under the Agricultural Water Reinvestment Program, the County would need to build additional treatment capacity and recycled water storage facilities, with an estimated cost of $3,120,000.

9.4.2 *Agricultural Outreach*

It is obvious that successful reinvestment of water in the Basin by agricultural reuse requires the participation of agriculturalists in the Eastern Area. The County has initiated outreach to the agricultural growers in Los Osos and will continue to do so in order to implement the Urban Water Reinvestment Program and especially the Agricultural Water Reinvestment Program. The County's objective is to prioritize agricultural reuse deliveries that create overall benefits to the Basin and mitigate seawater intrusion. Thus, the County will deliver recycled water on a strict priority basis to: (1) properties within the Basin that will offset existing pumping of the Basin by using recycled water; and (2) properties within the Basin that will use recycled water in addition to existing pumping of the Basin. The County will not deliver recycled water to any properties located outside the Basin.

The County, in conjunction with the Coastal San Luis Resource Conservation District, has completed a formal outreach program to inform local growers about the LOWWP, schedule, water quality and costs of recycled water, and to answer questions and develop grower interest. The County has conducted information sessions with growers and has discussed the LOWWP one-on-one with many growers and property owners. Outreach will continue throughout the LOWWP, before and after the initial agreements have been obtained, to ensure that growers' needs are addressed and to identify new recycled water users who will provide a greater basin benefit or subscribe to deliveries of future capacity.

Six agricultural owners/growers have signed program participation agreements that were approved on October 25, 2011 by the County Board of Supervisors. These properties provide an estimated 80 acres of agricultural land that will be potentially irrigated with the recycled water, and will be adequate to meet the reuse requirements for the LOWWP. The County is now negotiating delivery schedule agreements with agricultural water users for an estimated 160 AFY of recycled water that will be available during the Urban Water Reinvestment Program. It is anticipated that delivery agreements with the growers will be for approximately five to 10 years, in order for growers to recoup their costs for infrastructure investments required to irrigate with recycled water. During this period, the County will continue to reach out to other property owners in the Basin for the next round of delivery agreements, after the first term is completed, or to subscribe to flows from new development.

Pricing for the recycled water will be based on negotiations with those property owners who have signed the program participation agreements. Since all agriculture production is attained through private well production, the pricing of recycled water will most likely vary significantly. Growers with sufficient well production may only desire to purchase water at discount rates, but those properties with limited well production will be willing to pay higher rates.

The County will work with the growers to develop a Crisis Management Plan. The Crisis Management Plan will incorporate standard operating procedures for delivery and testing and the steps that will be implemented if a food safety issue were to occur. A crisis may include, but not be limited to, failed water quality tests, damage to recycled water infrastructure that would preclude the ability to deliver recycled water to the customers, or to an outbreak of a food related illness, whether or not it is related to the recycled water quality.

9.5 Coastal Commission Permit Conditions

The CDP for the LOWWP contains a number of conditions related to water resource management in the Basin, including reinvestment of recycled water. Each of those conditions is listed below for convenience in coordinating with this Basin Plan.

(A) *Special Condition No. 5*

Los Osos Basin Recycled Water Management Plan. Prior to construction, the Permittee shall submit two copies of a Los Osos Basin Recycled Water Management Plan (Basin Plan) to the Executive Director for review and approval. The objective of the Basin Plan shall be to ensure that implementation of the project, including the sites designated for disposal of the treated effluent, is accomplished in a manner designed to maximize long-term ground and surface water and related resource (including wetlands, streams, creeks, lakes, riparian corridors, marshes, etc.) health and sustainability, including with respect to offsetting seawater intrusion as much as possible, within the Los Osos Groundwater Basin. The Basin Plan shall be structured so as to allow its programs to be developed, and any physical development underlying the implementation of such programs constructed, concurrent with construction of the approved project, and for it to be implemented concurrent with commencement of operation of the approved project. The Basin Plan may be structured to allow phasing if necessary to better achieve Basin Plan objectives. The Basin Plan shall include the following main components:

a. **Recycled Water Reuse Program.** As reflected in County condition 97, the Recycled Water Reuse Program shall ensure that all tertiary treated recycled water is disposed of in locations within the Los Osos Groundwater Basin that will maximize its ability to meet Basin Plan objectives, where the highest priority for reuse shall be replacing existing potable water use with recycled water use where feasible and appropriate, including with respect to both urban and agricultural reuse. The Reuse Program may include recycled water application at the Broderson leach field (not to exceed 448 AFY on an average annual basis) and at the Bayridge leach field (approximately 33 AFY or the amount shown to be necessary for maintaining Willow Creek and downstream resources in their pre-project state or better), but it shall prioritize beneficial reuse through (a) developing and installing recycled water connections and entering into delivery/use agreements with urban and agricultural property owners as much as possible, and (b) developing and installing other recycled water delivery systems, in both cases with a priority for locations where such beneficial reuse will go the furthest toward meeting Basin Plan goals. The Reuse Program may include other areas that may be beneficial to the Los Osos Groundwater Basin.

b. **Water Conservation Program.** The Water Conservation Program required by the County project, which limits indoor water use to no more than 50 gallons per person per day on average within the Basin, shall be incorporated into the Recycled Water Management Plan. The Program shall be designed to help Basin residents to reduce their potable water use as much as possible through measures including but not limited to retrofit and installation of low water use fixtures, and grey water systems. The Program shall include enforceable mechanisms designed to achieve its identified goals, including the 50 gallons per person per day target, and shall include provisions for use of the $5 million committed by the Permittee to initiate water conservation measures pursuant to the Basin Plan as soon as possible following CDP approval. The Permittee shall coordinate with water purveyors to the maximum extent feasible to integrate this conservation program with purveyor implemented outdoor water use reduction measures.

c. **Monitoring Program.** The Monitoring Program shall be designed to quantitatively and qualitatively assess the effectiveness of the Basin Plan over time to ensure its objectives are achieved, and shall include: a baseline physical and ecological assessment of ground and surface water and related resources to be monitored; measurable goals and interim and long-term success criteria for those resources, including at a minimum clear criteria that demonstrate that the health and sustainability of Plan area resources are steadily improving over time, including with respect to seawater intrusion; monitoring provisions, including identification of appropriate representative resource monitoring locations and data types (e.g., groundwater levels and quality; wetland, stream, creek, riparian, and marsh plant and animal abundance, hydrology, and water quality; etc.) and a schedule for proposed monitoring activities. The Monitoring Program shall also include measures to clearly document the manner in which recycled water is being reused and water is being conserved pursuant to the Recycled Water Reuse and Water Conservation Programs.

d. **Reporting and Adaptive Management Program.** Annual reports (two copies) documenting implementation and effectiveness of the Basin Plan shall be submitted to the Executive Director for review and approval by December 31st of each year that the project operates. Each report shall include all monitoring data (including documenting all recycled water reuse for the preceding year, all water conservation efforts and effects, and all resource changes identified), shall describe the progress towards achieving the success criteria of the plan, and shall make recommendations, if any, on changes necessary to better meet Basin Plan objectives and achieve success. On the latter, the annual reports shall be premised upon the concept of adaptive management that responds to information developed and effects better understood over time in association with the project, and is intended to allow for project changes covered by this CDP, unless the Executive

Director determines that a CDP amendment is necessary, through the annual report approval process provided that such changes result in better resource protection and better means to achieve Basin Plan objectives over the long-term. Changes, including identified remediation steps, shall be completed per the timetable identified in any approved annual report, or within 30 days of report approval where no such timetable is specified.

The Permittee shall undertake development in accordance with the approved Los Osos Basin Water Recycling Management Plan.

(B) *Condition No. 6*

Tertiary Treatment. The treatment plant shall provide Disinfected Tertiary Recycled Water as defined at Section 60301.230 of Title 22 of the California Code of Regulations, which means a filtered and subsequently disinfected wastewater that meets the following criteria:

(a) The filtered wastewater has been disinfected by either:

(1) A chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or

(2) A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque-forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed a most probable number (MPN) of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Prior to providing tertiary treated water for agricultural uses the applicant shall develop a Recycled Water Management Plan for Agricultural Re-use. The use of tertiary treated water shall be consistent with resource protection strategies including but not limited to those designed to protect on and off site soils, and surface and groundwater resources through the use of appropriate site-specific management practices. The applicant shall consult with technical resource providers such as the University of California Cooperative Extension and USDA Natural Resources Conservation Service. The Plan shall be reviewed and approved by the Director of Planning and Building in consultation with the Agricultural Commissioner's Office prior to providing tertiary treated water for agricultural uses.

(C) *Condition No. 85*

Rehabilitation of disposal percolation fields shall be rotated so that no more than one field is under re-construction at a time.

(D) *Condition No. 86*

To prevent the wastewater treatment system from inducing growth that cannot be safely sustained by available water supplies, the sewer authority is prohibited from providing service to existing undeveloped parcels within the service area, unless and until the Estero Area Plan is amended to incorporate a sustainable buildout target that indicates that there is water available to support such development without impacts to wetlands and habitats.

(E) *Condition No. 87*

Concurrent with the operation of the facility, the County shall implement the Groundwater Level Monitoring and Management Plan that details methods for measuring and responding to changes in groundwater levels that could affect wetland hydrology and habitat values. The Plan includes provisions for monitoring groundwater levels, surveys for wetland plant and animals, monitoring wetland hydrology and water quality, appropriate response procedures should impacts be identified, annual reporting, and an education program to encourage property owners to convert septic systems into areas capable of groundwater recharge.

(F) *Condition No. 88*

In order to maintain existing levels of groundwater recharge and protect coastal water quality, the County shall evaluate and, where appropriate, assist property owners in the implementation of opportunities to re-use existing septic tank effluent disposal systems (e.g., leach fields) to filter and percolate stormwater runoff. Prior to the connection of individual properties the County shall, at the consent of the landowner, evaluate whether existing on site wastewater disposal facilities have adequate capacity and depth to groundwater to accommodate and percolate stormwater runoff, and if so, provide site-specific recommendations on how to connect such a system.

(G) *Condition No. 97*

Disposal of treated effluent shall be reserved for the following sites/uses:

a. Broderson (not to exceed 448 AFY on an average annual basis)
b. Urban re-use within the Urban Reserve Line (as identified in the Effluent Re-Use and Disposal Tech Memo, July 2008);
c. Agricultural re-use overlying the Los Osos Groundwater Basin;

d. Environmental reservations (not less than 10 percent of the total volume of treated effluent); and
e. Other agricultural re-use within Los Osos Valley.

Total agricultural re-use shall not be less than 10% of the total treated effluent. Disposal shall be prioritized to reduce seawater intrusion and return/retain water to/in the Los Osos groundwater basin. Highest priority shall be given to replacing potable water uses with tertiary treated effluent consistent with Water Code Section 13550.

No amount of treated effluent may be used to satisfy or offset water needs that result from non-agricultural development outside the Urban Reserve Line of the community of Los Osos.

(H) *Condition No. 99*

Within one year of adoption of a due diligence resolution by the Board of Supervisors, electing to proceed with a wastewater project, a water conservation program shall be developed by the applicant in consultation with the local water purveyors within the prohibition zone for the community of Los Osos, that meets the goal of 50 gallons per day / per person for indoor use. The applicant shall provide 5 (five) million dollars of funding towards a water conservation program for indoor water conservation. Incentives shall be provided to homeowners and other property owners who install conservation measures within the first year.

(I) *Condition No. 101*

The applicant shall utilize the existing Bayridge leach field (APN 074-491¬033) to dispose of approximately 33 acre feet per year of treated effluent upon decommissioning of the existing leach field and connection to the community sewer system. The applicant shall consult with the Los Osos Community Services District (LOCSD) prior to the design phase of the project regarding use of said facilities to ensure all their concerns are addressed.

(J) *Condition No. 103*

Prior to individual property connections to the waste water system, each property owner shall provide verification to the satisfaction of the Planning Director that all toilets, showerheads and faucets have been replaced with high efficiency versions of the same.

(K) *Condition No. 104*

Agriculture irrigation lines and other wastewater effluent disposal lines shall be located within existing right-of-ways (including agricultural field access ways) and other areas known to not include, or that can be demonstrated to no include, cultural or biological resources. Use of the effluent shall be consistent with all other local, State, and Federal regulatory requirements including but not limited to the

Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands requirements of the Central Coast Regional Water Quality Control Board.

(L) *Condition No. 108*

Prior to individual property connections to the wastewater treatment project, each property owner shall provide verification to the satisfaction of the Public Works Department (in consultation with the Planning Director) that a water meter meeting American Water Works Association (AWWA) standards, and approved by the water company serving the individual property, has been installed or is existing on the connection site. A water meter shall be installed on each legally established residential / commercial unit prior to connection to the wastewater treatment project. Water usage information shall be made available to the sewer authority on a quarterly basis or on a schedule agreed to by the water purveyors and the County to verify the water savings derived from the water conservation program.

(M) *Condition No. 111*

Routine flushing of sewer system lines shall utilize recycled water. In the event of an emergency situation, potable water may be used to flush the sewer system if non-potable water is determined to be infeasible.

[This page intentionally blank]

10

BASIN INFRASTRUCTURE PROGRAM

10.1 Introduction

The Basin faces a significant and immediate challenge. The Lower Aquifer is subject to seawater intrusion that can be controlled only by reducing extractions from that layer, especially from the Western Area. As explored in this Basin Plan, extractions from the Lower Aquifer can be reduced in several ways: decreasing urban water demands, as set forth in the Urban Water Use Efficiency Program in Chapter 8; using recycled water in lieu of groundwater, as set forth in the Water Reinvestment Program in Chapter 9; developing additional water supplies, as set forth in the Supplemental Water Program in Chapter 11 and Imported Water Program in Chapter 12; and shifting groundwater production upward and landward within the Basin. The Basin Infrastructure Program set forth in this chapter is intended to assess and implement that last strategy.

The Basin Infrastructure Plan directly furthers several goals set forth in Section 2.4 of this Basin Plan:

Immediate Goals

1. *Halt or, to the extent possible, reverse seawater intrusion into the Basin.*

2. *Provide sustainable water supplies for existing residential, commercial, community and agricultural development overlying the Basin.*

Continuing Goals

3. *Establish a strategy for maximizing the reasonable and beneficial use of Basin water resources.*

4. *Provide sustainable water supplies for future development within Los Osos, consistent with local land use planning policies.*

7. *Allocate costs equitably among all parties who benefit from the Basin's water resources, assessing special and general benefits.*

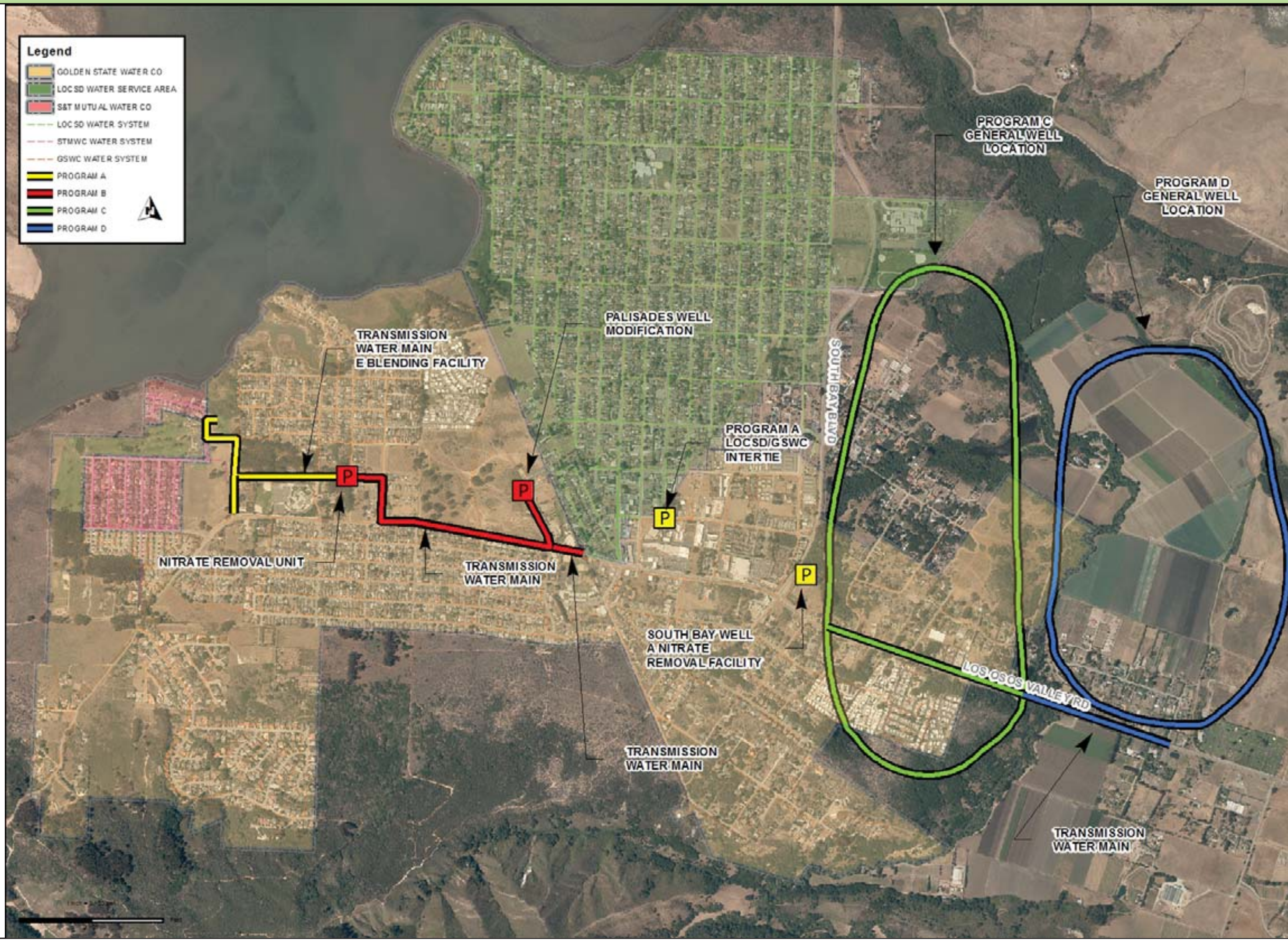
This Basin Infrastructure Program is based on the physical division of the Basin into Upper and Lower Aquifers, as described in Section 5.4, so that production of groundwater from one aquifer layer does not have the same impact on seawater intrusion as production from the other layer. In addition, as described in Section 5.9, production of groundwater from wells located in the Lower Aquifer in the Western Area causes a greater inducement of seawater intrusion than wells located in either the Central or Eastern Areas. The Basin Infrastructure Program takes advantage of these physical features of the Basin, by transferring groundwater production from the highly sensitive Lower Aquifer in the Western Area upward to the Upper Aquifer and landward to the Central and Eastern Areas.

The Basin Infrastructure Program involves the construction of new groundwater production, conveyance and treatment infrastructure in the Basin that will allow the transfer of groundwater production from the Lower Aquifer to the Upper Aquifer and the shift of groundwater production within the Lower Aquifer away from the Western Area to the Central and Eastern Areas. Because the ability to transfer groundwater pumping between aquifers and areas within the Basin depends on the existence and use of a vertically and laterally extensive network of wells, pipelines and treatment facilities, it is the Purveyors that are able to and will undertake the improvements that comprise the Basin Infrastructure Program. The shifting of groundwater production by the Purveyors directly benefits all users of water within the Basin; however, this Basin Plan recommends that the Basin Infrastructure Program be partially funded by a Basin-wide assessment.

The Basin Infrastructure Program is divided into four parts, designated Programs A through D. Programs A and B would transfer groundwater production from the Lower Aquifer to the Upper Aquifer, and Programs C and D would shift production within the Lower Aquifer from the Western Area to the Central and Eastern Areas, respectively. The four programs build on and overlap each other to some extent.

The general locations of the components of the Basin Infrastructure Program are shown in Figure 55. Program A elements are generally unconnected and located throughout the Purveyors' service areas in the Western and Central Areas. Program B elements are also located in the urban core of the Western and Central Areas. The elements of Program C are located on the eastern side of the Central Area, and Program D elements are located in the Eastern Area, representing the landward shift in groundwater production.

Figure 55. Basin Infrastructure Program Map



In order to explain the impact of the Basin Infrastructure Program on the location of groundwater production within the Basin, this chapter uses the distributive graphic introduced in Section 4.7. To provide a baseline for comparing Programs A through D, Figure 56 depicts the distribution of maximum sustainable groundwater production under current conditions. Figure 56 shows the areas and aquifer layers from which groundwater would be produced to allow the maximum quantity of groundwater to be produced on a sustainable basis from the Basin as a whole. In order to identify the optimal distribution of production, the Model was used to calculate the impact of various pumping patterns on the Basin, so that groundwater production results in a Basin Yield Metric of exactly 100, and there is no seawater intrusion into the Basin. In this chapter, the focus of the distribution graphics is on the maximum sustainable supply of groundwater, regardless of water demands.

Figure 56. Baseline Distribution of Groundwater Production

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	50	530	80
Lower Aquifer	300	860	720
Total			2,540

Note: All figures expressed in and rounded to the nearest 10 AF.

In order to build on other programs established in this Basin Plan, Figure 56 assumes that the LOWWP will be constructed and the Urban Water Reinvestment Program implemented as set forth in Chapter 9. The same assumption is applied to analyze Basin Infrastructure Programs A through D, so that the alternatives may be directly compared. If those assumptions are not made, the general results of the Basin Infrastructure Programs would be very similar, although the specific quantity of production from each area and aquifer layer could vary. The conclusions of this chapter would likely not materially change the assumptions regarding the LOWWP.

In addition to the theoretically optimal distribution of groundwater production shown in Figure 56, Figure 57 shows the actual distribution of production from 2006 through 2013. The real production in Figure 57 may be contrasted with the sustainable level of production in Figure 56, and the difference between the two graphics represents the level of unsustainable production in the Basin. This is particularly apparent in the Lower Aquifer's Western Area, where production exceeded the sustainable amount by approximately 2.5 times, or 460 AFY. In simple terms, stopping seawater intrusion into the Lower Aquifer requires the elimination of that 460 AFY of production, or transferring it to another location in the Basin.

Figure 57. Distribution of Groundwater Production (2006-2013)

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	50	520	80
Lower Aquifer	760	730	720
Total			2,850

Note: All figures expressed in and rounded to the nearest 10 AF.

10.2 Program A

Program A is designed to allow the Purveyors to increase groundwater production from the Upper Aquifer to the greatest extent practicable without construction of large-scale nitrate removal facilities. As of December 31, 2012, the Purveyors had initiated or completed most of the infrastructure improvements in Program A, and it is the intent of the Parties to complete all projects in Program A by the middle of 2015. The specific improvements in Program A are listed in Table 34 and described in the following sections. The costs listed in Table 34 and other locations within this chapter are calculated in 2013 dollars, and would need to be adjusted to the date of actual construction. Those figures do not include any financing costs.

Table 34. Basin Infrastructure Program A Improvements

Improvement	Capital Cost	Parties Involved
Water Systems Interconnection	$100,000	LOCSD/GSWC
Upper Aquifer Well	$600,000	LOCSD
South Bay Well Nitrate Removal	$640,000	LOCSD
Palisades Well Modifications	$15,000	LOCSD
Blending Project	$1,110,000	GSWC
Water Meters	$370,000	S&T
Total	$2,835,000	Purveyors

10.2.1 *Water Systems Interconnection*

LOCSD and GSWC currently share an interconnection between their water distribution systems, but the interconnection is undersized for sustained conveyance of water supplies from one utility to the other. As part of Program A, LOCSD and GSWC will construct a replacement interconnection between their water distribution systems.

The new interconnection, to be located on Los Olivos Avenue at 11th Street, will consist of a new underground vault, piping, isolation valves and a two-way flow meter. It will have a sustained capacity of 400 gpm, but could be operated up to 600 gpm for short periods of time. The interconnection could transfer as much as 500 to 600 AF of water annually between LOCSD and GSWC.

The new, expanded interconnection will allow LOCSD and GSWC to share water supplies during emergencies and will convey water between them in a manner that allows shifting of groundwater production within the Basin. The latter use integrates with Programs B, C and D by allowing LOCSD and GSWC to distribute groundwater produced from various locations within the Basin across their combined distribution networks. LOCSD and GSWC will enjoy some benefits from the improved interconnection immediately, while other benefits will not be realized until implementation of Programs B, C and D.

The new interconnection was designed by LOCSD and GSWC, and an agreement for joint construction and operation of the facility is currently being negotiated. The expected construction cost is approximately $100,000 and will be shared equally by LOCSD and GSWC. GSWC has obtained authorization from the CPUC for funding of the interconnection, and LOCSD has earmarked money from its capital improvements budget for the project.

10.2.2 *Upper Aquifer Well*

LOCSD will drill and construct a new water supply well to extract groundwater exclusively from the Upper Aquifer in the Central Area. It is expected that this new well may be utilized by LOCSD without nitrate removal or other groundwater treatment because of its location in an area where nitrate levels remain relatively low, and because the produced water will be blended with groundwater from the Lower Aquifer to meet all drinking water standards. The new well is expected to produce at least 150 AFY and cost approximately $600,000 to drill and equip.

10.2.3 *South Bay Nitrate Removal*

LOCSD has operated its South Bay Well in the Lower Aquifer for a number of years. In 2008, LOCSD constructed an Upper Aquifer well at the same site, with the intent that produced water would be blended with groundwater from the Lower Aquifer well. After construction, however, it became clear that the relative levels of nitrate in the Upper and Lower Aquifer wells did not allow a significant amount of blending without nitrate treatment.

Program A includes the installation of a relatively small "package" nitrate removal plant for the South Bay Upper Aquifer well. The facility will be capable of treating 70 gpm, with a maximum annual output of 100 AFY. Several treatment processes are available to remove nitrate from groundwater, and the most cost-effective method will be chosen at final implementation of the project.

The nitrate removal facility will enable LOCSD to produce an additional 100 AFY from the Upper Aquifer, in turn allowing the district to reduce its Lower Aquifer production by an equal amount. Although the size of the facility will be limited, it will have the added benefit of providing the Purveyors with valuable experience in operating such facilities within the Basin prior to implementation of larger-scale nitrate removal as part of Program B.

The nitrate removal project is expected to cost approximately $640,000. LOCSD has received grant money from the CDPH to cover 100 percent of capital costs for the project. The nitrate removal project is to be completed and operational by January 2015. LOCSD will be responsible for operation and maintenance costs associated with the nitrate removal unit, which are expected to be approximately $375 per AF, including brine disposal. Those costs are not capitalized, but will be included in the LOCSD operations budget each year during the life of the project.

10.2.4 *Palisades Well Modifications*

As described in Section 5.9, seawater intrusion into the Lower Aquifer includes a "finger" extending along the syncline of the Basin in Zone E, the deeper of the two layers in the Lower Aquifer. That finger has been induced, in part, by groundwater production from LOCSD's Palisades Well. As part of Program A, LOCSD has modified its Palisades Well to eliminate that finger of seawater intrusion.

Prior to this action, the Palisades Well had three screened intervals through which it drew groundwater, one located in Zone D and the other two in Zone E. Tests conducted by LOCSD during November 2012 showed that seawater intrusion in the Palisades Well was originating only from Zone E, and groundwater from Zone D remained unimpacted. In order to continue using the well without inducing further seawater intrusion, LOCSD blocked the withdrawal of Zone E groundwater from the Palisades Well. Completed in May 2013, LOCSD undertook a project to modify the well so that it produces groundwater exclusively from Zone D of the Lower Aquifer.

The project filled the bottom 120 feet of the well with cement grout and raised the pump. Filling in the lower two screened intervals that drew from Zone E is expected to reduce the yield of the Palisades Well, but produced water quality is expected to be much better. TDS in the produced water will decrease from 1250 to 250 mg/l, and chlorides will decrease from 550 to 30 mg/l. There will be the potential for upconing, or drawing seawater intrusion upwards from Zone E into Zone D, but the resulting impacts to water quality at the Palisades Well will be substantially less than under past well conditions.

LOCSD funded the project with approximately $15,000 from its 2012-2013 capital improvements budget.

10.2.5 *Blending Project*

As nitrate levels in the Upper Aquifer increased over the past several decades, the Purveyors were forced to discontinue using some Upper Aquifer wells. Those wells remain valuable assets, however, and Program A includes the construction of a blending project to allow the reactivation of an existing Upper Aquifer well owned by GSWC. Because of improved water quality through blending, nitrate removal will not be required to meet drinking water standards. The blending project is expected to allow GSWC to transfer 150 AFY of groundwater production from the Lower Aquifer to the Upper Aquifer.

In the blending project, GSWC will construct a pipeline between its Lower Aquifer Rosina Well and its Upper Aquifer Skyline Well, which is currently inactive. The project will also involve construction of an inline static mixer and larger diameter plant piping at the Rosina Well site, as well as supervisory control and data acquisition (SCADA) equipment and a nitrate analyzer for real-time measurement of blending operations.

The blending project is currently being designed by GSWC. The expected construction cost is approximately $430,000 for the pipeline and $680,000 for the blending facilities, for a total of $1.11 million. GSWC will be responsible for financing, constructing and operating this project. Funding for the project has been authorized by the CPUC and the permitting process is underway.

10.2.6 *Water Meters*

During the third and fourth quarters of 2011, S&T installed meters on all its water service connections. Beginning in November 2012, S&T began charging its members for the amount of water used rather than by a flat rate (as was its prior practice). Because it will result in reducing water demands by S&T customers, this project is included as a measure in the Urban Water Use Efficiency Program set forth in Chapter 8. The project also included in Basin Infrastructure Program A because it required infrastructure improvements for implementation. Installing meters on all water service connections are expected to decrease groundwater extractions by S&T from the Lower Aquifer in the Western Area. While the exact demand reduction is unknown, it is anticipated that savings could be as much as 25 AFY.

