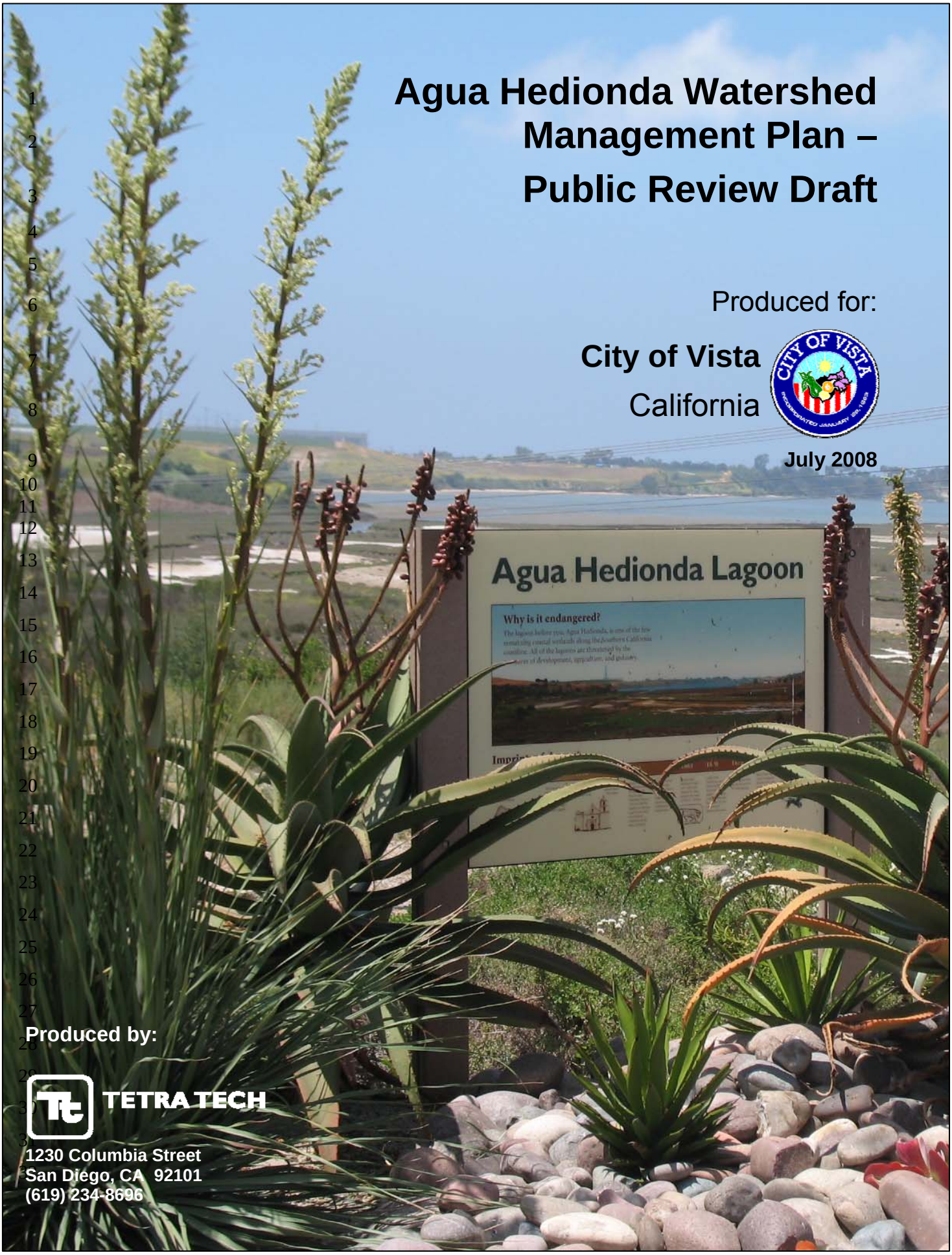
Agua Hedionda Watershed Management Plan – Public Review Draft

Produced for:

City of Vista

California

July 2008



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Acronyms

ACOE – Army Corps of Engineers
BIA – Building Industry Association
BMP – Best Management Practice
CDFG – California Department of Fish and Game
CEQA – California Environmental Quality Act
CRAM – California Rapid Assessment Method
DEM – Digital Elevation Model
DWR – California Department of Water Resources
EDD – Extended Dry Detention
EMCs – event mean concentrations
HMPs – Habitat Management Plans
IRWMP – Integrated Regional Water Management Plan
LID – Low Impact Development
LSPC – Loading Simulation Program C++
JURMPs – Jurisdictional Urban Runoff Management Programs
MLPA – 1999 Marine Life Protection Act
MM – Management Measures
MP – Management Practices
MPA – Marine Protected Area
NEPA – National Environmental Policy Act
NGOs – Non-governmental Organizations
PAMA – Pre-approved Mitigation Areas
SANDAG – San Diego Area Council of Governments
SDG&E – San Diego Gas & Electric
SDRWQCB – San Diego Regional Water Quality Board
SELC – San Elijo Lagoon Conservancy
SET – Site Evaluation Tool
SSO – Sanitary Sewer Overflows
TAC – Technical Advisory Committee
TMDL – Total Maximum Daily Loads
TSS – Total Suspended Solids
USEPA – U.S. Environmental Protection Agency

WDRs – Waste Discharge Requirements

WMP – Watershed Management Plan

WPG – Watershed Planning Group

Executive Summary

[To be included in final version.]

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1 Introduction

The Agua Hedionda Watershed Management Plan (WMP) provides a comprehensive, scientifically-based plan for preserving, restoring, and enhancing the Agua Hedionda watershed's natural functions and features. The WMP assesses past, present, and future watershed conditions and identifies management needs throughout the watershed, considering the complex relationships among different watershed processes. Governments, organizations, citizens, and other interested stakeholders were involved throughout the planning process to ensure that the WMP reflects local management needs and priorities. As the watershed faces additional stress from development, the WMP will provide a foundation for successfully addressing both past and future degradation, and as further watershed-related regulations are adopted, the WMP can be used to guide decision makers towards the most beneficial management practices for the watershed.

The Agua Hedionda watershed is located in southern California, about 35 miles north of downtown San Diego. The watershed drains about 30 square miles of land and includes portions of four municipalities -- Carlsbad, Vista, Oceanside, and San Marcos -- as well as area in the unincorporated portions of the County of San Diego. The Agua Hedionda Creek headwaters begin in the San Marcos Mountains in west central San Diego county. Agua Hedionda Creek flows into the Agua Hedionda Lagoon, which discharges into the Pacific Ocean. While a few natural and agricultural areas remain, urban development characterizes much of the watershed.

Prior to the inception of this plan, the Agua Hedionda watershed had experienced significant signs of degradation. Fallen trees in stream channels were among the most evident signs that rapid urban growth was severely impacting stream channel stability. Monitoring indicated that water quality in the streams had significantly degraded. To address these and other concerns, the City of Vista, in cooperation with the Carlsbad Watershed Network, received a grant from the State Water Resources Control Board to develop a plan to manage and restore the watershed. The purpose of the Agua Hedionda Watershed Management Plan (WMP) is to provide a comprehensive plan to restore watershed functions and minimize future degradation.

The Agua Hedionda WMP was developed using a multifaceted approach, which integrated stakeholder involvement, science, engineering, accountability methods, and feasibility evaluation. Development of this plan included several types of public participation. A watershed coordinator was hired to coordinate the public outreach. The Watershed Planning Group (WPG) – with representations from local and state governments, federal agencies, environmental organizations, and local citizens – was formed to provide input and make recommendations throughout development of the management plan. The Technical Advisory Committee (TAC) helped establish assumptions for future land use conditions, comment on draft findings, screen candidate Best Management Practices (BMPs) and Low Impact Development (LID) scenarios to evaluate in more detail, and provide input on candidate sites for stream restoration, BMP retrofits, and land acquisition. Outreach meetings were held with local governments, and project reports were posted on a project website to provide wider public access to materials.

Early in the process, Tetra Tech worked with the WPG to develop the following goals for the plan:

1. Design land use and infrastructure so as to minimize impacts on the watershed.
2. Protect, restore and enhance habitat in the watershed.
3. Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts.
4. Support compliance with regional, state, and federal regulatory requirements.

5. Increase awareness and stewardship within the watershed, including encouraging policy makers to develop policies that support a healthy watershed.

Following the WPG's initial meetings, Tetra Tech conducted field reconnaissance, stream characterization, geomorphic analysis, data analysis, and watershed modeling to assess the current and future conditions in the watershed. Preliminary indicators were selected to measure the achievement of the goals and objectives. Then, the WPG finalized its goals, objectives, and indicators, and Tetra Tech used these indicators to identify management opportunities that would best achieve the WPG's goals and objectives. Tetra Tech produced the following reports that document these assessments in detail:

- Water Quality Analysis and Recommendations Report (Tetra Tech, 2007)
- Watershed Acquisition and Restoration Opportunity Report (Tetra Tech, 2008a)
- Watershed Modeling and Geomorphic Analysis Report (Tetra Tech, 2008b)
- Bioengineering Management and Implementation Report (Tetra Tech, 2008c)

These reports are available from the WMP website (http://www.carlsbadwatershednetwork.org/AH-WMP.html) or through the City of Vista.

Rather than duplicate this documentation, the WMP draws upon the conclusions of these reports to recommend an approach for addressing priority watershed issues and achieving the WPG's goals. The Management Opportunity Database, a spreadsheet tool, will be provided to decision makers that contains ownership information for all parcel or site-based opportunities.

The recommendations of the Agua Hedionda WMP represent a geographically focused, comprehensive watershed planning effort. The plan considers existing and future resource conditions, key watershed processes, and priority watershed issues. Current regulations and other policies are evaluated as potential building blocks for the plan recommendations. The goals and objectives developed by stakeholders in the WPG form the foundation for the identification of management opportunities. The plan presents management measures for achieving and sustaining measurable water quality improvements and recommends focus areas where opportunities will complement each other and lead to greater functional uplift. Finally, strategies are provided to help facilitate implementation of plan recommendations which include implementation responsibilities and timelines.

2 Watershed Characteristics

2.1 LOCATION AND POPULATION

The Agua Hedionda watershed is located in San Diego County and within the Carlsbad Hydrologic Unit. It is approximately 20,175 acres (31.5 mi^2) and is divided into two subareas: the Buena hydrologic subarea (904.32) in the upper watershed and Los Monos hydrologic subarea (904.31) in the lower watershed (Figure 2-1). The watershed includes portions of four municipalities, Carlsbad, Vista, Oceanside, and San Marcos, as well as area in the unincorporated portions of the County of San Diego. These different jurisdictions are estimated to have a total population of about 65,000 people living in the watershed (CWN, 2008).

The watershed contains approximately 37 linear miles of stream including Agua Hedionda, Roman, Little Encinas, La Mirada, Calavera, and Buena creeks and several unnamed tributaries. It also includes three significant standing bodies of water: the Agua Hedionda Lagoon, Lake Calavera, and Maerkle Reservoir (a covered water storage facility). Major transportation corridors include Interstate 5, State Route 78, the Pacific Coast Highway, and the Santa Fe Railroad.

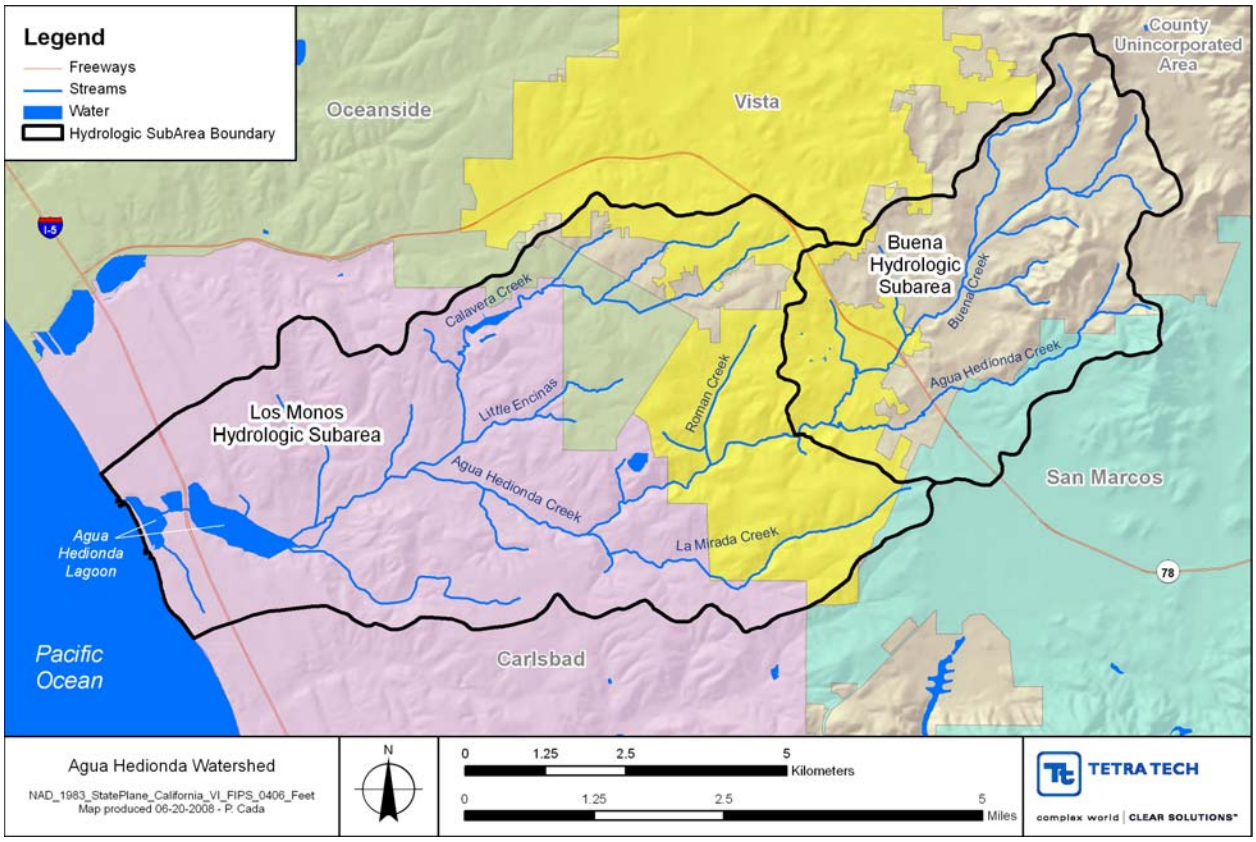

Figure 2-1. Agua Hedionda Watershed

2.2 SUBWATERSHEDS

The Agua Hedionda watershed was divided into smaller units, or subwatersheds, to provide a common basis for assessment and management recommendations. The subwatershed delineation for Agua Hedionda is derived from a 10-meter resolution digital elevation model (DEM) from the National Elevation Dataset. Boundaries were modified using the municipal storm sewer networks, 2-foot contour topography layers, and aerial images. Accordingly, 29 subwatersheds (not including the "beach" watershed, model ID 999) were delineated with an average size of 1.1 mi^2 covering a total area of 31 mi^2 (Figure 2-2).

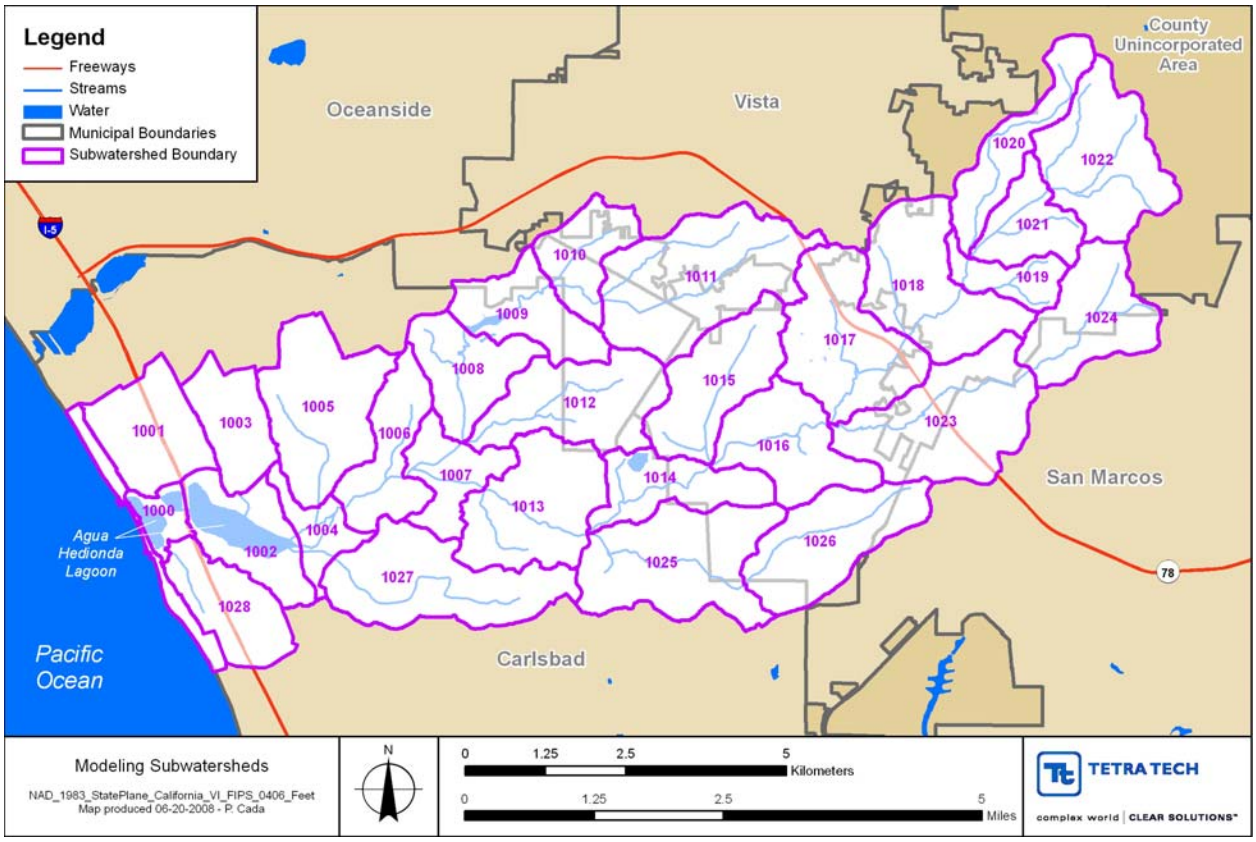

Figure 2-2. Map of Agua Hedionda Model Subwatersheds

2.3 Land Use and Land Cover (Existing and Future)

2.3.1 Land Use

It is well known that land use can be a major force behind watershed health and degradation. In most cases, land development will increase the volume, frequency and magnitude of runoff within the watershed thus leading to increased pollutant loads and physical impacts to stream channels. Therefore, considering existing and future land use patterns within the watershed is an integral part of a watershed management plan.

Current (defined as year 2007) and planned land use (defined as year 2030) information was obtained from the San Diego Area Council of Governments (SANDAG). SANDAG has updated the land use layers continuously since 2000 using aerial photography, the County Assessor Master Property Records file, and other ancillary information. The planned land use data were derived from the Series 11 Regional Growth Forecast using each municipality's master development plans. Since each jurisdiction has their own individualized way of categorizing their future land use designations, an aggregate planned land use code was devised.

Both SANDAG GIS coverages were modified using GIS parcel data to allow for a finer resolution of residential categories based on lot size. Additionally, future land use was modified based on feedback from municipalities on expected changes in under- and un-developed land uses from the existing (2007)

condition. SANDAG classifications were grouped into a smaller number of categories for subsequent modeling applications (Tetra Tech, 2008b).

In 2007, residential areas covered nearly as much area in the watershed (34 percent) as the categories of agriculture and open spaces (38 percent) combined (Table 2-1). By this time residential developments had spread into the central and upper watershed, bringing human influences into closer contact with streams and displacing agriculture and open spaces (Figure 2-3). In fact, agricultural lands had already decreased 55 percent since 1986 levels (Tetra Tech, 2007). And most of the areas categorized as "transitional" before 2007 had been developed into residential and industrial spaces.

As noted in the 2030 Regional Growth Forecast for the San Diego Region (SANDAG, 2005), the watershed is intended to become primarily residential (46 percent total, with 32 percent as Very Low-, Low-, Medium-Density Residential and Single Family Multiple Units, and 14 percent considered Multiple Family/High Density Residential), warehouse, industrial and transportation (22 percent), and open space (19 percent) (Table 2-1). Nearly all current agricultural land is planned for development, while it is projected that open space will be reduced 33 percent from 2007 levels (Figure 2-4). Although the land use plans have provided for open space buffers along much of the streams in the lower portion of the watershed, the vast majority of the upper watershed shows development adjacent to stream corridors.

Table 2-1. Percent of Watershed for Each Land Use Class in 2007 and 2030

LULC Description	Area – 2007 (%)	Area – 2030 (%)
Agriculture	8%	0%
Heavy Commercial	1%	3%
High Density Residential	8%	8%
Low Density Residential	6%	10%
Lt. Commercial/Office/Institutional	4%	5%
Medium Density Residential	5%	12%
Multi-Family Residential	4%	6%
Open Space	29%	19%
Open/Recreation	1%	2%
Parks/Recreation	2%	2%
Single Family Multiple Units	2%	2%
Transitional	0%	0%
Very Low Density Residential	9%	8%
Warehouse/Industrial/Transportation	20%	22%
Water	2%	2%

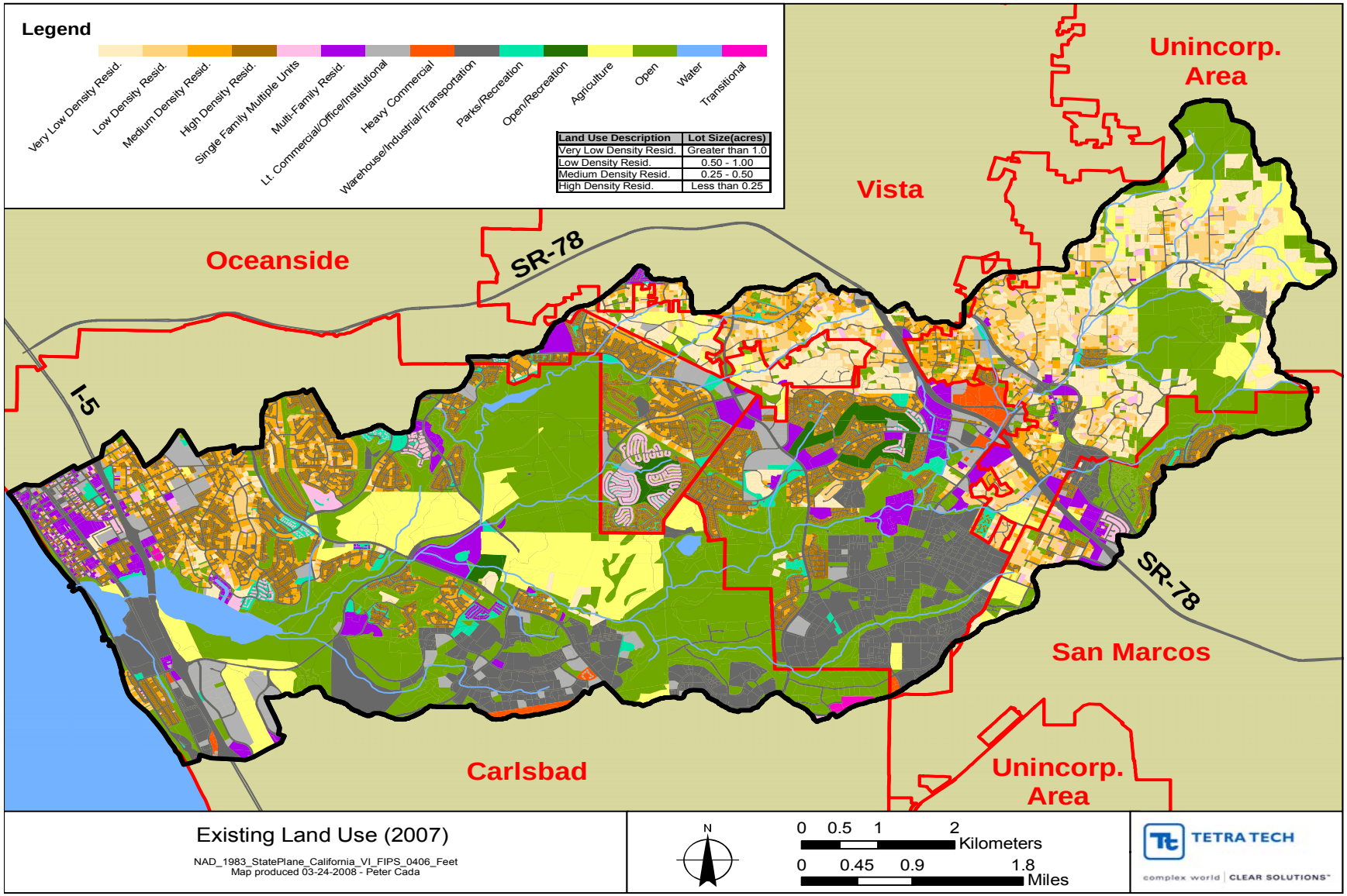

Figure 2-3. Existing (2007) Land Use in the Agua Hedionda Watershed

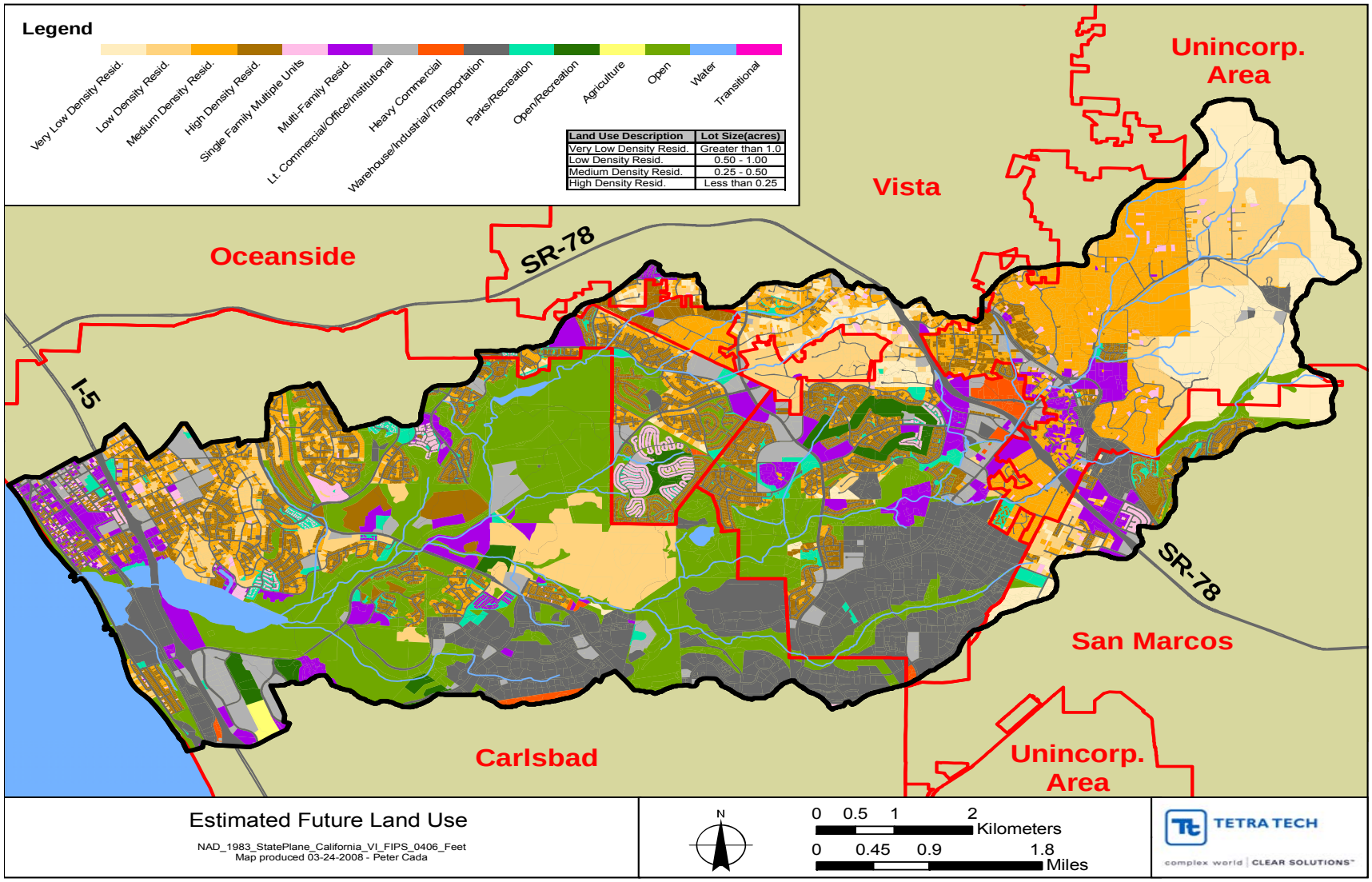

Figure 2-4. Estimated Future (2030) Land Use in the Agua Hedionda Watershed

2.3.2 Impervious Surfaces

Urbanization can have profound influences on watershed health. As land is converted to rooftops, roads, and parking lots, impervious surface area increases leading to increased storm runoff while less surface water is able to infiltrate. These increases in impervious surface lead to greater volume, frequency and magnitude of runoff within the watershed. The Center for Watershed Protection Impervious Cover Model (CWP, 2007a) indicates that certain zones of stream quality exist, most notably at about 10 percent impervious cover, where sensitive stream elements (e.g., sensitive aquatic species, excellent habitat structure, and excellent water quality) begin to become lost from the system. A second threshold appears to exist at around 25 to 30 percent impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores). However, these categories are based heavily upon mid-Atlantic and Puget Sound research and may be less applicable to Southern California watersheds.

The 2001 National Land Cover Data (30-meter resolution) was used to assess trends in imperviousness throughout the watershed. The watershed upstream of the lagoon has an average imperviousness of about 29 percent (32 percent if measuring from the lagoon outlet).[1] The upper portion of the watershed generally has a lower percentage of impervious surfaces than the lower watershed. Pockets of low imperviousness are present in the central watershed, especially along Little Encinas Creek (Figure 2-5). The intensely developed areas just to the north and south of the Agua Hedionda lagoon (Subwatersheds #1001 and #1028) have percentages well above 50 percent (Figure 2-5).

It is important to note that conditions within a stream segment are influenced by the entire upstream contributing area. The stress on any particular reach is a result of cumulative imperviousness and associated runoff upstream of that reach. Headwaters subwatersheds with relatively high imperviousness may not exhibit as severe stream impacts as downstream subwatersheds that have a higher cumulative imperviousness. Even subwatersheds that have relatively low imperviousness within the immediate subwatershed area may experience severe impacts from upstream subwatersheds with high cumulative imperviousness.

[1] In the main stem of Agua Hedionda Creek in particular, NLCD impervious data is based on reflectance. In Southern California, it appears to count beaches and other sandy areas as impervious surfaces (which they are not). Undeveloped areas also have dispersed, bare rock. This is naturally disconnected land and should not be considered impervious. Therefore, this data may overestimate imperviousness in some parts of the watershed, particularly in less developed portions.

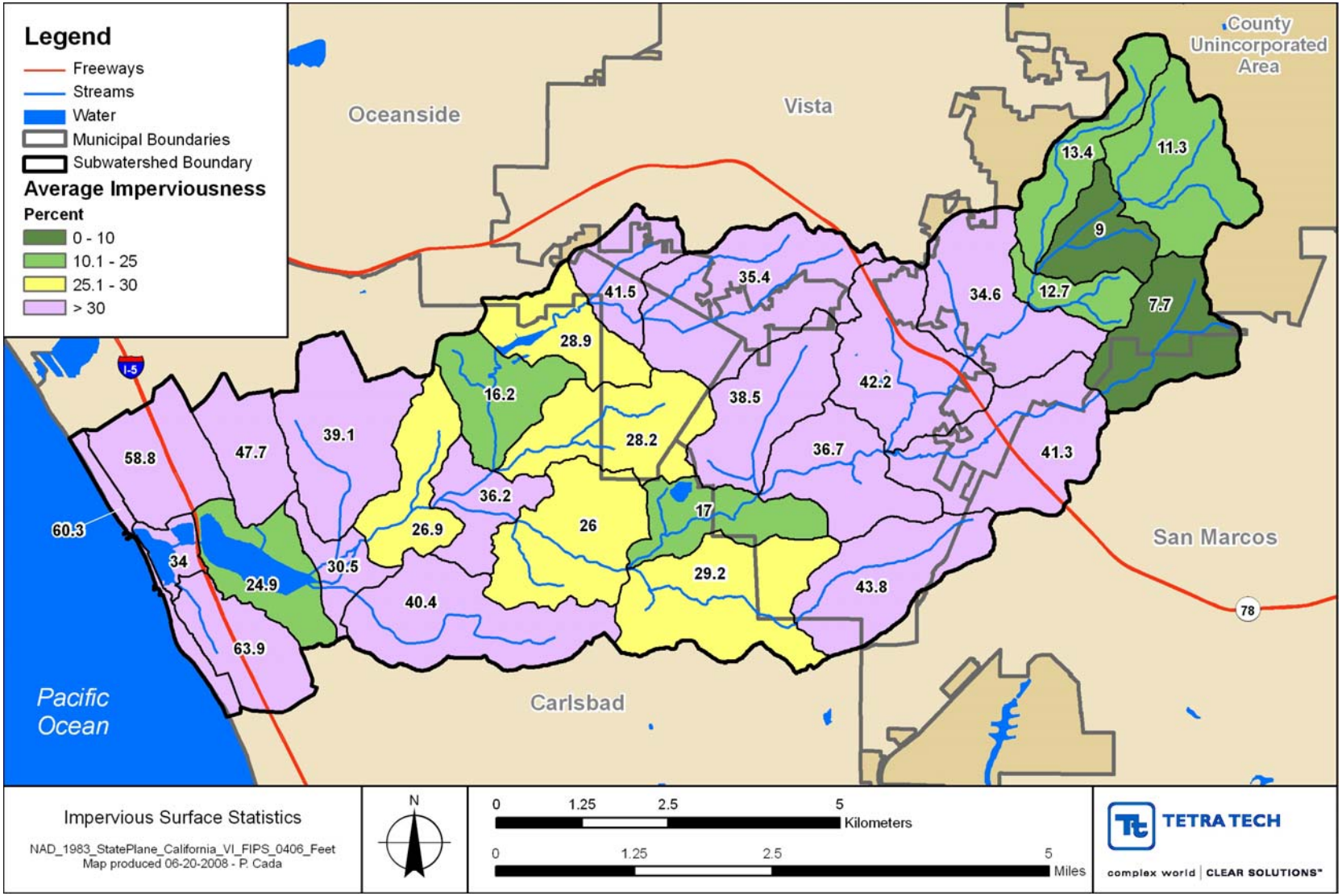

Figure 2-5. Percent Impervious Surface Cover for Each Subwatershed

3 Assessment and Planning Approach

3.1 Mission, Goals, and Objectives

To develop the Agua Hedionda WMP, Tetra Tech worked with the City of Vista using a multifaceted approach, which integrated stakeholder involvement, science, engineering, accountability methods, and feasibility evaluations. Development of this plan included several types of public participation:

- Watershed Planning Group (WPG) – This group was formed to provide input and make recommendations throughout development of the management plan. Membership is comprised of 50 citizens and representative groups or organizations in the watershed that have a stake or interest in the Watershed Management Plan. Ten meetings were held to develop goals and objectives, review and comment on draft findings, and to develop recommendations for the plan. In addition, members of the group were trained and participated in the watershed field reconnaissance and characterization.
- Technical Advisory Committee (TAC) – This group was comprised of local government technical advisors from planning and engineering departments (Table A-2). The group helped establish assumptions for future land use conditions, comment on draft findings, screen candidate BMPs and LID scenarios to evaluate in more detail, and provide input on, candidate sites for stream restoration, BMP retrofits, and land acquisition.
- Watershed Coordinator – The watershed coordinator solicited, assembled and managed the project stakeholders to maximize their input to the WMP development. This important role maintained the continuity and focus of the various stakeholders, the project team and the funding agency.
- Outreach meetings – Meetings were held with local jurisdictions, agencies and stakeholders, including the Cities of Carlsbad and Vista Engineering and Planning Departments, County of San Diego Department of Land Use Planning, California Department of Fish and Game, the US Fish and Wildlife Service, California Coastal Commission, California State Lands Commission, Carlsbad Watershed Network, and Agua Hedionda Lagoon Foundation, Poseidon Resources, and Cabrillo Power II.
- Web Distribution – Project information and reports were posted on a project website to provide wider public access to materials produced by the process. (http://www.carlsbadwatershednetwork.org/AH-WMP.html)

At its initial meeting, the WPG discussed issues that the plan should address and drafted preliminary Mission, Goals and Objectives. After Tetra Tech reviewed existing studies and water quality data and evaluated the future conditions highlighted in Section 2, the Goals and Objectives were refined by the WPG. The Goals and Objectives (Table 3-1) are a critical part of the watershed management plan providing the basis for determining what issues need to be managed and how they should be addressed.

Table 3-1. Mission, Goals, and Objectives

Mission Statement
Preserve, restore and enhance the watershed's natural functions and features.
Goals and Objectives
1. Design land use and infrastructure so as to minimize impacts on the watershed.
a) Design and construct infrastructure projects (e.g., sewer lines) in a manner that minimizes impacts on watershed functions (i.e., water quality, habitat, and hydrology).
b) Design and construct new developments, recreation areas, etc., in a manner that minimizes impacts on watershed functions, including minimizing impervious areas.
2. Protect, restore and enhance habitat in the watershed.
a) Protect and expand undeveloped natural areas to protect habitat.
b) Protect, enhance, and restore terrestrial habitat, especially existing vegetation in riparian areas.
c) Provide riparian habitat to improve and maintain wildlife habitat.
d) Provide natural area connectivity to improve and maintain wildlife habitat.
e) Maintain stable streambanks and riparian areas to protect instream aquatic habitat and mature trees.
f) Maintain and protect instream habitat to support native aquatic biology.
g) Maintain and protect lagoon habitat.
***3. Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts*.**
a) Restore and protect beneficial watershed functions and uses including
▪ Wildlife habitat
▪ Recreation
▪ Protection from flood damage
b) Design and construct restoration projects to minimize impacts to
▪ Streambanks
▪ Riparian areas
▪ Wildlife habitat areas
***4. Support compliance with regional, state, and federal regulatory requirements*. (While there are many regulatory requirements, several compliance issues are key to addressing existing impacts and mitigating impacts from future development, as follows.)**
a) The San Diego Regional Water Quality Control Board has listed Aqua Hedionda Creek, Buena Creek, and Agua Hedionda Lagoon as impaired and not supporting designated beneficial uses under the Clean Water Act Section 303(d). Future compliance includes
▪ Meeting water quality standards for Total Dissolved Solids, Manganese, Selenium, and Sulfates for Aqua Hedionda Creek;
▪ Meeting water quality standards for DDT, Nitrate-Nitrite, and phosphate for Buena Creek.
▪ Meeting water quality standards for sediment and bacteria in Agua Hedionda lagoon.

b) The San Diego Regional Water Quality Control Board and local governments in the watershed have stormwater management requirements for controlling sedimentation and erosion during construction. Future compliance will require adequate inspection and enforcement.
c) The San Diego Regional Water Quality Control Board and local governments in the watershed have LID and stormwater management requirements to control post-construction runoff from new development. Compliance will require plan review, site inspection, and long-term BMP inspection and maintenance to ensure BMP requirements are being met.
d) Reduce non-compliance events for water quality objectives and sedimentation and erosion control.
5. Increase awareness and stewardship within the watershed, including encouraging policymakers to develop policies that support a healthy watershed. **This includes minimizing impervious area and providing for stream buffers.**
a) Form collaborative Agua Hedionda Watershed Council to sustain long-term watershed management.
▪ Determine the most appropriate organization and venue for Council.
▪ Hire part- or full-time Watershed Coordinator.
▪ Gain support from local political and business leaders.
▪ Obtain long-term governance and funding for Watershed Coordinator and Council support.
b) Support adoption and implementation of the Watershed Management Plan as well as ordinances, regulations, policies, and procedures by local jurisdictions, agencies, and environmental conservation organizations.
c) Disseminate information to local governments to support scientifically based, sound decision-making.
d) Develop a consistent and comprehensive message for watershed health and actions citizens can take. Distribute through website, water bills, press releases, brochures, and presentations.
e) Encourage Low Impact Development (LID) at the new development, redevelopment and individual homeowner and project level.
f) Reward good stewardship though an awards program that recognizes project sponsors that implement programs that preserve and enhance watershed health.
g) Develop partnerships with business, residents, NGOs, Cities, the County, Agencies, schools and private entities throughout the watershed to leverage opportunities for watershed stewardship.

3.2 ESTABLISHING INDICATORS AND ASSESSMENT TOOLS

Indicators are measurable or predictable quantities that can be used to measure the current health of the watershed and to track progress toward meeting watershed goals and objectives. Indicators can be linked to the natural resource or to program actions. Example natural resource indicators for the objectives listed above might include benthic community, channel morphology, and riparian habitat (e.g., as defined by percent undisturbed forest within the 100-year floodplain). Example programmatic tracking indicators include the number of local governments adopting the WMP or the number of presentations made to local

governments on WMP findings. Often, there are multiple indicators associated with a given objective. Since it is important to evaluate existing conditions as well as predict future conditions, some selected indicators reflect parameters that can be or have been observed in the field (called observed indicators), other selected indicators reflect parameters that can be used in modeling to compare current and future conditions (called predictive indicators), while other indicators are used to track progress in meeting goals and objectives during plan implementation (called tracking indicators). Indicators were established so that appropriate tools and methods could be selected to support detailed watershed assessment and planning. To be capable of evaluating how indicators respond to different management actions, Tetra Tech developed different assessment tools, including a watershed model, a site-evaluation model, and GIS analysis. Table 3-2, Table 3-3, and Table 3-4 summarize the indicators selected, how they are linked to the management objectives, and the assessment tools used.

Table 3-2. Infrastructure/Development Management Indicators

Indicator	Linked to Objectives	Assessment Tools/Methods
Water Quality (Modeling of Future Conditions): Relative nutrient, upland sediment, and bacteria loading	1a, 1b	Watershed Model
Water Quality (Observed/measured): Instream – Copper, Turbidity, Total Dissolved Solids, Total Suspended Solids, Total Phosphorus, Total Nitrogen, Enterococcus, Fecal Coliform, Pesticides: DDT, diazinon, chlorphyrifos Lagoon – Total Suspended Solids, Turbidity, Total Phosphorus, Total Nitrogen, Enterococcus, and Fecal Coliform	1a, 1b	N/A (This is a future tracking indicator for use during plan implementation.)
Aquatic Habitat (IBI ratings, benthic bioclass, aquatic habitat index)	1a, 1b	Data Analysis
Existing native riparian habitat extent and connectivity (percent land cover)	1a, 1b	GIS Analysis
Stream stability	1a, 1b	Field Reconnaissance Watershed Model
Frequency, magnitude, and duration of extreme high flows	1a, 1b	Watershed Model
Flood elevation	1a, 1b	N/A (This is a future tracking indicator for use during plan implementation.)
Constraints to restoration (qualitative)	1a	Field Reconnaissance GIS Analysis
Planned road/bridge/culvert construction projects	1a	N/A (This is a future tracking indicator for use during plan implementation.)

Indicator	Linked to Objectives	Assessment Tools/Methods
Planned utility expansion	1a	N/A (This is a future tracking indicator for use during plan implementation.)
Percent imperviousness	1b	GIS Analysis Watershed Model
Percent of development with LID controls	1b	N/A (This is a future tracking indicator for use during plan implementation.)
Percent of development controlled by BMPs	1b	N/A (This is a future tracking indicator for use during plan implementation.)

[1] Percent land cover can be used as an approximate measure of connectivity; however, true connectivity would be verified through visual assessment of the GIS data.

[2] San Elijo Lagoon Conservancy

Table 3-3. Habitat Management Indicators

Indicator	Linked to Objectives	Assessment Tools/Methods
Percent of the watershed in natural area 2007 Percent change in watershed natural area: Tracking indicator for plan implementation.	All	GIS Analysis
Existing terrestrial habitat extent and connectivity (percent land cover)	All	GIS Analysis
Invasive species extent and status of treatment	2a through 2d	GIS Analysis
Existing riparian habitat extent and connectivity (percent land cover within 100-year floodplain)	2b, 2c, 2e	GIS Analysis
MSCP and MHCP priority communities extent	All	GIS Analysis
Location of priority tree species (i.e., 100-year oaks) along streams	2e	GIS Analysis
Stream stability	2e	Field Reconnaissance Watershed Model
Frequency, magnitude, and duration of extreme high flows	2e, 2f	Watershed Model
Aquatic Habitat 2007 Aquatic Habitat Future – Tracking for plan implementation	2e, 2f	Field Reconnaissance

Indicator	Linked to Objectives	Assessment Tools/Methods
Aquatic Biodiversity 2007 Aquatic Biodiversity Future – Tracking for plan implementation	2f	GIS Analysis Data Analysis
Lagoon Habitat Quality 2007 Lagoon Habitat Quality – Tracking for plan implementation	2g	GIS Analysis Data Analysis
Unprotected terrestrial habitat extent and connectivity (percent land cover)	All	GIS Analysis
Unprotected riparian habitat extent and connectivity (percent land cover within 100-year floodplain)	All	GIS Analysis
MSCP and MHCP priority communities extent on unprotected land or near unprotected land	All	GIS Analysis

[1] Percent land cover can be used as an approximate measure of connectivity; however, true connectivity would be verified through visual assessment of the GIS data.

[2] San Elijo Lagoon Conservancy

[3] San Diego Multiple Species Conservation Program

[4] This will require an assessment of field observations and spatial data to determine the portions of the lagoon to be targeted for improved protection and maintenance. Indicators would include natural vegetation, wetland vegetation, invasive species, and water quality parameters. An assessment of available data should be undertaken before the indicators are finalized.

Table 3-4. Restoration Management Indicators

Indicator	Linked to Objectives	Assessment Tools/Methods
Goal #2 Habitat Indicators	3a, 3b	GIS Analysis
Existing recreation areas, including trails and natural areas (location, use, potential future impacts)	3a	N/A (This is a future tracking indicator for use during plan implementation.)
Degree of flood control within reach	3a	N/A (This is a future tracking indicator for use during plan implementation.)

These indicators and assessment tools were used to evaluate existing conditions, predevelopment conditions, future conditions, and Low Impact Development and BMP implementation.

Table 3-5. Stewardship Programmatic Indicators

Indicator	Linked to Objectives	Assessment Tools/Methods
Formation of Agua Hedionda Watershed Council	5a	N/A (This is a future tracking indicator for use during plan implementation.)
Securing funds for and contracting with a Watershed Coordinator	5a	N/A (This is a future tracking indicator for use during plan implementation.)
Number of jurisdictions, agencies and local NGOs to adopt, accept or formally recognize WMP as a decision making tool	5b	N/A (This is a future tracking indicator for use during plan implementation.)
Number of presentations to local government departments and councils or boards regarding WMP findings	5c	N/A (This is a future tracking indicator for use during plan implementation.)
Development of consistent and comprehensive message for watershed health	5d	N/A (This is a future tracking indicator for use during plan implementation.)
Number of website postings, mailers, bill inserts, press releases or brochures distributed	5d	N/A (This is a future tracking indicator for use during plan implementation.)
Number of LID workshops for new development, redevelopment and individual homeowners	5e	N/A (This is a future tracking indicator for use during plan implementation.)
Number of Watershed Steward Awards given to local businesses for implementing pollution reducing practices	5f	N/A (This is a future tracking indicator for use during plan implementation.)
Number of partnerships throughout the watershed that are leveraged to expand stewardship efforts or messages	5g	N/A (This is a future tracking indicator for use during plan implementation.)

3.3 OTHER EVALUATION CRITERIA

An effective watershed management plan requires not only sound scientific and engineering analysis; it also requires cost and feasibility analysis. Therefore, in evaluating different management options, additional evaluation criteria were used such as:

- Meets multiple objectives
- Relative cost

- Stakeholder support
- Site feasibility (e.g., site access, utility constraints, etc.)
- Political feasibility
- Administrative feasibility

These criteria are discussed in more detail in Section 6.

4 Existing and Future Watershed Conditions

4.1 WATER QUALITY CONDITIONS AND TRENDS

4.1.1 Agua Hedionda Water Quality Analysis

The San Diego Regional Water Quality Board (SDRWQCB) has listed Agua Hedionda Creek, Buena Creek, and Agua Hedionda Lagoon as impaired and not supporting designated beneficial uses under the Clean Water Act Section 303(d). Portions of the Agua Hedionda Creek are impaired for total dissolved solids (TDS), manganese, selenium, and sulfates. Buena Creek is listed for DDT, nitrate-nitrite, and phosphate. The lagoon is listed as impaired from excess sediment and bacteria. Though several of the impairments are attributed to unknown sources, the bacterial and sediment-related impairments have been attributed to urban runoff and other nonpoint sources. Sediment nonpoint sources may include natural background sources (i.e., sparse chaparral type cover on undeveloped land), channel erosion, and stormwater runoff from construction, post-construction, and agricultural sites. Bacteria nonpoint sources may include natural background sources, (i.e., wildlife) residential irrigation runoff, septic systems, sanitary sewers, and pet waste. Monitoring is underway to collect sufficient data to develop Total Maximum Daily Loads (TMDLs) for these waterbodies under a separate project.

A general watershed characterization and review of existing data was conducted using available regional and local datasets and previous assessment reports (Tetra Tech, 2007). The review described both spatial and temporal trends in the watershed to evaluate current water quality conditions and provide recommendations to best meet existing and future regulatory, planning and monitoring needs.

The data review suggested that sediment (TSS and turbidity) and bacteria (coliforms and enterococcus) are the greatest threats to watershed function in the Agua Hedionda watershed. Concentrations of these constituents exceed water quality objectives the majority of the time. Moreover, reports of significant upward trends in TSS, turbidity, and fecal coliform at the wet weather monitoring station suggest the problem is getting worse (Weston, 2007a). Turbidity was higher in the receiving water samples, an expected pattern based on the storm-driven nature of this parameter. Impairment from indicator bacteria such as fecal coliform is, however, both a dry and wet weather problem in the watershed.

While the lack of wet weather monitoring sites inhibits the evaluation of spatial patterns, samples collected as part of the dry weather monitoring (storm drains and instream) show particularly high bacteria levels in La Mirada Creek, which drains commercial development, as well as Calavera Creek upstream of Lake Calavera. High salinity (a parameter closely related to TDS) is also found along Calavera Creek in areas draining residential development, suggesting a human source, although groundwater is likely the chief contributor to TDS levels throughout the watershed.

While nitrogen does not appear to be a significant threat in most of the watershed, the impairment of Buena Creek combined with the significant upward trend of nitrate (Weston, 2007a) suggest that it could become a problem in the future. Phosphorus levels in the watershed are a concern as well: concentrations exceed the Basin Plan WQO and Buena Creek is 303(d)-listed for phosphate. Some potential sources of nutrients throughout the watershed include fertilized lawns, fertilized agricultural fields, and atmospheric deposition. Irrigation return flow during dry weather can transport significant amounts of nutrients, particularly nitrogen, to receiving waters via subsurface flow. During wet weather events, build up of nitrogen and phosphorus on impervious surfaces from atmospheric deposition and other urban activities is available for surface runoff.

There is some evidence to suggest that pesticides are a threat in the watershed; however, toxicity tests have not borne out a persistent impact on the biological community. In addition, Weston (2007a)

observed that the number of pesticide exceedances has decreased since 2002. There is also little indication that metals present a significant problem for aquatic life in the watershed based on an evaluation of metals toxicity.

Given the lack of evidence for widespread and severe toxicity in the watershed, the poor biological community as seen in biotic integrity indices can likely be attributed to habitat degradation from scour during storms and sediment transport from both upland and instream sources.

4.1.2 Watershed Scenario Modeling

To support the development of the WMP, a watershed model using the Loading Simulation Program C++ (LSPC) was developed to provide an evaluation of the differences between past and future pollutant loading conditions relative to existing watershed conditions, and supply additional insights into the potential hydromodification impacts on the physical integrity of stream channels and habitat. LSPC is a continuous watershed model supported by U.S. Environmental Protection Agency (USEPA) and has been used widely throughout Southern California. The watershed model describes hydrology and pollutant loading of TN, TP, sediment, and bacteria (fecal coliform). The model application is documented in Tetra Tech (2008b).

