Watershed Action Plan

San Bernardino County

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Table of Contents

Executive Summary iii

1 Introduction 1-1
- 1.1 Background 1-1
- 1.2 Regional NPDES Permit Program Requirements 1-1
- 1.3 Phase 1 of WAP Development 1-2
- 1.4 Phase 2 of WAP Development 1-4
- 1.5 Watershed Action Plan Task Force 1-5
- 1.6 WAP Development Process Overview 1-7
- 1.7 WAP Structure 1-8

2 Watershed Characteristics 2-1
- 2.1 Location 2-2
- 2.2 Physiography 2-2
- 2.3 Land Use 2-3
- 2.4 Geology 2-3
- 2.5 Climate 2-4
- 2.6 Water Resources 2-5

3 WAP Purpose and Overarching Goals 3-1
- 3.1 Integrated Watershed Management Approach 3-1
- 3.2 Watershed Protection Principles 3-2

4 WAP Phase I 4-1
- 4.1 WAP Task Force Workshops 4-1
  - 4.1.1 Residential Workshop 4-1
  - 4.1.2 Commercial/Industrial/Retail Workshop 4-3
  - 4.1.3 Parks and Public Facilities Workshop 4-4
  - 4.1.4 Streets and Arterials 4-5
- 4.2 WAP Linkages and Other Watershed Efforts 4-7
  - 4.2.1 SWQSTF 4-7
  - 4.2.2 OWOW 4-7
  - 4.2.3 MSWMP 4-8
  - 4.2.4 WQMP 4-8
  - 4.2.5 LID Implementation 4-8
  - 4.2.6 TMDL Implementation Plans 4-8
  - 4.2.7 Chino Basin Master Plan 4-8
  - 4.2.8 SAWPA IRWMP 4-9
- 4.3 WAP Program Specific Objectives 4-9
- 4.4 Watershed Geodatabase 4-10
  - 4.4.1 Development Summary 4-10
  - 4.4.2 Maintenance and Enhancement Schedule 4-14
  - 4.4.3 Coordination with Regional Board Staff and Agency/Stakeholder Outreach and Coordination 4-17
- 4.5 Hydromodification Assessment 4-18

4.6 Channel Assessment and Classification 4-18
4.7 Causes of Stream Degradation 4-19
4.8 System-wide Evaluation Retrofit Opportunities 4-19
4.9 System-wide Evaluation of Restoration Opportunities 4-20
4.10 WAP Phase I Tasks Relationships 4-21

5 WAP Implementation 5-1
5.1 Phase II Recommendations 5-1
5.1.1 Watershed Action Plan and Watershed Geodatabase Integration 5-1
5.1.2 Hydromodification Monitoring Plan and Hydromodification Management Plan 5-2
5.1.3 Watershed Geodatabase Training and Outreach Recommendations 5-2
5.1.4 Regional Treatment BMPs Regulatory Approval 5-3
5.1.5 Retrofit Recommendations 5-3
5.2 Long-Term WAP Program Implementation 5-3
5.2.1 LIP Coordination 5-4
5.2.2 Regional BMP Project Opportunities 5-4
5.2.3 Watershed Benefit Estimation 5-5
5.2.4 Funding 5-5
5.2.5 WAP Administration and Tracking 5-5

Tables

Table 1: WAP Data Layers 4-16

Figures

Figure 1: Watershed Geodatabase Mapping Site 4-12

Appendices

Appendix A: Stakeholder Workshop Series Notes
Appendix B: Hydromodification Assessment Technical Memo
Appendix C: Channel Assessment and Classification Technical Memorandum
Appendix D: Causes of Degradation Technical Memorandum
Appendix E: System-wide Evaluation to Identify Retrofit Opportunities Technical Memorandum
Appendix F: System-wide Evaluation to Identify Restoration Opportunities Technical Memorandum
Appendix G: Watershed Geodatabase Data Dictionary

Executive Summary

The Watershed Action Plan (WAP) for San Bernardino County and its Copermittees is a requirement of the San Bernardino County Municipal Separate Storm Sewer System (MS4) Permit. It was developed through a collaborative process with the County, the Copermittees, and other watershed stakeholders. The WAP development involved several WAP Task Force meetings and WAP development workshops where watershed stakeholders provided input on the WAP and watershed development processes. The County and Copermittees intend to use the WAP to help improve water quality and to implement an integrated water resources approach in the Santa Ana River Watershed.

The WAP is structured to help the County, Copermittees, and stakeholders collaborate with Orange and Riverside Counties to ensure a holistic approach to watershed management throughout the Santa Ana River Watershed. Its purpose is to improve integration of water quality, stream protection, stormwater management, water conservation and re-use, and flood protection with land use planning and development processes. This goal will be accomplished using:

- An Integrated Watershed Management Approach, an imperative methodology that should be used whenever planning a sustainable development or community intended to coexist with and compliment the native environment and ecosystem in which it resides in.
- Watershed protection principles and policies necessary for water quality protection, including avoiding disturbance of water bodies, minimizing changes in hydrology and pollutant loading, preserving wetlands and other natural areas, using appropriate Best Management Practices, employing the Ahwahnee Principles of community design, using CEQA and Low Impact Development, and others.

As part of the WAP, the following will be undertaken:

- Development of a Hydrologic Conditions of Concern Map/Watershed Geodatabase is required that incorporates the delineation of existing unarmored or soft-armored drainages in the permitted area that are vulnerable to geomorphology changes due to hydromodification and those channels and streams that are engineered, hardened, and maintained.
- Development, testing, and implementation of the Watershed Geodatabase as a primary interactive reference tool.
- Hydromodification Assessment to determine thresholds for determining whether a creek is subject to hydromodification impacts due to future development.
- Channel Assessment and Classification to determine how the existing drainages were classified.
- Causes of Degradation investigation of three major watersheds within the County of San Bernardino: San Antonio Watershed, Cucamonga Watershed and Live Oak Watershed to determine how degradation has occurred as the watersheds have matured.

- Identification of Retrofitting Opportunities to develop a list of sites throughout the County where there appear to be opportunities to further pursue regional projects for water quality improvement.
- Development of a Hydromodification Management Plan and Hydromodification Monitoring Plan based on existing science and efforts.
- Integration of the Stormwater Quality Standards Task Force, One Water One Watershed, Municipal Stormwater Management Plan, Water Quality Management Plan, Low Impact Development, and Total Maximum Daily Load requirements to provide beneficial synergies for the entire watershed and streamline the approach to restore the watershed's natural resources and provide environmental benefits.

1 Introduction

1.1 Background

The Watershed Action Plan (WAP) for San Bernardino County and its Copermittees is a specific permit requirement in the San Bernardino County Municipal Separate Storm Sewer System (MS4) Permit. The County and Copermittees intend to use the WAP to help improve water quality and to implement an integrated water resources approach in the Santa Ana River Watershed. The WAP provides a path towards achieving water quality improvement in the context of specific watershed protection principles developed by watershed stakeholders; physical factors of the watershed, such as climate, geography and land use; regulatory requirements of the MS4 permit for San Bernardino County and the Copermittees; and other water resource needs in the watershed. The WAP is a collaborative effort between San Bernardino County, the Copermittees, and other affected stakeholders in the watershed that have committed to using an integrated watershed management approach to improve water quality in the region.

1.2 Regional NPDES Permit Program Requirements

The San Bernardino County MS4 Permit identifies specific requirements for the development of the WAP. The intent of the WAP as identified by the Santa Ana Regional Water Quality Control Board (Regional Board) in the MS4 Permit Fact Sheet is a long-term holistic approach to address water quality and hydromodification impacts resulting from urbanization. This goal is to be achieved through integration of water quality, stream protection, stormwater management, and re-use strategies with land planning policies, ordinances, and plans within each jurisdiction to the maximum extent practicable (MEP). The Regional Board also emphasized that the plans for each jurisdiction should address cumulative impacts of development on vulnerable streams; preserve or restore, consistent with the maximum extent practicable standard, the structure and function of streams; and protect surface water and groundwater quality.

The specific requirements for development of the WAP are set forth in Order No. R8-2010-0036 Section XI, New Development (Including Significant Re-Development), Sub-section B, Watershed Action Plan. The first requirement of the WAP is that the Permittees develop an integrated watershed management approach to improve integration of planning and approval processes with water quality and quantity control measures. It is also a requirement of the WAP that each of the Permittees review the watershed protection principles and policies, specifically addressing urban and stormwater runoff in their planning procedures. The Principal Permittee, in collaboration with the Co-Permittees, is responsible for developing a WAP that describes and implements the Permittees' approach to coordinated watershed management. The objective of the WAP as identified in the MS4 Permit is to improve integration of water quality, stream protection, stormwater management, water conservation and re-use, and flood protection, with land use planning and development processes. The Permit requires the WAP be developed in two phases.