The installation of meters on all S&T water service connections cost approximately $370,000, and was paid for by S&T members through use of reserve funds and an assessment of $900 per member.

10.2.7 *Conclusion*

Overall, implementation of Program A allows the Purveyors to sustainably produce as much as 185 AFY from the Upper Aquifer in lieu of 80 AFY from the Lower Aquifer. In addition, Program A would eliminate production of groundwater from Zone E by LOCSD's Palisades Well and reduce S&T's water demands on the Lower Aquifer by as much as 25 AFY.

Figure 58 depicts the distribution of groundwater production from the Basin after implementation of Program A. More specifically, Figure 58 shows the maximum quantity of groundwater that may be produced without causing seawater intrusion, based on the Model, after implementation of Program A. When compared to the baseline distribution in Figure 56, Figure 58 shows that the result of implementing Program A would be to reduce production from the Lower Aquifer in the Western and Central Areas by approximately 80 AFY and increase production from the Upper Aquifer by 185 AFY. That transfer of production will assist in preventing seawater intrusion into the Lower Aquifer, even though the increase in Upper Aquifer production is greater than the reduction in pumping from the Lower Aquifer.

Figure 58. Distribution of Groundwater Production for Program A

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	90	680	80
Lower Aquifer	270	810	720
Total			2,650

Note: All figures expressed in and rounded to the nearest 10 AF.

Based on the Model, the result of implementing Program A is an increase in the Sustainable Yield$_X$ of the Basin from 2,540 AFY to 2,650 AFY, which captures a marginal yield of 110 AFY. The anticipated capital cost of Program A improvements is $2,115,000.

As noted above, the Purveyors have agreed to implement all projects in Program A, and completion of Program A is assumed when analyzing Programs B, C and D. The schedule for implementing Program A projects is shown in Table 35. Program A will have been fully implemented by the 2016.

Table 35. Basin Infrastructure Program A Schedule

	2011		2013				2014				2015-2016			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Water Systems Interconnection									■	■	■	■		
Upper Aquifer Well										■	■	■	■	■
South Bay Well Nitrate Removal					■	■	■	■	■	■				
Palisades Well Modifications			■	■										
Blending Project					■	■	■	■						
Water Meters	■	■												

10.3 Program B

Program B has been designed to maximize the use of Upper Aquifer groundwater through the construction of additional wells and a community nitrate removal facility. Program B builds upon and would follow implementation of Program A. The specific improvements are listed in Table 36 and described below.

Table 36. Basin Infrastructure Program B Improvements

Improvement	Capital Cost	Parties Involved
LOCSD Wells	$2,700,000	LOCSD
GSWC Wells	$3,200,000	GSWC
Community Nitrate Removal Facility	$11,350,000	LOCSD/GSWC
Total	$17,250,000	Purveyors

10.3.1 *LOCSD Wells*

LOCSD would construct two new Upper Aquifer wells to increase its production capacity from that layer. Together, it is expected that these wells would allow LOCSD to produce an additional 300 AFY from the Upper Aquifer and reduce its extractions from the Lower Aquifer by an equal amount. It is expected that the two wells would produce water with nitrate levels higher than the drinking water standard of 45 mg/l, and nitrate removal would be required in the short and intermediate terms. Thus, Program B includes construction of pipelines from the new wells to a community nitrate removal facility, which is tentatively planned for location at the site of GSWC's Rosina Well. The construction of two Upper Aquifer wells and associated pipelines is expected to cost approximately $2,700,000.

10.3.2 *GSWC Wells*

Under Program B, GSWC would construct one new Upper Aquifer well, which would expand its production capacity by 200 AFY in that layer. In addition, GSWC would construct one new Lower Aquifer well in the Central Area, with an anticipated yield of 200 AFY. That well is also contained in Program C as Expansion Well No. 2, but would only be constructed once if both programs were implemented. Combined, the two wells would allow GSWC to reduce its groundwater production from the Lower Aquifer in the Western Area by up to 400 AFY.

Like the new Upper Aquifer wells to be constructed by LOCSD, it is expected that GSWC's new Upper Aquifer well would produce water with nitrates above the legal standard for drinking water quality, absent treatment. The GSWC Upper Aquifer well would include piping to connect it to the community nitrate facility. Because Expansion Well No. 2 would draw groundwater from the Lower Aquifer, it would not require nitrate treatment and would be piped directly into the GSWC distribution system. GSWC's construction of two new wells and associated pipelines is expected to cost approximately $3,200,000.

10.3.3 *Community Nitrate Removal Facility*

In order to allow increased use of groundwater from the Upper Aquifer, the Purveyors would need to remove nitrates from water produced by new Upper Aquifer wells, including two for LOCSD, one for GSWC and, potentially, one or two for S&T. The Parties have determined that the necessary quantity of groundwater would be treated most economically and effectively through construction of a single, community nitrate facility rather than two or more separate facilities. Accordingly, Program B includes the construction of a shared nitrate removal facility.

The relatively small package nitrate removal plant to be installed by LOCSD as part of Program A would be retained, even after construction of the community nitrate removal facility as part of Program B, because of the earlier timing of the package plant and the anticipated availability of grant funding for associated capital costs. Once the package plant is in place, the Parties have decided not to incur the expenses associated with constructing additional pipelines from the Upper Aquifer South Bay Well to the community facility.

There are several technologies currently available for removal of nitrates from groundwater, including ion exchange and RO. In addition, various companies are working to make other treatment technologies effective at nitrate removal, and some of those technologies may be commercially available at the time for implementation of Program B. LOCSD and GSWC will coordinate to select an effective and economical technology at the time for design and construction of the community nitrate removal facility. For cost estimation purposes at the current planning stage, this Basin Plan assumes that ion exchange will be the technology employed.

As envisioned, the facility would be capable of treating between 450 and 950 AFY at the Rosina Well site, with an average treatment of 700 AFY. That capacity would handle the production from three or four new Upper Aquifer wells, with the potential addition of one or more existing wells, if nitrate treatment becomes necessary.

To date, the South County Sanitation District's ocean outfall has been identified as the nearest possible brine disposal facility. It has capacity for 50,000 gpd, but uses only 5 percent of that capacity currently. The Los Osos community nitrate removal facility would need 15,000 gpd, or three loads per day. Prior to use of that ocean outfall, the Parties would need to obtain an institutional agreement with South Coast Sanitation District and conduct environmental review of such a project under CEQA.

The expected capital cost to install an ion exchange unit is approximately $2,100,000. Annual operation and maintenance costs are estimated to be $300 per AF, plus brine disposal costs of an additional $300 per AF. The present value of such costs over a 30-year period, assuming that operational costs escalate at the rate of inflation with a discount rate of 4.5 percent, would be $9,250,000.[132] New

[132] *See* Rodney T. Smith, *Project Evaluation II: Thoughts about Interest Rates*, Water Strategist Community Blog

technologies may allow for lower capital, operations or brine disposal costs, and LOCSD and GSWC will consider potential methods to reduce costs in selecting a technology in future.

It is not expected that the nitrate removal facility will need to be operated permanently. As the LOWWP intercepts urban wastewater in Los Osos, and as treated water discharged to the Broderson site migrates into and through the Basin, nitrate levels are expected to decrease in groundwater in the Upper Aquifer. In addition, there will be some impact from the removal of nitrates from produced groundwater and exportation of such nitrates from the Basin. One study estimated that approximately 30 years will be required in order to flush nitrates from the Basin, although that study has not been updated more recently.[133] In designing the nitrate removal facility, the Parties will consider performing a mass balance analysis of nitrates in the Basin to determine the rate at which nitrates may be removed from the Basin, and therefore how long nitrate treatment may be required. That information may be useful in selecting a technology, and in planning the expected life of the facility.

10.3.4 *Conclusion*

Implementation of Program B allows the Purveyors to produce an additional 700 AFY from the Upper Aquifer in lieu of reducing production from the Lower Aquifer in the Western Area by 195 AFY. Figure 59 shows the distribution of groundwater production after the implementation of Programs A and B, which can be compared with the distributions in Figure 56 (baseline) and Figure 58 (Program A only). The result of implementing both Programs A and B will be to reduce production from the Lower Aquifer in the Western Area more than under Program A, and to increase production from the Upper Aquifer in both the Western and Central Areas. That transfer of groundwater production from the Lower Aquifer to the Upper Aquifer will have a direct, beneficial impact on seawater intrusion. As groundwater production from the Lower Aquifer in the Western Area largely stops, so will seawater intrusion.

As described in Section 10.2.7, the result of implementing Program A would be an increase in the Sustainable Yield$_X$ of the Basin from 2,540 AFY to 2,650 AFY, a marginal yield of 110 AFY. The marginal yield from implementing Program B would be an additional 520 AFY, for a Sustainable Yield$_X$ of 3,170 AFY. The anticipated capital cost of all Program A and B improvements, including the present value of operation, maintenance and brine disposal costs, would be $19,365,000.

Unlike Program A, the Parties have not unconditionally agreed to implement Program B. The determination of whether to implement Program B depends upon whether the residents of Los Osos decide to provide funding for the Basin Infrastructure Program through a Basin-wide assessment and whether the County

(January 11, 2013).

[133] Gus Yates & Derrik Williams, *Simulated Effects of a Proposed Sewer Project on Nitrate Concentrations in the Los Osos Valley Groundwater Basin*, at 18-19 (2003).

and Coastal Commission approve a Los Osos Area Plan that would allow development of lots that are currently undeveloped or underdeveloped. If the Parties choose to implement Program B, implementation would take likely approximately 3.5 years, with one year for permitting, one year for design, and 1.5 years for construction, including the procurement process.

Figure 59. Distribution of Groundwater Production for Program AB

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	550	920	80
Lower Aquifer	80	820	720
Total			3,170

Note: All figures expressed in and rounded to the nearest 10 AF.

10.4 Program C

Program C includes a set of infrastructure improvements that would allow the Purveyors to shift some groundwater production within the Lower Aquifer from the Western Area to the Central Area. Since groundwater production from the Central Area induces less seawater intrusion than the same amount of production from the Western Area, this landward shift increases the Sustainable Yield$_X$ of the Basin. Program C consists of three wells located on the eastern side of the Central Area, an upgrade to GSWC's water main located along Los Osos Valley Road and pipelines to connect each of the expansion wells to that main.

The three wells in Program C would be located to prevent or minimize impacts to private wells already producing groundwater from the Central Area. That is expected to be possible because the new wells would penetrate the Lower Aquifer, whereas existing domestic wells are concentrated in the Upper Aquifer.

Table 37. Basin Infrastructure Program C Improvements		
Improvement	**Capital Cost**	**Parties Involved**
Expansion Well No. 1	$1,400,000	GSWC
Expansion Well No. 2	$2,000,000	GSWC
Expansion Well No. 3	$1,600,000	LOCSD
Los Osos Valley Road Main Upgrade	$1,500,000	GSWC
S&T/GSWC Interconnection	$40,000	S&T/GSWC
Total	$6,540,000	Purveyors

10.4.1 *Expansion Well No. 1*

Expansion Well No. 1 would be located in the vicinity of Sunny Oaks Mobile Home Park south of Los Osos Valley Road in the GSWC service area. A well in this location is estimated to be capable of producing approximately 300 AFY. In order to connect the well to the main along Los Osos Valley Road, installation of approximately 2,400 lineal feet of eight-inch piping would be necessary. The cost to construct Expansion Well No. 1 and its connecting pipeline is estimated at $1,400,000.

10.4.2 *Expansion Well No. 2*

Expansion Well No. 2 would tentatively be located along the eastern edge of the GSWC service area north of Los Osos Valley Road. A well in this location is estimated to be capable of producing approximately 200 AFY. In order to connect a well in this location to the Los Osos Valley Road water main, installation of 1,300 lineal feet of eight-inch piping would be necessary. The projected cost to construct this well and pipeline is $2,000,000.

Expansion Well No. 2 is also included within Program B and would not need to be constructed again if Program B were implemented first.

10.4.3 *Expansion Well No. 3*

Expansion Well No. 3 would be located east of the LOCSD service area near the north end of Sage Avenue. Connecting the well to Los Osos Valley Road would require approximately 5,000 linear feet of pipeline. The well is expected to produce 100 AFY at a cost of $1,600,000.

10.4.4 *S&T/GSWC Interconnection*

An undersized interconnection also exists between GSWC and S&T. As part of Program C a new interconnection will be built in the vicinity of Salano Street and Skyline Drive with a capacity to meet the needs of sunset Terrace Development.

10.4.5 *Los Osos Valley Water Main Upgrade*

In order to enable GSWC's Los Osos Valley Road water main to accommodate additional flows from the three expansion wells in Program C, a portion of the main would need to be replaced with a larger diameter pipe. An eight-inch portion of the water main that runs through the Central Area, roughly from Sea Oaks Drive to Tierra Drive, would be replaced with a 12-inch main to provide additional capacity. The up-sized pipeline would also provide sufficient capacity to convey groundwater from three expansion wells in Program D to the water distribution systems of GSWC and LOCSD.

10.4.6 *Conclusion*

When compared to current conditions, implementation of Program C would allow the Purveyors to decrease their production from the Lower Aquifer in the Western Area by 175 AFY, while increasing production from the Central Area by 275 AFY in the Lower Aquifer and 385 AFY in the Upper Aquifer. Overall, Program C would increase Sustainable Yield$_X$ of the Basin by 460 AFY over baseline conditions.

Figure 60 illustrates the distribution of groundwater production after the implementation of Programs A and C, which can be compared with the baseline distribution in Figure 56. The result of implementing Program C would be to reduce production from the Lower Aquifer in the Western Area and increase production from both the Upper and Lower Aquifers in the Central Area. Implementation of Program C would allow the Purveyors to suspend most production from the Lower Aquifer in the Western Area, which would have a direct, beneficial impact on seawater intrusion.

If the Purveyors were to implement Programs A, B and C together, which would allow them to increase production from the Upper Aquifer by 530 AFY while decreasing production from the Lower Aquifer by 180 AFY. Implementation of the three Programs would increase the Sustainable Yield$_X$ of the Basin by 350 AFY over Programs A and C only, and by 180 AFY over Programs A and B only.

Figure 60. Distribution of Groundwater Production for Program AC

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	90	860	80
Lower Aquifer	130	1130	720
Total			3,000

Note: All figures expressed in and rounded to the nearest 10 AF.

Figure 61 shows the distribution of groundwater production from the Basin if the parties were to implement Programs A, B and C together. The distribution is similar to that shown in Figure 60, except that production capacity is increased substantially in the Upper Aquifer in the Western Area and somewhat in the Central Area, which allows a further reduction in production from the Lower Aquifer in both the Western and Central Areas.

Figure 61. Distribution of Groundwater Production for Program ABC

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	500	980	80
Lower Aquifer	80	1,000	720
Total			3,350

Note: All figures expressed in and rounded to the nearest 10 AF.

The result of implementing Programs A and C together would be an increase in the Sustainable Yield$_X$ of the Basin from a baseline of 2,540 AFY to 3,000 AFY, a marginal yield of 460 AFY at a combined capital cost of $8,655,000. Thus, Programs A and C have a lower combined capital cost than Programs A and B together. This is primarily due to the relatively large expense of nitrate treatment, which is not part of Program C.

If Programs A, B and C were all implemented, they would increase Sustainable Yield$_X$ to 3,350 AFY, which is 180 AFY more than implementing only Programs A and B, and 350 AFY more than implementing only Programs A and C. The combined capital, operation, maintenance and brine disposal costs for Programs A, B and C together would be $25,905,000. That combination would produce marginal Sustainable Yield$_X$ of 810 AFY.

As with Program B, the Parties have not unconditionally agreed to implement Program C. The strategy for determining which portions of the Basin Infrastructure Program to implement is discussed in Chapter 14. If Program C were implemented, the expected schedule would likely include one year for planning, six months for design, and one year for construction, including the procurement process. That would equal a two and one-half year timeline from the date that the Parties decided to implement Program C.

10.5 Program D

Program D consists of infrastructure improvements that would allow the Purveyors to increase groundwater production within the Eastern Area. Specifically, Program D would include three new wells and pipelines to connect those wells to GSWC's Los Osos Valley Road water main, as shown in Table 38.

Table 38. Basin Infrastructure Program D Improvements

Improvement	Capital Cost	Parties Involved
Expansion Well No. 4	$1,100,000	LOCSD/GSWC
Expansion Well No. 5	$1,875,000	LOCSD/GSWC
Expansion Well No. 6	$1,225,000	LOCSD/GSWC
Total	$4,200,000	Purveyors

In Program D, the Purveyors would construct three new water supply wells east of Los Osos Valley Creek, in locations to be determined based on availability of land and productive characteristics. The three wells are expected to be able to produce 200 AFY each. New pipelines would be required to connect the wells to the existing Los Osos Valley Road main owned and operated by GSWC. For planning purposes, this Basin Plan assumes that three pipelines would be needed for Expansion Wells Nos. 4, 5 and 6, with lengths of approximately 1,500 feet, 2,500 feet and 5,000 feet. The total capital cost for Program D would be $4,200,000.

Like Programs B and C, the Parties have not determined whether to implement Program D. It is clear, however, that Program D would only be implemented after completion of Programs A, B and C. Thus, the impact of Program D on the Basin is only analyzed in concert with those programs. Figure 62 depicts the distribution of groundwater production for Program D. When compared to the distribution for Programs A, B and C in Figure 61, it can be seen that Program D results primarily in increasing production from the Lower Aquifer in the Eastern Area. While there are minor variances in production from the other aquifer layers and areas, the only substantial change is an increase in production from the Eastern Area by 200 AFY.

Figure 62. Distribution of Groundwater Production for Program ABCD

	Western Area	Central Area	Eastern Area
Upper or Alluvial Aquifer	530	960	80
Lower Aquifer	80	940	920
Total			3,500

Note: All figures expressed in and rounded to the nearest 10 AF.

A significant change is seen when comparing the distribution of pumping from the baseline in Figure 56 with that for Program D in Figure 62. Program D results in substantially greater production from the Upper Aquifer in both the Western and Central Areas, the virtual elimination of production from the Lower Aquifer in the Western Area and an increase in production from the Lower Aquifer in the Eastern Area. Overall, this results in an increase in the Sustainable Yield$_X$ of the Basin from 2,540 AFY to 3,500 AFY, which is a marginal yield of 960 AFY. That represents almost a 40 percent increase in the Sustainable Yield$_X$ of the Basin, which would have a significant impact on preventing seawater intrusion.

The cost of implementing Program D is projected to be $4,200,000. Together, Programs A, B, C and D would cost an estimated $30,105,000.

10.6 Conclusion

As set forth in this chapter, the Basin Infrastructure Program includes several options for development of new groundwater production, conveyance and treatment infrastructure that would allow the Purveyors to transfer their production from the Lower Aquifer to the Upper Aquifer and from the Western Area to the Central and Eastern Areas. Shifting groundwater production in that manner would increase the quantity of water that could be produced from the Basin in a sustainable manner, as shown by an increase in the Sustainable Yield$_X$ metric. A summary of several combinations of Basin Infrastructure Programs A through D is listed in Table 39.

Table 39. Summary of the Basin Infrastructure Programs

Program Combination	Cost	Sustainable $Yield_X$	Basin Development Metric
Baseline	$0	2,540 AFY	73%
Program A	$2,835,000	2,650 AFY	76%
Program A + B	$20,085,000	3,170 AFY	91%
Program A + C	$9,335,000	3,000 AFY	86%
Program A + B + C	$24,585,000	3,350 AFY	96%
Program A + B + C + D	$28,785,000	3,500 AFY	100%

Because the Basin Infrastructure Program would be implemented in combination with other programs of this Basin Plan, a detailed discussion of the potential choices of programs, and the recommended course of action by the Parties, are withheld until Chapter 13. Even in isolation, however, the Basin Infrastructure Plan demonstrates significant ability to prevent seawater intrusion and improve the condition of the Basin.

[This page intentionally blank]

11

SUPPLEMENTAL WATER PROGRAM

11.1 Introduction

This chapter sets forth several alternatives for the development of a Supplemental Water Program for the Basin. For purposes of this Basin Plan, "supplemental water" is defined as water within the Plan Area that does not derive from potable water supplies within the aquifers of the Basin. The supplemental water supplies analyzed in this chapter include rainwater harvesting, stormwater capture, greywater reuse and brackish groundwater desalination. Supplemental water programs differ from other programs in this Basin Plan in that the primary focus is not on the Basin itself, but on other, non-Basin water supplies that could be developed within the Plan Area. Supplemental water in some respects is like water use efficiency improvements, in that its primary effect is to reduce demands on the Basin.

Based on the analysis in this chapter, rainwater harvesting, stormwater capture and greywater reuse do not provide any significant benefits to the Basin. Only groundwater desalination has the potential to support the Immediate and Continuing Goals of this Basin Plan as set forth in Section 2.4. However, it is not the intent of the Parties to implement any Supplemental Water Program at this time. The analysis contained in Chapter 14 finds that supplemental water will not be needed to achieve a sustainable Basin, even under the Buildout Population Scenario. The main purposes of identifying and analyzing potential supplemental water supplies is to ensure that this Basin Plan does not neglect any cost-effective solution for the Basin and to provide a comparator for other Basin Plan programs.

11.2 Rainwater Harvesting

Rainwater harvesting, or rainwater capture, is the accumulation and storage of rainwater for reuse before it reaches the ground and percolates into an aquifer. Rainwater can be collected from the roofs of houses, businesses and local institutions, such as schools. In addition to capturing rainwater for use, rainwater harvesting decreases the amount of runoff that reaches bays and estuaries, and thus has the potential to aid in improving water quality.

Some states, such as Colorado, prohibit rainwater harvesting without a permit. However, California does not regulate rainwater collection. Some water agencies and cities in California have rainwater rebate programs which reimburse residents for purchase of rainwater catchment barrels.

For example, the City of Los Angeles has adopted a voluntary Rainwater Harvesting Program. Los Angeles calculated that if all homes in the City of Los Angeles—roughly 800,000—utilized a rain barrel, approximately 2,400 AF of rainwater could be captured annually. Although Los Angeles does not have a mandatory rainwater ordinance, it sponsors rainwater harvesting educational events and materials as part of its Rainwater Harvesting Program. This program focuses on disconnecting gutter downspouts from impervious surfaces and redirecting them into areas where rainwater can percolate into soil or collect into rain barrels. Other cities with rainwater programs include Culver City and Santa Monica.

In 2009, the City of Tucson, Arizona enacted the nation's first municipal rainwater harvesting ordinance for commercial projects. The ordinance requires developers to construct a rainwater harvesting system as part of the project and to ensure that 50 percent of the project's landscape water budget is supplied by harvested rainwater. Rainwater harvesting has also been implemented in states as diverse as Ohio, Kentucky, Florida, Texas, Oregon, Washington and Hawaii.

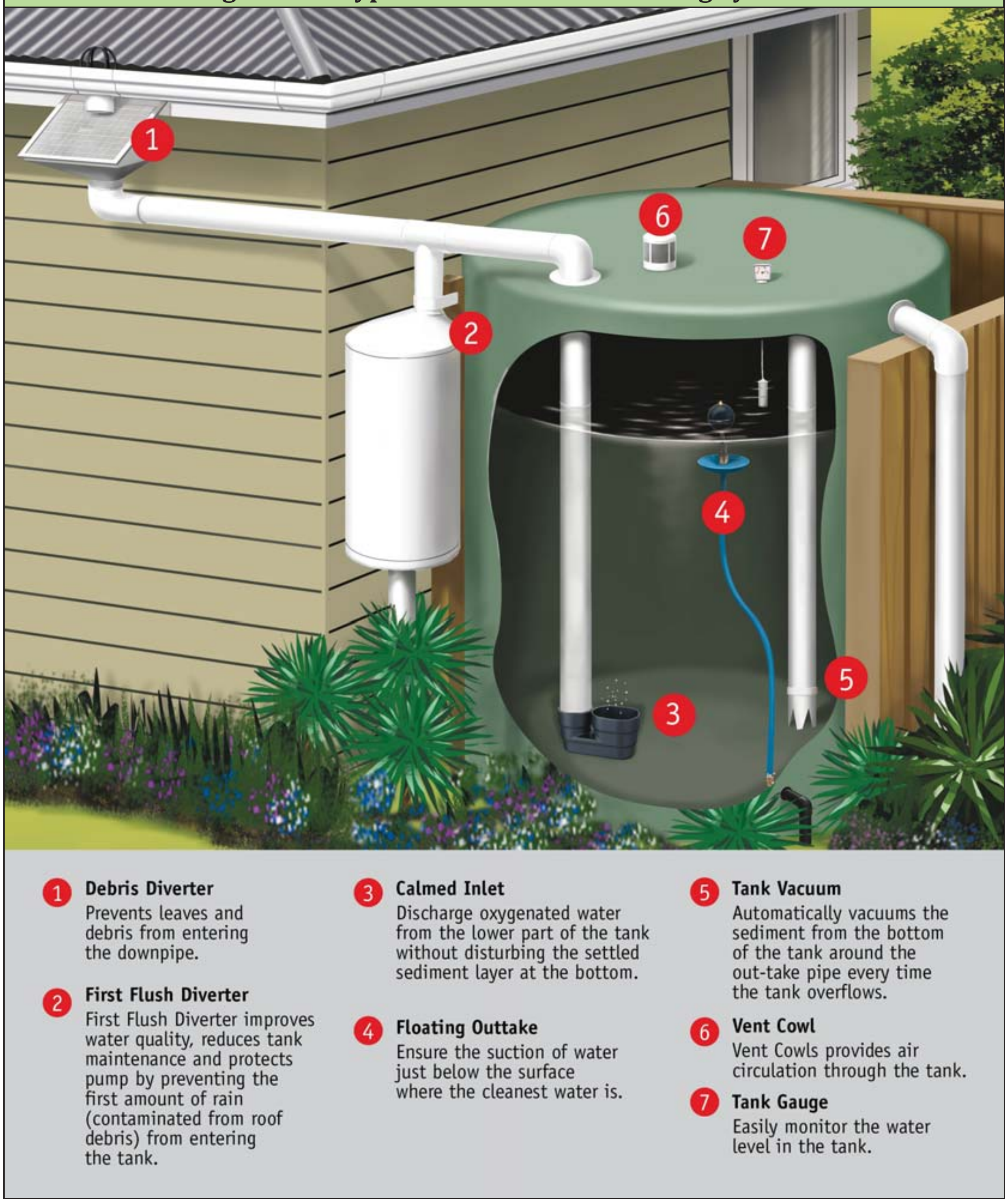
The global leader in rainwater harvesting is Australia. In the state of Queensland, which suffered a decadal drought from 2000 through 2010, the household penetration of rainwater harvesting systems rose from approximately 8 percent in 2004 to 40 percent by 2009. The Queensland Government provided financial rebates, totaling $240 million as of October 2008, and sponsored social marketing programs to promote household use of rainwater harvesting.

Rainwater harvesting systems can be relatively simple to construct and are potentially successful in most habitable locations. Rainwater collected from roofs will most likely not be potable and must be treated prior to human consumption. However, untreated rainwater can typically be used to flush toilets, wash clothes, water vegetation and wash cars. Simple systems can be designed to use gravity, simple filtration and a covered cistern or barrel. More complex systems may include a gutter to collect and divert the water from the roof to a cistern, a treatment system to prevent contamination, and a pump for using the system. A typical rainwater harvesting system is shown in Figure 63.

Rainwater harvesting could be accomplished in Los Osos using traditional above- or below-ground tanks or barrels. In addition, each homeowner in the Basin is currently on a septic system. Once the LOWWP is constructed and the community's wastewater discharge is processed by the LOWWP, the septic tanks will no longer be used. Abandoned septic tanks could be used to catch rainwater during the rainy season (primarily the winter and spring) and as a source of water for landscape irrigation during the dry season (primarily during the summer).

Use of harvested rainwater for landscape irrigation by individual residential, commercial and institutional property owners would allow a reduction in groundwater usage within the Plan Area. Harvesting of rainwater would not necessarily result in an improvement to the Basin, however, as such harvesting may simply sequester rainwater that would otherwise recharge the Upper or Lower Aquifers. Rainwater harvesting is ideal for properties that overly the perched zone of the Basin, as shown on Figure 21, or in the area served by stormwater pump stations operated by LOCSD. Other areas in the community are generally tributary to percolation areas which replenish the Basin.

Figure 63. Typical Rainwater Harvesting System



This Basin Plan does not adopt rainwater harvesting for action by the Parties because of challenges in implementation. Rainwater harvesting requires the design, construction, operation and maintenance of infrastructure on private residential, commercial and institutional properties, which can be relatively intrusive and requires integration with private buildings and other structures. Therefore, the Parties are not well placed to undertake the actions necessary to implement rainwater harvesting, when compared to individual property owners.

The Parties support the voluntary implementation of rainwater harvesting by property owners within the Plan Area, and may provide educational materials as part of the Urban Water Use Efficiency Program. Some property owners may have the resources and desire to implement rainwater harvesting on their own property, and they may do so consistent with this Basin Plan.

11.3 Stormwater Capture

Stormwater harvesting is the collection of water from the ground from areas that are designed for such collection. While rainwater harvesting is implemented at the level of the individual homeowner, stormwater capture involves the construction of community-level facilities to capture all of the stormwater in a given tributary area, including street runoff.

The stormwater capture concept would be feasible in areas tributary to LOCSD's stormwater pumping facilities that discharge to Morro Bay. Depending on rainfall patterns, these stations typically discharge 20 to 30 AFY. Assuming that larger storms may not be fully contained, implementation of stormwater capture could save 15 to 20 AFY, and could include facilities such as:

- Low impact roadside facilities such as bioretention, percolation trenches, and new terminal percolation basins. These facilities may not be viable in many areas until the LOWWP is implemented, which is expected to increase the separation between the ground surface and groundwater in low-lying areas of the community;

- Community stormwater storage and reuse facilities, which may be viable at Baywood School;

- Connection of a centralized stormwater collection system to privately-owned septic tanks abandoned after construction of the LOWWP, with perforation of tank floors to enhance percolation; and

- Terminal wetlands.