Evaluation of the following indicators under WMP goals 1 and 2 is supported by the modeling analysis: water quality in terms of relative nutrient, upland sediment, and bacteria loading; stream stability; frequency, magnitude, and duration of extreme high stream flows; and percent imperviousness. Analysis of past, present, and future scenarios is used to guide identification of current areas of degradation and contributors to impairment as well as potential threats from future development.

Four scenarios were modeled to evaluate past (predevelopment scenario), present (existing scenario) and future (future scenario) conditions in the Agua Hedionda watershed.

1. The **Predevelopment Scenario** models all developed land as open space.
2. The **Existing Scenario** is based on 2007 land use (as of approximately January 1) and contains a representation of BMP treatment for development that has occurred since 2001, as well as a small amount of treatment that occurred before that time.
3. The **Future Scenario with the Future BMP treatment**. This is based on assumptions about planned development through 2030 overlaid with current stormwater control requirements. The Future with BMPs Scenario also contains nearly 1,000 acres of redevelopment and associated new treatment planned for by the City of Vista.
4. The **Future Scenario without the BMP treatment**.

Pollutant loading to the lagoon is a concern due to its impaired status for bacteria and sediment. While this analysis did not provide the EPA-required TMDL (this will occur later in time under another effort), it can provide a relative understanding of current and future conditions. In the analysis, the Future Scenario with Future BMPs Scenario results in loading slightly lower pollutant loads than under the Existing Condition, a desirable result (Table 4-1).

Future development with BMPs as represented in the model is predicted to result in an overall decrease in sediment, bacteria, and nutrient loading to the lagoon due to three factors: (1) preservation of open space, (2) the conversion of agricultural land to residential and non-residential development that is treated by stormwater BMPs, and (3) the redevelopment with associated stormwater BMP treatment of significant portions of the watershed. The modeling results were sensitive to these changes. In particular, if the planned redevelopment does not occur as represented in the model scenarios (e.g., without treatment as required by the 2007 Order), the watershed could be at greater risk of degradation. Further, since the

assimilative capacity of the lagoon has not been determined to date, additional reductions beyond those predicted by this watershed model in the future scenario could be needed.

Table 4-1. Percent Change in Average Annual Loading Relative to the Existing Scenario

Pollutant	Predevelopment	Existing	Future w/o BMPs	Future w/ BMPs
TN	-63%	0%	9%	-6%
TP	-86%	0%	12%	-5%
Fecal	-93%	0%	13%	-12%
Sediment	-11%	0%	7%	-7%

Trends in pollutant loading in the future throughout the watershed are also driven by development of agricultural land and redevelopment. Decreases in loading seen here tend to mask any increases that are derived from the development of open space even though one-third of open space is planned for development. Overall increases in pollutant loading (at least >1 percent) occur in only a few subwatersheds. Most of the area-averaged increases in loading are predicted to occur in the uppermost portion of the watershed; however it is important to note that the upper subwatersheds have a much lower existing level of loading compared to other subwatersheds.

The modeling results were used to select key areas or priority subwatersheds where watershed management and improvement projects can be focused. Eight subwatersheds were selected in the following manner (Figure 4-1). First, subwatersheds that ranked in the highest quartile within each of the selected metrics were selected. Metrics considered were existing unit area loading of fecal coliform, sediment, TN and TP from the watershed model as well as the hydrologic metric, difference between existing and predevelopment T_{Qmean}. The T_{Qmean} metric is the proportion of time that stream flow is above the annual daily-averaged mean level; the difference between the predevelopment and existing scenario values provides an indicator of the impact of urbanization on the flow regime or channel hydromodification. Subwatersheds that occurred in the top quartile of three or more of the selected metrics were considered high priority for management opportunities, most importantly BMP retrofits.

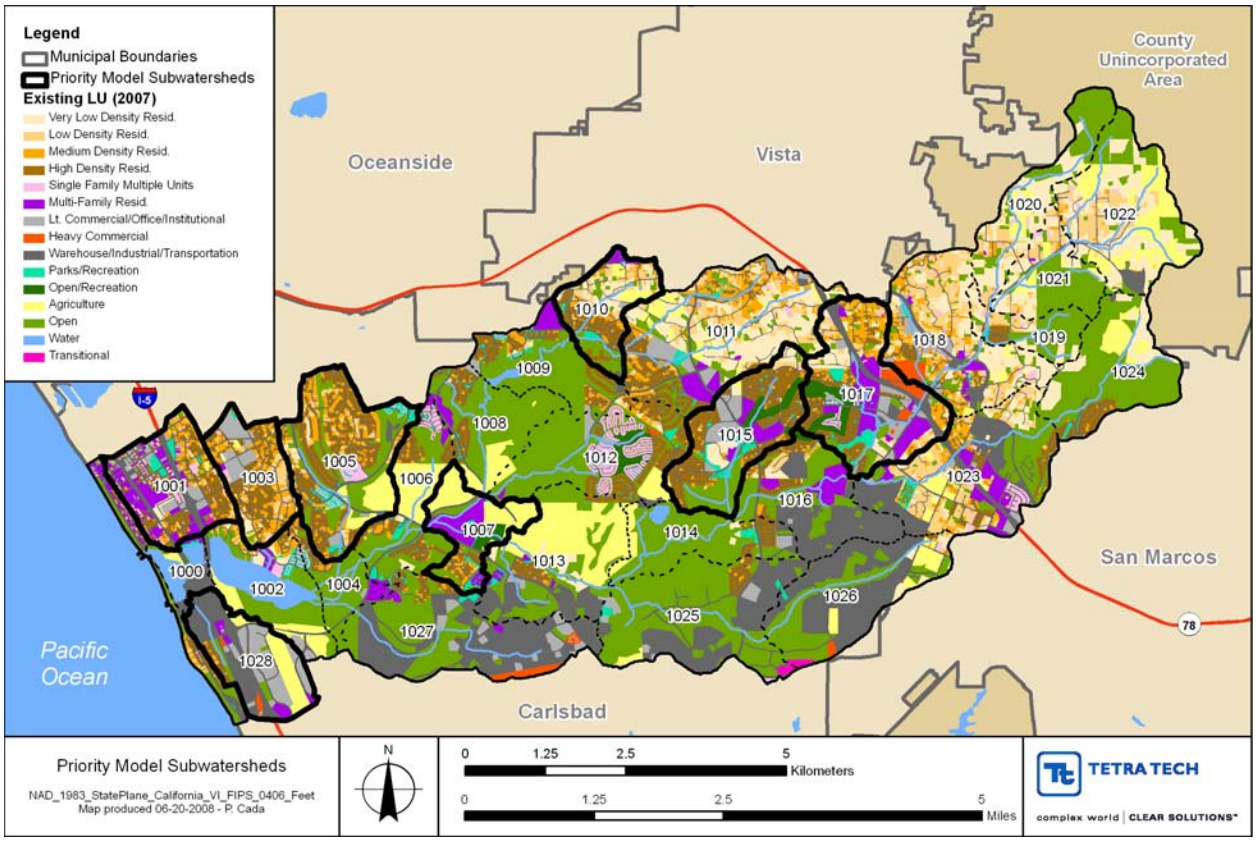

Figure 4-1. Priority Subwatersheds with Highest Existing Runoff Volume and Pollutant Loading

4.2 GEOMORPHOLOGY CONDITIONS AND TRENDS

Geomorphology refers to the study of landforms and the processes that shape them and is particularly relevant to stream functions within the context of a watershed assessment. A geomorphic analysis of stream channels in the Agua Hedionda watershed was conducted to evaluate how geomorphic processes have influenced the existing channels, and to investigate the need for and appropriateness of stream restoration measures. The analysis of the geomorphic condition included two primary components: 1) observations made during a field assessment, and 2) a review of historic data including aerial photography and topographic maps. An evaluation of simulated hydrology from the watershed model supplemented these analyses.

Based on the field assessment, the existing geomorphic condition of stream channels in the Agua Hedionda watershed spans the full range of possibilities. Some reaches do not exhibit instability (e.g., the upper reach of La Mirada Creek and the upper reach of Little Encinas Creek) whereas other reaches are typical of incising and widening reaches (e.g., the upper reach of two headwater tributaries to Buena Creek or the central portion of Agua Hedionda Creek (the latter is shown in Figure 4-2), and the upper reach of Calavera Creek), and some reaches appear to have naturally reached a state of post-disturbance equilibrium (e.g., the upper reach of Agua Hedionda Creek).

Figure 4-2. An Incised and Widening (with recent slumping) Reach of Agua Hedionda Creek

The review of historic data utilized a series of historical aerial photographs for the years 1939, 1963, 1990, and 2002. The available aerial photographs represent conditions that range from relatively sparse development to current levels of development. The historic context provided through the aerial photograph review allows for preliminary assessments of morphologic change due to natural variability versus impacts due to human influence.

In conjunction, the field assessment and aerial photograph analyses revealed that the stability of the channel has been negatively impacted over time at many locations throughout the stream system. The results suggest that channel modification due to past watershed development has occurred in many parts of the watershed. These impacts are most significant over a reach of upper Calavera Creek and much of the lower reaches of Agua Hedionda Creek (Figure 4-3). Other impacted reaches were noted but were not as significant. A combination of stabilization, restoration, and stormwater retrofit practices is needed to address these existing impacts. Planned new development has the potential to further degrade stream channels in the Agua Hedionda watershed, although the impacts can be mitigated to a large extent by existing BMP requirements that address peak flows from future development. The need for additional protection measures should be explored during the development of the San Diego Region Hydromodification Plan.

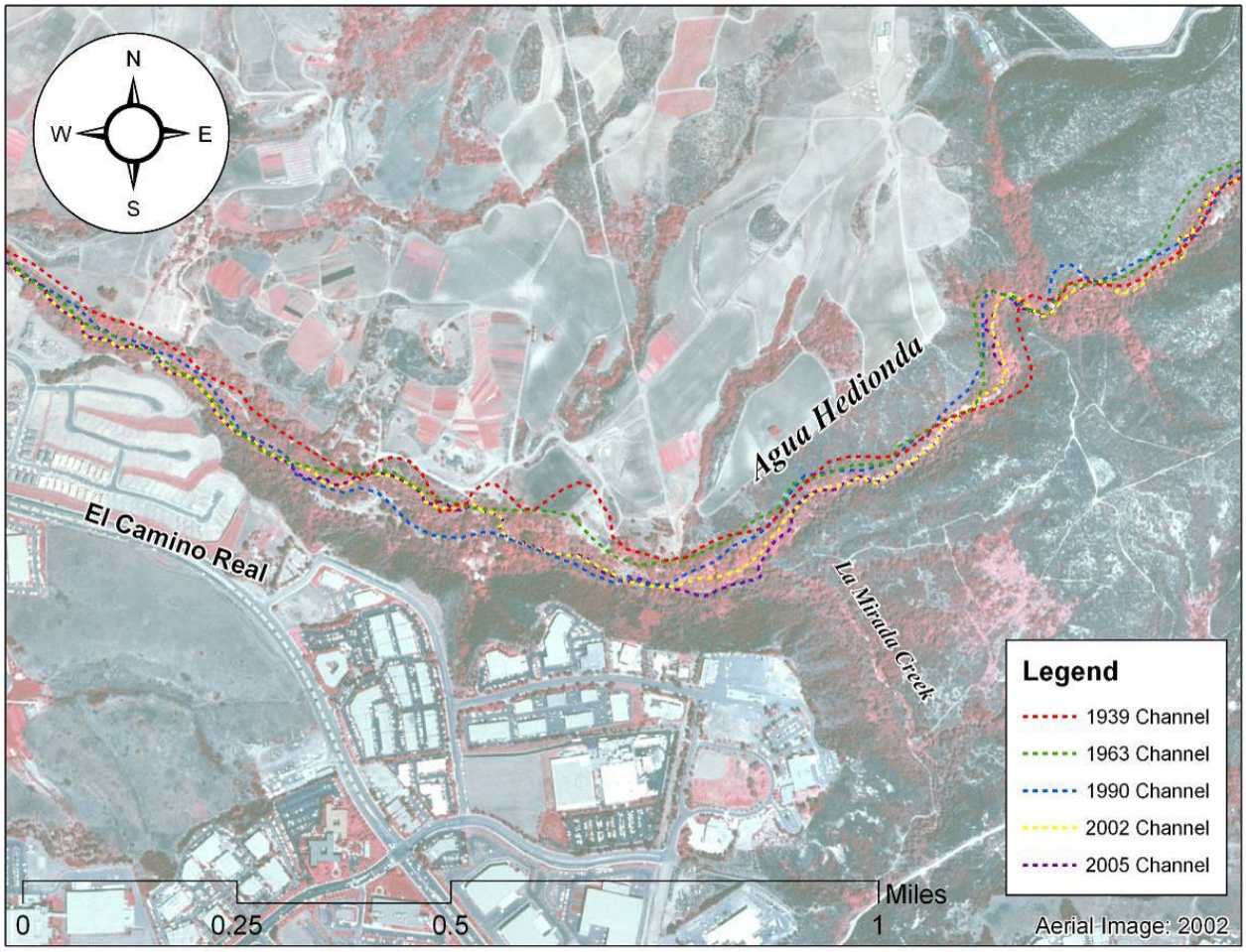

Figure 4-3. Channel Analysis in Lower Agua Hedionda Creek

4.2.1 Comparison with Hydrologic Modeling Results

Hydromodification is a concern in many Southern California watersheds. Hydromodification is the alteration of the natural flow of water through a landscape, and typically takes the form of stream channel modification or channelization. Hydrographs, plots illustrating the magnitude of stream flow during a storm event, were created based on simulation results from the watershed model. These hydrographs provided insight into the potential impact that changes in the rates and volumes of streamflow can have on stream channels. Peak flows under the Future BMP Scenario were reduced to or below Existing levels in nearly every case. However, a focus on the tails of the storm events revealed persistence over time of higher flows in the Future BMPs Scenario. Though its effect in the Agua Hedionda watershed is unclear, this increase in the duration of elevated flows has been associated with a potential for additional stream channel impacts. Studies have indicated that controlling only the peak flow may not be fully protective of stream channels due to an increase in the duration of erosive bankfull and sub-bankfull events (Brown and Caraco, 2001). Attempts to mitigate the problem have often incorporated extended detention and slow release of a channel protection volume. This issue should be explored further during the development of the Hydromodification Plan for the county.

To compare modeling results with the geomorphic analysis, a hydrologic metric, T_{Qmean}, was developed for the predevelopment and existing scenario using the GeoTools package (Raff et al., 2007). The subwatersheds with the least percentage change would be expected to have the least impact on channel

morphology. The geomorphic analysis identified the Upper Agua Hedionda Creek and most of the mainstem of Buena Creek as exhibiting little channel movement over time. These areas correspond well to the subwatersheds with the least change in T_{Qmean} (i.e., the light orange and yellow shaded areas in the upper portion of the watershed shown in Figure 4-4). The impacted reaches on the upper Calavera Creek noted in the geomorphic analysis correspond to subwatersheds with large changes in the metric (c.f. subwatersheds 1011 and 1010 in Figure 4-4). La Mirada Creek is aggrading (accumulating sediment) based on the site evaluation corresponding to a moderate T_{Qmean} difference in the upper drainage area.

Areas where the two lines of evidence, the geomorphic analysis and the model, do not converge are at Little Encinas Creek and Roman Creek. The expected geomorphic impact to Roman Creek based on the difference in T_{Qmean} is not realized, apparently due to the presence of large rock contributing to stability. Field characterization near the outlet of Roman Creek showed a channel that may have been impacted in the past but was equilibrating to watershed conditions.

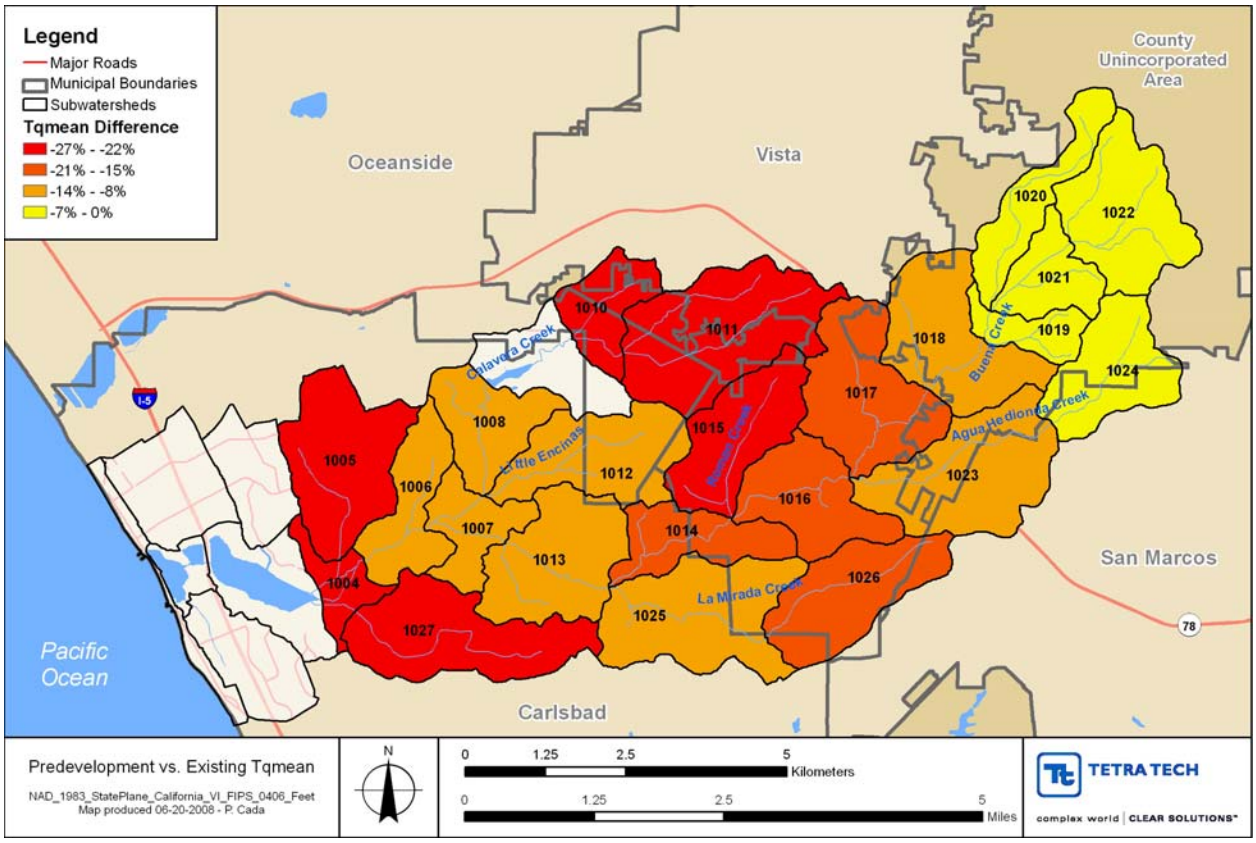

Figure 4-4. Changes in Hydrologic Metric (T_{Qmean}) from Predevelopment to Existing

4.3 CLIMATE CONDITIONS AND TRENDS

Hydrologic conditions in the region, within California, and in the Colorado River basin will likely be altered as a result of global climate change (based on conditions observed over the past century). According to a recent California Department of Water Resources (DWR) report:

> "Climate change may seriously affect the State's water resources. Temperature increases could affect water demand and aquatic ecosystems. Changes in the timing and amount of

precipitation and runoff could occur. Sea level rise could adversely affect the Sacramento-San Joaquin River Delta and coastal areas of the State."

Potential effects of climate change on California's water resources and expected consequences include:

- Reduction of the State's average annual snowpack,
- Changes in the timing, intensity, location, amount, and variability of precipitation,
- Long-term changes in watershed vegetation and increased incidence of wildfires,
- Sea level rise,
- Increased water temperatures, and
- Changes in urban and agricultural water demand. (DWR, 2006)

These consequences could have a significant impact on the Agua Hedionda watershed. More intense coastal storms could magnify the hydromodification effects in the channels causing additional erosion and sedimentation. Rising sea level would inundate existing lagoon saltwater marshes. If land is available along the margins of the lagoon this could represent a shift; however if additional land is not preserved, it may result in a loss of salt marsh habitat. The watershed beaches may also shrink because of rising seas and increased erosion from more intense winter storms. Currently, many beaches are protected from erosion through manmade sand replenishment (or "nourishment") programs, which bring in sand from outside sources to replace the diminishing supply of natural sand (CCCC, 2006).

4.4 HABITAT CONDITIONS AND TRENDS

The Agua Hedionda watershed has experienced an extensive loss of habitat throughout its terrestrial, wetland, and aquatic ecosystems. When vegetation cover was mapped in 1995, about 27 percent of the watershed remained in natural, relatively undisturbed areas. This natural vegetation has decreased since 1995 to about 22 percent of the watershed, and without further habitat protection or restoration, natural area in the watershed is likely to decrease to 12 percent at build-out based on the extent of currently protected natural vegetation in the watershed.[1] The following sections describe the general habitat conditions in the watershed and provide information on lagoon habitat, plant communities, and sensitive species. This information provides the baseline for evaluating management opportunities that can restore, preserve, and enhance habitat for plant and animal species in the watershed.

4.4.1 General Habitat Conditions

This section provides an overview of general habitat conditions in the watershed, and addresses four major habitats: riparian, wetland, aquatic, and upland. Existing habitat connectivity within the watershed is also discussed. All forms of habitat in the watershed not only provide wildlife habitat but also provide watershed and water quality functions that contribute to the overall health of the Agua Hedionda watershed.

A detailed, comprehensive inventory of vegetation communities in the region was last conducted in 1995 by the San Diego Area Council of Governments (SANDAG). Figure 4-5 displays the distribution of major vegetation classifications within the watershed (SANDAG, 1995). Although most of the watershed

[1] Local and regional governments are currently preparing habitat management plans that may protect additional land once enacted.

is classified as non-native vegetation, unvegetated land, or developed land, significant areas of scrub/chaparral and herbaceous communities are present (Table 4-2).

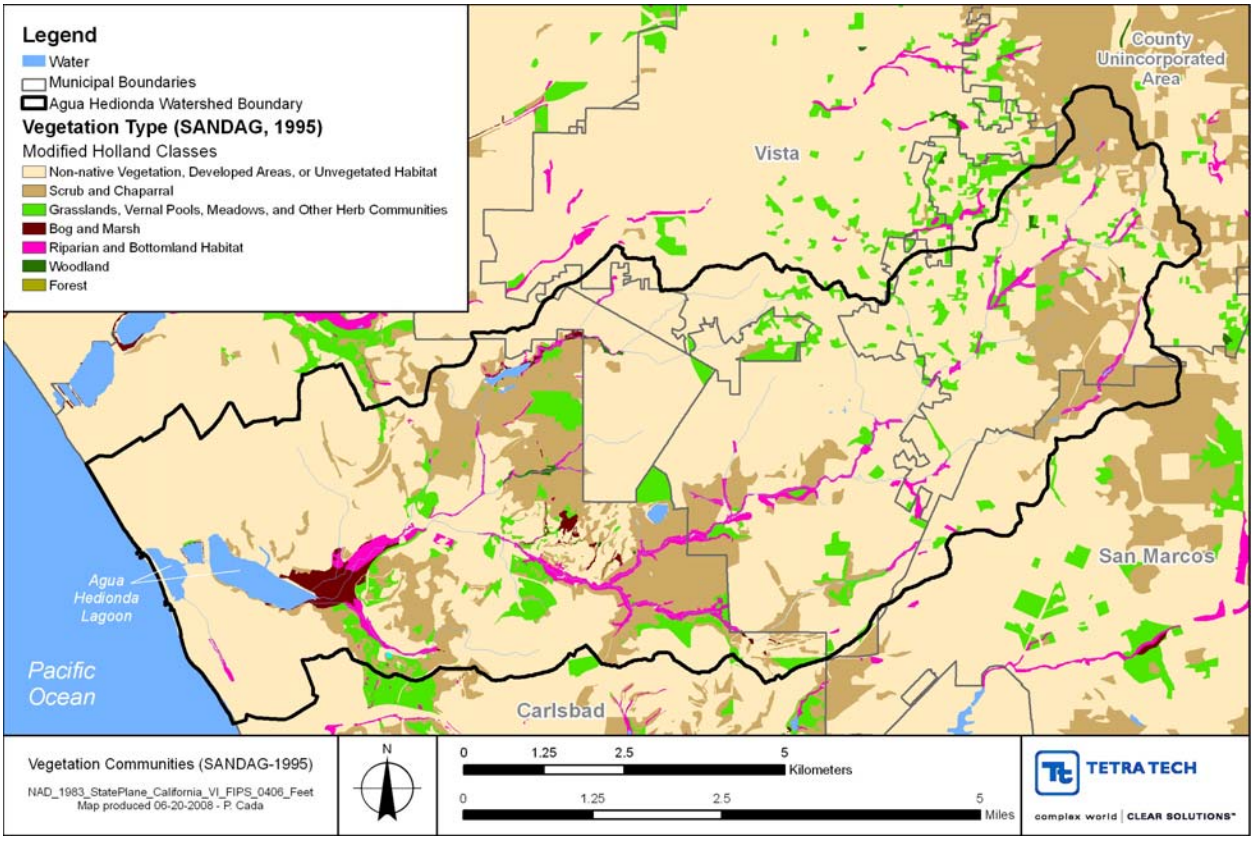

Figure 4-5. Vegetation Communities Available in the Watershed

Table 4-2. Vegetation Community Types in Agua Hedionda Watershed

Vegetation Community	Acreage
Non-native Vegetation, Developed Areas, or Unvegetated Habitat	14,100
Scrub and Chaparral	3,800
Grasslands, Meadows, and Other Herb Communities	1,200
Riparian and Bottomland Habitat	500
Estuarine	300
Bog and Marsh	200
Disturbed Wetland	53
Woodland	26
Forest	0.1

Many of the natural vegetation communities are fragmented due to roads, agriculture, and residential and commercial development. As natural vegetation communities are divided into smaller and smaller parcels, native plant and animal species may be threatened due to reduced mobility. Meanwhile, invasive species often thrive in fragmented habitats (discussed in more detail in Section 4.4.1.2).

Riparian habitat (also known as riparian, or stream, buffer) exists between stream channels and upland areas and provides important benefits for the protection and restoration of watershed functions. This land provides habitat, protects streambanks from erosion, and acts as a filter for many pollutants from adjacent uplands. By approximating the historic extent of riparian vegetation, Tetra Tech estimated that 60 percent of riparian vegetation has been lost. Land along stream channels in Figure 4-5 with little or no natural vegetation indicates areas where a major loss of riparian habitat has occurred. Loss of riparian habitat has occurred throughout the watershed, but this loss is most evident along Buena and Agua Hedionda creeks in the central and upper portions of the watershed and along the upper reaches of Calavera Creek.

Wetland habitat may overlap with riparian habitat and generally includes seasonally or intermittently flooded areas that provide a transitional habitat area between open water and dry land. Wetland habitat in general supports a high degree of biodiversity. Some wildlife species depend on wetlands as their exclusive habitat, while others that live in upland areas still depend on wetlands for essential resources, including food and water. In addition to wildlife functions, wetland habitat provides functions important to water quality, including nutrient cycling and sediment trapping.

The loss of wetland habitat has been particularly significant within the watershed. California has lost more than 90 percent of its historic wetlands and has experienced a much greater loss than the national average of 50 percent (State Coastal Conservancy, 1989). Agua Hedionda watershed exemplifies this loss. Using hydric soils data and the National Wetlands Inventory, Tetra Tech estimated that the watershed has experienced an 82 percent loss in wetland habitat. Historically, most of the wetlands likely occurred in the lower, more coastal portion of the watershed. Much of this land is either highly developed or disturbed by agriculture, leaving little coastal wetland habitat remaining except for the lagoon. Vernal pools were likely to exist historically in the watershed, but neither Tetra Tech's research nor stakeholder knowledge has indicated that any vernal pools remain.[1] The locations of existing wetlands can be seen in Figure 4-5 within the bog and marsh and riparian and bottomland habitat vegetation classes. The disturbed wetland class indicates locations of wetlands that may still exist, but vegetation has been disturbed or removed.

Considering these wetland losses, the Agua Hedionda Lagoon is an important habitat resource for the watershed. The primary wildlife habitat provided by the lagoon is open water. In addition to the open water areas, eelgrass beds provide habitat for fish and crabs, and mudflats provide feeding areas for migrant birds. The marsh areas, although limited, provide additional habitat diversity for a variety of species (State Coastal Conservancy, 1989). (See Section 4.4.1.1 for more details.)

Upstream of the lagoon, watershed impacts, including development, have degraded or destroyed aquatic habitat within stream channels. Biological monitoring data indicates that benthic macroinvertebrate biodiversity is relatively poor at select sample locations in the watershed, as reported in Tetra Tech (2007). During October 2007 field reconnaissance, Tetra Tech evaluated aquatic habitat qualitatively throughout the watershed and found a range of aquatic habitat quality, including some potentially high quality sites. Benthic macroinvertebrate sampling at additional locations may reveal higher diversity in locations with higher quality habitat, but these results are difficult to project based on the intermittent nature of the streams and the high sediment load throughout the watershed.

[1] A vernal pool is a shallow, intermittently flooded wetland that is typically dry during the summer and fall (Mitch and Gosselink, 2000).

The diverse habitats within Agua Hedionda watershed support species sensitive to further habitat degradation, including those listed on state and federal endangered and threatened species lists. Table 4-3 lists the endangered and threatened species, designated at the state and federal levels, that are likely to occur within the watershed or have occurred in the past. At the federal level, a species is designated as "endangered" if it is in danger of extinction within most or all of its range, and a species is designated "threatened" if it is likely to become an endangered species in the future. The state listing generally corresponds with this definition, but some species may not match the federal listing if they are considered more or less rare within state boundaries.

All listed species except for two are presumed to occur in the watershed (noted as "presumed extant" in the table). The tidewater goby (*Eucyclogobius newberryi*) no longer occurs in the Agua Hedionda Lagoon and is thought to no longer occur in the watershed (noted as "possibly extirpated" in the table; see table footnote). The California least tern (*Sternula antillarum browni*) has been observed in the vicinity of the lagoon but is not believed to nest within the watershed due to absence of foraging habitat (MEC, 1995) and is designated in the table as "extirpated" (see table footnote).

Table 4-3. Federal and State Endangered and Threatened Species Identified within the Agua Hedionda Watershed (CNDDB, 2008)

Scientific Name	Common Name	Presence[1]	Federal Listing	State Listing
Acanthomintha ilicifolia	San Diego thorn-mint	Presumed Extant	Threatened	Endangered
Arctostaphylos glandulosa ssp. crassifolia	Del Mar manzanita	Presumed Extant	Endangered	None
Brodiaea filifolia	thread-leaved brodiaea	Presumed Extant	Threatened	Endangered
Charadrius alexandrinus nivosus	western snowy plover	Presumed Extant	Threatened	None
Eryngium aristulatum var. parishii	San Diego button-celery	Presumed Extant	Endangered	Endangered
Eucyclogobius newberryi	tidewater goby	Possibly Extirpated[2]	Endangered	None
Navarretia fossalis	Moran's navarretia	Presumed Extant	Threatened	None
Passerculus sandwichensis beldingi	Belding's savannah sparrow	Presumed Extant	None	Endangered
Polioptila californica californica	coastal California gnatcatcher	Presumed Extant	Threatened	None
Rallus longirostris levipes	light-footed clapper rail	Presumed Extant	Endangered	Endangered
Sternula antillarum browni	California least tern	Extirpated	Endangered	Endangered
Vireo bellii pusillus	least Bell's vireo	Presumed Extant	Endangered	Endangered

[1] "Presumed Extant" means that a species is likely to occur in the watershed; "Possibly Extirpated" means that a species has been observed in the past but may not occur, at present, within the watershed; "Extirpated" means that a species has been observed in the past but is unlikely to occur, at present, within the watershed.

[2] The tidewater goby no longer occurs in the Agua Hedionda Lagoon.

Due to the extensive loss of habitat across all ecosystems, existing upland habitat is important to consider because it maintains existing biodiversity and protects water quality, particularly for highly erodible upland areas. In the lower portion of the watershed, most of the remaining upland natural vegetation has been preserved, but in the upper portion of the watershed, large tracts of upland habitat remain unprotected.

Another major habitat impact has been the loss of connectivity between the upper and lower portions of the watershed. Since this loss is due to development, no feasible opportunity exists to restore this habitat connectivity. Despite this loss, significant tracts of natural wildlife habitat still exist both in the lower and upper portions of the watershed, and a combination of preservation and restoration could be successful at maintaining and enhancing the current habitat connectivity.

4.4.1.1 Agua Hedionda Lagoon

Agua Hedionda means "stinking water" in Spanish; named presumably because of the odor of the stagnate water (MEC, 1995). Agua Hedionda is a salt marsh slough which was dredged to its current configuration in 1954 by San Diego Gas & Electric (SDG&E) to provide cooling water for the Encina Power Plant. Prior to dredging, the estuary was a slough that was only occasionally open to the ocean. The lagoon covers approximately 230 acres and is made up of three basins separated by the Railroad (built in the late 1800s), the Pacific Coast Highway, locally re-named as Carlsbad Boulevard (1910), and Interstate 5 (1967). The three lagoon basins include the 66-acre outer basin (westernmost basin), the 27-acre middle basin, and the 140-acre inner basin (AHLF, 1991). The lagoon is connected to the ocean by an inlet bordered by two rock jetties at the northern end of the outer basin. The lagoon is 0.5 mile wide at its widest point and extends 1.7 miles inland from the coast to the mouth of Agua Hedionda Creek.

Figure 4-6. View of Agua Hedionda Lagoon

The original dredge depth of the lagoon was approximately 8 ft mean sea level; however, it is believed to be shallower now due to sediment discharged from Agua Hedionda Creek and sand entering the lagoon through the jetties. The outer basin is dredged every one to three years to remove sediment (mostly sand entering from the ocean through the jetties) to maintain adequate water storage and related tidal prism for drawing sea water for the once-through cooling system that cools the Cabrillo Power Plant on the southwest edge of the lagoon. The inner basin was re-dredged once in 1998 through 1999. The margins of the lagoon vary significantly from gentle to steep slopes along the northern and southern shores, to nearly flat salt marsh expanses along the eastern shoreline neat the mouth of Agua Hedionda Creek. Eelgrass is found in all three lagoon basins primarily in the shallower depths which provide a valuable habitat for benthic organisms that are fed upon by birds and fishes (MEC, 1995).

The lagoon empties into the Pacific Ocean within the Southern California Bight. Longshore currents, driven by winds and ocean swells, generally move water and sand in a southerly direction along the coast. The shoreline adjacent to the lagoon is gently sloping and sandy bottomed with occasional kelp beds. The beaches outside of the lagoon are in the City of Carlsbad and are a popular destination for locals and tourists alike for swimming, surfing, fishing, diving, jogging and relaxing. Beneficial Uses of Agua Hedionda Lagoon include:

- Industrial Service Supply (IND)
- Contact Water Recreation (REC-1)
- Non-contact Water Recreation (REC-2)
- Commercial and Sport Fishing (COMM)
- Preservation of Biological Habitats of Special Significance (BIOL)
- Estuarine Habitat (EST)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Marine Habitat (MAR)
- Aquaculture (AQUA)
- Migration of Aquatic Organisms Spawning, Reproduction, and/or Early Development (SPWN)
- Shellfish Harvesting (SHELL)

The San Diego Regional Water Quality Control Board (SDRWQCB) has determined that the Aqua Hedionda Lagoon does not meet certain water quality objectives for indicator bacteria and sedimentation/siltation (SDRWQCB, 2007). The SDRWQCB is in the process of developing Total Maximum Daily Loads (TMDLs) for Agua Hedionda Creek and Agua Hedionda Lagoon.

The lagoon contains four primary habitat categories: subtidal, flats, marsh and upland. These habitats support a large number and variety of species, some of which are threatened or endangered. The lagoon is an important habitat for coastal marine and resident fish, particularly as nursery habitat for commercially and recreationally important coastal species such as California halibut and diamond turbot. The most abundant fish are silversides (topsmelt and juvenile atherinids) and gobies. Gobies consist of five species, but the most common are arrow and yellowfin. The lagoon also supports a variety of benthic invertebrates, including cockles, mussels, bubble snails, mud dwelling snails, amphipod crustaceans, isopod crustaceans, mysids and shrimp. Following is a list of the special status bird species identified in and around the lagoon (MEC, 1995):

- California Brown Pelican – federally endangered

- California Least Tern – federally endangered
- Western Snowy Plover – federally endangered
- Belding's Savannah Sparrow – State of California endangered

The majority of the lagoon is currently owned by Cabrillo Power II and supports a thriving marine ecosystem. It is home to the Hubbs-SeaWorld fish hatchery and white sea bass research facility, the Carlsbad Aquafarm (commercial mussel farm), YMCA Camp and the Agua Hedionda Lagoon Foundation's Discovery Center. Surrounding the lagoon are agricultural fields to the south and residential development to the north. The eastern shore of the lagoon is the California Department of Fish & Game Agua Hedionda Lagoon Ecological Reserve. The lagoon extension of the reserve is designated by the California legislature, through the 1999 Marine Life Protection Act (MLPA), as a Marine Protected Area (MPA), known as the Agua Hedionda Lagoon State Marine Reserve. The purpose of designating a MPA is to protect marine ecosystems, diminish the impacts from human activities that are altering and degrading our coastal and marine environment, and improve recreational and education opportunities offered by these special areas.

Lagoon Restoration Efforts

As a baseline for evaluating future management actions, recent lagoon restoration efforts will be important to consider. Significant impacts to the lagoon have been caused by excessive sediment loading and invasive aquatic plant infestation. Past restoration efforts have focused on mitigating these impacts and enhancing both the natural function and industrial uses of the lagoon. The most recent restoration efforts have been successful at restoring lagoon habitat and mitigating for sediment and invasive species impacts.

Since the Cabrillo Power Plant uses the lagoon for cooling water and dredges the outer lagoon about every two years, the Agua Hedionda Lagoon is one of the few lagoons in the area to receive continuous tidal flushing because it is regularly dredged and has jetties (State Coastal Conservancy, 1989). Tidal flushing helps to maintain low concentrations of pollutants within the lagoon and reduce eutrophication (Howes et al., 1991). The entire lagoon was completely dredged during 1998 through 1999, which significantly increased tidal flushing. Following the dredging, eelgrass beds were restored to provide enhanced marine nursery areas (San Diego Wetlands, 2008).

The most recent restoration project successfully removed an infestation of *Caulerpa taxifolia*, an invasive seaweed. This invasive species was discovered in the lagoon in June 2000. Treatment occurred between June 2000 and September 2001, and following treatment, surveys were conducted four times per year. The last patch of *Caulerpa taxifolia* was eradicated in September 2002. Surveys were conducted twice per year from summer 2003 through December 2005, and no additional patches were discovered (SCCAT, 2008). The removal of this invasive species has protected and enhanced the eel grass beds within the lagoon, which are an important habitat for fish and other aquatic species. If left uncontrolled, *Caulerpa taxifolia* could be a major threat to California marine and tidal ecosystems. In the Mediterranean Sea, where similar climatic conditions exist, the seaweed covers 30,000 acres of sea floor and has destroyed natural aquatic communities, displaced native plants and animals, and decreased overall biodiversity. The Mediterranean infestation has also caused economic damage to fishing, tourism, boating, and other recreational industries (SCCAT, 2008). Protection from further infestations will be an important management activity for the lagoon.

Sediment loading to the lagoon has caused impacts to lagoon habitat in the past, but dredging the inner lagoon on a regular basis could be cost prohibitive. Considering the success of recent restoration efforts, the most promising restoration opportunity for lagoon habitat is likely to be the control of upstream sediment loading which will involve stormwater BMP retrofits and stream restoration measures. If a dredging project occurs in the future, upstream sediment management will help protect the benefits of that dredging project as well. Land acquisition and buffer restoration adjacent to and near the lagoon would

enhance the diversity and health of the lagoon habitat and the wildlife communities supported by the lagoon.

4.4.1.2 Invasive Plant Species

Invasive plant species, both aquatic and terrestrial, threaten habitat quality throughout the Agua Hedionda watershed. Populations of invasive plant species can dominate a plant community by out-competing native species, increasing soil erosion, and altering fire regimes, nutrient cycling, and hydrology. Invasive species data were collected by the San Elijo Lagoon Conservancy (SELC) as part of their recent study of restoration of riparian/wetlands habitat in the Carlsbad Hydrologic Unit (SELC, 2007).

SELC found pampas grass (*Cortaderia selloana*) and giant reed (*Arundo donax*) to be the most dominant invasive species within the Agua Hedionda watershed (Table 4-4; Figure 4-7). However, the presence of periwinkle (*Vinca major*), salt cedar (*Tamarix sp.*), castor bean (*Ricinus communis*), artichoke thistle (*Cynara cardunculus)*, palms (*Washingtonia robusta* or *Phoenix canariensis)*, and pepperweed (*Lepidium latifolium)* are also a concern.

Table 4-4. Acreage of Invasive Plant Species Present in the Agua Hedionda Watershed (SELC)

Common Name	Scientific Name	Acreage
Pampas grass	*Cortaderia selloana*	98.4
Giant reed	*Arundo donax*	22.9
Periwinkle	*Vinca major*	6.9
Salt cedar	*Tamarix sp.*	4.4
Castor bean	*Ricinus communi*	4.3
Artichoke thistle	*Cynara cardunculus*	3.6
Palms	*Washingtonia robusta* or *Phoenix canariensis*	2.7
Pepperweed	*Lepidium latifolium*	0.01
Total		**143.2**

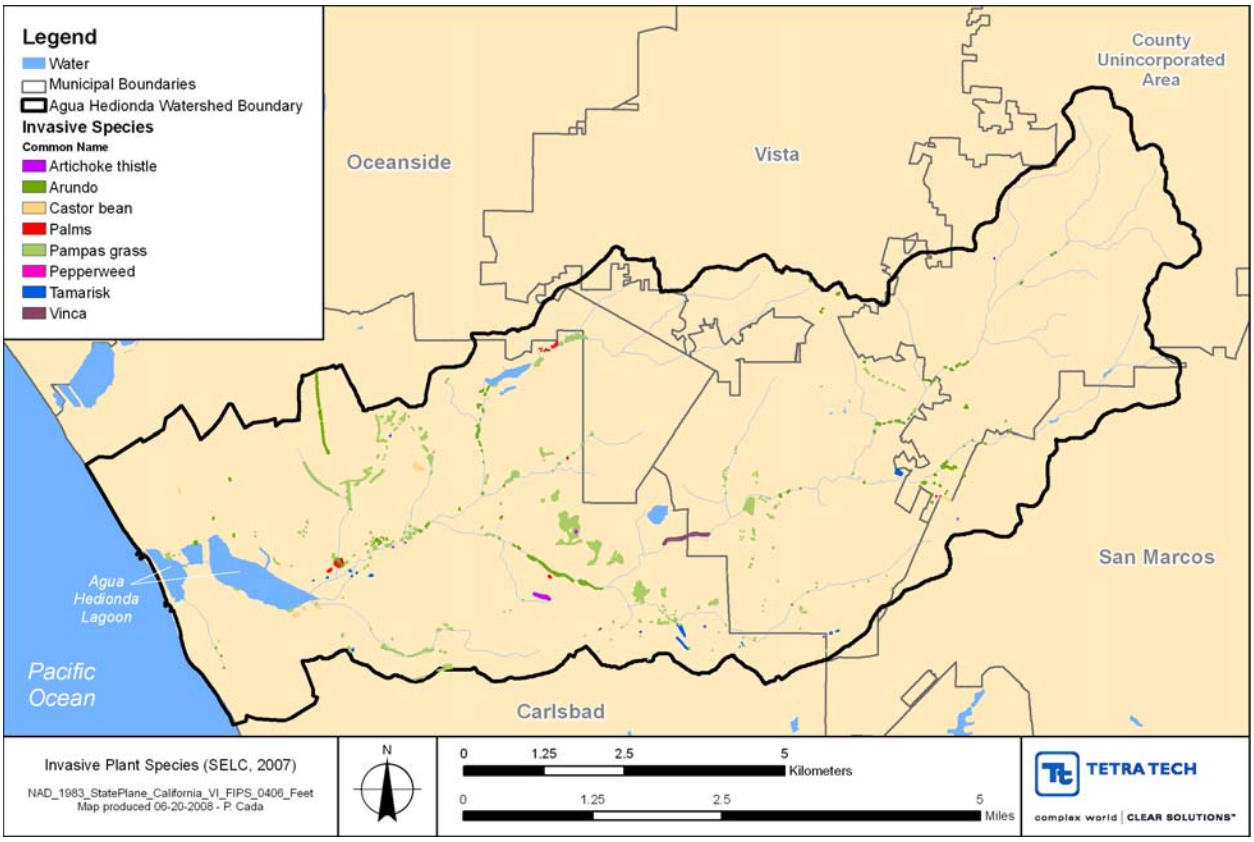

Figure 4-7. Invasive Plant Species Present in the Watershed

4.5 CULTURAL RESOURCES

Native Americans have inhabited the Agua Hedionda watershed for approximately 9,000 years and many archeological sites have been discovered in the watershed (Howes et al., 1991). The first known inhabitants were the hunter-gatherer groups known today as the Kumeyaay people. Around 1,000 B.C., the Luiseno people began to inhabit the watershed, either replacing or co-existing with the Kumeyaay people. The Luiseno people made salt and gathered shellfish for food, tools, and jewelry. The native people lived off the abundant sea life and fertile land along the coast of northern San Diego County for many centuries. The Luiseno culture changed rapidly with the arrival the Spanish expedition of Don Gaspar de Portola and Father Juan Crespi, and the Mission San Luis Rey was established in 1798 (Howes et al., 1991; AHLF, 2008).

There are many Luiseno people living today who are active in the Agua Hedionda watershed preserving their history, cultural and way of life. Descendants of the Luiseno people are formerly known as the San Luis Rey Band of Mission Indians. Native American artifacts are commonly unearthed during construction projects and protection of these cultural resources is a key consideration during development of the Agua Hedionda Watershed (Howes et al., 1991; AHLF, 2008).

4.6 PRIORITY WATERSHED ISSUES

A number of priority watershed issues emerged from the assessment of watershed conditions and trends within the Agua Hedionda watershed. Urban land use has increased over time in the watershed, replacing agriculture and natural open space. Although much of the watershed is already developed, future

development is expected to cause additional impacts to water quality and stream stability. Development regulations are estimated to reduce future impacts if fully enforced. However, additional management is needed to successfully improve and restore watershed functions. The watershed could be at greater risk of degradation if planned redevelopment does not occur as represented in model scenarios (e.g., without treatment as required by the 2007 Order).

Sediment and bacteria were found to be particular pollutants of concern. Sediment nonpoint sources include natural background sources, channel erosion, and stormwater runoff from construction, post-construction, and agricultural sites. Bacteria nonpoint sources include natural background sources, irrigation runoff, septic systems, sanitary sewers, and pet waste. Sediment and bacteria concentrations in Agua Hedionda Creek appear to be increasing and may indicate increased threats to water quality and aquatic communities under future conditions. Irrigation practices are believed to alter natural hydrology and increase nutrient and bacteria loading during extended dry periods. Waterbody impairments, as listed in Section 4.1.1, indicate portions of the watershed where particular pollutants have degraded watershed functions. Impaired waterbodies include Agua Hedionda Creek, Buena Creek, and Agua Hedionda Lagoon.

Stream channel modification, from a natural to impacted state, has been observed throughout the watershed. Typical impacts include habitat degradation and channel and bank erosion. These impacts are most significant along the upper reaches of Calavera Creek and much of the lower reaches of Agua Hedionda Creek. Although current regulatory efforts are expected to reduce impacts from future development, future development is expected to have some effect. If current impacts are not addressed, future development could lead to greater channel instability and increased erosion. Control of peak flow may not be sufficient to protect stream stability and channel protection volume requirements may be warranted. Current impacts will need to be addressed as well, especially reaches identified as highly unstable.

The watershed has experienced significant loss of natural habitat across all ecosystems. The majority of wetland and riparian habitat in the watershed has either been cleared or developed, and these losses are most evident in coastal areas, upper Calavera Creek, and along Buena and Agua Hedionda creeks in the central and upper watershed. The largest areas of unprotected habitat, both riparian and upland, exist in the upper watershed, while the largest protected areas occur in the lower watershed. Current habitat planning efforts may protect additional land, but without additional preservation efforts, future development could reduce natural habitat to 13 percent of the watershed.

Predicted climate change may present a challenge to planning long-term management in the Agua Hedionda watershed. Extreme shifts in weather patterns may increase sediment loading, channel erosion, and other stressors that already have an impact on watershed functions. Climate change may also endanger existing habitat and could present increased hazards to both human and animal life in the watershed.

Due to the large number of priority issues within the watershed, successful management will require attention to how different pollutant sources and stressors interact in the watershed and how different management techniques can be brought together to address these multiple issues. A review of current regulations and policies can help to further differentiate priorities by indicating where policies will address priority issues and where additional management is needed.

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5 Management Building Blocks and Gaps

Section 4 considered existing and future conditions within the watershed and identified the priority issues for management. Toward addressing these issues, an evaluation of current regulations was used to determine if additional policies or regulations would contribute to the goals of this WMP. Appendix A summarizes the current regulations and policies that are relevant to the WMP goals, including water quality standards, stormwater management requirements, riparian buffer requirements, floodplain management requirements, and habitat management plans.

Management building blocks are regulations or policies that are currently addressing a priority watershed issue and whose benefits can be augmented by additional management. Management gaps occur where a policy does not address a particular priority issue or objective in the watershed. Identifying building blocks and gaps in management can lead to the selection of priority management needs, like habitat restoration, within the watershed. In this section, key management building blocks are discussed and management needs are identified.

5.1 Key Watershed Management Building Blocks

The review of current regulations and other policies within the Agua Hedionda watershed revealed a number of management building blocks for the WMP. Efforts to improve watershed functions within the watershed have been ongoing for at least two decades. Local governments began managing stormwater in the 1990s, and stormwater management requirements for private development began with the 2001 Order. More recent efforts, like the 2007 Order and the ongoing habitat management planning, continue to reduce impacts to watershed functions. The Agua Hedionda WMP considers the current management framework and how implementation of the plan can work alongside these efforts to achieve the plan's goals and objectives. This section highlights current watershed management efforts that can be augmented by the WMP and management gaps not currently addressed by existing policies.

303(d) List and TMDLs

Section 4.1 lists the impaired waters within the watershed. Waterbodies are placed on the California 303(d) list if the water quality objectives are not met, indicating that the existing and beneficial uses of these waterbodies are impaired. The Regional Board will be developing Total Maximum Daily Loads (TMDLs) for these impairments. The water quality assessment in Section 4.1 indicated that sediment and bacteria loading are particular pollutants of concern for the watershed. The listing of Agua Hedionda Lagoon for sedimentation/siltation and bacteria will help support management efforts to reduce these pollutants in the future. The listing of Buena Creek for nitrate, nitrite, and phosphorus will also help support management efforts to reduce nutrient loading to Buena Creek, an issue highlighted in the water quality assessment. However, completion of these TMDLs, except for the lagoon, is not expected until 2019, and implementation of management as a result of each TMDL is uncertain. Except for the lagoon impairment, it does not appear that other impairments in the watershed will be addressed within the next 10 years. Although the lagoon TMDL monitoring is moving forward, completion of the TMDL Implementation Plan is not anticipated for a few years.

IRWMP

The Integrated Regional Water Management Plan (IRWMP) is a regional water resource management effort that represents concurrent efforts aimed at securing long-term water supply reliability by first recognizing the inter-connectivity of water supplies and the environment and then pursuing projects yielding multiple benefits for water supplies, water quality, and natural resources. Although the schedule plan updates vary, the project lists are usually updated every few years, and the plan is likely to be updated every five years (Rob Hutsel, San Diego River Park Foundation, personal communication to Heather Fisher, June 2008). Opportunities identified through IRWMP planning efforts that remain unfunded could be investigated for implementation by local jurisdictions and organizations. Likewise, opportunities identified through this WMP could be implemented that augment efforts under the IRWMP. Agua Hedionda watershed management efforts should include tracking where IRWMP implementation occurs in the watershed. Public review periods for future IRWMPs can be used to support a greater focus within the Agua Hedionda watershed if past IRWMPs have overlooked important opportunities that relate to regional water resource priorities.

SD RWQCB 2007 Order

The 2007 Order is a major management building block for this WMP. The requirements of the 2007 order that particularly relate to the WMP's goals and objectives are: 1) Low Impact Development, 2) Hydromodification Plans, 3) Sediment and Erosion Control and 4) Watershed Urban Runoff Management. The degree of successful implementation and enforcement of these requirements will determine their effectiveness on improving watershed functions within the Agua Hedionda watershed.