1.3 Phase 1 of WAP Development

Within 12 months of adoption of this Order, the Principal Permittee, in coordination with the Co-Permittees shall:

- Identify program-specific objectives for the WAP; the objectives will include consideration of:
    - The watershed protection principles specified in Section XI.C.3.a - g, below;
    - The Permittee's planning and procedure review required in XI.B.2, above;
    - Potential impediments to implementing watershed protection principles during the planning and development processes, including but not limited to Low Impact Development (LID) principles and management of the impacts of hydromodification;
    - Impaired waters [Clean Water Act (CWA) § 303(d) listed] with and without approved Total Maximum Daily Loads (TMDLs), pollutants causing impairment, monitoring programs for these pollutants, control measures, including any Best Management Practices (BMPs) that the Permittees are currently implementing, and any BMPs the Permittees are proposing to implement. In addition, if a TMDL has been developed and an implementation plan is yet to be developed, the WAP shall specify that the responsible Permittees should develop constituent-specific source control measures, conduct additional monitoring and/or cooperate with the development of an implementation plan, where feasible, and consistent with the MEP standard.
- Develop a structure for the WAP that emphasizes coordination of watershed priorities with the Permittees' Local Implementation Plans (LIPs) via the areawide model LIP;
- Identify linkages between the WAP and the Stormwater Quality Standards Task Force (SWQSTF), Municipal Stormwater Management Program (MSWMP), Water Quality Management Plan (WQMP), the implementation of LID, and the TMDL Implementation Plans;
- Identify other relevant existing watershed efforts (Chino Basin Master Plan, Santa Ana Watershed Project Authority's (SAWPA's) Integrated Regional Water Management Plan (IRWMP), etc., and their role in the WAP;
- Ensure that the Hydrologic Conditions of Concern (HCOC) Map Watershed Geodatabase is available to watershed stakeholders via the World Wide Web, and has incorporated the following information:
    - Delineation of existing unarmored or soft-armored drainages in the permitted area that are vulnerable to geomorphological changes due to hydromodification and those channels and streams that are engineered, hardened, and maintained (EHM).

- Geographic Information System (GIS) layers for known sensitive species, protected habitat areas, drainage boundaries, and potential stormwater recharge areas and/or reservoirs;
- 303(d)-listed waterbodies and associated pollutants;
- Available and relevant regulatory and technical documents accessible via hyperlinks;
- Develop a schedule and procedure for maintaining the Watershed Geodatabase, and develop a draft schedule for expected enhancements to increase functionality;
- Review the Watershed Geodatabase with Regional Board staff from the Stormwater, TMDL, and Watershed Planning/ Program Sections, and other resource agencies, to verify attributes of the Geodatabase, including drainage feature stability/susceptibility/risk assessments, and the intended use of the Geodatabase to support regulatory processes such as WQMP approvals, Clean Water Act Section 401 Water Quality Standards Certifications (401 Certifications), and LID BMP feasibility evaluations;
- Identify potential causes of identified stream degradation including a consideration of sediment yield and balance on a watershed or subwatershed basis.

- Conduct a system-wide evaluation[1] to identify opportunities to retrofit existing stormwater conveyance systems, parks, and other recreational areas with water quality protection measures, and develop recommendations for specific retrofit studies that incorporates opportunities for addressing applicable TMDL implementation plans, hydromodification management, and/or LID implementation within the permitted area.
- Conduct a system wide evaluation to identify opportunities for joint or coordinated development planning to address stream segments vulnerable to hydromodification and coordinated re-development planning to identify restoration opportunities for hardened and engineered streams and channels. The WAP shall identify contributing jurisdictions and the stream segments that will benefit from this coordination.
- Invite participation and comments from resource conservation districts, water and utility agencies, state and federal agencies, non-governmental agencies and other interested parties in the development and use of the Watershed Geodatabase;

[1] For example, see the 2005 RBF Retrofit Study conducted for Orange County MS4 permittees.

- Submit the Phase 1 components in a report to the Executive Officer for approval. The Report shall be deemed acceptable to the Regional Board if the Executive Officer submitted raises no written objections within 30 days of submittal.

1.4 Phase 2 of WAP Development

Within 12 months of the approval by the Executive Officer of the Report from Phase 1, above, the Principal Permittee, in coordination with the Copermittees, shall:

- Contingent upon consensus with Regional Board staff and other resource agencies as described in XI.B.3.a.vii, above, specify procedures and a schedule to integrate the use of the Watershed Geodatabase into the implementation of the MSWMP, WQMP, and TMDLs;
- Develop and implement a Hydromodification Monitoring Plan (HMP) to evaluate hydromodification impacts for the drainage channels deemed most susceptible to degradation. The HMP will identify sites to be monitored, include an assessment methodology, and required follow-up actions based on monitoring results. Where applicable, the monitoring sites may be used to evaluate the effectiveness of BMPs in preventing or reducing impacts from hydromodification.
    - The HMP should be prioritized based on drainage feature/susceptibility/risk assessments and opportunities for restoration.
- Conduct training workshops in the use of the Watershed Geodatabase. Each Permittee must ensure that their planning and engineering staffs attend a workshop.
- Conduct demonstration workshops for the Watershed Geodatabase to be attended by appropriate upper-level managers and directors from each Permittee.
- Develop recommendations for streamlining regulatory agency approval of regional treatment control BMPs. The recommendations should include information needed for submittal to the Regional Board for approval of regional treatment control BMPs. At a minimum, this information should include:
    - BMP location;
    - type and effectiveness in removing pollutants of concern;
    - projects tributary to the regional treatment system;
    - engineering design details;
    - funding sources for construction, operation and maintenance; and
    - parties responsible for monitoring effectiveness, operation and maintenance.

  The Permittees are encouraged to collaborate and work with other counties to facilitate and coordinate these recommendations.
- Implement applicable retrofit or regional treatment recommendations from the evaluation conducted in Section B.3.a.ix, above.

- Submit the Phase 2 components in a report to the Executive Officer. The submitted report shall be deemed acceptable to the Regional Board if the Executive Officer raises no written objections within 30 days of submittal.

1.5 Watershed Action Plan Task Force

The adoption, by the Santa Ana Regional Water Quality Control Board, of new MS4 (Municipal Separate Storm Sewer System) permit regulations in January of 2010 , brought new requirements for development and municipal projects, including a priority for infiltration of stormwater on site. The San Bernardino County Flood Control District (District), as the Principal MS4 Permittee, is required to prepare a Watershed Action Plan (WAP) (Phase 1 by January 2011 and Phase 2 by January 2012) and a Water Quality Management Plan (WQMP) Guidance Document (by July 2011) that will assist cities and the development community in implementing the new MS4 Permit requirements.

Regional and local agencies, in conjunction with development leaders within the Inland Empire recognize that capture and infiltration of stormwater, as prioritized by the new MS4 Permit, is an important way to augment and enhance the reliability of local water supplies. At the same time, there is concern about the potential complexity and practical implementation of the process to conduct a site-specific analysis to determine whether this level of infiltration is feasible using Low Impact Development (LID) techniques. There is also some debate as to whether standardized, feasibility-based screening as the sole driver for implementation activities provides the greatest benefit to a watershed or region from both the environmental and integrated water resources perspectives.

The District has identified a concept for the WAP which would, where appropriate and beneficial, encourage an integrated approach to stormwater management on a regional basis in conjunction with the Water Masters for the upper Santa Ana watershed. Specifically, the District is proposing to convert the WAP into a local planning tool that would help identify areas where stormwater infiltration is an appropriate action as well as locations where it may be infeasible given soil, geologic, or groundwater conditions. Those locations that cannot be clearly designated would require a more detailed level of assessment, consistent with the MS4 requirements, in order to determine the feasibility/appropriateness of stormwater infiltration. The WAP would then be integrated into the WQMP development process, providing consistency in interpretation and facilitating reviews.

The benefits of this approach include cost savings, comprehensive and consistent technical analyses, and simplicity, resulting in straight-forward guidance that will assist local governments and property owners to easily identify locations where infiltration or other technical solutions should occur. It would also help the region determine whether a stormwater offset program could be developed to encourage investments in areas where additional stormwater infiltration would provide water supply and water quality benefits. There are many technical issues that would need to be worked out as part of the development of an integrated WAP.