This Basin Plan does not recommend implementation of stormwater capture at this time due to the relatively small quantity of water projected to be generated by such a program. The Parties may seek to implement stormwater capture in the future as other programs in this Basin Plan have been completed.

11.4 Greywater Reuse

Greywater reuse is becoming a more widely accepted source of water supply. Greywater reuse allows individual homeowners, institutions, end users and industrial and commercial buildings to use greywater on site for landscaping and other non-potable uses. In certain area, greywater reuse has the potential to reduce the demand for new water supplies and may also reduce the energy and carbon footprint of water services. In the United States, it is estimated that greywater comprises up to 50 percent of single-family household use.[134] Accordingly, greywater reuse can be a key tool for decreasing reliance on new water supply to serve everyday household needs.

Greywater is generally defined as the wastewater generated from household uses, that has not come into contact with sewage. Greywater typically includes water generated from clothes washers, showers, baths and bathroom sinks. Greywater is distinguishable from more heavily contaminated "blackwater" generated by toilets and "dark greywater" generated by dishwashers and kitchen sinks that contains food waste. Greywater is also distinguishable from, but can potentially be combined with, rainwater. Greywater can be used for purposes that do not require potable water, such as landscaping or flushing toilets.

Greywater is often pre-treated before it is used and the degree of treatment can vary widely. Greywater may contain some of the same contaminants as sewage, but at lower concentrations that make its use safe. Greywater systems range from simple, low-cost devices that divert greywater to direct reuse to complex treatment processes incorporating sedimentation tanks, bioreactors, filters, pumps and disinfection. There are three main types of greywater systems: (1) diversion systems, which do not store greywater (but may filter and disinfect it); (2) physical greywater systems, which allow storage, filtration and disinfection of greywater; and (3) biological greywater treatment systems, which use biological processing technologies to treat greywater.

Diversion systems immediately use greywater rather than treating or storing it. One common type of system diverts water from shower and sink drains into toilet water tanks to be used for flushing. These systems typically involve some filtration to capture lint, hair, fats, grease, etc., and may also involve basic disinfection to kill bacteria. Systems that reuse sink water to fill toilets cost between $100 and $500.[135] Another common diversion system is one that diverts drain water to outdoor irrigation, often requiring additional plumbing and irrigation tubing. These systems are relatively inexpensive and are best used in areas that have vegetation so that infiltration of applied greywater is possible. Another less common diversion system diverts greywater from showers and sinks into treatment wetlands or other plant- and soil-based filters.

Greywater systems that store, filter and treat greywater utilize a wide variety of treatment techniques. They include disinfection, activated carbon filtering and sand filtering. Treatment is necessary to reduce bacteria and other microorganisms that could multiply during storage. These systems typically involve holding tanks, filters and pumps, and cost between $1,000 and $5,000 for a single-family home. Due to

---

[134] Pacific Institute, *Overview of Greywater Reuse: The Potential of Greywater Systems to Aid Sustainable Water Management* (2010).
[135] *Id*.

the use of holding tanks and filtration units, the systems are often land-intensive and may be inappropriate for small lots in Los Osos.

Greywater systems that use aerobic biological treatment can be scaled up or down to meet different treatment needs. Treatment technologies in these systems include membrane filters to remove contaminants, bacteria and viruses, as well as aerobic biological treatment. The more complex systems are relatively expensive, costing as much as $10,000 for a single-family household.

The United States does not have a national greywater policy so regulation is left to the states. Approximately thirty states regulate the use of greywater. In California, the Legislature has encouraged the use of greywater in appropriate circumstances,[136] and the California Department of Housing and Community Development has incorporated greywater use standards into the California Plumbing Code.[137] The County allows greywater conversions under the Plumbing Code provisions.

The Parties are not recommending implementation of greywater use as part of this Basin Plan, because approximately 90 percent of all properties in the Plan Area will be connected to the LOWWP. When completed, that project will collect and treat all wastewater from within the Wastewater Service Area, and reuse all produced water as detailed in the Water Reinvestment Program set forth in Chapter 9. Thus, construction and operation of the LOWWP would make greywater systems redundant and of no benefit.

There is some potential benefit from installation of greywater systems outside the Wastewater Service Area by individual property owners. As with rainwater harvesting, implementation challenges associated with installation and operation of facilities on private properties make greywater systems inappropriate for action by the Parties. Private property owners with the necessary resources and desire are encouraged to consider greywater use for their own implementation.

11.5 Groundwater Desalination

This section explores the potential for desalinating groundwater in the Basin to produce supplemental water supplies. As described in Section 5.9, groundwater within Zone E of the Lower Aquifer is highly saline within the Western Area, and the same is true to a lesser extent in Zone D. Thus, there is an essentially limitless supply of seawater within the Basin that could be produced for desalination purposes. The primary goal of this Basin Plan is to prevent the further flow of seawater into the Lower Aquifer, while this section describes a way of using a portion of that seawater to produce potable water.

[136] *See* Cal. Stats., Chap. 577, § 3 (2011); Cal. Water Code § 14877.3.
[137] *See* 24 Cal. Code Regs., Part 5, Chap. 16A, Part I [http://www.hcd.ca.gov/codes/shl/2007CPC_Graywater_Complete_2-2-10.pdf].

While desalination in some locations relies on seawater withdrawn directly from the ocean or an enclosed or semi-enclosed bay or inlet, in Los Osos the best approach would be to produce groundwater from Zone E in the Western Area as the source water. Using wells located in the Western Area to produce groundwater would avoid the need to construct an ocean water intake and associated raw water conveyance piping. In addition, such wells naturally filter out sediments that may be present in ocean water and avoid potential environmental impacts from an ocean intake.

11.5.1 *Desalination Processes*

Desalination can be made of raw seawater or brackish water (lower chloride and TDS concentrate). Brackish water is water with a total dissolved solids (TDS) within the range of 1,000 to 10,000 mg/L. Groundwater within Zone E of the Lower Aquifer has higher TDS than brackish levels, and the operation of wells would be expected to draw higher salinity seawater toward their cones of depression. Therefore, source water within the Basin would be roughly equivalent to seawater, rather than brackish water.

Reverse osmosis (RO) is the preferred method of desalinating seawater in the United States. RO osmosis purifies water by forcing it through semi-permeable membranes, allowing water to pass but retaining the impurities of heavy metals and compounds such as lead and nitrates, which must be disposed of. Because the membranes can be damaged by large particles in the feed water, RO typically involves significant pre-treatment processes. Use of pretreatment filters extends the life of the desalting membranes used in RO. The kind of pretreatment used depends on several factors: (1) source of the feed water; (2) composition of the feed water; and (3) function of the feed water. Some amount of water will be rejected as part of RO as brine; the amount of brine will depend on the configuration of the system. The process requires an energy source as well as disposal of brine to either a wastewater system or another source that can be properly discharge the brine.

11.5.2 *Options for Seawater Desalination*

There are currently permanent as well as temporary options for desalination of seawater to serve the Los Osos community.

Seawater desalination operations and plants can be purchased as modules that are easily installed in a desired location. For example, Aqualyng, a company based in Norway, specializes in modular seawater RO desalination plants. Their standard module sizes are: 500 m^3/day (150 AFY), 1,000 m^3/day (300 AFY), 2,000 m^3/day (600 AFY), 5,000 m^3/day (1,500 AFY) and 10,000 m^3/day (3,000 AFY). Aqualyng has installed plants worldwide.

GE also manufactures and installs desalination facilities and can operate the facilities if necessary. Its facilities range in size from small plants producing 600 AFY for hotels and resort complexes to very large plants producing 60,000 AFY. GE's global installed capacity includes approximately 600 MGD (675,000 AFY) of RO systems.

Mobile desalination units are also available. DWR owns several mobile units and has a logistical plan for deploying them to drought-stricken and water-stressed areas of the state. They can be hooked up to existing municipal water storage and delivery systems. The units used by DWR generally use RO as their treatment process. The units, resembling a large trailer, come in a variety of sizes and use a variety of chemical treatments and membranes to filter and purify water and make it suitable for human consumption.

Mobile units are self-contained desalination plants housed in a steel container and are modular so additional units can be added to increase capacity as needed. All pre- and post-treatment stages are accommodated within the container. A unit can typically be housed in a standard 20-ft to 40-ft commercial steel container that can be hauled or transported by truck, barge or airlifted.

Unlike permanent desalination plants, temporary mobile units can be commissioned, installed and put into production in a short period of time. In 2008, GE Water Mobile Seawater Desalination Solutions was able to deliver a two-train mobile desalination unit to Aruba within 5 weeks of the order date. Each train was capable of producing 300 gpm of high purity water from seawater.

Several water treatment and purification companies provide mobile water desalination units for purchase or lease. Single-pass or dual-pass RO stages are available. Companies who provide the units include GE Water, Suez Environnement/Degremont, Veolia Water, Seven Seas Water, Applied Membranes and GeoPure Water Technologies.

The selection of an appropriate treatment technology depends on the specific chemistry and other characteristics of the source water, as well as the treatment site size, energy costs and brine disposal method. If the Parties were to commence planning for a desalination facility, they would hire an expert consultant with experience designing and operating multiple desalination plants, who would assist in the technology selection and design of the treatment plant.

11.5.3 *Seawater Desalination Costs*

The costs categories associated with an RO desalination process are: feed water intake and brine discharge; feed water quality and variations; finished water quality; distribution; permitting and regulatory; project delivery mechanism; and other associated costs (e.g., power costs, proximity to power source, availability and cost of skilled labor, environmental mitigation, etc.). These individual categorical factors that cause and contribute to the overall cost of a project are largely common to all projects. However, the magnitude of the costs in each category can vary significantly among different projects due to site specific conditions, resulting in cost differences. Unit costs for several RO seawater desalination plants located around the world are summarized in Table 40.

Table 40. Costs for Selected Seawater Desalination Projects		
Desalination Project	**Unit Cost ($/AF)**	**Capacity (AFY)**
Perth I, Australia	$1,515	36,500
Gold Coast, Australia	$3,034	37,000
Sydney, Australia	$2,542	74,000
Hadera, Israel	$814	97,000
Tampa, Florida, USA	$1,257	28,000
Carlsbad, California, USA†	$2,064	56,000
Sand City, California, USA	$2,599	300

† This facility is not yet operational. $2,064 represents the upper range of the contractual price between San Diego County Water Authority and the private developer of the project.

The wide range of unit costs shown in Table 40 demonstrates that desalination costs are highly site-specific, with intake/discharge and distribution costs accounting for major differences in unit cost across different projects. Construction costs can also significantly impact the unit costs as was the case on the Gold Coast where the project was constructed in 2007 and 2008 when worldwide construction costs peaked. Power costs, proximity to power source, availability and cost of skilled labor, and environmental mitigation are a few of the other costs that drive overall project cost for desalination facilities.

In California, power costs are significant. Without normalizing data from foreign desalination plans for the site specific conditions in California (e.g. labor, construction, equipment costs, etc.), electrical energy accounts for between 30 and 40 percent of the total water production costs of a typical membrane seawater desalination plant. When site-specific conditions are taken into account, power costs for overall more expensive desalination facilities in California is likely to contribute closer to 20 to 30 percent of the total costs of water production.

This Basin Plan relies on cost data from the desalination plant in Sand City, California to estimate the cost of a facility in Los Osos. That facility is of a similar size to the potential plant in Los Osos, uses a similar intake method (discussed below) and is located in coastal California. The Sand City facility had capital costs of approximately $6 million for the treatment process and $6 million for the intake wells, distribution piping and backbone infrastructure. Operation and maintenance costs are approximately $1,230 per AF of produced water. This has been reduced by one calculation to a cost of $2,599 per AF of produced water.[138]

For Los Osos, it is estimated that the costs of a groundwater seawater desalination facility would be approximately $16.75 million for the first 250 AFY of capacity, over 30 years. The expansion of that capacity to 750 AFY would cost an additional $23.5 million, for a total of $40.25 million. The unit cost of the expansion would be lower

[138] This figure was calculated by the CPUC for the purchase of water from the Sand City plant by California-American Water Company. *See Application of California-American Water Company (U210W) for an Order Authorizing Recovery of Costs for the Lease of the Sand City Desalination Facility and Associated Operating and Maintenance Costs*, Decision 13-04-015, at 30 (April 18, 2013).

than for the initial facility based on the fact that certain intake, building structure and distribution piping costs would have already been constructed for the initial phase of 250 AFY. It is possible that the costs of a desalination facility in Los Osos would exceed those in Sand City based on higher costs for brine disposal, but determining the costs in Los Osos more precisely would require specific planning for a supplemental water project in the future.

11.5.4 *Intake and Brine Concentrate Discharge*

Feed water intake configuration directly affects capital and operational costs of the treatment process, environmental impacts and the difficulty of permitting. Possible intake type are as follows: beach wells; horizontal directional-drilled wells; radial wells; constructed seabed/infiltration gallery; submerged open intake; surface open intake; and co-located intake. As noted above, the intake for any desalination plant in Los Osos would likely consist of groundwater wells in Zone E of the Lower Aquifer in the Western Area. That is partly because the Coastal Commission and other agencies with regulatory jurisdiction over development of intake infrastructure have recently declared that open water intakes are disfavored because of concerns pertaining to entrainment of planktonic biomass. It is therefore anticipated that an open water intake will not be permitted unless all reasonable options for subsurface intake have been demonstrated to be infeasible.

Based on the Model, the result of using three intake wells drawing 1,000 AFY of groundwater from Zone E of the Lower Aquifer in the Western Area would be to draw seawater toward those wells in Zone E. Since the wells would be drilled in the Western Area in a portion of Zone E that has already been impacted by seawater intrusion, that would not constitute a negative impact on the Basin. The Model also concluded that any future cessation of production from the three intake wells would allow the Basin to return to its pre-project condition, without any lingering impacts. Therefore, from the perspective of Basin management, the construction and operation of three intake wells would be feasible.

The other challenge facing desalination plants is how to dispose of the brine concentrate stream produced as a facility byproduct. The chosen method of disposal for the brine concentrate stream also impacts overall costs. On the low end of the cost range are sanitary sewer disposal ($100,000 to $400,000 per MGD), a power plant outfall ($200,000 to $600,000 per MGD), and a wastewater treatment plant outfall ($300,000 to $2 million per MGD). More expensive disposal methods are constructing a new ocean outfall with diffusers ($2 million to $5.5 million per MGD), evaporation ponds ($3 million to $9.5 million per MGD) and zero-liquid discharge ($5.5 million to $15 million per MGD). Most desalination plants yielding the lowest water production costs have brine concentrate discharges either located in coastal areas with very intensive natural mixing or are combined with power plant outfall structures which use the buoyancy of the warm power plant cooling water to provide accelerated initial mixing and salinity plume dissipation at lower cost.

For Los Osos, discharge of brine concentrate could be difficult to permit and expensive. Options include siting a new ocean outfall or attempting to discharge the brine concentrate through an existing ocean outfall, such as the outfall used for return of cooling water from the Morro Bay Power Plant, which is the present outfall used by the City of Morro Bay for intermittent use of its existing desalination plant. Each option would face significant challenges. A new ocean outfall would require pipe installation under Montana de Oro State Park and the area surrounding Morro Bay, which is a National Estuary. Permits would be required from the Coastal Commission, California Department of Parks and Recreation, State Lands Commission and RWQCB, among other permitting agencies. The prospect of successful permitting of a new outfall would be difficult.

Efforts to use Morro Bay Power Plant's outfall would face significant challenges as well. In addition to uncertainty with respect to contracting for use of the outfall and the costs and permitting issues associated with discharge pipeline north to the City of Morro Bay, the power plant's future operation is uncertain in light of developing restrictions on the use of "once-through" ocean cooling systems like that used at the plant and financial issues pertaining to the plant's present owner.

Another existing outfall that could be sought for use is the outfall used by the Morro Bay-Cayucos Wastewater Plant jointly owned by the City of Morro Bay and the Cayucos Sanitary District. However, the Cayucos Sanitation District has objected to the use of this outfall for the City of Morro Bay's existing desalination plant, and it is unlikely that a new desalination plant in Los Osos would be permitted to use this outfall. If the Parties were to consider building a desalination facility in the future, they would coordinate with the City of Morro Bay and Cayucos Sanitation District regarding the potential use of their ocean outfall for brine disposal.

Identifying a permitable and affordable brine disposal method is likely to be the largest challenge facing a desalination plant in Los Osos. This issue would need to be revisited in the event that the Parties decided to pursue a Supplemental Water Program based on desalinating seawater from the Basin.

11.5.5 *Facility Siting and Distribution*

Production capacity of a desalination facility affects the size and extent of equipment needed and the space necessary to locate the treatment plant. Coastal communities that utilize desalination as a source of drinking water are usually in close proximity to the treatment facility; therefore, land is usually priced at a premium. The cost of locating a facility closer to the point of use and a suitable power source should be weighed against the costs associated with additional intake and discharge pipeline easements, transmission line costs, construction materials, permits, labor and maintenance associated with locating a plant further from an intake/discharge or distribution service area. Because a desalination facility would likely be located in the developed area of Los Osos, it would not be likely to require extensive transportation to reach the water distribution systems of the Purveyors. The Purveyors would need to conduct a hydraulic analysis of their systems to determine the optimal points of delivery and whether their distribution networks would need to be improved to accept delivery of desalinated water.

For Los Osos, the siting of a desalination plant could be challenging given that a facility would be located in the Coastal Zone and therefore subject to regulation by the Coastal Commission. It is possible that a facility could be permitted if it were necessary to create a sustainable Basin, but as explained in this Basin Plan, it is not now anticipated that supplemental water supplies will be required.

11.5.6 *Project Delivery Mechanism*

The size of the project, expected contract duration, location, competition, risk allocation and project owner preferences all affect the project delivery mechanism. Globally, the design-build-own-operate-transfer (DBOOT) development strategy has been a successful model to develop desalinated water at a low all-inclusive cost. Without exception, the lowest cost desalination projects to date have been delivered under turnkey DBOOT contracts where private sector developers or consortia share risks with the public sector based on their respective abilities to control and mitigate their respective project related risks. The lower costs associated with DBOOT project delivery are driven in part by lower insurance and contingency costs in DBOOT contracts, which are between 10 and 20 percent of the total capital cost. Similar costs for the more traditional project design-bid-build projects can be higher.

Projects in Australia have recently utilized the owner-engineer-contractor "alliance" delivery method. The alliance model allows further minimization and isolation of owner risks. This model incorporates a two-stage bidding process involving selection of qualified private sector companies and then engages the top two companies in a competitive project development phase (which is paid for by the owner). Insurance and contingency premiums for this model are historically more than 30 percent of total project costs. Past experience has shown that the alliance structure allows projects to be completed more quickly than the DBOOT structure, while the DBOOT structure is the least expensive. Traditional design-bid-build contracting tends to be the most expensive and slowest structure of the three.

11.5.7 *Conclusion*

The Model was used to evaluate the impact on the Basin of a potential groundwater desalination facility. A hypothetical scenario was developed in which a groundwater desalination project extracted 1,000 AFY from three groundwater wells located in Zone E in the Western Area, without changing other Basin infrastructure or management. The Model predicted that the seawater intrusion front would move approximately 2,000 feet inland within the Lower Aquifer compared to a scenario with no desalination, but freshwater production levels in Zone D and the Upper Aquifer would not need to be reduced in order to maintain the freshwater-seawater interface at a sustainable location. If the groundwater desalination wells were stopped, salinity would return to non-desalination levels, with no long-term impacts on the Basin.

In other words, the Model predicts that the Purveyors could extract and desalinate saline groundwater from Zone E in the Western Area, without causing salinity to exceed sustainable levels in freshwater production wells, and without any long-term negative impacts to the Basin. This analysis is preliminary in nature, and prior to implementing any desalination project, the Parties would need to undertake a more extensive review of the specific operations being proposed and its projected impact on the Basin.

For purposes of this Basin Plan, construction and operation of a groundwater desalination facility is considered to be technically feasible in Los Osos, without causing any negative impacts on the Basin. The largest challenges to successful implementation of such a facility are likely to be permitting through the Coastal Commission and RWQCB, brine disposal and cost. Based on those concerns, and the identification of other solutions for the Basin as set forth in this Basin Plan, the Parties do not recommend pursuing a groundwater desalination facility at this time.

11.6 Supplemental Water Conclusions

Based on the analysis above, this chapter concludes that rainwater harvesting, stormwater capture and greywater reuse have the potential to generate relatively small amounts of water for the Basin, but face significant challenges for Basin-wide implementation by the Parties. Therefore, the Parties do not intend to take any actions to further those potential supplemental water programs. Residents, businesses and institutions in Los Osos may implement such actions on their own properties if they desire.

According to the preliminary analysis in this chapter, the construction and operation of a groundwater desalination facility by the Purveyors is feasible and would potentially benefit the Basin. Such a facility would be relatively expensive and difficult to permit, however, when compared to other Basin Plan programs, and according to the analysis in Chapter 14 would not be necessary to achieve a sustainable Basin. Therefore, the Parties do not recommend implementation of groundwater desalination at this time.

[This page intentionally blank]

12

IMPORTED WATER PROGRAM

12.1 Introduction

This chapter sets forth several alternatives for the development of an Imported Water Program for the Basin. For purposes of this Basin Plan, "imported water" is defined as water made available for use within the Plan Area from a source located outside the Plan Area. Imported water in some respects is like water use efficiency improvements, in that its primary effect is to reduce demands on the Basin. If imported water were acquired for Los Osos, it would most likely be used to meet potable demands of the Los Osos community that are currently served by the Purveyors. By meeting some portion of the potable needs of the community with imported water, the quantity of groundwater pumped from the Basin could be reduced, thereby mitigating seawater intrusion.

An Imported Water Program has the potential to support all Immediate and Continuing Goals of this Basin Plan as set forth in Section 2.4. However, as set forth in Section 2.5.1, the water management principles for this Basin Plan include the following:

- *Water supplies and demands of the Basin will be managed to avoid the need for imported water supplies in the Plan Area, to the extent possible.*

There are several major reasons for this water management principle. First, the focus in this Basin Plan on sustainability supports the concept of the Los Osos community living within the means of its natural capital, including water supplies, rather than reaching out to import water from another area. While large cities often must import water supplies, smaller communities like Los Osos should avoid importing water to the extent possible. This preference for use of local water supplies is reflected in California state law.[139]

[139] *See* Cal. Water Code §§ 108, 10620 (in preparing an urban water management plan, a water supplier "shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions").

Second, the water supplies of the Basin are likely to be more reliable over the long term than imported water supplies. As long as it is managed pursuant to the other programs in this Basin Plan, Basin groundwater is highly reliable. Imported water supplies are subject to shortages in their sources and conveyance infrastructure failures, including interruptions of electrical power.

Third, imported water supplies tend to be more costly than local supplies, due to the need for extensive or complex infrastructure. Such costs include design, construction, financing, operation, maintenance, repair and replacement of infrastructure. The costs associated with imported water supplies in Los Osos are analyzed in this chapter and compared to the costs of other Basin Plan programs in Chapter 14.

Finally, past experience has revealed significant public antipathy in Los Osos toward imported water. The Parties have considered this public preference in the development of this Basin Plan.

Based on the water management principles of this Basin Plan, it is not the intent of the Parties to implement any Imported Water Program. The analysis contained in Chapter 14 finds that neither supplemental nor imported water will be needed to achieve a sustainable Basin. Thus, the purposes of identifying and analyzing potential imported water supplies in this chapter are to ensure that this Basin Plan does not neglect any potential solution for the Basin and to provide a comparator for other Basin Plan programs.

12.2 Overview of Water Importation

Many areas of California import water from other parts of the state. Large-scale water transportation projects include the Central Valley Project, State Water Project, Los Angeles Aqueduct, Hetch Hetchy Aqueduct, Mokelumne Aqueduct and Colorado River Aqueduct. Sources of water for those projects include the Sacramento, San Joaquin, Owens, Tuolumne, Mokelumne and Colorado River systems. Some of those projects are depicted on the map in Figure 64.

Within San Luis Obispo County, there are two regional water distribution projects that could be used to supply water to Los Osos:

- The State Water Project (SWP), from which the San Luis Obispo County Flood Control and Water Conservation District (SLOCFCWD) has an entitlement to import up to 25,000 AFY for distribution to its 10 subcontractors within the county;

- The Nacimiento Water Project (NWP), which was constructed during 2007-2011 by SLOCFCWD and delivers up to 17,500 AFY of water from Lake Nacimiento to its five contractors.

Each of those projects is discussed in the sections below, as well as other potential sources of imported water for Los Osos.

Figure 64. Selected Water Importation Projects in California

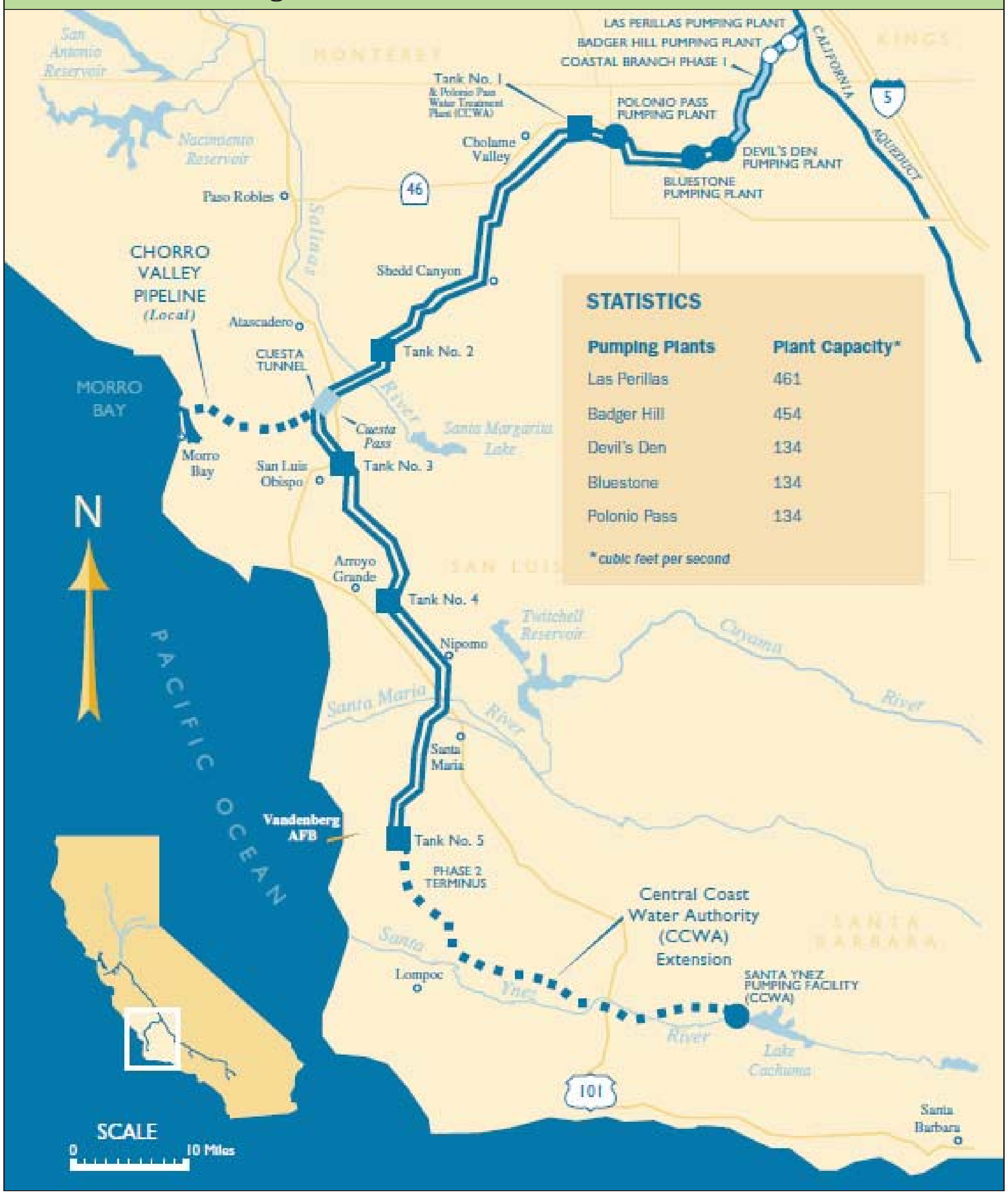
Source: DWR.

12.3 State Water Project

The SWP is one of the largest water development and distribution projects in California. It was constructed and is owned and operated by DWR on behalf of 29 contractors located in northern, central and southern California, including SLOCFCWD.

The SWP currently includes 33 storage facilities, 21 reservoirs and lakes, 20 pumping plants, 9 power plants and almost 700 miles of aqueducts and pipelines. SWP supplies are diverted from the Feather River at Lake Oroville, released and conveyed through the Sacramento-San Joaquin Bay Delta (Delta), rediverted at the Harvey O. Banks Delta Pumping Plant in the southern Delta and conveyed through the California Aqueduct to central and southern California. SWP water is routed from the California Aqueduct to San Luis Obispo and Santa Barbara Counties through the Coastal Branch of the SWP, which is operated by the Central Coast Water Authority (CCWA). Figure 65 is a map of Coastal Branch facilities.