Stormwater best management practices are currently selected based on a qualitative assessment of pollutant removal efficiency (high, medium, or low removal efficiency; see Appendix A for more details). Without quantitative pollution reduction targets, it will be difficult for jurisdictions to ensure that stormwater management is fully addressing pollutants of concern and protecting water quality from further impairment. Simple modeling tools that predict development site pollutant loading can help jurisdictions enforce stormwater regulations. The modeling tools would measure the pollutant removal efficiency of stormwater BMPs and predict the pollutant loading rate for a development site. Model input would be based on local conditions and measured pollutant removal efficiencies for BMPs. Developers would enter their site data into the model, and development review staff would compare model output to loading targets and determine if a development meets the stormwater requirements.

The 2007 Order Low Impact Development requirements for priority developments have the potential to provide a substantial reduction in impervious surface and promotion of infiltration within the watershed. However, local enforcement will determine how effectively these requirements are implemented. Development plan review staff will need to be knowledgeable of LID techniques and be able to identify where LID implementation is lacking in development plans. The extent to which specific LID BMPs are required will also affect the effectiveness of the 2007 Order. For example, the BMP "minimize disturbance to natural drainages" would ideally be interpreted as using natural drainage paths within the site's stormwater management system. If this requirement is not strictly enforced, it could be interpreted more broadly to mean minimizing direct impacts to stream channels without attention to drainage paths throughout a development site. The effectiveness of the 2007 Order will depend on each jurisdiction's interpretation of the requirements. Guidance provided as part of this WMP can provide insight into more specific and effective requirements for the use of LID in the watershed. Since local jurisdictions will be working on their specific interpretation within the next two years, this WMP can provide timely support and guidance to those jurisdictions.

The permanent hydromodification requirements, projected to be in place by 2009, will help protect streams from increased channel erosion and instability. These requirements will address impacts from future new development and redevelopment. Although these requirements will help minimize future impacts, development approved prior to 2009 will not be obligated to comply with these requirements.

This gap in management could lead to increased impacts in the short-term. Current and future regulations will be addressing peak flows, but it is possible that channel protection volume requirements will be needed to protect streams from further degradation. Since a large portion of the watershed is already developed, additional management in already developed areas will be needed to thoroughly address current levels of bank erosion and instability, especially in areas that are not likely to redevelop. Stream channels impacted by past development will require measures to restore natural channel morphology and bank stability.

Although regional sediment and erosion control (S&E) requirements have not changed significantly between the 2001 and 2007 orders, the local jurisdictions could take advantage of this ordinance change to strengthen S&E enforcement. Tetra Tech was unable to determine the extent that sediment loading from new construction was contributing to sediment within streams. However, upland sediment loading is expected to have an impact. If jurisdictions review how effective their current requirements are and assess compliance, they may determine that stricter requirements or enforcement would lead to sediment reduction benefits.

The 2007 Order also requires that the jurisdictions within the Carlsbad Watershed collaborate in the development and implementation of a watershed-based program that addresses urban runoff quality. They are required to identify high priority pollutants and their sources and develop collective watershed strategy to abate the sources and reduce the discharge of pollutants causing the high priority water quality problems of the watershed (it should be noted that for the 2007 Order the watershed is defined at the Carlsbad Hydrologic Unit and the Agua Hedionda Watershed Is a sub-watershed). The Carlsbad WURMP Co-Permittees are also required to measure the effectiveness of their program which can be leveraged with the monitoring recommendations of this WMP. The WURMP requirement of the 2007 Order is a strong building block for the WMP.

Riparian Buffer Protection

The cities of Carlsbad and Vista have buffer regulations in place that will provide an essential level of riparian habitat protection for future new development and redevelopment. All jurisdictions in the watershed address riparian buffer protection to some degree in their stormwater management regulations, but additional protection measures could be warranted. As discussed in Section 4.4, the majority of riparian habitat has already been impacted. Restoration of riparian habitat would be needed to fully address habitat and water quality needs within the watershed.

Floodplain Management

Local floodplain management ordinances currently provide prevention of flood hazards and some degree of flood retention by prohibiting most structures within the floodplain. Past development has likely impacted much of the watershed's natural flood retention and control functions. Both the regulatory review and habitat assessment results suggest a need for natural floodplain restoration within the watershed.

Habitat Management

Current habitat management planning efforts, both regional and local, provide a comprehensive and effective means for protecting critical habitat for sensitive species. The MHCP and Carlsbad Habitat Management Plans (HMPs) are protecting critical habitat in the lower portion of the watershed. Local HMPs for Vista, San Marcos, and Oceanside are expected to protect additional critical habitat once finalized, and the North County MSCP is expected to protect critical habitat in the remainder of the watershed. Across the watershed, these planning efforts will provide an important building block for watershed management. However, these efforts focus on habitat and not specifically on protecting land for multiple purposes, like downstream water quality and channel protection. Additional habitat management will likely be needed that addresses all priority issues within the Agua Hedionda watershed while building upon current habitat protection efforts.

Water Conservation

In June 2008, Governor Arnold Schwarzenegger formally declared that drought conditions exist in California and called for a number of steps to address drought conditions throughout the state. The declaration calls for increased water conservation by local governments and water agencies as part of a suite of proposed measures (Steinhauer, 2008). As a result of increased water conservation, water use for irrigation may decrease in the future.

Appendix A includes a summary of the State of California's model water conservation ordinance, which is currently under development. This ordinance, once in place, is expected to fill an important management gap within the watershed. The watershed assessment revealed that nutrient loading during extended dry periods in Buena Creek is likely caused, in part, by irrigation of lawns and landscaping. Improved water conservation will help address this loading and return stream hydrology to a more natural cycle. Implementation of the model water conservation requirements will likely require stakeholder support and outreach to fully achieve the benefits of the stricter requirements.

Ongoing Infrastructure Improvements

Local jurisdictions have recently developed sewer master plans and storm drain master plans, and these plans are resulting in ongoing and upcoming infrastructure improvements. Since sewer pipes are often in the creek, sewer pipe removal, relocation, or replacement may coincide with preservation or restoration opportunities and could augment these management efforts. Jurisdictions will also be required to mitigate impacts from infrastructure projects which may provide further opportunities for preservation and restoration within the watershed.

Current Non-Regulatory Management Efforts

Non-governmental organizations have been working in the watershed to manage and improve watershed functions. One example of these efforts is the removal of the invasive aquatic plant *Caulerpa* from Agua Hedionda Lagoon, which was a joint effort between the Agua Hedionda Lagoon Foundation and Southern California Caulerpa Action Team, described in Section 4.4.1.1. The major NGOs working in the watershed are:

- Agua Hedionda Lagoon Foundation
- Preserve Calavera
- Friends of Hedionda Creek
- Carlsbad Watershed Network

Management efforts within the watershed are not limited to the scope of the above groups. San Elijo Lagoon Conservancy (SELC) has also been active in the watershed through monitoring and invasive species management efforts. Additional groups are expected to be interested in continuing and building upon their past management efforts in the watershed.

Although many groups are active in the watershed, the watershed does not have an overarching organization that coordinates all watershed management efforts. A watershed-wide coordinating organization, either through a local government or NGO, will be needed to successfully implement this plan.

5.2 BASELINE CONDITIONS: GAP ASSESSMENT

Baseline conditions are those conditions within a watershed that are occurring or will occur in the future without further efforts to improve watershed functions. The baseline conditions assessment evaluates the existing and future conditions in the watershed without further action in relation to the WPG goals and

objectives. The relationship among priority watershed issues, management building blocks, and management gaps is considered as well. Through this assessment, types of management are identified that will be necessary to achieve the WPG goals and objectives.

Goal 1. Design land use so as to minimize impacts on the watershed.

a. Design and construct infrastructure projects (e.g., sewer lines) in a manner that minimizes impacts on watershed functions (i.e., water quality, habitat, and hydrology).

b. Design and construct new developments, recreation areas, etc., in a manner that minimizes impacts on watershed functions, including minimizing impervious areas.

The baseline existing and future conditions relating to this goal and associated objectives center around existing and future land use/land cover in the watershed. The land use assessment under Section 2.3 shows that a majority of the watershed is currently developed, and that medium to high density land[1] will increase from 44 percent of the watershed in 2007 to 58 percent of the watershed in 2030. Increases will occur across all medium to high density land uses, both commercial and residential, but the greatest increase is projected in medium density residential, which is likely to increase from 5 to 12 percent of the watershed. Since most of this increased density will occur in the upper watershed, the impact there will be more significant. The average imperviousness of the watershed was estimated to be greater than 30 percent and is projected to increase with increases in development.

Past development and increases in impervious surface have contributed to the high pollutant concentrations and water quality impairments noted in the water quality assessment (Section 4.1.1). In addition to these impacts, the geomorphic analysis found that past development and infrastructure has likely contributed to channel instability at many locations throughout the stream system. These impacts appear to be caused, in part, by unnaturally high flows during storm events. Increases in developed land, particularly imperviousness, are expected to further negative impacts to streams.

The modeling assessment, described in Section 4.1, found that recently enacted regulations, particularly the 2007 Order, will help to mitigate impacts from future development. However, the model results were sensitive to the following changes:

- Preservation of open space
- The conversion of agricultural land to residential and non-residential development that is treated by stormwater BMPs
- The redevelopment with associated stormwater BMP treatment of significant portions of the watershed

In particular, if the planned redevelopment does not occur as represented in the model scenarios (e.g., without treatment as required by the 2007 Order), the watershed could be at greater risk of degradation. Further, since the assimilative capacity of the lagoon has not been determined to date, additional reductions beyond those predicted by the watershed model in the future scenario could be needed.

The majority of riparian habitat in the watershed has either been cleared or developed. This loss of vegetated areas along streams has likely contributed to bank erosion and channel instability. Lack of riparian buffers has also contributed to increased sediment and other pollutant loading to streams. Most flooding occurs in riparian areas, and therefore flooding hazards are most likely to occur in areas where riparian habitat has been cleared and developed. Riparian habitat within 50 feet of streams will be

[1] Medium to high density land use includes all developed land uses except for parks/recreation, low density residential, and very low density residential.

protected in most portions of the watershed within the cities of Carlsbad and Vista in the future. However, the past impacts to riparian habitat will continue to contribute to watershed impacts if this habitat is not restored.

These results suggest that without further action, new development and infrastructure projects are likely to cause increased watershed degradation. To assist in achieving Goal #1 and the associated objectives, the Agua Hedionda WMP provides the following:

- Recommendations for minimizing impacts from new development/redevelopment (Section 6.1)
- Identification of high quality areas for preservation that could be severely impacted by development (Section 6.2)

In concert with these strategies, infrastructure design to minimize watershed impacts should be encouraged through policies and oversight by watershed jurisdictions and other stakeholders.

Goal 2. Protect, restore and enhance habitat in the watershed.

a) Protect and expand undeveloped natural areas to protect habitat

b) Protect, enhance, and restore terrestrial habitat, especially existing vegetation in riparian areas

c) Provide riparian habitat to improve and maintain wildlife habitat

d) Provide natural area connectivity to improve and maintain wildlife habitat

e) Maintain stable streambanks and riparian areas to protect instream aquatic habitat and mature trees

f) Maintain and protect instream habitat to support native aquatic biology

g) Maintain and protect lagoon habitat

The baseline existing and future conditions relating to this goal and associated objectives include the existing and expected future conditions of the major habitat types in the watershed: upland, riparian, lagoon, and other wetland habitats. As established in previous sections, the watershed has experienced extensive loss of habitat across all habitat types. Additional habitat, especially in the upper portion of the watershed remains unprotected and threatened by future development. Mature trees along streambanks are threatened by undercutting; some mature riparian trees have already been lost, and additional losses are likely to occur if current hydromodification and channel stability trends continue.

Recent lagoon restoration efforts have helped improve wetland habitat conditions, but excessive sediment loading to the lagoon is likely to continue if upstream sediment sources are not addressed. Historic loss of coastal habitat will also not be addressed without additional management.

To address these issues and help to achieve Goal #2 and the associated objectives, the Agua Hedionda WMP identifies the following opportunities:

- Land acquisition opportunities for habitat preservation
- Riparian buffer restoration opportunities
- Wetlands restoration opportunities
- Stream restoration opportunities

The indicators identified under Goal #2 were used to evaluate and prioritize these opportunities. This identification and prioritization are described in more detail in Sections 6.2 and 6.3.

Goal 3. Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts.

a) Restore and protect beneficial watershed functions and uses including:
   - Wildlife habitat
   - Recreation
   - Protection from flood damage

b) Design and construct restoration projects to minimize impacts to:
   - Streambanks
   - Riparian areas
   - Wildlife habitat areas

Since this goal encompasses all watershed functions, the baseline existing and future conditions relating to this goal would include all priority issues discussed in Section 4.5:

- Sediment and bacteria were found to be particular pollutants of concern
- Impaired waterbodies include Agua Hedionda Creek, Buena Creek, and Agua Hedionda Lagoon
- Stream channel modification, from a natural to impacted state, has been observed throughout the watershed
- The watershed has experienced significant loss of natural habitat across all ecosystems
- Climate change presents a challenge to planning long-term management in the Agua Hedionda watershed

To achieve Goal #3 and its associated objectives, successful management will require attention to how different pollutant sources and stressors interact in the watershed and how different management techniques can be brought together to address these multiple issues. In addition to the management techniques identified for Goals #1 and #2, the stormwater best management practice (BMP) retrofits will provide opportunities to reduce pollutant loading and control stormwater flows from past development that otherwise lacks stormwater management.

To minimize potentially negative impacts from management opportunities, the potential for one type of management to benefit or hinder another type of management will need to be considered. The plan provides recommended focus areas in which the complementary benefits of different management opportunities are considered. The focus area assessment identifies portions of the watershed where management is likely to successfully address the multiple priories under this goal, including recreational areas, flood control, water quality, and habitat. The focus areas are described in Section 6.8.

Goal 4. Support compliance with regional, state, and federal regulatory requirements.

a) The SDRWQCB has listed Aqua Hedionda Creek, Buena Creek, and Agua Hedionda Lagoon as impaired and not supporting designated beneficial uses under the Clean Water Act Section 303(d). Future compliance includes:
   - Meeting water quality standards for Total Dissolved Solids, manganese, selenium, and sulfates for Aqua Hedionda Creek
   - Meeting water quality standards for DDT, nitrate-nitrite, and phosphate for Buena Creek
   - Meeting water quality standards for sediment and bacteria in the Lagoon

b) The SDRWQCBand local governments in the watershed have stormwater management requirements for controlling sedimentation and erosion during construction.

- Track compliance with BMP requirements

c) The SDRWQCB and local governments in the watershed have LID and stormwater management requirements to control post-construction runoff from new development. Compliance will require plan review, site inspection, and long-term BMP inspection and maintenance to ensure BMP requirements are being met**.**

d) Reduce non-compliance events for water quality objectives and sedimentation and erosion control

The following management gaps illustrate the baseline conditions relating to this goal and associated objectives:

- Planned efforts to address water quality impairments within the next decade except for the lagoon impairment, which is currently being addressed through the development of a TMDL
- Hydromodification requirements in association with the required Hydromodification Plans (HMPs) are under development but are net yet in place
- Numeric pollution reduction targets for stormwater management
- Specific requirements and implementation/enforcement methods for 2007 Order LID requirements
- Methods to reduce upland sediment loading from construction sites beyond current regulations and enforcement

The first management gap indicates that although the lagoon TMDL is currently being developed, water quality standards for impaired streams within the watershed are not likely to be met within the next decade without additional watershed management. All management techniques recommended by this plan would contribute toward meeting water quality standards, and plan implementation may prevent other waterbodies from being listed as impaired. The selection of focus areas in Section 6.8 considers how management techniques can be implemented to address impairments within the watershed.

The remaining three management gaps indicate that local jurisdictions are working toward meeting the 2007 Order and may need support, through this watershed plan, to fully comply with the intent of the regulations. This plan provides recommendations for effectively applying LID approaches within the watershed (Section 6.1) and for conducting citizen education and outreach to help encourage compliance with regulations (Section 6.6).

Goal 5. Increase awareness and stewardship within the watershed, including encouraging policymakers to develop policies that support a healthy watershed. This includes minimizing impervious area and providing for stream buffers.

a) Form collaborative Agua Hedionda Watershed Council to sustain long-term watershed management.

b) Support adoption and implementation of the Watershed Management Plan as well as ordinances, regulations, policies, and procedures by local jurisdictions, agencies, and environmental conservation organizations.

c) Disseminate information to local governments to support scientifically based, sound decision-making.

d) Develop a consistent and comprehensive message for watershed health and actions citizens can take. Distribute through website, water bills, press releases, brochures, and presentations.

e) Encourage Low Impact Development (LID) at the new development, redevelopment and individual homeowner and project level.

f) Reward good stewardship though an awards program that recognizes project sponsors that implement programs that preserve and enhance watershed health.

g) Develop partnerships with business, residents, NGOs, Cities, the County, Agencies, schools and private entities throughout the watershed to leverage opportunities for watershed stewardship.

Stewardship management gaps include:

- An overarching environmental protection group is missing in the watershed.
- Collaboration between local jurisdictions, agencies and local environmental organizations.
- Political support for the watershed management process.
- Watershed-specific educational message to educate decision makers, stakeholders and the public.

Citizens and environmental groups are currently active in the watershed and current educational programs promote awareness of watershed issues. However, the WPG has indicated that more outreach is needed to policymakers to encourage additional management, particularly to minimize impervious area and preserve and restore riparian habitat. This plan provides recommendations for organizing a comprehensive watershed implementation and stewardship effort that would be led by a collaborative watershed council. Recommended outreach efforts include education for local boards, educational materials, technical and policy-oriented workshops and programs, and management partnerships. These recommendations are discussed in Section 6.6.

5.3 SUMMARY OF MANAGEMENT GAPS AND NEEDS

Several management gaps emerged from the above evaluation of current regulations and key management building blocks and gaps. Management opportunities can be identified that address these management gaps and build upon past and current management efforts. The following major management gaps were identified through the above evaluation:

- Planned efforts to address water quality impairments, except for the lagoon impairment, within the next decade.
- Numeric pollution reduction targets and modeling tools for evaluating development sites under stormwater management regulations.
- Specific requirements and implementation/enforcement methods for the 2007 Order LID requirements.
- Hydromodification management in developed areas not slated for redevelopment and restoration of stream channels impacted by past development.
- Methods to reduce upland sediment loading from construction sites beyond current regulations and enforcement.
- Restoration of existing impacts, including loss of riparian habitat (including matures trees and other natural vegetation along streambanks), wetland habitat, and aquatic habitat.
- Natural floodplain restoration.
- Land protection that addresses all priority issues in the watershed, including water quality, channel stability, and habitat.
- An overarching watershed organization that coordinates all watershed management efforts.

Opportunities to tracking other efforts and provide outreach and support were also identified; these opportunities are addressed as part of this plan, but the above management gaps represent where this WMP is likely to provide the most benefit while building upon past management efforts. For each gap, this plan provides opportunities to protect and restore watershed functions. Cooperation among jurisdictions, NGOs, and people who live and work in the watershed will be needed to fully address the above management gaps.

6 Recommended Watershed Management Opportunities

This section presents the management opportunities identified to achieve the WPG's goals and objectives. These opportunities were selected to address priority issues discussed in Section 4, build upon current management efforts, and resolve the management gaps outlined in Section 5. This section is organized by the following management types (Sections 6.1 through 1.1):

- New Development Site Management
- Preservation and Riparian Buffer and Wetlands Restoration
- Stream Restoration
- Stormwater BMP Retrofit Projects
- Citizen Stewardship/Public Outreach
- Funding and Sustained Support

After each of these management types are introduced, Section 6.8 describes how Tetra Tech selected focus areas where different management types would complement each other and, if implemented in concert, provide greater watershed benefits.

At the end of each section, key implementation actions are listed for the opportunities. It is important to note that restoration and BMP retrofit projects may require the following permits:

- Coastal Development Permit for construction within the Coastal Zone
- Section 404 Permit from the U.S. Army Corps of Engineers construction impacting to jurisdictional waters of the U.S.
- 401 Water Quality Certification from the Regional Board for conditions placed in the Section 404 Permit to protect water quality
- Streambed Alteration Agreement from California Department of Fish and Game due to impacts to jurisdictional wetlands and streambeds
- Local Development Permits (i.e., grading, building or other construction related permits)

Proposed watershed management projects may also require an evaluation under the California Environmental Quality Act (CEQA), which requires state and local agencies to evaluate the environmental impacts of their actions. It a project involves the use of federal funds, an evaluation under the National Environmental Policy Act (NEPA) may also be required.

6.1 New Development Site Management

New development has a significant potential to exacerbate existing watershed impacts, or even create new ones in relatively unimpacted streams. Development can increase pollutant loading rates in runoff, and can also increase the frequency and duration of erosive flows in stream channels. Appropriate site management can partially or even fully mitigate development impacts, depending to a large degree on how aggressively they are implemented. Site management measures can meet several of the WPG's goals and objectives, including #1b (design and construct new developments, recreation areas, etc., in a manner that minimizes impacts on watershed functions, including minimizing impervious areas) and all of objectives under Goal #4 (support compliance with regional, state, and federal regulatory requirements).

Measures can also support Goal #2 (protect, restore, and enhance habitat in the watershed) depending on whether riparian area and habitat protection are included in site management.

Many of the following sections focus on specific opportunities identified through watershed-wide surveys. New development/redevelopment site management, on the other hand, is an ongoing process related to current or potential future regulations, and the interpretation and enforcement of those regulations. Two aspects of site management are discussed:

1. Irrigation requirements (for reducing irrigation return flow)
2. Site stormwater management

Irrigation Return Flow

Irrigation return flow is likely an important component of nutrient impacts to the watershed and lagoon. Under natural conditions, many Agua Hedionda creeks should be dry much of the time, but low flows persist throughout the year. Irrigation in developed areas of the watershed exceeds the capacity of the soil and vegetation to evaporate and transpire the applied water, so excess irrigation water flows through shallow groundwater to adjacent streams. Low flow monitoring data (e.g.,, Buena Creek) show highly elevated concentrations of both total phosphorus and total nitrogen, and is correlated with developed areas of the watershed. Lawn and landscaping fertilization is likely an important nutrient source in shallow groundwater. Reducing irrigation return flow impacts has two separate components – reducing nutrient loads at the source, and reducing return flow itself.

Several tools can be employed to reducing fertilizer use at both new and existing development sites, including:

- Homeowner education about the impacts of over-fertilization
- Encourage or require soil testing to determine proper fertilization rates
- Certification and training of lawn and landscaping care companies to require application of fertilizer at appropriate rates, and prevent misapplication to impervious surfaces

Irrigation cannot be eliminated from the developed landscape of the Agua Hedionda watershed; it is essentially required by California law (Public Resources Code 4291) for fire protection around building structures. A 100-foot "minimum defensible space" must be maintained around housing structures, including a 30-foot perimeter "Home Defense Zone" which must have few trees and vegetation with high moisture content. However, this does not imply overwatering; in fact, San Diego Department of Planning and Land Use recommends using drought tolerant plant species and providing irrigation only when necessary (San Diego County, 2008).

If irrigation meets but does not exceed demand, then irrigation return flow can be greatly reduced or even eliminated. However, low water rates provide little incentive to conserve water, and irrigation water use comprises about 50 to 70 percent of total water use (Carlos Michelon, San Diego County Water Authority, personal communication, March 4, 2008). California Assembly Bill 325, the Model Local Water Efficient Landscape Ordinance, went into effect in 1993 and specifies restrictions on irrigation throughout California; however, adherence to these restrictions appears to be limited. Rulemaking is currently underway to strengthen the 1992 requirements by 2010.

Irrigation return flow can be reduced, and perhaps nearly eliminated by implementing the following measures:

- Stronger enforcement of the Model Local Water Efficient Landscape Ordinance in its current form, and adopting and enforcing the pending update
- Property owner education about the impacts of irrigation return flow

- Pilot programs to test innovative technologies for sensing irrigation demand and reducing water use
- Explore the possibility of cost-sharing for technologies that reduce water use

Stormwater Management

Providing adequate sediment and erosion control practices during site construction is a critical part of site management for protecting water resources. While active construction sites are usually developed and stabilized within a relatively short time period, the construction phase of a project has an especially high risk for impacting water resources. Soil erosion rates from uncontrolled construction sites can be extremely high, especially if gullies or washouts develop. Fortunately, the managing authorities in the Agua Hedionda watershed already have strong and well-developed sediment and erosion control programs (David Hauser, City of Carlsbad, personal communication, October 2007). These programs should continue to be supported and maintained to ensure compliance with requirements, thus reducing the risk of construction phase impacts to water quality. See Appendix A for more information about sediment and erosion control regulations.

Post-construction stormwater runoff can be managed in many ways, and the combination of site design and BMP selection can lead to a plan that minimizes stormwater impacts to water resources. This section provides an exploration of projected benefits of two different stormwater management scenarios – one based on basic adoption of LID practices as specified by the 2007 Order (called "*Basic LID*"), and another based on a higher level of LID implementation (called "*Enhanced LID*"). The degree to which LID practices will be required in the future depends on many factors. There is currently some uncertainty in the Agua Hedionda watershed about future requirements – implementation of pending TMDLs may include a stormwater management component, with recommendation for specific BMPs to optimize reductions for target pollutants. Communities may elect to implement LID to varying degrees. The modeled LID scenarios should not be interpreted as extremes in design, nor should the results be seen as absolute. Many other scenarios with varying degrees of LID implementation could be conceived, and pollutant removal performance is based on central tendencies from monitoring studies, but inherently contains some uncertainty. The scenarios also use generic site assumptions, but in reality each site is unique and presents its own opportunities for adoption of LID practices.

Assumptions for each of the two scenarios were developed for the following representative land uses:

- Medium Density Residential
- Multi-family Residential
- Commercial
- Industrial/Warehouse

The selection of treatment practices was influenced by the following factors:

- Existing post-construction stormwater management requirements
- Constraints related to the physical environment of the watershed that limit the use of certain practices
- For each type of site modeled, treatment practice feasibility with respect to site layout and economic considerations

Each of these is discussed, followed by a summary of the LID scenario analysis. The following information used for treatment practice selection has application to stormwater management and LID in a broader sense, and forms the basis for many of the recommendations in the Prioritization section. Details of the analysis are presented in Appendix J, including site specific assumptions, BMP performance assumptions, and the modeling framework used for the analysis.

Post-construction Stormwater Management Requirements

Regulations are the primary driver for shaping site stormwater management, and well constructed requirements can be used to implement watershed-wide goals. The 2007 Order stipulates that local governments must encourage the use of LID in new development and redevelopment projects. San Diego County has developed a Low Impact Development Handbook to provide guidance during this initial phase of LID implementation. The Manual states that there is "a lack of research and pilot projects in an arid environment". With the few LID examples in the region, there is a lack of project information or lessons learned.

At a minimum, developers must meet the existing design criteria from the 2001 Order, which include:

- Volume-control based BMPs that provide treatment to the volume of runoff produced from a 24-hour 85th percentile storm event
- Flow-control based BMPs that provide treatment for a specified flow rate based on a set rainfall intensity (either fixed or dependent on the local 85th percentile storm)

Additional peak flow requirements are specified by the 2007 Order (matching pre-development peak flows up to the 10-year 24-hour storm event). All site designs under both scenarios are assumed to meet the requirements of both the 2001 and 2007 Orders as stated above. However, the extent of required future LID adoption is unknown, so the two LID scenarios vary in the assumed level of LID adoption.

Environmental Constraints

Rainfall. The Agua Hedionda watershed gets approximately 10 to 13 inches of rainfall per year. Many of the streams in the watershed are dry except during the large, infrequent rain events (or their baseflow is maintained artificially by irrigation return flow). Techniques that require substantial water input to maintain a permanent pool (e.g., wet ponds and wetlands) are not likely to be seen as sustainable by some stakeholders, and have another risk – if water rates increase, or if the pool is maintained by irrigation return flow that dwindles under irrigation use restrictions, the pools could dry up and become a sediment and pollutant source. Other techniques developed for more humid environments (e.g., bioretention) may not perform as expected without permanent irrigation. Note that the arid environmental constraint affects not only new development projects, but also redevelopment and retrofit projects.

Fire. As noted in the discussion regarding irrigation return flow, there are state fire safety rules that limit the type and density of vegetation within 100 feet of building structures. These regulations may potentially affect the feasibility of some practices that rely on vegetation for treatment; especially those that work best when distributed throughout a site. When selecting plants for BMPs, developers may need to strike a balance between appropriate hydrologic requirements and fire resistance. Note that this constraint affects not only new development projects, but also redevelopment and retrofit projects.

Slope. The steep slopes present in much of the watershed pose a challenge to minimizing the use of fill material (because fill is often used in construction to maximize buildable area). Fill slopes are designed specifically to minimize infiltration of water into the fill and drain runoff off the land surface. As a result, the engineered compacted soil is not conducive to infiltrating excess runoff on steep slopes. Tetra Tech analyzed the developable land in the Agua Hedionda Watershed per designated future land use, and determined that slope is not a major constraint for new development requiring stormwater management. 0 depicts the areas projected to develop in the watershed in green, orange, and pink. Green indicates areas with slope less than 15 percent, orange is used for slopes 15 percent to 25 percent, and red is for slopes greater than 25 percent. As the figure demonstrates, almost all of the developable land has a slope of less than 15 percent. The only exception is an area in the far eastern part of the watershed, which is anticipated to develop as Very Low Density Residential (cross-hatched area) and would not be considered a priority project under the 2001 and 2007 Orders. However, slope is an important consideration at individual sites, and may limit the choice of management practices.

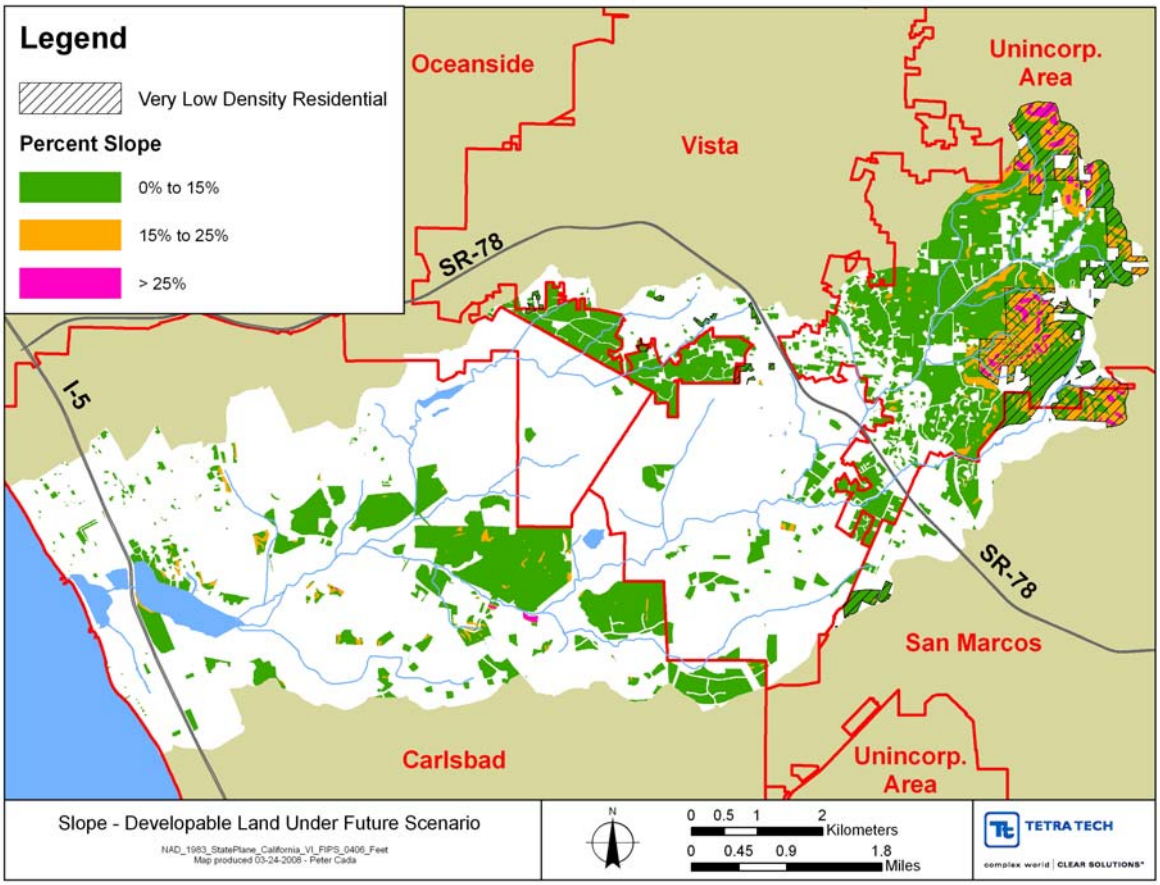

Figure 6-1. Slope Class for Developable Land

Soil Infiltration Rate. Many LID practices rely on infiltration of stormwater runoff, a treatment method that is highly effective for pollutant treatment and volume reduction. Infiltration trenches and infiltration basins rely on good underlying soil infiltration rates, while treatment by bioretention and porous pavement technologies is improved when infiltration is supported. However, soils with low or very low infiltration rates may slow percolation of stored runoff to the point of being ineffective. For example, in the Piedmont region of the Southeastern U.S. where heavy clay soils dominate, an underdrain system is specified for bioretention (North Carolina Division of Water Quality, 2007). On the other hand, many areas in Seattle, WA with mapped soils showing low infiltration rates were found to support higher rates than expected, and BMPs placed at these sites completely drain and infiltrate runoff within 72 hours (Tracy Tackett, Seattle Public Utilities, personal communication, June 22, 2008). Tetra Tech analyzed the developable land in the Agua Hedionda Watershed per designated future land use, and determined that soil infiltration rates are a major constraint for using LID for new development requiring stormwater management. As seen in 0, most of the developable area has a soil hydrologic group of D (shown in red), which has very low infiltration rates. Most of the remaining developable land has group C soils (shown in orange), which have low infiltration rates. A very small portion of developable land has B soils (shown in yellow), which have moderate infiltration rates. The ubiquitous presence of soils with low or very low infiltration rates in areas projected for future development may eliminate altogether the LID practices that rely exclusively on infiltration, and increase the cost of other practices (such as bioretention and larger porous pavement installations) where an underdrain system may need to be installed and connected to a storm drainage system.

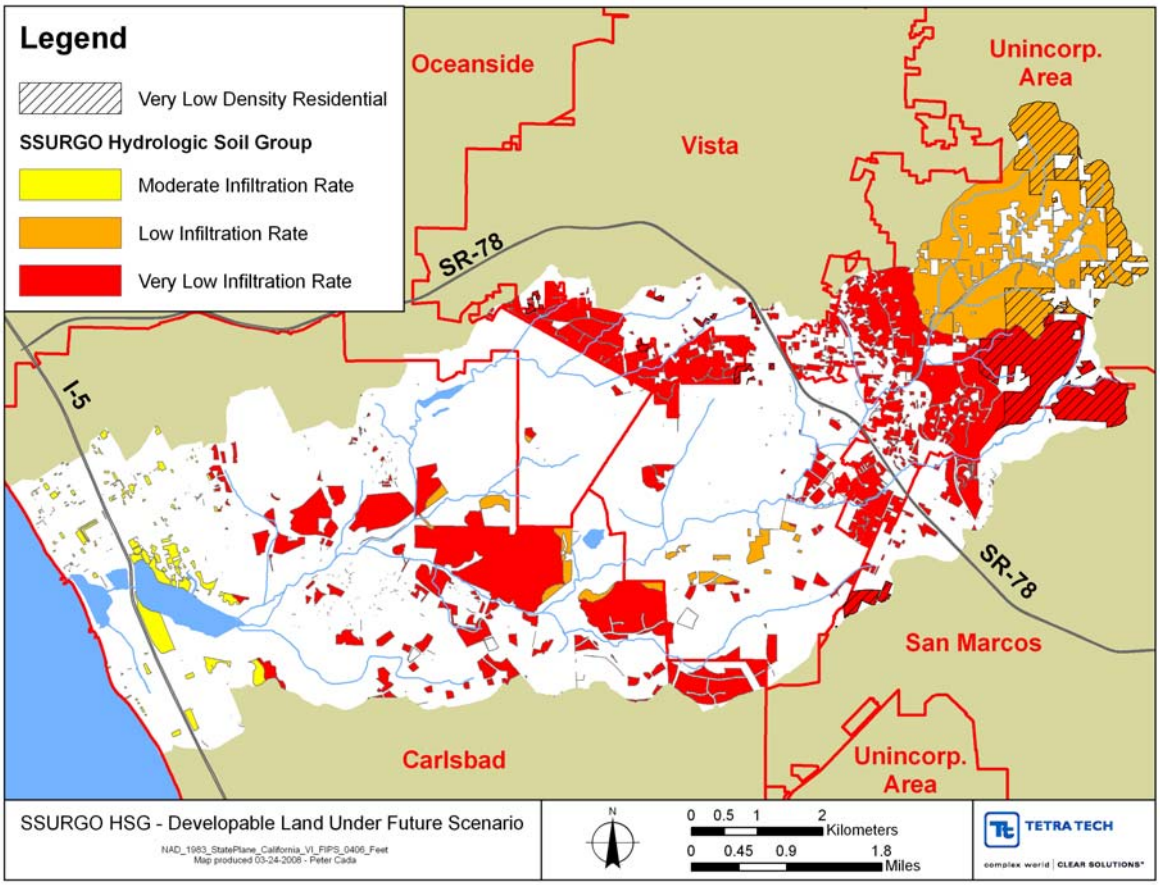

Figure 6-2. Soil Hydrologic Group for Developable Land

Site Specific Practice Feasibility

Site land use and layout of buildings, sidewalks, and driving surfaces has a strong influence on what practices can be incorporated. If a site has a high percentage of impervious area, there is limited pervious area for most structural BMPs. The distribution of the impervious area is also an important factor; if the impervious area is concentrated, it will be more difficult to use dispersed LID BMPs that treat runoff nearer the source; by the same token, it may be easier to route runoff to well-placed BMPs.

As discussed previously, an analysis of two stormwater management scenarios (*Basic LID* and *Enhanced LID*) was performed for four representative land uses to explore potential benefits to water resource protection. The land use categories and impervious area assumptions are shown in Table 6-1. The analysis is presented in detail in Appendix J.

Table 6-1. LID Scenario Land Use Categories

Land Use	Percent Impervious Area	Comments
Medium Density Residential	33%	Single family homes
Multi-family Residential	65%	Mix of large buildings, roads/parking areas, and pervious surfaces distributed throughout the site
Commercial	85%	Small strip shopping center
Industrial/Warehouse	72%	Industrial facility in center of site, surrounding by access roads and parking areas

The *Basic LID* scenario is based on the combined use of vegetated swales (or bioswales) for water quality treatment of part of the site, and an extended dry detention basin treating all of the site, providing both hydrologic control for the 2001/2007 Order requirements, as well as water quality treatment benefits. The site assumptions and configurations are identical to those used in the Agua Hedionda Watershed Modeling and Geomorphic Analysis Report (Tetra Tech, 2008b) for the same land uses. The *Enhanced LID* scenario begins with the *Basic LID* scenario assumptions, but assumes a higher level of treatment, balancing feasibility and cost considerations. For instance, bioretention is not used due to the uncertainty regarding proper vegetation and potential increased cost if an underdrain system is required. Porous pavement was included but not used extensively, again due to uncertainty about infiltration. Large cisterns for irrigation water were included for the Multi-family and Commercial classes, where the combination of large roof surface area and centralized irrigation systems are assumed to make the practice more cost effective. Some of the scenarios assume impervious area reductions as well. The following specific changes implemented in the *Enhanced LID* scenario include:

- Medium Density Residential – a cluster design is used, grouping the housing units closer together on smaller lots, and leaving one-third of the site as undeveloped open space. Impervious area is reduced by decreasing driveway length, sidewalk use, and overall road footprint.
- Multifamily Residential – Impervious area is reduced somewhat by more efficient layout. Porous pavement is used for all sidewalks. The swales treat a greater proportion of the site. Large cisterns capture roof runoff, and reuse the water for irrigation.
- Commercial – Porous pavement is used for large fraction of the parking area. Large cisterns capture roof runoff, and reuse the water for irrigation.
- Industrial – The most challenging site, with layout constraints and little economic incentive for cisterns for irrigation. Porous pavement parking spaces is assumed (a small fraction of the total paved surface), and the swales treat a greater proportion of the site.

Further details regarding site layout assumptions and BMP treatment are discussed in Appendix J. The results of the analysis estimate that implementation of *Basic LID* treatment practices would reduce sediment loads by about 60 – 70 percent, and fecal coliform loads by almost 90 percent. Total nitrogen and total phosphorus removal would be considerably less, ranging from 35 – 45 percent and 25 to 30 percent, respectively. The *Enhanced LID* techniques improve sediment removal to some degree for most of the develop classes, but nitrogen and phosphorus removal are improved considerably. Multi-family Residential and Commercial land uses under *Enhanced LID* provide additional storm event peak flow and duration reductions due to the use of large cisterns, and are likely to reduce risk of downstream channel erosion over the *Basic LID* design. More results are shown the LID Implementation Benefits section (7.4.1) and in Appendix J.

The following actions will be required to successfully implement the recommendations in this section:

- Revision of local codes to incorporate recommended *Basic LID* techniques.
- *Basic LID* techniques include reducing and disconnecting impervious area; extended dry detention; swales or bioretention; and stream buffers (included in Order 2007-001).
- Tracking compliance with stormwater management and LID.
- Review the site plan and engineering plans for compliance with LID requirements (included in Order 2007-001).
- Implementation of the *Enhanced LID* techniques following the adoption of new hydrology and/or new water quality requirements.
- Additional revision of local codes, as needed, to meet future, more stringent requirements.
- Feasibility studies for cisterns, porous pavement, and bioretention without irrigation. If soil infiltration rates are found to be higher than expected and support bioretention and porous pavement without underdrain systems, then feasibility studies should be expanded to include infiltration basins on sites with lower slopes and low risk for grade failure.
- Stronger enforcement of the Model Local Water Efficient Landscape Ordinance in its current form, and adopting and enforcing the pending update.
- Programs to support reduced use of irrigation for developed sites, including property owner education, pilot programs to test innovative technologies for use reduction, and cost-sharing for technologies that reduce water use.

Implementation strategies to accomplish these actions are described in more detail in Section 1.

6.2 PRESERVATION AND RIPARIAN BUFFER AND WETLANDS RESTORATION

The Agua Hedionda Watershed Management Plan provides an opportunity to identify 1) remaining high quality habitat and 2) opportunities to restore lost habitat. Land acquisition prevents remaining natural areas from being developed or disturbed; this type of management also maintains the existing quality of the natural areas through stewardship activities, such as invasive species control. Riparian buffer restoration seeks to remove invasive species and revegetate native riparian vegetation along streams and other waterbodies. Wetlands restoration reestablishes wetland hydrology and vegetation on land where historic wetlands have been impacted or destroyed. Some overlap occurs between these practices and stream restoration, but generally stream restoration focuses more on restoring the shape and function of a stream through instream controls, recontouring, and other engineering practices.

The preservation and restoration opportunities were evaluated based on screening criteria that measure how well the opportunities meet the goals and objectives of the WMP. These opportunities particularly address Goal #2 while also addressing water quality concerns relating to Goal #3. Indicators identified to measure achievement of these goals were used when selecting and evaluating these opportunities. The opportunities considered for land acquisition, buffer restoration, and wetlands restoration are collectively referred to hereafter as "AqRest" opportunities.

6.2.1 Screening Criteria

The screening criteria used for the AqRest opportunities identify conditions in the watershed where management would be most successful at achieving the WPG's habitat objectives under Goal #2 and

water quality objectives under Goal #3. Table 6-2 lists the screening criteria developed for the purpose of selecting and prioritizing AqRest opportunities and illustrates which criteria were used for each type of opportunity. Several of the screening criteria are used to prioritize more than one opportunity. In the Agua Hedionda Watershed Acquisition and Restoration Report (Tetra Tech, 2008a), details are provided on how screening criteria and associated data were used to evaluate each type of opportunity.

The data and screening criteria were used to calculate metrics to measure achievement of the WPG's objectives. A metric is defined, for the purposes of this evaluation, as a measurement that can be used to identify and prioritize management opportunities according to the goals and objectives. Metric methods can vary in complexity, from the count of species observations per subwatershed to a set of rules involving treatment status and distance from invasive species infestations.

The metrics were used to develop a scoring system that prioritized management opportunities. A separate scoring system was developed for each type of management. The scoring systems were linked in some cases, where a metric calculated for one type of management helped better prioritize another type of management. For example, the priority subwatershed metric developed for the land acquisition prioritization was also applied to the buffer and wetlands restoration prioritization to identify restoration opportunities that provided connectivity to existing habitat. Following Tetra Tech (2008a), the WPG provided comments on the screening criteria and the updates were made to the prioritization and scoring methods, as detailed in Appendix B. Screening criteria added following these comments are noted in Table 6-2.

Table 6-2. Initial Screening Criteria Selected to Evaluate Land Acquisition, Buffer Restoration, and Wetlands Restoration Opportunities

Screening Criteria / Data	Land Acquisition	Buffer Restoration	Wetlands Restoration
SC-1 Natural Area	✓		
SC-2 Protected Natural Areas	✓		
SC-3 Unprotected Natural Areas	✓		
SC-4 Existing Terrestrial Habitat	✓		
SC-5 Invasive Species Extent and Status of Treatment	✓		
SC-6 Riparian Habitat (Existing and Estimated Historic Extent)	✓		
SC-7 Priority Subwatersheds	✓	✓	✓
SC-8 Restoration Reaches	✓	✓	
SC-9 MSCP/MHCP Species	✓		
SC-10 Aquatic Habitat	✓		
SC-11 Wetland Function using California Rapid Assessment Method	✓		✓
SC-12 Lagoon Subwatersheds	✓		
SC-13 Erosion Hazard Index	✓		
SC-14 Riparian Buffer or Wetland Restoration Opportunity		✓	✓
SC-15 Riparian Restoration Opportunity		✓	
SC-16 Wetlands Restoration Opportunity			✓
SC-17 Mature Riparian Trees		✓	✓[1]
SC-18 Sewer Constraints		✓	✓
SC-19 Road and Bridge Constraints		✓	✓
SC-20 Priority and Linkage Subwatersheds		✓	✓
SC-21 Coastal Subwatersheds			✓
SC-22 Stakeholder Priority	✓[1]		✓
SC-23 Total Opportunity Area	✓[1]		

[1] These screening criteria were added following stakeholder comments on Tetra Tech (2008a).

As a parallel effort to identify AqRest opportunities, Tetra Tech asked WPG members, resource agencies, conservation organizations, and other stakeholders to recommend locations in the watersheds for land acquisition and preservation as well as wetlands restoration. Under the stakeholder priority screening criteria, the stakeholder recommended opportunities that contained natural area or wetlands restoration opportunity were given a higher score under either the land acquisition or wetlands restoration prioritization. For a subset of these opportunities, stakeholders provided information on the location, amenities, and status of management, which is provided in the Management Opportunity Database (a spreadsheet tool that will be given to decision makers with the WMP).

6.2.2 Prioritization

6.2.2.1 Land Acquisition for Preservation

Parcels with unprotected natural area were considered opportunities for land acquisition and habitat preservation within the watershed. Prioritization focused on evaluating both the quality of the parcel identified for preservation and the quality of the surrounding habitat. The methods used to score and rank the parcels identified for preservation are described in Tetra Tech (2008a). As indicated above, these scoring methods were updated based on WPG comments. Detailed scoring results are provided in the opportunity database provided with this plan.

Figure 6-3. View of Upland Terrestrial Habitat

Table 6-3 lists the 25 top ranking land acquisition and preservation opportunities based on the revised scoring methods. Planning-level, conceptual costs are provided based on methods outlined in Tetra Tech (2008a). These costs include the cost to preserve the land from further development (acquisition cost) and the cost to manage the land in perpetuity (endowment cost). Long-term management needs may include invasive species control, fire prevention, removal of diseased trees, and other maintenance activities. The successful preservation of these properties depends on their location being kept confidential prior to landowner outreach. For this reason, their locations are only provided in the confidential opportunity atlas in Appendix G.

Figure 6-4. Existing Natural Riparian Habitat – Agua Hedionda Creek (Reach 17)

The 25 top ranking land acquisition and preservation opportunities range from about 2 to 50 acres and include 387 acres in total. The cost of purchasing and maintaining all top ranking parcels is estimated to range from $38 to $95 million for fee simple acquisition. This cost may be reduced through purchase of conservation easements, bargain sales, etc. The total cost per acre is estimated to range from $45,000 to $280,000. The variation in cost per acquisition is due to the differences in value between riparian, upland, and coastal areas. Riparian areas are typically undevelopable and therefore less expensive to acquire than upland areas; land in coastal areas tends to be more expensive than land in more inland areas. Since these estimates are planning-level, conceptual costs, they should not be used for funding allocation in a capital budget plan but can be used to estimate costs for a grant application.

The following actions will be required to successfully implement the recommended land acquisition and preservation opportunities:

- Field evaluation.
- Identify project proponent (site-by-site)[1]
- Landowner outreach
- Coordination with cultural resources priorities
- Secure funding sources
- Identify/secure stewardship organizations
- Develop stewardship plan
- Purchase Property
- Annual acquisition/restoration workshop
- Update/maintain prioritization tool

Implementation strategies to accomplish these actions are described in more detail in Section 1 and Appendix H.

[1] Note: Project proponent is one or more entities that wishes to acquire the project site. The proponent may be a local government or other agency, an NGO, and/or a private sector entity that has mitigation needs.

Table 6-3. Land Acquisition and Preservation Top Ranking Opportunities and Conceptual Cost Estimates

WMP ID	Acres of Undisturbed Natural Area	Land Acquisition Cost		Endowment Cost		Total Cost		Total Cost Per Acre	
		Low	High	Low	High	Low	High	Low	High
LA-01	8.5	$616,000	$1,479,000	$85,000	$254,000	$701,000	$1,733,000	$83,000	$204,000
LA-02	15.7	$986,000	$2,310,000	$157,000	$470,000	$1,143,000	$2,780,000	$73,000	$178,000
LA-03	6.1	$391,000	$919,000	$61,000	$182,000	$452,000	$1,101,000	$74,000	$181,000
LA-04	7.6	$455,000	$1,058,000	$76,000	$227,000	$531,000	$1,285,000	$70,000	$170,000
LA-05	5.4	$404,000	$974,000	$54,000	$161,000	$458,000	$1,135,000	$86,000	$212,000
LA-06	11.8	$759,000	$1,786,000	$118,000	$353,000	$877,000	$2,139,000	$75,000	$182,000
LA-07	39.0	$2,986,000	$7,219,000	$390,000	$1,169,000	$3,376,000	$8,388,000	$87,000	$215,000
LA-08	2.3	$82,000	$163,000	$23,000	$69,000	$105,000	$232,000	$45,000	$100,000
LA-10	6.4	$620,000	$1,544,000	$64,000	$191,000	$684,000	$1,735,000	$107,000	$272,000
LA-11	49.4	$4,827,000	$12,037,000	$494,000	$1,482,000	$5,321,000	$13,519,000	$108,000	$274,000
LA-12	38.6	$2,880,000	$6,936,000	$386,000	$1,159,000	$3,266,000	$8,095,000	$85,000	$210,000
LA-18	7.6	$496,000	$1,170,000	$76,000	$227,000	$572,000	$1,397,000	$76,000	$185,000
LA-35	38.3	$3,517,000	$8,708,000	$383,000	$1,149,000	$3,900,000	$9,857,000	$102,000	$257,000
LA-41	2.8	$277,000	$693,000	$28,000	$83,000	$305,000	$776,000	$110,000	$280,000
LA-42	18.5	$1,850,000	$4,625,000	$185,000	$555,000	$2,035,000	$5,180,000	$110,000	$280,000
LA-43	29.4	$2,937,000	$7,343,000	$294,000	$881,000	$3,231,000	$8,224,000	$110,000	$280,000
LA-44	18.7	$1,868,000	$4,670,000	$187,000	$560,000	$2,055,000	$5,230,000	$110,000	$280,000
LA-46	8.2	$823,000	$2,058,000	$82,000	$247,000	$905,000	$2,305,000	$110,000	$280,000
LA-48	3.2	$318,000	$795,000	$32,000	$95,000	$350,000	$890,000	$110,000	$280,000

WMP ID	Acres of Undisturbed Natural Area	Land Acquisition Cost		Endowment Cost		Total Cost		Total Cost Per Acre	
		Low	High	Low	High	Low	High	Low	High
LA-50	2.0	$200,000	$500,000	$20,000	$60,000	$220,000	$560,000	$110,000	$280,000
LA-52	37.7	$3,772,000	$9,430,000	$377,000	$1,132,000	$4,149,000	$10,562,000	$110,000	$280,000
LA-53	16.8	$1,683,000	$4,208,000	$168,000	$505,000	$1,851,000	$4,713,000	$110,000	$280,000
LA-55	2.0	$196,000	$490,000	$20,000	$59,000	$216,000	$549,000	$110,000	$280,000
LA-57	4.0	$398,000	$995,000	$40,000	$119,000	$438,000	$1,114,000	$110,000	$280,000
LA-58	6.5	$654,000	$1,635,000	$65,000	$196,000	$719,000	$1,831,000	$110,000	$280,000

6.2.2.2 Buffer Restoration

Riparian habitat exists between stream channels and upland areas and typically intersects with the floodplain. Riparian buffer restoration involves restoring natural vegetation where riparian habitat has been previously impacted or destroyed. Riparian buffer restoration will provide an important management strategy, particularly when coupled with preservation, bioengineering, and BMP retrofit opportunities. Much of the riparian vegetation in the watershed has been disturbed; however a significant area of land exists where it can be restored.