It is with this premise that the District formed a Watershed Action Plan Task Force initially in concept in January of 2010 and with full membership by June of the same year. The mission of the group is the development of an integrated approach to storm water management on a regional basis. This would be accomplished through the integration of regulatory, agency, development, manufacturing, construction, and professional aspects for a holistic solution. Led by the District and receiving guidance from a hands-on group of advisors that include representatives from the cities, private development, water agencies, watermasters, LID manufacturers, hydrogeology consultants, educational institutes, and the Santa Ana Regional Water Quality Control Board. The Task Force is structured to provide an opportunity for a larger group of interested stakeholders to participate in workshops and the review of proposed work products.

Task Force Members:

- County of San Bernardino
- The County of San Bernardino Flood Control District
- City of Big Bear Lake
- City of Chino
- City of Chino Hills
- City of Colton
- City of Fontana
- City of Grand Terrance
- City of Highland
- City of Loma Linda
- City of Montclair
- City of Ontario
- City of Rancho Cucamonga
- City of Redlands
- City of Rialto
- City of San Bernardino
- City of Upland
- City of Yucaipa
- Orange County
- Riverside County
- Building Industry Association
- Chino Basin Watermaster
- Contech
- Geosyntec Consultants
- Heal The Bay
- Inland Empire Utility Agency
- Inland Empire Waterkeeper
- Lewis Operating Corp.
- RBF Consulting

- San Bernardino Valley Water District
- SAWPA
- Water Resources Institute
- Western Municipal Water District

Task Force Stakeholders:

- Santa Ana RWQCB
- Counties & Regional Agencies
- Local Agencies
- Water Masters
- Water Purveyors
- Educational Institutions
- Private Development
- Environmental Community
- Construction Industry
- Product Manufacturing
- Technical Professionals
- Planning Professionals
- Legal Professionals

1.6 WAP Development Process Overview

Once the WAP requirement was identified in the San Bernardino MS4 permit, the County of San Bernardino began planning the development of the WAP through coordination of the Watershed Action Plan Task Force. The Task Force began to plan the development of the WAP nearly one year ago through several Task Force Meetings. It became apparent through these meetings that to have an effective WAP more stakeholders with different perspectives and different water resource needs should be involved to ensure a collaborative integrated watershed management approach to the WAP. The WAP was developed through a collaborative process with the County, the Copermittees, and other watershed stakeholders. This collaborative process involved several WAP Task Force meetings and WAP development workshops where watershed stakeholders could provide input on the WAP and watershed development processes. The details of these workshops are provided in Section 4. The workshops provided the opportunity to receive input form various watershed stakeholders which helped to formulate the objectives and structure of the WAP. The results of these workshops along with the Phase I tasks were used to develop the WAP document, which meets the requirements of the MS4 permit and provides framework for WAP implementation.

1.7 WAP Structure

The WAP has been designed to meet the intent and purpose of the WAP requirements established in the MS4 permit. Furthermore, the organization of the WAP is designed so that land planning and development processes will include water quality, stream protection, stormwater management, water conservation and re-use, and flood protection in an integrated manner. The structure is also designed for future coordination and collaboration among not only the County and the Co-permittees but also the stakeholders that are affected by an integrated watershed management approach to land use and development planning in the watershed.

One of the MS4 permit requirements in developing the WAP is to identify watershed protection principles and watershed priorities for the watershed. Once these watershed protection principles and watershed priorities are identified there must be a mechanism to ensure they are implemented. The structure of the WAP allows for the watershed priorities and watershed protection principles that were developed through stakeholder meetings to be coordinated and implemented as priorities through the Permittees' Local Implementation Plan (LIP). These watershed protection principles will be specified in the areawide model LIP, which will present a framework for the development of the Permittees' individual LIPs. The Permittees' LIP serves as the implementation tool to ensure that the watershed protection principles are considered and implemented in every element of a jurisdiction's program.

The WAP structure consists of an introduction that provides overall background on the WAP, requirements in the MS4 permit, and details about the WAP Task Force and the WAP development process and structure. The information in the background section is necessary to understand the context in which the WAP was developed. The next section of the WAP provides information about the watershed itself to understand some of the challenges and constraints presented by various watershed characteristics and to identify the watershed stakeholders. The purpose and the overarching goals of the WAP are identified in the third section. This section details the purpose and goals of the WAP through an integrated watershed management approach, and the watershed protection principles identified by both the permit and the stakeholders. Section four of the WAP identifies the activities and special studies performed in Phase 1 of the development of the WAP. This section describes the WAP workshops, the watershed linkages and other efforts, and identifies the WAP program specific objectives. The last section of the WAP deals with implementation where recommendations of Phase 2 are provided and a long-term implementation program for the WAP is discussed. The overall structure of the WAP provides the understanding of where the WAP originated, why it was developed, how its first Phase was developed, including a framework for its future development and implementation.

The WAP structure also allows for effective coordination with Orange and Riverside Counties in in the development of a tri-county watershed management approach for the Santa Ana River Watershed. The WAP implementation section provides a framework for ongoing coordination with Orange and Riverside Counties to ensure consistency in the tools for implementation of watershed protection principles throughout the Santa Ana River Watershed. This consistency will assist in ensuring that watershed protections principles are achieved in each of these three jurisdictions.

2 Watershed Characteristics

San Bernardino County stretches across a significant portion of Southern California. The county boundary runs laterally from the eastern sides of Los Angeles and Orange County and extends to the eastern end of the California State Border. San Bernardino County Flood Control District manages the stormwater conveyance systems and water conservation within San Bernardino County. The District is subdivided into six zones with interests, responsibilities or geographical divisions distinctive of the particular zone. The total area the District covers is 20,105 square miles.

Zone 1 consists of 275 square miles in the westerly portion of the San Bernardino Valley. Zone 1 extends from Beech Avenue in the Fontana area to the Los Angeles County line, all south of the San Gabriel mountain range divide. This includes the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga and Upland with the community of Etiwanda.

Zone 2 consists of 318 square miles in the central area of the San Bernardino Valley, easterly of Zone 1 to approximately the Santa Ana River and City Creek demarcations. This includes the Cities of Colton, Fontana, Grand Terrace, Highland, Loma Linda, Redlands, Rialto and San Bernardino with the communities of Bloomington, Del Rosa, Devore and Muscoy.

Zone 3 consists of 366 square miles in the easterly end of the San Bernardino Valley, east of Zone 2 including the Cities of Highland, Loma Linda, Redlands, San Bernardino and Yucaipa with the community of Mentone.

Zone 4 consists of 1,783 square miles in the Mojave River Valley from the San Bernardino Mountains to Silver Lakes. This includes the Cities/Towns of Adelanto, Apple Valley, Barstow, Hesperia and Victorville and all or portions of the communities of Baker, Baldy Mesa, Daggett, Desert Knolls, El Mirage, Helendale, Hinkley, Hodge, Lenwood, Oro Grande, Phelan, Pinon Hills, Silver Lakes, Spring Valley Lake, Wrightwood and Yermo.

Zone 5 consists of 163 square miles in the mountainous watershed of the Mojave River on the crest and north slopes of the San Bernardino Mountains. This area includes the communities of Arrowbear Lake, Blue Jay, Cedar Glen, Crestline, Green Valley Lake, Lake Arrowhead, Lake Gregory, Rimforest, Running Springs, Silverwood Lake, Skyforest, Snow Valley and Twin Peaks.

Zone 6 consists of 17,200 square miles in the remainder of the County not embraced by the other zones. This includes portions of the San Gabriel and San Bernardino Mountains and the semi-desert portion of the County. This also includes the Cities/Towns of Big Bear, Needles, Yucca Valley and Twenty-nine Palms with the communities of Amboy, Joshua Tree, Lucerne Valley, Morongo Valley, Newberry Springs and Trona.

This Watershed Action Plan focuses on portions of the county which lie within the Santa Ana River Watershed. Zones 1, 2, and 3 make up the majority of the county area tributary to the watershed. Zones 4 and 5 are located on the ridge of the watershed and contribute a relatively insignificant amount of tributary area to the watershed. Zone 6 is also located on the ridge of the watershed but has a small amount of area within the Santa Ana River Watershed. This area is the

most southwest corner of zone 6 located near Big Bear. In summary, only zones 1, 2, 3, and 6 will be discussed in further detail in the following sections.