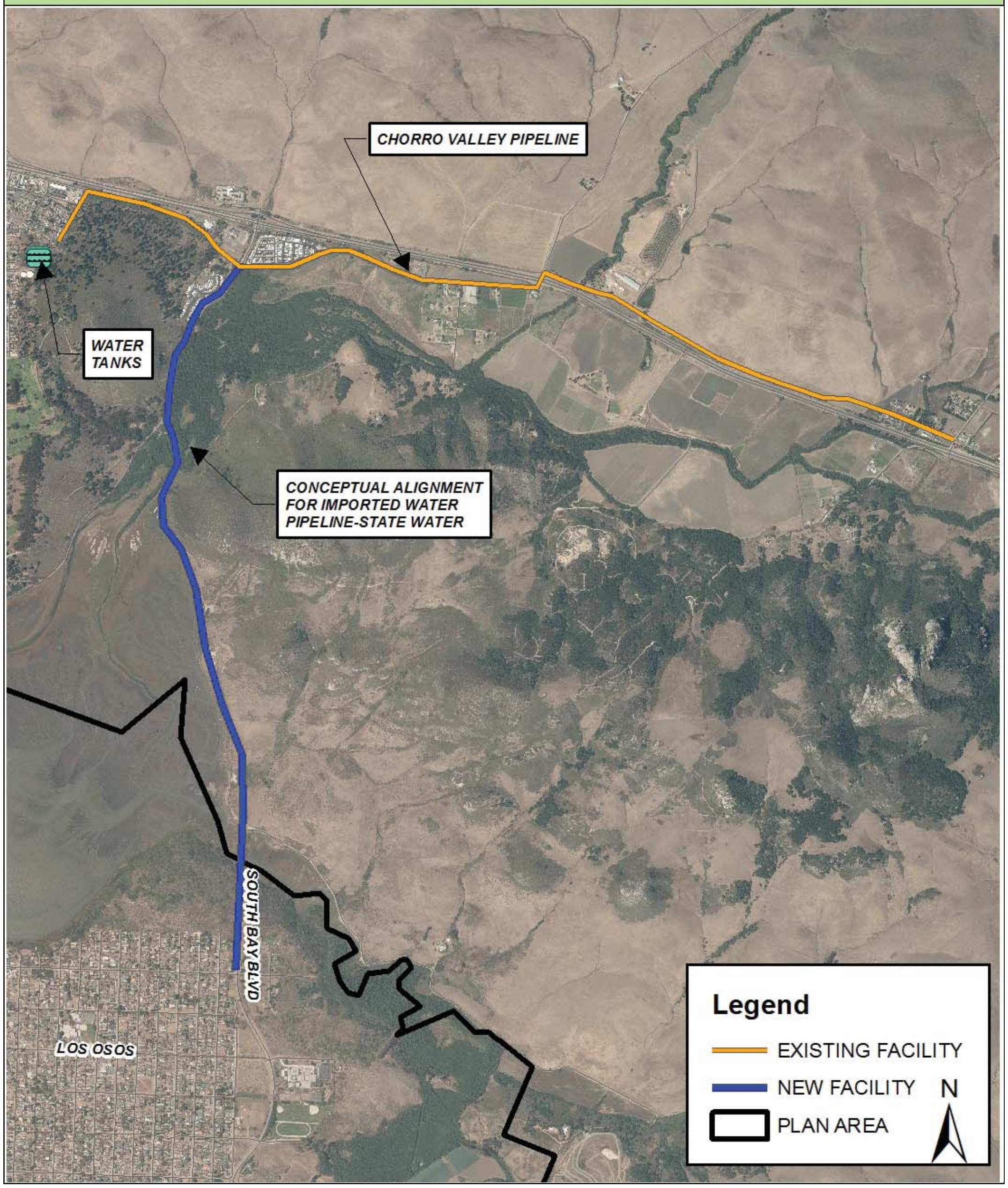
Figure 65. SWP Coastal Branch Facilities



Source: DWR.

Water delivered through the Coastal Branch is treated to potable drinking water standards at the Polonio Pass Water Treatment Plant. After treatment, water flows to the Chorro Valley Turnout, where it is diverted for delivery to the City of Morro Bay, California Men's Colony, County Operations Center and Cuesta College. The Chorro Valley Pipeline is owned by SLOCFCWD and operated by both that agency and CCWA.

Figure 66. Potential Route of Los Osos Connection to the SWP



In order to receive water from the SWP, one or more participating Purveyors would need to physically connect their water distribution systems in Los Osos to the Coastal Branch facilities. The County has studied potential methods of connection and determined that the best method would be to construct a pipeline from Los Osos to the Chorro Valley Pipeline along South Bay Boulevard, as shown in Figure 66.[140] The exact alignment and point of connection to the Purveyors' water distribution systems would need to be determined in the future. It is expected that the Purveyors would encounter significant permitting challenges for this pipeline route, which would pass through Morro Bay State Park and extensive wetland areas.

A potential limitation on the ability of the Purveyors to receive water from the SWP is the water conveyance capacity of the Coastal Branch and Chorro Valley Pipeline that is available to SLOCFCWD. While SLOCFCWD has a contract with DWR for delivery of up to 25,000 AFY of SWP supplies, the pipelines were only designed to convey 4,830 AFY to SLOCFCWD due to limited interest among water purveyors at the time of design and construction in the 1990s. During preliminary studies for development of the Coastal Branch, provisions were made for all potential future users of SWP water, including 300 AFY for Los Osos. However, since none of the Purveyors contracted for any SWP water, the Chorro Valley pipeline was not designed to accommodate any water deliveries to Los Osos.

Until 2011, it was believed that the peak seasonal requirements of the City of Morro Bay required the entire capacity of the Chorro Valley Pipeline, which would leave no capacity available for Los Osos. However, a 2011 report determined that the Chorro Valley Pipeline could be operated to create excess capacity above its design value, by as much as 2,642 AFY.[141] While it is possible that SWP water could be made available to the Purveyors for use in Los Osos, the ability to deliver that water through the Coastal Branch has not been definitively analyzed. Prior to any action to import SWP water to Los Osos, a detailed analysis of pipeline capacity would be required, to determine whether sufficient capacity would exist above the requirements of previously subscribed subcontractors.

Beyond physical capacity in the Coastal Branch, the Purveyors would need to secure legal agreements with all the agencies with interests in the SWP and Coastal Branch, including DWR, SLOCFCWD and CCWA. The Purveyors have not initiated any discussions with those agencies about participation in the SWP, and the outcome of any such negotiations, if pursued, would be speculative at this time.

Another factor limiting the usefulness of a Los Osos connection to the SWP is that the project's water supplies are not reliable at the quantity of contractual entitlements. The water entitlements of all SWP contractors total approximately 4.2 million AFY, but the project delivers a lesser amount during all years, based on lower delivery requests, hydrologic deficiencies in the Feather River watershed, infrastructure capacity and legal, environmental and regulatory restrictions. Between 2001 and 2010, the SWP delivered an average of 2.1 million AFY, and DWR

---

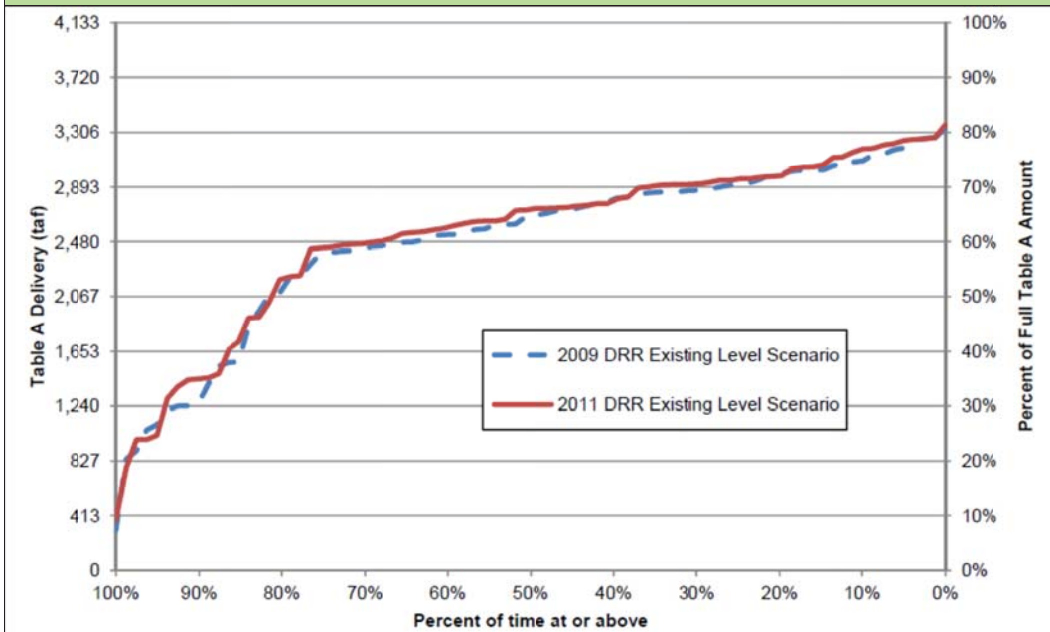
[140] Carrollo Engineers, Inc., *San Luis Obispo County, Los Osos Wastewater Project Development, Technical Memorandum: Imported Water* (July 2008).

[141] Water System Consulting, Inc., *Capacity Assessment of the Coastal Branch, Chorro Valley, & Lopez Pipelines* (December 22, 2011).

has estimated that the SWP will be able to deliver an average of only 2.5 million AFY in future years through 2030.[142]

Figure 67 shows an exceedance curve for the projected yield of the SWP under existing conditions (as that term is defined by DWR). While the average reliability of SWP supplies is projected to be 61 percent in future years, deliveries in particular years are projected to vary widely between 9 and 81 percent of contractual entitlements (known as Table A amounts). Variable reliability can be mitigated through use of SWP programs such as carryover water, Article 21 water and dry year programs, but is likely to have continuing impacts on the value of SWP supplies as a potential source of imported water for Los Osos and other communities.

Figure 67. SWP Delivery Reliability



Source: DWR, *Technical Addendum to the SWP Delivery Reliability Report 2011* (June 2012).

One of the most important factors affecting the reliability of SWP supplies is a complex set of environmental restrictions on SWP diversions from the southern Delta for the protection of several endangered species. Restrictions on diversions during the spring and early summer limit deliveries of SWP supplies in central and southern California. The ability to avoid some of those restrictions hinges on development and implementation of the Bay Delta Conservation Plan (BDCP), which is being prepared by DWR in conjunction with other state and federal agencies and the SWP contractors. That process is extremely uncertain.

A primary issue is the proposed development of a new isolated conveyance system, consisting of two tunnels that would convey water beneath the Delta from the Sacramento River to the SWP and CVP facilities south of the Delta. If constructed,

[142] DWR, *The State Water Project Final Delivery Reliability Report 2011* (June 2012).

the proposed tunnels would mitigate some of the present Delta reliability concerns arising from environmental restrictions. The proposed tunnels are highly controversial and expensive, however, with projected costs in excess of $24.5 billion for construction, operation and maintenance over 50 years. It is uncertain whether the BDCP will ever be approved or implemented.

In addition to operational concerns stemming from environmental restraints, Delta deliveries face long-term risks associated with climate change and sea level rise, as well as the prospect of catastrophic levy failure from an earthquake, which could preclude or substantially reduce Delta deliveries for an extended period. These restrictions should be taken into account if Los Osos were to consider acquisition of SWP supplies in the future.

Costs associated with connecting Los Osos to the SWP could be substantial. In 2008, the County estimated that buy-in costs for the SWP could be as high as $20,000 per AF, or $20 million for the 1,000 AF supply analyzed in this Basin Plan. The cost of constructing a turnout and pipeline from the Chorro Valley Pipeline to Los Osos is expected to be approximately $3 million, based on a cost of $1.5 million per mile. In addition, the County estimated that ongoing SWP costs would be approximately $1,250 per AF, which would yield a present value of $27,500 per AF over 30 years or $27.5 million for 1,000 AFY. Combined, the cost of importing SWP supplies into Los Osos is projected to be approximately $50.5 million over 30 years.

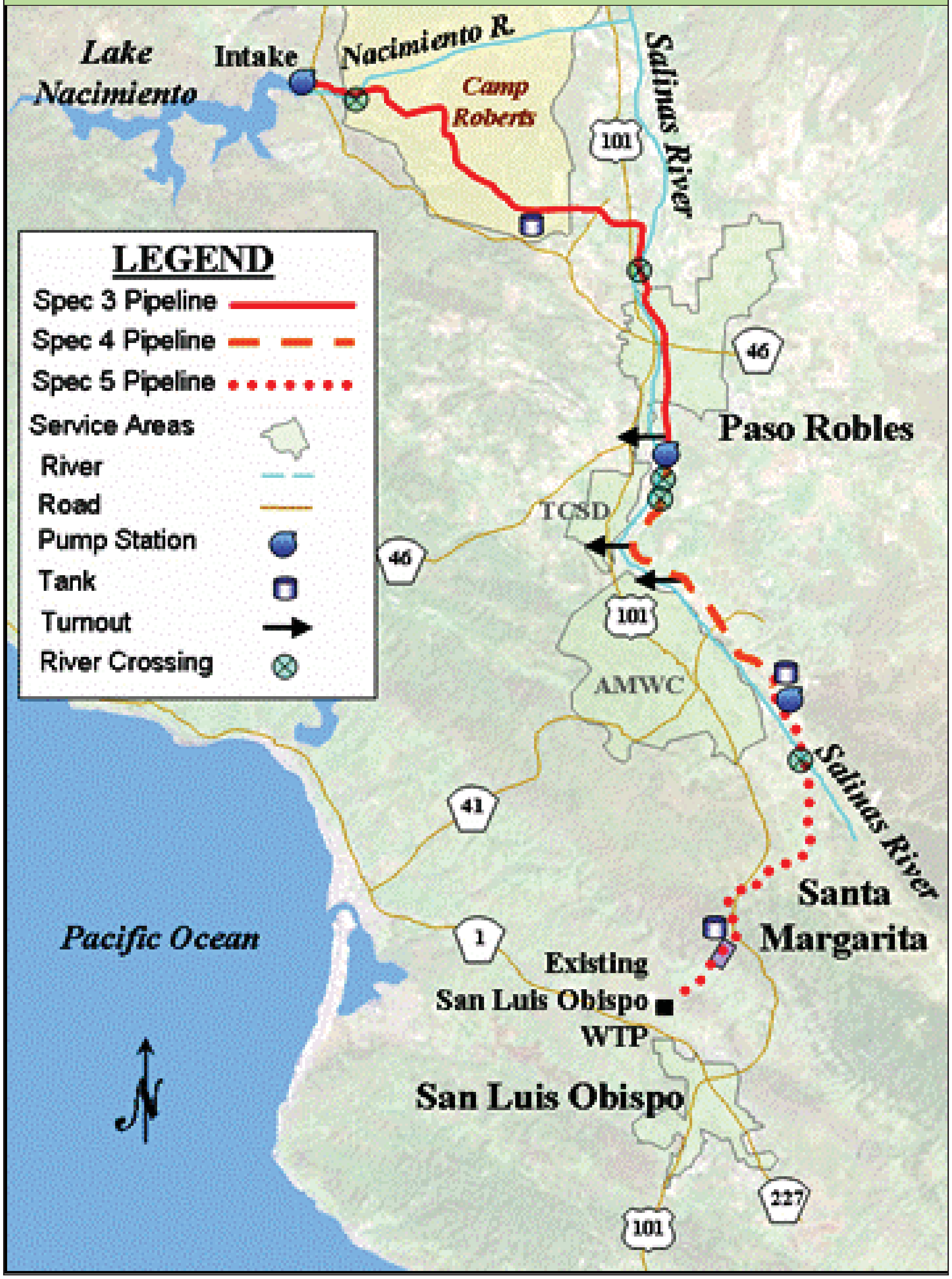
As described above, connecting the Los Osos community to the SWP would face a number of challenges, including engineering, environmental, permitting, contracting, finances and public sentiment. The discussion in this Basin Plan serves only as a preliminary discussion of those issues, since the Parties do not recommend importing water into the Basin at this time. Further detailed analysis would be necessary to formulate a plan for connecting to the SWP if this option were to be pursued in the future.

12.4 Nacimiento Water Project

The NWP is a local water development and distribution project owned and operated by SLOCFCWD. The project delivers up to 17,500 AFY of water from Lake Nacimiento in the Salinas River basin in the northern part of San Luis Obispo County to five contractors, including the City of Paso Robles, Templeton Community Services District, Atascadero Mutual Water Company, City of San Luis Obispo and Benefit Zone A of County Service Area 10 (located in Cayucos). The project also delivers water to property owners adjacent to Lake Nacimiento outside of the main NWP distribution system.

The NWP consists of an intake at Lake Nacimiento and a 45-mile pipeline with its southern terminus at the City of San Luis Obispo Water Treatment Plant, as shown on Figure 68. CSA10 does not have a physical connection to the NWP, and deliveries to CSA10 are accomplished through an exchange of water with the City of San Luis Obispo from Whale Rock Reservoir.

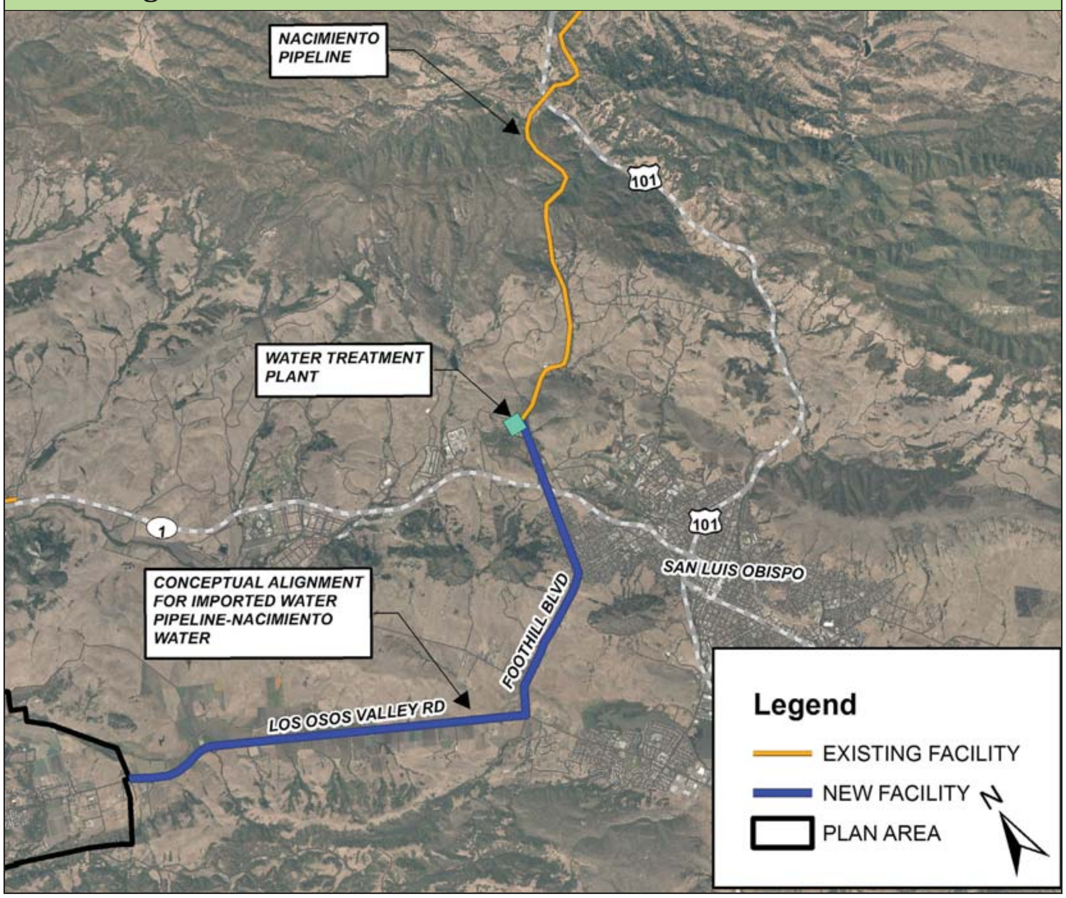
Figure 68. Nacimiento Water Project Facilities



The overall NWP yield of 17,500 AFY may be divided into three categories: 1,750 AFY of "Prior Commitment Water" which is designated for the benefit of lakeside users and not available for diversion; 9,655 AFY which is committed to the five contractors based on the Water Delivery Entitlement Contract; and 6,095 AFY of "Reserve Water" which is available for delivery but currently unsubscribed.

The mechanics of arranging for the delivery of NWP water to Los Osos would be largely the same as for SWP supplies. First, the Purveyors would need to physically connect their water distribution systems to the NWP. This could be accomplished either through building a new treated water pipeline from the City of San Luis Obispo Water Treatment Plant along Los Osos Valley Road to Los Osos as shown on Figure 69, or by arranging for the City of San Luis Obispo to treat and inject water from the NWP into the Chorro Valley Pipeline for delivery to Los Osos through the new pipeline discussed in Section 12.3. The first option would involve a 9-mile pipeline at a cost of approximately $13.5 million, while the second option would require construction of the South Bay Boulevard pipeline for approximately $3.5 million, including a connection from the City of San Luis Obispo Water Treatment Plant to the Chorro Valley Pipeline. The pipeline along Los Osos Valley Road would likely encounter fewer legal and permitting challenges, but would be more expensive.

Figure 69. Potential Route of Los Osos Connection to the NWP



Prior to connecting Los Osos to the NWP, further analysis would need to be performed on the capacity of the NWP pipeline from Lake Nacimiento to its southern terminus. The pipeline was sized for the existing project participants, and the ability of the NWP facilities to handle additional deliveries to Los Osos would need to be confirmed.

In addition to establishing a physical connection, the participating Purveyors would need to negotiate an agreement with SLOCFCWD to acquire a portion of Reserve Water from the NWP. Such an agreement would require the approval of SLOCFCWD and at least 55 percent of the existing NWP contractors. In addition, the Purveyors would need to obtain a contract with the City of San Luis Obispo for treatment of the water at the city's water treatment plant. The Purveyors could build their own treatment plant, but that approach would likely be less economical than arranging for the city to treat NWP supplies at its existing plant. Los Osos participation in the NWP could prove to be a lengthy and complicated process requiring extensive negotiations with multiple parties.

Costs associated with connecting Los Osos to the NWP would likely be similar to those for the SWP. For the fiscal year from October 1, 2011 through September 30, 2012, annualized debt service costs for prior capital investments in the NWP were $1,746 per AF, while fixed operations and maintenance expenses were $131 per AF. Total annual costs could be expected to be approximately $2,000 per AF on an ongoing basis. Over 30 years, that would yield a present value of approximately $44,000 per AF, or $44 million for 1,000 AF. Adding the costs of a connection pipeline, the 30-year cost to import NWP supplies into Los Osos could range from $47.5 to $57.5 million.

As with the SWP, connecting the Los Osos community to the NWP would face a number of challenges, including engineering, environmental, permitting, contracting, finances and public sentiment. The discussion in this Basin Plan serves only as a preliminary discussion of those issues, since the Parties do not recommend importing water into the Basin at this time. Further detailed analysis would be necessary to formulate a plan for connecting to the NWP if this option were to be pursued in the future.

12.5 Other Imported Water Sources

In addition to the SWP and NWP, Los Osos could acquire imported water supplies from various holders of water entitlements in California. Certain areas of the state have been the source of water transfers in recent years, and water entitlement holders in those areas may be willing to sell water or water rights in the future. Those areas and types of rights include:

- State Water Project entitlements from contractors other than San Luis Obispo County Flood Control and Water Conservation District;
- Settlement contract holders on the Sacramento River;
- Private water right holders on various tributaries to the Sacramento River;
- Private water right holders on the Cosumnes or Mokelumne Rivers;
- Private water right holders on various tributaries to the San Joaquin River;
- Private water right holders on the Kings, Kaweah or Kern Rivers;
- Groundwater right holders in the Central Valley or other basins.

For each of those potential sources of imported water supplies, the Purveyors would need to identify specific holders of legal entitlements who might be willing to enter into a sales transaction, perform due diligence on the physical, legal, environmental and regulatory features of each entitlement, negotiate financial and other business terms for a potential acquisition, obtain permits from relevant agencies (such as the State Water Resources Control Board, California Department of Water Resources, California Department of Fish and Wildlife and U.S. Bureau of Reclamation), and obtain financing for the acquisition of the entitlement. This process can be expected to require between three and five years to accomplish (excluding resolution of any litigation), and transaction costs are likely to range from $250,000 to $1 million, depending on the source and degree of difficulty.

Within the past decade, completed transactions involving the potential sources of water described above have ranged from approximately $2,000 to $7,000 per AF of water entitlement, with most transactions falling in the range from $2,000 to $4,000 per AF. Market prices for water entitlements in California are subject to significant variation, based on a number of factors including hydrology, economic conditions and statewide and regional land development trends. In addition, each water entitlement has specific features that impact the price it is likely to command. For purposes of this Basin Plan, imported water entitlements are expected to be available for approximately $4,000 per AF. For a transaction to acquire 1,000 AFY, that would equal $4 million, plus $1 million in transaction costs, for a total estimate of $5 million.

Each of these imported water options would also require transportation of the supplies to Los Osos. This would most likely be accomplished via the SWP, including the Coastal Branch and Chorro Valley Pipeline facilities, and a new pipeline to Los Osos. Acquisition of the legal right to convey water through SWP facilities is difficult, since DWR and the SWP contractors are generally reluctant to make space available for transfers of non-SWP supplies. It would be speculative at this time to predict whether the Purveyors could negotiate access to SWP facilities, or what the cost would be of such conveyance. If it is assumed that the cost of conveyance would be the same for non-SWP supplies as for SWP water, then the cost of conveying another imported water source to Los Osos could be approximately $27,500 per AF over 30 years. Adding $5 million for acquisition of water supplies and $3 million for construction of a pipeline to Los Osos, that yields a total expense of $35.5 million over 30 years.

Obtaining other imported water supplies for Los Osos would face a number of challenges, including engineering, environmental, permitting, contracting, finances and public sentiment. Those obstacles are likely to be significantly more difficult to overcome than for obtaining either SWP or NWP supplies, even though the potential costs could be less. The discussion in this Basin Plan serves only as a preliminary discussion of those issues, since the Parties do not recommend importing water into the Basin at this time. Further detailed analysis would be necessary to formulate a plan if this option were to be pursued in the future.

12.6 Summary of Imported Water Options

The various options for imported water are summarized in Table 41. As noted above, the projected costs for each of the potential imported water options are preliminary and subject to significant revision in the future. Nevertheless, the costs are sufficiently defined to allow comparison with other programs in this Basin Plan. The costs of a potential Imported Water Program would be higher than other programs.

Table 41. Imported Water Options	
Source of Imported Water	**30-Year Cost for 1,000 AFY ($1000)**
State Water Project	50,500
Nacimiento Water Project	57,500
Other Sources	35,500

While imported water could provide one means of offsetting potable water demands and thereby reducing seawater intrusion in the Basin, it would likely face significant political, institutional, legal, financial, environmental and engineering challenges. In addition, it would be inconsistent with the principle established in Section 2.5.1 disfavoring imported water supplies. Based on the analysis in Chapter 14, it is apparent that the Basin can be managed to avoid the need for imported water. Therefore, the Parties do not recommend implementing the Imported Water Program.

[This page intentionally blank]

13

WELLHEAD PROTECTION PROGRAM

13.1 Introduction

Wellhead protection refers to the process of managing the activities within a delineated source area or protection zone to prevent drinking water source contamination. The primary process for wellhead protection established by the State of California for public drinking water supplies is administered by the CDPH under the Drinking Water Source Assessment and Protection (DWSAP) program. The DWSAP program satisfies the mandates of the 1996 Safe Drinking Water Act and is authorized under California Health and Safety Code § 116762.60.

USEPA and CDPH encourage the development of wellhead protection programs for all sources of drinking water. A Drinking Water State Revolving Fund was established by the 1996 Safe Drinking Water Act. The fund disburses federal money to states through the USEPA. In California, the CDPH disburses available funds to qualifying projects under the Safe Drinking Water State Revolving Fund, although other funding sources are available for public water systems.

There are several types of wellhead protection processes besides the DWSAP program currently in place. Well construction standards, point-source discharge regulations and hazardous waste management guidelines are some of the existing processes that help manage activities within the Basin to protect water quality. Additional processes are being developed that will further increase wellhead protection, such as septic systems management, the LOWWP, Salt and Nutrient Management plans and this Basin Plan.

13.2 DWSAP Program

Participation in the DWSAP program is required for public water systems, and consists of three steps: (1) delineation of the source area or protection zone for a groundwater supply well or well field; (2) completion of the Possible Contaminating Activity (PCA) inventory, the Physical Barrier Effectiveness (PBE) determination, and the vulnerability analysis for the subject area/zone; and (3) implementation of wellhead protection measures and contingency plans. The first two steps constitute the drinking water source assessment and have been completed by the Purveyors.

Updates of the source assessments are recommended by the CDPH every five years. The third step is ongoing, as discussed herein.

13.2.1 *Delineation of Source Area and Protection Zone*

The source area is the capture area for a drinking water source. For a groundwater source, the source area is the recharge area and the area within delineated protection zones. Protection zones differentiate areas of varying significance in terms of threat to the water source from contamination.

The potential recharge area for drinking water sources within the Basin effectively covers the onshore Plan Area. The Upper Aquifer is recharged primarily from percolation of precipitation (including percolation of storm water runoff in swales and detention basins), either directly through the overlying dune sands or indirectly from leakage through overlying perched and semi-perched aquifers, and from residential and agricultural return flows. Freshwater recharge to the Lower Aquifer comes primarily from the alluvial deposits in the Los Osos Creek valley and from Upper Aquifer leakage.

DWSAP guidelines are used to establish boundaries for three protection zones around a supply well. Zone A is the capture zone within which groundwater could potentially be produced by a well over two years of continuous pumping. Zone B5 extends the potential capture zone to five years, and Zone B10 extends the potential capture zone to ten years of continuous pumping.

13.2.2 *PCA, PBE and Vulnerability Analysis*

PCA inventories are compiled from a survey of protection zone activities and historical records. Four checklists are provided by the DWSAP program for conducting PCA inventories. These include Commercial/Industrial activities, Residential/Municipal activities, Agricultural/Rural activities, and Other activities. Following a completed inventory, the PCAs are assigned vulnerability points based on the risk of contamination they pose to the drinking water source. Risk ranking tables are provided by the DWSAP program. Higher risk PCAs are assigned more points than lower risk PCAs. Zone points are also assigned to protection zones, and added to the PCA points.