Riparian buffer restoration management measures, as considered in this management plan, would include restoration (i.e., planting) of riparian vegetation. Appropriate plant communities will need to be selected, and a planting plan should be developed for each site that identifies planting zones based on hydrology, soils, slopes and other factors) for the selected plant communities. Construction activities will involve invasive plant removal, grading, soil conditioning, planting, and soil stabilization. Maintenance and monitoring will be required to ensure success of the restoration. Section 6.3 recommends stream restoration opportunities that use additional measures to restore stream functionality.

It will be important to prioritize riparian buffer restoration where it will provide the greatest benefits for wildlife populations and water quality. One of the WPG's objectives is to enhance and restore riparian habitat. Restoration near or adjacent to existing habitat will directly address this objective because the existing habitat quality will be enhanced by connectivity to the restored areas. When implemented upstream of stream restoration projects, riparian buffer restoration will help protect existing and restored aquatic habitat downstream. Buffer restoration can also enhance efforts to protect mature trees in riparian corridors and will help to establish a new generation of Coast Live Oak and other priority riparian species. Riparian buffers will also provide erosion control and some removal of stormwater pollutants.

To identify areas where riparian habitat could be restored, Tetra Tech estimated the historic and current extent of riparian habitat. This area was estimated using the 100-year floodplain, vegetation cover GIS data, and aerial photographs. The estimated extent of riparian habitat, existing and historic, was termed the targeted buffer area and is shown in Figure 6-5. Undeveloped parcels without natural vegetation were identified as opportunities for riparian habitat restoration.

Figure 6-5 displays the locations of the buffer restoration opportunities and groups the opportunities into three priority levels based on the updated scoring. Table 6-4 lists the 27 top ranking buffer restoration opportunities based on the revised scoring methods; these opportunities are displayed as the high priority level in Figure 6-5. The methods used to score and rank the opportunities are described in Tetra Tech Figure 6-5 (2008a). As indicated above, these scoring methods were updated based on WPG comments. Detailed scoring results are provided in the opportunity database provided with this plan.

Planning-level, conceptual costs in Table 6-4 are based on methods outlined in Tetra Tech (2008a). These costs include preserving the land from further development (acquisition cost), restoring riparian vegetation, and managing the land in perpetuity (endowment cost). Long-term management needs may include invasive species control, fire prevention, removal of diseased trees, and other maintenance activities. Since these estimates are planning-level, conceptual costs, they should not be used for funding allocation in a capital budget plan but can be used to estimate costs for a grant application.

The 27 top ranking buffer restoration opportunities range from about 0.2 to 29 acres and include 129 acres in total. The estimated cost of purchasing through fee simple acquisition, restoring, and maintaining all top ranking parcels is estimated to range from $10 to $19 million. This cost may be reduced through purchase of conservation easements, bargain sales, etc. The total cost per acre is estimated to range from $42,000 to $160,000 per acre. The variation in cost per acquisition is due to the differences in value between riparian and upland as well as public versus private ownership. Riparian areas are typically

undevelopable and therefore less expensive to acquire than upland areas. Some parcels are owned by public entities and, therefore, acquisition costs for these parcels were assumed to be zero.

The following actions will be required to successfully implement the recommended buffer restoration opportunities:

- Project proponent[1] identification (site-by-site basis)
- Field evaluation
- Landowner outreach
- Contact ACOE and other permitting agencies
- Coordinate with trails and infrastructure
- Coordination with cultural resources priorities
- Preliminary design and cost estimate
- Secure needed permits
- Secure funding
- Secure stewardship organizations
- Final planning and design
- Develop stewardship plan
- Implement Projects
- Annual acquisition/restoration workshop
- Updating/maintaining prioritization tool

Implementation strategies to accomplish these actions are described in more detail in Section 1 and Appendix H.

[1] Project proponent is one or more entities that wish to conduct stream buffer or wetland restoration on the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.

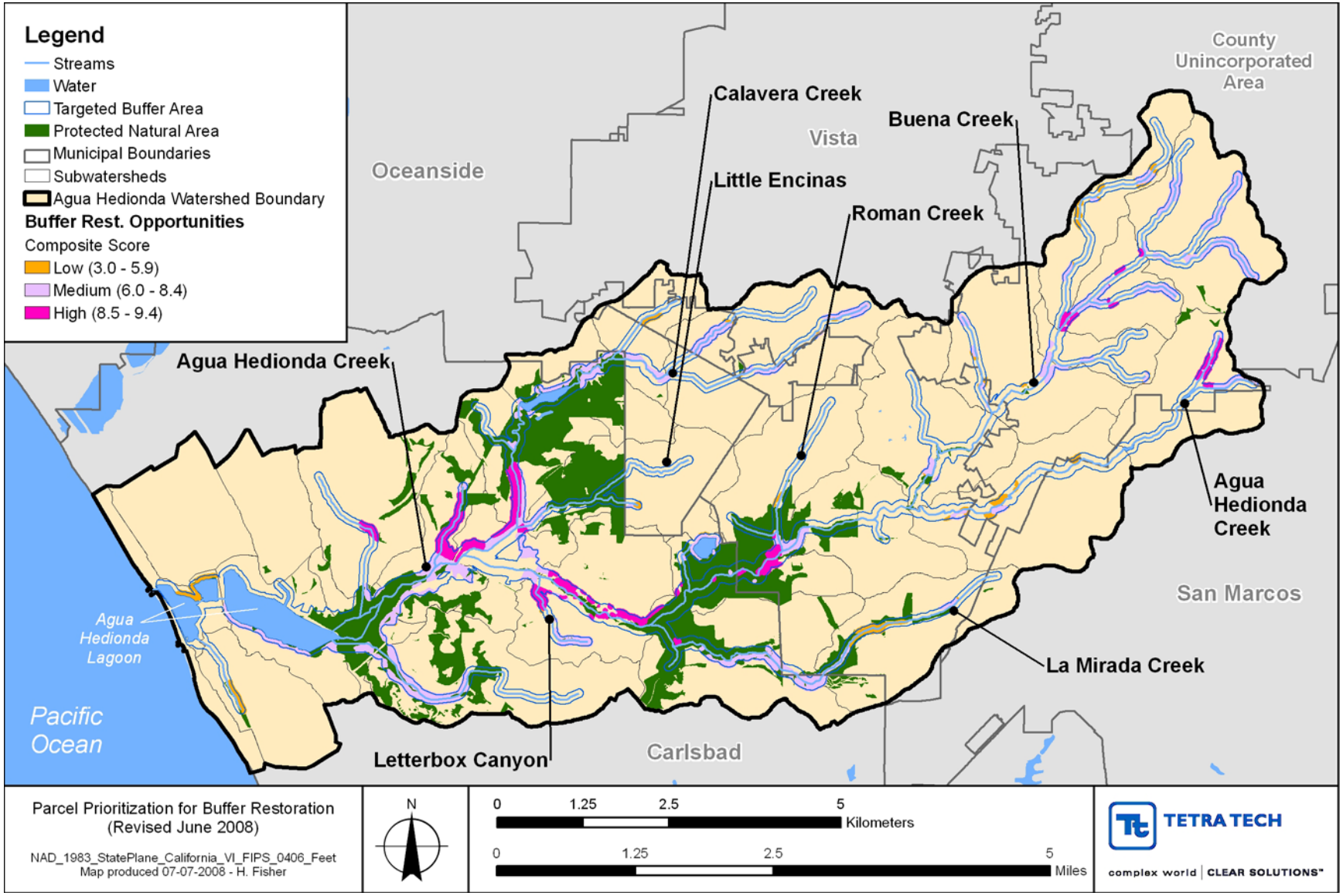

Figure 6-5. Buffer Restoration Opportunities

Table 6-4. Buffer Restoration Top Ranking Opportunities and Conceptual Cost Estimates

WMP ID	Acres of Restoration Opportunity	Land Acquisition Cost		Restoration Cost		Endowment Cost		Total Cost	
		Low	High	Low	High	Low	High	Low	High
BR-01	11.0	$384,000	$769,000	$329,000	$549,000	$132,000	$329,000	$845,000	$1,647,000
BR-02	4.3	$0	$0	$129,000	$214,000	$51,000	$129,000	$180,000	$343,000
BR-03	1.9	$66,000	$132,000	$57,000	$94,000	$23,000	$57,000	$146,000	$283,000
BR-04	1.6	$56,000	$112,000	$48,000	$80,000	$19,000	$48,000	$123,000	$240,000
BR-05	1.0	$34,000	$67,000	$29,000	$48,000	$12,000	$29,000	$75,000	$144,000
BR-06	0.8	$29,000	$59,000	$25,000	$42,000	$10,000	$25,000	$64,000	$126,000
BR-07	0.7	$24,000	$48,000	$20,000	$34,000	$8,000	$20,000	$52,000	$102,000
BR-08	4.1	$143,000	$287,000	$123,000	$205,000	$49,000	$123,000	$315,000	$615,000
BR-10	1.3	$45,000	$90,000	$38,000	$64,000	$15,000	$38,000	$98,000	$192,000
BR-11	1.2	$41,000	$83,000	$36,000	$59,000	$14,000	$36,000	$91,000	$178,000
BR-12	1.1	$39,000	$77,000	$33,000	$55,000	$13,000	$33,000	$85,000	$165,000
BR-13	1.1	$37,000	$75,000	$32,000	$53,000	$13,000	$32,000	$82,000	$160,000
BR-14	0.8	$28,000	$56,000	$24,000	$40,000	$10,000	$24,000	$62,000	$120,000
BR-16	0.2	$0	$0	$7,000	$12,000	$3,000	$7,000	$10,000	$19,000
BR-19	1.2	$41,000	$82,000	$35,000	$59,000	$14,000	$35,000	$90,000	$176,000
BR-21	0.8	$0	$0	$25,000	$42,000	$10,000	$25,000	$35,000	$67,000
BR-22	0.8	$28,000	$55,000	$24,000	$39,000	$9,000	$24,000	$61,000	$118,000
BR-26	21.2	$742,000	$1,484,000	$636,000	$1,060,000	$254,000	$636,000	$1,632,000	$3,180,000
BR-28	3.1	$110,000	$220,000	$94,000	$157,000	$38,000	$94,000	$242,000	$471,000

WMP ID	Acres of Restoration Opportunity	Land Acquisition Cost		Restoration Cost		Endowment Cost		Total Cost	
		Low	High	Low	High	Low	High	Low	High
BR-30	1.2	$40,000	$81,000	$35,000	$58,000	$14,000	$35,000	$89,000	$174,000
BR-31	0.4	$15,000	$30,000	$13,000	$21,000	$5,000	$13,000	$33,000	$64,000
BR-36	29.2	$1,021,000	$2,042,000	$875,000	$1,459,000	$350,000	$875,000	$2,246,000	$4,376,000
BR-37	12.4	$432,000	$865,000	$371,000	$618,000	$148,000	$371,000	$951,000	$1,854,000
BR-38	11.0	$384,000	$768,000	$329,000	$549,000	$132,000	$329,000	$845,000	$1,646,000
BR-39	8.6	$299,000	$599,000	$257,000	$428,000	$103,000	$257,000	$659,000	$1,284,000
BR-40	7.2	$253,000	$506,000	$217,000	$361,000	$87,000	$217,000	$557,000	$1,084,000
BR-46	0.9	$31,000	$63,000	$27,000	$45,000	$11,000	$27,000	$69,000	$135,000

6.2.2.3 Wetlands Restoration

As discussed in Section 4.4, the Agua Hedionda watershed has most likely lost the majority of its historical wetland habitat. Wetlands restoration would seek to restore some of this lost habitat while enhancing the connectivity of overall habitat in the watershed. Beyond habitat, wetlands restoration would also restore the water quality functions of wetlands, including flood control, sediment trapping, and nutrient attenuation.

The types of wetlands restoration measures will vary depending on site-specific characteristics, however, they will typically involve grading and excavation to restore wetland hydrology, invasive species removal, and revegetation. Once properties are identified for landowner outreach and implementation, the opportunities will need to be evaluated in the field and conceptual wetlands restoration designs would need to be developed for each opportunity. Appropriate plant communities will need to be selected, and a planting plan should be developed for each site that identifies planting zones based on hydrology, soils, slopes and other factors) for the selected plant communities. Construction activities will involve invasive plant removal, grading and excavation, soil conditioning, planting, and soil stabilization. Maintenance and monitoring will be required to ensure success of the restoration.

Tetra Tech spoke with a number of mitigation bank managers during the development of the WMP, and those managers generally indicated that wetlands restoration opportunities are difficult to find in the San Diego area, and that coastal wetlands restoration opportunities tend to be both difficult to find and expensive. To ensure that remaining opportunities are captured within the Agua Hedionda WMP, Tetra Tech developed comprehensive geographic information system (GIS) screening methods that identified undeveloped land where wetland vegetation has been cleared or where wetland hydrology has been altered or destroyed. Tetra Tech also documented stakeholder recommendations for wetland restoration opportunities to supplement the opportunities identified through the GIS analysis.

Figure 6-6 displays the locations of the wetlands restoration opportunities and groups the opportunities into three priority levels based on the updated scoring. Table 6-5 lists the 12 top ranking wetlands restoration opportunities based on the revised scoring methods; these opportunities are displayed as the high priority level in Figure 6-6. The methods used to score and rank the opportunities are described in Tetra Tech (2008a). As indicated above, these scoring methods were updated based on WPG comments. Detailed scoring results are provided in the opportunity database provided with this plan.

Planning-level, conceptual costs in Table 6-5 are based on methods outlined in Tetra Tech (2008a). These costs include preserving the land from further development (acquisition cost), restoring wetland vegetation and hydrology, and managing the land in perpetuity (endowment cost). Long-term management needs may include invasive species control, fire prevention, removal diseased trees, and other maintenance activities. Since these estimates are planning-level, conceptual costs, they should not be used for funding allocation in a capital budget plan but can be used to estimate costs for a grant application.

The 12 top ranking wetland restoration opportunities range from about 0.2 to 21 acres and include 47 acres in total. The estimated cost of purchasing through fee simple acquisition, restoring, and maintaining all top ranking parcels is estimated to range from $3 to $10 million. This cost may be reduced through purchase of conservation easements, bargain sales, etc. The total cost per acre is estimated to range from $42,000 to $250,000 per acre. The variation in cost per acquisition is due to public versus private ownership. Some parcels are owned by public entities and, therefore, acquisition costs for these parcels were assumed to be zero. None of the wetlands restoration opportunities were in coastal subwatersheds and, therefore, higher coastal property values were not considered.

Two promising wetlands restoration opportunities were added to the stakeholder recommended list after the above analysis. These opportunities are both on California Department of Fish and Game (CDFG)

managed ecological reserve lands. They are tidally influenced but function relatively poorly due to a number of factors, principally elevation and drainage. The creation of greater tidal channels and vegetated marshlands in the present salt panne habitat areas is recommended to provide greater larval fish production at Agua Hedionda Lagoon. It should be noted that some of the higher flats are used by nesting birds and thus some consideration should be given to how restoration can provide a net benefit instead of replacing one resource or habitat with another (Keith Merkle, Merkle & Associates, personal communication to Meleah Ashford, July 2008). The Management Opportunity Database provides more details on these and other stakeholder recommended wetlands restoration opportunities.

The following actions will be required to successfully implement the recommended wetlands restoration opportunities:

- Project proponent[1] identification (site by site basis)
- Field evaluation
- Landowner outreach
- Contact ACOE and other permitting agencies
- Coordinate with trails and infrastructure
- Coordination with cultural resources priorities
- Preliminary design and cost estimate
- Secure needed permits
- Securing funding
- Secure stewardship organizations
- Final planning and design
- Develop stewardship plan
- Implement Projects
- Annual acquisition/restoration workshop
- Updating/maintaining prioritization tool

Implementation strategies to accomplish these actions are described in more detail in Section 1 and Appendix H.

[1] Project proponent is one or more entities that wish to conduct stream buffer or wetland restoration on the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.

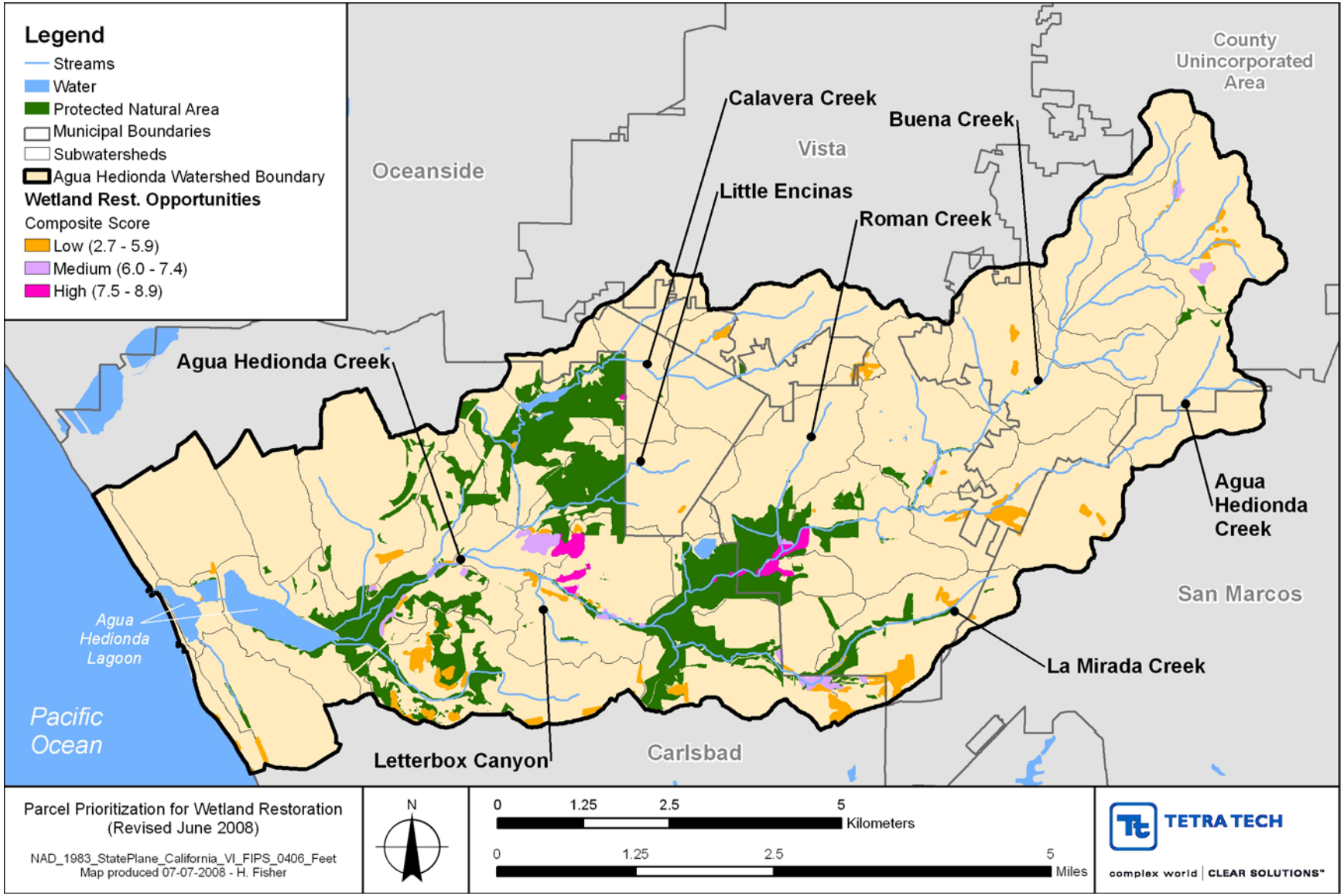

Figure 6-6. Wetlands Restoration Opportunities

Table 6-5. Wetlands Restoration Top Ranking Opportunities and Conceptual Cost Estimates

WMP ID	Acres of Restoration Opportunity	Land Acquisition Cost		Restoration Cost		Endowment Cost		Total Cost	
		Low	High	Low	High	Low	High	Low	High
WR-01	6.1	$213,000	$426,000	$183,000	$761,000	$73,000	$183,000	$469,000	$1,370,000
WR-02	3.6	$0	$0	$108,000	$448,000	$43,000	$108,000	$151,000	$556,000
WR-04	0.4	$16,000	$31,000	$13,000	$56,000	$5,000	$13,000	$34,000	$100,000
WR-05	0.9	$33,000	$66,000	$28,000	$118,000	$11,000	$28,000	$72,000	$212,000
WR-07	0.2	$0	$0	$7,000	$30,000	$3,000	$7,000	$10,000	$37,000
WR-08	4.3	$0	$0	$130,000	$543,000	$52,000	$130,000	$182,000	$673,000
WR-09	3.3	$0	$0	$100,000	$417,000	$40,000	$100,000	$140,000	$517,000
WR-10	3.0	$0	$0	$90,000	$377,000	$36,000	$90,000	$126,000	$467,000
WR-11	0.2	$7,000	$13,000	$6,000	$24,000	$2,000	$6,000	$15,000	$43,000
WR-13	20.5	$716,000	$1,433,000	$614,000	$2,558,000	$246,000	$614,000	$1,576,000	$4,605,000
WR-14	4.2	$146,000	$292,000	$125,000	$522,000	$50,000	$125,000	$321,000	$939,000
WR-16	0.4	$0	$0	$12,000	$51,000	$5,000	$12,000	$17,000	$63,000

6.3 STREAM RESTORATION

The stream restoration opportunities identified for the Agua Hedionda WMP support the WPG's Goal #2 – to protect, restore and enhance habitat in the watershed. The main focus of the stream restoration projects is objective 2e – maintain stable streambanks and riparian areas to protect instream aquatic habitat and priority tree species. The stream restoration projects also address objective 2b – protect, enhance, and restore terrestrial habitat, especially existing vegetation in riparian areas by providing a stable environment (i.e., stable streambanks). The stream restoration projects indirectly meet objective 2g – maintain and protect lagoon habitat by limiting the delivery of excess sediment that is a result of mass wasting of unstable streambanks.

Stream restoration opportunities focus on in-stream measures that meet these goals and objectives. Stream restoration, as recommended in this WMP, involves installing grade control structures within a stream channel to achieve an equilibrium between sediment inflow and transport capacity of the stream. Components of grade control structures include loose rock structures, channel lining, and more rigid structures. Loose rock structures are recommended for stream stabilization to mimic the appearance of natural stream beds. The traditional rock grade control structures would be low profile (approximately two feet in height) and can be used to create riffles along the stream. It may be necessary to add fill to the channel bed to begin to rebuild the bed elevation to an equilibrium state. Completely soft bank stabilization measures are not recommended because the highly erosive forces evident in the watershed would likely undermine these measures. Additional information on grade control structures is provided in Tetra Tech (2008c).

6.3.1 Screening Criteria

Based on the geomorphic analysis in Tetra Tech (2008b), the most significant stream concern is the widespread channel erosion. As discussed in 4.2, some channel banks have experienced significant bank erosion while other locations have been limited to undercutting at the toe of the bank. Numerous locations have experienced channel incision (lowering of the channel invert). However, some amount of erosion in the channel can be seen in most reaches of the stream systems throughout the watershed.

Stream restoration opportunities were identified based on the following investigations:

- Field reconnaissance
- Stakeholder recommended opportunities
- Review of historic aerial photographs

These investigations were part of the geomorphic analysis described in Section 4.2. The opportunities were selected where evidence of significant channel erosion and instability was found and where restoration was likely to have the greatest success at restoring functionality. Once opportunities were identified, additional field reconnaissance was conducted to determine the specific restoration needs of the stream reaches. Conceptual plans for each stream reach were developed that describe the measures necessary to address channel erosion and instability.

At this level of conceptual design, Tetra Tech made the assumption that changes to the channel slope would be adequate to achieve equilibrium conditions to restore stream functions. It is important to note that additional hydrologic, hydraulic, and sediment transport modeling will be required to move to detailed project design, and this modeling may show that channel modifications, such as channel widening, may be also be necessary to achieve an equilibrium condition.

6.3.2 Prioritization

The evidence of channel erosion and instability was used to identify restoration opportunities that would have the greatest likelihood of success for reducing channel erosion in the watershed. All of the stream restoration projects identified herein are considered high priority projects. The WPG reviewed the opportunities and concluded that all opportunities should be prioritized equally for implementation. They represent those projects where the more significant stability issues are present as well as those that have gained local interest. The location of the identified stream restoration opportunities is illustrated in Figure 6-7. The opportunities area is described in more detail in Tetra Tech (2008c) and 10 percent conceptual plans are provided in Appendix C.

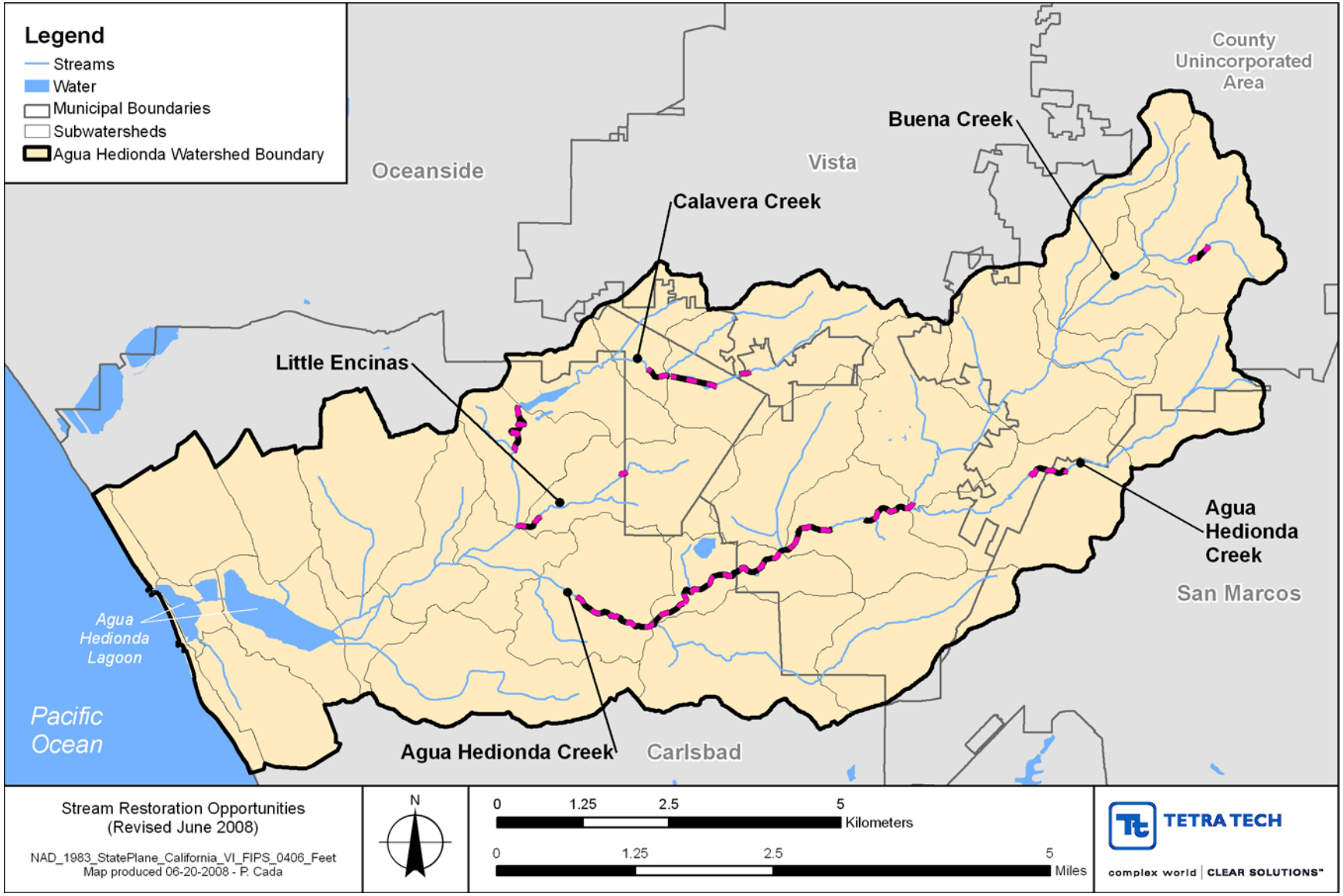

Figure 6-7. Stream Restoration Opportunities

No further prioritization of opportunities is provided; however it is understood that the various agencies and organizations will be interested in pursuing projects that have different elements and support different issues. Below is a description of the five critical factors that were identified and evaluated for each project followed by Table 6-6 which identifies whether each factor applies to an individual project.

- **WMP Goals**
  - Specific objectives for which the project was evaluated include:
    - (1) Objective 2b: Protect, enhance, and restore terrestrial habitat, especially existing vegetation in riparian areas
    - (2) Objective 2e: Maintain stable streambanks and riparian areas to protect instream aquatic habitat and priority tree species.
- **Location**
  - Is the project located in the lower portions of the watershed? It is likely that projects located in the lower watershed can have a greater impact on sediment trapping and prevent that sediment from reaching the lagoon.
- **Public Ownership**
  - Is the property identified for the project in public ownership?
- **Critical Timing**
  - Does the channel exhibit concerns or issues that appear to require more immediate attention? The following critical timing issues have been identified:
    - SR-02 – imminent failure of concrete grade control structure
    - SR-06 – channel is completely blocked with debris at one location
    - SR-07 – development is imminent; property currently available
    - SR-11 – parking lot damage has occurred and will likely continue
- **Multiple Benefits**
  - Can multiple benefits be integrated with the project? The following multiple benefits have been identified:
    - SR-01 – provide flooding relief
    - SR-02 – coordinate with planned sewer line upgrades
    - SR-05 – restoration of significant watershed function prior to planned development

Based on the strong evaluation of project SR-02 and identification of a project proponent (the City of Vista), this project was targeted for further development. For this project, Tetra Tech conducted additional data collection and design to support development of 10 percent conceptual plans. This information is provided in Appendix D.

Table 6-6. Summary of Stream Restoration Opportunities

WMP_ID	Subwatershed Model ID(s)	Length (feet)	Obj 2b: Protect Existing Riparian Veg.	Obj 2e: Maintain Stable Streambanks	Located in Lower Watershed	Public Ownership	Critical Timing	Multiple Benefits	Associated Demonstration BMP (see Section 6.4)
SR-1	1023, 1017, 1016	2,949	x	x				x	
SR-2	1016	2,525	x	x		x	x	x	SW-1
SR-3	1014, 1015, 1016	7,120	x	x	x	x			
SR-4	1013, 1014, 1025	6,272	x	x	x	x			SW-2, SW-3, SW-4
SR-5	1013	600			x			x	SW-2, SW-3, SW-4
SR-6	1022	1,329		x			x		
SR-7	1011	516		x			x	x	
SR-8	1011	2,237		x					
SR-9	1008, 1010, 1011	4,503	x	x	x	x			
SR-10	1012	430	x	x		x			SW-5
SR-11	1007, 1008, 1012	1,454		x	x		x		

Planning-level, conceptual costs were estimated for the stream restoration opportunities (Table 6-7). Additional analysis, modeling and design work will be required to support the restoration opportunities and to develop detailed cost estimates. The following estimates are for a conceptual level of planning and are more appropriate for identifying the relative cost of opportunities among the various sites. These cost estimates should not be used for funding allocation in a capital budget plan but can be used to estimate costs for a grant application. More details on the assumptions used can be found in Tetra Tech (2008c).

Table 6-7. Stream Restoration Opportunity Conceptual Cost Estimates

Site	Total Cost
Site SR-1	$352,046
Site SR-2	$343,924
Site SR-3	$677,361
Site SR-4	$602,917
Site SR-5	$202,778
Site SR-6	$228,639
Site SR-7	$1,158,681
Site SR-8	$298,889
Site SR-9	$485,000
Site SR-10	$187,222
Site SR-11	$268,241

The following actions will be required to successfully implement the recommended stream restoration opportunities:

- Landowner outreach
- Project proponent identification (site-by-site basis)[1]
- Contact ACOE and other permitting agencies
- Coordinate with trails and infrastructure
- Coordinate with cultural resources priorities
- Preliminary design and cost estimate
- Secure needed permits
- Secure funding sources
- Secure stewardship organization
- Final planning and design

[1] Project proponent is one or more entities that wish to conduct stream restoration on the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.

- Develop stewardship plan
- Implement projects
- Annual acquisition/restoration workshop
- Update prioritization tool; coordinate with sewer and storm drain infrastructure programs

Implementation strategies to accomplish these actions are described in more detail in Section 1 and Appendix H.

6.4 STORMWATER BMP RETROFIT PROJECTS

Most of the land that was developed within the Agua Hedionda watershed prior to the year 2001 was not treated for stormwater runoff. Without stormwater controls, the increased runoff can erode stream channels, increase pollutant loadings, cause downstream flooding, and decrease groundwater recharge.

With Order 2001-01, the Regional Board began requiring widespread treatment of stormwater with BMPs to meet MS4 permit requirements. The MS4 co-permittees within Agua Hedionda watershed are San Diego County and the cities of Carlsbad, Vista, Oceanside, and San Marcos. The Order applies to "priority projects", which includes essentially all projects in the Agua Hedionda watershed except for those at the lowest densities. An estimated 70 percent of the development that occurred between the 2001 Order and the year 2007 received some level of stormwater treatment. Areas not receiving treatment were either not considered priority projects or received relatively ineffective treatments (e.g., drain inserts used alone). The Regional Board subsequently updated the permit with additional treatment requirements (e.g., peak flow control and LID) in January 2007 by issuing Final Order No. R9-2007-0001, the 2007 Order. The vast majority of new development now requires treatment of stormwater according to the 2001 and 2007 Orders. Stormwater retrofit projects are meant to address areas that currently are not treated as a result of the 2001 or 2007 Order.

Stormwater BMP retrofit opportunities identified for Agua Hedionda WMP support goal #2, to protect, restore and enhance habitat in the watershed, and goal #3, to restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts. The stormwater retrofit opportunities address both hydromodification impacts and water quality degradation. The process for screening potential BMP retrofit sites and the resulting opportunities are described in the following sections.

6.4.1 Screening Criteria

To address untreated development and restore water quality within the watershed, it is recommended that a program of installing stormwater BMP retrofits be initiated. There are more than 6,000 acres of untreated development within the watershed excluding roads, parks, and very low and low density residential development. Given limited resources to install BMPs to address all of the untreated development within the watershed, a screening process was employed to identify retrofit locations that maximize effectiveness and feasibility. The screening process was implemented on two fronts. First, publically-owned sites were selected within the priority subwatersheds, those with the highest existing runoff and pollutant loading, identified in Section 2. Second, sites adjacent to the identified stream restoration reaches were selected.

There are nearly 3,000 acres of untreated parcels in the priority model subwatersheds first presented in Section 4.1.2. Since it is unlikely that BMPs can be installed to treat all of these parcels in the near term, publically-owned parcels within these subwatersheds have been identified as highest priority parcels for BMP placement (Figure 6-8). There are about 347 acres in 56 parcels of publically owned land within these subwatersheds (Table 6-8). Approximately half are city-owned while the remaining are owned by

school districts, water districts, and the State of California. Given the costs of land acquisition, these parcels represent some of the most feasible potential sites to construct BMP retrofits.

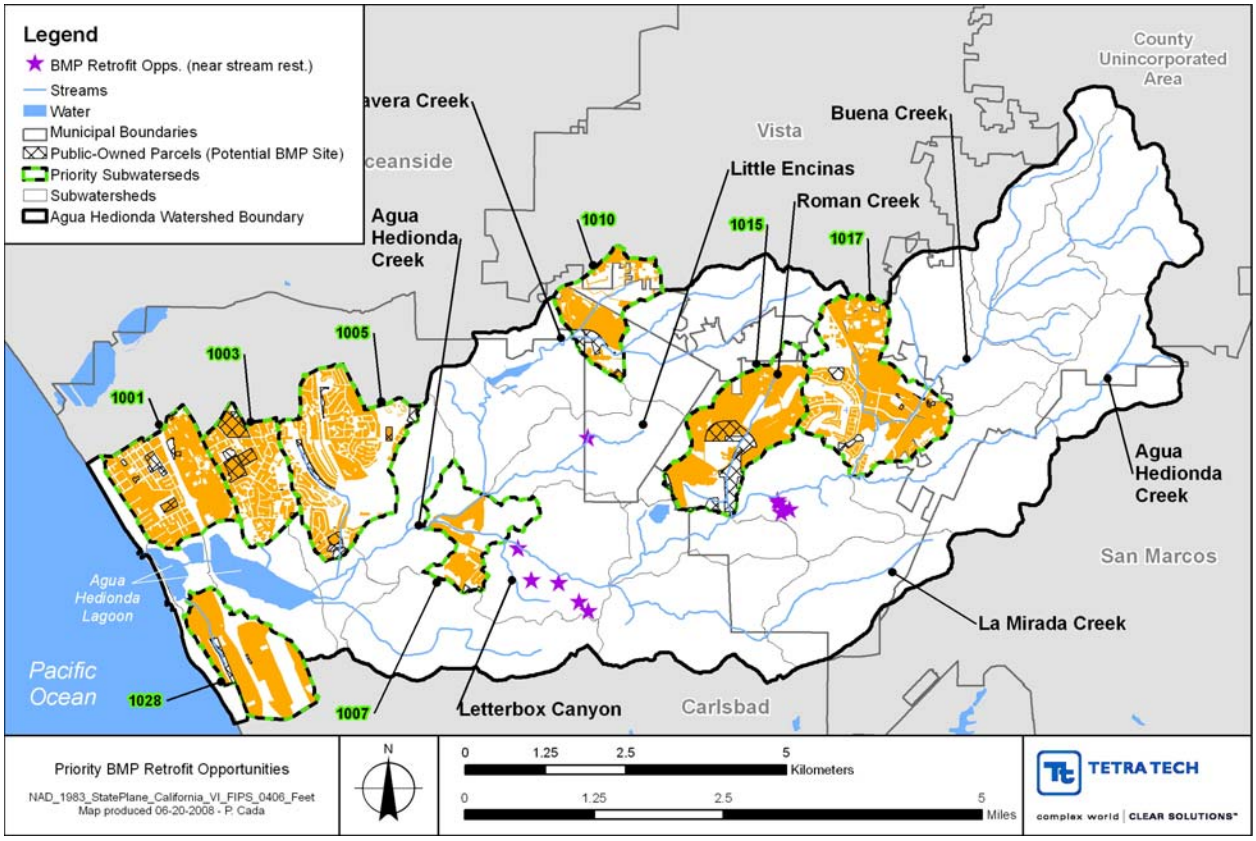

Figure 6-8. Priority BMP Retrofit Opportunities

Table 6-8. Public-Owned Parcels Located within Priority Subwatersheds

Owner	Number of Parcels	Total Parcel Area (ac)	Subwatershed Model ID(s)
Carlsbad Municipal Water District	2	55.9	1005, 1006, 1012, 1014, 1015
Carlsbad Unified School District	18	86.4	1001, 1003, 1005
City of Carlsbad	40	253.8	1001, 1003-1010, 1013, 1027, 1028
City of Carlsbad Redevelopment Agency	3	4.8	1001
City of Oceanside	3	27.1	1009-1011
City of Vista	23	109.9	1015-1017
Regents of the University of California	5	76.6	1014-1015
State of California	3	93.3	999, 1002, 1004, 1005, 1028
Vista Irrigation District	3	2.3	1010, 1015-1017
Vista Unified School District	1	34.6	1015

Stormwater retrofit opportunities have also been identified along reaches where stream restoration projects have been prioritized (Figure 6-8). Site maps for each site are provided in Appendix D. Supplementing the stream restoration project with stormwater retrofits will increase the benefits of the project and provide additional hydraulic stability.

The BMPs chosen for retrofits near stream restoration sites include extended dry detention (typically at the outlets of the drainage areas), rainwater capture cisterns, permeable pavement, and vegetated swales (used as either bioswales along road sides or as recessed medians). Table 6-9 provides details regarding the drainage areas and BMPs selected for each retrofit site. Note that the cumulative percentage of area treated by BMPs exceeds 100 percent for two of the retrofit sites. This occurs because some of the BMPs in those cases treat only a portion of the drainage area, while the extended dry detention ponds treat the entire drainage area. This BMP "treatment train" is common practice where land area limits the use of larger, centralized structures and when more stringent water quality goals are to be met. BMPs in series can provide additional stormwater treatment benefits.

SW-4 was split into two subwatersheds – the larger residential area treated by the extended dry detention, and the median swale to the south of the residential area. The drainage areas are not actually connected, so they were evaluated separately.

Table 6-9. Drainage Area and BMP Retrofit Descriptions

Retrofit Site	Total Drainage Area (ac)	Estimated Percent Impervious	Percent of DA Treated By BMP			
			Extended Dry Detention	Cistern	Vegetated Swale	Permeable Pavement
SW-1	45.0	75%	100%	7.9%		1.8%
SW-2	31.6	72%		5.6%	3.3%	
SW-3	27.7	70%	100%			
SW-4a	30.3	38%	100%		18.5%	
SW-4b	6.9	82%			100%	
SW-5	2.4	85%			100%	

Potential BMP retrofit opportunities have been provided and may form the basis of a targeted program to addressed untreated development in the watershed. For the targeted subwatersheds shown in Figure 6-6, additional upland assessment and site selection will be necessary using publically-owned land as a first cut of potential BMP placement sites. Once sites are selected, additional prioritization is conducted, and funding sources are identified, additional data collection will be needed to support detailed cost estimates, design, permitting and construction. The retrofit sites located outside of the priority subwatersheds, but adjacent to the stream restoration sites, may also be considered for implementation. Though concept designs have been provided as an example of what might be installed on the sites, additional site data would need to be collected to support more detailed design and cost estimation.

Steps included in the implementation process for BMP retrofits include:

- Landowner outreach
- Preliminary design and cost estimation
- Permitting
- Identify and secure funding

- Final planning, design and costs
- Project construction.

6.5 MONITORING

Once WMP implementation has begun, a coordinated monitoring program for water quality, land use change and treatment, restoration, and retrofits should be initiated. Specific tracking indicators identified by the WPG can be integrated with existing monitoring requirements under programs such as the MS4 permit and the MHCP and MSCP programs. Periodically, implementation activities should be reviewed along with water quality monitoring results to provide an understanding of the progress being achieved in managing and restoring the Agua Hedionda watershed. As new information is gathered and effectiveness is assessed, planned implementation actions may need to be modified under a process of adaptive management.

In addition to ambient water quality monitoring through the watershed, land treatment tracking and restoration monitoring are additional components needed as part of WMP implementation. Tracking is recommended for future land use change and any associated BMP treatment. As noted in Section 3, additional WMP tracking indicators include percent of development with LID controls and percent of development with BMPs. This can be coordinated with SUSMP annual reports, SANDAG land use data updates, and other tracking requirements.

6.5.1 Monitoring Indicators

The WPG has selected multiple water quality indicators for future tracking in the watershed (Table 6-10). Indicators include sediment, nutrients, bacteria, metals and pesticides for tributaries to the Agua Hedionda Lagoon. Lagoon indicators include TSS, turbidity, TP, TN, enterococcus, and fecal coliform. The parameters chosen represent those tied to existing impairments and other constituents that are considered elevated and warrant future tracking. Though not specifically identified as a tracking indicator by the WPG, bioassessment will be important to track for restoration of aquatic habitat and biological communities. The basis for parameter selection is discussed further below.

Table 6-10. Monitoring Indicators for the Agua Hedionda Watershed

Indicator	Variables	Linked to Goal #1 Objectives
Observed Water Quality	Tributaries - Copper, Turbidity, Total Dissolved Solids, Total Suspended Solids, Total Phosphorus, Total Nitrogen, Enterococcus, Fecal Coliform, DDT, diazinon; chlorphyrifos Lagoon - Total Suspended Solids, Turbidity, Total Phosphorus, Total Nitrogen, Enterococcus, and Fecal Coliform	1a, 1b
Aquatic Habitat	IBI ratings, benthic bioclass, aquatic habitat index	1a, 1b
Wetland Habitat	CRAM Ratings	1a, 1b

6.5.2 Existing Monitoring in the Watershed

Monitoring has been conducted by multiple organizations in the Agua Hedionda watershed. Each has their own objectives. The Co-permittees have monitoring requirements for their Municipal NPDES Permit which has the following goals:

1. Assess compliance with Order No. R9-2007-0001
2. Measure and improve the effectiveness of the Co-permittees' urban runoff management programs
3. Assess the chemical, physical, and biological impacts to receiving waters resulting from urban runoff discharges
4. Characterize urban runoff discharges
5. Identify sources of specific pollutants
6. Prioritize drainage and sub-drainage areas that need management actions
7. Detect and eliminate illicit discharges and illicit connections to the MS4
8. Assess the overall health of receiving waters

Monitoring to comply with SDRWQCB Investigation Order No. R9-2006-076 (lagoon monitoring) to support source assessments and linkage analyses for TMDL development for sediment (TSS and turbidity) and bacterial constituents is ongoing and described further below. Other organizations have supplemented this monitoring including the San Elijo Lagoon Conservancy, the Watershed Stewards Training for Citizens Monitoring, the Agua Hedionda Lagoon Foundation, and the Carlsbad Watershed Network (described further in Tetra Tech, 2007).

6.5.2.1 Receiving Waters and Urban Runoff Monitoring Program

Regular monitoring is required as part of the Receiving Waters Monitoring Program and Urban Runoff Monitoring program described in the 2007 Order. Receiving waters monitoring is required at a mass loading station, a temporary watershed assessment station, two bioassessment stations, in the lagoon, and at selected coastal storm drains. The mass loading station is monitored twice during wet weather events and twice during dry weather flow events during each year of required monitoring on Agua Hedionda Creek at El Camino Real. The SELC supplements this with continuous flow monitoring.

In Agua Hedionda, mass loading monitoring is required in permit years 1, 2, and 4. Additional monitoring occurs as a temporary watershed assessment station monitoring in year 4. Bioassessment monitoring is required in year 1 and 4 at two sites. Lagoon monitoring of chemistry, toxicity, and benthic infauna is also required in either year 2 as part of the special program (Bight 2008) or in all of the other four permit years.

In addition to toxicity tests, the parameters listed in Table 6-11 are required to be collected at the mass loading and temporary watershed assessment stations.

Table 6-11. Parameters Collected at the Mass Loading Station (based on 2007 Order)

Physical Parameters, Nutrients, Hydrocarbons	Pesticides	Metals (Total and Dissolved)	Bacteria
TDS	Diazanon	Antimony	Total Coliform
TSS	Chlorpyrifos	Arsenic	Fecal Coliform
Turbidity	Ambition	Cadmium	Enterococcus
Total Hardness		Chromium	
pH		Copper	
Specific Conductance		Lead	
Temperature		Nickel	
Dissolved Phosphorus		Selenium	
Nitrite and Nitrate		Zinc	
TKN			
Ammonia			
BOD (5-day)			
COD			
TOC and DOC			
MBAS			
Oil and Grease			

Urban runoff monitoring has several additional monitoring components including MS4 outfalls, source identification, and dry weather monitoring. Dry weather samples have been collected at 10 instream stations and in over 50 storm drains in the Agua Hedionda watershed (these programs are currently being revised based on requirements of the 2007 Order). Co-permittees are also required to utilize monitoring data and analysis from the Receiving Waters Monitoring Program to assess the effectiveness of their programs.

6.5.2.2 TMDL Monitoring

The SDRWQCB issued Investigation Order No. R9-2006-076 to the dischargers to the creeks and lagoons in San Diego County that are 303(d) listed for sediment, nutrients, TDS and bacteria. The Order requires collection of data for the development of TMDLs under the Clean Water Act. The purpose of the monitoring is to address the principal data needs required to develop watershed loading and lagoon water quality models for the parameters of interest in the lagoons to develop TMDLs (City of Encinitas, 2007).

The monitoring plan for Agua Hedionda Lagoon includes: (1) continuous monitoring of hydrodynamic and certain water quality parameters (salinity, temperature, flow or water level, and turbidity[1]), (2) wet weather monitoring, and (3) dry weather monitoring. Monitoring of hydrology and core chemical parameters (salinity, temperature, turbidity, and water-level and flow) will be measured via data sondes at

[1] At the mass emission station, turbidity is only collected during the dry weather index periods.

the mass emission site, within each segment, and at the ocean outlet. Storm event sampling is planned for the ocean outlet at Pacific Coast Highway Bridge, at the lagoon outlet at I-5, at the tributary, the main lagoon segment, and the mass loading station (Figure 6-9). Sediment sampling following the storm event is also planned for the main lagoon segment. Storm events with rainfall ranging from 0.2 inch to 1 inch or greater will be targeted. Dry weather monitoring consists of storm drains, each mass emission site, ocean inlet, and within lagoon sampling sites during key "index" periods. Sampling is expected to be completed in the fall of 2008.

Pollutagraph sampling at the mass emission tributary site will occur during two storm events with eight samples taken throughout the pollutagraph per storm. Five samples will be collected per storm for bacteria analysis. Parameters include flow, TSS, TDS, sediment particle size distribution, and bacteria (fecal coliform, total coliform, and enterococcus).

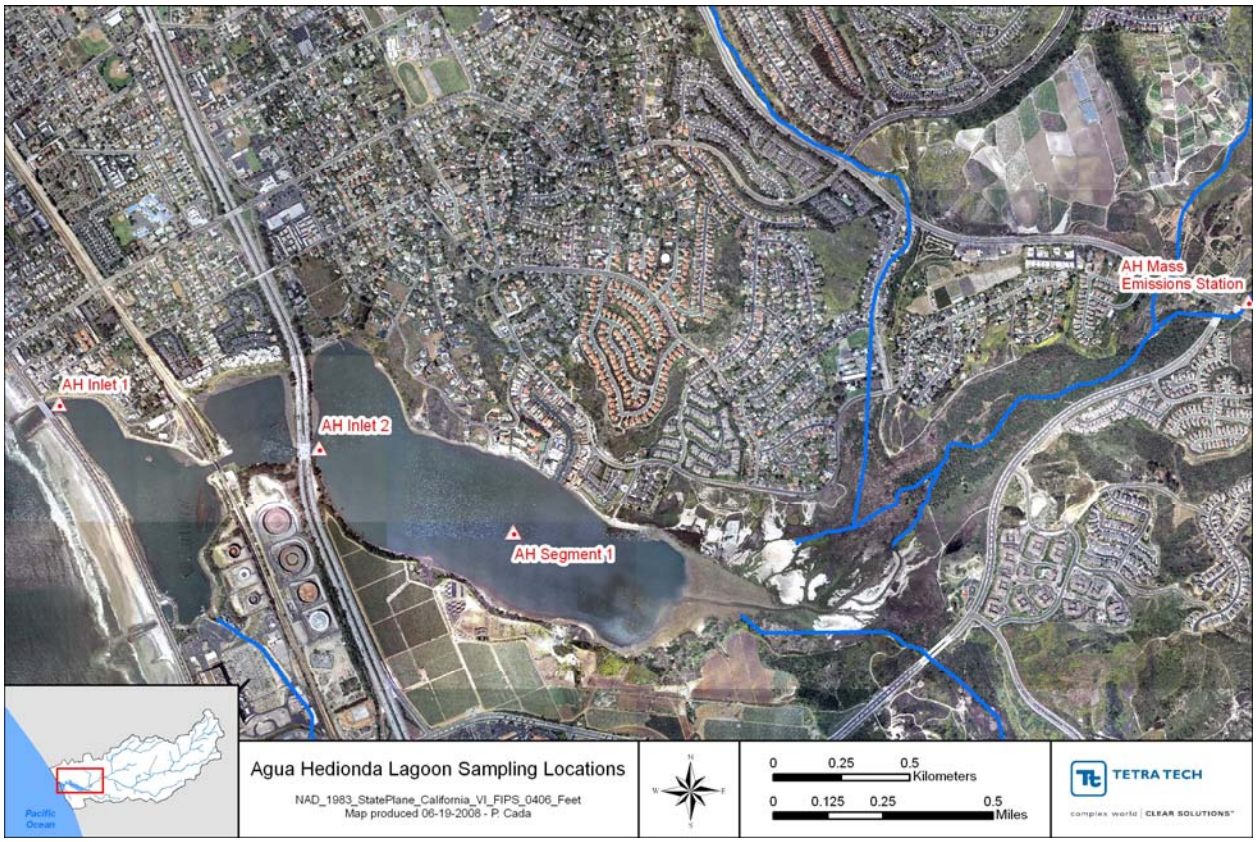

Figure 6-9. Map of TMDL Monitoring Sites

6.5.2.3 CRAM Monitoring

The California Rapid Assessment Method (CRAM) is a technique for monitoring wetlands. It can be used for monitoring efforts within a watershed context to assess cumulative impacts, assist with locating the best sites for restoration, and reporting on restoration project success. It also has the potential to be an excellent tool to standardize the reporting of site impacts and compensatory mitigation under the 401/404 programs, and perhaps for TMDL purposes. In the Fall of 2007, 23 CRAM assessment were performed throughout the watershed. These assessments were utilized to develop the recommendations in this WMP. Future CRAM monitoring can fill in gaps spatially through the watershed and over time to monitor improvements or degradation at specific sites.