2.1 Location

The Santa Ana River watershed is located in southern California, south and east of the city of Los Angeles. The watershed includes much of Orange County, the northwestern corner of Riverside County, the southwestern corner of San Bernardino County, and a small portion of Los Angeles County. The watershed is bound on the south by the Santa Margarita watershed, on the east by the Salton Sea and Southern Mojave watersheds, and on the north/west by the Mojave and San Gabriel watersheds. The watershed is approximately 2,650 square miles in area.

The headwaters of the Santa Ana River are in the San Bernardino Mountains with two of its major tributaries Bear Creek and Mill Creek. Other tributaries include Lytle Creek originating in the San Gabriel Mountains and the San Jacinto River originating in the San Jacinto Mountains. These major tributaries confluence to form the Santa Ana River in the San Bernardino Valley located at the southern base of the Transverse Ranges of the San Bernardino Mountains. The Santa Ana River traverses through the San Bernardino Valley before cutting through the Santa Ana Mountains and flowing to the Orange Coastal Plain. Eventually the river discharges to the ocean in the City of Huntington Beach.

2.2 Physiography

At just over 20,000 square miles, San Bernardino County is just slightly larger than the states of Maryland, Delaware, Rhode Island, and Massachusetts combined. It is the only county in California bordered by both Arizona and Nevada, and is one of only two counties in California bordering more than one U.S. state. Zones 1, 2, and 3 of the San Bernardino County Flood Control District are part of the Inland Empire area in southern California, which also includes Riverside County. The Inland Empire is located within the San Bernardino Valley. The San Bernardino Valley was cut from fast moving floodwater flowing from mountain ranges in the north, east and south that collectively drain into the Santa Ana River basin which, discharges to the ocean through Riverside and Orange County.

The upper tributaries of the watershed consist of mountainous terrain home to the San Bernardino National Forest. According to US Geological Survey maps of the Forest, it consists of two large areas or tracts: a northern and southern portion. Elevations range from 2,000 to 11,499 feet.

The northern portion of the forest has a west border that adjoins Angeles National Forest and runs north-south about ten miles west of Interstate 15. The area has a west extent west of Mount San Antonio, and Wrightwood in San Bernardino County. Parts of the east extent of the northern portion extend about ten miles east of Big Bear City and include the San Gorgonio Wilderness. The southernmost portion is bisected by the Riverside County line and abuts the Morongo Indian Reservation north of Cabazon. The southern portion of the forest borders Toro Peak and the Santa Rosa Indian Reservation to the south and Snow Creek Village and the Morongo Indian Reservation to the north. This forest includes lumber resources, residential communities, resorts,

waterfalls and lakes, Indian resources such as historically important caves and pictographs, and research stations for local educational institutions.

Urban and commercial development has sprawled throughout the valley at the base of the foothills. Although a significant number of the cities and towns are residential communities in which residents commute to nearby Los Angeles or Orange County for work. The San Bernardino Valley is still an important transportation center to the state and country. The Ports of Los Angeles and Long Beach are located approximately 70 miles to the east where a high percentage of goods destined for national and international transport pass through the valley, most of it on trains or trucks. In addition, BNSF has an intermodal transfer facility in San Bernardino. The valley is also crossed by two major interstates and their auxiliaries. Mass transit trains and buses both serve the valley along with an international airport in Ontario. The urban area is ranked by *Forbes Magazine* as one of the American's unhealthiest commutes. The southwest area of the county consists of residential, commercial, and industrial use, as well as agriculture preserves and farmland.

2.3 Land Use

The Santa Ana River watershed is substantially urbanized with approximately 32% of the land being residential, commercial, or industrial. Agricultural land makes up approximately 10% of the watershed and the watershed is home to approximately 5 million people.

The majority of the watershed is within the San Bernardino Mountains, which is home to the federally managed San Bernardino National Forest. The forest covers more than 800,000 acres and includes five wilderness areas: San Gorgonio, Cucamonga, San Jacinto, Santa Rosa and Bighorn Mountain.

2.4 Geology

Much of the San Bernardino County portion of the Santa Ana River Watershed is made up of the San Bernardino Mountains and Valley. The San Bernardino Valley encompasses one of two drainage basins of the Santa Ana River, the Inland Santa Ana Basin. Underneath the surface area of this drainage basin are several large ground water sub-basins, which capture water in underground aquifers. Designated ground water sub-basins include: Chino, Rialto-Colton, Riverside-Arlington, San Bernardino (Bunker Hill), Yucaipa and San Timoteo. Most of the strata in the flat valleys and basins of the watershed are underlain by thousands of feet of sediment deposited by transient seas during historic climate changes and by erosion. Most of the mountains in and rimming the basin consist of granite batholiths approximately 75 million years old. However, much of the rock overlying the highlands, above elevations of 8,000 to 9,000 feet, is ancient metamorphic rock up to 1.7 billion years old. This rock originally formed at the bottom of the ancient Pacific Ocean and was uplifted to the highest peaks of the mountains. Even in ice ages, glaciers have rarely occurred on Southern California mountains, so the rock has remained there for tens of millions of years without significant erosion. The geologic base of the Santa Ana River is made up of ancient igneous, metamorphic, and sedimentary rock.

Diverse and complex faulting and geologic instability have shaped the Santa Ana River watershed. The San Andreas Fault runs across the northern section of the watershed and was responsible for causing the uplift of the San Bernardino Mountains, part of the Transverse Ranges of Southern California. The Elsinore-Whittier Fault Zone crosses the Santa Ana River further downstream, near the Orange County/Riverside County line. This fault caused the rising of the Santa Ana Mountains, Puente Hills, East Orange Hills, Chino Hills, Loma Ridge, and the other mountain ranges and ridges that run northwest-southeast across the lower section of the watershed, comprising the coastal Peninsular Ranges. While the larger San Andreas Fault allowed the Transverse Ranges to rise to above 10,000 feet in many places, the Peninsular Ranges are only about half that height. The San Andreas and San Jacinto fault zones enter the valley along the San Bernardino Mountains and San Jacinto Mountains, respectively. The two fault lines converge to less than 10 km apart in the city of San Bernardino, and less than 3 km in the northwestern part of the basin near the Cajon Pass.

During the last glacial period, when climate change during the Wisconsinian Glaciation caused rivers in Southern California to increase greatly in volume, the Santa Ana was able to cut across the Peninsular Ranges, creating the only gap across the range. During this period, the Santa Ana River changed course multiple times, creating wind gaps in the Peninsular Range and occasionally entrenching into the channel of the ancestral San Diego Creek. The river later returned to its old course and abandoned the San Diego Creek channel, leaving it a wind gap across the Huntington Beach/Newport Beach mesa.

Historical storm events have created large alluvial fans in the flood plains of the valley. Existing soil conditions are relatively consistent throughout the valley and foothills of the San Bernardino Mountains. The western and central foothills contain mainly sandy to gravelly loams with more fine sands in the south and gravelly deposits in the north. The eastern portion of the foothills contains predominately sandy and gravelly loams with more coarse gravelly sandy loams in north east areas. The upper east foothills contain more stony loamy sand. Bedrock becomes more apparent in higher elevations with decreasing amounts of gravelly coarse sand.

2.5 Climate

The Santa Ana River Watershed has a Mediterranean climate with hot dry summers and cooler wet and sometimes snowy winters. Rainfall ranges from 12 inches per year in the coastal plain, to 18 inches per year in the inland valleys, to 40 inches per year in the mountains. Due to the climate, there is little natural perennial surface water in the watershed. The upper part of the watershed in the mountains has the highest gradient and water quality is usually of high quality. Flows in the Upper Valley from the Seven Oaks Dam to the City of San Bernardino consist of storm flows and rising groundwater. From the City of San Bernardino to the City of Riverside the Santa Ana River flows perennially and includes publicly owned treatment works, publicly owned treatment works (POTW), discharge. From the City of Riverside to northern part of Orange County, flow consists of POTW discharges, urban runoff, irrigation runoff water and surfacing groundwater.

Sage scrub and the Yucca plant are the predominant natural vegetation along washes and uplands; it intergrades with chaparral at elevations of 1900 to 2300 feet. Other vegetation

consists of a patchwork of grasslands, riparian woodlands, and mixed hardwood forests, which border the valley in the mountains on the north and east. The Santa Ana winds blow into the valley from the Cajon Pass, which exits the valley's north end between the San Gabriel and San Bernardino mountains. The seasonal Santa Ana winds are felt particularly strongly in the San Bernardino area as warm and dry air is channeled through nearby Cajon Pass at times during the autumn months. This phenomenon markedly increases the wildfire danger in the foothill, canyon, and mountain communities that the cycle of cold wet winters and dry summers helps create.