The next step in the vulnerability analysis is to determine the PBE of the source in relation to the aquifer type and material, the presence of abandoned or improperly destroyed wells, depth to water, and subject well construction and operation. PBE scores are grouped into three effectiveness categories (low, moderate, and high) that add PBE vulnerability points to the PCA points and Zone points described above. The final step in the vulnerability analysis is tabulating the Prioritized Listing of PCAs, which combines the three types of vulnerability points for each PCA into a Vulnerability Score, and ranks the PCAs from highest to lowest score. The drinking water source is most vulnerable to the types of PCAs with the highest score and to any PCAs associated with a contaminant detected in the water source, regardless of Vulnerability Score.

13.2.3 *Protection Measures and Contingency Plans*

Once the Prioritized Listing of PCAs is developed for a drinking water supply well, it is submitted (along with the other DWSAP documentation) to CDPH. At that point, regulators or purveyors can update the monitoring program for a water system to include testing for constituents of concern associated with specific PCAs that carry a high Vulnerability Score. The DWSAP program also provides water purveyors with PCA information to consider when developing new wells. Existing wellhead protection measures provided by the water purveyors include well site security and surface drainage control, public outreach for septic tank management and the proper disposal of household hazardous waste, and basin groundwater monitoring.

Contingency plans are required under the Safe Drinking Water Act to locate and provide alternative drinking water supplies in the event of contamination. The Purveyors have system interties and options for wellhead treatment that would be implemented in the event of source contamination. These contingency plans are specific to the infrastructure and operations of each Purveyor.

13.2.4 *DWSAP Program Results*

The results of PCA Prioritized Listings for public supply wells indicate that the most common and highest overall risk to the public drinking water supply is from septic systems at high density (more than one system per acre). Other PCAs with high vulnerability scores for multiple (three or more) wells included housing at high density (>1 house per 0.5 acres), National Pollutant Discharge Elimination System (NPDES)/Waste Discharge Requirements (WDR) regulated discharges, storm water discharges and detention basins, water supply wells, and seawater intrusion.

The Purveyors will continue to update their DWSAP efforts, as required by law. It is expected that the construction and operation of the LOWWP by the County, as well as the nitrate removal facility pursuant to Basin Infrastructure Program B, will assist in reducing nitrate degradation of water quality in the Upper Aquifer.

13.3 Other Wellhead Protection Measures

Wellhead protection is included in several management and regulatory processes. Collectively, these processes currently protect or will protect drinking water sources from contamination, including contamination from the highest risk activities that have been identified by the public supply well DWSAPs.

13.3.1 *Well Abandonment*

Abandoned wells provide the potential for pollutants or contaminants to enter or spread into Basin groundwater. Therefore, well abandonment represents a key concern in groundwater management. The Basin Management Committee and Parties will coordinate with County Environmental Health Services to obtain written notice concerning well abandonment projects.

Improperly constructed and abandoned wells can impair yields and increase the potential for groundwater contamination. The Parties support the California Model Well Code standards, and will work with County Environmental Health Services to provide information to well owners throughout the Basin regarding proper well construction and abandonment procedures.

13.3.2 *Well Standards*

State standards for water wells are contained in DWR Bulletin 74-81 (Water Well Standards: State of California, December 1981) and DWR Bulletin 74-90 (California Well Standards, June 1991). The County's Code of Ordinances, Title 8 (Health and Sanitation), Chapter 8.40, regulates the construction, repair, modification and destruction of wells in the County and incorporates the state's standards by reference.

Proper construction of groundwater monitoring wells is important to the integrity of a groundwater monitoring program. Wells accepted into the DWSAP program will have been checked for proper construction and surface drainage control.

Wells can provide direct conduits for contaminants to reach groundwater. Active wells are maintained and inspected periodically, so there is a lower risk of an accidental breach at the wellhead. Abandoned or improperly destroyed wells, however, pose a greater risk, depending on their location and condition. County Code considers a well abandoned if it "has not been used for a period of one year, unless the owner declares in writing to the health officer, his intention to use the well again for supplying water or other associated purpose (such as an observation well or injection well) and receives approval of such declaration. All such declarations shall be renewed annually." State standards additionally require that all abandoned wells be destroyed. Inactive (not abandoned) wells should be properly maintained so as not to impair water within the well and groundwater encountered by the well.

13.3.3 *Point-Source Discharge Regulations*

Point-source discharges are high-risk PCAs for drinking water sources in the Basin. Wellhead protection measures for these discharges are provided through NPDES permitting, WDRs, and Storm Water Pollution Prevention Plans (SWPPP).

13.3.4 *Hazardous Materials Management*

Hazardous material management is regulated by the California Department of Toxic Substances Control (DTSC). The USEPA authorizes DTSC to enforce the Resource Conservation and Recovery Act program in California. Other state and local agencies also partner with DTSC in various ways, such as the oversight of cleanups, emergency response, household hazardous waste management programs, and waste oil and electronic recycling programs. Hazardous materials management provides wellhead protection from high-risk PCAs involving industrial/commercial activities, gas stations, and high-density housing.

13.3.5 *Septic System Management*

Septic system discharges in Los Osos are regulated by the RWQCB, although many systems would be decommissioned under the proposed sewer project. Onsite management plan development and implementation is required for septic systems under RWQCB Resolution R3-2008-0005. RWQCB staff is currently in the process of developing implementation policy, which will authorize local agencies to implement the RWQCB's basin plan.

13.3.6 *The LOWWP*

The most common and highest-risk PCA identified by public drinking water DWSAPs are septic systems at high density. Contamination from septic systems has been measured in Basin drinking water sources. The LOWWP will provide wellhead protection by removing most of the current septic-related nitrogen and microbiological mass loading to the Basin.

13.3.7 *Basin Plan*

This Basin Plan is committed to halting seawater intrusion, another high-risk PCA that is threatening multiple drinking water wells. Pumping strategies and conservation measures designed to balance the Basin's freshwater supply with its domestic, agricultural, and environmental water demands are a part of wellhead protection. The Groundwater Monitoring Program will provide measures of effectiveness for assessing the success of wellhead protection efforts related to controlling septic discharges, salt and nutrient loading and seawater intrusion.

[This page intentionally blank]

14

SOLUTIONS FOR THE BASIN

14.1 Introduction

The programs set forth in Chapters 7 through 13 are designed to address the twin challenges of nitrate degradation of the Upper Aquifer and seawater intrusion into the Lower Aquifer. Each program focuses on a different aspect of water management, such as collecting and organizing groundwater data (Groundwater Monitoring Program), improving water use efficiency (the Urban Water Use Efficiency Program), or shifting the location of groundwater production within the Basin (Basin Infrastructure Program). Collectively, the programs are designed to achieve all Immediate and Continuing Goals established in Section 2.4 of this Basin Plan.

This chapter describes various combinations of the programs and analyzes each combination to determine whether it would achieve Basin Plan goals. Each combination is analyzed using the Model to predict how implementation of the various program actions would impact the Basin metrics set forth in Chapter 6. Through this process, several combinations have been identified that would achieve Basin Plan goals, and this chapter discusses which of those programs are selected by the Parties for implementation.

Based on that analysis, the Parties recommend the following programs for immediate implementation:

- Groundwater Monitoring Program;
- Urban Water Use Efficiency Program;
- Urban Water Reinvestment Program;
- Basin Infrastructure Programs A and C; and
- Wellhead Protection Program.

The Parties also recommend the following programs for potential implementation, if the County and the Coastal Commission were to allow future development in Los Osos as part of the LOCP and LOHCP:

- Basin Infrastructure Programs B and D; and

- Either Basin Infrastructure Program D or the Agricultural Water Reinvestment Program.

The Parties are not recommending implementation of the Supplemental Water Program based on its cost, as discussed in this chapter. In addition, the Parties have not selected the Imported Water Program for any further consideration, based on cost and the water management principles in Section 2.5.1.

This chapter describes those Basin Plan programs that focus on increasing water supplies (Section 14.2), those programs that focus on lowering water demands (Section 14.3), program combinations that will achieve the Basin metrics set forth in Chapter 6 (Section 14.4), and the Parties' selection of programs for implementation (Section 14.5). For ease of reference, this chapter uses abbreviations for each Basin Plan program, as listed in Table 42. Program combinations are also abbreviated.

Table 42. Abbreviations for Basin Plan Programs

Program	Abbreviation	Basin Plan Location
No Programs	N	N/A
Groundwater Monitoring Program	M	Chapter 7
Urban Water Use Efficiency Program	E	Chapter 8
Urban Water Reinvestment Program	U	Section 9.2.7
Agricultural Water Reinvestment Program	G	Section 9.4
Basin Infrastructure Program A	A	Section 10.2
Basin Infrastructure Program B	B	Section 10.3
Basin Infrastructure Program C	C	Section 10.4
Basin Infrastructure Program D	D	Section 10.5
Supplemental Water Program	S	Chapter 11
Wellhead Protection Program	P	Chapter 13

14.2 Water Supply Programs

Several of the programs in this Basin Plan would result in increasing the Sustainable Yield_X of the Basin, which is a supply-side impact on the Basin.

The Basin Infrastructure Program would increase Sustainable Yield_X by transferring groundwater production away from the Lower Aquifer in the Western Area, where it creates a relatively high inducement to seawater intrusion, to the Upper Aquifer and the Central and Eastern Areas. The Basin Infrastructure Program also increases water supplies in the Basin by making it possible to capture currently underutilized supplies in both the Upper Aquifer and Eastern Area.

Compared to no action, the Water Reinvestment Program would increase Sustainable Yield_X by providing recharge to the Basin at the Broderson and Bayview Estates leach fields, and at the locations of urban and agricultural water reinvestment. Use of recycled water in lieu of groundwater would also have a demand-side impact on the Basin, but the focus of the analysis in this section would be on supply-side impacts.

The Supplemental Water Program would primarily have a demand-side impact by allowing the Purveyors to reduce their use of groundwater from the Basin. There would be supply-side impacts also, however, based on recharge to the Basin from return flows derived from use of desalinated groundwater supplies. These impacts of the Supplemental Water Program are analyzed in this section.

While each of the three programs addressed above would have individual impacts on water supplies in the Basin, none of the programs would be implemented separately, but in some combination. To compare supply-side impacts to the Basin from implementing the various programs, this chapter uses several combinations of those programs, as set forth below.

- **No Programs (N).** This combination would not implement any of the programs set forth in this Basin Plan that result in the creation of additional water supplies. Because it consists of no action, the No Programs combination also serves as a baseline for comparison of other combinations with current conditions. Since the Parties have already committed to implementing at least the Urban Water Reinvestment Program and Basin Infrastructure Program A, the No Programs combination does not represent a baseline for decision-making in this Basin Plan. That role is reserved for Combination U+A.

- **Urban Water Reinvestment Program (U).** This combination would implement only the Urban Water Reinvestment Program set forth in Chapter 9. Analyzing this combination, along with Combinations A and U+A, isolates the benefits to the Basin from the Urban Water Reinvestment Program, as opposed to the benefits of implementing that program in conjunction with Basin Infrastructure Program A.

- **Basin Infrastructure Program A (A).** This combination would include only Basin Infrastructure Program A. Analyzing this combination, along with Combinations U and U+A, isolates the benefits to the Basin from Program A, as opposed to the benefits of implementing Program A in conjunction with the Urban Water Reinvestment Program.

- **Urban Water Reinvestment Program with Basin Infrastructure Program A (U+A).** This combination would consist of Basin Infrastructure Program A along with the Urban Water Reinvestment Program. Because the County is required to implement the Urban Water Reinvestment Program as part of the LOWWP, and the Purveyors have previously initiated the projects within Basin Infrastructure Program A, Combination U+A represents a baseline for decision-making in this Basin Plan.

- **Urban Water Reinvestment Program with Basin Infrastructure Programs A and B (U+AB).** This combination would include all projects identified for maximum utilization of the Upper Aquifer in Basin

Infrastructure Programs A and B, along with the Urban Water Reinvestment Program. It would not include any landward shifting of groundwater production to the Central and Eastern Areas, other than some incidental shifting to the Central Area in the Upper Aquifer.

- **Urban Water Reinvestment Program with Basin Infrastructure Programs A and C (U+AC).** This combination would allow the landward shifting of some groundwater production from the Western Area to the Central Area, and some transfer of production to the Upper Aquifer, pursuant to Basin Infrastructure Programs A and C. It would also include the Urban Water Reinvestment Program. It would differ from Combination U+AB in that it would not contain the community nitrate removal facility.

- **Urban Water Reinvestment Program with Basin Infrastructure Programs A, B and C (U+ABC).** This combination would maximize the sustainable yield of the Western and Central Areas of the Basin in both the Upper and Lower Aquifers through implementation of Basin Infrastructure Programs A, B and C. It would also include the Urban Water Reinvestment Program.

- **Urban and Agricultural Water Reinvestment Programs with Basin Infrastructure Programs A, B and C (UG+ABC).** Compared with the combinations described above, this would be the first combination to involve agricultural water users in the Eastern Area of the Basin. Combination UG+ABC would add the Agricultural Water Reinvestment Program to Combination U+ABC, but would not include the construction of any new groundwater production facilities in the Eastern Area. This combination would maximize the sustainable yield of the Western and Central Areas of the Basin, but reduce production in the Eastern Area below sustainable yield. As noted in Chapter 9, the Agricultural Water Reinvestment Program would only be implemented if additional urban development were allowed by the County and Coastal Commission in Los Osos, since the LOWWP is not expected to produce recycled water in quantities that would allow agricultural water reinvestment unless development occurs.

- **Urban Water Reinvestment Program with Basin Infrastructure Programs A, B, C and D (U+ABCD).** This combination would include all projects within the Basin Infrastructure Program, to allow maximum utilization of both the Upper and Lower Aquifers across the Western, Central and Eastern Areas of the Basin. It would include Urban Water Reinvestment, but not the Agricultural Water Reinvestment Program. This combination produces the maximum Sustainable Yield$_X$ for the Basin, and thus achieves a Basin Development Metric of 100 percent.

- **Urban and Agricultural Water Reinvestment Programs with Basin Infrastructure Programs A, B, C and D (UG+ABCD).** This combination adds the Agricultural Water Reinvestment Program to Combination U+ABCD. By reducing groundwater production in the Eastern Area to meet agricultural demands, this combination would result in less than full utilization of the Eastern Area. As noted above, the Agricultural Water Reinvestment Program would only be implemented if additional urban development were allowed by the County and Coastal Commission in Los Osos.

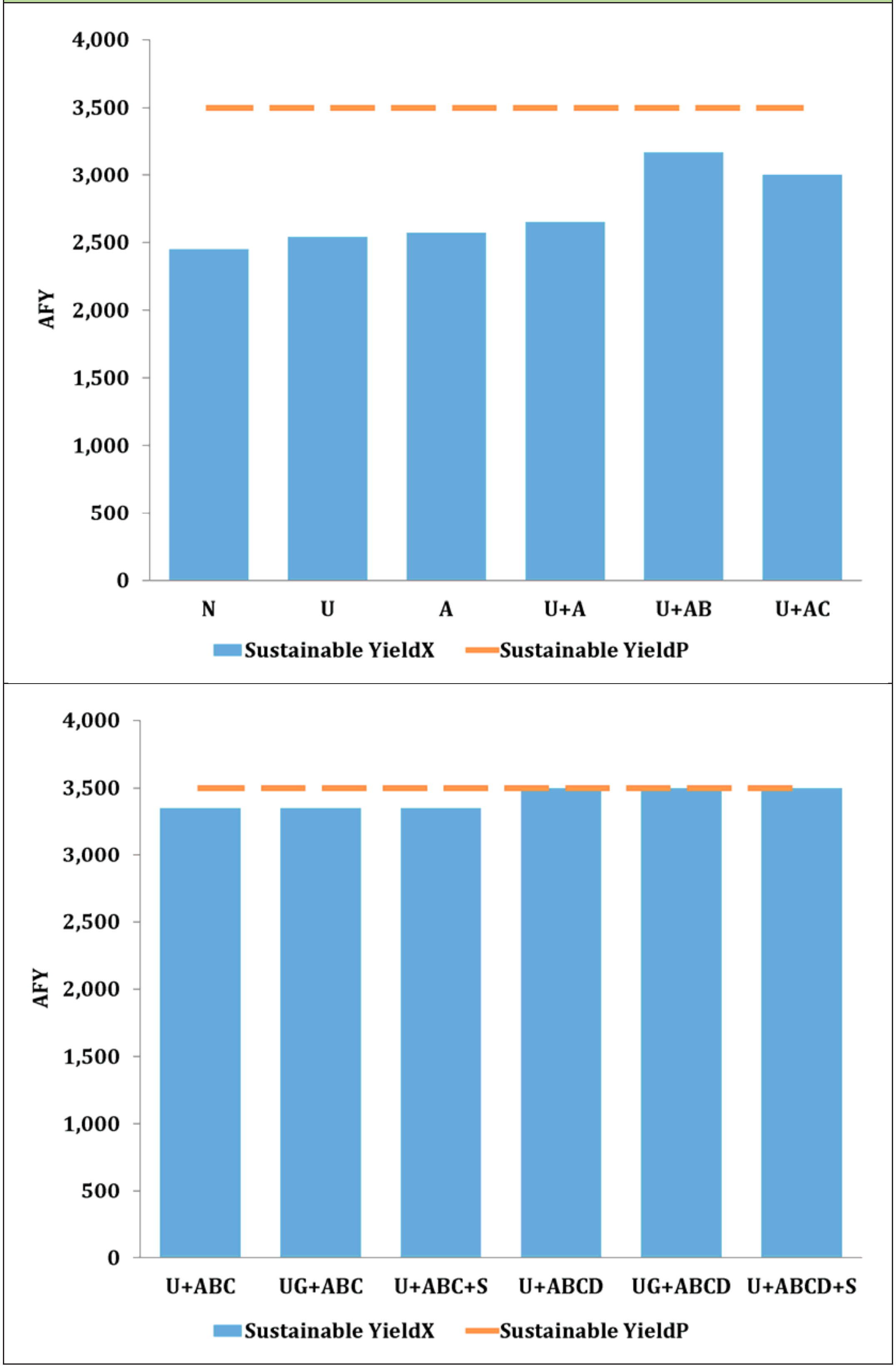
- **Urban Water Reinvestment Program with Basin Infrastructure Programs A, B, C and D and Supplemental Water (U+ABCD+S).** This combination would add desalinated groundwater from the Supplemental Water Program to Combination U+ABCD. The primary impact from adding desalinated groundwater would be demand-side, but there would be limited supply-side impacts as well. Since Supplemental Water is not recommended for implementation in this Basin Plan, its impact on the Basin was not specifically calculated using the Model.

Each of the combinations set forth above were analyzed to determine the resulting Sustainable Yield$_X$ of the Basin, as calculated by the Model. Table 43 lists the results of that analysis, including the Sustainable Yield$_X$ and Basin Development Metric of each combination. In addition, Figure 70 depicts the Sustainable Yield$_X$ attained by each combination in comparison to the Sustainable Yield$_P$ of 3,500 AFY. As more program components are implemented with each combination, the Sustainable Yield$_X$ generally increases, and the Basin Development Metric approaches 100 percent.

Table 43. Summary of Water Supply Program Combinations

Program Combination	Sustainable Yield$_X$	Basin Development Metric
N	2,450 AFY	70%
U	2,540 AFY	73%
A	2,570 AFY	73%
U+A	2,650 AFY	76%
U+AB	3,170 AFY	91%
U+AC	3,000 AFY	86%
U+ABC	3,350 AFY	96%
UG+ABC	3,350 AFY	96%
U+ABC+S	>3,350 AFY	>96%
U+ABCD	3,500 AFY	100%
UG+ABCD	3,500 AFY	100%
U+ABCD+S	>3,500 AFY	>100%

Figure 70. Comparative Sustainable Yield of Water Supply Combinations



14.3 Water Demand Programs

Several Basin Plan programs would reduce water demands in Los Osos. Those programs would have a beneficial, demand-side impact on the Basin by reducing the percentage of Sustainable Yield$_X$ that is produced in any given year, i.e., the Basin Yield Metric. It is the goal of this Basin Plan to maintain a Basin Yield Metric equal to or less than 80 in order to provide a margin of safety for sustainable production from the Basin.

The Urban Water Use Efficiency Program is focused directly on reducing urban water demands in the Basin. There are several alternative approaches set forth as Urban Water Use Efficiency Programs A through E in Chapter 8. As part of the LOWWP, the County has committed to implementing urban water use efficiency measures within the Wastewater Service Area that are equivalent to Program D. The Parties to this Basin Plan propose to implement a similar level of efficiency measures for urban water users outside the Wastewater Service Area. The County would implement the two programs for administrative effectiveness and efficiency through 2018, after which the Purveyors would assume that responsibility. The analysis in Chapter 8 found that if Urban Water Use Efficiency Program D were implemented under the Existing Population Scenario, urban water demands in Los Osos would fall from their 2012 level of 1,720 AFY to approximately 1,450 AFY. Under the Buildout Population Scenario, urban water demands would be up to 2,100 AFY, as opposed to 2,900 AFY without water efficiency improvements.

The Water Reinvestment Program is designed, in part, to reduce water demands that must be met through production of groundwater from the Basin. Reinvesting recycled water for either urban or agricultural water uses would allow water users to avoid using a similar quantity of groundwater. As noted in Section 14.2, there are also supply-side impacts from implementation of the Water Reinvestment Program, caused by transferring the location of groundwater production within the Basin and recharging the Basin with recycled water return flows.

Under the Urban Water Reinvestment Program, recycled water would be delivered to several schools categorized as urban water users, including Los Osos Middle School, Monarch Grove Elementary School, Baywood Elementary School and Sunnyside Elementary School. Together, recycled water deliveries to those schools would reduce water demands from groundwater by approximately 40 AFY. In addition, approximately 70 AFY of groundwater demands would be offset through use of recycled water for Sea Pines Golf Course, the community park and Los Osos Valley Memorial Park.

The Agricultural Water Reinvestment Program would deliver recycled water to irrigation water users who execute a recycled water purchase agreement with the County. Up to 500 AFY of recycled water is expected to be available for agricultural reuse, with the exact amount depending on the extent to which new land development is permitted in Los Osos. Some portion of that recycled water might be delivered to lands within the Plan Area that were previously dry-farmed, so that there would be no reduction in groundwater demands.

The Supplemental Water Program would reduce the demand for groundwater from the potable aquifers of the Basin, by meeting those demands with desalinated groundwater. The quantity of desalinated water could vary widely, with an assumed range between 0 and 750 AFY for purposes of this Basin Plan. This chapter assumes that 250 AFY of desalinated water would be produced under the Existing Population Scenario and 750 AFY under the Buildout Population Scenario, since those quantities would achieve optimal results in combination with other Basin Plan programs. Use of 750 AFY of supplemental water could be achieved by pumping approximately 1,000 AFY of saline groundwater, as described in Section 11.5.

As with the water supply programs discussed in Section 14.2, this section analyzes several combinations for implementation of the Urban Water Use Efficiency Program, Urban Water Reinvestment Program, Agricultural Reinvestment Program and Supplemental Water Program. Each of the combinations is subject to development levels under the Existing Population Scenario and Buildout Population Scenario, and are described below.

- **No Programs (N).** This combination would not implement any of the programs set forth in this Basin Plan that result in the reduction of groundwater demands. Since the Parties have already committed to implementing the Urban Water Use Efficiency Program and Urban Water Reinvestment Program, the No Programs combination does not represent a baseline for decision-making in this Basin Plan. That role is reserved for Combination E+U.

- **Urban Water Use Efficiency Program (E)**. This combination would implement only the Urban Water Use Efficiency Program as set forth in Chapter 8. Since the Parties have already committed to implementing the Urban Water Reinvestment Program, this combination does not represent a baseline for decision-making in this Basin Plan. That role is reserved for Combination E+U.

- **Urban Water Use Efficiency Program and Urban Water Reinvestment Program (E+U).** This combination would implement the Urban Water Use Efficiency Program and the Urban Water Reinvestment Program with maximum deliveries of 780 AFY. Since the County is required to implement both these programs as part of the LOWWP, this combination represents a baseline for decision-making in this Basin Plan.

- **Urban Water Use Efficiency Program and Urban and Agricultural Water Reinvestment Programs (E+UG).** This combination includes Urban Water Use Efficiency Program D and the Urban and Agricultural Water Reinvestment Programs with maximum deliveries of 780 AFY and 340 AFY, respectively. This combination reduces groundwater demands to the greatest extent possible without supplemental water supplies. Because it relies on the availability of larger quantities of recycled water, this combination is only analyzed under the Buildout Population Scenario.

- **Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Supplemental Water Program (E+U+S).** This combination would implement Urban Water Use Efficiency Program D and the Urban Water Reinvestment Program with maximum deliveries of 780 AFY. In addition, this combination includes the Supplemental Water Program at the quantities listed above (250 AFY or 750 AFY). This combination reduces potable groundwater demands to the greatest extent possible without requiring any participation by agricultural water users.

The projected water demands for each use category, under each combination and for each development scenario, are shown in Table 44 and Figure 71. As more programs are implemented with each successive combination, projected water demands generally decrease. Water demands are generally reduced only in the urban and community facility categories, as those are affected by the Urban Water Use Efficiency and Urban Water Reinvestment Programs. Agricultural water demands are reduced by 480 AFY in Combination E+UG based on implementation of the Agricultural Water Reinvestment Program.[143]

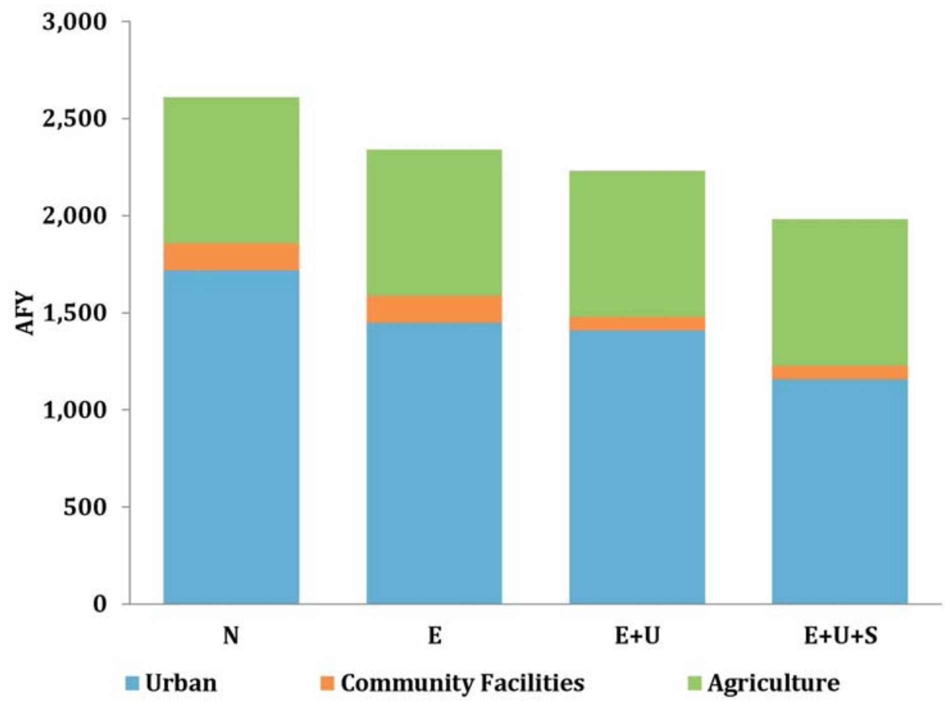
Table 44. Summary of Water Demand Program Combinations

	Urban	Community	Agriculture	Total
Existing Population Scenario				
N	1,720	140	750	2,610
E	1,450	140	750	2,340
E+U	1,410	70	750	2,230
E+U+S	1,160	70	750	1,980
Buildout Population Scenario				
N	2,340	140	750	3,230
E	2,100	140	750	2,990
E+U	2,060	70	750	2,880
E+UG	2,060	70	270	2,400
E+U+S	1,310	70	750	2,130

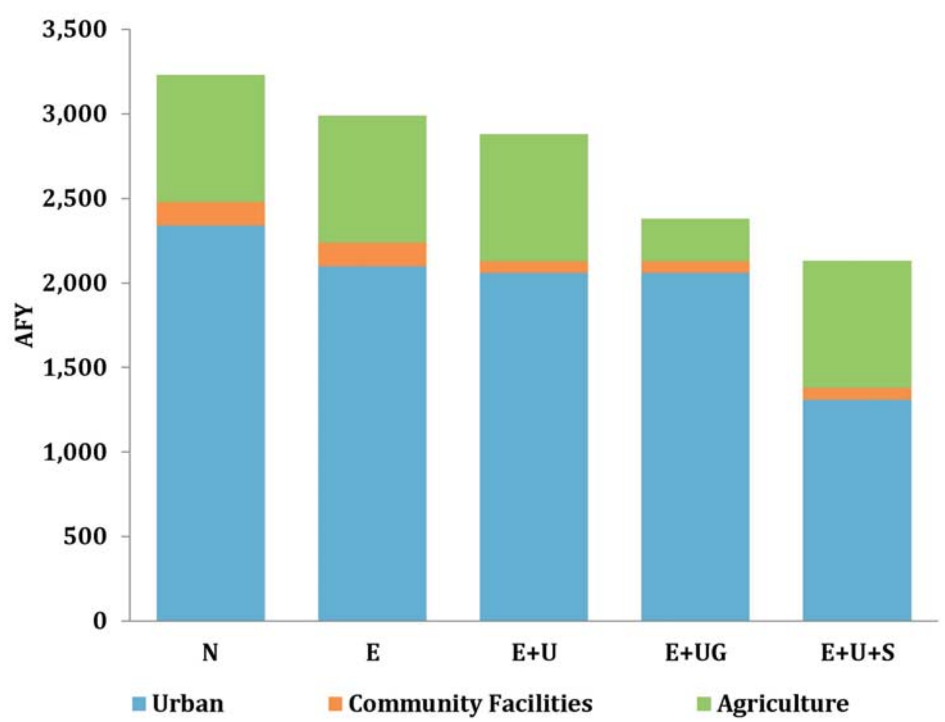
[143] The figure of 480 AFY was achieved by adding the 140 AFY of agricultural reuse proposed under the Urban Water Reinvestment Program to the 340 AFY proposed under the Agricultural Water Reinvestment Program.