6.5.3 Future WMP Monitoring Recommendations

All of the WMP indicators listed in Table 6-10 are collected at the mass loading station on Agua Hedionda Creek (at El Camino Real) and in the lagoon, with a few exceptions. Total phosphorus and DDT are not included in the list of parameters for the mass loading station sampling under the MS4 permit. Since DDT is persistent in the environment and no existing sources are expected, limited monitoring in Buena Creek (e.g., twice a year) of this parameter is likely sufficient. Dissolved phosphorus rather than total phosphorus is collected under the existing permit requirements. The addition of total phosphorus at the mass loading station should be considered given the present uncertainty in the linkage and response of lagoon algal communities.

The specific parameters required for the lagoon monitoring were not identified in the 2007 Order. Nutrients are not being collected as part of the TMDL monitoring since the lagoon is not impaired for nutrients. Both nutrients and bacteria should be monitored in the lagoon on an annual basis. Lagoon sampling should be conducted at the mid-channel station shown in Figure 6-9.

Wet weather monitoring extended to additional sites within the watershed would provide a better understanding of pollutant sources, areas requiring treatment, and watershed improvements. Additional wet weather sites to consider that augment existing wet weather monitoring and provide additional spatial understanding of storm-driven loading include:

1) Buena Creek near Dry Weather Station AH-13 (Figure 6-10)
2) Stormwater Outfalls not currently monitored in Subwatersheds 1001, 1003, and 1005
3) La Mirada Creek near Dry Weather Station AH-59 (Figure 6-10)
4) Calavera Creek at Lake Boulevard and Waverly Road

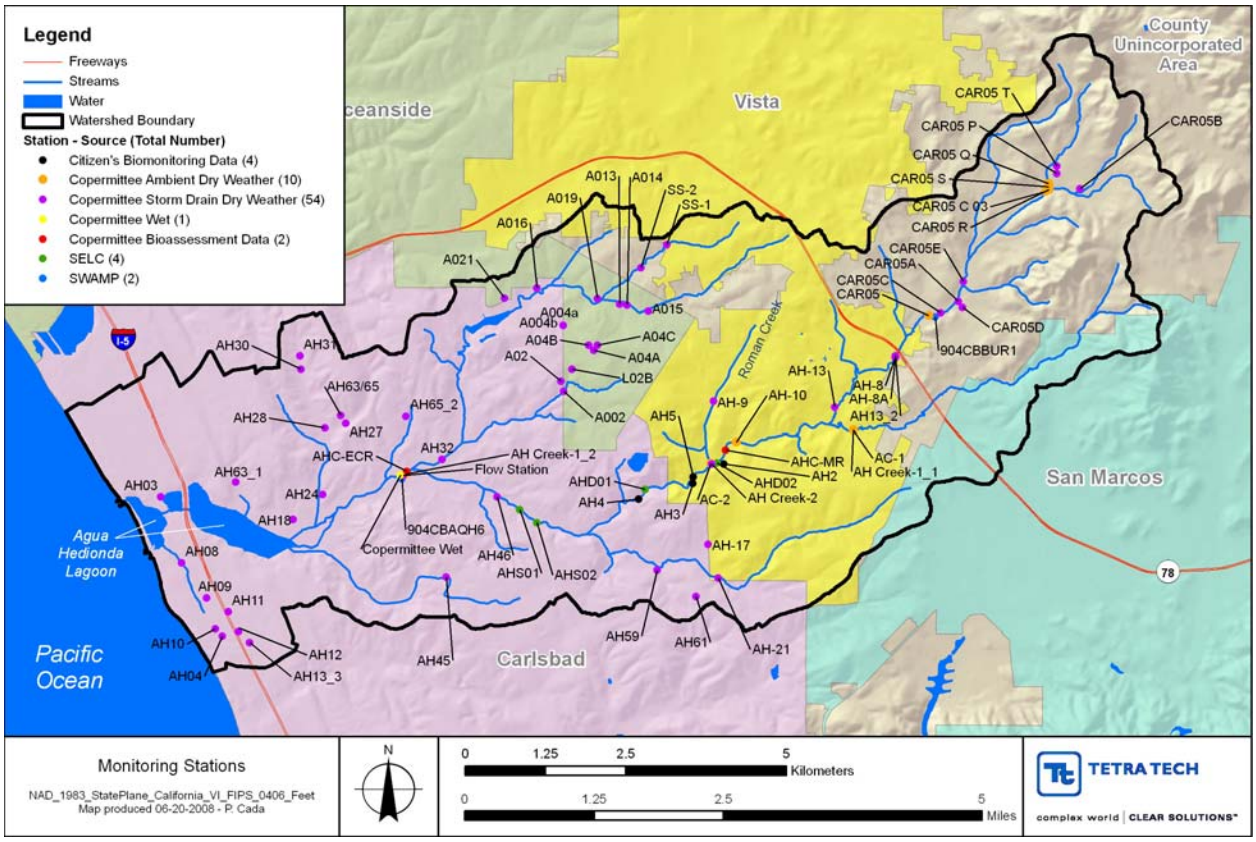

Figure 6-10. Monitoring Stations in the Agua Hedionda Watershed

Progress in meeting the TMDL objectives and to address the remaining impairments will require monitoring in the future in the lagoon and its tributaries. This monitoring plan will likely not be developed until after the TMDL is developed. The implementation monitoring should be coordinated with monitoring needed to support the goals and objectives of this WMP.

Bioassessment monitoring, including aquatic habitat, could be improved by adding other sites beyond the two required under the permit. Habitat was an important component of the goals and objectives of the WMP. As such, additional sites are warranted. In addition to AHC-ECR and AH-MR, recommended sites include AHS02 and a representative site on Buena Creek, to be determined during plan implementation.

Based on strong interest expressed by the WPG, we recommend that California Rapid Assessment Method (CRAM) data be periodically collected and assessed for wetland areas of the watershed. Monitoring results from CRAM assessments should be compared to results reported in Tetra Tech (2007) to assess improvement or degradation in wetland functions.

In addition to the ambient monitoring needs described in the preceding sections, pre- and post-construction monitoring of any projects implemented in association with the WMP should be conducted as resources allow. This would include stream restoration and BMP retrofit projects. Such monitoring can demonstrate real benefits of these practices and provide programmatic feedback for reporting the MS4 permit.

The following actions will be required to successfully implement the recommended monitoring:

- Long term stream and lagoon monitoring program (supplementing current monitoring by Co-permittees)

- Collect and assess physical, chemical, and biological data
- Periodically report on monitoring results
- Long-term wetlands monitoring (CRAM)
- Collect and assess physical, chemical, and biological data from multiple programs
- Periodically report on monitoring results
- Inspections and maintenance of sanitary sewer systems
- Check lines for leaks, illicit connections, and overflows (included in the CA Sanitary Sewer Overflows Waste Discharge Requirements (SSO WDRs))
- Monitor effectiveness/efficacy of BMP demonstration projects
- Inspections and maintenance of storm drainage systems
- Increase efforts to clear and maintain storm drains and drainageways to remove deposited materials. (Included in "Regional Channel Maintenance" program.) Note: Any disturbance to natural channels should be minimized.
- Construction site inspection and enforcement action
- Conduct onsite inspections and take enforcement actions, as needed, during construction (included in Order 2007-001)
- Stormwater BMP inspection and enforcement
- Staff inspect onsite stormwater management systems and take enforcement action, as needed, on failing systems (included in Order 2007-001)
- Track key Watershed Management Plan Indicators.

Implementation strategies to accomplish these actions are described in more detail in Section 1 and Appendix H.

6.6 CITIZEN STEWARDSHIP/PUBLIC OUTREACH

6.6.1 Collaborative Watershed Council

Stewardship and management of the Agua Hedionda watershed depends on the collective efforts of citizens, businesses, non-governmental organizations (NGOs) and governmental agencies. A Watershed Council is recommended as a way to establish and support a strong partnership among those organizations which have significant authority or resources for managing the watershed. It is also intended to ensure meaningful public participation in the decision-making. A Watershed Coordinator should be hired to staff the Council.

Watershed management should be adaptive—a living process that responds to changing conditions, needs, and information. Instituting a Watershed Council establishes an approach that can adapt to changing needs and will allow current and future issues to be addressed in ways that are both environmentally sound and fiscally responsible. It is an approach in which all stakeholders pool and coordinate their technical and financial resources to achieve the watershed management goals.

This Plan recommends that the Council include multiple coordinating forums to support stakeholder involvement, providing an opportunity for everyone to participate to the level they want to contribute and providing a known place to "plug in."

Watershed Council. This group should comprise lead staff and officials from partners that have significant authority and/or resources to manage the Agua Hedionda watershed. The purpose of the Council is to coordinate on policy, funding, and resource allocation issues, to provide sustained leadership, to ensure that the partnership is strong, and that the management plan is updated as needed.

It is highly recommended that one elected official from each local government jurisdiction be appointed to the Council. This is vital for successful implementation because of their power to direct staff, approve budgets and/or sponsor grant efforts for management measures. In addition, this group of stakeholders is responsible for the infrastructure in the watershed and represents the regulated community, generally held responsible for compliance with water quality regulations, including future TMDL implementation.

Technical Advisory Committee. This Committee should include staff representatives from governmental agencies and select non-governmental organizations with expertise on water resource and land planning issues in the watershed. The purpose of the Committee is to help carry out the activities of the Watershed Management Plan and to report recommendations to the Council.

Watershed Partners. This group is comprised of interested citizens, NGOs, local land owners, media and businesses. It also includes responsible parties that are regulated by other agencies, such as the local Co-permittees who are responsible for NPDES Permit and TMDL compliance. The Watershed Partners would have a key role in implementing the WMP. It is envisioned that the Watershed Planning Group members, responsible for guiding the development of the WMP, would participate in this group.

Funding Committee. The purpose of the Funding Committee is to provide and seek funding opportunities to finance implementation of the WMP. The Funding Committee would include local governments, state and federal agencies, and private foundations, developers or corporations. These stakeholders can provide direct funding, grants and loans. The partners need to be informed continuously about the cost of implementing the WMP projects and the benefits provided to the community. The funding partners on the Committee would make recommendations to the Council on funding opportunities and priorities.

As a first step for the Council, it is recommended that a grant be secured to hire a Watershed Coordinator who would support the work of the Council. In the future, the work and staff of the Council could be funded through Council partners, grants, reallocation of local government fees, etc.

6.6.2 Education of Local Boards to Gain Support for Watershed Management

Because it is recommended that the local boards (City Council, City Planning Commissions, Agency Boards, and County Supervisors) provide primary support and possible funding for the WMP projects, their support is critical. The Watershed Council should meet with these boards during their regularly scheduled meetings on an annual basis to update them on the needs, benefits and progress of the WMP implementation. Table 6-12 provides a guideline for the content and goals of these meetings.

Table 6-12. Content and Goals for Educating Local Boards

Meeting Number	Content	Goal
1	Introduction of the WMP, goals & objectives, summary of recommendations, and plans for implementation. This should include how the WMP meets current board goals and relates to the board's existing programs.	Adoption of the WMP Support for the WMP Participation of Board Member/s on Watershed Council and direction for staff participation Commitment to include WMP explicitly in future board goals
2	Overview of the WMP (refresher), summary of actions to date, identification of barriers to implementation, request for assistance to overcome barriers (if appropriate), and request for continued support.	Continued support for the WMP Understanding of how the WMP helps meet general board goals Commitment to include the WMP explicitly in future board goals
Annually	Same as #2. Present new finding and information about watershed conditions and management opportunities.	Same as #2. Help adapt the Watershed Plan as needed.

6.6.3 Development of Citizen Education Materials

Education of the general public is an important first step in order to effect changes in habits that impact the watershed. It is important to educate the public about the direct benefit of a healthy watershed to their quality of life. The public must understand what a healthy watershed looks like and how they can contribute to positive watershed health. Educational materials should strive to be distributed in English and Spanish. Educational materials can include:

- Brochures
- Agency bill inserts (brief flyers in water bills)
- Write-ups in local city, agency, NGO and appropriate groups' newsletters and websites. Specifically these would include:
  - Local jurisdiction – Cities of Carlsbad, Oceanside, San Marcos, and Vista, the County of San Diego
  - Local Water Agencies – Carlsbad Municipal Water District, City of Oceanside Water Utilities Department, Vallecitos Water District, Vista Irrigation District
  - Local Sewer Agencies – the Buena Sanitation District (Vista), City of Carlsbad, City of Oceanside Water Utilities Department, City of Vista Sanitation District, and Vallecitos Water District
  - Local NGOs – Agua Hedionda Lagoon Foundation, Preserve Calavera, Friends of Hedionda Creek, Carlsbad Watershed Network
  - Appropriate Groups – local Homeowner Associations, Chambers of Commerce, primary businesses (Poseidon, Cabrillo Power Plant, YMCA, Hubbs SeaWorld, etc.)

- Press releases to local media, including the *North County Times*, *Union Tribune* (North County section and Spanish edition, *Enlace*), and *Coast News*
- Training for watershed monitoring

6.6.4 LID Workshops and Training

Low Impact Development has been identified in the WMP as a strong tool to mitigate impacts from future development and support non-degradation of water quality and watershed health. To promote LID use in its most optimal form for the watershed, LID workshops and training sessions are recommended. The purpose of these workshops and training sessions is to increase implementation of the most effective LID techniques throughout the watershed. Workshops should be held for jurisdictional staff, private sector developers and engineers, and the interested general public. There are good opportunities to collaborate on the workshops with other organizations, including local jurisdictions, San Diego Coastkeeper and the Building Industry Association (BIA). The workshops should include general LID education, however they should focus on local knowledge obtained from the modeling effort in this WMP (see Section 6.1 and Appendix J). It is recommended that workshops and training for municipal staff be performed by other professionals or professional organizations. Education for engineers and developers might best be received from professionals within local jurisdictions who will be approving developer plans, whereas workshops for the general public could be conducted by local jurisdictions and by NGOs.

6.6.5 Annual Awards Program

An annual awards program is recommended to encourage and recognize local efforts toward watershed protection. This program should be coordinated through the Watershed Council. To be transparent and objective, the program should have specific objectives, guidelines, nomination criteria and prioritization processes. It is recommended that these guidelines be formally drawn up and voted on by the Watershed Council and posted on the webpage. Awards should be considered for individuals, public officials, developers, businesses, and NGOs. Presentation of the awards should include a press release to maximize publicity and the educational value of the event.

6.6.6 Annual Progress Workshops

A number of watershed actions are being recommended that will involve numerous agencies and groups. To keep track of "who's doing what" in the watershed and progress made on WMP implementation, it is recommended that Watershed Partners have annual progress workshops. This would also be a forum to share lessons learned on LID techniques, successful BMP retrofits, etc. These workshops could be held in conjunction with the annual acquisition/restoration workshop.

6.6.7 Management Partnerships

Many partnership opportunities exist within the watershed to leverage programs towards project implementation. These partnerships should not be underestimated as a means to implement the WMP. A partial list of key opportunities is presented in Table 6-13.

Table 6-13. WMP Partnership Opportunities

Partnership Organization	Potential Partnering Opportunity	Potential Project for Opportunity
Local, State & Federal Agencies	Funding	Land acquisition, restoration projects
Carlsbad Watershed Co-permittees	Collaboration	Educational materials, workshops, meetings
Utility Agencies	Collaboration, Matching Funds	Restoration for infrastructure construction and maintenance, educational material development and distribution
Private Developers	Funding, Matching Funds	Acquisition and/or restoration as mitigation for development
NGOs	Collaboration	Educational material and events, project prioritization, awards program
Businesses	Collaboration	Educational material distribution, awards program, workshops

6.6.8 Data/Information Management Via Website

Information sharing is important to maximize collaboration and keep stakeholders informed. As data is collected in the watershed by various stakeholders, it is helpful to integrate that data and use it for decision making, whether it be for management measure selections, effectiveness evaluations, or project prioritization. It is recommended that a website be the best avenue for information sharing. The website should maintain program information including an overview of the WMP, announcements, events calendar, meeting archives, educational material ongoing projects, and links to other related programs. It should be maintained on a regular basis which will include staff time to prepare updates and funding to support website hosting.

Implementation strategies to accomplish citizen stewardship/public outreach actions are described in more detail in Section 1 and Appendix H.

6.7 ACTION: FUNDING AND SUSTAINED SUPPORT

Securing and maintaining stable and diverse funding for WMP will be challenging and an ongoing action. A wide range of funding options is available for watershed actions and having a variety funding sources will help avoid interruptions in implementation and reliance on a single entity for support (EPA, 2005). This section discusses a variety of funding options most applicable to the watershed; other means do exist for funding and sustaining support for watershed management, and those options should be explored as well.

6.7.1 Grant Programs

The California voters have been generous in past ten years supporting a range of water related bond programs. In addition, there is wide support for community-based watershed restoration programs. Water quality related actions that are well supported include stormwater quality best management practices (BMPs) and low impact development (LID). Many of these programs are oriented towards "brick and mortar" implementation; therefore having a Plan with specific projects identified sets the Agua Hedionda WMP up well for implementation.

A wide range of grant programs are available so that it is important to match the appropriate project with the grant program. Some of the primary grant programs that are appropriate for the Agua Hedionda management measures include small grant programs for education and outreach programs and development and support of the Watershed Council and Watershed Coordinator, and larger grant programs for implementation projects, such as acquisition and restoration. Appendix H provides a list of several current grant programs, who administers the grant, the type of projects eligible for the project and the range of available funds for each grant.

Almost all grants require some amount of matching funds be contributed by the recipient of the funds. Grant match provides granting organizations the assurance that the grant recipient is dedicated to the project and willing to put in their own effort or finances. Matching funds are generally in the range of 10 to 20 percent. In rare cases no matching funds are required and in some grant programs up to 50 to 75 percent matching is required. Matching funds generally are in the form of in-kind labor, up-front funding of project design or environmental clearance, or pre-project monitoring used to define the project need. Many funding agencies have restrictions regarding where the matching funds can be derived, for instance grants from the State generally disallow matching funds to be derived from other State funds or programs.

Once the project has been aligned to a grant program, the grant scope must be outlined. Often grant programs require a two-step process where a conceptual scope is submitted and if approved the grant applicant will be asked back for a full proposal that is more detailed. The level of detail of the scope depends on the grant requirements; however, it is always helpful to have the project well scoped out prior to any grant application so that the technical feasibility, project budget and schedule are well understood. The projects outlined in this WMP are generally in a conceptual stage and require additional effort to develop the scope and budget for a grant application. During the scoping process project partners should be identified who will provide support for the project either financially or technically.

In the Agua Hedionda watershed there are many ongoing projects that can also be leveraged as matching funds for the recommended management measures. These include partnering with ongoing educational programs by the various NGOs in the watershed, jurisdictions (particularly the Carlsbad Watershed Urban Runoff Management Program), and private organizations who perform environmental education to support their business. Another source of matching funds that is promising in the Agua Hedionda Watershed is partnering with other implementation projects performed by jurisdictions, agencies or private ventures. In the near future it is likely that the jurisdictions within the watershed will be implementing projects associated with improvements and maintenance to their sewer, water and storm drain infrastructure. These projects may be implemented in conjunction with watershed projects for matching funds or the implementation of the infrastructure project may require mitigation that can be used to leverage a larger grant project. In addition, local development projects will be required to mitigate impacts. All of these types of projects create opportunities for partnerships on large mitigation projects and for matching funds.

It is important to contact appropriate agencies as early as possible to gain support for the project. The implementation projects recommended in this WMP will require agency environmental clearance that in some cases may require substantial effort. Agencies are generally willing to meet with project proponents to discuss their projects and provide assistance and direction regarding the approval process. The various agencies and environmental clearances that are likely to be required for project implementation are discussed in Appendix A, Summary of Key Federal, State, and Local Regulations Applicable to the Watershed. In most cases, the projects support the goals of the agencies so that they can be helpful partners. Grant agencies look favorably on the involvement of a variety of agencies because it shows a higher level of support and more likely rate of project success.

Finally, preparing the grant application can require a significant effort. to make the application as competitive as possible, it is important to know the project and applicant eligibility requirements, project types to be funded and program goals. The applicant should discuss the project with the granting agency

in advance to better understand the funding probability of each project. Often the granting agency will have a public meeting to discuss the grant program well in advance of sending out a request for proposals. Many grant programs will have a list serve that can be joined to receive automated information about upcoming programs.

6.7.2 Coordination with Agencies

Several agencies have ongoing programs that could fund projects within the watershed. Often agencies are interested in land acquisition to develop preserves or protect natural habitat. State and federal funds or programs are established for preservation efforts, particularly where there are endangered species, or sensitive habitat. The State of California Wildlife Conservation Board Grant program funds restoration and enhancement of wildlife habitat, development of public access facilities for wildlife oriented uses and protection of habitat through fee acquisitions and conservation easements. The Partners for Fish and Wildlife Program provides technical support and funding for on-the-ground wetland restoration projects on private land. The National Fish and Wildlife Foundation also provide grants for projects that sustain, restore and enhance the nation's fish, wildlife, plants, and their habitats through their Keystone Initiative Grants and Special Grant Programs.

The State and federal wildlife agencies also sign off on mitigation plans and often a project has a need to mitigate offsite which requires an acquisition or restoration project. Caltrans also is involved in acquisition and restoration projects for road project mitigation and is another potential partner. The regional planning agency, San Diego Association of Governments (SANDAG), will soon be allocating acquisition funds from the 1/2 cent Transnet sales tax measure. In addition, there may be opportunities with local jurisdictions to coordinate on projects related to their MHCP/MSCP efforts or as mitigation for development projects. Universities may also be interested in developing or expanding preservation or restoration programs.

It is recommended that these agencies be contacted on a regular basis to discuss the WMP recommended projects and request that they consider the project lists when developing their agency goals and priorities. These agencies can also be helpful in identifying funding opportunities that may arise that are appropriate for the WMP projects. Another important aspect of coordinating with agencies is to keep them informed of locally available projects that can be used for mitigation and stress the need to implement local projects to offset local impacts.

6.7.3 Mitigation Programs

As development within the watershed grows and infrastructure projects (freeways, roads, pipelines, etc.) are planned there will need to mitigate their impacts. Most of the acquisition and restoration projects outlined in the WMP are suitable projects for mitigation. Furthermore, since most agencies request that mitigation be implemented near to the area of the impact and prefer areas where a detailed analysis and comprehensive process has been conducted for mitigation site identification, mitigation compensation is a good option for funding implementation of the projects recommended herein.

The challenge is matching mitigation needs to projects. Mitigation requirements are generally required at a specific size, and only in rare cases will that size match directly with a project outlined in this WMP. However, with come creativity this can be overcome. Options include developing mitigation banks, pre-approved mitigation areas (PAMA), or an in-lieu fee program. These programs are designed to pool resources from a range of mitigation requirements to create a larger project that is more likely to have a greater benefit to the watershed. These programs are a tremendous benefit to project proponents in need of mitigation and can result in significantly more benefit to the watershed then a group of smaller mitigation projects scattered throughout the watershed. The other benefit to this approach is collectively obtaining permits for the mitigation and long-term management of the final project. Mitigation Banks can

be established by a city, county or land management organization who will perform the upfront project design and permitting and then sell-off credits or acres to project proponents in need of mitigation. One example in the watershed is the 180-acre Carlsbad Highlands Mitigation Bank created by the which is now sold out and the property is being managed by CDFG as part of the Carlsbad Highlands Ecological Reserve (TAIC, 2008).

6.7.4 Watershed Council Support

Having a long-term organization such as a Watershed Council to oversee and sustain the implementation of the WMP will be one of the keys to its success. Keys to the success for the Watershed Council is having a Watershed Coordinator who will manage and support the organization, coordinate activities and obtain sustained funding for management implementation.

Funding and hiring a Watershed Coordinator in the near term (i.e., six months) is essential. The WMP, which has well documented watershed needs and recommendations, provides a strong basis and momentum for establishing a Watershed Coordinator position and establishing a Watershed Council. This momentum should be capitalized on quickly.

Funding for a Watershed Coordinator can be obtained from a variety of sources. Agencies, such as the Department of Conservation, are recognizing the importance of Watershed Councils and Watershed Coordinators and have a grant program established solely for that purpose. Other grant agencies are also recognizing this need and are open to funding such a position either outright or as a part of a larger project. Again, with some creativity, the watershed coordinator position can be funded from a variety of sources; however, a more sustained form of funding is desirable in order to maintain a long-term connection to the watershed and the programs outlined herein.

More diverse forms of support include additional types of grants, local agencies and/or jurisdictions, NGOs and the business community. For example, each project that is funded in the watershed can also have a component included in the scope to support the Watershed Council and Watershed Coordinator. Most grants from the State of California require that public meeting be held and technical advisory committees or watershed planning groups be established to oversee the project. This can be used as an opportunity to support the Watershed Coordinator. Appendix H provides a list of funding opportunities in the form of grants to support a watershed coordinator. Because of their role in overseeing development, local jurisdictions will be key participants in the Watershed Council. As such, they could also be considered as potential funding sources for the Watershed Coordinator and Watershed Council.

6.7.5 Implementation

The following actions will be required to successfully implement the efforts described above:

- Grant Programs
  - Identify target grant programs
  - Match projects to grant programs
  - Scope projects, identify partnerships and matching funds
  - Contact appropriate agencies and discuss projects
  - Prepare grant applications
- Coordination with Agencies
  - Identify target agencies and funding opportunities through agency programs
  - Meet quarterly with appropriate agencies to discuss priorities and opportunities

- Coordinate with Universities
- Mitigation Programs
  - Meet with jurisdictions and agencies to discuss mitigation banks and in-lieu fee programs
  - Align projects with mitigation banks and in-lieu fee programs
  - Obtain agency support for mitigation banks and in-lieu fee programs
  - Outreach to development community
- Watershed Council Support (Watershed Coordinator Support)
  - Prepare scope for watershed and staffing needs ($)
  - Obtain local support from agencies, jurisdictions, NGOs and the business community
  - Identify grant/funding opportunities and pursue with grant proposals
  - Redirection of City fees

Implementation strategies to accomplish key actions are described in more detail in Section 1.

6.8 RECOMMENDED FOCUS AREAS FOR MANAGEMENT

The selection of individual opportunities in the previous sections was based on a watershed-wide review of management needs and opportunities. Each priority opportunity represents a location where a significant management need exists. Several of the stream restoration opportunities address bank undercutting that is endangering mature riparian trees. The top ranking land acquisition opportunities represent parcels where large tracts of undisturbed natural area are unprotected and where new development would have the greatest impact on water quality and habitat relative to other unprotected parcels. Drawing from individual priorities, the combined benefits of multiple management types was considered in selecting the focus areas. Although some individual prioritizations considered the relationship among types of opportunities (e.g., the restoration opportunity metric for the acquisition and restoration opportunities), the purpose of the focus areas was to select several comprehensive suites of opportunities that would be implemented in concert to achieve a greater functional benefit.

Tetra Tech based the selection of focus areas on the location of management opportunities, the WPG's goals and objectives, and general trends in modeling and monitoring data. Each focus area represents a portion of the watershed where a significant management need exists and where a number of opportunities would complement each other. The portions of the watershed not selected as focus areas contained fewer complementary management opportunities and/or presented constraints to management. Most notably, Tetra Tech considered the Calavera Creek drainage area as a potential focus area but concluded that the Lake Calavera dam should be repaired before planning a comprehensive restoration effort within this drainage. In addition to this factor, the upper portion of the Calavera Creek drainage area did not present as many complementary management opportunities as the selected focus areas. In general, the selected focus areas presented more promising habitat preservation and restoration opportunities than other portions of the watershed.

The selection of focus areas does not imply that management should only be focused in these selected areas. Tetra Tech recommends that funding be focused in these portions of the watershed in the near term, and that management opportunities within the focus areas should be implemented in concert where possible. The priority lists and decision-making tools provided with the plan may lead implementers to select promising management opportunities outside the focus areas because an opportunity presents itself. With sufficient funding and other support, it may be possible to implement the focus area management at the same time as other priority management actions throughout the watershed.

Where possible, upstream management within focus areas should be accomplished first. During implementation, trade-offs will need to be considered between readily available opportunities and those that provide the greatest functional benefit. For example, several extended dry detention (EDD) opportunities may exist that, if implemented, would protect a stream restoration opportunity from damage during storm events. The stream restoration opportunity may have funding available first, while EDD facilities are still in the conceptual design phase and are several years away from funding. Implementers will need to consider the risk of implementing the stream restoration site prior to the upstream protection versus the delayed benefits if the restoration is postponed. In this situation, implementers may decide to construct the stream restoration first if there is a low risk of damage, and then construct the EDD facilities as soon as possible following the restoration.

Tetra Tech recommends three focus areas for watershed management:

- Headwaters Focus Area: The headwaters of Agua Hedionda and Buena creeks, including subwatersheds 1019, 1020, 1021, 1022, and 1024.
- Mainstem Focus Area: The mainstem of Agua Hedionda Creek along SR-02, SR-03 and SR-04 and land draining to the creek that has a significant impact on this reach, including subwatersheds 1013, 1014, 1015, 1016, and 1017.
- Lagoon Focus Area: Agua Hedionda Lagoon and subwatersheds draining directly to the lagoon, including 1000, 1002, and 1004 as well as land within adjacent subwatersheds directly impacting the lagoon.

The focus areas directly address the WPG's goals and objectives. They most strongly address Goals #2 and #3 by representing where the greatest improvement in habitat and water quality can be achieved. The focus areas also address Goal #1 by identifying management opportunities that would help protect downstream efforts and ensure management success overall. Efforts through goals #4 (regulatory compliance support) and #5 (outreach, education, and stewardship) can also be achieved by concentrating management in the focus areas. Emphasis on regulatory compliance and citizen outreach with these focus areas will help ensure that the greatest functional benefits are achieved. The following bulleted lists provide the rationale for selecting these focus areas, and specific management opportunities are recommended within each focus area.

Headwaters Focus Area

Location: The headwaters of Agua Hedionda and Buena Creeks, including subwatersheds 1019, 1020, 1021, 1022, and 1024 (Figure 6-11).

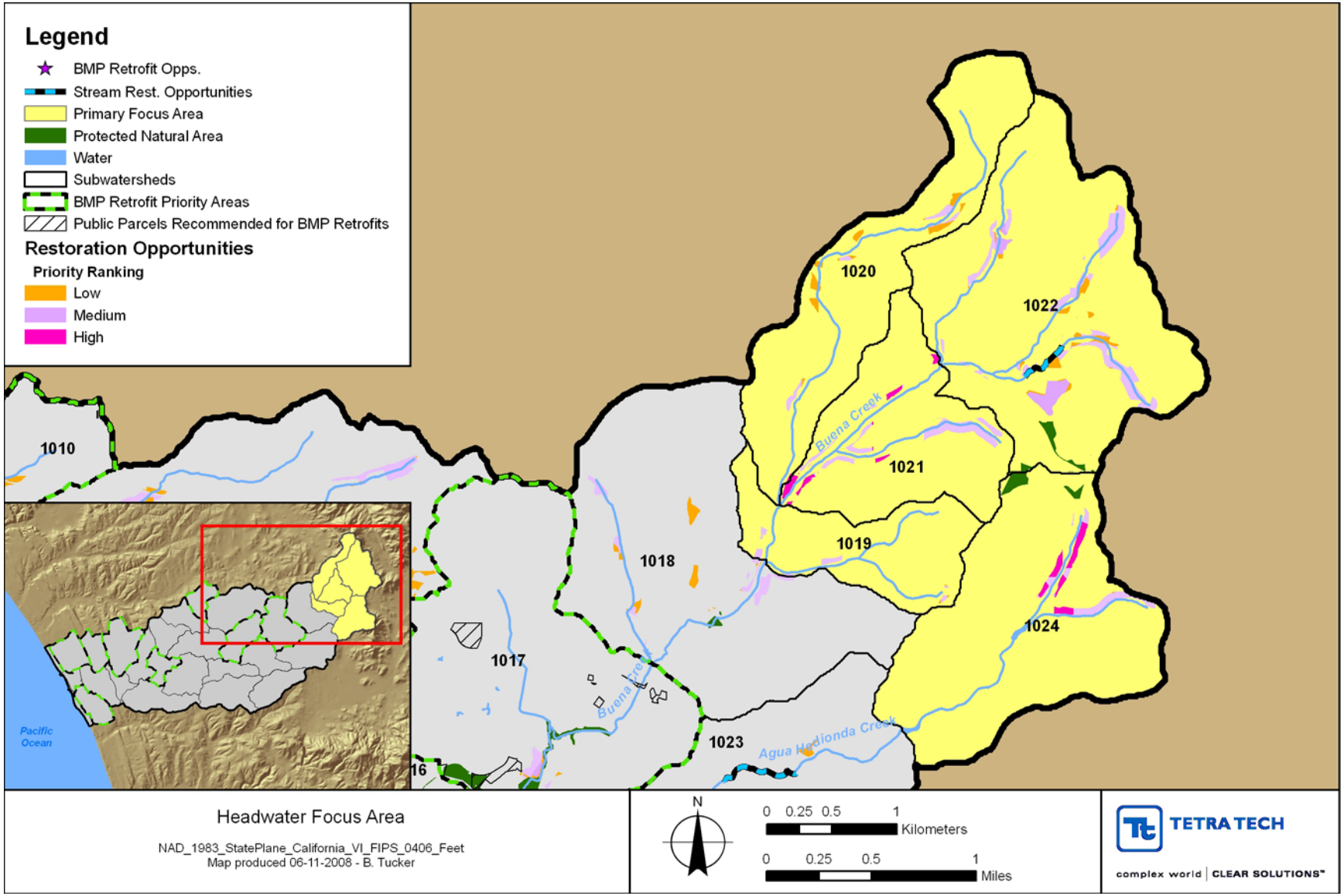

Figure 6-11. Headwaters Focus Area (This focus area contains a large area of land acquisition opportunity but is not shown due to the sensitive nature of these opportunities.)

Rationale for Selection:

- Is the least developed portion of the watershed and contains large opportunities for land preservation (acquisition)
- Has high potential for future development
- Has high potential for future pollutant loading and stream erosion risk
- Buena Creek Headwaters experiences high nitrate loading during extended dry periods. A potential source may be nutrient-laden irrigation return flow from lawns.
- Agua Hedionda Headwaters have been designated as a stakeholder priority for land acquisition and preservation and contain the majority of high priority land acquisition opportunities based on the WMP's overall prioritization criteria.
- Buena Creek Headwaters contain a large number of medium priority acquisition opportunities based on the WMP's overall prioritization criteria.

Complementary Management Actions:

- New Development Site Management: General attention to compliance with new standards and application of innovative practices, including LID, and consideration of enhanced management. Recommend that jurisdictions focus on minimizing nutrient load from new lawns and other landscaping.
- Preservation:
  - Primary focus on preserving top ranking, high priority opportunities: LA-01, LA-02, LA-03, LA-04, LA-06, LA-07, LA-01, LA-11, LA-12, LA-18, LA-35, LA-41, LA-42, LA-43, LA-44, LA-46, LA-48, LA-50, LA-52, LA-53, LA-55, LA-57, and LA-58.
  - Secondary focus on preserving large tracts and remaining riparian areas among the medium priority opportunities, including any stakeholder priorities that are not listed above.
- Buffer Restoration:
  - Primary focus on restoring top ranking, high priority opportunities: BR-03, BR-04, BR-05, BR-06, BR07, BR-08, BR-10, BR-11, BR-12, BR-13, BR-14, and BR-22.
  - Secondary focus on restoring medium priority opportunities. No stakeholder priorities have been identified, but stakeholder input should be considered when selecting projects for implementation.
- Wetlands Restoration: Wetlands restoration opportunities are limited in this focus area to medium and low priority opportunities.
  - Primary focus on the highest scoring opportunities: WR-62, WR-64, WR-65, and WR-66.
  - No secondary focus due to limited opportunity.
- Stream Restoration: Primary focus on SR-06 on Buena Creek.
- BMP Retrofits: BMP retrofits should not be a primary focus, but may be a secondary focus where opportunities are available for EDD and downspout disconnection.
- Monitoring:
  - Pre- and post-construction monitoring of stream restoration sites.
  - Land treatment tracking for new development.

- Citizen Stewardship:
  - Outreach to landowners throughout focus area on the benefits of controlling invasive species and maintaining natural vegetation on their property.
  - Promotion of enhanced new development site management among stormwater regulators and developers.

Mainstem Focus Area

Location: The mainstem of Agua Hedionda Creek along SR-02, SR-03 and SR-04 and land draining to the creek that has a significant impact on this reach, including subwatersheds 1013, 1014, 1015, 1016, and 1017 (Figure 6-12).

Rationale for Selection:

- Contains the largest, contiguous stream restoration need and opportunity within the watershed, which addresses endangered mature trees and channel erosion.
- Includes two subwatersheds targeted for BMP retrofits due to high pollutant loading and a large number of untreated parcels. The loading from these subwatersheds is expected to have an influence on water quality within the stream restoration opportunities and contribute to hydraulic stability.
- Stream, buffer, and wetlands restoration opportunities are adjacent to protected natural areas and public recreational areas.
- Has high potential for complementary habitat restoration, preservation, and flood retention opportunities.

Complementary Management Actions:

- New Development Site Management: General attention to compliance with new standards and application of innovative practices, including LID, and consideration of enhanced management. Recommend that jurisdictions focus on addressing hydromodification to protect channel stability. Most of the focus area is developed, but some potential for future development exists.
- Preservation: Land acquisition opportunities are limited in this focus area to medium and low priority opportunities.
  - Primary focus on preserving riparian portions of medium priority land acquisition opportunities to maintain habitat contiguity and protection of restored channels, including the highest scoring opportunities (including LA-08, LA-20, LA-05) and the nearest opportunities upstream from SR-02 (including LA-126 and LA-348).
  - Secondary focus on preserving stakeholder priorities not listed above and additional upland areas.
- Buffer Restoration:
  - Primary focus on restoring top ranking, high priority opportunities: BR-01, BR-02, BR-16, BR-19, BR-21, BR-30, BR-31, BR-38, BR-39, BR-40, and BR-46. Some overlap occurs with wetlands restoration opportunities.
  - Secondary focus on restoring medium priority opportunities. No stakeholder priorities have been identified, but stakeholder input should be considered when selecting projects for implementation.

- Wetlands Restoration:
  - Primary focus on the top ranking, high priority opportunities that are contiguous and present a significant flood retention opportunity: WR-01, WR-02, WR-04, WR-05, WR-08, WR-09, WR-10, WR-11, and WR-20.
  - Secondary focus on other top ranking, high priority opportunities: WR-07, WR-13, WR-14, and WR-19.
- Stream Restoration:
  - Primary focus on opportunities SR-02, SR-03, and SR-04.
  - Secondary focus on opportunity SR-01.
- BMP Retrofits:
  - Primary focus on EDD upstream of SR-03 and SR-04. For maximum benefit, EDD retrofits should be implemented throughout the focus area in a decentralized manner so that flow control mimics natural hydrology. SW-01 BMPs are provided as example opportunities that would complement stream restoration.
  - For subwatersheds 1015 and 1017, primary focus on retrofits that reduce pollutant loading.
- Monitoring:
  - Pre- and post-construction monitoring of restoration and retrofit sites.
  - Land treatment tracking for new development.
- Citizen Stewardship: Include outreach to property owners along creek regarding maintenance of riparian habitat, control of invasive species, minimization of erosion, and other practices. Small, low-scoring acquisition and restoration opportunities can be used to target outreach.

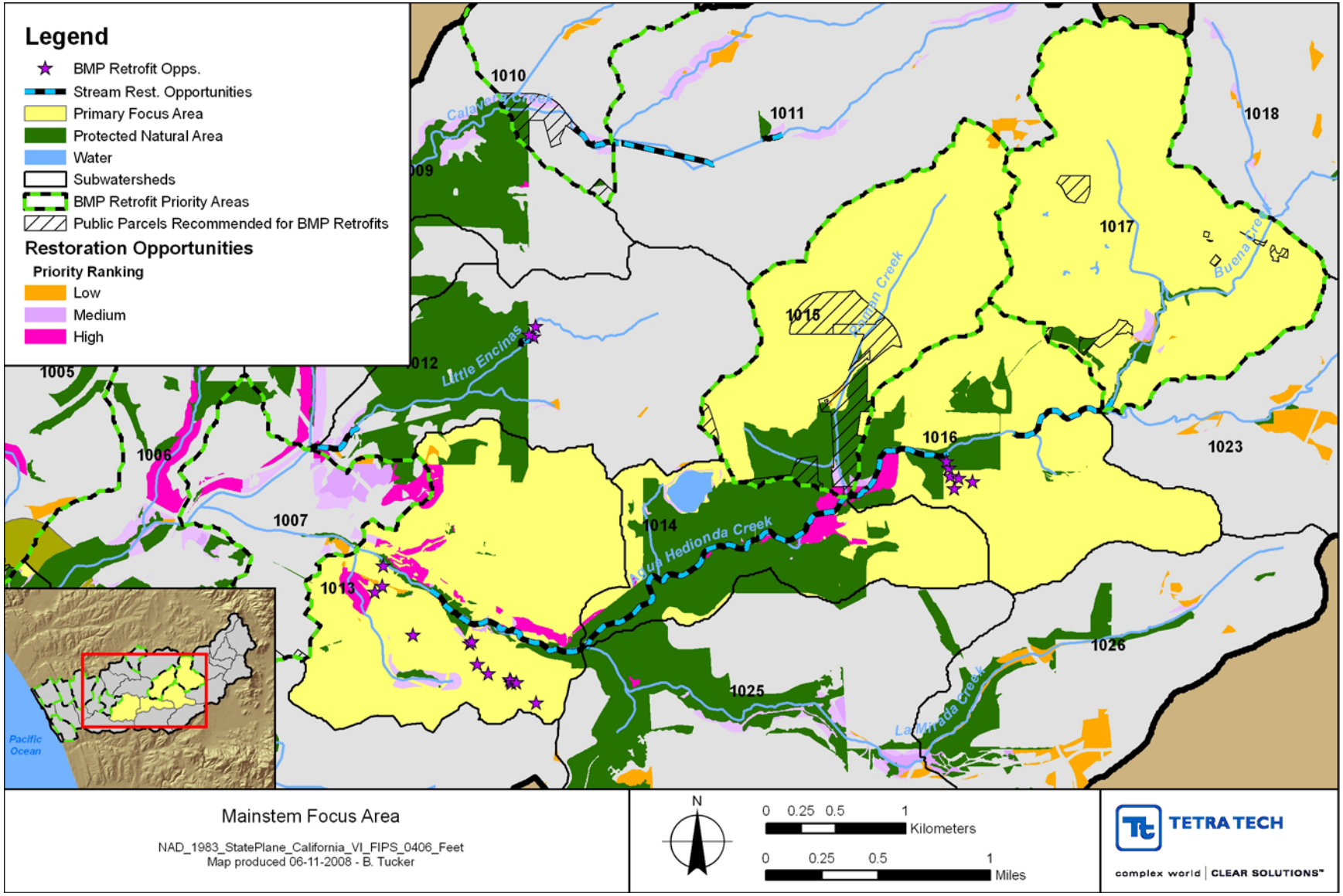

Figure 6-12. Mainstem Focus Area (Land acquisition opportunities are not shown.)

Lagoon Focus Area

Location: Agua Hedionda Lagoon and subwatersheds draining directly to the lagoon, including 1000, 1002, and 1004, as well as land within adjacent subwatersheds directly impacting the lagoon (Figure 6-13).

Rationale for Selection:

- Represents a large portion of the remaining wetland habitat in the watershed.
- Lagoon habitat is listed as a priority under WPG goals and objectives.
- Includes subwatersheds targeted for BMP retrofits due to high pollutant loading and large number of untreated parcels. The loading from these subwatersheds is expected to have an influence on water quality within the lagoon.

Complementary Management Actions:

- New Development Site Management: General attention to compliance with new standards and application of innovative practices, including LID, and consideration of enhanced management. Recommend that jurisdictions focus on minimizing pollutant loading and encouraging developers to incorporate wildlife habitat into development designs. Most of the focus area is developed, but some potential for future development exists.
- Preservation: Land acquisition opportunities are limited in this focus area to medium and low priority opportunities.
    - Primary focus on preserving high scoring, medium-priority opportunities: LA-70, LA-135, LA-137, LA-138, LA-139, LA-140, and LA-208.
    - Secondary focus on preserving additional medium priority opportunities.
- Buffer Restoration: Buffer restoration opportunities are limited in this focus area to medium and low priority opportunities.
    - Primary focus on restoring high scoring, medium-priority opportunities: BR-125, BR-92, BR-89, BR-215, and BR-168.
    - Secondary focus on restoring remaining riparian areas among the medium and low priority opportunities and additional buffer restoration opportunities identified by stakeholders.
- Wetlands Restoration: Wetlands restoration opportunities are limited in this focus area to medium and low priority opportunities.
    - Primary focus on the highest scoring opportunities: WR-62, WR-64, WR-65, and WR-66.
    - No secondary focus due to limited opportunity.
- Stream Restoration: Not applicable.
- BMP Retrofits: Focus subwatersheds #1001, #1003, and #1005. Infiltration BMPs, such as bioretention, and porous pavement should be investigated since soils may be suitable for these practices.
    - Monitoring: Pre- and post-construction monitoring of restoration and retrofit sites.
    - Land treatment tracking for new development.
- Citizen Stewardship: Focus on developing management partnerships among stakeholders and organizations with mitigation needs. Continue and enhance current education efforts on lagoon water quality and habitat.

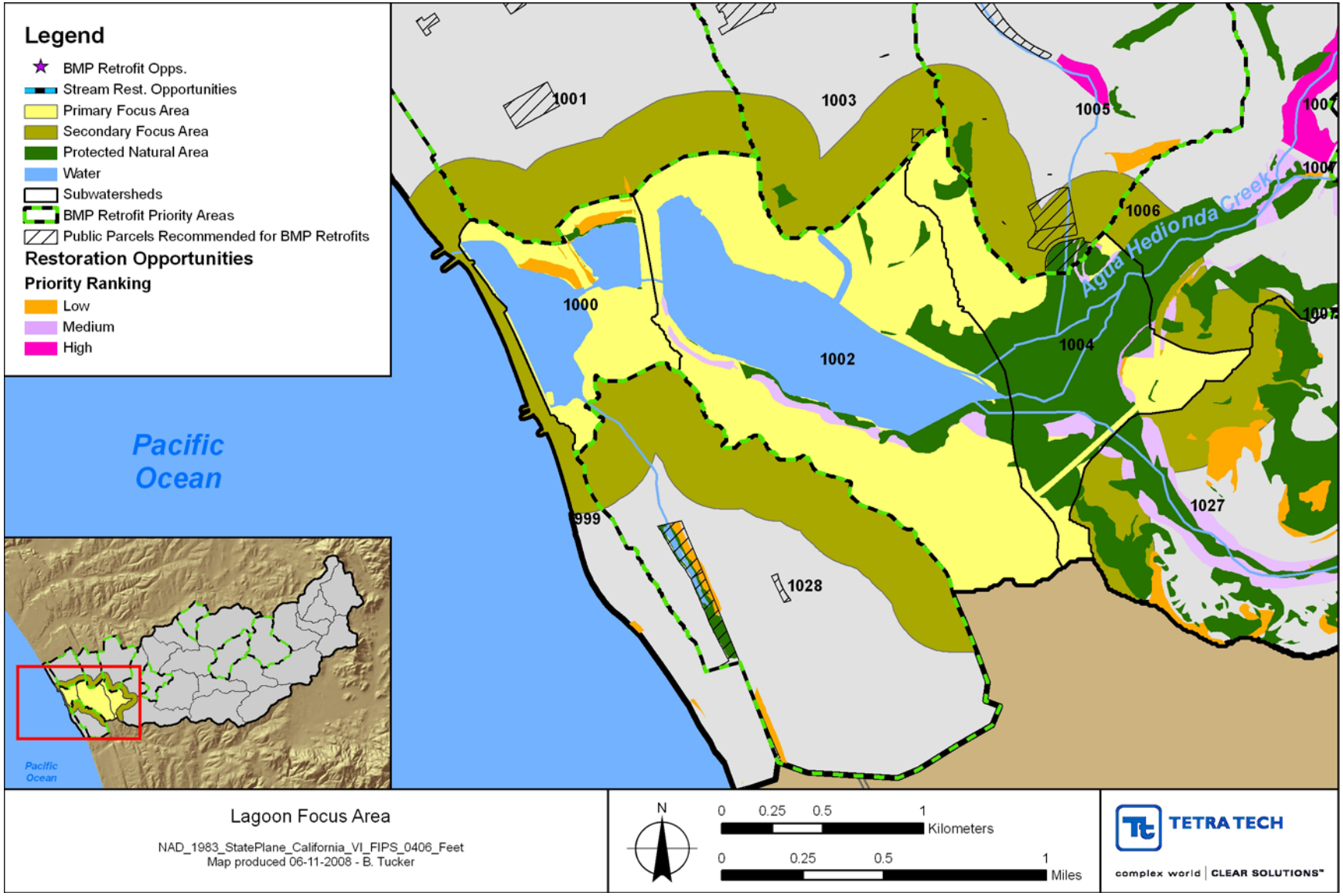

Figure 6-13. Lagoon Focus Area (Land acquisition opportunities are not shown.)

7 Implementation

7.1 Primary Roles and Responsibilities in Carrying Out the Actions

Implementation of the WMP will depend on all stakeholders taking an active role, though the roles will vary greatly by action. Some actions will be implemented jointly by various stakeholders; some actions will be lead by NGOs; other actions, because of differing land use authority and permitting requirements, will be implemented separately by local jurisdictions to address specific conditions in specific areas of the watershed; other actions will be led by private or public sector partners needing mitigation opportunities.

The timing of actions, even certainty about their timing, will also vary greatly: some actions are currently ongoing, others have target dates that are time certain, while other actions have a high degree of uncertainty regarding time of implementation.

All implementation actions will be carried out as funds are available. Excepts where actions are noted to be part of ongoing permit or regulatory requirements, the actions recommended are considered to be voluntary, i.e., not conducted through a regulatory program. Many of the actions will, however, help the region achieve multiple goals and regulatory requirements, as outlined in Section 7.6 below.

As discussed in Section 6, two key actions which can greatly enhance implementation of this Plan and long-term watershed management are the hiring of a part-time watershed coordinator and the formation of a watershed council. Of the action items listed below, these are the highest priority for short-term implementation (within 6 to 12 months).

The sections below briefly discuss all of the recommended implementation actions that were introduced in Section 6, and present the recommended roles and responsibilities by each management plan component:

- New development site management
- Preservation
- Riparian buffer, wetland, and stream restoration
- BMP stormwater retrofit
- Monitoring and enforcement
- Citizen stewardship/citizen outreach
- Funding and sustained support

Appendix H provides a summary list of recommendations, key group responsible for implementing each action, as well as potential funding sources.

Responsible Group: Co-Permittees. This will involve the planning and engineering departments of local jurisdictions in the watershed.

7.1.1 New Development Site Management Actions

Leadership Role – Local Jurisdictions

High Priority Action A. Revision of local codes to incorporate recommended *Basic LID* techniques.