2.6 Water Resources

There are many natural resources in the San Bernardino portion of the Santa Ana River Watershed. National and regional parks such as Glen Helen, El Prado, and Cucamonga-Guasti provide recreational use for swimming, boating, hiking, fishing, horseback riding, and camping. The large tributary area provides recharge for the local groundwater basins, which supply potable water to residents and businesses. Natural rivers and streams provide a sustainable living environment for native habitat. The Santa Ana Watershed contains some of the best and largest riparian habitat in all of Southern California, primarily in the Prado Basin area which is home to more than 300 species of plants, 13 species of reptiles, 47 species of breeding birds, 11 raptor species, and 23 mammal species. Included are threatened and endangered species such as the least Bell's vireo, arroyo chub, and Santa Ana sucker. The deterioration of the water quality along the Santa Ana River, its tributaries, and in Prado Basin continues to threaten the viability of the native habitat. Improved downstream water quality conditions will serve to protect and preserve the region's rich habitat.

3 WAP Purpose and Overarching Goals

The purpose of the WAP is to improve integration of water quality, stream protection, stormwater management, water conservation and re-use, and flood protection with land use planning and development processes. The WAP identifies an integrated watershed management approach and specifies watershed protection principles that if implemented in development planning processes will help achieve the purpose of the WAP. The integrated watershed management approach and watershed protection principles developed by the Permittees are provided in this section.

3.1 Integrated Watershed Management Approach

The Integrated Watershed Management (IWM) Approach is a sustainable development approach designed to improve land and watershed management. The IWM approach involves consideration of the following development concepts:

Incorporation of mixed use communities that integrate housing, retail shops, work places, schools, parks, mass transit systems, and civic facilities essential to the daily life of the residents into development projects. Facilities should be within easy walking distance of each other and connected to an integrated transportation system that encourages pedestrian and bicycle use. A community containing a diversity of housing types and businesses will enable citizens from a wide range of cultural groups, economic levels, and age groups to live within its boundaries. Likewise, wildlife corridors and open space areas should be well defined and protected from human sprawl.

Design public spaces to encourage the attention and presence of people at all hours of the day and night. Street orientation and the placement of buildings should incorporate the use of shading to contribute to the energy efficiency of the community. Materials and methods of construction should exhibiting a continuity of history and culture and compatibility with the climate of the region to encourage the development of local character and community identity. Community design should conserve and utilize natural resources, promote recycling, alleviate waste, incorporate efficient energy and water systems, and use natural terrain, drainage, and vegetation throughout the community, especially within parks and greenbelts.

Integrating land-use planning with larger transportation network built around mass transit rather than freeways. Regions should be bounded by a continuous system of greenbelt/wildlife corridors based on natural conditions. Regional institutions and services (government, stadiums, museums, etc.) should be located in the urban core.

An integrated planning process would be provided through increased local government interaction with regional municipalities. This would create a sustainable living environment rather than allowing developer-initiated, inefficient piecemeal communities to be developed. General plans should designate where new growth, infill or redevelopment will be allowed to occur. These plans should be developed through an open process to include multiple participants to encompass the community as a whole.

3.2 Watershed Protection Principles

A workshop was held on January 12, 2011 so the County, Copermittees, and other stakeholders could collaborate to develop common principles and policies necessary for water quality protection. The other objectives of the workshop were to receive input from the Co-permittees and the stakeholders regarding example plans and ordinances that incorporate watershed principles as well as receive recommendations for incorporating watershed principles into Permittee planning documents and processes.

Specific watershed protection principles that are identified in the MS4 permit were presented in the workshop and are incorporated here in the WAP as the baseline watershed protection principles. These principles include:

a. Avoid disturbance of natural water bodies, drainage systems and flood plains; conserve natural areas; protect slopes and channels; minimize impacts from stormwater and urban runoff on the biological integrity of natural drainage systems and water bodies;

b. Minimize changes in hydrology and pollutant loading; require incorporation of controls including structural and non-structural BMPs to mitigate any projected increases in pollutant loads and flows; ensure that post-development runoff rates and velocities from a site do not adversely impact downstream erosion, stream habitat; minimize the quantity of stormwater directed to impermeable surfaces and the MS4s; maximize the percentage of permeable surfaces to allow more percolation of stormwater into the ground;

c. Preserve wetlands, riparian corridors, and buffer zones; establish reasonable limits on the clearing of vegetation from the project site;

d. Use properly designed and well maintained water quality wetlands, biofiltration swales, watershed-scale retrofits, etc., where such measures are likely to be effective and technically and economically feasible;

e. Provide for appropriate permanent measures to reduce stormwater pollutant loads in stormwater from the development site; and

f. Establish development guidelines for areas particularly susceptible to erosion and sediment loss.

g. Consider pollutants of concern (identified in the risk-based analysis provided in the 2006 Report of Waste Discharge (ROWD), the annual reports and the list of impaired waterbodies (303(d) list)) and propose appropriate control measures.

Participants at the workshop collaborated on the development of other watershed protection principles. The principles that were identified during the workshop include:

<u>Ahwahnee Principles</u>

- Natural resources such as wetlands, flood plains, recharge zones, riparian areas, and open space, should be identified, preserved, and restored as valuable assets for such uses as flood protection and water quality improvement.
- Water holding areas, including creek beds and recessed athletic fields should be incorporated into urban landscapes.
- Permeable surfaces should be used for hardscape, with impervious surfaces minimized, so that land is available to absorb stormwater, reduce polluted runoff, recharge groundwater and reduce flooding.
- Dual plumbing should be used to allow the use of greywater for landscape irrigation in new development.
- Community design should maximize use of recycled water for landscape irrigation, toilet flushing, and commercial/industrial uses, with purple pipe installed in new construction and redevelopment in anticipation of future recycled water use.
- Water conservation technologies for new construction and retrofit should be incorporated in new construction and redevelopment.
- Maximize locally available, drought-proof water supplies (i.e., groundwater treatment and brackish water desalination).

Other Watershed Protection Principles Identified

- Use of design BMPs to mimic a site pre-development hydrology (maximize permeable areas, conserve natural resources, minimize directly connected impervious areas).
- Proposal of appropriate control measures for pollutants of concern.
- Use of the California Environmental Quality Act (CEQA) as an opportunity for LID concepts.
- Maintaining stormwater runoff capture in local basins rather than using the prior conventional approach of allowing runoff to be sent to the ocean.
- Expansion of facilities to have basins become more self-sufficient.
- Integration of new development and existing re-development planning at an earlier stage in the process to address the overall watershed.

The watershed protection principles identified were then used in a discussion of Permittee planning procedures, including CEQA preparation, General Plans and specific plans, Conditions of Approval, tract maps, and the Water Quality Management Plan(WQMP) development and approval process. The review of planning procedures and discussion resulted in recommendations for incorporating the watershed principles in Permittee planning documents and processes. The recommendations developed include:

CEQA

- Improvement of focus on water quality from initial environmental review.

- Integration of CEQA as a better management and planning tool rather than merely relying on its potential as a regulatory tool.

General Plans / Specific Plans

- Use of the Recharge Master Plan as part of General Plan updates.
- Inclusion of water quality solutions need at an earlier stage of the project inception process.
- Evaluation of city municipal codes to better integrate public works/engineering with planning.
- Evaluation of integration of water overall with supply, re-use, recycled uses, flow and erosion.
- Use of the General Plan to provide key planning for project integration into the Specific Plans and overall local planning. Local implementation in conjunction with regional watershed efforts integral to overall development planning efforts.
- Use of LID as a planning strategy.
- Evaluation of regional and sub-regional opportunities.
- Streamlining the project process, critical to assisting with the next steps in development.

Conditions of Approval / Tract Maps / WQMPs

- Inclusion of water quality requirements earlier in the process at planning inception.
- Include watershed features in development maps.
- Evaluation of site development for a collective approach to water quality and water supply, etc.
- WQMP standard template should include focus towards legacy pollution that may impact infiltration.

Removing Barriers to Implementation

- Improvement in plan checking process.
- Offsite opportunity implementation process.
- Development of timing requirements for the In Lieu Program (Local or Regional).
- Communication with Policy Makers within agencies for local implementation.
- Expansion of Model Local Implementation Plan scope of work.
- Evaluation of linkages to other programs.