Figure 71. Summary of Water Demand Programs

Existing Population Scenario



Buildout Population Scenario



14.4 Balancing Water Supplies and Demands

Preceding sections of this chapter described a number of combinations for supply- and demand-side water management programs in the Basin. The next step in determining the effectiveness of each combination to meet the goals of this Basin Plan is to analyze various cross-combinations of supply- and demand-side programs together. To that end, Table 45 shows the Basin Yield Metrics that would result from several combinations of supply and demand programs.[144] Table 45 does not include calculations for combinations that are inconsistent, which are represented in the table by cross-hatching. In addition, the analyzed combinations are divided into two groups: those that would meet Basin Plan goals are shaded purple; and those that are not expected to meet Basin Plan goals are shaded orange.

Table 45. Basin Yield Metrics for Supply/Demand Combinations

		Demand Combinations				
		N	E	E+U	E+UG	E+U+S
Existing Population Scenario						
Supply Combinations	N	107	96			
	U			88		
	A	102	91			
	U+A			84		75
	U+AB			70		62
	U+AC			74		66
	U+ABC			67		59
	U+ABCD			64		57
Buildout Population Scenario						
Supply Combinations	N	132	122			
	U			113		
	A	126	116			
	U+A			109		80
	U+AB			91		67
	U+AC			96		71
	U+ABC			86		64
	UG+ABC			85	72	64
	U+ABCD			82		75
	UG+ABCD			82	69	61

[144] For definition of the Basin Yield Metric, see Section 6.3.2(A).

For the Existing Population Scenario, it is apparent that certain programs must be completed in order to achieve a sustainable Basin, including the Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Basin Infrastructure Program A. In addition, the Parties must implement either Basin Infrastructure Program B or C or the Supplemental Water Program at 250 AFY. It is clear that Basin Infrastructure Program D is unnecessary to achieve a sustainable Basin under the Existing Population Scenario. A summary of the most likely combinations is presented in Table 46, along with the expected Basin Yield Metric, Water Level Metric and Chloride Metric that would result from each. These combinations were selected for further consideration because they are expected to satisfy the Basin Plan goals, with relatively lower costs than other combinations.

Table 46. Most Likely Program Combinations

Combination	Water Demand†	Sustainable Yield$_X$†	Basin Yield Metric	Water Level Metric‡	Chloride Metric*
Existing Population Scenario					
E+U+AB	2,230	3,170	70	10	60
E+U+AC	2,230	3,000	74	10	65
E+U+A+S	1,980	2,650	75	10	65
Buildout Population Scenario					
E+UG+ABC	2,380	3,350	72	9	70
E+U+ABCD	2,880	3,500	82	8	85
E+UG+ABCD	2,380	3,500	68	10	60
E+U+A+S	2,130	2,650	80		

† Expressed in AFY. ‡ Expressed in feet msl. * Expressed in mg/l.

For the Buildout Population Scenario, the selection of a combination would depend heavily on whether the Supplemental Water Program were implemented under the Existing Population Scenario. If a groundwater desalination plant were previously constructed to produce 250 AFY (the assumed level for the Existing Population Scenario), then it would be reasonable for the Parties to simply install additional desalination capacity (500 AFY, for a total of 750 AFY of produced water) to achieve a sustainable Basin under Combination E+U+A+S.

If, on the other hand, the Supplemental Water Program were not to have been initiated under the Existing Population Scenario, the Parties would be unlikely to construct and operate a new desalination facility for the Buildout Population Scenario, because the costs associated with such a facility would exceed those of implementing further portions of the Basin Infrastructure Program. In order to achieve a sustainable Basin in that circumstance, the Parties would need to implement the Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Basin Infrastructure Programs A, B and C. The Parties would also need to implement either Basin Infrastructure Program D or the Agricultural Water

Reinvestment Program.[145] The Parties could implement both Basin Infrastructure Program D and the Agricultural Water Reinvestment Program in order to maximize the buffer between sustainable and actual production from the Basin.

14.5 Selection of Basin Programs

The process of selecting among several alternatives is often best achieved with reference to the purposes to be served by the proposed action. This Basin Plan began in Sections 2.4 and 2.5 by identifying goals and principles for management of water resources in the Basin. The programs and combinations explored in Part II of this Basin Plan, and especially the metrics of Chapter 6, have been designed with those principles and goals in mind.

This Basin Plan uses two types of criteria to choose between the combinations identified above as alternative actions: threshold and differentiating. Threshold criteria are those that determine whether a proposed action is sufficient to be considered. The threshold criteria for this Basin Plan are whether each combination would meet the Basin Yield Metric goal of 80, the Water Level Metric Target of 8 meet msl and the Chloride Metric Target of 100 mg/l. As explained in Chapter 6, those metrics were designed to measure success in achieving the Basin Plan goals set forth in Section 2.4, which focus on halting seawater intrusion into the Basin and providing sustainable water supplies for existing and future residential, commercial, community and agricultural development within Los Osos. Each of the combinations listed in Table 46 would be expected to satisfy the threshold criteria for this Basin Plan. Therefore, the remainder of this section focuses on differentiating criteria.

Differentiating criteria are those that distinguish between alternatives that otherwise satisfy all threshold criteria. This Basin Plan assesses each combination below based on several differentiating criteria, including the following:

- Level of protection against seawater intrusion;
- Level of sustainability and avoidance of water supply risks;
- Level, equitable distribution and volatility of costs;
- Promotion of water use efficiency;
- Protection of environmentally sensitive areas within or influenced by Basin hydrology; and
- Level of risk arising from future changes in water supplies.

[145] Even though Combination E+U+ABCD only achieves a Basin Yield Metric of 82, which is higher than the goal of 80, it is sufficient to meet other metrical goals established in the Basin Plan because a large proportion of groundwater production would be from the Upper Aquifer and the Central and Eastern Areas, away from the sensitive Lower Aquifer in the Western Area.

It may be expected that the differentiating criteria will not all be aligned. For example, one combination may provide a greater level of protection against seawater intrusion, but may also cost more. Thus, differentiating criteria require careful—and often necessarily subjective—consideration of the strengths and weaknesses of each combination. Unlike threshold criteria, which consider each alternative individually for satisfaction of a constant standard, judgments related to differentiating criteria provide value by comparing alternatives to each other.

The costs associated with each combination are discussed in Section 14.5.1. Because the other differentiating criteria of this Basin Plan vary based on the level of development in Los Osos, they are considered for the Existing Population Scenario in Section 14.5.2 and for the Buildout Population Scenario in Section 14.5.3.

14.5.1 *Costs*

The financial burden of various water and wastewater projects on the Los Osos community has always been a significant concern. The earliest study of a potential wastewater collection, treatment and disposal system for Los Osos in 1986 expressed that "[a]n ongoing concern of the County and of Los Osos/Baywood Park residents is the financial implication of an area-wide sewerage project. However, in light of the Regional Board's 1983 amendment to the Basin Plan, a sewerage project appears inevitable."[146] Although the need for a community wastewater project and other water supply projects has become clearer since that time, as degradation of water quality in the Upper Aquifer and seawater intrusion into the Lower Aquifer have decreased the sustainability of the community's water supply, the economic burden of a solution remains a critical concern.

It is important to analyze three economic aspects of the various programs considered in this Basin Plan. First, the Basin Plan must accurately identify the costs of each program and combination of programs, so that the Parties and the residents, businesses and institutions of Los Osos understand the costs of their actions. Second, the Basin Plan must compare the costs of various alternative actions, including the likely costs of non-action or delay. Third, the Basin Plan considers how such costs will be paid, including financing and which parties in Los Osos should pay for each program in order to achieve an equitable cost distribution.

Table 47 shows the projected costs of each Basin Plan program individually. There is some overlap between certain programs, so the cost of a combination of programs is not necessarily the sum of the costs in Table 47. It should also be remembered that certain program costs are not new, but would reimburse the LOWWP for benefits conferred on water users in the Basin. The costs shown in Table 47 include the life cycle costs of each program over a 30–year span, including capital and operations costs, where appropriate.

[146] ES, *Phase One—Sewerage Planning Study, CSA No. 9 – Los Osos, Baywood Park, Cuesta-by-the-Sea*, at 1-4 (1986).

Table 47. Projected Costs of Basin Plan Programs	
Program	**Cost ($1000)**
Groundwater Monitoring Program (M)	650
Urban Water Use Efficiency Program (E)	5,500
Urban Water Reinvestment Program (U)	18,290
Agricultural Water Reinvestment Program (G)	3,120
Basin Infrastructure Program A (A)	2,835
Basin Infrastructure Program B (B)	17,250
Basin Infrastructure Program C (C)	6,540
Basin Infrastructure Program D (D)	4,200
Supplemental Water Program @ 250 AFY (S)	16,750
Supplemental Water Program @ 750 AFY (S)	40,250
Wellhead Protection Program (P)	0

In order to compare the combinations being considered for implementation, Table 48 lists the projected costs of each combination of programs. That table also shows the costs that would be attributable to new construction and reimbursement of the LOWWP for Basin benefits.

Table 48. Projected Costs of Program Combinations			
Combination	**Cost of New Construction ($1000)**	**Cost of LOWWP ($1000)**	**Total Cost ($1000)**
Existing Population Scenario			
M+E+U+AB+P	21,235	23,290	44,525
M+E+U+AC+P	10,525	23,290	33,775
M+E+U+A+S+P	20,735	23,290	44,025
Buildout Population Scenario			
M+E+UG+ABC+P	25,775	26,410	52,145
M+E+U+ABCD+P	29,975	23,290	53,225
M+E+UG+ABCD+P	29,975	26,410	56,345
M+E+U+A+S+P	44,235	23,290	67,525

14.5.2 *Existing Population Scenario*

Immediate Goal No. 2 of this Basin Plan is to "[p]rovide sustainable water supplies for existing residential, commercial, community and agricultural development within Los Osos." Existing development is reflected in the Existing Population Scenario, and sustainable water supplies are those that allow the satisfaction of all metrical goals set forth in Chapter 6.

Three combinations identified in this chapter are expected to achieve the metrical goals, while meeting all water demands in Los Osos. All three include the Urban Water Use Efficiency Program, Urban Water Reinvestment Program and Basin

Infrastructure Program A. They differ in whether they implement Basin Infrastructure Program B or C or the Supplemental Water Program at 250 AFY. There is no substantial difference between the three combinations based on most the criteria of this Basin Plan.

- All three combinations provide sufficient protection against seawater intrusion, although Combination M+E+U+AB+P provides the most protection with a projected Basin Yield Metric of 70.
- None of the combinations has a substantial effect on water efficiency.
- There is no substantial difference between the three combinations in the level of risk arising from future changes in water supplies. All three rely on the same groundwater resource and are subject to the same long-term risk of changes to that resource.
- All three combinations allow the Los Osos community to avoid importing water from outside the Plan Area.

There is a difference between the combinations with regard to sustainability and water supply risks. Combination M+E+U+AC+P presents a relatively low risk due to not requiring nitrate treatment or desalination, thus avoiding the environmental impacts of electricity usage from those two processes and the reliability risks associated with operation of relatively complex treatment infrastructure.

The other criterion that substantially differentiates the three combinations is cost. Basin Infrastructure Program B is designed to maximize production from the Upper Aquifer, and in order to achieve that purpose while producing water that meets all drinking water standards, the Purveyors must construct and operate a community nitrate removal facility, as described in Section 10.3.3. The facility bears a relatively high capital and operations cost of $17.25 million over its expected life of 30 years. That is reflected in the relatively high cost of Combination M+E+U+AB+P.

Similarly, the construction and operation of a groundwater desalination facility in the Supplemental Water Program would be relatively expensive, with a projected cost of $16.75 million over 30 years for 250 AFY. It is also noteworthy that while there is an expectation that the nitrate treatment system in Basin Infrastructure Program B could be abandoned after approximately 30 years due to attenuation of nitrate levels in the Upper Aquifer, groundwater desalination would need to continue past 30 years in order to maintain a sustainable Basin.

In addition to the high level of cost associated with Basin Infrastructure Program B and the Supplemental Water Program, those programs also introduce greater cost volatility. Capital costs for the common wells and pipelines that make up Program C are relatively well known, as opposed to a nitrate treatment or groundwater desalination facility. In addition, the primary operational cost components of both nitrate treatment and groundwater desalination are electric power and brine disposal. Electricity prices can be highly volatile, and brine disposal is also subject to increased costs based on power or fuel costs and potential regulatory changes.

Based on the criteria discussed above, the Parties recommend implementation of Combination M+E+U+AC+P for the Existing Population Scenario. It is expected that implementing the Urban Water Use Efficiency Program, Basin Infrastructure Programs A and C and the Urban Water Reinvestment Program will meet all the metrical goals defined in Chapter 6 and Immediate Goals Nos. 1, 2 and 3 from Section 2.4.

14.5.3 *Buildout Population Scenario*

This Basin Plan establishes Continuing Goal No. 4 to "[p]rovide sustainable water supplies for future development within Los Osos, consistent with local land use planning policies." It is not the purpose of the Parties to determine desirable levels of future development in Los Osos through this Basin Plan; rather, it has been prepared as a water supply planning document with a primary focus on halting seawater intrusion into the Basin. At the same time, the Parties have identified certain programs that could be undertaken to allow land development in the future, should the County and Coastal Commission choose to permit that development to occur. The Parties are not ignorant of the connection between sustainable water supplies in the Basin and potential future development.

There are four interconnected restrictions on future development in Los Osos. First, the RWQCB has prohibited discharges of municipal wastewater to septic tanks within most of the Los Osos community. Without the construction of the LOWWP, no new development can occur within the Prohibition Zone.

Second, the Coastal Commission placed restrictions on the connection of new development to the LOWWP. Condition 6 of the CDP provides:

> ***Wastewater Service to Undeveloped Properties.*** *Wastewater service to undeveloped properties within the service area shall be prohibited unless and until the [LOCP] is [adopted] to identify appropriate and sustainable buildout limits, and any appropriate mechanisms to stay within such limits, based on conclusive evidence indicating that adequate water is available to support development of such properties without adverse impacts to ground and surface waters, including wetlands and all related habitats.*

That condition requires that the County demonstrate a sustainable Basin before the Coastal Commission will allow adoption of the LOCP or connection of any new properties to the LOWWP.

Third, the County has adopted an LOS III for the Basin as part of its Resource Management System, as described in Section 5.7.2. That determination is considered by the County for any development applications, and a change in that LOS would be necessary before any significant development were permitted. Lastly, the County is currently in the process of preparing the LOCP and LOHCP. Those processes will include consideration of sustainable water supplies for the level of allowed future development.

This Basin Plan is agnostic regarding the level of future development approved by the County and Coastal Commission. It does identify a set of alternatives that would allow future development to occur while maintaining sustainable water supplies in the Basin.

The population of the Plan Area in 2012 was approximately 14,600, which was used as the basis for the Existing Population Scenario. The population expected under the Buildout Population Scenario would be 19,850, an increase of 5,250. While achieving a Basin Yield Metric of 80 or less was used as a threshold criterion for the Existing Population Scenario, whether the Basin can support additional development is not a binary determination. For example, it is possible that the implementation of a combination of Basin Plan programs would allow some additional development, but not the full buildout expected under the Buildout Population Scenario.

Table 49 shows the marginal population that could be added in the Plan Area, while still achieving a sustainable Basin Yield Metric of 80. For example, if the Parties were to implement Combination M+E+U+AC+P as recommended in this Basin Plan, the Basin would have a Sustainable Yield$_X$ of 3,000 AFY, of which 80 percent could be produced sustainably, with a 20 percent buffer. That would equal water supplies of 2,400 AFY, while under the Existing Population Scenario water demands would be only 2,230 AFY. The 170 AFY difference could be used to support a marginal population of 1,620 in Los Osos.

Table 49. Marginal Sustainable Population for Combinations

Combination	80% of Water Supplies	EPS Water Demands	Marginal Water Supplies	Marginal Sustainable Population
M+E+U+AB+P	2,540	2,230	310	2,950
M+E+U+AC+P	2,400	2,230	170	1,620
M+E+U+A+S+P	2,120	1,980	140	1,330
M+E+U+ABC+P	2,680	2,230	450	4,290
M+E+UG+ABC+P	2,680	1,730	950	9,050
M+E+U+ABCD+P	2,800	2,230	570	5,430
M+E+UG+ABCD+P	2,800	1,730	1,070	10,190
M+E+U+A+S+P	2,120	1,980	540	5,150

Note: Program S in the first combination above includes 250 AFY of supplemental water, while the second combination includes 750 AFY.

The marginal population figures in Table 49 do not account for the buildout limit expected under the Buildout Population Scenario. Figure 72 shows the sustainable population for each of the combinations from Table 49, along with 2012 and buildout population levels. If the Parties were to implement one of those combinations, the increase in population would be limited to the lesser of the sustainable population shown in Figure 72 or the buildout limit of 19,850.

There are several distinctive features of the combinations analyzed for the Buildout Population Scenario, as shown in Table 50. First, the combinations that were considered as alternatives for the Existing Population Scenario would allow some additional development within the Plan Area, but would limit the population to a level below buildout, as shown in Table 49 and Figure 72. Second, every alternative that meets the water demands of the Buildout Population Scenario on a sustainable basis includes either nitrate removal or desalination facilities. Third, without groundwater desalination, every combination that meets the water demands of the Buildout Population Scenario includes either agricultural reinvestment or the location of Purveyor wells in the Eastern Area.

Figure 72. Sustainable Population of Program Combinations

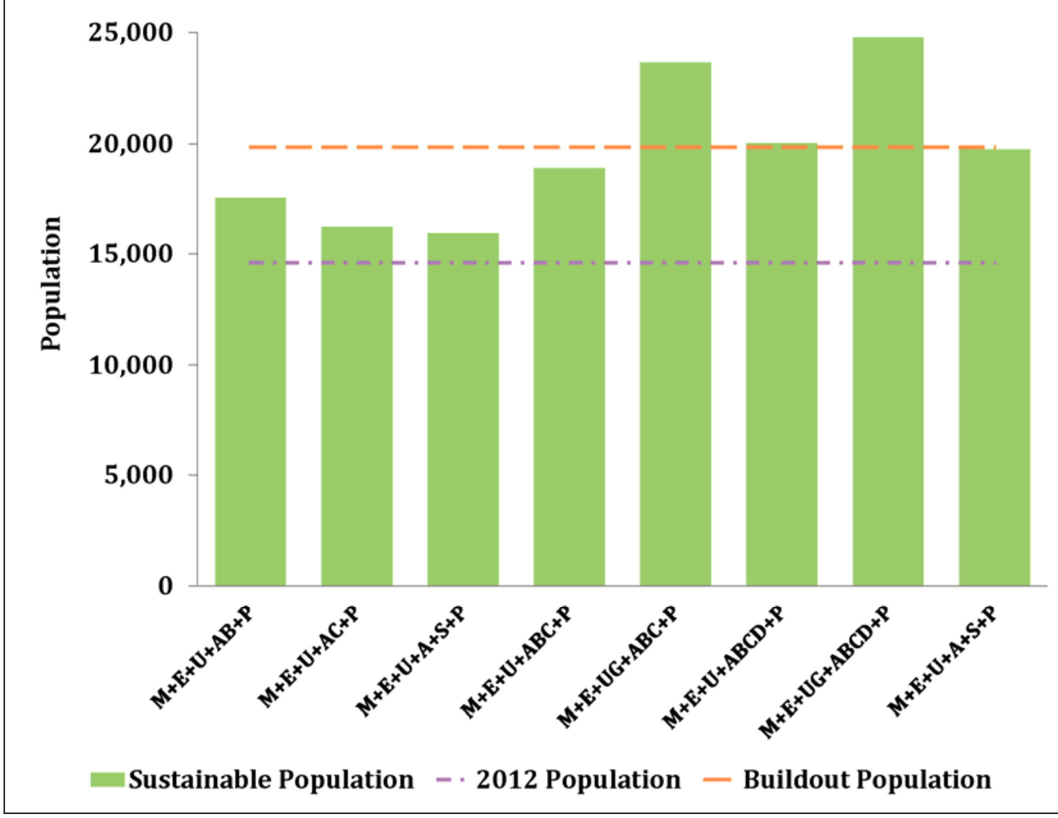


Table 50. Features of the Combinations

Combination	Limits Buildout Population	Requires Upper Aquifer Use	Requires Agricultural Water Reuse	Requires Urban Production in Eastern Area	Requires Groundwater Desalination
M+E+U+AB+P	■				
M+E+U+AC+P	■				
M+E+U+A+S+P	■				■
M+E+U+ABC+P	■	■			
M+E+UG+ABC+P		■	■		
M+E+U+ABCD+P		■		■	
M+E+UG+ABCD+P		■	■	■	
M+E+U+ABC+S+P		■			■
M+E+U+ABCD+S+P		■		■	■

As an alternative to the combinations discussed above, the County and Coastal Commission could adopt a limit on future growth within the Plan Area based on the population that could be sustainably supported according to the analysis shown in Table 49 and Figure 72.

As noted in Section 14.5.1, this Basin Plan recommends implementation of Combination M+E+U+AC+P for the Existing Population Scenario. For the Buildout Population Scenario, this Basin Plan recommends implementation of either Combination M+E+U+ABCD+P or Combination M+E+UG+ABC+P. Those combinations allow the Los Osos community to reach buildout development at the lowest overall cost.

The question of whether to implement Basin Infrastructure Program D or the Agricultural Reinvestment Program does not need to be resolved at the current time. Each has its own merits. For example, if development is allowed by the County and Coastal Commission in Los Osos, it will generate additional flows from the LOWWP, and those flows will need to be disposed of in some manner. The Agricultural Water Reinvestment Program would provide a means of disposing of the LOWWP outflows as well as maintaining a sustainable Basin. However, successful implementation of that program requires participation by agricultural growers in the Eastern Area. If the County were unsuccessful in gaining the participation of agricultural water users, or there were other reasons to improve the sustainability of the Basin, implementation of Basin Infrastructure Program D would be a viable alternative.

14.6 Long-Term Water Balance

Maintaining a long-term water balance that prevents seawater intrusion and provides a sustainable water supply for the community is a fundamental goal of the Basin Plan. The Basin Model has been used to assist in evaluating the long-term water balance under 2012 pumping conditions and under various scenarios representing water reinvestment and infrastructure programs.

A groundwater basin is a dynamic system with numerous sources of inflow and outflow. The basin water balance, or hydrologic budget, is an accounting of these components of inflow and outflow. The Basin Plan divides the basin into four areas (Dunes and Bay, Western, Central, and Eastern) that overlie four aquifers (Perched, Upper, Lower, and Alluvial).

Figure 73 presents the long-term water balance for the Basin under normal climatic conditions with year 2012 groundwater production distribution. For practical purposes, three of the basin areas (Dunes and Bay, Western, and Central) have been combined. The water balance includes basin boundary flows as well as intra-basin flows between the Perched Aquifer, Upper Aquifer, Lower Aquifer, and the combined Alluvial and Lower aquifers in the Eastern Area.

The estimated 2012 baseline hydrologic budget for the basin is 4,320 AFY. The components of basin inflow are percolation of precipitation/irrigation return flow (2,580 AFY), septic return flow (830 AFY), Los Osos Creek inflow (610 AFY), subsurface groundwater inflow from outside the basin (230 AFY), and seawater intrusion (70 AFY). The components of outflow are well production (2,610 AFY), subsurface outflow to the ocean and bay from the upper aquifer (1,290 AFY), and surface outflow/evapotranspiration to Willow Creek, Los Osos Creek, and Warden Creek (420 AFY).

Figures 74 and Figure 75 present the long-term basin water balance for the recommended Existing Population Scenario (M+E+AC+U) and for the recommended Buildout Development Scenario (E+ABC+UG). The hydrologic budgets for these Basin Plan scenarios are 4,000 AFY and 3,910 AFY, respectively. Table 1 below compares the differences in basin balance between the 2012 condition and Basin Plan Scenarios.

Table 51. Long-Term Water Balance, Los Osos Basin

Budget Items		2012 baseline (AF)	Basin Plan Scenario M+E+AC+U (NFD) (AF)	Basin Plan Scenario E+ABC+UG (Buildout) (AF)
Inflow	% of Precip. / Irrig. return	2,580	2,570	2,620
	Septic Return	830	100	100
	Los Osos Creek	610	630	500
	Subsurface groundwater	230	220	210
	Seawater Intrusion	70	0	0
	Broderson and Bayridge Est.	0	480	480
Outflow	Well production	2,610	2,230	2,380
	Subsurface groundwater	1,290	1,560	1,220
	Willow/Los Osos/Warden Creek	420	210	310
Total Hydrologic Budget		4,320	4,000	3,910

The main reduction in the total budget from the 2012 baseline to the scenarios is due to the redistribution of septic return by the LOWWP. Some wastewater is returned through direct infiltration at the Broderson and Bayridge Estates leach fields. The rest of the wastewater collected is distributed as offsets to other budget components, such as reductions in purveyor pumping through urban reuse, golf course pumping, and agricultural irrigation well pumping. Water conservation also reduces the wastewater supply in the Existing Population Scenario.

Besides the redistribution of wastewater in the basin, changes between the baseline and the Existing Population Scenario includes slight creek inflow increases with creek outflow decreases, significant decreases in well production along with increases in subsurface outflow, and the elimination of seawater intrusion. These basin responses are a result of conservation (mostly indoor) and urban water reinvestment, limited upper aquifer development with blending, and shifting purveyor production to the eastern Central Area (Plans A and C). The Basin Yield Metric for this scenario is 71.

For the Buildout Development Scenario, changes from the Existing Population Scenario include decreases in creek inflow and increases in outflow, an increase in basin well production with a slight increase in irrigation returns, and a decrease in subsurface outflow (without inducing long-term seawater intrusion). These changes are accomplished through significant increases in purveyor production from upper aquifer development and nitrate removal facilities (Plan B), along with a significant reduction in agricultural irrigation pumping from the Agricultural Water Reinvestment Program. The Basin Yield Metric for this scenario is 74.