Pursuant to Order 2007-001, local government Co-permittees in the region are required to incorporate LID requirements and standards into their local codes and ordinances by March 2010. Tetra Tech screened which LID techniques may be most effective to use in the Agua Hedionda watershed to meet the current water quality and quantity requirements and the WMP goals and objectives. It is recommended that local governments in the watershed incorporate the following specific *Basic LID* techniques into their local LID standards and codes as preferred for development applications: reducing and disconnecting impervious area; extended dry detention; swales or bioretention; and stream buffers.

Action B. Tracking compliance with stormwater management and LID.

Pursuant both to LID ordinance revisions enacted by local governments in March 2008 and future revisions to be enacted in March 2010, local planning and engineering staff should review the site plan and engineering plans for compliance with stormwater treatment and LID requirements. Two of the Watershed Management Indicators are percent of future development using the *Basic LID* techniques recommended in Action A and percent of future development using BMPs. Therefore the watershed coordinator should work with the local jurisdictions to track this indicator every 2 to 3 years.

If the planned redevelopment does not occur as represented in the model scenarios (e.g., without treatment as required by the 2007 Order), the watershed could be at greater risk of degradation. Given this risk, the coordinator should track the extent of redevelopment in the watershed and how it is treated. If significantly less redevelopment occurs, additional BMP retrofits to untreated development should be considered.

Responsible Groups: Local planning and engineering department, Watershed Coordinator.

Action C. Implementation of the *Enhanced LID* techniques as new hydrology and/or new water quality requirements are adopted.

The SWQCB is currently drafting a sediment and a bacteria Total Maximum Daily Load (TMDL) for the Agua Hedionda Lagoon and Co-permittees will be soon required to adopt Hydromodification requirements in accordance to the 2007 Order. If, as a result, new water quality and or hydrology requirements are adopted in the future covering the Agua Hedionda watershed, it is recommended that Co-permittees consider adding *Enhanced LID* requirements to their local codes and ordinances. Based on a screening of the LID techniques that are likely to be most effective in the Agua Hedionda watershed, the enhanced requirements would include stronger efforts to reduce impervious area and disconnect impervious areas; use of porous pavement in select areas of the site, and use of rainwater capture cisterns. This would be in addition to the "*Basic LID* techniques" listed above.

Responsible Groups: Local planning and engineering departments.

Action D. Feasibility study for cisterns, porous pavement, and bioretention without irrigation.

Local engineering departments should jointly seek funding or sponsorship of pilot studies for appropriate design and use of porous pavement and appropriate plantings for bioretention cells without irrigation. In addition studies should be undertaken to evaluate the cost effectiveness of using cisterns in the watershed. The local jurisdictions should also oversee the pilot studies and share results. These studies could be funded as pilot studies through upcoming grant opportunities, as partnership projects with local water authorities, or as demonstration projects sponsored by product vendors.

Responsible Groups: Local engineering departments.

7.1.2 Preservation Actions

Leadership Role – Project Proponent and Watershed Coordinator/Watershed Council

High Priority Action A. Field evaluation.

Conduct a site visit of each of the 25 priority preservation sites to determine if the site has been disturbed and to confirm that the site still exhibits characteristics that made it a priority preservation site. Use checklist drawn from prioritization report. If possible, organize a field evaluation (1 or 2 days) event with watershed partners. Alternatively, the Project Proponent, once identified, could do the field evaluation.

Responsible Groups: NGOs, CA Fish and game, US Fish and Wildlife, local jurisdictions, project proponent.

High Priority Action B. Identify project proponent (site-by-site).

The Project Proponent is one or more entities that wish to acquire the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.

Responsible Groups: Watershed Coordinator, local jurisdictions, NGOs

High Priority Action C. Landowner outreach.

Develop landowner outreach materials that convey a unified message about the area of interest, the parcel's importance in protecting the streams and lagoon, potential benefits to the landowner of selling and/or donating the property or conservation easements, etc. Develop outreach strategy (coordinating with watershed partners) so that each landowner is contacted by the appropriate person. Verify that landowner information developed as part of WMP information is up-to-date.

Responsible Groups: NGOs for private property, local jurisdictions for public property.

Action D. Coordination with cultural resources priorities.

There are confidential databases of cultural resource sites in the watershed. If one or more of the preservation sites also coincides with a cultural resource site, it could raise the priority of the site and increase the potential funders for acquisition.

Responsible Groups: NGOs and Project Proponent

Action E. Secure funding sources.

Responsible Groups: Project Proponent, Watershed Coordinator/Watershed Council, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action F. Identify/secure stewardship organizations and develop stewardship plan.

An organization must be identified to provide long-term stewardship of the site, which includes but is not limited to fire prevention, invasive species control, and replanting. The Stewardship organization should develop a stewardship plan and ensure that funding is provided to implement it.

Responsible Groups: Project Proponent and stewardship organization.

Action G. Purchase property.

Purchase could include fee simple acquisition, purchase of conservation easements, donation of land, and/or bargain sale.

Responsible Groups: Project Proponents, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action H. Annual acquisition/restoration workshop.

Each year watershed partners should meet to discuss which lands have been acquired and restored in the previous 12 months, new sites that have been identified that should be considered for acquisition or restoration, new acquisition and restoration initiatives, priority sites that have been developed and therefore need to be removed from consideration, proposals to revise the criteria and weighting for prioritizing sites, new potential funding sources, etc. The new Watershed Coordinator and Watershed Council should organize and host the event.

Responsible Groups: Watershed Coordinator/Watershed Council, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action I. Update/maintain prioritization tool.

The WMP prioritization tool should be updated annually based on information from the annual acquisition/restoration workshop.

Responsible Group: Watershed Coordinator

7.1.3 Riparian Buffer, Wetland and Stream Restoration

Leadership Role – Project Proponent

Note: The New Development Site Management actions include preservation of stream buffers in future development applications in the watershed. This is separate from the recommended riparian buffer restoration projects (see New Development Site Management High Priority Action A).

High Priority Action A. Identify project proponent (site-by-site).

The Project Proponent is one or more entities that wish to acquire the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.

Responsible Groups: Watershed Coordinator, local jurisdictions, NGOs

High Priority Action B. Field evaluation.

Conduct a site visit to confirm the site has not been disturbed and to confirm that the site meets criteria which made it a priority buffer, wetland, or stream restoration site. Use checklist from WMP prioritization report.

Responsible Group: Project proponent.

High Priority Action C. Landowner outreach.

Verify that landowner information developed as part of WMP information is up-to-date. Develop outreach materials regarding the importance of the site, generally what is being proposed, the environmental benefits of the project, and the potential tax benefits to the property owners.

Responsible Group: Project proponent, NGOs

Action D. Contact ACOE and other permitting agencies.

Have pre-design meeting with the ACOE, CA Fish and Game, local engineering departments, and other potential permitting agencies to determine which types of permits will be needed for the project site.

Responsible Group: Project Proponent

Action E. Coordinate with local trails and infrastructure plans.

Determine if the site is part of a local water, sewer, road, or other infrastructure plan or a trails plan that would either nullify restoration of the site or would complement restoration of the site.

Responsible Group: Project Proponent

Action F. Coordination with cultural resources priorities.

There are confidential databases of cultural resource sites in the watershed. If one or more of the restoration sites also coincides with a cultural resource site, it could raise the priority of the site and increase the potential funders for restoration. Alternatively, a cultural resource site may nullify disturbance of the site for restoration.

Responsible Groups: Project Proponent and NGOs

Action G. Develop design and cost estimates.

Planning-level, conceptual costs were estimated and presented in the WMP for the buffer, wetland and stream restoration opportunities however, additional analysis, modeling and design work will be required to support the restoration opportunities and to develop detailed cost estimates for funding allocation.

Responsible Groups: Project Proponent

Action H. Secure needed permits.

Depending on the nature of the proposed activities projects, agency permits may be required, including Coastal Development Permit for construction within the Coastal Zone, Section 404 Permit from the U.S. Army Corps of Engineers construction impacting to jurisdictional waters of the U.S., 401 Water Quality Certification from the Regional Board for conditions placed in the Section 404 Permit to protect water quality, Streambed Alteration Agreement from California Department of Fish and Game due to impacts to jurisdictional wetlands and streambeds, and Local Development Permits (i.e., grading, building or other construction related permits). Proposed watershed management projects may also require an evaluation under the California Environmental Quality Act (CEQA), which requires state and local agencies to evaluate the environmental impacts of their actions. It a project involves the use of federal funds, an evaluation under the National Environmental Policy Act (NEPA) may also be required.

Responsible Groups: Project Proponent

Action I. Secure funding sources.

A variety of funding options may be used to support restoration projects depending on the type of project and how it matches up with funding sources.

Responsible Groups: Project Proponent, Watershed Coordinator/Watershed Council, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action J. Identify/secure stewardship organizations and develop stewardship plan.

An organization must be identified to provide long-term stewardship of the site, which includes but is not limited to fire prevention, invasive species control, and replanting. The Stewardship organization should develop a stewardship plan and ensure that funding is provided to implement it.

Responsible Groups: Project Proponent and stewardship organization.

Action K. Implement projects.

Responsible Groups: Project Proponents

Action L. Annual acquisition/restoration workshop.

Each year watershed partners should meet to discuss which lands have been acquired and restored in the previous 12 months, new sites that have been identified that should be considered for acquisition or restoration, new acquisition and restoration initiatives, priority sites that have been developed and need to be removed from consideration, proposals to revise the criteria and weighting for prioritizing sites, new potential funding sources, etc. The new Watershed Coordinator and Watershed Council should organize and host the event.

Responsible Groups: Watershed Coordinator/Watershed Council, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action M. Update/maintain prioritization tool.

The WMP prioritization tool should be updated annually based on information from the annual acquisition/restoration workshop.

Responsible Group: Watershed Coordinator

7.1.4 Stormwater BMP Retrofit

Leadership Role – Local Jurisdictions

Action A. Site selection and feasibility (untreated areas).

The WMP identified areas that have the highest pollutant loading and stormwater volume impacts and that also were developed before stormwater BMPs were required. These "untreated" areas need to be surveyed to identify promising sites for BMP retrofits and to screen for project feasibility on the highest ranking sites. As redevelopment is monitored over time, untreated areas slated for redevelopment should be considered for BMP retrofits if redevelopment trends change and the land is likely to remain untreated. Each local government engineering department in the watershed should conduct individual surveys for untreated areas within their jurisdiction.

Responsible Group: Local engineering departments

Action B. Collection of additional site data.

The WMP identified five potential demonstration sites that may complement the proposed stream restoration projects. Additional data need to be collected to assist in BMP selection, sizing, and location.

Responsible Group: Local engineering departments (individual surveys for untreated areas within their jurisdiction)

Action C. Landowner outreach.

Verify that landowner information developed as part of WMP information is up-to-date. Develop outreach materials regarding the importance of the site, generally what is being proposed, the environmental benefits of the project, flood reduction benefits to the property owner, and the potential fee waivers or other incentives for the property owners.

Responsible Group: Local engineering departments

Action D. Preliminary design and cost estimate.

Based on final selection of BMPs for the site, develop preliminary design and cost estimates.

Responsible Group: Local engineering departments

Action E. Secure needed permits.

It is anticipated that BMP retrofits on the demonstration sites and in the untreated areas will be on sites that have been highly disturbed in the past and therefore would not require the types of permits required for restoration projects. However, some permits may be required, depending on the BMP selected and the site location.

Responsible Group: Local engineering departments

Action F. Secure funding sources.

A variety of funding options may be used to support restoration projects depending on the type of project and how it matches up with funding sources.

Responsible Groups: Project Proponent, Watershed Council, NGOs, CA Fish and Game, US Fish and Wildlife, ACOE, local jurisdictions

Action G. Implement projects.

Responsible Group: Local engineering departments

Action H. Monitor effectiveness/efficacy of demonstration projects.

Given that the use of LID techniques is relatively new in the San Diego region, there is a need to monitor the effectiveness of these techniques in managing stormwater peak volume and pollutant loading. This monitoring should include measuring inflow and outflow of the BMPs as well as downstream conditions.

Responsible Groups: Local engineering departments and universities

7.1.5 Monitoring and Enforcement

Leadership Role – Local Jurisdictions and NGOs

Action A. Long term stream and lagoon monitoring program.

Collect and assess physical, chemical, and biological data for streams in the watershed and the lagoon through a long-term monitoring program. This monitoring is to supplement current monitoring by Co-permittees (see recommendations in Section 6.5). Periodically report on monitoring results using baseline water quality data from the WMP and water quality goals as benchmarks for comparison.

Responsible Groups: Co-permittees, NGOs, universities

Action B. Long-term wetlands monitoring (CRAM).

Periodically collect and assess CRAM data for wetland areas of the watershed. As a part of the WMP, the Southern California Coastal Water Research Project (SCCWRP) conducted a one-day CRAM training event which was well attended by NGOs, agencies and local jurisdictions. A partnership with SCCWRP, through a local NGO or university would be a good partnership to implement this action long-term. It is important that the data be fully analyzed and made available to stakeholders at a central location such as the Agua Hedionda Lagoon Discovery Center. Periodically report on monitoring results using CRAM monitoring results from the WMP as a benchmark for comparison.

Responsible Group: NGOs

Action C. Inspections and maintenance of sanitary sewer systems.

Check lines for leaks, illicit connections, and overflows. Inspect sewage conveyance systems (pipes, pump stations, manholes) to ensure proper functioning. This ongoing work is included in the new Sanitary Sewer Order (State Waste Discharge Requirements (WDR) Order 2006-0003-DWQ)

Responsible Group: Local wastewater/sewer departments

Action D. Monitoring effectiveness/efficacy of BMP demonstration projects.

Given that the use of LID techniques is relatively new in the San Diego region, there is a need to monitor the effectiveness of these techniques in managing stormwater peak volume and pollutant loading. This monitoring should include measuring inflow and outflow of the BMPs as well as downstream conditions.

Responsible Groups: Local engineering departments and universities

Action E. Inspections and maintenance of storm drainage systems.

Increase efforts to clear and maintain storm drains and drainageways to remove deposited materials. For storm drain pipes, cleaning is especially needed with pipes too flat to be self-cleansing. Clearing of drainageways should involve routine inspection of drainage channels and creeks. This ongoing work is also included in "Regional Channel Maintenance" program. The Regional Channel Maintenance Workgroup has developed a guide for maintenance activities which should facilitate this recommended action.

Responsible Groups: Local jurisdictions

Action F. Construction site inspection and enforcement action.

During construction, conduct onsite inspections and take enforcement actions, as needed. This ongoing work is also included in Order 2007-001.

Responsible Groups: Local jurisdictions

Action G. Stormwater BMP inspection and enforcement.

Regularly inspect stormwater controls to certify their proper functioning and to require repair of failing systems. This action is also included in Order 2007-001.

Responsible Groups: Local jurisdictions

Action H. Tracking key watershed management plan indicators.

In order to measure the effectiveness of the WMP and the actions taken in meeting the goals and objectives, it is important to track the WMP key indicators over time. These indicators include, but are not limited to, stream water quality, riparian habitat extent, percent change in the watershed's natural area,

location of mature tree species, percent imperviousness, percent of new development implementing LID, etc. Tracking of key WMP indicators will require ongoing support, commitment and funding. Many of the indicators to be tracked will require analysis using GIS tools and modeling. Although some of the indicators can be tracked by NGOs, complete implementation will best be performed by the Watershed Coordinator or hiring a consultant through the Watershed Council or NGOs. If implementation of the WMP becomes an integral part of local jurisdictions' WURMP and TMDL implementation programs this action could fall under their assessment purview.

Responsible Groups: Watershed Coordinator/Watershed Council, NGOs, local jurisdictions

7.1.6 Citizen Stewardship/Public Outreach

Leadership Role – Watershed Coordinator/Watershed Council, Local Jurisdictions

High Priority Action A. Collaborative Agua Hedionda Watershed Council.

This includes creation of a permanent watershed council supported by a part-time watershed coordinator. It is recommended that each local government have an elected official as representative on the board of the Watershed Council. To me most effective, the Watershed Council should be formalized with an agreement in the form of a Memorandum of Understanding, Joint Powers Agreement or Memorandum of Agreement between local jurisdictions. The Council may also wish to form as a non-profit organization. It is also recommended that the Council have several stakeholder committees: watershed partners, technical advisory committee, and funding committee.

Responsible Group (for forming Council): local jurisdictions

Action B. Reporting to local governments and local boards.

The Watershed Council should meet with these boards during their regularly scheduled meetings on an annual basis to update them on the needs, benefits and progress of the WMP implementation.

Responsible Group: Watershed Coordinator/Watershed Council

Action C. Distribution of educational materials.

Educational materials can include brochures, agency bill inserts (brief flyers in water bills), press releases, presentations to schools and civic groups.

Responsible Groups: Watershed Coordinator/Watershed Council, local jurisdictions, NGOs

High Priority Action D. LID workshops and training.

The workshops should include general LID education, however they should focus on local knowledge obtained from the modeling effort in this WMP (see Section 6.1 and Appendix J). It is recommended that workshops and training for municipal staff is performed by other professionals or professional organizations.

Responsible Groups: Local jurisdictions, NGO

Action E. Annual awards program.

An annual awards program is recommended to encourage and recognize local efforts towards watershed protection. Awards should be considered for individuals, Public Officials, developers, businesses, or NGOs.

Responsible Group: Watershed Coordinator/Watershed Council

Action F. Annual progress workshop.

This workshop would allow watershed partners to discuss progress made in implementing the WMP and new initiatives for the coming year.

Responsible Groups: Watershed Council, NGOs, local jurisdictions

Action G. Management partnerships.

Establish partnerships within the watershed to leverage programs towards project implementation.

Responsible Groups: Watershed Coordinator/Watershed Council, Local jurisdictions, University, Private mitigation proponents (Developers, Poseidon, Caltrans, Cabrillo, Power Plants), US Fish and Wildlife, CA Fish and Game, SANDAG, etc.

Action H. Aqua Hedionda Website.

The website should maintain program information including an overview of the WMP, announcements, events calendar, meeting archives, educational material ongoing projects, and links to other related programs. It should be maintained on a regular basis which will include staff time to prepare updates and funding to support website hosting.

Responsible Group: Watershed Coordinator/Watershed Council

7.1.7 Funding and Sustained Support

Leadership Role – Watershed Coordinator and Local Jurisdictions

High Priority Action A. Grant Programs.

Successfully tapping into grant programs will involve identifying target grant programs, matching projects to grant programs, identifying partnerships and matching funds, contacting appropriate agencies, and preparing grant applications. A wide range of potential funding options are discussed in Section 1.1. The responsibility for obtaining grant funding falls with the Watershed Coordinator, local jurisdictions and NGOs as grant applicant and project sponsors.

Responsible Groups: Watershed Coordinator, local jurisdictions, NGOs

High Priority Action B. Coordination with agencies.

Identify target agencies and funding opportunities through agency programs. Meet quarterly with appropriate agencies to discuss priorities and opportunities.

Responsible Groups: Watershed Coordinator, local jurisdictions, NGOs

High Priority Action C. Mitigation programs.

Identifying win-win opportunities for addressing mitigation needs and implementing preservation/restoration projects requires aligning projects with mitigation banks and in-lieu fee programs; obtaining agency support for mitigation banks and in-lieu fee programs; and conducting outreach to the development community, public and private sector entities in need of mitigation credits.

Responsible Groups: Watershed Coordinator, local jurisdictions, NGOs

High Priority Action D. Watershed Council Support (Watershed Coordinator Support).

The Watershed Council and Watershed Coordinator will require startup and ongoing funding support. Key steps to securing this support include preparing a scope for the watershed council and staffing needs

($); obtaining local support from agencies, jurisdictions, NGOs and the business community; identifying grant/funding opportunities and pursue with grant proposals; explore redirection of City fees.

Responsible Groups: startup – local jurisdictions and NGOs; ongoing support – Watershed Coordinator, local jurisdictions, NGOs, other watershed partners

7.2 TIMELINES AND MILESTONES

Clearly some recommended actions take priority, either because they are most essential to preservation and restoration of the Agua Hedionda Watershed, or because they are required before other actions can move forward, or both. A number of the recommended actions are ongoing, particularly the monitoring and enforcement activities. Appendix H, Implementation Actions, provides proposed timelines for each of the recommended WMP actions, noting where timelines of certain actions are yet to be determined.

Below are the proposed timelines for High Priority Actions.

- Hire part-time Watershed Coordinator – September 2008-March 2009
- Establish Watershed Council – September 2008-September 2009
- Conduct field evaluation of priority preservation sites – August 2008-February 2009.
- Identify project proponents for preservation and restoration projects – TBD (potentially concerted effort could begin after hiring watershed coordinator)
- Conduct field evaluation/verification for the restoration sites– TBD dependant on indentifying project proponents
- Conduct landowner outreach for preservation and restoration projects – TBD dependant on indentifying project proponents
- Host annual preservation/restoration workshop – August 2009 (and annually thereafter)
- Conduct LID workshops and training – TBD (dependent on local jurisdiction resources and grants)
- Revise local codes to include *Basic LID* techniques and standards – March 2010
- Track key watershed indicators – 2011-2012 (every 3 to 5 years thereafter)
- Secure Funding –TBD (potentially concerted effort could begin after hiring watershed coordinator)

Ongoing programs that affect Agua Hedionda watershed planning and funding efforts also have key milestones that should be tracked over the next several years. These program milestones include:

- Requirements for Sanitary Sewer Order (State Waste Discharge Requirements (WDR) Order 2006-0003-DWQ) for Wastewater Collection Agencies
- Water Conservation Ordinance adoption by local jurisdictions
- MSCP implementation (County)
- Lagoon TMDL
- Reissuance of San Diego County Municipal Stormwater Permit (Order 2007-001)
- IRWMP Update – Prop 84 Planning Grant
- Stormwater Grants
- Flood Control Grants

7.3 ESTIMATED COSTS AND FUNDING

Estimated Cost and Funding

Implementation of the WMP will require funding and sustained support. Estimated cost for some of the key WMP components are summarized below. The cost of the citizen stewardship actions is yet to be determined.

New Development Site Management

Local governments' revision of codes and ordinances to incorporate the use of LID is an existing requirement, not an added cost to local jurisdictions and the development community of the WMP. Studies have shown that use of LID can in some cases reduce overall development costs, depending on the site design. These reductions are often found in reduced paving costs (due to narrower streets, shorter driveways, etc.), reduced infrastructure costs (e.g., using swales in place of curb and gutter), and reduced grading costs. Cost saving site designs are more often achieved in rural and suburban development rather than highly urbanized developments.

Preservation

25 properties

387 acres to preserve

$38 to $95 million in total acquisition costs (fee simple acquisition)

Cost per acre: $45,000 to $280,000 per acre

Potential Funding Sources: Mitigation Banks and In-lieu program; Project Mitigation Needs (developers, Poseidon, Caltrans, Cabrillo, Power Plant, etc.); Grants – SWRCB (Prop 84), DWR (Prop 84 and 1e), San Diego County IRWM (Prop 84), EPA 319(h), OPC, Wetland Recovery, State Tribal and local Government (EPA); MHCP and MSCP implementation, U.S. Fish & Wildlife, California Department of Fish & Game

Riparian Buffer Restoration

27 properties

129 acres to restore

$10 to $19 million in total acquisition and restoration costs

Total cost per acre: $42,000 to $160,000 per acre

Potential Funding Sources: Mitigation Banks and In-lieu programs

Project Mitigation Needs (developers, Caltrans, SANDAG Transnet, Poseidon, Caltrans, Cabrillo, Power Plant, etc.); Grants –SWRCB (Prop 84), DWR (Prop 84 and 1e), San Diego County IRWM (Prop 84), EPA 319(h), OPC, Wetland Recovery, State Tribal and local Government (EPA)

Wetland Restoration

12 properties

47 acres to restore

$2 to $10 million in total acquisition and restoration costs

Total cost per acre: $42,000 to $250,000 per acre

Potential Funding Sources: Mitigation Banks and In-lieu programs

Project Mitigation Needs (developers, Caltrans, SANDAG Transnet, Poseidon, Caltrans, Cabrillo, Power Plant, etc.); Grants – SWRCB (Prop 84), DWR (Prop 84 and 1e), San Diego County IRWM (Prop 84), EPA 319(h), OPC, Southern California Wetland Recovery Project, State Tribal and local Government (EPA)

Stream Restoration

11 reaches to restore

31,500 feet, or 6 miles to restore

$9 to $11 million in restoration costs

Potential Funding Sources: Mitigation Banks and In-lieu programs

Project Mitigation Needs (developers, local jurisdictions' CIP project, Caltrans, SANDAG Transnet, etc.); Grants (SWRCB (Prop 84), DWR (Prop 84 and 1e), San Diego County IRWM (Prop 84), EPA 319(h), OPC, Wetland Recovery, State Tribal and local Government (EPA)

BMP Retrofit Demonstration Projects

Six BMP retrofit sites were identified. Some sites included multiple BMPs on the conceptual design.

Table 7-1 provides conceptual level unit costs associated with each BMP:

Table 7-1. Stormwater Retrofit Costs

BMP	Unit Price
Bioretention	$6.00/cf
Bioswales	$1.00/cf
Cisterns	$7.5K/1,800 gallons
Depressed medians	$1.00/cf
Grading	$2/cy
Media filter	$4.5/cfs -$3k/catch basin
Pervious paving	$10 - $15/sf
Trees	$3.50/sf
Shrubs	$1.75/sf
Trash Traps	$350/opening

Potential Funding Sources: Local jurisdictions, vendors; Grants (EPA 319)

Monitoring and Enforcement

Many of the monitoring and enforcement actions fall within current local government responsibilities and do not pose additional management cost, e.g. inspections/maintenance of sanitary sewer systems; inspections/maintenance of storm drainage systems; construction site inspection, stormwater BMP Inspection, and Co-permittee stream and lagoon monitoring. The cost of the enhanced monitoring, of continued CRAM monitoring, and of tracking watershed indicators has not been determined.

Potential Funding Sources: Local jurisdictions; Grants

Citizen Stewardship

Cost to be determined

Potential Funding Sources: SWRCB (Prop 84); DWR (Prop 84 and 1e); San Diego County IRWM (Prop 84); EPA 319(h); OPC; Southern California Wetland Recovery Project, State Tribal and local Government (EPA)

Funding and Sustained Support

$10,000 grant for forming Watershed Council (one time cost)

$100,000 annually for watershed coordinator (preliminary estimate including salary, fringe, and overhead)

Potential Funding Sources: Grants: Southern California Wetland Recovery Project , Department of Conservation; Local jurisdictions; Local businesses, Private Foundations

7.4 ESTIMATED IMPACTS AND BENEFITS

Below we present how each of the key actions contribute to preservation, restoration and enhancement of the watershed, where possible using results of the watershed and site scale modeling of the Agua Hedionda watershed as well as accepted literature values. The information can be used to help educate citizens, businesses, and elected officials about the benefits of the actions recommended and used in grant applications to support implementation efforts.

While the benefits are discussed individually, it is important to note that the recommended actions work together to achieve greater functional uplift for the watershed. In fact, the Focus Areas are designed to leverage actions and maximize overall preservation and restoration benefits for the Agua Hedionda watershed.

7.4.1 LID Implementation Benefits

LID Implementation Benefits

When looking at cumulative pollutant loading and peak volume near the mouth of the watershed, the watershed modeling indicates that if certain land conversion (e.g., from agricultural to LID development) is realized, *Basic LID* techniques are implemented for future development and redevelopment, and land preservation is achieved, communities in the watershed should be able to "hold the line" on pollutant loading and peak discharge. Implementing *Enhanced LID* techniques would achieve even greater cumulative benefits in the watershed.

What are the LID benefits on a site scale? Table 7-2 through Table 7-5 show the results of the site pollutant loading analysis/modeling of different types of development in the Agua Hedionda watershed. The percentages reflect the reduction in load from an untreated site with default percent impervious area assumptions. The *Basic LID* implementation scenario assumes adoption of practices meeting the 2007 order, with minimal incorporation of additional LID. The *Enhanced LID* implementation scenario assumes the development site not only meets the 2007 order requirements, but additional LID measures have been incorporated with some consideration for economic feasibility. The *Enhanced LID* scenarios are just an example of what might be achieved; other configurations are possible, and may be influenced by changes to regulations resulting from pending TMDL and hydrology implementation requirements. Details about the scenarios are discussed in Section 6.1 and Appendix J.

It is estimated that implementation of *Basic LID* techniques for new development would achieve 60 percent to 70 percent reduction in sediment load and an 88 percent reduction in fecal coliform load, which

are key problem parameters for the watershed and lagoon. It is expected to also achieve a 35 to 45 percent reduction in Total Nitrogen and a 25 to 30 percent reduction in Total Phosphorus. Implementation of the *Enhanced LID* techniques are predicted to provide substantially greater reductions in Total Nitrogen and Total Phosphorus, especially for multi-family, commercial, and industrial development (e.g., approximately 50 to 65 percent reduction in Total Nitrogen compared with the 35 to 45 percent reduction under the *Basic LID* approach).

Table 7-2. Medium Density Residential LID Benefits

Medium Density Residential	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	45%	58%
Total Phosphorus	30%	45%
Sediment	70%	71%
Fecal Coliform	88%	91%

Table 7-3. Multifamily Residential LID Benefits

Multifamily Residential	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	35%	65%
Total Phosphorus	25%	60%
Sediment	59%	68%
Fecal Coliform	88%	93%

Table 7-4. Commercial Development LID Benefits

Commercial	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	37%	58%
Total Phosphorus	26%	54%
Sediment	62%	67%
Fecal Coliform	88%	98%

Table 7-5. Industrial Development LID Benefits

Industrial	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	37%	48%
Total Phosphorus	26%	32%
Sediment	61%	74%
Fecal Coliform	88%	88%

The previous tables demonstrate the potential benefits of using stormwater management and LID techniques to reduce pollutant load washoff from stable, developed sites. However, an additional impact from development is the increase in peak flow and runoff volume resulting of conversion of natural land cover to developed pervious and impervious surfaces. What results is an increased risk of channel erosion, from both higher peaks and longer durations of flow. Figure 7-1 compares design storm event hydrographs for the Basic versus *Enhanced LID* scenarios for multifamily development. As seen in the *Basic LID* hydrographs on the left, the extended dry detention basin designed under the 2007 order requirements reduces the peak flow to values lower than existing conditions (assumed to be undeveloped land) for all three design storms. However, for the 5- and 10-year events there is a period of time when the post-with-BMPs flow exceeds existing conditions, resulting in a longer duration of potentially erosive conditions in the receiving stream. The *Enhanced LID* scenario incorporates large cisterns (with assumed water reuse) that provide additional runoff storage, and greatly reduce flow during the most potentially erosive portion of the post-with-BMPs hydrograph, nearly matching the existing hydrograph. LID techniques can not only improve pollutant removal, but also reduce total runoff volume and change storm event hydrologic response to more closely mimic natural conditions. Hydrographs for Medium Density Residential, Commercial, and Industrial development are provided in Appendix J.

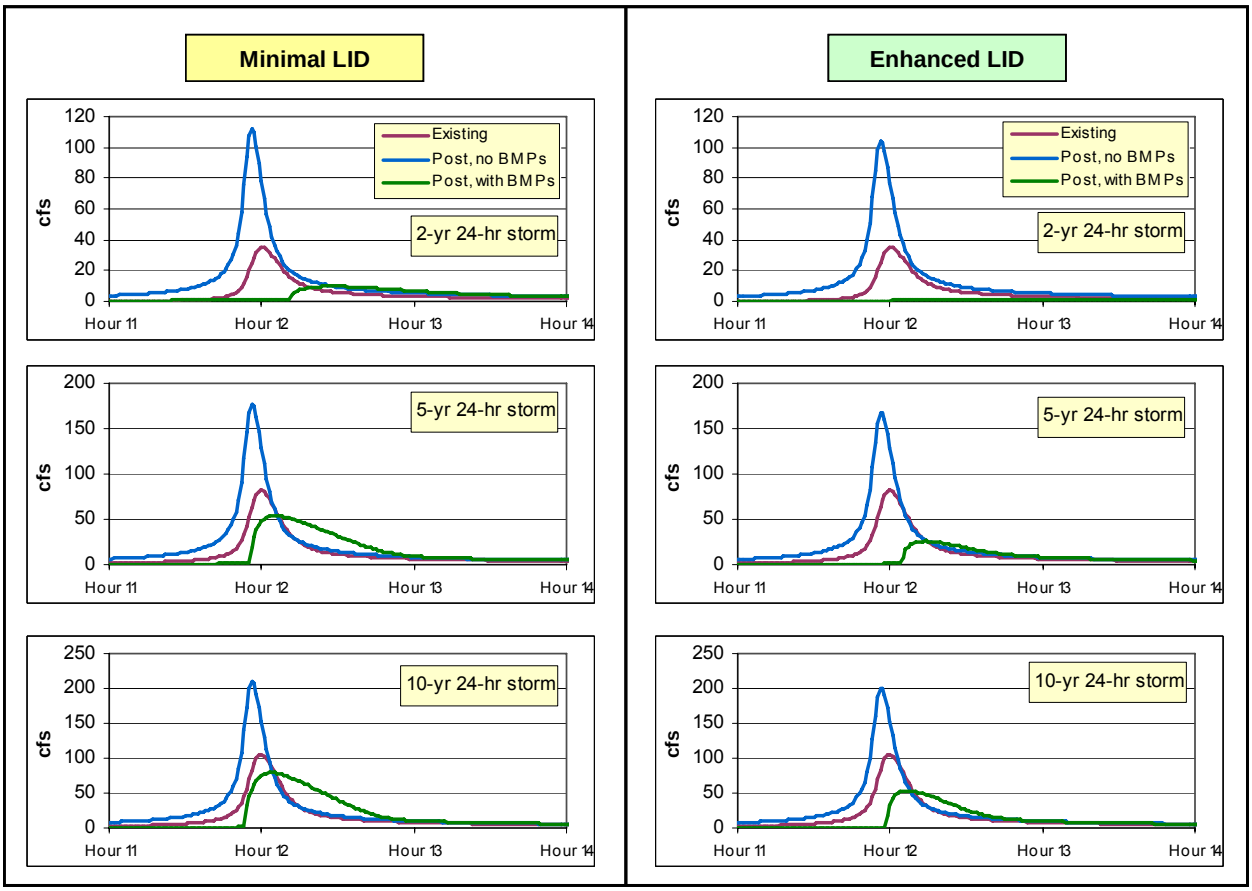

Figure 7-1. Projected Hydrographs for *Basic LID* and *Enhanced LID* Scenarios for Multifamily Development

7.4.2 Preservation Benefits

In the Agua Hedionda watershed, land preservation directly supports the WPG goal "preserve habitat in the watershed" (Goal #2). It also supports the goals to restore watershed functions (Goal #3), and to support compliance with regulatory requirements (Goal #4).

While the habitat benefits of land preservation are difficult to quantify, the watershed modeling results do shed light on the benefits of pollution and runoff prevention. For example, if the zoning for a particular parcel allows medium density residential development, then developing the land would generate double stormwater runoff and double the total phosphorus per acre runoff than preserving the land in open space (see Table 7-6). If zoning allows high density residential, it would generate approximately 6 times the stormwater runoff and 20 times the total phosphorus as preserving it in open space. The table shows that preservation of land can significantly reduce fecal coliform, total nitrogen, total phosphorus, and surface runoff volume on a site basis.

Table 7-6 suggests that sediment loading, in some cases, can be lower or similar when developed compared to when preserved. First, the watershed land in its natural state has erosive soils and high sediment loading. When an area develops, it has more impervious area and less natural area that can erode. However, it is important to note that the figures shown in Table 7-6 do not include the sediment impacts due to greater impervious area and associated stormwater volume (i.e., hydromodification and stream bank erosion). Therefore, overall sediment reduction benefits can be better understood by comparing both the sediment loading and surface runoff columns to open space conditions.

For each parcel targeted for acquisition, pollutant loading and runoff prevention can be estimated by matching the current zoning of the property to the appropriate land use category in Table 7-6. Multiply the acres by the loading and runoff factors (e.g., TP lb/ac/yr) for both the zoned land use and the preserve open space. The difference between the two will yield the loading/runoff reduction benefit.

Preservation of the priority parcels can have a significant impact on localized stream water quality, streambank stability, and habitat diversity. In tandem with the other WMP actions, preservation can also help restore water quality and hydrology functions on a watershed scale.

Table 7-6. Open Space Preservation Benefits

Land Use	Fecal Coliform #/ac/yr	TN lb/ac/yr	TP lb/ac/yr	Sediment ton/ac/yr	Surface Runoff in/yr
Preserved Open Space	1.60E+09	1.34	0.05	0.64	1.23
Medium Density Residential	2.22E+10	1.55	0.12	0.52	2.48
Low Density Residential	2.42E+10	1.81	0.14	0.76	2.94
Very Low Density Residential	2.43E+10	2.12	0.14	1.24	3.54
Lt. Commercial/Office/Institutional	4.14E+09	4.67	0.43	0.60	4.98
Warehouse/Industrial/Transportation	5.00E+09	4.75	0.50	0.49	5.86
Multi-Family Residential	9.37E+10	7.30	0.91	0.42	6.04
High Density Residential	1.10E+11	7.96	1.02	0.82	6.86
Heavy Commercial	7.32E+09	6.59	0.73	0.60	8.46

Loading rates based on average annual model simulation of future land use scenario. It includes BMP treatment for applicable land uses.

7.4.3 Riparian Buffers Restoration Benefits

Stream buffers are an important tool in the protection and restoration of watershed functions. A stable, vegetated streambank is a crucial component of stream channel protection and sediment reduction. Without vegetation along a stream, streambanks can slough off and may become more susceptible to failure during high flow events. Riparian buffers also serve as filters for sediment and other pollutants such as nutrients in runoff from adjacent land.

Buffers with widths of approximately 50 to 100 feet (or greater) can provide water quality functions, stabilize the streambank, and protect aquatic habitat (Wenger, 1999). The benefits for stream stability are difficult to quantify. However, the filtering and denitrification effects of riparian buffers and filter strips have been studied extensively. General estimates of effectiveness at reducing pollutants in runoff from adjacent land are as follows: 70 to > 90 percent reduction in TSS, 50 to 90 percent reduction in TP, and 50 to >90 percent of TN (Unsicker et al., 1984, Wenger et at., 1999, CASQA BMP Manual). The effectiveness varies based on width, vegetation type, subsurface flow paths (particularly for N), and position in the landscape.

7.4.4 Wetland Restoration Benefits

The benefits of wetland restoration include flow control, nutrient cycling, and habitat diversity. These wetland benefits, however, are difficult to model and quantify. In the Agua Hedionda watershed, wetland restoration supports several of the WPG goals, including restoring and enhancing habitat in the watershed (Goal #2), restore watershed functions (Goal #3), and supporting compliance with regulatory requirements (Goal #4). Wetland restoration actions can also strengthen other WMP actions, such as buffer restoration, stream restoration, and land preservation.

7.4.5 Stream Restoration Benefits

Instream sedimentation combined with contribution from upload sources is one of the primary concerns in the Agua Hedionda watershed. Sediment from instream sources contributes to impairment in the lagoon as well as degradation of aquatic habitat and associated biological communities in Agua Hedionda Creek and its tributaries. The purpose of the proposed stream restoration projects described in Section 6.3 is to stabilize stream channels in order reduce sediment generated by eroding streambanks and incising channels. The specific benefits of these projects are difficult to quantify based on information gathered to date. Nonetheless, reducing instream sources of sediment is expected to improve water quality, enhance aquatic habitat, stabilize morphologic instabilities, decrease sediment loading to the lagoon, and ultimately improve the diversity and abundance of aquatic communities in both the lagoon and its tributaries.

7.4.6 BMP Retrofit Benefits

Table 7-7 show the results of the site pollutant loading analysis/modeling of the conceptual designs of different types of BMP retrofit demonstration sites, located near proposed stream restoration sites, in terms of percent reduction of annual flow volume and pollutant loading. This information allows for comparison between sites and provides a general indication of the overall performance of retrofit benefits throughout the watershed. The performance of SW-1 is dominated by the extended dry detention basin that treats the entire drainage area, but the cistern does contribute to the reductions, especially for runoff volume. The performance for SW-2 is less than the other sites for TSS and nutrients, which is not surprising since the BMPs treat less than 10 percent of the total drainage area. SW-3 and SW-4a have similar performance in terms of percent removal, and reflects the similarity of treatment between the sites.

SW-4b and SW-5 are also very similar; both represent drainage areas for median swales treating adjacent road area.

Table 7-7. Percent Annual Pollutant Load Reductions for Each Retrofit Site

Retrofit Site	Flow Volume (in/yr)	TSS (tons/yr)	TN (lb/yr)	TP (lb/yr)	Fecal Coliform (# x 10^9/yr)
SW-1	13.6%	51.0%	30.5%	27.2%	89.7%
SW-2	6.2%	6.0%	7.8%	6.7%	6.1%
SW-3	5.0%	49.0%	23.7%	20.2%	87.9%
SW-4a	5.0%	49.0%	23.7%	20.7%	88.0%
SW-4b	13.0%	81.0%	55.1%	23.6%	0.0%
SW-5	13.1%	81.0%	55.6%	25.0%	0.0%

The analysis demonstrates that the retrofit BMPs provide pollutant load and runoff reductions for their receiving watersheds. Furthermore, the BMPs reduce storm event peak flow and runoff volume, an important component of mitigating risk of geomorphic change in streams receiving the runoff. Note that the drainage area delineations and impervious area estimates used in the analysis above should not be used for engineering design.

7.5 ADAPTIVE APPROACH

Watershed management is ongoing work that must respond and adapt to changing conditions. The WMP recommends several procedures or actions that enable this adaptive approach: long-term monitoring; management indicators for plan performance evaluation; and a Watershed Council that can make plan updates.

Monitoring

This WMP recommends that local jurisdictions continue to collect and analyze chemical, physical, and biological data for both the streams and the lagoon, and that NGOs continue the CRAM monitoring of wetland areas in the watershed. Enhanced monitoring is recommended in some locations, particularly wet weather monitoring and bioassessments. Analysis of this monitoring will help determine if water quality objectives are being met and will help track progress from baseline (2007) conditions. Monitoring can also help determine if and where problem sources exists.

Watershed Indicators

The Watershed Council should work with partners to analyze results of the monitoring data as well as other important tracking indicators: percent riparian habitat, percent impervious area, percent of new development using LID. These watershed indicators should be used for evaluating plan performance. Results should be incorporated into the Council's and local government's decision-making process for adapting the management plan.

Watershed Council

The Watershed Council will provide a mechanism for routine watershed management plan updates. It is recommended that the Council revisit the Plan every 5 to 10 years, considering recommendations on Plan revisions from the Watershed Partners Committee and Technical Advisory Committee.

7.6 How the Plan Supports Regional Requirements and Initiatives

Many regional plans exist that relate closely to the Agua Hedionda WMP. Many of them were consulted when developing the goals and objectives for this WMP and the recommendations considered these programs as collaborative opportunities. The discussion below shows the various programs that affect watershed management in the region and how this plan is consistent with and integrates with them.

7.6.1 Local Urban Runoff Management Programs

7.6.1.1 Jurisdictional Urban Runoff Management Program (JURMPS)

San Diego Regional Board Order No. R9-2007-0001 (NPDES Permit No. CAS0108758), *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, the San Diego Unified Port District, and the San Diego County Regional Airport Authority* (2007 Order), describes requirements for the control of pollutant discharges from municipal storm sewer systems (MS4s) within San Diego County. The provisions of the 2007 Order require the development and implementation of comprehensive Jurisdictional Urban Runoff Management Programs (JURMPs). The JURMP outlines actions that will be taken to control and reduce pollutants within the jurisdiction. Most of the recommendations within this WMP support the objectives of the JURMPs, but likely the most applicable are the recommended Citizen Stewardship/Public Outreach and the Stormwater BMP Retrofit actions.

Also as a part of the JURMP are the SUSMP and Hydromodification requirements. The recommended new development site management actions support the SUSMP and Hydromodification requirements by outlining techniques that are most effective for this specific watershed at accomplishing the goals of the WMP and of these two programs.

7.6.1.2 Carlsbad Watershed Urban Runoff Management Program (WURMP)

The 2007 Order also requires that the Co-permittees within the Carlsbad Watershed collaborate in the development and implementation of a watershed-based program that addresses urban runoff quality. The rationale for this need is simple: urban runoff does not follow jurisdictional boundaries and often travels through many jurisdictions while flowing to receiving waters. Therefore, the actions of multiple municipalities within a watershed can have a cumulative impact upon shared receiving waters. The mechanism that the 2007 Order uses to require watershed collaboration is the development of the Watershed Urban Runoff Management Plan (WURMP). The goal of the Carlsbad WURMP is to reduce the discharges of pollutants from the municipal separate storm sewer system (MS4) to the maximum extent practicable (MEP) and prevent urban runoff discharges from the MS4 from causing or contributing to a violation of water quality standards. (CWURMP 2008).

The Agua Hedionda Watershed is within the Carlsbad Hydrologic Unit, which is designated a watershed by the SDRWQCB for the purposed of the 2007 Order. In reality there are unique six watersheds within the Carlsbad Hydrologic Unit. The Agua Hedionda WMP supports the goals and objectives of the Carlsbad WURMP and its implementation can satisfy many of the requirements of the WURMP. Specifically the Agua Hedionda WMP supports:

- Activity ID# CHU-WQA11: Land Acquisitions – This activity consists of supporting the implementation the northern subarea plan. While this plan has yet to be approved by the County of San Diego, lands have been and will continue to be acquired from willing sellers. As discussed below, the MSCP has identified target preservation areas in the upper watershed.

- Activity ID #: CHU-WQEA1: Residential Irrigation Runoff Reduction Education – This activity will focus on education of area residents related to water quality impacts of irrigation runoff.
- Activity ID #: CHU-WQEA4: LID and Watershed Planning for Community Planning and Sponsor Groups – This activity involves educating local planning and sponsor groups throughout the unincorporated County on low impact development (LID) and watershed planning principles, practices, and requirements.
- Proposed Public Participation Activities – The Carlsbad Watershed Co-permittees are responsible for implementing a watershed-specific public participation mechanism within the watershed. The mechanism encourages participation from other organizations within the watershed (such as other agencies, private companies, environmental groups, etc.)

7.6.2 MHCP/MSCP and Open Space Plans (Some Jurisdictions)

The Multiple Habitat Conservation Program (MHCP) and Multiple Species Management Program (MSCP) are comprehensive conservation planning processes that address the needs of multiple plant and animal species in San Diego County. The MHCP goal is to conserve approximately 19,000 acres of habitat and to contribute to the habitat preserve system for the protection of more than 80 rare, threatened, or endangered species. (SANDAG) Within the Agua Hedionda Watershed, the MHCP covers the jurisdiction of Carlsbad, Vista, Oceanside and San Marcos. The acquisition priorities developed in this WMP considered the MHCP as an indicator so that the areas identified herein overlap partially or fully with the MHCP priorities.

The goal of the MSCP is to ensure the long-term survival of sensitive plant and animal species, protect the natural vegetation found throughout San Diego County, and provide for economic development of the region through the development of large-scale open-space preserves created through acquisition of land (County of San Diego). One technique used in the MSCP is the designation of pre-approved mitigation areas (PAMAs), which are areas identified with high biological value in which conservation will be encouraged. PAMAs are proposed for the North County MSCP Subarea and are defined as habitat areas that the Wildlife Agencies have pre-approved as meeting the criteria for the reduced mitigation requirements as specified in the County's MSCP Plan. Early drafts of the North County MCSP Subarea Plan identify a PAMA in the upper watershed which overlaps partially or fully the acquisition recommendations of this WMP.

7.6.3 Carlsbad Watershed Management Plan

The Carlsbad Watershed Management Plan includes five Plan Goals and twelve Plan Objectives that were used as a foundation for developing the goals and objectives for this plan. Thus, this plan supports all of the goals and objectives of the Carlsbad Watershed Management Plan; however, it specifically helps meet *Action No. 3 Plan at the Watershed Level, but Analyze and Implement at the Sub-watershed Level* (note that the reference to the watershed level in this context includes all of the Carlsbad Hydrologic Unit).

7.6.4 San Diego County IRWMP

The Goals and objectives for the San Diego Integrated Water Management Plan (SDIRWMP) were also used to develop the goals and objectives for this WMP. The specific goal that the Agua Hedionda WMP supports is *Goal No. 3 Protect and Enhance Water Quality.* The specific objectives that are supported by this plan include:

- Objective C - Further the scientific and technical foundation of water management,

- Objective F - Reduce the negative effects on waterways and watershed health caused by hydromodification and flooding,
- Objective G - Effectively reduce sources of pollutants and environmental stressors, and
- Objective H - Protect, restore, and maintain habitat and open space

Also the following Water Management Strategies from the SDIRWMP are employed in the Agua Hedionda WMP:

- Ecosystem restoration
- Ecosystem preservation
- Environmental and habitat protection and improvement
- Wetlands enhancement and creation
- Pollution prevention
- Water quality protection and improvement
- Urban runoff management
- Watershed management and planning
- Stakeholder/Community Involvement
- Enhance scientific and technical knowledge

7.6.5 RWQCB Basin Plan, WMI, SWRCB NPS Strategic Plan, California Ocean Plan

7.6.5.1 Watershed Management Initiative (WMI)

The SWRCB and RWQCBs have developed a special initiative called the "Watershed Management Initiative" to address issues related to watershed management, describe current regional efforts, and establish an action plan to implement watershed management plans statewide. The two goals of the WMI are to "*preserve, enhance, and restore water resources while balancing economic and environmental impacts,"* and *"promote cooperative relationships and to improve support for the regulated community and the public."* The stakeholder-driven development process used to develop the WMP and the development of recommendations to preserve, enhance and restore the watershed supports the goals of the WMI. This WMP supports and was driven by the SDRWQCB watershed management approach's seven guiding principles: geographic focus, comprehensive perspective, partnerships with stakeholders, coordinated priority setting, best use of resources, improved decision making and improved efficiency.

7.6.5.2 SDRWQCB's Basin Plan

The SDRWQCB's Basin Plan is designed to preserve and enhance water quality and protect the beneficial uses of all regional waters. It designates existing and potential beneficial uses of groundwater and surface waters in the Region and establishes groundwater and surface water quality objectives to protect the designated beneficial uses. Several water bodies in the watershed do not meet the Basin Plan objectives and are considered impaired. This WMP supports the Basin Plan as it aims to reduce pollutants in the watershed, thereby enhancing water quality and protecting the watershed's many beneficial uses.

7.6.5.3 SWRCB NPS Strategic Plan

The State Water Resources Control Board implements a Non-point Source (NPS) Pollution Program. The NPS Pollution Plan goals include:

- Track, monitor, assess, and report NPS Program activities
- Target NPS Program activities
- Coordinate with public and private partners in all aspects of the NPS Program
- Implement Management Measures (MM) and Management Practices (MP)

The 2003-2008 NPS Five-Year Implementation Plan objectives include:

- Promote the implementation of MMs and related practices by all levels of water quality managers (federal, State, watershed groups and other stakeholders)
- Preserve water quality in waterbodies that are currently meeting California water quality standards and protect them from future degradation for impacts of nonpoint source pollution
- Promote the implementation of MMs and use of MPs for the NPS components of TMDLs or in CWA section 303(d) listed water bodies in order to improve water quality
- Promote better leverage of inter-agency and private entity resources for NPS Programs

The project meets the NPS Control Plan goals on a watershed level by implementing management measures (MMs) to reduce and prevent NPS pollution from entering receiving waters. The WMP recommends utilization of MMs from the Urban Category, Forestry Category, Hydromodification Category, and Wetlands, Riparian Areas and Vegetated Treatment Systems Category of the State Water Resources Control Board State of California NPS Five-Year Implementation Plan (July 2003 through June 2008). Recommendations for monitoring and tracking programs are integrated into the plan to measure the effectiveness of the management measures and the overall plan implementation. The collaborative effort between local government, agency, academic and NGOs provides an interdisciplinary approach to the WMP. Implementation of the Plan can also be used to also address TMDLs for the lagoon and creeks.

7.6.6 Agency Plans

7.6.6.1 California Department of Fish and Game

The mission of the Department of Fish and Game (DFG) is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. DFG's Strategic Plan is organized into four key themes; 1) Public Service, Outreach and Education, 3) Cooperative Approaches to Resource Stewardship and Use, 3) Manage Wildlife from a Broad Habitat Perspective, and 4) Organizational Vitality. This WMP supports the first three themes by establishing a forum for collaboration and stewardship, and presenting recommendations that look at cumulative effects and a broad-based, ecosystem-wide approach to habitat preservation.

DFG owns and maintains the Agua Hedionda Lagoon Ecological Reserve along Agua Hedionda Creek between the mouth and El Camino Real. Recommendations in the WMP include Stormwater Retrofit sites that would protect the Reserve, and preservation and restoration opportunities that would enhance and expand the open space around the Reserve. DFG also has designated a part of the lagoon as a marine protected area. The Agua Hedionda Lagoon State Marine Reserve is adjacent to and waterside of the Reserve and is a "no take" zone for fishing other than for restricted management purposes. The WMP

recommends projects that will reduce sediment from entering the lagoon that could impact the Marine Reserve.