Recommendations

- Set up a workgroup on development of In Lieu Program with Regional Board and Water Masters.
- Develop additional strategies with Water Masters for recharge. This is currently being worked on with the Regional Board.
- Define Harvest and Re-Use approaches.
- Better capitalize on the investments made by the storm drain and water recharge infrastructure improvements.

Barriers

- Ongoing maintenance costs of In Lieu Program (life cycle costs).
- Caution on use of flood control basin primary use and objectives. Partnerships with Water Masters and the Flood Control District are critical for the balance of the use.
- Water rights policies and beneficial uses for stormwater impacts for watershed areas that need preservation of habitat and other resources.

Additional Concepts

- Higher watershed basin as part of the In Lieu Program.

4 WAP Phase I

4.1 WAP Task Force Workshops

A requirement of the MS4 Permit is for the County, in coordination with the Co-Permittees, to identify program-specific objectives for the WAP. The approach the County and the Co-Permittees used to develop these objectives for the WAP included holding a series of workshops that focused on key elements of the program. The County and Co-Permittees expanded the scope of the workshops by inviting other interested stakeholders in the watershed and members of the WAP Task Force to ensure representation of a variety of viewpoints. The following WAP workshops were held to identify the program specific objectives:

- Residential Workshop (December 10, 2010)
- Commercial/Retail/Industrial Workshop (December 10, 2010)
- Watershed Efforts and Linkages (December 15, 2011)
- Watershed Protection Principles (January 12, 2011)
- Parks and Public Facilities (January 19, 2011)
- Streets and Arterials (January 20, 2011)

4.1.1 Residential Workshop

The format of the residential workshop included a presentation of residential scenarios and types of participants in water quality implementation, discussion about residential planning principles, and development of recommendations for future planning principles. The basis for Residential Categories is impervious footprint. The intent was to keep the model simple and consistent with other planning and technical categories. The residential scenarios discussed included the following:

- Low Density
- Medium Density
- High Density

The participants in residential water quality implementation were identified as the following:

- Public Agencies (County, Municipal)
- Developers
- Home Owner Associations
- Home Builders
- Regulatory Agencies

- Non-governmental Organizations (NGOs)

The residential planning principles that were identified are recommended for further evaluation through the WAP and in the development of the WQMP template. The residential planning principles identified included the following:

- Competing Regulatory Agency / Outside Requirements
- Synergy / Conflicts Resolution with Overall Project / Area Solutions
- Sustainability Principles Incorporation into Solutions (Infiltration, Water Supply, Sizing Criteria, Recharge Opportunities)
- Site Planning / Density
- Regional vs. Local Solutions (Project Scale Issues)
- Maintenance / Life Cycle Cost Evaluation
- Construction / Initial Cost Evaluation
- Design Principles and Design Integration (Self Retaining Stormwater, Landscape, Arterial and Streets)
- WQMP / Code Approach
- Groundwater Recharge
- Regional and Local Solutions through Agency Planning with Water Masters (Potential Legal and Physical Constraints in Developing Solutions)
- Hydromodification
- Aesthetics
- Multiuse of Sites (Parks, Trails, Habitat)
- Water Conservation / Drought Friendly Landscape
- Building Structure Materials
- Vector Management

The recommendations for future planning principles included the following:

<u>CEQA</u>

- Increase Project Level Evaluation (Specific / General Plan Level)

<u>General Plan / Specific Plan (High Level)</u>

- Design Guideline Enhancement
- More Detailed Project Findings
- Update General Plans

- Higher Level of Detail in Specific Plan Sections

Conditions of Approval / Tract Maps / WQMPs

- Increase Detail Requirements

4.1.2 Commercial/Industrial/Retail Workshop

The format of the commercial/industrial/retail workshop included a presentation of commercial/industrial/retail scenarios and types of participants in water quality implementation, discussion about planning principles, and development of recommendations for future planning principles. The basis for Commercial Categories is impervious footprint and similarities in use. Site layouts for commercial sites are often driven by marketing and circulation requirements. The commercial/industrial/retail scenarios discussed included the following:

- Retail / Office / Mixed Use / Institutional
- Industrial

The commercial/industrial/retail planning principles that were identified are recommended for further evaluation through the WAP and in the development of the WQMP template. The commercial/industrial/retail planning principles identified included the following:

- Competing Regulatory Agency / Outside Requirements
- Synergy / Conflicts Resolution with Overall Project / Area Solutions
- Sustainability Principles Incorporation into Solutions (Infiltration, Water Supply, Sizing Criteria, Recharge Opportunities)
- Site Planning / Layout
- Regional vs. Local Solutions (Difficult with separation of private and public
- maintenance)
- Maintenance / Life Cycle Cost Evaluation
- Construction / Initial Cost Evaluation
- Design Principles and Design Integration (Self Retaining Stormwater, Landscape, Arterial & Streets)
- WQMP / Code Approach
- Groundwater Recharge
- Simplicity of Solutions
- Multiuse of Sites (Parks, Trails, Habitat)
- Water Conservation / Drought Friendly Landscape

The recommendations for future planning principles included the following:

CEQA

- Increase Project Level Evaluation (Specific / General Plan Level)

General Plan / Specific Plan (High Level)

- Design Guideline Enhancement
- More Detailed Project Findings
- Update General Plans
- Update Zoning Code
- Develop WQMP Concepts with Preliminary Drainage Concepts

Conditions of Approval / Parcel Maps / WQMPs

- Increase Detail Requirements

4.1.3 Parks and Public Facilities Workshop

The format of the Parks and Public Facilities workshop included a presentation of park and public facility types, a discussion of planning principles that should be considered, and development of recommendations for future planning principles. The park types were classified as follows:

- Natural
- Developed

The parks planning principles that were identified are recommended to be further evaluated through the WAP and in the development of the WQMP template. The parks planning principles identified included the following:

- Use of parks for regional and retrofit opportunities
- Overlapping use of recreational facilities with flood control
- Parks classification affected by use, size, and maintenance
- Parks may need to be evaluated as components in an overall strategy
- Assessment of primary benefit (Natural vs. Developed)
- Introduce planning principles at park concept development

The recommendations for future park planning principles included the following:

CEQA

- Amend the Initial Study checklist at the local or statewide level

General Plan / Specific Plan (High Level)

- Early planning criteria development

- Encourage design integration
- Policy statement revisions
- Storm drain master plan integration

The public facility types were classified as follows:

- Industrial
- Administrative
- Utilities

The public facility principles that were identified are recommended for further evaluation through the WAP and in the development of the WQMP template. The public facility planning principles identified included the following:

- Classification affected by use
- A facility is evaluated as a whole and not as components
- Commercial/industrial principles apply
- Consolidation of facilities into complexes
- Higher density for administrative functions
- Clarify retrofit threshold
- Encourage application of water quality features in retrofit projects
- Introduce planning principles at concept development

The recommendations for future public facility planning principles included the following:

CEQA

- Amend the Initial Study checklist at the local or statewide level

General Plan / Specific Plan (High Level)

- Early planning criteria development
- Encourage design integration
- Policy statement revisions
- Storm drain master plan integration

4.1.4 Streets and Arterials

The format of the Streets and Arterials workshop included a presentation of street types, facility types, a discussion of planning principles that should be considered, and development of recommendations for future planning principles. The park types were classified as follows:

- Streets with no parkways and medians

- Streets with parkways
- Streets with parkways and medians

The street principles that were identified are recommended for further evaluation through the WAP and in the development of the WQMP template. The street planning principles identified included the following:

- There needs to be a balance with flood control facilities, protecting life and property, and being able to capture rainfall for re-use or harvesting to comply with permit.
- Consider a mechanism for early discussion with developers regarding those "must do" items for water quality/water conservation prior to submission of plans. This should no longer be an afterthought once the site is designed.
- A policy should be in place for those sites where infiltration (LID principles) is infeasible to allow the participation in In Lieu programs through regional treatment opportunities.
- Consideration that many developers prefer to receive a policy (e.g., General Plan) or guidance document that informs them where the agency plans on handling water quality/water conservation rules and regulations.
- Evaluate the potential to promote return to rural street sections for new arterials and streets.
- Consider utilization of reverse parkway drains to parkways and medians for existing arterials.
- Use of more sub-regional to regional systems to assist citywide or countywide street networks.
- Create more street tree programs for locations that have no treatment with Filterra-type systems.
- Potentially reduce street widths in locations where no parkways exist, balancing circulation needs.
- Develop a standard tool kit that an agency can apply in different existing street scenarios.