Figure 73. Water Balance: 2012 Baseline

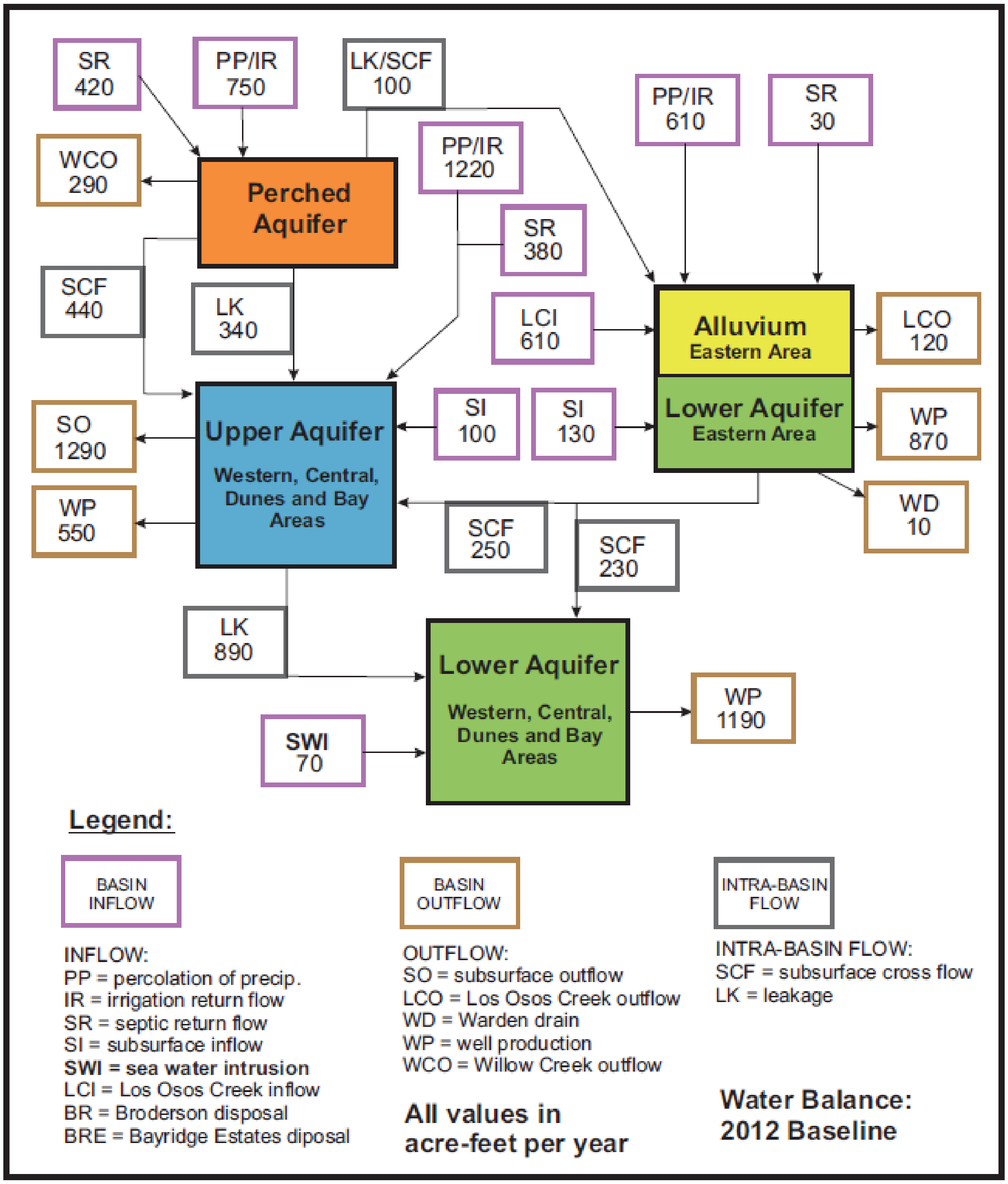


Figure 74. Water Balance: No Further Development

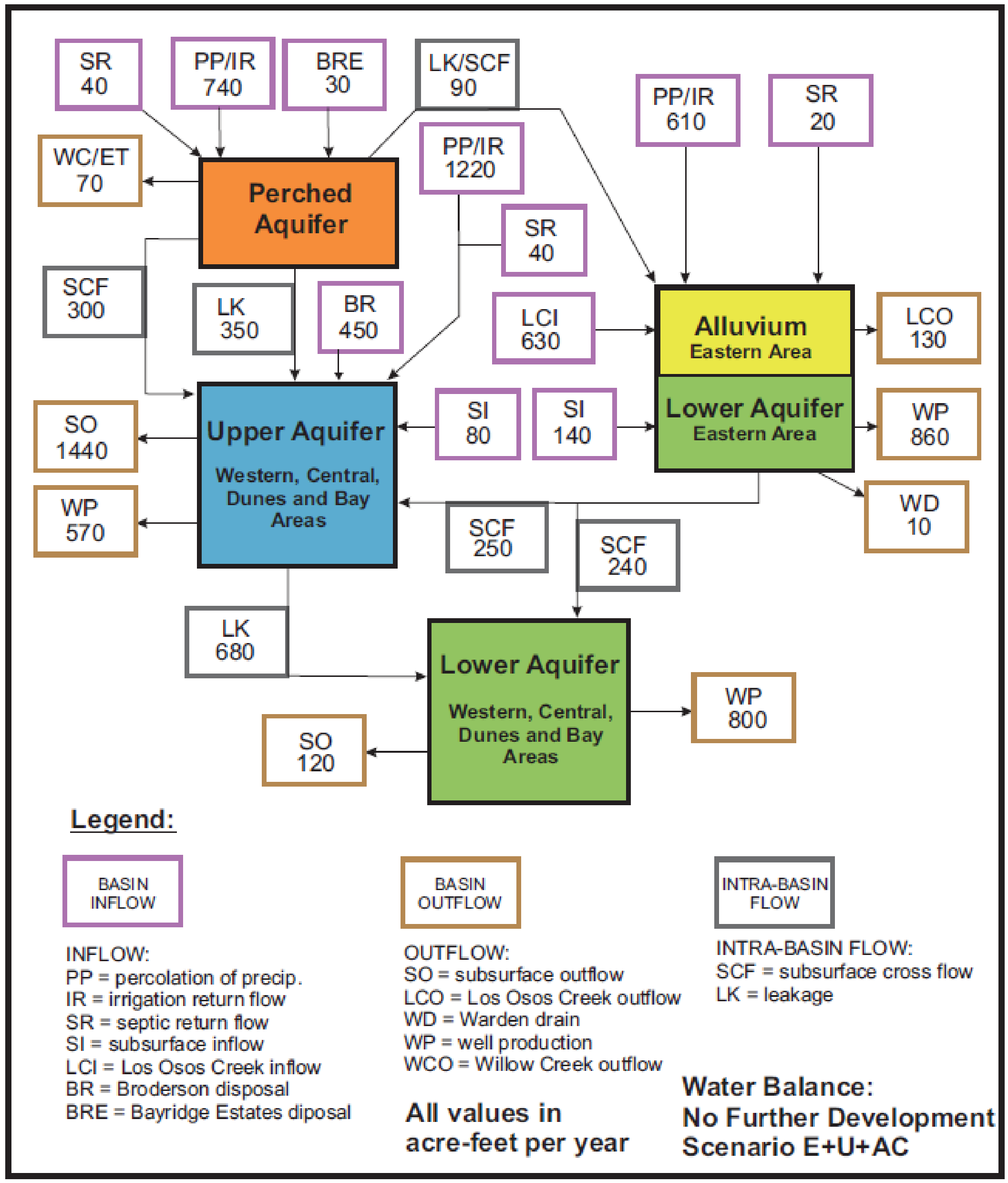
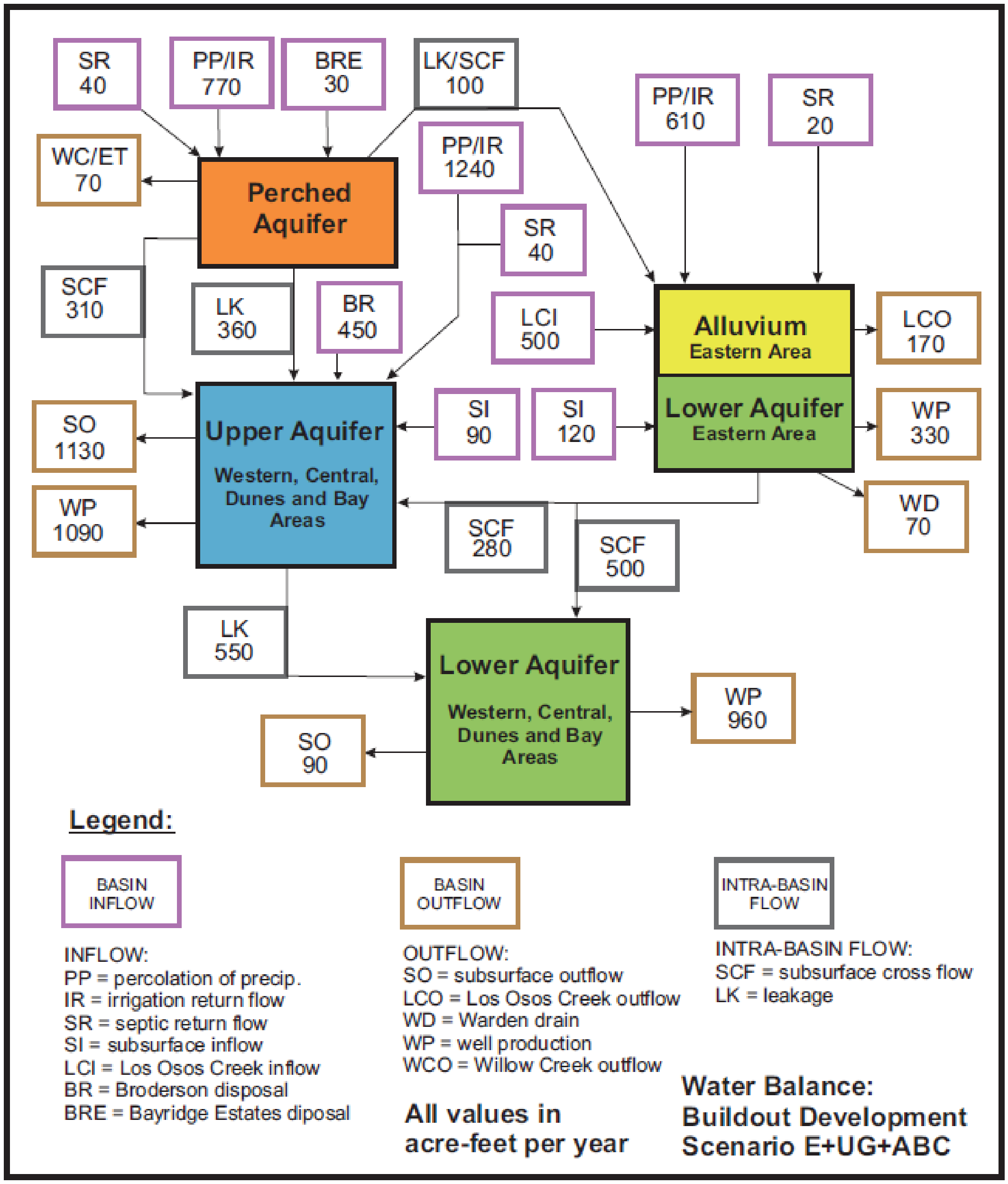


Figure 75. Water Balance: Buildout Development



[This page intentionally blank]

15

FUNDING OF THE BASIN PLAN

15.1 Introduction

Chapters 6 through 14 of this Basin Plan define the two major challenges facing the Basin—degradation of water quality in the Upper Aquifer and seawater intrusion into the Lower Aquifer—and identify potential combinations of programs that would meet those challenges. While those chapters identify the costs associated with each strategy for achieving a sustainable Basin (see Table 48), they do not discuss how those costs will be funded. That is the purpose of this chapter.

This chapter supports almost all Immediate and Continuing Goals of this Basin Plan, as funding will be necessary for all actions to provide sustainable water supplies in the Basin. Specifically, this chapter is intended to accomplish Continuing Goal No. 7:

7. *Allocate costs equitably among all who benefit from the Basin's water resources.*

In keeping with this goal, this chapter applies two principles for the equitable allocation of costs associated with Basin Plan implementation. First, all water-using properties should pay for the cost of achieving a sustainable Basin under current conditions, because all such properties contributed to the overall decline in Basin conditions. Second, properties that may be developed in the future should pay for the costs of achieving and maintaining a sustainable Basin in light of future water demand associated with the development of those properties.

15.2 Existing Population Scenario

As discussed in Section 14.5.2, this Basin Plan recommends that the Parties undertake Combination M+E+U+AC+P and the programs listed in Table 52 in order to achieve Immediate Goals Nos. 1, 2 and 3. Based on the analysis contained in the preceding chapters, implementation of those programs is expected to halt seawater intrusion into the Basin and provide sustainable water supplies for existing residential, commercial, community and agricultural development within Los Osos.

Table 52. Basin Plan Programs for Existing Population Scenario	
Program	**Cost ($1000)**
Groundwater Monitoring Program	650
Urban Water Use Efficiency Program	5,500
Urban Water Reinvestment Program	18,290
Basin Infrastructure Program A	2,835
Basin Infrastructure Program C	6,540
Wellhead Protection Program	0
Total	33,815

In the near term, most of the costs of Basin Infrastructure Program A will be recovered by the Purveyors through rates and tariffs charged to their water utility customers, as listed in Table 53. The one exception is that LOCSD has received grant funding approval from CDPH for construction of the South Bay Well nitrate removal facility.

Each Purveyor has its own process for setting rates and tariffs. LOCSD will address its future water rates through the process dictated by state law, including preparation of a rate study and a public hearing pursuant to Proposition 218. GSWC will address its future capital needs for Basin Program Infrastructure A in its next general rate case, which will be initiated in 2014 for rates that would take effect January 1, 2016. That process involves extensive review and public participation in front of the CPUC. S&T will adjust its rates and assessments as necessary, by Board action. The Purveyors may incorporate components of Program A costs into the financing program implemented by the Basin Management Committee to fund the costs of achieving a sustainable Basin under current conditions.

Table 53. Purveyors' Costs for Basin Infrastructure Program A				
Improvement	**CDPH**	**LOCSD**	**GSWC**	**S&T**
Water Systems Interconnection	--	50	50	--
Upper Aquifer Well	--	600	--	--
South Bay Well Nitrate Removal	640	0	--	--
Palisades Well Modifications	--	15	--	--
Blending Project	--	--	1,110	--
Water Meters	--	--	--	370
Totals	640	665	1,160	370
Grand Total				2,835

All figures in $1000.

As discussed in Chapter 13, costs associated with the Wellhead Protection Program are expected to be minimal. In the near term, the Basin Management Committee members will self-fund the costs of this program. These costs will be included for long-term, ongoing funding through the financing mechanism implemented by the Basin Management Committee. This chapter does not separately include any financing of costs for the Wellhead Protection Program.

This Basin Plan recommends that the costs associated with the remaining programs for the Existing Population Scenario be financed through a special tax or assessment on all developed (water-using) properties. The Basin Management Committee may sponsor the funding through the establishment of a community facilities district or other appropriate financing mechanism. The costs to be financed are shown in Table 54. Assuming that $30.94 million is financed over 30 years, at an interest rate of 5.5 percent, plus 2 percent financing cost and 10 percent debt reserve, total annual debt service, including payment of principal and interest, would be approximately $2.4 million.

Table 54. Programs Financed by Basin CFD

Program	**Cost ($1000)**
Groundwater Monitoring Program	650
Urban Water Use Efficiency Program	5,500
Urban Water Reinvestment Program	18,290
Basin Infrastructure Program C	6,540
Total	30,980

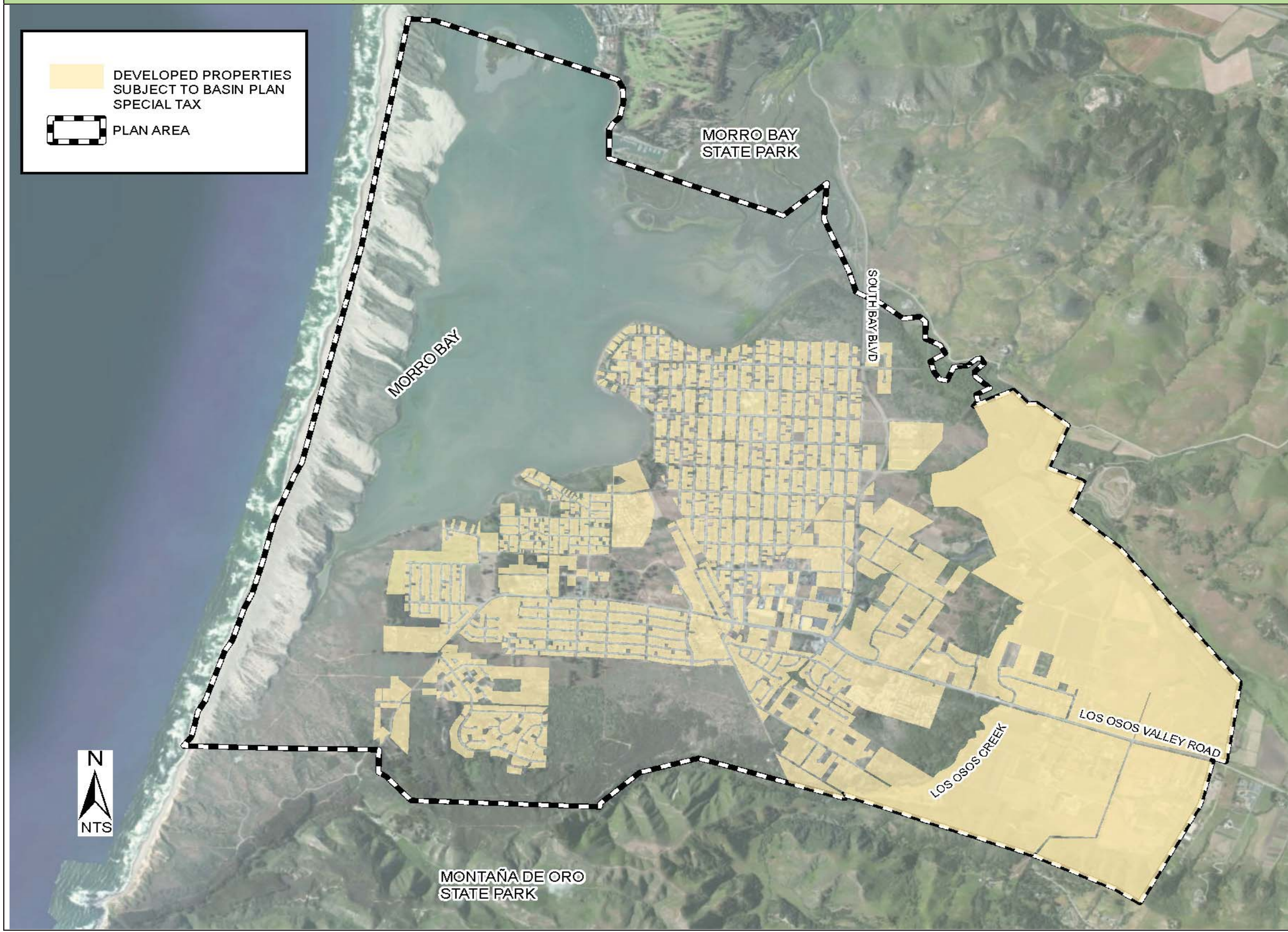
Under the recommendation in this Basin Plan, all water-using properties within the Basin will pay for the costs of achieving a sustainable Basin under current conditions. A map of all water using properties in the Plan Area is shown in Figure 76. The Basin Management Committee will support its recommendations through detailed financing studies, which will include more exact principal, interest and total debt service projections. The estimates contained in this Basin Plan are intended to allow an intelligent discussion of alternatives for action under this Basin Plan.

The Parties anticipate the formation of the entity responsible for the implementation of the special tax or assessment in early 2015, and the voter approval process to be completed by late 2015 or early 2016.

While this Basin Plan recommends the implementation of Combination M+E+U+AC+P to achieve a sustainable Basin under the Existing Population Scenario, two other alternatives were considered in Chapter 14. The financing required for the three alternatives is shown in Table 55 to allow comparison with the selected combination. As seen, the selected combination is the least expensive between the three potential combinations, which was a large part of why Combination M+E+U+AC+P is recommended by the Parties in this Basin Plan.

Table 55. Comparative Costs to be Financed	
Program	**Cost to be Financed ($1000)**
M+E+U+AB+P	41,690
M+E+U+AC+P	30,940
M+E+U+A+S+P	41,190

Figure 76. Developed Properties Subject to Bond Repayment



15.3 Buildout Population Scenario

While Section 14.5.3 discusses the financing of improvements to achieve a sustainable Basin under the Existing Population Scenario, this section addresses financing of additional improvements under the Buildout Population Scenario.

The additional improvements that may be required to achieve a sustainable Basin under the Buildout Population Scenario are listed in Table 56. As explained in Section 14.5.3, based on the Model, it is projected that the Basin metrical goals can be achieved by implementing Basin Infrastructure Program B and either the Agricultural Water Reinvestment Program or Basin Infrastructure Program D.[147] This Basin Plan does not choose between those alternative programs, but leaves that decision until a later date. That approach is reasonable in light of the fact that neither program would need to be implemented until after approval by the County and Coastal Commission of the LOCP and LOHCP. As noted in Section 14.5.3, the County and Coastal Commission could also limit allowed growth in Los Osos, therefore making one or more of the programs in Table 56 unnecessary.

Table 56. Basin Plan Programs for Buildout Population Scenario

Program	Cost ($1000)
Agricultural Water Reinvestment Program	2,120
Basin Infrastructure Program B	17,250
Basin Infrastructure Program D	4,200
Total	23,570

This Basin Plan recommends that the costs of the programs required to allow development of currently undeveloped parcels within the Plan Area be borne primarily by those property owners. Based on the recommended strategy, the projected costs to be shared are as shown in Table 57. That table includes the higher costs of Basin Infrastructure Program D, as opposed to the lower costs of the Agricultural Water Reinvestment Program, in order to be conservative.

As with the financing of projects by current water-using properties, the Basin Management Committee intends to sponsor a special tax or assessment on undeveloped parcels within the Plan Area through a community facilities district or other appropriate financing mechanism, to pay for the additional costs required to accommodate the water demand associated with new development. The financing mechanism will include funding to pay for operation and maintenance expenses associated with the nitrate removal facility of Basin Infrastructure Program B. Assuming that $12.2 million is financed over 30 years, at an interest rate of 5.5 percent, plus 2 percent financing cost and 10 percent debt reserve, the total annual debt service, including payment of both principal and interest, would be

[147] The analysis in Section 14.5.3 also found that the Basin Plan metrics could be achieved by implementing a Supplemental Water Program for at least 250 AFY, but that program was not carried forward due to its cost and past disfavor by the public.

approximately $780,000. Adding that to annual operation and maintenance expenses of $420,000 would equal a total of $1.2 million per year to be financed as discussed in this paragraph.

If the Parties were to determine in the future that it was necessary to implement additional programs in order to maintain a sustainable Basin, then the funding would be adjusted to meet the costs of that approach.

It is the intent of the Parties that the method described above to fund additional infrastructure for the Buildout Population Scenario be presented to property owners at the same time they are presented with the option to pay for improvements associated with the LOWWP. The Basin Management Committee will coordinate the timing of the approval process discussed in this section with the County for the LOWWP.

Table 57. Additional Programs To Be Financed

Program	Capital Cost ($1000)	O&M Cost ($1000)
Basin Infrastructure Program B	8,000	9,250
Basin Infrastructure Program D	4,200	0
Total	12,200	9,250
Grand Total		21,450

15.4 Community Decision-Making

The strategy recommended in this Basin Plan has been or will be submitted to the public in Los Osos for review, comment and decision in two ways.

First, a draft of this Basin Plan was released for public review and comment. Comments were used to refine the Basin Plan as a part of the preparation of release this updated Basin Plan. Implementation of certain actions under this Basin Plan will require external approvals, such as from the Coastal Commission and CPUC. The Parties intend to initiate those approval processes in 2015.

Second, the funding mechanisms discussed in this chapter will be submitted to property owners within the Plan Area for approval at one or more elections. If the community were not to approve funding, the Parties would revisit the financing strategy for this Basin Plan, so that they are able to take required actions to prevent seawater intrusion into the Basin. It is anticipated that the most likely financing strategy would be for the Purveyors to include the costs of this Basin Plan actions in their water utility rates, and for the County to include its share of costs for this Basin Plan in its wastewater utility rates.

[This page intentionally blank]

16

IMPLEMENTATION OF THE BASIN PLAN

16.1 Introduction

Chapters 7 through 13 of this Basin Plan describe a collection of programs for potential implementation by the Parties and others in the Basin. Chapters 14 and 15 evaluate the effectiveness, cost and funding sources for various combinations of the programs. This Chapter 16 sets forth the actions that the Parties will undertake pursuant to this Basin Plan, along with a timeline for those actions.

16.2 The Basin Plan Process

16.2.1 *Public Review Process*

The Parties released a draft of this Basin Plan for public review on August 1, 2013, in recognition of the great interest of the public in water resources management in Los Osos. Public review also furthered the need to achieve public support for the actions recommended in this Basin Plan, especially in light of the need for voter approval of funding for the Basin Plan as set forth in Chapter 15.

Several public agencies provided comments on the draft Basin Plan, as well as a limited number of individual citizens. The Parties reviewed all comments provided and considered modifications to the Basin Plan based on each comment. The Parties did make several changes to the Basin Plan in response to comments, but did not incorporate every suggestion.

16.2.2 *Adoption of the Basin Plan*

It is the intention of the Parties to present this Basin Plan to each of their respective policy decision makers for adoption during the first half of 2015. Following adoption of the Basin Plan by each of the Parties, the Parties will jointly submit the Basin Plan and stipulated judgment to the Court for approval in the Adjudication by mid-2015. It is the goal of the Parties to obtain Court approval by the summer of 2015, although the Court's schedule may impact that timeline.

16.2.3 *Periodic Review of the Basin Plan*

This Basin Plan was prepared during the period from 2008 through 2014. It is expected that the Parties will gain significant additional understanding of the Basin by implementing the Basin Plan actions. Management of a groundwater basin is always an iterative process, and management of the Basin is expected to be no exception. Therefore, the Parties will review the Basin Plan periodically to determine if additional data collection or technical analyses would be necessary or convenient, whether the metrics established in Chapter 6 should be modified, and whether the programs set forth in the Basin Plan have been implemented as planned and have had the predicted impact on the Basin, particularly with reference to seawater intrusion and nitrate concentrations. Such a review will occur at predetermined times set forth below and at regular intervals determined to be appropriate by the Parties thereafter.

16.2.4 *Adaptive Management Plan*

The purpose of the Adaptive Management Plan is to provide the final "check and balance" for the Basin Plan to ensure that the overall objectives of the groundwater basin are being met. Evaluating the groundwater basin on an annual basis allows the Basin Management Committee to:

1. Evaluate the trends of the groundwater basin
2. Identify any voids in the collected data
3. Report the data analysis to the various interested parties (Department of Water Resources, Regional Water Board, Coastal Commission)
4. Modify the Basin Plan based on the current conditions and visible trends of the groundwater basin
5. Modify procedures to utilize current best management practices
6. Modify pumping, treatment and/or reuse procedures if groundwater basin trends are showing signs of degradation of water quality, including increased levels of contamination and/or increased levels of seawater intrusion

Adaptive Management is used to provide guidance on the overall effectiveness of the Basin Plan and to provide a tool with which to modify the programs to better meet the overall Basin objectives. The Adaptive Management process is to ask and answer the following questions:

7. Are all Programs reaching targeted objectives? If yes, are there any factors that might change the Programs from continuing to reach targeted objectives? If no, why are the Programs not reaching targeted objectives?
8. What changes need to be made to reach the targeted objectives?
9. What is the schedule for getting the Programs back on target to reaching objectives?

Each program of the Basin Plan will contain an Adaptive Management analysis which will include the following:

10. Evaluation of recent changes made in prior years
11. Summary of recommendations and projected benefits
12. Project cost impact of program changes
13. Anticipated implementation schedule
14. Documentation and public information

If negative trends or subsequent failure to meet the success criteria occur, such trends are expected to occur slowly over several years, and will likely take equal or more time to reverse. Identified problem areas will be addressed through the Adaptive Management analysis to identify suitable remedial action.

16.3 Plan Implementation Timeline

16.3.1 *Groundwater Monitoring Program*

The Groundwater Monitoring Program established in Chapter 7 contains a number of actions by the Basin Management Committee to monitor and report on various measurements and metrics related to the Basin. Monitoring implemented as part of this program will be vital to understanding how other actions undertaken pursuant to the Basin Plan will impact the Basin.

The Groundwater Monitoring Program will be implemented in two phases: the first for establishment of the program, and the second for annual monitoring and reporting in all years. As shown in Table 58, the first phase will be conducted during the third and fourth quarters of 2014, and the second phase will be implemented at various points during each year beginning in the first quarter of 2015. Water level monitoring will take place in April and October of each year, with water quality monitoring also occurring each October for the constituents listed in Table 16 and Table 17. Precipitation and stream flow will be measured on a daily basis throughout the year.

The annual report will be designed during establishment of the Groundwater Monitoring Program in 2014, but the first annual report will not be published until April 2015 based on monitoring data gathered during 2014 and groundwater production reported in the first quarter of 2015. That schedule will be followed in later years, subject to modification if deemed appropriate by the Parties or the Basin Management Committee.

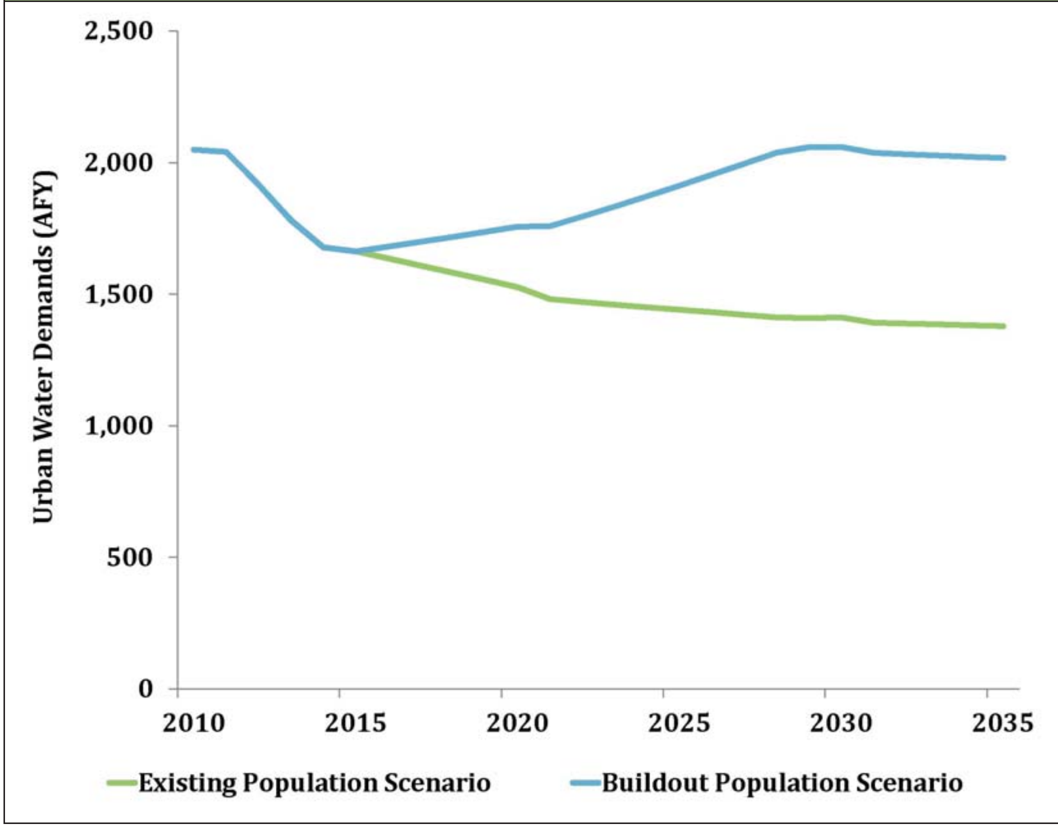
Table 58. Groundwater Monitoring Program Schedule								
	2014				Later Years			
	1	2	3	4	1	2	3	4
Establish Program								
• Create electronic databases			■	■				
• Conduct wellhead surveys			■	■				
• Adopt monitoring protocols			■	■				
• Adopt reporting rules			■	■				
Monitoring Actions								
• Water level monitoring		■		■		■		■
• Water quality monitoring				■				■
• Precipitation monitoring	■	■	■	■	■	■	■	■
• Stream flow monitoring	■	■	■	■	■	■	■	■
Reporting Actions								
• Design annual report			■	■				
• Purveyors report production	■				■			
• Calculate Basin metrics		■				■		
• Publish annual report						■		

Actions by Basin Management Committee (■) and All Purveyors (■).