7.6.6.2 Southern California Wetland Recovery Project

The Southern California Wetlands Recovery Project (SCWRP) is a partnership of 18 state and federal agencies working cooperatively with local government, business, and non-profit organizations to acquire, restore, and enhance coastal wetlands in Southern California. The goal of SCWRP is to accelerate the pace, extent, and effectiveness of coastal wetlands restoration. The SCWRP's six regional goals are:

- Preserve and restore coastal wetland ecosystems.
- Preserve and restore stream corridors and wetland ecosystems in coastal watersheds.
- Recover native habitat and species diversity.
- Integrate wetlands recovery with other public objectives.
- Promote education and compatible access related to coastal wetlands and watersheds.
- Advance the science of wetlands restoration and management in Southern California.

SCWRP develops a Work Plan on a biannual basis that identifies priorities for Southern California wetlands restoration and enhancement. The Agua Hedionda WMP supports the goals of the SCWRP and specifically multiple projects for acquisition and restoration recommended in this WMP support the Work Plan Tier I and II project priority list for the Stream Corridors/Riparian Areas.

7.6.6.3 SANDAG

SANDAG's TransNet Environmental Mitigation Program coordinates with local jurisdictions, wildlife agencies, the building industry, and stakeholders to acquire open space for mitigation and to provide funding for management and monitoring. The Agua Hedionda WMP identifies acquisition and restoration priorities through a comprehensive watershed approach that can be used to implement the TransNet Environmental Mitigation Program.

It will be important in coming years to maintaining connections with these regional agencies to continually show how the WMP support regional requirements and initiatives, both to build support for the plan and to build win-win partnerships for project implementation.

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Appendix A. Summary of Key Federal, State, and Local Regulations Applicable to the Watershed

This appendix reviews the existing and planned environmental regulations relevant to the Agua Hedionda Watershed Plan goals and objectives. The following types of regulations and policies are summarized:

- Water Quality
- Stormwater Management
- Sediment and Erosion Control
- Stream/Riparian Buffer Protection
- Floodplain Management
- Water Conservation
- Habitat Management
- Watershed Permitting

Most of the regulations discussed in this section relate to how watershed functions are currently being protected and how functions will be protected in the future. Information on historical stormwater requirements is also included. The watershed permitting section provides a brief discussion of potential permit requirements for projects proposed by the Agua Hedionda Watershed Plan, which will be important to consider during implementation.

Water Quality

The USEPA has delegated the authority to develop and administer Clean Water Act programs to the State of California. Because the State's landscape varies dramatically, the responsibility has been divided among nine regional water quality control boards (RWQCBs). The State Water Resources Control Board (SWRCB) is the agency that oversees the nine regional boards. Under the SWRCB, each regional board acts as a semi-autonomous water quality agency. Each regional board is required to develop a Water Quality Control Plan, or Basin Plan, that contains water quality criteria for its region. The SWRCB also develops statewide water quality control plans, including the Ocean Plan and Thermal Plan.

The State of California has enacted statewide water quality regulations that apply to all regional boards. The State Antidegradation Policy is one such regulation relevant to the Agua Hedionda watershed. This policy requires that the condition of high quality waters of the state be maintained to the maximum extent possible. Under this policy, a discharge cannot be allowed that degrades the condition of high quality waters, even when the water's condition is of higher quality than necessary to support its beneficial use. Degradation can only be allowed after analysis has shown that the action would provide a net social, environmental, and economic benefit. This policy satisfies the federal Clean Water Act antidegradation policy requirement (40 Code of Federal Regulations (CFR) 131.12). Agua Hedionda Creek and other waterbodies in the watershed can be defined as high quality waters if they meet the water quality criterion for a particular constituent.

SWRCB maintains a 5-year strategic plan that guides state and regional board water resource protection efforts. As a part of this strategy, each Regional Board develops a Watershed Management Approach that is part of the Integrated Plan for Implementation of the statewide Watershed Management Initiative (WMI). The San Diego Regional Board's chapter includes the prioritization of watersheds for management; through this prioritization, the Regional Board plans to devote management resources to those watersheds that have strong stakeholder support for implementation of watershed management activities (SDRWQCB, 2002).

Water Quality Control Plan (Basin Plan)

The Basin Plan designates existing and beneficial uses of regional waters to be protected by the plan's objectives. The San Diego Regional Board, whose jurisdiction includes the Agua Hedionda watershed, has developed a Basin Plan which includes existing and beneficial uses for coastal, inland surface, and ground waters. The following tables list all existing and beneficial uses assigned to waterbodies in the San Diego Region. Uses assigned to Agua Hedionda waterbodies are indicated by solid or empty circles within each table; a solid circle indicates an existing use, and an empty circle indicates a potential use. Existing uses are defined as uses that have actually occurred since November 28, 1975 or uses for which the water quality and quantity is suitable to allow the use to be attained (SD RWQCB, 2007a).

Existing and beneficial uses are reported for four inland surface waters within the Agua Hedionda watershed, separated by hydrologic subarea (HSA), as shown in Table A-1. All four waterbodies share the same beneficial uses, which include water supply, recreational, and habitat uses. The lower reaches of Agua Hedionda Creek (HSA 4.31) also have an existing use of Preservation of Biological Habitats of Special Significance (BIOL). Agua Hedionda Lagoon falls under Coastal Waters within the Basin Plan, and Table A-2 lists the existing and beneficial uses for the lagoon, which include most of the coastal water uses within the Region.

The Basin Plan reports that only a small portion of the region supplies appreciable quantities of ground water due to the lack of permeable geologic formations. Development has impacted most of the ground waters in the region, and ground water recharge programs will be needed to maintain adequate ground water table elevations as development progresses. Table A-3 reports the beneficial uses for ground water in the Agua Hedionda watershed. A solid circle indicates an existing use, and an empty circle indicates a potential use. Most ground waters in the Region are designated MUN or AGR. None of the Agua Hedionda groundwaters supply water to a lake or stream (FRSH) or supply water to another hydrologic unit (GWR).

Table A-1. Agua Hedionda Watershed Existing Beneficial Uses for Inland Surface Waters (taken directly from (SD RWQCB (2007a))

Beneficial Use	Waterbody			
	Agua Hedionda Creek	Buena Creek	Agua Hedionda Creek	Letterbox Canyon
Hydrologic Unit Basin Number	4.32	4.32	4.31	4.31
Municipal and Domestic Supply (MUN)	●	●	●	●
Agricultural Supply (AGR)	●	●	●	●
Industrial Process Supply (PROC)				
Industrial Service Supply (IND)	●	●	●	●
Ground Water Recharge (GWR)				
Freshwater Replenishment (FRSH)				
Hydropower Generation (POW)				
Contact Water Recreation (REC1)	●	●	●	●
Non-contact Water Recreation (REC2)	●	●	●	●
Warm Freshwater Habitat (WARM)	●	●	●	●
Cold Freshwater Habitat (COLD)				
Wildlife Habitat (WILD)	●	●	●	●
Preservation of Biological Habitats of Special Significance (BIOL)			●	
Rare, Threatened, or Endangered Species (RARE)				
Spawning, Reproduction, and/or Early Development (SPWN)				

Table A-2. Agua Hedionda Watershed Existing Beneficial Uses for Coastal Waters (taken directly from SD RWQCB (2007a))

Beneficial Uses	Waterbody: Agua Hedionda Lagoon
Hydrologic Unit Basin Number	4.32
Industrial Service Supply (IND)	●
Navigation (NAV)	
Contact Water Recreation (REC1)	●
Non-contact Water Recreation (REC2)	●
Commercial and Sport Fishing (COMM)	●
Aquaculture (AQUA)	●
Warm Freshwater Habitat (WARM)	
Estuarine Habitat (EST)	●
Marine Habitat (MAR)	●
Wildlife Habitat (WILD)	●
Preservation of Biological Habitats of Special Significance (BIOL)	●
Rare, Threatened, or Endangered Species (RARE)	●
Migration of Aquatic Organisms (MIGR)	●
Spawning, Reproduction, and/or Early Development (SPWN)	●
Shellfish Harvesting (SHELL)	●

Table A-3. Agua Hedionda Watershed Beneficial Uses for Ground Waters (taken directly from SD RWQCB (2007a))

Beneficial Uses	Waterbody			
Hydrologic Subarea (HSA)	**Los Monos HSA[1]**	**Los Monos HSA[2]**	**Los Monos HSA[3]**	**Buena HSA**
Hydrologic Unit Basin Number	**4.31**	**4.31**	**4.31**	**4.32**
Municipal and Domestic Supply (MUN)	●	○	○	●
Agricultural Supply (AGR)	●	○	●	●
Industrial Process Supply (PROC)				
Industrial Service Supply (IND)	●	○	○	●
Ground Water Recharge (GWR)				
Freshwater Replenishment (FRSH)				

[1] These beneficial uses do not apply westerly of the easterly boundary of the right-of-way of Interstate 5 and this area is excepted from the sources of drinking water policy. The beneficial uses for the remainder of the hydrologic area are as shown.

[2] These beneficial uses designations apply to the portion of HSA 4.31 bounded on the west by the easterly boundary of Interstate Highway 5 right-of-way, on the east by the easterly boundary of El Camino Real, and on the north by a line extending along the southerly edge of Agua Hedionda Lagoon to the easterly end of the lagoon, thence in an easterly direction to Evans Point, thence easterly to El Camino Real along the ridge lines separating Letterbox Canyon and the area draining to the Marcario Canyon.

[3] These beneficial uses apply to the portion of HSA 4.31 tributary to Agua Hedionda Creek downstream from the El Camino Real crossing, except lands tributary to Marcario Canyon (located directly southerly of Evans Point, land directly south of Agua Hedionda Lagoon, and areas west of Interstate Highway 5).

Each Regional Board is responsible for developing the water quality objectives for its region. The term "water quality objectives" is used in California to include all narrative and numerical water quality criteria. Under the State Porter-Cologne Water Quality Act, the regional boards must use their judgment to determine water quality objectives that provide for "reasonable protection of beneficial uses and the prevention of nuisance (CERES, 1996)."

In its Basin Plan, the SD Regional Board specifies numerical and narrative water quality objectives which are sufficient to protect a water's beneficial uses. Objectives have been set for the following parameters for Inland Surface Waters, Enclosed Bays and Estuaries, Coastal Lagoons and Ground Waters:

- Agricultural Supply Beneficial Use
- Ammonia, Un-Ionized
- Bacteria - Total and Fecal Coliform
- Bacteria - E. Coli and Enterococci
- Biostimulatory Substances
- Boron
- Chlorides
- Color
- Dissolved Oxygen
- Floating Material
- Fluoride
- Hydrogen Ion Concentration (pH)
- Inorganic Chemicals - Primary Standards
- Iron
- Manganese
- Methylene Blue - Activated Substances (MBAS)
- Nitrate
- Oil and Grease
- Organic Chemicals - Primary Standards
- Percent Sodium and Adjusted Sodium Adsorption Ratio
- Pesticides
- Phenolic Compounds
- Radioactivity
- Secondary Drinking Water Standards
- Sediment
- Suspended and Settleable Solids
- Sulfate
- Tastes and Odors
- Temperature
- Total Dissolved Solids
- Toxicity
- Toxic Pollutants
- Trihalomethanes
- Turbidity

For ocean waters, objectives are specified in the separate Ocean and Thermal Plans; however, the Basin Plan sets ocean water objectives for dissolved oxygen and hydrogen ion concentration (pH). The objectives in the Thermal Plan also apply to bays, estuaries, and other coastal and interstate waterbodies and are discussed below.

Within their Basin Plans, the regional boards must also specify plans and policies for meeting the objectives, which include actions to be taken, a timeline for proposed actions, and a plan for evaluating success with achieving the objectives. The San Diego Basin Plan includes policies for point source control, waste disposal, dredging, nonpoint source control, remediation of hazardous materials, and total maximum daily loads (TMDLs). The Basin Plan also specifies the requirements of regional monitoring programs.

California Ocean Plan

The Water Quality Control Plan for the Ocean Waters of California, or the Ocean Plan, designates beneficial and existing uses and prescribes water quality objectives for all ocean waters within California's jurisdiction. The Ocean Plan includes numeric or non-numeric objectives for bacterial, physical, chemical, biological, and radioactive constituents (SWRCB, 2005).

California Thermal Plan

The Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California, known as the Thermal Plan, regulates the discharge of thermal and elevated temperature waste into waterbodies. The Thermal Plan outlines specific regulations by type

of waterbody and also includes general regulations to protect beneficial uses from temperature impacts (SWRCB, 2007).

303(d) List

Waterbodies are placed on the California 303(d) list if the water quality objectives are not met, indicating that the existing and beneficial uses of these waterbodies are impaired. Table A-4 lists the impairments within the Agua Hedionda watershed from the San Diego Region 2006 303(d) list.

Table A-4. San Diego Regional Board 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments for the Agua Hedionda Watershed (SD RWQCB, 2006)

Waterbody Type	Name	Pollutant/Stressor
Rivers/Stream	Agua Hedionda Creek	Manganese
		Selenium
		Sulfates
		Total Dissolved Solids
Rivers/Stream	Buena Creek	DDT
		Nitrate and Nitrite
		Phosphate
Estuarine	Agua Hedionda Lagoon	Indicator bacteria
		Sedimentation/Siltation

The Regional Board will be developing TMDLs for these impairments. Dischargers of pollutants to Agua Hedionda Lagoon are currently being required to collect monitoring data needed for the Regional Board's TMDL assessment for bacteria and sediment. The schedule for TMDL development for other constituents is 2019.

Integrated Regional Water Management Plan

Another regional planning effort relating to water quality is the Integrated Regional Water Management Plan (IRWMP). The passing of California's Proposition 50 provided state funding for watershed management projects identified at the regional level. To use the funding, each Region must complete an IRWMP, which involves the identification of regional priority water management projects. The San Diego IRWMP was developed jointly by the County Water Authority, City of San Diego, and County of San Diego and was adopted by these entities in October and November 2007. The goals of the IRWMP were to:

1. Optimize water supply reliability.
2. Protect and enhance water quality.
3. Provide stewardship of the Region's natural resources.
4. Coordinate and integrate water resource management.

The effort identified 162 management opportunities region-wide. During the prioritization, the projects were placed in 2 tiers: Tier I contains projects that would meet the Proposition 50 funding requirements, and Tier II contains projects that support the plan's goals but are not likely to meet the Proposition 50 requirements (SD RWMG, 2007).

Urban Runoff and Stormwater Management

Each regional board operates a stormwater program that issues permits to comply with federal NPDES requirements. Under the Clean Water Act, the federal NPDES stormwater program requires municipal separate storm sewer systems (MS4s) designated by the EPA to meet stormwater runoff control requirements. The SWRCB has issued an MS4 General Permit that applies to all regulated MS4s in the state. To facilitate compliance with the Statewide Small MS4 General Permit, the San Diego Regional Board is one of several regional boards who have issued a regional permit. In addition to the municipal stormwater permit, the regional boards also administer a statewide General Construction Permit, which regulates stormwater discharges from construction sites, and a statewide General Industrial Permit, which regulates stormwater discharges for specific industrial practices.

Prior to 1990, California did not require local governments to manage stormwater. To comply with the federal Clean Water Act Section 402(p) rulemaking and the first statewide general municipal stormwater permit, the Regional Board adopted its first regional stormwater permit by Order 90-42 in 1990. The permit required local governments to initiate urban runoff and stormwater management programs, eliminate illicit discharges, and implement BMPs on existing development. The BMPs that were implemented on existing development tended to be source control BMPs, such as street sweeping. Order 90-42 did not require new development to control and treat stormwater (P. Hammer, San Diego Regional Water Quality Control Board, personal communication, December 11, 2007). Prior to 2001, sediment and erosion control requirements were in place but were not enforced.

With Order 2001-01, the San Diego Regional Board updated the MS4 permit in 2001 to include stormwater control and treatment requirements for new development, hereafter referred to as the 2001 Order (SD RWQCB, 2001). The Regional Board subsequently updated the permit in January 2007 by issuing Final Order No. R9-2007-0001, hereafter referred to as the 2007 Order (SD RWQCB, 2007b). These orders regulate discharges of urban runoff, defined as:

> Urban Runoff – all flows in a storm water conveyance system and consists of the following components: (1) storm water (wet weather flows) and (2) non-storm water illicit discharges (dry weather flows) (SD RWQCB (2007b).

The co-permittees were required to comply with most of the order's provisions by January 23, 2008. However, due to staff reassignments for fire storm recovery efforts, co-permittees were granted an extension of 60 days for several of the plan updates and the Construction Ordinance update. All co-permittees have complied with the 2007 Order using general requirements and are working to develop more specific requirements within a two-year timeframe.

The MS4 co-permittees within Agua Hedionda watershed are San Diego County and the cities of Carlsbad, Vista, Oceanside, and San Marcos. Each co-permittee must prepare a written account of its plan to comply with the overall 2007 order and incorporate the permit requirements into their jurisdiction's stormwater requirements. This written account is entitled the Jurisdictional Urban Runoff Management Plan (JURMP). Several other plans are required under the order, including the Standard Urban Stormwater Mitigation Plan (SUSMP), which outlines the structural and nonstructural practices to be used to meet MS4 permit requirements for new development and significant redevelopment and provides guidelines for the selection, design, implementation, and maintenance of those practices. The co-permittees will have to update JURMPs and SUSMPs developed under the 2001 Order to comply with the 2007 Order. All jurisdictions in the Agua Hedionda watershed were required to update their stormwater plans and requirements by January 23, 2008 although the deadline was extended 60 days beyond this date due to fire storm damage. All co-permittees have complied with the 2007 Order using general requirements and are working to develop more specific requirements within a two-year timeframe. The following sections describe the major requirements of the 2001 Order as well as the additional requirements of the 2007 Order.

Priority Developments

The pollutant discharge requirements outlined in the 2001 and 2007 Orders apply to Priority Developments, whose characteristics are specified in the order and include most new and redevelopment above specific areas or densities. Under the current and future requirements, new development priority developments include, but are not limited to, housing subdivisions of 10 or more dwelling units and commercial and heavy industry developments above one acre. The following developments greater than 5,000 square feet are also considered priority developments: restaurants, retail gasoline outlets, all hillside development, and paved areas that will be used for transportation. Development is considered "hillside" if it is located on erosive soils and on natural soil with slopes equal to or greater than 25 percent. Redevelopment is considered priority development if it creates, adds, or replaces at least 5,000 square feet of impervious surfaces on an already developed site that falls under the same development and location categories as priority new development.

Priority development includes development discharging stormwater to receiving waters of environmentally sensitive areas (ESAs), including water bodies designated as supporting a RARE beneficial use (supporting rare, threatened or endangered species) and CWA 303(d) impaired water bodies. Agua Hedionda Lagoon qualifies as an ESA since it is designated in the Basin Plan as supporting a RARE beneficial use. Priority development impacting an ESA is defined as:

> All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10 percent or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands (SD RWQCB, 2007b).

Pollutants of Concern and Treatment Control BMP Requirements

All priority developments must employ treatment control BMPs under the 2001 and 2007 orders. The developer must prepare a stormwater management plan that details how stormwater will be managed on the site. The developer must also specify the pollutants of concern. The SUSMP specifies pollutants of concern for general development categories; additional pollutants may be considered if a development will discharge to a 303(d)-listed waterbody.

Next, treatment control BMPs are selected to treat the pollutants of concern for a particular development. Each co-permittee's current SUSMP contains a list of treatment BMPs whose pollutant removal efficiencies are rated according to high, medium, and low pollutant removal. The developer must use a single BMP or treatment train that addresses each pollutant of concern with high or medium pollutant removal. Low ratings are only allowed if a feasibility analysis shows that high to medium BMPs are not feasible. Developers must site BMPs as close as possible to the pollutant source unless shared BMPs are used.

As an example of how the regional requirements are applied, Table A-5 shows the BMP selection matrix from the City of Carlsbad's SUSMP (City of Carlsbad, 2003). Table A-5 designates which BMPs are expected to provide medium or high pollutant removal efficiencies, and developers are expected to use this table as a guide in selecting BMPs to comply with treatment requirements. The City of Carlsbad based its BMP selection matrix on the following references: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (USEPA, 1993), *National Stormwater Best Management Practices Database Version 1.0* developed by the American Society of Civil Engineers (ASCE) in 2001, and the 2001 *Guide for BMP Selection in Urban Developed Areas* released by the ASCE Environmental and Water Resources Institute.

Table A-5. City of Carlsbad Structural Treatment Control BMP Selection Matrix (taken directly from City of Carlsbad (2003))

Pollutant of Concern	Treatment Control BMP Categories[1]						
	Biofilters	Detention Basins	Infiltration Basins[2]	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Hydrodynamic Separator Systems[3]
Sediment	M	H	H	H	L	H	M
Nutrients	L	M	M	M	L	M	L
Heavy Metals	M	M	M	H	L	H	L
Organic Compounds	U	U	U	U	L	M	L
Trash & Debris	L	H	U	U	M	H	M
Oxygen Demanding Substances	L	M	M	M	L	M	L
Bacteria	U	U	H	U	L	M	L
Oil & Grease	M	M	U	U	L	H	L
Pesticides	U	U	U	U	L	U	L

[1] L = Low removal efficiency; M = Medium removal efficiency; H = High removal efficiency; U = Unknown removal efficiency.

[2] Including trenches and porous pavement.

[3] Also known as hydrodynamic devices and baffle boxes.

Hydrology Requirements

The following regional hydrology requirements for priority developments are currently in place and will continue to be in place with the 2007 Order:

i. Volume-based treatment control BMPs shall be designed to mitigate (infiltrate, filter, or treat) the volume of runoff produced from a 24-hour 85th percentile storm event, as determined from the County of San Diego's 85th Percentile Precipitation Isopluvial Map,

or

ii. Flow-based treatment control BMPs shall be designed to mitigate (infiltrate, filter, or treat) either:

a) the maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event

or

b) the maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity (for each hour of a storm event), as determined from the local historical rainfall record, multiplied by a factor of two.

In addition to enforcing the current hydrology requirements, the co-permittees must collaborate on the development of a Hydromodification Plan (HMP) by January 2009. The HMP will specify criteria to

reduce downstream erosion and protect stream habitat. As the HMP is being developed, the co-permittees were required to develop interim criteria by January 2008 (deadline was extended to March 2008). The co-permittees have hired consultants to develop both the interim and permanent HMP criteria.

The interim criteria will apply to any development greater than 50 acres that does not drain to a hardened facility (e.g., concrete channel) leading directly to the ocean. The interim criteria are likely to involve a tool that calculates the required size of treatment basin based on a site's land use and impervious surface (D. Hauser, City of Carlsbad, personal communication, October 19, 2007).

The permanent HMP criteria will apply to all priority developments and will maintain runoff at or near the pre-development peak flow for a continuous range of storm events (e.g., all events within the 2-yr to 10-yr range). The continuous range of storm events would represent the events during which the greatest, cumulative erosion impact is likely to occur. This type of requirement has been used in northern California, and a storm event range of the 2-year to 10-year storms has been applied. Although modeling is required to determine the appropriate range for southern California, a storm event range closer to the 5-year to 15-year storm may be used since rainfall frequency is lower in southern California (D. Hauser, City of Carlsbad, personal communication, October 19, 2007).

Low Impact Development (LID) Requirements

The 2007 Order requires priority development projects to use Low Impact Development (LID) techniques to minimize impervious surface and promote infiltration. Each priority development must be designed to minimize connected impervious areas and direct runoff from impervious surface to pervious areas. The pervious areas must be designed to treat and infiltrate runoff from impervious areas. For priority developments with low traffic areas and appropriate soils, a portion of the impervious surface must be constructed with permeable pavement. In addition to the use of these LID design techniques, developers are required to implement the following LID BMPs where applicable and feasible:

- Conserve natural areas
- Minimize width of streets, parking areas, and walkways
- Minimize impervious footprint
- Minimize soil compaction
- Minimize disturbance to natural drainages

The deadline for the incorporation of LID requirements into each co-permittee's SUSMP was January 23, 2008 although the deadline was extended 60 days from this date due to firestorm damage. All co-permittees have complied with the 2007 Order using general requirements and are working to develop more specific requirements within a two-year timeframe.

Watershed Urban Runoff Management Plans (WURMP)

The 2007 Order also requires that the Co-permittees within the Carlsbad watershed collaborate in the development and implementation of a watershed-based program that addresses urban runoff quality. The rationale for this need is simple; urban runoff does not follow jurisdictional boundaries, and often travels through many jurisdictions while flowing to receiving waters. Therefore, the actions of multiple municipalities within a watershed can have a cumulative impact upon shared receiving waters. The mechanism that the Municipal Permit uses to require watershed collaboration is the development of the Watershed Urban Runoff Management Plan (WURMP). The purpose of the WURMP is to identify and address the highest priority water quality issues/pollutants and their sources in each watershed. In addition, the Municipal Permit requires that the Co-permittees develop activities that address education, public participation, and land use planning on a watershed basis. Agua Hedionda is included in the Carlsbad watershed (more correctly the Carlsbad Hydrologic Unit). The Carlsbad watershed Co-permittees includes the jurisdictions of Carlsbad, Escondido, Encinitas, Oceanside, San Marcos, Solana

Beach, Vista and the County of San Diego. The original Carlsbad WURMP was developed in 2003 and is currently under revision, due to the RWQCB in March 2008. The lead co-permittee for the Carlsbad WURMP was Encinitas for the first four years of the program and has recently transferred to the City of Carlsbad.

Sediment and Erosion Control

Sediment and erosion control requirements were first enforced under the 2001 order and similar requirements will continue to be enforced under the 2007 order. Although sediment and erosion control requirements were in place with earlier permits, enforcement became stronger after the 2007 Order. Under both orders, co-permittees must develop a construction program as part of their JURMP that reduces pollutant discharges from construction sites to the maximum extent practicable (MEP), prevents water quality objective exceedances from these discharges, and meets additional requirements. The regional requirements are in addition to the requirements under the statewide General Construction Permit, which outlines inspection requirements, specifies contents of Storm Water Pollutant Prevention Plan (SWPPP) to be prepared by the developer, and defines standard practices for stabilization and design of BMPs. The co-permittees must include sediment and erosion control practices in their construction program.

According to the 2001 and 2007 Orders, each co-permittee must evaluate the threat of construction sources to water quality and develop standards to address these sources, including a minimum set of construction BMPs. As part of the required BMPs, the following conditions must be minimized to the MEP: extent of clearing and grading, exposure time of bare soil, and extent of grading during wet periods. Temporary reseeding of disturbed areas must occur as rapidly as possible, and preservation of natural hydrologic areas and riparian buffers must be implemented where feasible. Erosion prevention is required to be used as the most important measure for keeping sediment on site during construction, but it must be used in concert with other methods including sediment controls, slope stabilization, and permanent revegetation (as early as feasible). Slope stabilization is required on all inactive slopes during the rainy season and during rain events in the dry season. Slope stabilization on active slopes is required during all rain events, regardless of the season.

The sediment and erosion control requirements in the 2007 Order are similar to the requirements in the 2001 Order. The major change in 2007 was the addition of a requirement for advanced treatment on some sites. The 2007 order requires co-permittees to determine whether a site is an exceptional threat to water quality; for these designated sites, a developer is required to use advanced treatment, which involves mechanical or chemical means to flocculate and remove suspended sediment from construction site runoff prior to discharge.

The Carlsbad sediment and erosion control requirements provide an example of how the current Sediment and Erosion Control requirements are implemented by a co-permittee. Under the Carlsbad requirements, self-inspection of a construction site must occur daily during rain events and during earth moving in the wet season. The developer must conduct daily weather forecasting, and self-inspection checklists must be updated regularly. Inactive areas must be protected and stabilized. BMPs must be deployed to protect all exposed areas within 24 hours of a predicted storm event. The City of Carlsbad must preapprove the developer's "Weather triggered" plan for protecting disturbed areas during weather events (City of Carlsbad, 2003).

Riparian Buffer Protection

Riparian areas are generally defined as land that exists between streams and upland areas, usually within floodplain areas. Developers are sometimes required to preserve riparian areas as water quality protection buffers within a certain distance of streams, either termed "riparian" or "stream" buffers. Some jurisdictions require developers to restore natural vegetation to a riparian buffer area where it has been previously removed. When left undisturbed in natural vegetation or managed with dense vegetation,

riparian buffers intercept and slow stormwater runoff before it enters the stream and filter pollutants from stormwater runoff. Riparian vegetation along stream banks also helps protect the stream channel from severe erosion and bank failure. Each jurisdiction in the watershed addresses the use of riparian buffers for stormwater management and flood control, and some require a certain distance from a stream or wetland to be left undisturbed.

The regional stormwater management requirements include riparian buffer requirements that apply to all jurisdictions in the watershed. The 2001 order requires the implementation of construction site BMPs, which includes riparian buffers. The 2001 language requires the use of BMPs listed or their equivalents, while the language for use of riparian buffers and other construction site BMPs is stronger in the 2007, in which these BMPs are the minimum required to be implemented at construction sites. Neither one of the orders specifies a particular width or area for the riparian buffer. The local ordinances do not appear to provide more specific requirements than the 2001 or 2007 orders.

Vegetative buffers are among the stormwater BMPs allowed for use in meeting the regional stormwater requirements, and these buffers could include natural vegetation, managed grass, or other managed vegetation. Under Vista and Oceanside's stormwater site design regulations, vegetative buffer areas are not specifically required, but "appropriate use of buffer areas" is required by a developer when selecting site design BMPs. The other jurisdictions allow the use of vegetative buffers as stormwater BMPs, but do not specifically require their use as a stormwater BMP.

Beyond the regional requirements listed above, the City of Carlsbad requires developers to preserve a minimum 50-foot buffer of riparian habitat and 100-ft buffer for wetlands – 100 feet from outside edge of riparian/wetland vegetation – within the City of Carlsbad's coastal zone, as designated by the Carlsbad Habitat Management Plan (HMP). The coastal zone boundary roughly corresponds with the El Camino Real corridor within the watershed. The Carlsbad HMP contains additional buffer requirements for specific habitats (City of Carlsbad, 2004).

The City of Vista requires protection of stream banks and channels under Chapter 13 of its municipal code, Storm Water Management and Discharge Control Program. Owners or tenants of property where a stream exists are not allowed to remove bank vegetation except to remove excessive vegetation that retards the flow of water. Any necessary removal of vegetation must be done in a manner that "minimizes the vulnerability of the watercourse to erosion." This chapter also includes a prohibition of development within 50 feet of the centerline of a stream or 20 feet from the top of a bank, whichever distance is greater (City of Vista, 2008). Within this buffer, the city requires a developer to leave existing vegetation undisturbed and to revegetate areas without natural vegetation (John Conley, City of Vista, personal communication to Heather Fisher, June 2008).

For all jurisdictions in the watershed, development is restricted within the floodplain according to Floodplain Management requirements, as outlined in the next section. The floodplain requirements do not specify that vegetation must be left undisturbed.

Floodplain Management

All municipalities within the Agua Hedionda watershed have floodplain management regulations that seek to minimize flood hazards as well as flood-related erosion and mudslide hazards. The local floodplain ordinances designate a floodplain administrator who reviews development plans to ensure compliance with flood hazard regulations. All municipalities have adopted FEMA delineated floodways and areas of flood-related erosion and mudslide hazards. San Marcos is the only municipality in the watershed that uses an overlay zone to designate its flood hazard areas. Carlsbad is the only municipality that requires a special use permit for any development within designated flood, flood-related erosion, or mudslide hazard areas. Designated flood related erosion or mudslide areas exist within all of the watershed's municipalities except for the City of Vista; the floodplain management regulations for the municipalities with these areas have specific regulations for flood-related erosion or mudslide hazards.

The municipal floodplain regulations can be found in the following chapters of each jurisdiction's municipal code: Carlsbad, Chapter 21.110; Vista, Chapter 16.48; Oceanside, Article IX; and San Marcos, Chapter 20.76.

Under the municipal floodplain ordinances, the floodplain administrator reviews all development permits and verifies that a development will not increase flood hazards in any portion of the municipality and that the site itself is reasonably safe from flooding. The floodplain ordinances contain standards for construction in special flood hazard areas. New residential structures must be built at or above the base flood elevation, with additional requirements varying by residential zone. The administrator also reviews mud hazards in a proposed development and specifies requirements for mitigating the hazards in the design of the development. All municipalities that have mudslide hazard areas include specific mudslide hazard regulations in their floodplain ordinances; mudslide hazard areas exist in all jurisdictions except the City of Vista.

A "Floodway," or "Regulatory Floodway" is defined as "the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot." Within an adopted regulatory floodway, all encroachments are prohibited, including fill, new construction, substantial improvements, and other development. These encroachments are prohibited in all areas of the floodway unless a registered civil engineer certifies and demonstrates that the proposed encroachment shall not result in an increase in flood levels during the base flood discharge.

All municipalities that have flood-related erosion-prone areas include regulations for flood-related erosion-prone areas in their floodplain ordinances; flood-related erosion-prone areas exist in all jurisdictions except the City of Vista. Permits are required for construction in all designated flood-related erosion-prone areas and measures must be taken to either relocate a proposed improvement or sufficiently protect against an erosion hazard. Within Zone E on the Flood Insurance Rate Map, all new development must be setback from the ocean, lake, bay, riverfront or other natural body of water. The setback must consist of a natural vegetative buffer or contour strip. The buffer may be used for agricultural, forestry, outdoor recreation, and other appropriate open space uses. The extent of the setback is determined by an evaluation of the flood-related erosion hazard and erosion rate, the anticipated "useful life" of the proposed structure, and the geologic, hydrologic, topographic and climatic characteristics of the site.

San Diego County's floodplain regulations are similar to those enforced by the municipalities in the watershed. The County's floodway and floodway fringe regulations require development to be set back from the floodway boundary a distance of 15 percent of the floodway width (but not to exceed 100 feet). This set back requirement may be increased if the development is within a designated erosion hazard area. The San Diego floodway regulations can be found under Section 86.604 of the County's Resource Protection Ordinance. The County recently completed a Floodplain Management Plan in August 2007 (County of San Diego, 2007) which evaluates the County's current flood control policies and recommends data collection needs and measures for flood mitigation and prevention. Watershed-specific recommendations focused on the County's major watersheds. The County's major watersheds were selected to include watersheds located completely within incorporated communities or within undeveloped unmapped areas of eastern San Diego County; the Agua Hedionda watershed, as well as the entire Carlsbad Hydrologic Unit, do not meet these criteria and was not included in the County's major watersheds

Habitat/Endangered Species/Vegetation

In 1992, the California Natural Communities Conservation Planning (NCCP) Act created a voluntary program in which landowners, local governments, and other stakeholders can work with the state government to prioritize land important for species conservation and identify land where development can occur without severely impacting important habitat. The federal government has a similar program, under the Endangered Species Act, which requires the preparation of Habitat Conservation Plans (HCPs).

Through these federal and state programs, local governments can produce plans for conserving endangered and threatened species habitat and, in the process, obtain federal and state permits for development. This planning process seeks to reduce the need for single-species mitigation while balancing future development needs with the protection of multiple endangered and threatened species.

In response to the NCCP Act, the San Diego region has developed several multijurisdictional habitat planning efforts. The Agua Hedionda watershed falls under the jurisdiction of two of these efforts: the Multiple Habitat Conservation Program and the North County Multiple Species Conservation Subarea Plan.

Multiple Habitat Conservation Program

San Diego Association of Governments (SANDAG), the county's regional planning agency, administers the Multiple Habitat Conservation Program (MHCP). The goal of the MHCP is to "maintain biodiversity and ecosystem health in the region while maintaining quality of life and economic growth opportunities." The program also seeks to create, manage, and monitor an ecosystem reserve in northwestern San Diego County. The MHCP presides over the seven cities within the MHCP subregion, which include the four municipalities in the Agua Hedionda watershed: Carlsbad, Vista, Oceanside, and San Marcos. These cities are required to develop individual, citywide subarea plans, termed Habitat Management Plans (HMPs), detailing specific habitat protection policies that comply with the MHCP plan.

SANDAG has developed and adopted the MHCP plan, which outlines requirements for each citywide subarea plan. The MHCP plan is based on a biological analysis and a determination of which sensitive species will be covered under the plan's policies. The plan outlines policies that cover habitat for sensitive species and also specifies policies for individual species. Compliance with the MHCP plan and citywide subarea plans is designed to meet habitat mitigation requirements under the Federal Endangered Species Act as well as the NCCP Act (SANDAG, 2003).

The City of Carlsbad has developed its Habitat Management Plan for Natural Communities to serve as its HCP under federal regulations as well as its HMP under the MHCP requirements (City of Carlsbad, 2004). The other cities in the watershed are currently developing their HMPs.

North County Multiple Species Conservation Subarea Plan

To meet the requirements of the NCCP ACT, San Diego County passed the Biological Mitigation Ordinance (BMO), established the Multiple Species Conservation Program (MSCP), and developed a countywide Multiple Species Conservation Plan (MSCP Plan). The BMO outlines the goals and objectives of the MSCP and specifies criteria for public and private development projects. It also states the limits to allowed habitat impact and required mitigation measures for such impacts. The BMO development design criteria require the preservation of corridors or significant resources by avoiding development in these areas and clustering development. Reduction in road standards may also be considered as a means to avoid impacts. No land is condemned under this program, but development must conform to the standards in the BMO (MSCP, 2007).

The countywide MSCP Plan provides guidance on the preparation of subarea plans for each jurisdiction within the MSCP Planning Area. Each subarea plan identifies critical habitat for endangered and threaten species within the San Diego region and provides guidance on land acquisition. The subarea plans identify land that will provide critical habitat for endangered and threaten species, and federal, state, and local agencies use the plan to guide land acquisition decisions. The Agua Hedionda watershed intersects with the North County Subarea, where a draft MSCP plan is projected to be released for public review by June 2008. This subarea plan will apply to the unincorporated portion of the watershed (MSCP, 2007).

Water Conservation

Water is provided throughout the watershed by four water agencies:

- Vista Irrigation District
- Carlsbad Municipal Water District
- City of Oceanside
- Vallecitos Water District

The Vista Irrigation District supplies water to the City of Vista and the unincorporated areas of the watershed. The Carlsbad Municipal Water District supplies water to the City of Carlsbad within the watershed boundaries. City of Oceanside Water District supplies Oceanside's water, and Vallecitos Water District supplies water to San Marcos.

These agencies purchase their water from the Region's water wholesale agency, the San Diego County Water Authority. Nearly 90 percent of the regions water is imported from three sources: the Metropolitan Water District of Southern California (MWD), conserved agricultural water from the Imperial Irrigation District (IID), and conserved water from projects that are lining the All-American and Coachella Canals. MWD is the largest supplier and derives its water supply from two sources: the Colorado River and the State Water Project (SDIRWMP, 2007).

The regions' water supplies are currently being strained by an eight-year drought in the Colorado River Basin, low snowpack in the Sierras, a 2007 court order to reduce water pumping to southern California to protect the endangered smelt in the San Joaquin-Sacramento River Delta, and agricultural water supply cutbacks. MWD cut supplies to agricultural users participating in their Interruptible Agricultural Water Program by 30 percent beginning in January of 2008. (The IAWP program enables agricultural users to purchase water at reduced rates in exchange for taking a water supply cut before business and residential users during times of shortage.) The Water Authority and its member agencies are implementing plans and programs to diversify water supplies and increase long-term water supply reliability. Programs include water transfer with the Imperial Irrigation District and supplies from canal lining projects, water conservation, and developing new local water supplies such as groundwater, recycled water and seawater desalination (CWA 2008).

On June 4, 2008, California Governor Arnold Schwarzenegger signed Executive Order S-06-08 which proclaimed a statewide drought. The Order takes immediate action to address a dire situation where numerous California communities are being forced to mandate water conservation or rationing. The lack of water has created other problems, such as extreme fire danger due to dry conditions, economic harm to urban and rural communities, loss of crops and the potential to degrade water quality in some regions.

In 2005, regional water demand consisted of 58 percent residential, 29 percent commercial and industrial, and 13 percent agriculture. This is projected to be 62 percent residential, 32 percent commercial and industrial, and 6 percent agriculture by 2030. Outdoor water use for single family home accounts for as much as 60 percent of the urban residential water used in the region (CWA, 2007). The focus of water conservation efforts in the region has moved from indoor uses to outdoor uses. Reduction in outdoor water use can also lead to reduced urban runoff which transports pollutants to waterways.

CWA projections show that implementing existing and proposed urban water demand (conservation) BMPs would produce water savings of approximately 108,400 acre-feet/year by the year 2030 within the CWA's service area (compared to 53,400 acre-feet/year in 2005). These future water conservation savings will be realized through residential programs (incentives for water saving household appliances, efficiency standards for water-saving devices installed in new residential construction, landscape savings through water budgets, large landscape audits) and incentives for irrigation hardware replacements (weather-based irrigation controllers, efficiency irrigation devices, and artificial turf), and commercial/industrial efficiency

incentive programs. Nearly half of the savings will come from landscape/irrigation controls and compliance with efficiency standards.

In the spring of 2008, CWA drafted a model ordinance for drought response conservation program and asked its member agencies to adopt the ordinance. The model ordinance outlines voluntary and mandatory restrictions including commercial and residential landscape irrigation, washing of vehicles, required repairs of leaks and breaks in irrigation systems, and filling of ornamental pools and fountains. The model ordinance sets up four levels of increasingly higher demand reduction targets and associated water use restrictions that can be implemented by local agencies. The higher stages of the ordinance include mandatory restrictions with accompanying penalties for noncompliance.

The State of California is planning to enact this model water conservation ordinance in 2009. Jurisdictions will be given a year to adopt the new ordinance or incorporate it into their regulations. If jurisdictions do not adopt these regulations by the deadline, the State ordinance will become the over-riding law. The model ordinance is likely to have more stringent standards for irrigation than current water conservation efforts in the watershed (Carlos Michelon, San Diego County Water Authority Water Resources, personal communication to Meleah Ashford, January 2008).

Watershed Project Permitting

Projects proposed in the Agua Hedionda Watershed Plan, depending on the nature of the proposed activities, may require the following permits (Brown and Caldwell, 2007):

- Coastal Development Permit for construction within the Coastal Zone
- Section 404 Permit from the U.S. Army Corps of Engineers construction impacting to jurisdictional waters of the U.S.
- 401 Water Quality Certification from the Regional Board for conditions placed in the Section 404 Permit to protect water quality
- Streambed Alteration Agreement from California Department of Fish and Game due to impacts to jurisdictional wetlands and streambeds
- Local Development Permits (i.e., grading, building or other construction related permits)

Proposed watershed management projects may also require an evaluation under the California Environmental Quality Act (CEQA), which requires state and local agencies to evaluate the environmental impacts of their actions. It a project involves the use of federal funds, an evaluation under the National Environmental Policy Act (NEPA) may also be required.

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Appendix B. Revisions to Land Acquisition, Buffer Restoration, and Wetlands Restoration Scoring Methods

Following Tetra Tech (2008a), the WPG provided comments on the screening criteria and the following updates were made to the prioritization methods.

- Land Acquisition Parcel Scoring
  - Erosion hazard metric weight doubled.
  - The number of top ranking parcels was increased from 13 to 25.
  - A stakeholder priority metric was added that gave a score of 10 to each opportunity that intersected with a stakeholder recommended acquisition site. Opportunities that did not intersect with a stakeholder priority were given a score of 1. The location of one priority could not be disclosed to Tetra Tech due to the sensitive nature of the location; for this priority, all parcels within the coinciding subwatershed were given a score of 10. Since the land acquisition analysis only considers natural, undisturbed area, only stakeholder priorities containing natural vegetation were included.
  - A total area metric was added that scored opportunities based on the total acres of natural area by quartile. The lowest quartile of natural area received a score of 2.5, and the highest quartile of natural area received a score of 10.
- Buffer Restoration
  - The weight for the Sewer Lines metric was halved. This change was made because sewer lines impacting riparian areas may be removed in the future. Removal or relocation of sewer lines may be a management opportunity to coincide with buffer restoration.
- Wetland Restoration
  - A mature riparian trees metric was added using the same rules as the buffer restoration mature riparian trees metric.
  - The weight for the Sewer Lines metric was halved for the same reasoning as the corresponding buffer restoration metric.

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Appendix C. Stream Restoration Concept Sheets

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Appendix D. Additional Data Collection and Design for SR-02

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Appendix E. BMP Retrofit Concept Sheets

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Appendix F. SET Retrofit Analysis Supporting Documentation

Benefits of Retrofit Opportunities

In planning BMP retrofit projects, the effectiveness of the BMPs proposed is an important consideration. The following analysis demonstrates the potential benefits of the five projects located adjacent to the proposed stream restoration projects. The analysis also gives an indication of the benefits of potential BMP placement on the publically-owned parcels located in high priority subwatersheds identified earlier.

The annual water quality and annual hydrology benefits were estimated for each of the BMP retrofit sites located near the stream restoration reaches. Pre- and post-development loads and runoff were calculated using the Site Evaluation Tool (SET). The SET was developed for the assessment of development impacts to water quality at the site level, and has been customized for many locations throughout the United States (Job et al., 2008). The tool is founded upon sound scientific principles and models, and is capable of evaluating the impact of development on downstream water quality and the influence of Best Management Practices (BMPs) on hydrology and pollutant loads. The SET is particularly useful for assessing various LID techniques for stormwater management.

The SET calculates annual hydrology using the Simple Method (Schueler, 1987), and combines annual runoff with pollutant event mean concentrations (EMCs) to calculate pollutant loads. Runoff and loads are calculated separately for a variety of pervious and impervious land covers. For the Agua Hedionda SET, the annual runoff rates and pollutant EMCs were calculated from long term hydrology and pollutant loading time series generated by the Agua Hedionda LSPC watershed model (Tetra Tech, 2008b), allowing the Agua Hedionda SET to calculate site scale annual hydrology and loads specific to the watershed. Runoff and EMC values were calculated for pervious and impervious surfaces for both residential and commercial land uses.

BMP performance in the SET is estimated using pollutant percent removal rates (Table F-1). The removal rates for extended dry detention basins and swales were taken from the median removal rates published in the National Pollutant Removal Performance Database, Version 3 (Center for Watershed Protection, 2007). This study summarizes nationwide research for several BMP types. BMP performance in California's arid and semi-arid climates may differ somewhat from their results, but this study is the best available resource with a large enough sample size to estimate median mass-based pollutant removal. (Note that BMP performance was assessed differently in the LSPC model; the SET uses a simpler approach to estimate loads on an annual basis, while the LSPC model performs a long-term simulation on an hourly timestep, and uses BMP influent/effluent concentration relationships to estimate removal.) Annual hydrology impacts for extended dry detention basins and swales were estimated from LSPC model testing of the practices. Porous pavement performance was not reported in the Center for Watershed Protection database. Collins et al. (2007) report mixed results, as did Bean et al (2007). Bean et al. report nutrient removal for installations in sandy soils that support infiltration, though percent removal is not reported. The pollutant removal rates reflect best professional judgment of a review of these studies, but with the caveat that there is a great deal of uncertainty associated with them. Porous pavement that supports infiltration is likely to perform well if the underlying soils have high infiltration rates, less well if the soils have poor infiltration rates, and poorly if the installation has an impermeable liner. The porous pavement removal efficiencies are meant to reflect a retrofit installation with some storage capacity in the bottom layer, but with poor infiltration. For the rainwater cisterns, 85 percent of the total annual rainfall is assumed to be captured and later released onto landscaped areas for irrigation, and not contribute to annual runoff.

Table F-1. BMP Performance Assumptions at Retrofit Sites

	Percent Reduction				
BMP	Annual Hydrology (Infilt. + ET)	TSS	TN	TP	Fecal Coliform
Extended Dry Detention	5%	49%	24%	20%	88%
Vegetated Swale	13%	81%	56%	24%	0%
Porous Pavement	50%	35%	10%	20%	37%
Cistern*	85%	85%	85%	85%	85%

* Cistern sized to capture 85% of annual runoff from rooftop

Following retrofit site selection and SET setup, Tetra Tech delineated the drainage areas for each site using 2005 aerial imagery, a storm sewer layer, and 2-foot topography lines. The drainage area delineations should be considered approximate since they are based on limited data and were not determined in the field. Tetra Tech subsequently calculated the areas draining to each BMP for input into the SET. Percent imperviousness was determined from the 2001 National Land Cover Data (NLCD) percent impervious layer. NLCD, which is derived from satellite imagery, consists of a pixel grid with a resolution of 30 meters representing impervious percentage values. As discussed in the Agua Hedionda Modeling Report (Tetra Tech, 2008b), NLCD may overestimate impervious area in Southern California landscapes with bare soil (especially beaches and rural areas). However, the pervious areas of the retrofit drainage areas are mostly well vegetated, so NLCD should provide a general estimate of impervious area. The impervious estimates appear to correspond well with the building and paved infrastructure seen in the aerial imagery. Pervious and impervious area for the narrow swale drainage areas was calculated independently, using the length and width of road and pervious areas.

The predicted annual runoff and pollutant load reductions show a range of water quality and quantity improvements. Table F-2 shows treatment performance in terms of inches per year of volume reduction (which is normalized to site area), and site-scale load reduction with appropriate units. The pollutant load reductions are not normalized by site area; as a result, the reductions tend to be larger for the sites with greater area. Reporting loads (and not loads per acre) allows the results to be interpreted in terms of benefits to the larger watersheds to which the sites belong. Note that the underlying loading rates of the land surfaces affect the outcome (i.e., pervious versus impervious area, residential versus commercial). For instance, SW-3 and SW-4a have similar drainage area sizes and treatment, but the fecal coliform load removed by SW-4a is an order of magnitude larger than for SW-3. The increased removal reflects a higher underlying fecal coliform loading rate for SW-4a, which is a residential area; SW-3 is a commercial area and has a substantially lower fecal coliform loading rate. On the other hand, commercial areas show higher loading rates for nutrients, so SW-3 removes more nutrient mass than SW-4a.

Table F-2. Annual Pollutant Load Reductions from BMP Retrofits

Retrofit Site	Flow Volume (in/yr)	TSS (tons/yr)	TN (lb/yr)	TP (lb/yr)	Fecal Coliform (# x 10^9/yr)
SW-1	1.20	19.4	92	9.0	386
SW-2	0.54	1.7	16	1.6	14
SW-3	0.43	12.6	43	3.9	174
SW-4a	0.32	19.2	27	1.8	1,514
SW-4b	1.21	4.2	28	1.3	0
SW-5	1.24	1.4	10	0.5	0

Appendix G. Management Opportunity Atlas

(See separate map documents provided with WMP.)