The recommendations for future planning principles included the following:

<u>CEQA</u>

- Increase Project Level Evaluation (Specific / General Plan Level)

<u>General Plan / Specific Plan (High Level)</u>

- Consider alternative designs to conventional streets.
- Develop a policy on how alternatively designed facilities will be maintained including funding.

- Changes in the development code will require the education principals applied to decision makers and elected officials in all jurisdictions, as well as the County, that this is not only important but is required and will directly affect them.
- Consider an implementation policy to modify street tree programs to include systems that include aid in improvement of stormwater quality.
- Reduced street widths are needed to balance parking needs.

4.2 WAP Linkages and Other Watershed Efforts

Linking all of the important components of the WAP will create an efficient and effective strategy in order to meet the new requirements. Integrating the SWQSTF, One Water One Watershed (OWOW), MSWMP, WQMP, LID, and TMDL requirements will provide beneficial synergies for the entire watershed. Linking all of these processes together will provide a streamlined approach to restore the watershed's natural resources and provide vast environmental benefits.

In 2006, an Online Watershed Map (Geodatabase) was created and is the WAP's central component. San Bernardino County Flood Control started this map to locate the flood control drainage systems, and is adding links to other documents to look at potential basins, parks, and channels that can be retrofitted or restored. The ultimate goal is to be able to have the project proponents identify the facility, where it drains to, the environmental constraints, and the sites downstream for potential restoration and rehabilitation. The online map will eventually be accessible by the public with limited access depending on the role the person has in the project. The online Geodatabase will also provide template functionality for WQMPs, as well as important requirements regarding the MSWMP, LID, and TMDLs.

4.2.1 SWQSTF

The Stormwater Quality Standards Task Force is engaged with the standards regarding body contact with water during recreational activities where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs. Water contact implies a risk of waterborne disease transmission and involves human health; accordingly, criteria required to protect this use are more stringent than those for more casual water-oriented recreation. The Stormwater Quality Standards Task Force is working towards integration of water quality standards in the entire watershed.

4.2.2 OWOW

The One Water One Watershed Plan is a fundamental link to integrate everyone involved in the permit to work together to understand the layers of the Basin and how it relates to potable water. Knowing where water originates and where it is going will resolve the water supply issue by increasing awareness and responsibility with the public. The method for resolving water supply is through the water quality permits and the online Geodatabase, which enables the Permittees to go to the Regional Board and demonstrate the water quality benefit each improvement provides.

4.2.3 MSWMP

The Municipal Stormwater Management Plan documents all of the specific stormwater related activities carried out by the Permittees during the permit term. This important organizational tool will enable all of the Permittees to stay informed and updated on completed tasks and planned goals. Integrating this into the WAP and incorporating it into the online Geodatabase will be an essential and beneficial tool, keeping everyone informed on the latest activities in the watershed.

4.2.4 WQMP

Land development activities need to be addressed to meet certain aspects of the permit. An updated Water Quality Management Plan would focus on individual new and redevelopment projects within the watershed. Targeting all of these projects will ensure all new improvements and developments are designed to maintain, restore, and improve water quality. Incorporating updated design requirements into the WQMP would greatly benefit the watershed and its inhabitants.

The relationship between the WAP and the WQMP is that all of the watershed aspects required to be protected will be addressed in the WAP and integrated in the WQMP by using the online Geodatabase. This interactive tool will help enhance the design as well as assist in making beneficial decisions on projects.

4.2.5 LID Implementation

Incorporating Low Impact Development into the planning and design process of every project would greatly benefit the watershed and its inhabitants. LID is a site planning strategy that uses a water balance approach to reduce pollutant loads to receiving waters. Targeting all of these projects will ensure all new improvements and development are designed to maintain, restore, and improve water quality. The online Geodatabase will incorporate the use of LID when planning and developing design plans.

4.2.6 TMDL Implementation Plans

TMDLs are important tools that require Permittees to reduce pollutants within the watershed. Multiple TMDLs exist within the watershed and the online Geodatabase will be an essential tool in tracking the progress of each. The WAP will integrate TMDL requirements, progress, and developments into a streamlined plan to efficiently manage and meet the water quality standards set forth in the permit.

4.2.7 Chino Basin Master Plan

The initial concept for the Chino Creek Master Plan was to integrate renewable energy projects, including organics management, biosolids, and regional co-composters into immediate plans. During the process, it developed into a regional forum to address shared concerns over managing water use and protecting and improving open space and wildlife habitat in this quickly urbanizing area. Improvements to the water treatment and delivery systems, Prado Basin activities, stormwater best management practices, natural treatment systems for water quality improvement, low impact development concepts, local development proposals, and presentations

on recreation and trail systems are now being incorporated into the master plan. Dairy waste runoff, increased soil erosion, and increased stormwater flows with their resultant pollutants, have not only degraded water quality, but have also caused channel incision, loss of habitat, decreased infiltration and increased flooding within the watershed. Continuation and expansion of these practices necessitates implementing sustainable approaches to low-impact development, and implementing barriers to control the entrance of contaminants and high flows into receiving waters. The inclusion of natural treatment approaches to water quality improvement and flood flow reduction will provide opportunities for important habitat improvements and valuable passive and active recreation opportunities. The goal of the master plan is to evaluate and refine opportunities for multiuse and multiple purpose projects that improve water quality, flood protection, habitat and recreation and to identify the steps to implementation of these projects. The Chino Basin Mater Plan is an integral component of the WAP and needs to be incorporated into the watershed improvement efforts. Updates and planned activities will be included into the online Geodatabase so the task force can monitor and include the ongoing activities of the master plan.

4.2.8 SAWPA IRWMP

The Santa Ana Watershed Project Authority has implemented an Integrated Regional Water Management Plan to help restore a sustainable Santa Ana Watershed. The main goals of this plan are to have a drought-proofed, salt balanced, watershed that supports economic and environmental vitality in the year 2030. The IRWMP unites the watershed, and coordinates expertise, efforts and resources to accomplish a sustainable environment. The plan addresses all water-related problems and capitalizes on SAWPA Member Agencies' successful reputation in watershed-wide planning and problem solving. It envisions a single unified submittal to the state, engenders a collaborative approach to solving problems, allows influence to projects over which we have no authority, and addresses systematic and long-term needs. The plan is another integral component of the WAP and needs to be incorporated into the watershed improvement efforts. Updates and planned activities will be included into the online Geodatabase so the task force can monitor and include the ongoing activities of the master plan.

4.3 WAP Program Specific Objectives

The WAP Program Specific Objectives are a requirement identified in the MS4 permit. These objectives were developed through evaluation of all of the WAP workshops that were held. The WAP workshops provided an opportunity for stakeholders to provide input about their priorities in the watershed and how protection of the watershed can be achieved. Review of the workshops has provided an understanding of the underlying themes of the recommendations provided across the different workshops. The WAP Program Specific Objectives were developed with consideration of the input provided by stakeholders at the workshops, the underlying themes of the recommendations provided at the workshops, and consideration of items listed in Section XI.B.a.i in the MS4 permit. The WAP Program Specific Objectives include:

1. Identification and removal of impediments to the watershed protection principles.

2. Mitigation of impaired waters (TMDLs and 303(d) Listings)[2]

3. LIP coordination and implementation of watershed priorities.

4. Incorporation of an integrated water resources approach in all planning processes.

5. Coordination of recharge master plans with General Plan updates and watershed protection efforts

6. Incorporation of sustainability principles into watershed solutions

7. Incorporation of watershed protection, water quality and water conservation concepts including minimization of changes in hydrology and pollutant load as early as possible in planning procedures for development.

8. Educatation of all participants in the development process including elected officials about watershed protection, water quality improvement, and Low Impact Development.

9. Protection of receiving waters through avoidance of natural water bodies, conservation of natural areas, and preservation of wetlands, riparian corridors and buffer zones.

The County and the Co-permittees will use the WAP Program Specific Objectives to guide implementation of the WAP. Specific action steps to achieve these objectives will be developed through the WAP Task Force.