16.3.2 *Urban Water Use Efficiency Program*

Chapter 8 establishes an Urban Water Use Efficiency Program that seeks to reduce urban water demands on the Basin. Implementation will be in two phases, with the County responsible for most actions from 2013 through 2018 and the Purveyors assuming responsibility starting in 2019. The responsibilities of the various Parties are shown in Table 29 and Table 30. If the Urban Water Use Efficiency Program is implemented as set forth in Chapter 8, it is expected that urban water demands in the Basin will be as shown in Figure 77 for the Existing Population Scenario and Buildout Population Scenario.

Figure 77. Projected Urban Water Demands on the Basin (2010-2035)



16.3.3 *Water Reinvestment Program*

The Water Reinvestment Program established in Chapter 9 provides for the construction and operation of the LOWWP, which includes community wastewater collection and treatment facilities and a recycled water distribution system. The LOWWP will be constructed, owned and operated by the County. Recycled water will be delivered to users identified in Chapter 9, either by the County directly to those areas located outside a Purveyor's boundaries, or by the County pursuant to an agreement with the Purveyor in whose service area a user is located. This program has two phases: the Urban Water Reinvestment Program, which relies on recycled water produced under the Existing Population Scenario; and the Agricultural Water Reinvestment Program, which requires both the additional recycled water produced under the Buildout Population Scenario and the participation of agricultural water users overlying the Basin.

The schedule for implementing the Water Reinvestment Program is necessarily tied to the schedule for the LOWWP. As shown in Table 59, construction of the LOWWP wastewater collection and recycled water distribution systems has already commenced and is expected to be complete during the first half of 2014. Construction of the tertiary recycled water treatment plant is expected to begin in the first half of 2014 and be complete by the end of 2016. Connection of individual residences and businesses through sewer laterals will occur during 2016/2017.

The LOWWP is currently projected to begin collecting and treating sewage from the Wastewater Service Area in 2016, with a steady increase in quantity as residences and businesses are connected to the project. Recycled water will first be delivered to the Broderson and Bayridge Estates leach fields, followed by initial deliveries to urban and agricultural reuse during the irrigation season of 2017.

Table 59. Water Reinvestment Program Schedule

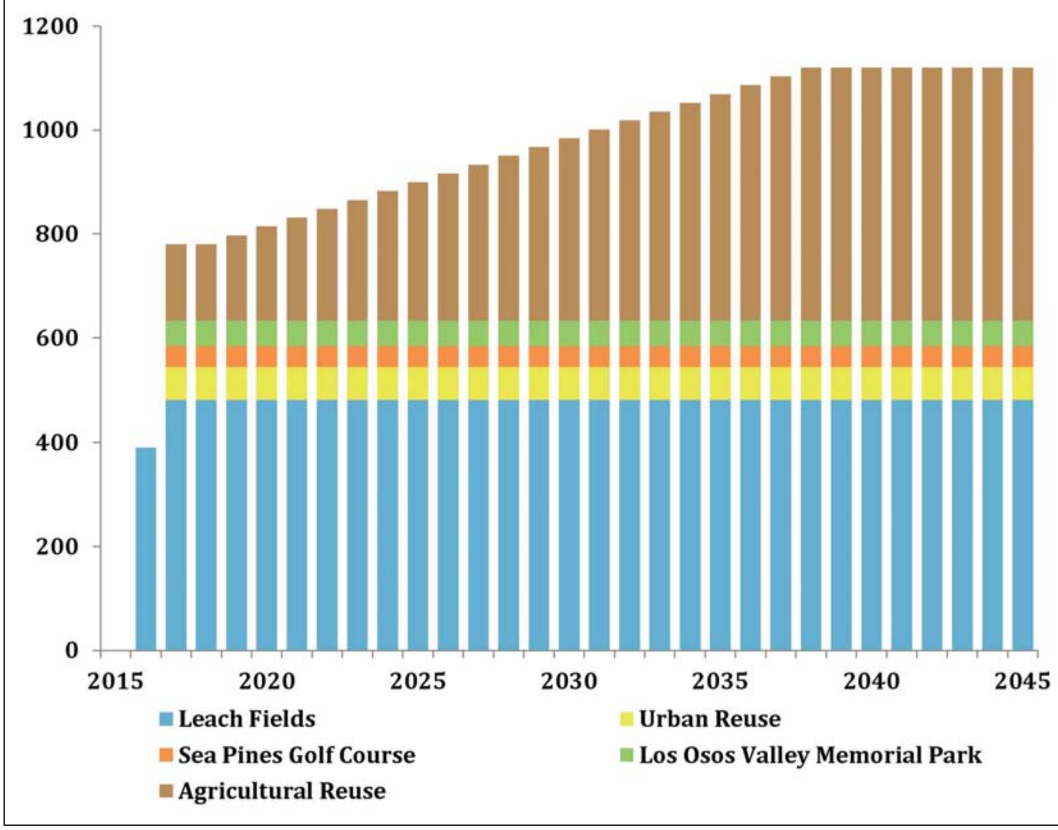
	2014	2015	2016	2017+
Construction				
Collection System	■			
Treatment Plant	■ ■	■ ■	■	
Recycled Water Distribution System	■			
Lateral Connections			■	■
Operations				
Wastewater Collection & Treatment			■	■ ■
Delivery to Leach Fields			■	■ ■
Delivery to Urban Reuse				■ ■
Delivery to Sea Pines Golf Course				■ ■
Delivery to Los Osos Memorial Park				■ ■
Delivery to Agricultural Reuse				■ ■

Actions by the County (■).

As described in Section 9.2.4, the LOWWP is not expected to generate its full quantity of recycled water at commencement of operations. During the first year of operations in 2016, the LOWWP will produce approximately 50 percent of its initial yield, or 390 AF. Starting in 2017, the LOWWP is expected to produce approximately 780 AFY of recycled water based on the Existing Population Scenario.

If the County and Coastal Commission were to authorize a LOCP and LOHCP that would enable land development and population growth in Los Osos, recycled water production could increase to approximately 1,120 AFY over the development period. In that event, the Parties may implement the Agricultural Water Reinvestment Program as a means to place all recycled water to beneficial use in the Basin. It is not expected that the LOCP and LOHCP would be completed before 2016, so that year is chosen as the proper time for the Los Osos community to decide whether to implement the Agricultural Water Reinvestment Program, with expenses as specified in Section 15.3. It would take approximately two years to build the necessary infrastructure, consisting of additional treatment capacity and recycled water storage facilities (see Section 9.4.1), and recycled water deliveries could begin as early as 2019. An illustrative timeline for deliveries of recycled water is shown in Figure 78, assuming that population growth is allowed in Los Osos over a 20-year period from 2019 through 2038.

Figure 78. Timeline of Recycled Water Deliveries



16.3.4 *Basin Infrastructure Program*

The Basin Infrastructure Program set forth in Chapter 10 consists of four component programs, designated Programs A through D. Programs A and B would transfer groundwater production from the Lower Aquifer to the Upper Aquifer, and Programs C and D would shift production within the Lower Aquifer from the Western Area to the Central and Eastern Areas, respectively. As described in Chapter 14, the Parties have selected Basin Infrastructure Programs A and C for immediate implementation. The Parties have also determined that if the County and Coastal Commission were to allow future development in Los Osos pursuant to the LOCP and LOHCP, the Purveyors will implement Program B and either the Agricultural Water Reinvestment Program or Program D.

Table 60 sets forth the schedule for implementing Basin Infrastructure Programs A through D. The various actions under Program A have already been accomplished or will be implemented by early 2015. Purveyors will implement the Basin Plan program elements promptly following financing approval. The Parties expect this could occur by early 2017.

The LOCP and LOHCP, and consequently, the decision whether to implement the Agricultural Water Reinvestment Program or Basin Infrastructure Program D, are not expected to be finalized before 2016. The Parties would make such a decision with appropriate public input in an expeditious manner so that property owners are not unreasonably delayed in their development efforts. Because any Basin Plan actions would require funding, implementation of Programs B and D would likely occur during 2017 and 2018 and be operational in 2019.

Table 60. Basin Infrastructure Program Schedule

	By 2013	2014	2015 thru 2017	2018+
Program A				
Water Systems Interconnection		■ (orange) ■ (purple)	■ (orange) ■ (purple)	
Upper Aquifer Well		■ (orange)	■ (orange)	
South Bay Well Nitrate Removal	■ (orange)	■ (orange)		
Palisades Well Modifications	■ (orange)			
Blending Project	■ (purple)	■ (purple)		
Water Meters	■ (yellow)			
Program B				
LOCSD Wells				■ (orange)
GSWC Wells				■ (purple)
Community Nitrate Removal Facility				■ (brown)
Program C				
Expansion Well No. 1			■ (brown)	
Expansion Well No. 2			■ (brown)	
Expansion Well No. 3			■ (brown)	
S&T/GSWC Interconnection			■ (yellow)	
Los Osos Valley Road Main Upgrade			■ (brown)	
Program D				
Expansion Well No. 4				■ (brown)
Expansion Well No. 5				■ (brown)
Expansion Well No. 6				■ (brown)

Actions by All Purveyors (■ brown), LOCSD (■ orange), GSWC (■ purple) and S&T (■ yellow).

16.3.5 *Supplemental Water Program*

The Parties have not identified any components of the Supplemental Water Program for community-wide implementation. Residents and businesses overlying the Basin are encouraged to implement rainwater harvesting and greywater reuse on their individual properties, but there is no schedule for implementation of such actions.

16.3.6 *Wellhead Protection Program*

The Wellhead Protection Program consists of several programs that will be implemented by the Purveyors, the County or other agencies on a continuous basis. The various programs and the entities responsible for each are listed in Table 61.

Table 61. Wellhead Protection Program Schedule

Program	Responsible Entity	2014+
Drinking Water Source Assessment and Protection	Purveyors	■ (brown)
Well Abandonment	County	■ (blue)
Well Standard	County	■ (blue)
Point Source Discharges	RWQCB	■ (black)
Hazardous Materials Management	DTSC	■ (black)
Septic Systems Management	RWQCB	■ (black)
Los Osos Wastewater Project	County	■ (blue)
Basin Plan	Basin Management Committee	■ (red)

Actions by All Purveyors (■), County (■),Basin Management Committee (■) and Others (■).

16.4 Conclusion

As described in the preceding sections, the various programs identified in this Basin Plan would be primarily implemented during the period from 2014 through 2018. The programs would be implemented in two phases, the first designed to achieve a sustainable Basin under the Existing Population Scenario and the second designed for the Buildout Population Scenario.

The programs designed to achieve a sustainable Basin under the Existing Population Scenario are listed in Table 62. As described in Chapter 15.2, the Parties intend to present the voters of Los Osos with a ballot measure in the fall of 2014 or spring of 2015 to approve issuance of bonds to finance implementation of those programs. If the voters approve the issuance of bonds, the Parties will proceed to implement the various actions on the schedule presented in Table 62.

Table 62. Implementation Schedule for EPS Programs

Program	‘14	‘15	‘16	‘17	‘18	‘19
Approval of Basin Plan	🟧	🟦	🟦	🟦	🟦	🟦
Groundwater Monitoring Program	🟥	🟦	🟦	🟦	🟦	🟦
Urban Water Use Efficiency Program	🟥	🟧	🟧	🟧	🟧	🟦
Urban Water Reinvestment Program	🟥	🟧	🟧	🟦	🟦	🟦
Basin Infrastructure Program A	🟧	🟦	🟦	🟦	🟦	🟦
Basin Infrastructure Program C	🟥	🟧	🟧	🟦	🟦	🟦
Wellhead Protection Program	🟦	🟦	🟦	🟦	🟦	🟦

Actions in Process (🟧), Actions Complete (🟦), and Decision Points (🟥).

The programs designed to achieve a sustainable Basin under the Buildout Population Scenario are listed in Table 63. As described above and in Section 15.3, a preliminary question is whether the County and Coastal Commission will approve a LOCP and LOHCP that allow additional development in Los Osos. If those agencies were not to approve such planning documents, then none of the programs in Table 63 would be implemented, unless they were deemed necessary or convenient at a later time to support a sustainable Basin under the Existing Population Scenario.

If the County and Coastal Commission were to approve the necessary planning documents for development, then the Parties would present a ballot measure to the owners of properties that could potentially be developed, for the issuance of bonds to finance the construction of the programs in Table 63. It is unlikely that the LOCP and LOHCP would be completed prior to 2015. Therefore, the schedule below assumes that the election would occur in the fall of 2016. If property owners were to approve the issuance of bonds, the design and construction period would be approximately two years for the three programs, ending in 2018. Thus, all programs would be complete and ready to support new development beginning in 2019. Of course, any delays in the approval of the LOCP, LOHCP or the issuance of bonds would also delay the implementation schedule for those programs that support a sustainable Basin under the Buildout Population Scenario.

Table 63. Implementation Schedule for BPS Programs

Program	‘16	‘17	‘18	‘19	‘20	‘21
Agricultural Water Reinvestment Program	🟥	🟧	🟧	🟦	🟦	🟦
Basin Infrastructure Program B	🟥	🟧	🟧	🟦	🟦	🟦
Basin Infrastructure Program D	🟥	🟧	🟧	🟦	🟦	🟦

Actions in Process (🟧), Actions Complete (🟦), and Decision Points (🟥).

The primary goal of this Basin Plan is to halt or, to the extent possible, reverse seawater intrusion into the Basin. In order to measure success in achieving that goal, Chapter 6 established several metrics for the Basin, *viz.*, the Basin Yield Metric, the Water Level Metric and the Chloride Metric. If the various programs in Table 62 and Table 63 are implemented, the Model predicts that all metric targets will be achieved.

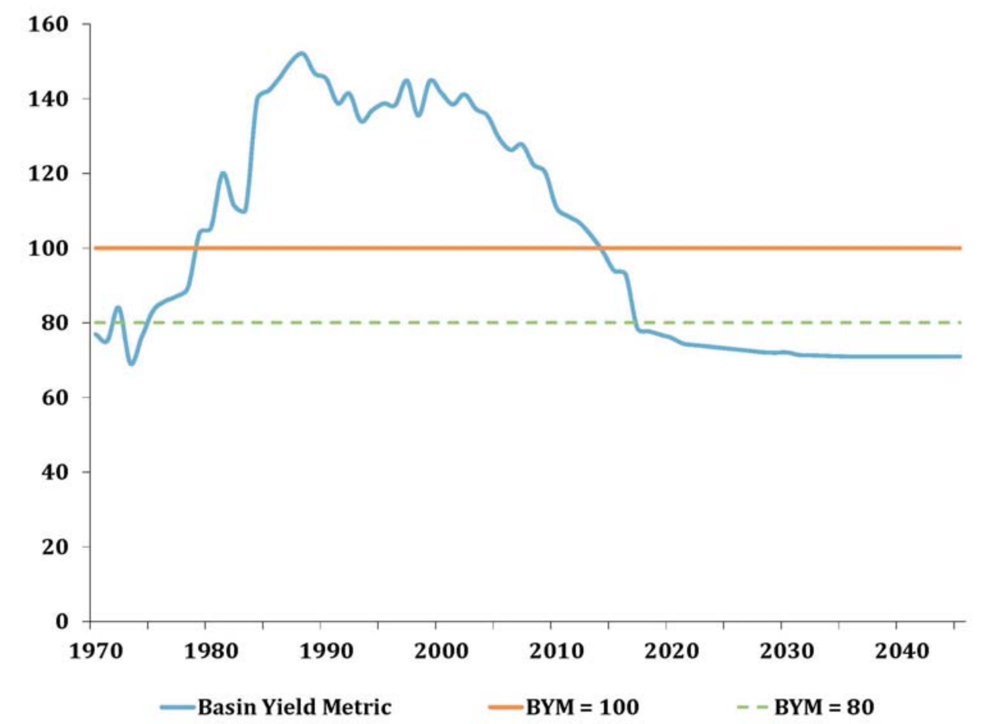
Figure 79 depicts the historical and projected values for the Basin Yield Metric from 1970 through 2045, for both the Existing Population Scenario and the Buildout Population Scenario. Under the Existing Population Scenario, it is predicted that the Basin Yield Metric will fall below the target of 80 for the first time in 2017, after implementation of the Urban Water Reinvestment Program and Basin Infrastructure Program C. In later years, the Basin Yield Metric will decline steadily to an equilibrium of 71, based on full implementation of the Urban Water Use Efficiency Program.

Under the Buildout Population Scenario, the Basin Plan would also achieve the Basin Yield Metric target of 80 in 2017. In order to maintain the Basin Yield Metric at or below 80, the Parties would need to implement the various programs listed in Table 63. The Model predicts that with those programs, the Basin Yield Metric will remain below 80, eventually reaching an equilibrium of 71 based on full implementation of the Urban Water Use Efficiency Program and Agricultural Water Reinvestment Program.

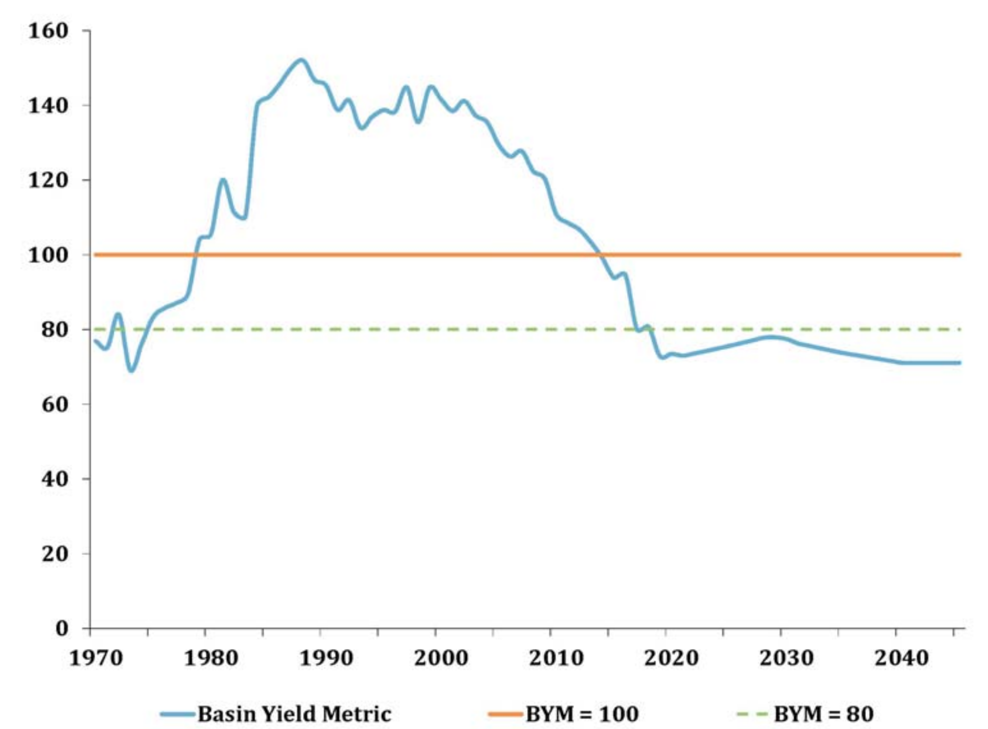
If the Basin Plan programs are implemented as described in this chapter, they would achieve a sustainable Basin Yield Metric by 2017. It is expected that the Water Level Metric would respond within five years, so that it would reach the target of 8 feet msl by 2022. The Chloride Metric would react more slowly, following the Water Level Metric by approximately 15 years. The Chloride Metric may rise above current levels before falling to below the target of 100 mg/l by approximately 2037. While that date seems to be far in the future, it will only be achieved through quick, decisive actions by the Parties and the residents, businesses and institutions of Los Osos, pursuant to this Basin Plan.

Figure 79. Historical and Projected Basin Yield Metric (1970-2045)

Existing Population Scenario



Buildout Population Scenario



17

BIBLIOGRAPHY

17.1 Introduction

This chapter contains a bibliography of all known prior studies and reports regarding the Basin.

17.2 Geologic Studies of the Basin

Asquith, D., *Review of Potentially Problematic Faults in San Luis Obispo County*, for County of San Luis Obispo (January 28, 1997).

17.3 Water Resource Studies of the Basin

California Department of Water Resources, *San Luis Obispo County Investigation*, Bulletin No. 18 (May 1958).

California Department of Water Resources, Sea Water Intrusion: Morro Bay Area, San Luis Obispo County, Bulletin No. 63-6 (February 1972).

California Department of Water Resources, *Los Osos-Baywood Ground Water Protection Study*, District Report (October 1973).

Brown and Caldwell, *Preliminary Groundwater Basin Management Study*, for San Luis Obispo County Service Area No. 9 (October 1974).

California Department of Water Resources, *Morro Bay Sandspit Investigation*, District Report (August 1979).

State Water Resources Control Board, *Geohydrology and Water Quality – Baywood-Los Osos Groundwater Basin, San Luis Obispo County, California* (October 1979).

United States Geological Survey, *Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County, California*, USGS Water-Resources Investigations Report 88-4081 (1988).

California Department of Water Resources, *Geohydrology and Management of Los Osos Valley Ground Water Basin, San Luis Obispo County*, District Report (July 1989).

The Morro Group and Tenera Environmental Services, *Freshwater Influences on Morro Bay, San Luis Obispo County, California*, for The Bay Foundation of Morro Bay (June 1990).

Engineering Development Associates and The Morro Group, *Preliminary Engineering Evaluation, Los Osos/Baywood Park Community Drainage Project*, for County Service Area No. 9J, Draft Report (December 1997)

Cleath & Associates, *Analysis of Ground Water Level Responses to Replacing Pecho Well Production with Production at South Bay Blvd or Los Olivos Well Sites, Los Osos Ground Water Basin*, for Southern California Water Company (October 1992).

Southern California Water Company, *Los Osos Valley Basin Report* (April 1994).

Woodward-Clyde Consultants, *Los Osos Groundwater Model Update and Post-Audit Analysis*, for Southern California Water Company (June 18, 1998).

URS Corporation, *Baseline Report of the Los Osos Valley Groundwater Basin, Los Osos, California*, for Southern California Water Company (August 3, 2000).

URS Corporation, *Management Scenario, Los Osos Valley Groundwater Basin, Los Osos, California*, for Southern California Water Company (August 14, 2000).

Weber Hayes & Associates, *Site Investigation Report: Bear Valley Chevron, 1099 Los Osos Valley Road, Los Osos, California* (August 2001).

Cleath & Associates, *Safe Yield Analysis of the Los Osos Valley Ground Water Basin*, for Los Osos Community Services District (July 2002).

Cleath & Associates, *Ground Water Basin Management Plan*, for Los Osos Community Services District (July 2002).

Cleath & Associates, *Ground Water Basin Management 2002 Model Update with MT3D*, for Los Osos Community Services District (September 2002).

Cleath-Harris Geologists, Inc., *Flow Model Conversion and Urban Area Yield Update* (July 29, 2009).

Hydrofocus, Inc., *Review of Cleath-Harris Geologists' July 2009 Memorandum "Flow Model Conversion and Urban Area Yield Update" (Corrected Version February 4, 2010)* (January 13, 2010).

Hydrofocus, Inc., *Review of Los Osos Basin Update and Current Wastewater Project Description—Revised* (August 3, 2010).

ISJ Working Group, *Los Osos Groundwater Basin Update* (2010).

17.4 Studies of Water Use in the Basin

Boyle Engineering, *Engineering Report on Water System Master Plan for Baywood Park County Water District* (December 1965).

County of San Luis Obispo, Planning Department, *The Population of San Luis Obispo County, 1965-1985* (1985).

Brown and Caldwell, *Water Management Program, Los Osos District*, for Southern California Water Company (August 1994).

John L. Wallace & Associates and Maddaus Water Management, *Urban Water Management Plan*, for Los Osos Community Services District (December 2000).

John L. Wallace & Associates and Cleath & Associates, *Water Master Plan*, for Los Osos Community Services District (August 2002).

Maddaus Water Management, *2011 Water Demand Analysis and Water Conservation Evaluation* (2011).

Aquacraft, *Review of 2011 Water Demand Analysis and Water Conservation Evaluation prepared by Maddaus Water Management* (October 10, 2011).

17.5 Planning Documents Related to the Los Osos Wastewater Project

California Department of Public Health, Bureau of Sanitary Engineering, *Report of Sanitary Engineering Survey of Public Water System, Los Osos* (1963).

Central Coast Regional Water Quality Control Board, *Staff Report on Nitrates and Ground Water Conditions in the Los Osos Ground Water Basin* (1970).

Grenz, A. and G. Coulter, *Preliminary Investigation into the Effects of Septic Tank/Leachfield Effluent on Ground Water in the Los Osos/Baywood Area* (1979).

Brown and Caldwell, *Los Osos Baywood Park – Phase I Water Quality Management Study*, for San Luis Obispo County Service Area No. 9 (April 1983).

Central Coast Regional Water Quality Control Board, *Staff Report re Resolution 83-12* (September 16, 1983).

Central Coast Regional Water Quality Control Board, *Memorandum re Basin Plan Amendment, Resolution 83-13* (September 27, 1983).

Brown and Caldwell, *Los Osos Baywood Park – Phase II Facilities Planning Study Project Report*, for San Luis Obispo County Service Area No. 9 (1984).

State Water Resources Control Board, *Workshop Report re Basin Plan Amendment, Resolution 83-13* (January 4-5, 1984).

State Water Resources Control Board, *Basin Plan Amendment*, Resolution 84-13 (January 19, 1984).

Brown and Caldwell, *Supplement to the Los Osos Baywood Park – Phase II Facilities Planning Study Project Report and Environmental Impact Report*, for San Luis Obispo County Service Area No. 9 (September 1984).

Pacific Geosciences, Inc., *Site 4 Well Logs*, for San Luis Obispo County Service Area No. 9 (1985).

Engineering Science, *Phase One – Sewerage Planning Study, CSA No. 9 – Los Osos, Baywood Park, Cuesta-by-the-Sea*, for County of San Luis Obispo Engineering Department (May 1986).

The Morro Group, *Environmental Impact Report, CSA 9 Wastewater Treatment Facilities, Los Osos, Baywood Park, Cuesta-by-the-Sea, San Luis Obispo County, California*, for County of San Luis Obispo, State Clearinghouse No. 84121914 (August 1987).

The Morro Group, *Final Supplemental Environmental Impact Report, CSA 9 Wastewater Treatment Facilities*, for County of San Luis Obispo, State Clearinghouse Nos. 84121914 and 89030816, ED83-191 (September 1989).

San Luis Obispo County Technical Advisory Committee, *Baywood-Los Osos Soil and Groundwater Nitrogen Study* (July 1994).

Metcalf & Eddy, *Los Osos Wastewater Study Task F – Sanitary Survey and Nitrate Source Study*, for County of San Luis Obispo (March 2, 1995).

Metcalf & Eddy, *Los Osos Wastewater Study Task G – Detailed Evaluation of Alternatives*, for County of San Luis Obispo (July 26, 1995).

Metcalf & Eddy, *Hydrogeologic Evaluation of the Proposed Broderson Recharge Site, Los Osos, California*, for County of San Luis Obispo (February 26, 1996).

Fugro West, Inc., *Los Osos Sewer Alternative Treatment Facility Sites Constraints Study*, for County of San Luis Obispo (Revised July 5, 1996).

Metcalf & Eddy, *Final Los Osos Wastewater Project Technical Memoranda*, for County Service Area No. 9 (Revised August 30, 1996).

Metcalf & Eddy, *Evaluation of Effluent Disposal at the Proposed Broderson Recharge Site, Los Osos, California*, for County of San Luis Obispo (November 21, 1997).

Solution Group, *Los Osos/Baywood Park Comprehensive Resource Management Plan* (November 24, 1997).

Questa Engineering Corporation, *Comprehensive Comparative Analysis of Alternative Wastewater Treatment Plans for Los Osos, San Luis Obispo County, California*, for California Coastal Commission (May 21, 1998).

County of San Luis Obispo, *Baywood Groundwater Study, Fourth Quarter 1998* (January 21, 1999).

Cleath & Associates, *Peer Review of Metcalf & Eddy Dry Well Disposal Study Draft Report, Broderson Recharge Site, Los Osos, California* (June 3, 1999).

Oswald Engineering, Inc., *Los Osos Community Facilities District Wastewater Facilities Project, Draft Project Report*, for Los Osos Community Services District (January 31, 2000).

CFS Geotechnical Consultants, *Geotechnical Study, Los Osos Wastewater Project, Los Osos, California*, for Los Osos Community Services District (June 19, 2000).

Cleath & Associates, *Hydrogeologic Investigation of the Broderson Site*, for Los Osos Community Services District (July 2000).

Cleath & Associates, *Wastewater Issues Evaluation, Los Osos*, for Los Osos Community Services District (November 3, 2000).

Cleath & Associates, *Hydrogeologic Investigation of the Broderson Site, Phase 2 – Impacts Assessment*, for Los Osos Community Services District (November 2000).

Crawford Multari & Clark, *Draft Environmental Impact Report for the Los Osos Community Services District Wastewater Facilities Project*, State Clearinghouse No. 9911103 (November 2000).

Crawford Multari & Clark, *Final Environmental Impact Report for the Los Osos Community Services District Wastewater Facilities Project*, State Clearinghouse No. 9911103 (March 1, 2001).

Montgomery Watson, *Wastewater Facilities Project, Final Project Report*, for Los Osos Community Services District (March 7, 2001).

Cleath & Associates, *Wastewater Disposal Sites Evaluation*, for Los Osos Community Services District (October 2001).

Cleath & Associates, *Nitrate Monitoring Program Design*, for Los Osos Community Services District (January 2002).

Montgomery Watson Harza, *Report of Waste Discharge for the Los Osos Wastewater Project*, for Los Osos Community Services District (June 28, 2002).

Cleath & Associates, *Los Osos Nitrate Monitoring Program, June-July 2002 Ground Water Monitoring*, for Los Osos Community Services District (November 2002).

Rincon Consultants, Inc., *Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring Report*, for County of San Luis Obispo (February 20, 2014).

[This page intentionally blank]