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Appendix H. Implementation Actions

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Table H-1. Management Plan Implementation

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
New Development Site Management			
Revision of local codes to incorporate recommended *Basic LID* techniques. *Basic LID* techniques include reducing and disconnecting impervious area; extended dry detention; swales or bioretention; and stream buffers. (Included in Order 2007-001)	- Co-permittees as part of local funding	- Co-permittees	March 2010
Tracking compliance with stormwater management and LID. - Review the site plan and engineering plans for compliance with LID requirements. - (Included in Order 2007-001)	- Co-permittees as part of local funding	- Co-permittees - Watershed Coordinator	Ongoing
Implementation of the *Enhanced LID* techniques as new hydrology and/or new water quality requirements are adopted. - Additional revision of local codes, as needed, to meet future, more stringent requirements.	- Co-permittees as part of local funding	- Co-permittees	As needed
Feasibility study for cisterns, porous pavement, and bioretention w/out irrigation.	- Grants (SWRQCB) - Prop 84 (stormwater) - Water Authority (for cisterns) - Ocean Protection Council - Private sector demonstration projects	- Local jurisdictions	August 2008- 2013
Preservation			
Field evaluation.	-	- NGOs - CA Fish and Game - US Fish and Wildlife - ACOE (with project proponent)	August 2008 – February 2009

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Identify project proponent (site-by-site) (Note: Project proponent is one or more entities that wishes to acquire the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.)	-	- Watershed Coordinator (new) - Local jurisdictions - NGOs	TBD
Landowner outreach	-	- NGO (for private property) - Local jurisdictions for public property	TBD
Coordination with cultural resources priorities	-	- NGO	TBD
Secure funding sources	- See Sustained Funding and Support Section	- Project Proponent - Watershed Council - NGOs - CA Fish and Game - US Fish and Wildlife - ACOE	TBD
Identify/secure stewardship organizations	-	- Project proponent	TBD
Develop stewardship plan	-	- Stewardship organization	TBD
Purchase Property	-	- NGOs - CA Fish and Game - US Fish and Wildlife - ACOE - MHCP/MSCP programs	Goal: Acquire 25 priority properties within 10 years (by 2018)
Annual acquisition/restoration workshop	-	- Watershed Coordinator - NGOs (existing) - CA Fish and Game - US Fish and Wildlife - ACOE	1st Workshop August 2009 Annually thereafter
Update/maintain prioritization tool	-	Watershed Coordinator (new) or NGO	Annually

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Riparian Buffer and Wetland Restoration			
Project proponent identification (site-by-site basis) - (Note: Project proponent is one or more entities that wish to conduct stream buffer or wetland restoration on the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.)	-	- Watershed Coordinator - Local jurisdiction - NGO	TBD
Field evaluation	-	- Project proponent	TBD
Landowner outreach	-	- NGO	TBD
Contact ACOE and other permitting agencies	-	- Project proponent	TBD
Coordinate with trails and infrastructure	-	- Project proponent	TBD
Coordination with cultural resources priorities	-	- Project proponent	TBD
Preliminary design and cost estimate	-	- Project proponent	TBD
Secure needed permits	-	- Project proponent	TBD
Securing funding	- See Sustained Funding and Support Section	- Project proponent	TBD
Secure stewardship organizations	-	- Project proponent	TBD
Final planning and design	-	- Project proponent	TBD
Develop stewardship plan	-	- Project proponent	TBD
Implement Projects	-	- Project Proponent	
Annual acquisition/restoration workshop	-	- Watershed Coordinator - Local jurisdiction - NGO	1st Workshop August 2009 Annually thereafter
Updating/maintaining prioritization tool	-	- Watershed Coordinator - Local jurisdiction - NGO	Annually

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Stream Restoration Projects			
Landowner outreach	-	- Watershed Coordinator - Local jurisdiction - NGO - Project Proponent	TBD
Project proponent identification (site-by-site basis) - (Note: Project proponent is one or more entities that wish to conduct stream restoration on the project site. The proponent may be a local government or other agency, an NGO and/or a private sector entity that has mitigation needs.)	-	- Watershed Coordinator - Local jurisdiction - NGO	TBD
Contact ACOE and other permitting agencies	-	- Project proponent	TBD
Coordinate with trails and infrastructure	-	- Project proponent	TBD
Coordinate with cultural resources priorities	-	- Project proponent	TBD
Preliminary design and cost estimate	-	- Project proponent	TBD
Secure needed permits	-	- Project proponent	TBD
Secure funding sources	- See Sustained Funding and Support Section	- Project proponent	TBD
Secure stewardship organization	-	- Project proponent	TBD
Final planning and design	-	- Project proponent	TBD
Develop stewardship plan	-	- Project proponent	TBD
Implement projects	-	- Project proponent	TBD
Annual acquisition/restoration workshop	-	- Watershed Coordinator - Local jurisdiction - NGO	1st Workshop August 2009 Annually thereafter
Update prioritization tool; coordinate with sewer and storm drain infrastructure programs	-	- Watershed Coordinator - Local jurisdiction - NGO	Ongoing

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Stormwater BMP Retrofit			
Site selection and feasibility (untreated areas)	- Local jurisdictions - Grants	- Local jurisdictions	September 2008-September 2011
Collection of additional site data (demonstration projects)	- Local jurisdictions	- Local jurisdictions	September 2008-September 2009
Landowner outreach	- Grants	- Local jurisdictions	January 2009 – January 2010
Preliminary design and cost estimate	- Local jurisdictions - Grants	- Local jurisdictions	TBD
Secure needed permits	- Grants	- Local jurisdictions	TBD
Final planning and design and cost estimates	- Local jurisdictions - Grants	- Local jurisdictions	TBD
Secure funding	- See Sustained Funding and Support Section	- Local jurisdictions	TBD
Implement Projects	- Local jurisdictions - Grants	- Local jurisdictions	TBD
Monitor effectiveness/efficacy of demonstration projects	- Grants	- Local jurisdictions	TBD
Monitoring and Enforcement			
Long term stream and lagoon monitoring program (supplementing current monitoring by Co-permitees) - Collect and assess physical, chemical, and biological data - Periodically report on monitoring results	- Co-permittees - NGOs (streamteam) - University	- Co-permittees - NGOs (streamteam) - University	Ongoing
Long-term wetlands monitoring (CRAM) - Collect and assess physical, chemical, and biological data Periodically report on monitoring results	- NGOs - Grants (WRP, other)	- NGOs	Ongoing
Inspections and maintenance of sanitary sewer systems - Check lines for leaks, illicit connections, and overflows. - (Included in SSO WDR)	- Ongoing sewer agency actions	- Sewer agencies	Ongoing

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Monitoring effectiveness/efficacy of BMP demonstration projects	- Local jurisdictions - Grants - University	- Local jurisdictions - Universities	TBD
Inspections and maintenance of storm drainage systems - Increase efforts to clear and maintain storm drains and drainageways to remove deposited materials. - (Included in "Regional Channel Maintenance" program)	- Local jurisdictions (ongoing)	- Local jurisdictions (ongoing)	Ongoing
Construction site inspection and enforcement action - Conduct on-site site inspections and take enforcement actions, as needed, during construction - (Included in Order 2007-001)	- Local jurisdictions (ongoing)	- Local jurisdictions (ongoing)	Ongoing
Stormwater BMP inspection and enforcement - Staff inspect onsite stormwater management systems and take enforcement action, as needed, on failing systems - (Included in Order 2007-001)	- Local jurisdictions (ongoing)	- Local jurisdictions (ongoing)	Ongoing
Tracking key Watershed Management Plan Indicators.	- Grants	- Watershed Coordinator - NGO	September 2011 Report (every 3 to 5 years)
Citizen Stewardship/Public Outreach			
Collaborative Agua Hedionda Watershed Council -	- See Sustained Funding and Support Section	- Local jurisdictions	September 2008- September 2009
Reporting to local governments and local boards -	- See Sustained Funding and Support Section	- Watershed Council	Annually
Distribution of educational materials/training - Watershed health - Good housekeeping measures - Citizen/classroom monitoring	- See Sustained Funding and Support Section	- Watershed Council - Local Jurisdictions (Co-permittees) - NGOs (e.g. CWN)	TBD
LID workshops and training -	- See Funding and Sustained Support Section	- Local Jurisdictions (Co-permittees) - NGOs (e.g. CWN)	TBD

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Landowner Workshops on Land Preservation	- See Funding and Sustained Support Section	- Watershed Coordinator - NGOs	TBD
Annual awards program -	- See Funding and Sustained Support Section	- NGOs - Watershed Council	TBD
Annual progress workshop	- See Funding and Sustained Support Section	- Local jurisdictions - Watershed Council - NGOs - Other watershed partners	TBD
Management partnerships	- See Funding and Sustained Support Section	- Local jurisdictions - University - Private mitigation proponents: Developers, Poseidon, Caltrans, Cabrillo, Power Plants - US Fish and Wildlife - CA Fish and Game - SANDAG - Etc.	Ongoing
Agua Hedionda Website	- See Funding and Sustained Support Section	- Watershed Coordinator	Ongoing

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Funding and Sustained Support			
Grant Programs - Identify target grant programs - Match projects to grant programs - Scope projects, identify partnerships and matching funds - Contact appropriate agencies & discuss projects - Prepare grant applications	- SWRCB (Prop 84) - DWR (Prop 84 and 1e) - San Diego County IRWM (Prop 84) - EPA 319(h) - OPC - Wetland Recovery - State Tribal and local Government (EPA) - Transnet (SANDAG)	- Watershed Coordinator - NGO - Local jurisdictions	Ongoing
Coordination with Agencies - Identify target agencies and funding opportunities through agency programs - Meet quarterly with appropriate agencies to discuss priorities and opportunities - Coordination with Universities	- Wetland Recovery Project (Coastal Conservancy) - Wildlife Agencies (DF&G, DF&W, Dept. of Conservation) - MSCP/MHCP Program - Caltrans - Channel Maintenance Programs - Transnet (SANDAG)	- Watershed Coordinator - NGO - Local jurisdictions/agencies	Ongoing
Mitigation Programs - Meet with jurisdictions and agencies to discuss mitigation banks and in-lieu fee programs - Align projects with mitigation banks and in-lieu fee programs - Obtain agency support for mitigation banks and in-lieu fee programs - Outreach to development community	- Mitigation Banks and In-lieu programs - Project Mitigation Needs (developers, Poseidon, Caltrans, Cabbrillo, Power Plants, etc.)	- Watershed Coordinator - NGO - Local jurisdictions	TBD

Management Plan Component	Potential Funding Sources	Responsible Group(s)	Implementation Timeline
Watershed Council Support (Watershed Coordinator Support) - Prepare scope for watershed and staffing needs ($) - Obtain local support from agencies, jurisdictions, NGOs and the business community - Identify grant/funding opportunities and pursue with grant proposals - Redirection of City fees	- Wetland Recovery Project (grants) - Department of Conservation (grants) - Local jurisdictions - Local businesses	Start up - Local jurisdictions Ongoing Support - Watershed Coordinator - Local jurisdictions - Other watershed partners	September 2008-September 2009

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Appendix I. Linking the Agua Hedionda WMP with IRWMP

The SWRCB and DWR have outlined a minimum set of standards in order for management plans to be considered an Integrated Regional Water Management Plan. These standards are established in the

http://www.swrcb.ca.gov/water_issues/programs/grants_loans/irwmgp/index.shtml

Table I-1. Agua Hedionda WMP Compliance with IRWM Standards

IRWM Standard Section	AH WMP Section	Comments
A. Regional Agency or Regional Water Management Group	Section 1.0	Lead Agency is City of Vista, Regional Water Management Group is the Watershed Planning Group
B. Region Description	Section 2.0 Watershed Characteristics	
C. Objectives	Section 3.1 Mission, Goals and Objectives	
D. Water Management Strategies	Section 6.0 Recommended Watershed Management Opportunities Section 7.6.4 San Diego IRWMP	Water Management Strategies used in this plan include: Ecosystem restoration Ecosystem preservation Environmental and habitat protection and improvement Wetlands enhancement and creation Pollution prevention Water quality protection and improvement Urban runoff management Watershed management and planning Stakeholder/Community Involvement Enhance scientific and technical knowledge
E. Integration	Section 6.8 Recommended Focus Areas for Management	This section presents an integration of the management actions in specific focus areas that will maximize benefits by using a variety of management strategies.
F. Regional Priorities	Section 4.0 Existing and Future Watershed Condition	

IRWM Standard Section	AH WMP Section	Comments
G. Implementation	Section 7 Implementation	
H. Impacts and Benefits	Section 7.4 Estimated Impacts and Benefits	
I. Technical Analysis and Plan Performance	Section 4.0 Existing and Future Watershed Section 7.4 Estimated Impacts and Benefits Condition Section 3.0 Establishing Indicators and Assessment Tools Section 6.0 Monitoring	
J. Data Management	Section 6.0 Monitoring Section 6.6.8 Data/Information Management Via Website	
K. Financing	Section 7.3 Estimated Costs and Funding	
L. Statewide Priorities	Section 7.6 How the Plan Supports Regional Requirements and Initiatives Appendix A. Summary of Key Federal, State and Local Regulations Applicable to the Watershed	
M. Relation to Local	Section 7.6 How the Plan Supports Regional Requirements and Initiatives	
N. Stakeholder Involvement	Section 6.6 Citizen Stewardship/Public Outreach	
O. Coordination	Section 7.1 Primary Roles and Responsibilities in Carrying Out the Actions Section 7.6 How the Plan Supports Regional Requirements and Initiatives	

Appendix J. Supporting Analysis for LID Scenarios

The analysis of two scenarios representing different levels of LID implementation was conducted to support the development of watershed management plan recommendations, discussed in Sections 6.1 and 7.4.1. One is based on basic adoption of LID practices as specified by the 2007 Order (called "*Basic LID*"), and another based on a higher level of LID implementation (called "*Enhanced LID*"). The degree to which LID practices will be required in the future depends on many factors. There is currently some uncertainty in the Agua Hedionda watershed about future requirements – implementation of pending TMDLs may include a stormwater management component, with recommendation for specific BMPs to optimize reductions for target pollutants. Communities may elect to implement LID to varying degrees. The modeled LID scenarios should not be interpreted as extremes in design, nor should the results be seen as absolute. Many other scenarios with varying degrees of LID implementation could be conceived, and pollutant removal performance is based on central tendencies from monitoring studies, but inherently contains some uncertainty. The scenarios also use generic site assumptions, but in reality each site is unique and presents its own opportunities for adoption of LID practices.

Assumptions

Assumptions for each of the two scenarios were developed for the following representative land uses as shown in Table J-1. The sites were conceptualized as a typical unit of land use draining to a peak flow control structure. For instance, a 10-acre strip shopping center was assumed to be treated by a single peak control structure. Single family residential developments can be quite large, but it was assumed that 20 acres represents a typical drainage area to a peak control structure. The multi-family and industrial sites were assumed to be somewhat larger.

Table J-1. *Basic* and *Enhanced LID* Scenario Land Use Categories

Land Use	Percent Impervious Area	Comments	Assumed Site Area
Medium Density Residential	33%	Single family homes	20 acres
Multi-family Residential	65%	Mix of large buildings, roads/parking areas, and pervious surfaces distributed throughout the site	40 acres
Commercial	85%	Small strip shopping center	10 acres
Industrial/Warehouse	72%	Industrial facility in center of site, surrounding by access roads and parking areas	60 acres

Treatment practices at each site were selected based on several criteria – current stormwater management requirements, physical environment constraints, site-specific feasibility, and cost considerations. The *Basic LID* scenario is based on the combined use of vegetated swales (or bioswales) for water quality treatment of part of the site, and an extended dry detention basin treating all of the site, providing both hydrologic control for the 2001/2007 Order requirements, as well as water quality treatment benefits. The site assumptions and configurations for the *Basic LID* scenario are identical to those used in the Agua Hedionda Watershed Modeling and Geomorphic Analysis Report (Tetra Tech, 2008b) for the same land uses. The *Enhanced LID* scenario begins with the *Basic LID* scenario assumptions, but assumes a higher level of treatment, balancing feasibility and cost considerations. For instance, bioretention is not used due to the uncertainty regarding proper vegetation and potential increased cost if an underdrain system is

required. Porous pavement was included but not used extensively, again due to uncertainty about infiltration. Large cisterns for irrigation water were included for the Multi-family and Commercial classes, where the combination of large roof surface area and centralized irrigation systems are assumed to make the practice more cost effective. Some of the scenarios assume more significant impervious area reductions as well. Specific changes implemented in the *Enhanced LID* scenario include:

- Medium Density Residential – A cluster design is used, grouping the housing units closer together on smaller lots, and leaving one-third of the site as undeveloped open space. Impervious area is reduced by decreasing driveway length, sidewalk use, and overall road footprint.
- Multifamily Residential – Impervious area is reduced somewhat by more efficient layout. Porous pavement is used for all sidewalks. The swales treat a greater proportion of the site. Large cisterns capture roof runoff, and reuse the water for irrigation.
- Commercial – Porous pavement is used for large fraction of the parking area. Large cisterns capture roof runoff, and reuse the water for irrigation.
- Industrial – The most challenging site, with layout constraints and little economic incentive for cisterns for irrigation. Porous pavement parking spaces is assumed (a small fraction of the total paved surface), and the swales treat a greater proportion of the site.

More detailed information about site layout assumptions for *Basic LID* and *Enhanced LID* is shown in Table J-2 and Table J-3. In the *Basic LID* scenario, there are two types of drainage areas – one where runoff is captured by a vegetated swale and then conveyed to an extended dry detention basin (EDD) for peak flow control and further water quality treatment, and another where runoff is captured and treated by the EDD only. The EDD is the same physical basin in both drainage areas, but it is assumed that only part of the site can reasonably be laid out to drain to a vegetated swale. The table shows the relative percentages in each drainage area type; for instance, swales treat 50 percent of the site for Medium Density Residential, while for Commercial, swales treat only 30 percent of the site. The Commercial site, at 85 percent impervious area, has limited space for a swale so a smaller percentage was used; on the other hand, single-family residential sites are more amenable to swale placement, which can be located adjacent to roads.

The *Enhanced LID* scenario table shows how adjustments to site design that increase the use of LID practices affects the sites' layouts. For instance, the use of a cluster design reduces road area by compacting the development area, and allows for the addition of undisturbed open space land cover, which has reduced pollutant loading rates. Note that the use of porous pavement is not listed in the BMP Treatment column, but as a land cover change (i.e., traditional pavement converted to porous pavement). Porous pavement does not typically receive runoff from adjacent surfaces, so it is modeled as a surface that provides treatment to itself. Cistern storage is assumed to be used for irrigation and contribute no direct surface runoff loads; however, a fraction of annual runoff is assumed to bypass the cisterns when they fill during large storm events, and the bypassed runoff is conveyed to the EDD.

The site layouts and BMP configurations were then modeled using the Site Evaluation Tool (SET). The SET was also used to estimate the benefits of the stormwater BMP retrofit sites as discussed in Appendix F, and more information about the SET itself, the development of loading rates from the LSPC model, and BMP performance assumptions are discussed there. In addition to calculating annual runoff and pollutant loads, the SET provides scoping-level storm event hydrographs for site outflow, and includes an estimation of BMP influence on the hydrographs. The SET was configured to represent storm event depths for the Agua Hedionda watershed, and the EDD influence on storm events was modified to represent 2007 Order requirements.

Table J-2. *Basic LID* Scenario Site Configuration

Medium Density Residential (33.8% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
House	11.2%	5.6%	5.6%
Driveway	6.8%	3.4%	3.4%
Sidewalk	4.6%	2.3%	2.3%
Road	11.2%	5.6%	5.6%
Lawn	66.2%	33.1%	33.1%
Undisturbed Open Space	0.0%		
Total:	100.0%	50.0%	50.0%

Multi-family Residential (65% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
Building	30.0%	7.5%	22.5%
Sidewalk	5.0%	1.3%	3.7%
Pavement (access, parking)	30.0%	7.5%	22.5%
Lawn	35.0%	8.7%	26.3%
Total:	100.0%	25.0%	75.0%

Commercial (85% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
Building	42.5%	12.7%	29.8%
Pavement	42.5%	12.8%	29.7%
Lawn	15.0%	4.5%	10.5%
Total:	100.0%	30.0%	70.0%

Industrial (72% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
Building	48.0%	14.4%	33.6%
Pavement	24.0%	7.2%	16.8%
Lawn	28.0%	8.4%	19.6%
Total:	100.0%	30.0%	70.0%

*Notes
"Swale → EDD" signifies a drainage area where a vegetated swale conveys treated runoff to an Extended Dry Detention Basin
"EDD Only" signifies a drainage area where runoff goes directly to an Extended Dry Detention Basin

Table J-3. *Enhanced LID* Scenario Site Configuration

Medium Density Residential (24.8% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
House	10.2%	5.1%	5.1%
Porous Pavement (patios)	1.0%	0.5%	0.5%
Driveway	4.6%	2.3%	2.3%
Sidewalk	1.5%	0.8%	0.7%
Road	7.5%	3.7%	3.8%
Lawn	42.2%	21.1%	21.1%
Undisturbed Open Space	33.0%		33.0%
Total:	100.0%	33.5%	66.5%

Multi-family Residential (60% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site		
		Swale → EDD*	EDD Only*	Cistern → EDD*
Building	30.0%			30.0%
Porous Pavement (sidewalk)	5.0%	2.5%	2.5%	
Pavement (access, parking)	25.0%	12.5%	12.5%	
Lawn	40.0%	20.0%	20.0%	
Total:	100.0%	35.0%	35.0%	30.0%

Commercial (85% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site		
		Swale → EDD*	EDD Only*	Cistern → EDD*
Building	42.5%			42.5%
Pavement	21.3%	6.4%	14.9%	
Porous Pavement (parking)	21.2%		21.2%	
Lawn	15.0%	4.5%	10.5%	
Total:	100.0%	10.9%	46.6%	42.5%

Industrial (72% Impervious)

Site Component	Total Percent	BMP Treatment Percent of Site	
		Swale → EDD*	EDD Only*
Building	48.0%	28.8%	19.2%
Pavement	18.0%	10.8%	7.2%
Porous Pavement (parking)	6.0%		6.0%
Lawn	28.0%	16.8%	11.2%
Total:	100.0%	56.4%	43.6%

*Notes
"Swale → EDD" signifies a drainage area where a vegetated swale conveys treated runoff to an Extended Dry Detention Basin
"EDD Only" signifies a drainage area where runoff goes directly to an Extended Dry Detention Basin
"Cistern → EDD" signifies a drainage area where overflow from a Cistern is conveyed to an Extended Dry Detention Basin

Results

As seen in Table J-4 and Table J-5, the *Basic LID* scenario is projected to significantly reduce sediment loads by about 60 – 70 percent, and fecal coliform loads by almost 90 percent. However, nutrient load reductions are considerably less, 35 – 45 percent for nitrogen and 25 – 30 percent for phosphorus. The *Enhanced LID* scenario improves sediment removal for some of the land uses, but shows dramatic gains in nutrient removal – about 50 – 65 percent for nitrogen and 30 – 60 percent for phosphorus.

Most of the removal is accomplished by BMP treatment, but the land cover changes implemented in Medium Density Residential (decrease in impervious cover and protection of undeveloped open space) and Multi-family Residential (decrease in impervious cover) also result in load reductions for most of the parameters (Table J-5). For instance, in the Medium Density Residential scenarios, the post-developed load (prior to BMP treatment) for total nitrogen under *Basic LID* is 71 lb/yr, while the *Enhanced LID* scenario is reduced to 54 lb/yr. This demonstrates the importance of load reduction at the source.

Figure J-1 through Figure J-8 show the estimated hydrographs for each land use and scenario combination for the 2-yr, 5-yr, and 10-yr 24-hr storm events. The most dramatic differences between the *Basic* and *Enhanced LID* scenarios are seen in the Multi-family Residential and Commercial land use simulations. Both of the land uses utilized large cisterns, adding significant additional storage volume that mitigates both the duration and peak during the most intense periods of rainfall.

Further discussion of results can be found in Sections 6.1 and 7.4.1.

Table J-4. Predicted Loads for Post-Developed Conditions (before and after treatment) for *Basic* and *Enhanced LID* Scenarios

Medium Density Residential	*Basic LID*		*Enhanced LID*	
	Pre-BMP	**Post-BMP**	**Pre-BMP**	**Post-BMP**
Total Nitrogen (lb/yr)	71	39	54	30
Total Phosphorus (lb/yr)	5.61	3.95	4.35	3.08
Sediment (ton/yr)	27.4	8.3	22.6	7.9
Fecal Coliform (# x 10^9/yr)	1,043	125	758	90

Multi-family Residential	*Basic LID*		*Enhanced LID*	
	Pre-BMP	**Post-BMP**	**Pre-BMP**	**Post-BMP**
Total Nitrogen (lb/yr)	201	131	192	70
Total Phosphorus (lb/yr)	17.9	13.5	16.9	7.2
Sediment (ton/yr)	32.5	13.2	36.1	10.4
Fecal Coliform (# x 10^9/yr)	3,458	415	3,239	225

Commercial	*Basic LID*		*Enhanced LID*	
	Pre-BMP	**Post-BMP**	**Pre-BMP**	**Post-BMP**
Total Nitrogen (lb/yr)	67	42	67	28
Total Phosphorus (lb/yr)	6.9	5.1	6.9	3.2
Sediment (ton/yr)	5.8	2.2	5.8	1.9
Fecal Coliform (# x 10^9/yr)	574	69	574	14

Industrial	*Basic LID*		*Enhanced LID*	
	Pre-BMP	**Post-BMP**	**Pre-BMP**	**Post-BMP**
Total Nitrogen (lb/yr)	345	218	345	179
Total Phosphorus (lb/yr)	33.9	25.2	33.9	23.1
Sediment (ton/yr)	45.5	17.6	45.5	12
Fecal Coliform (# x 10^9/yr)	3,765	452	3,765	450

Table J-5. Percent Reduction of Loads for *Basic* and *Enhanced LID* Scenarios

Medium Density Residential	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	45%	58%
Total Phosphorus	30%	45%
Sediment	70%	71%
Fecal Coliform	88%	91%

Multi-family Residential	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	35%	65%
Total Phosphorus	25%	60%
Sediment	59%	68%
Fecal Coliform	88%	93%

Commercial	Percent Reduction of Load	
	Basic LID	***Enhanced LID***
Total Nitrogen	37%	58%
Total Phosphorus	26%	54%
Sediment	62%	67%
Fecal Coliform	88%	98%

Industrial	Percent Reduction of Load	
	Basic LID	**Enhanced LID**
Total Nitrogen	37%	48%
Total Phosphorus	26%	32%
Sediment	61%	74%
Fecal Coliform	88%	88%

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	9.84	31.78	2.72
5-yr 24-hr storm (cfs)	30.46	60.87	20.51
10-yr 24-hr storm (cfs)	41.48	72.22	30.83

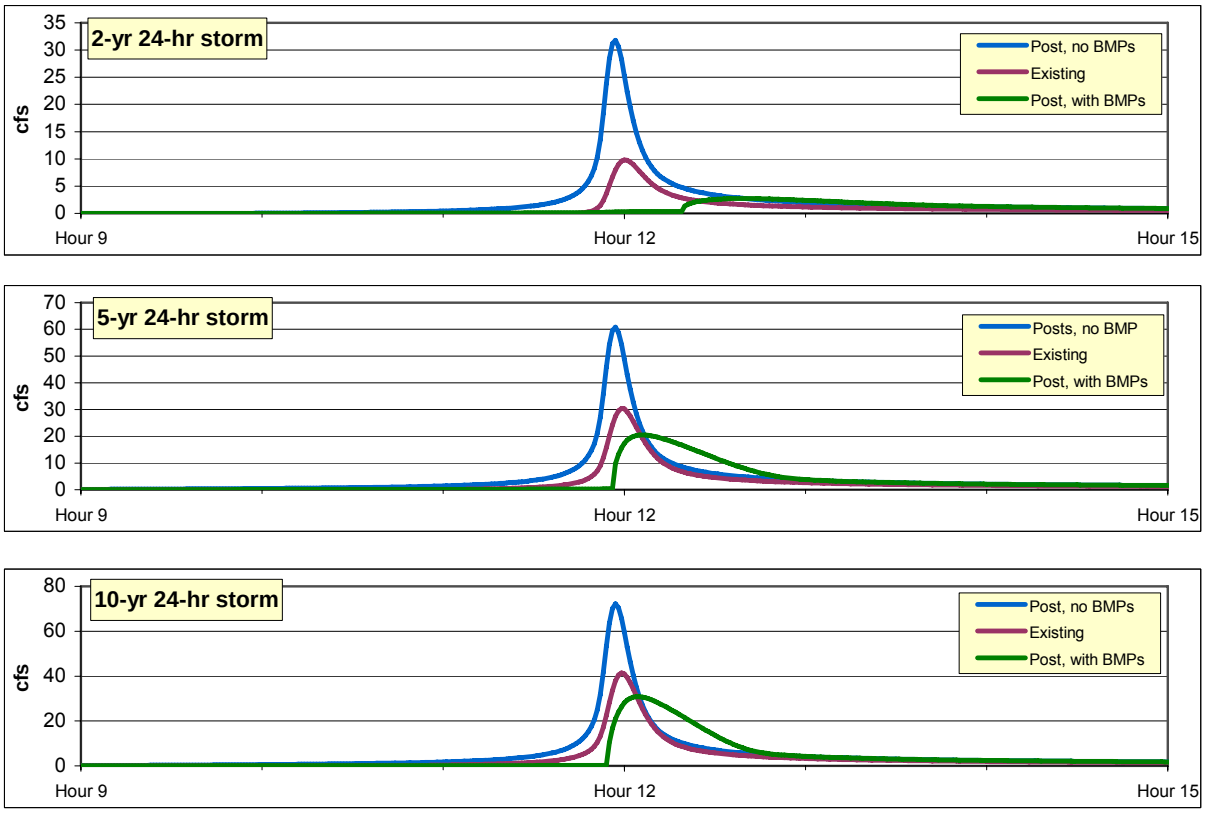

Figure J-1. Storm Event Peak Flow and Hydrographs, Medium Density Residential Land Use, *Basic LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	9.84	26.64	3.25
5-yr 24-hr storm (cfs)	30.46	50.14	20.92
10-yr 24-hr storm (cfs)	41.48	64.18	31.96

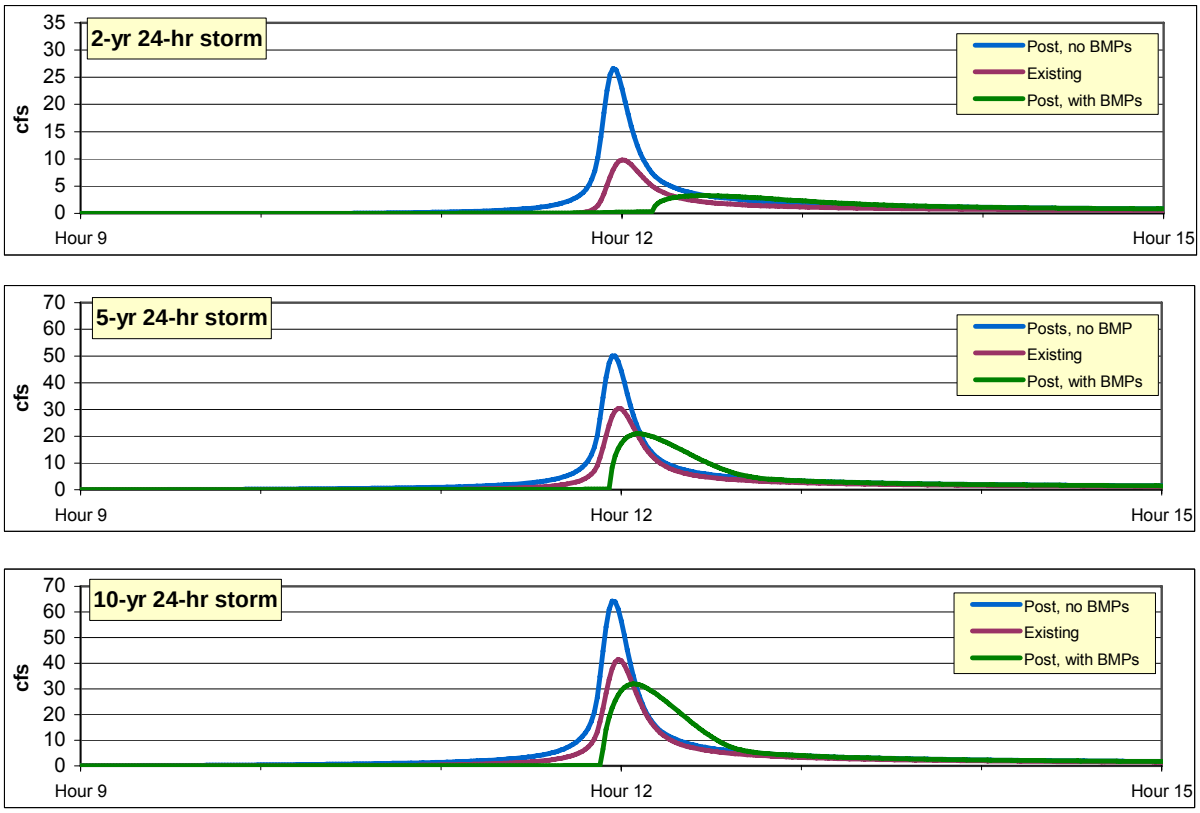

Figure J-2. Storm Event Peak Flow and Hydrographs, Medium Density Residential Land Use, *Enhanced LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	34.77	112.60	9.78
5-yr 24-hr storm (cfs)	82.02	177.39	53.90
10-yr 24-hr storm (cfs)	105.66	210.48	79.22

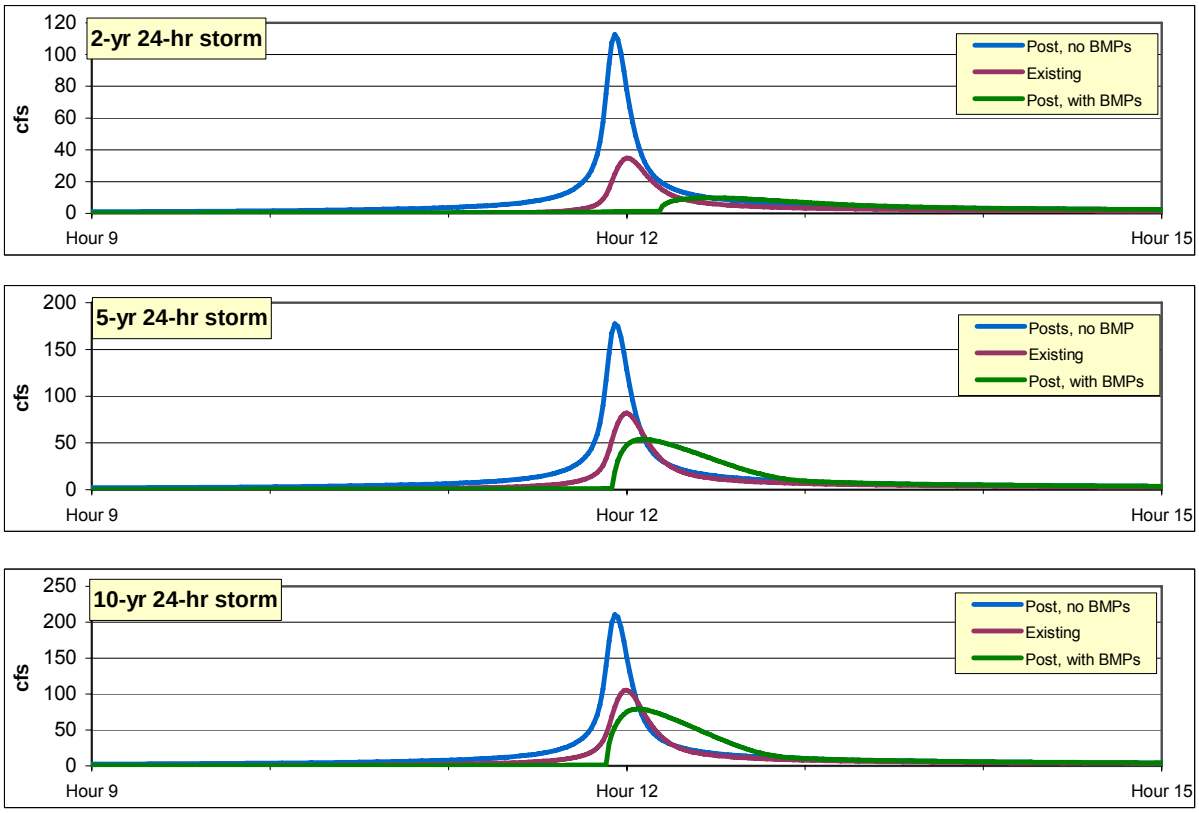

Figure J-3. Storm Event Peak Flow and Hydrographs, Multi-family Residential Land Use, *Basic LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	34.77	104.52	1.13
5-yr 24-hr storm (cfs)	82.02	167.74	25.96
10-yr 24-hr storm (cfs)	105.66	199.92	53.50

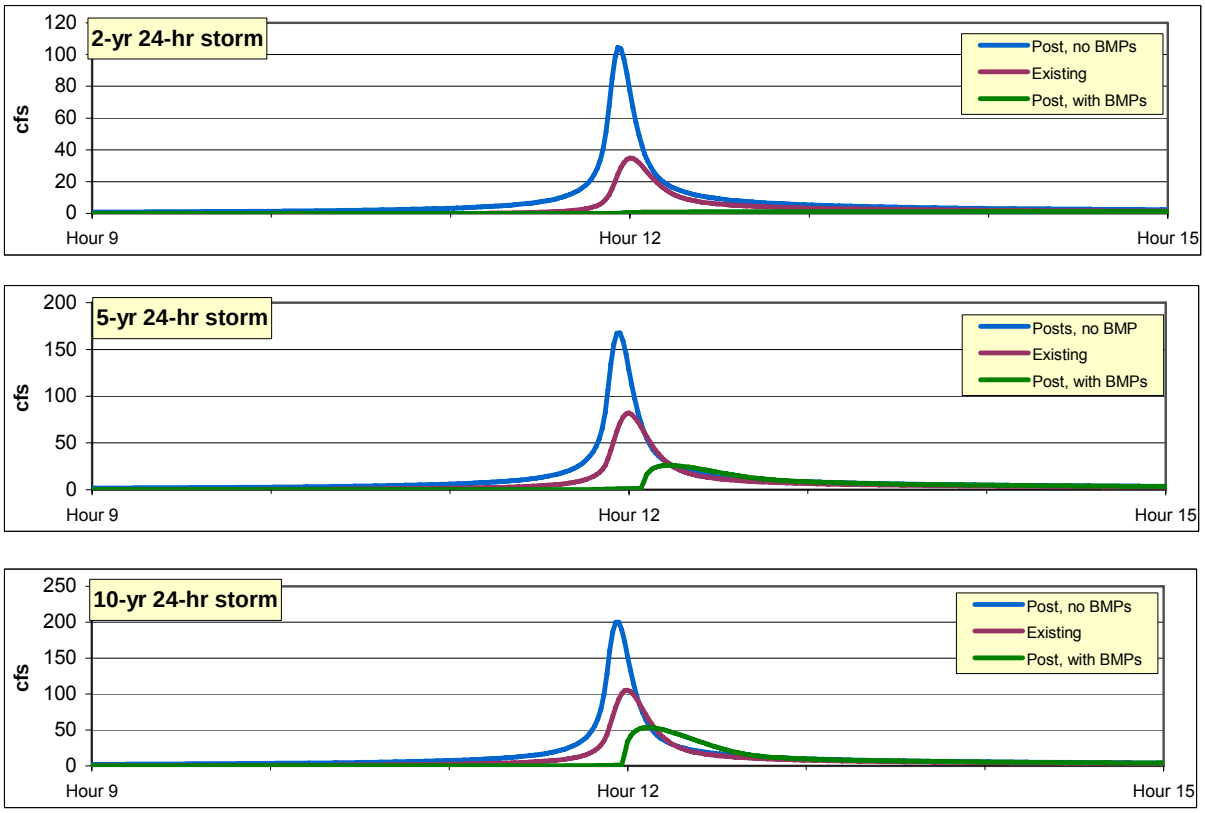

Figure J-4. Storm Event Peak Flow and Hydrographs, Multi-family Residential Land Use, *Enhanced LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	11.33	40.95	2.33
5-yr 24-hr storm (cfs)	26.80	64.09	16.47
10-yr 24-hr storm (cfs)	34.54	74.55	24.53

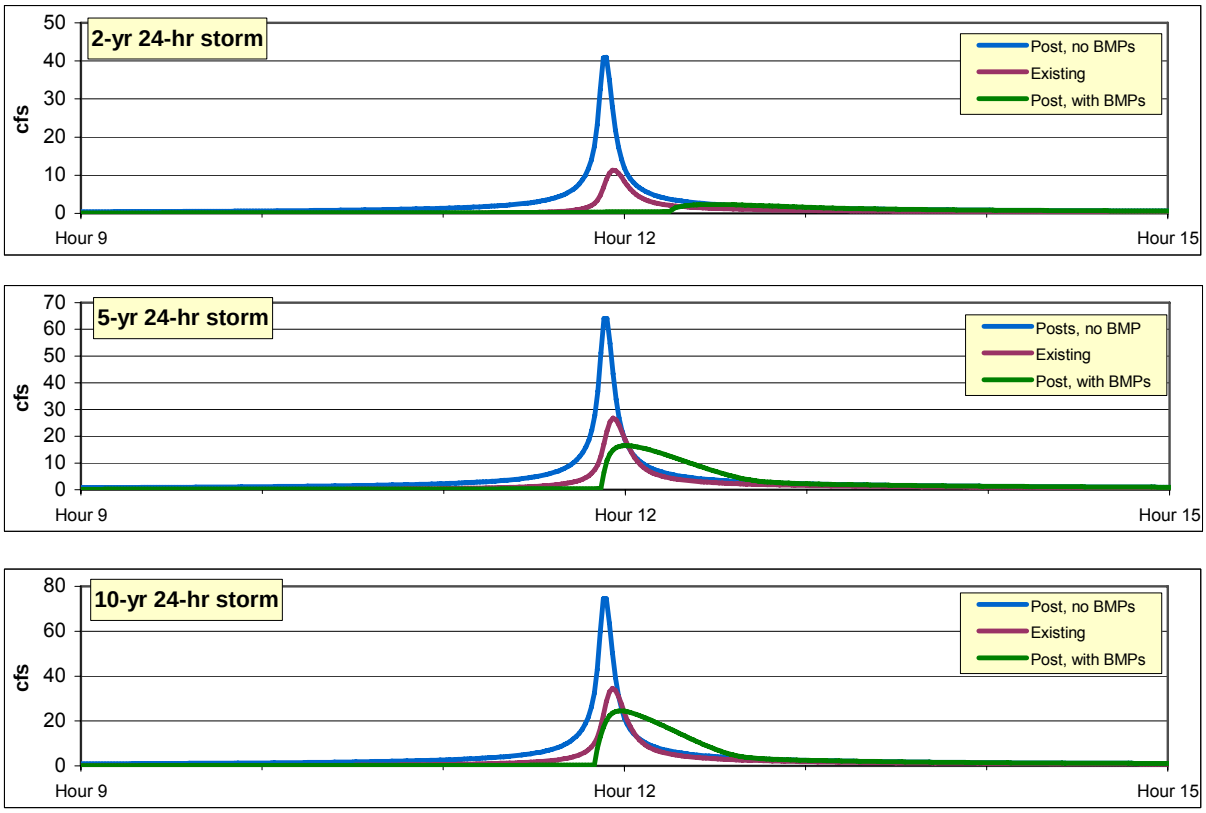

Figure J-5. Storm Event Peak Flow and Hydrographs, Commercial Land Use, *Basic LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	11.33	40.95	0.26
5-yr 24-hr storm (cfs)	26.80	64.09	1.09
10-yr 24-hr storm (cfs)	34.54	74.55	3.90

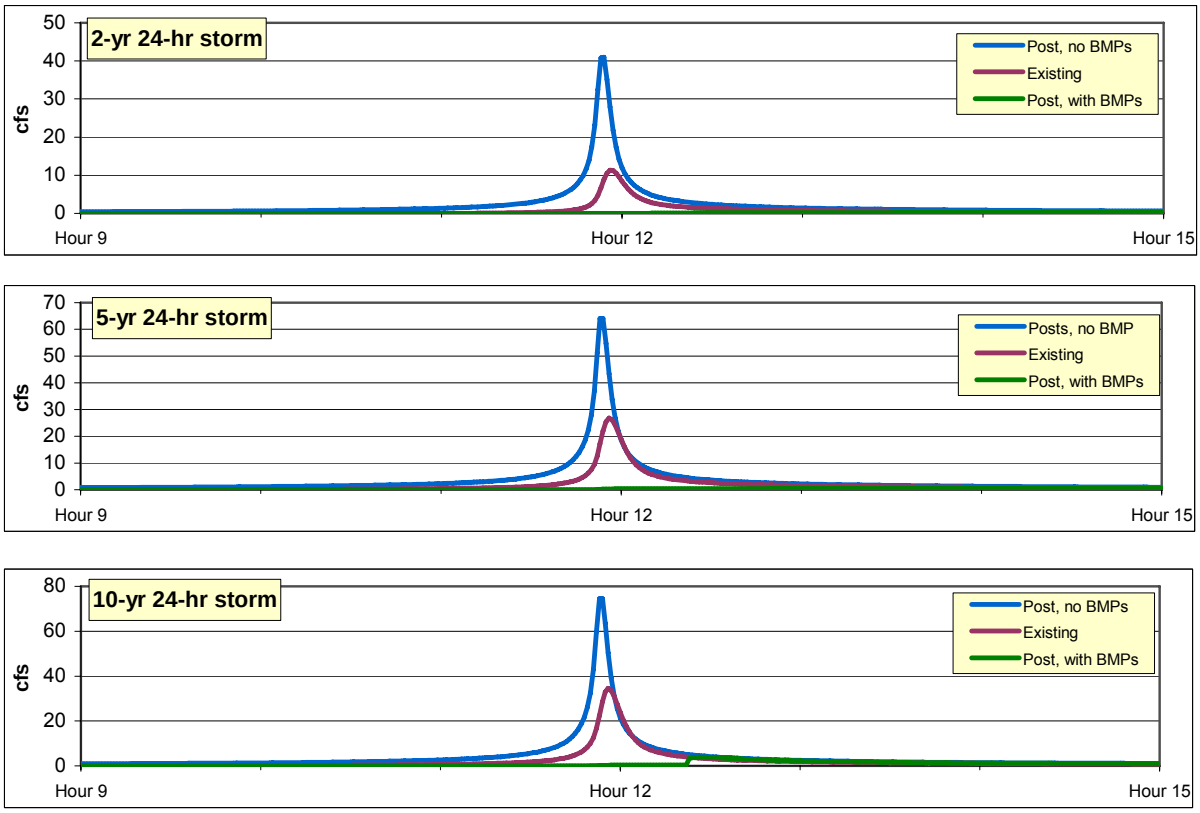

Figure J-6. Storm Event Peak Flow and Hydrographs, Commercial Land Use, *Enhanced LID* Scenario

	Existing Landuse	Design without BMPs	Design with BMPs
2-yr 24-hr storm (cfs)	23.20	167.77	8.41
5-yr 24-hr storm (cfs)	71.89	272.81	48.00
10-yr 24-hr storm (cfs)	97.72	307.48	71.20

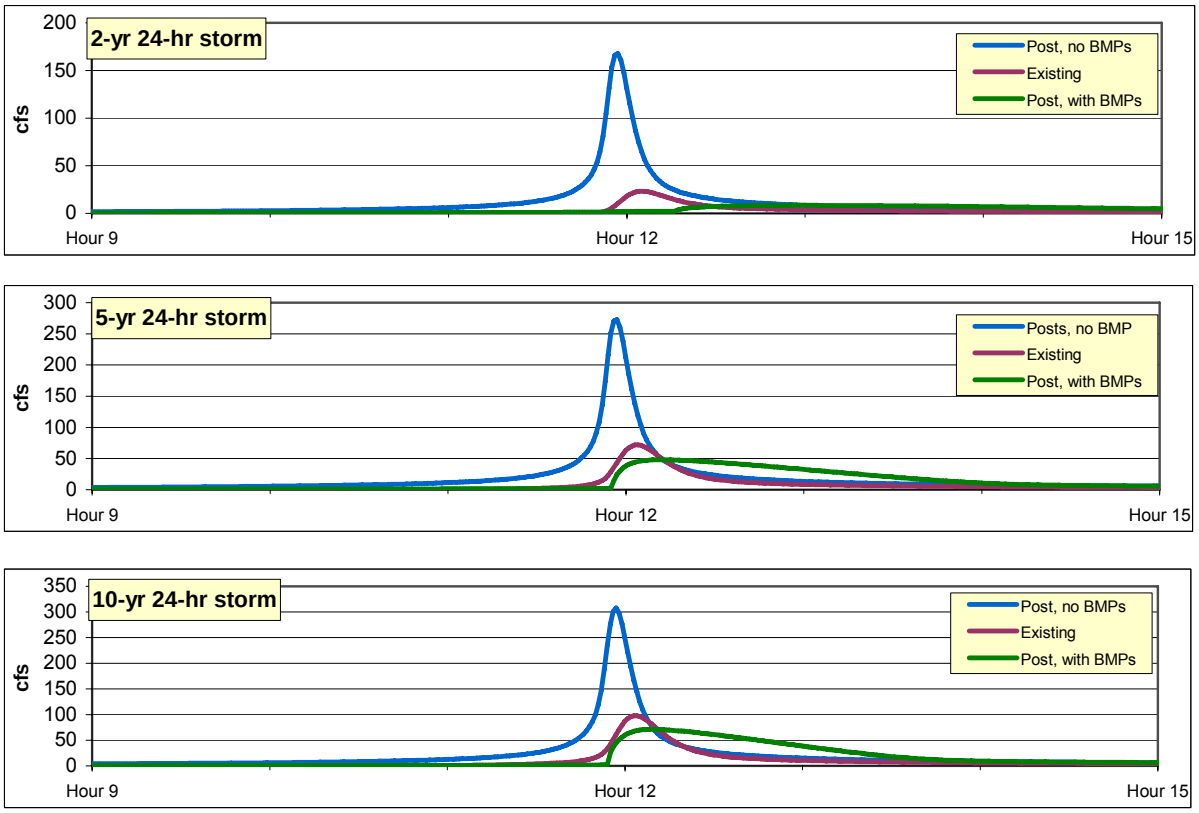

Figure J-7. Storm Event Peak Flow and Hydrographs, Industrial Land Use, *Basic LID* Scenario

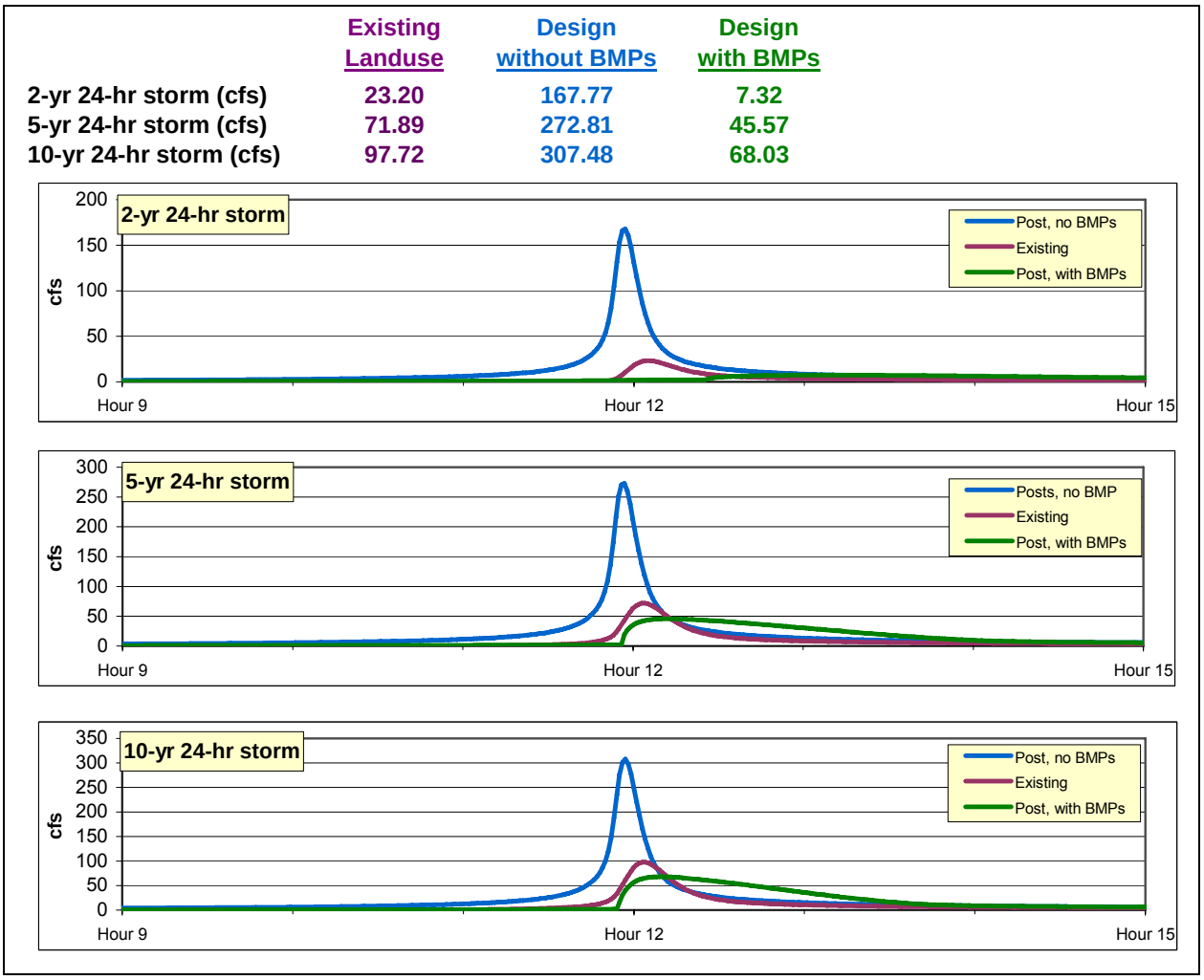

Figure J-8. Storm Event Peak Flow and Hydrographs, Industrial Land Use, *Enhanced LID* Scenario

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Appendix K. WPG and Public Review Comments

Table K-1. Comments from WPG and Public on WMP Draft [PLACEHOLDER]

Page#	Line#	Comment	Response

1