4.4 Watershed Geodatabase

4.4.1 Development Summary

A major component of the final work product under the WAP includes the development, testing, and implementation of the Watershed Geodatabase as the primary interactive reference tool. The Watershed Geodatabase is designed in such a manner as to allow for continuous live access to

[2] Impaired waters include 303(d) listed waters and TMDLs. If a TMDL has been developed and an implementation plan is yet to be developed, the responsible Permittees should develop constituent-specific source control measures, conduct additional monitoring and/or cooperate with the development of an implementation plan, where feasible, and consistent with the MEP standard.

storm water facility data, reports and studies, and data to support other regulatory processes such as WQMP development and approvals, CWA Section 401 Water Quality Standards Certifications (401 Certifications), and LID BMP feasibility evaluations over the Internet using only a web browser. The goal is to provide the information in a single, centralized, and maintained location where stakeholders, including developers, engineers, plan checkers, and regulators, can easily access the information. To accomplish this task, the Stormwater Program commissioned the development of an online mapping and data access application using current GIS technology. Further, through stakeholder meetings, individual contact, and research, a thorough review of available data and supporting reports and studies was completed to populate the Watershed Geodatabase. Additional information needed to complete the data requirements for the WAP includes:

- Engineering evaluation of local and regional drainage areas;
- Delineation of existing unarmored or soft-armored drainages that are vulnerable to geomorphological changes due to hydromodification and those channels and steams that are Engineered Hardened & Maintained (EHM);
- Classification of many significant non-EHM facilities as Low/Med/High susceptibility to hydromodification;
- Identification of facilities which pose restoration opportunities; and
- Identification of sites that pose retrofit opportunities.

Development of the Watershed Geodatabase was accomplished over a six-year period from inception to implementation started with an accurate inventory and mapping of the major facilities. The MS4 Copermittees, resource conservation districts, water and utility agencies, state and federal agencies, non-governmental agencies, and developers participated in the development of the Watershed Geodatabase. They provided comments and input throughout development of the application. A draft version of the application was made available online in 2006, and it has been incrementally updated as additional data and functionality became available. The Watershed Geodatabase is and will remain a work in progress, both from a data standpoint and in its functionality. A data maintenance plan has been developed and is presented in this document in order to ensure the complete, current, and accurate nature of the information within the limits of available data. Further enhancements are also anticipated through the implementation of the permit Phase 2 requirements to satisfy the additional needs and requests of the MS4 Copermittees.

4.4.1.1 Technology

The Watershed Geodatabase depends on state of the art GIS and Internet technologies. The system is powered by two computer servers purchased and maintained by the County Stormwater Program. These servers include a 64 bit, quad core data server running Microsoft SQL Server as the Relational Database Management System (RDBMS). The geographic components of this data server are supported using ArcSDE version 9.3.1 by ESRI. The second server is the application server that is connected to the Internet and serves up both the mapping

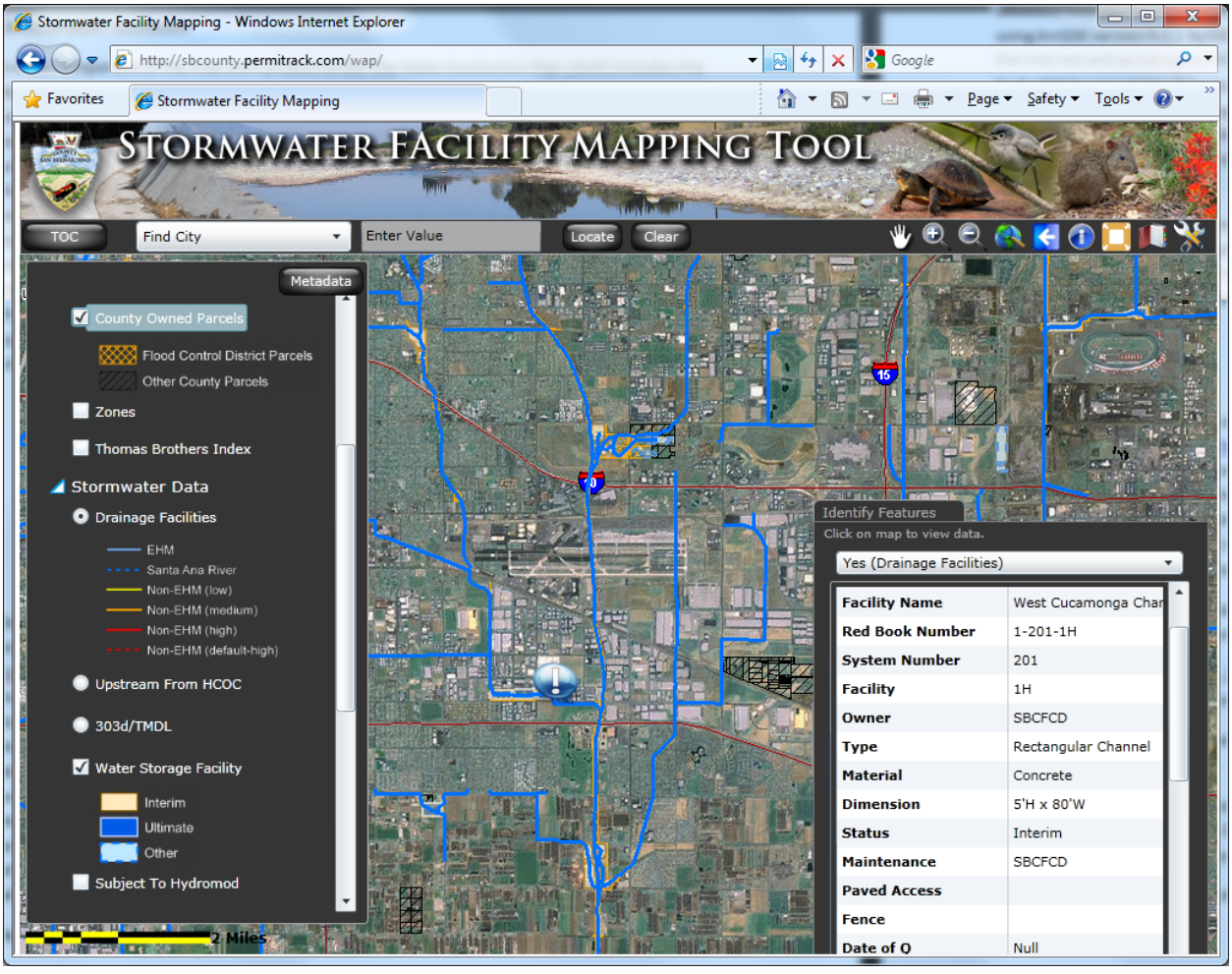
and web pages. The mapping on this server is supported by ArcGIS Server version 9.3.1 by ESRI. The mapping application is also supported by the Microsoft Silverlight version 4 browser plug-in, which is required to view the media rich content of the site including the mapping. The Watershed Geodatabase has been developed and optimized for the Microsoft Internet Explorer version 7 browser; however, it will operate to varying degrees in other browser environments.

The two servers are currently hosted at a server collocation center, which provides a secure environment, redundant high-speed Internet connectivity, and backup power, as well as regular full and incremental data backups. This internet connectivity will ensure that the HCOC Map/Watershed Geodatabase is available to watershed stakeholders via the World Wide Web.

4.4.1.2 Functionality

The Watershed Geodatabase is accessible through the domain address http://sbcounty.permitrack.com/WAP (see Figure 1).

Figure 1: Watershed Geodatabase Mapping Site



The mapping site provides basic functionality for bringing up a map and moving the field of view around the permitted area. Currently while under review by the Regional Board and other stakeholders, the site requires a password for access. One password has been provided at this time for general access. The password is “swprogram1”. As the application develops to further expand into the Phase 2 requirements, multiple passwords will be provided to focus the application and data organization for the type of user logging in.

The Watershed Geodatabase has the following functionality, capabilities, and layers which are implemented in the Silverlight environment.

- Navigation tools: Pan, Zoom In, Zoom Out, Zoom Extents, Back Extents, Identity, Measure, Activate Layer, Select by creating Polygon
- Searches: Find City, Find Channel Facility, Find Water Storage, Find Flood Control Parcel APN, Find Thomas Bros page,
- Base Map Layers: ESRI Prime World imagery, NGS Topo US 2d, Highways, County owned parcels – Flood Control District Owned Parcels, Drainage Course Facility Reaches, Water Storage Facilities, City Storm Drain, Street data, Counties, City Limits, Thomas Bros Page, County Flood Zone,
- Other Basic Functionality: Map Print, Map Legend, Image disclaimer, Help page, Metadata for each layer.

Main stormwater reference layers included in the site are listed below. A complete list of data included in the Watershed Geodatabase is presented in the data maintenance section, and the data dictionary is provided in Appendix G.

1. Stormwater Drainage Facilities including channels and basins
    a. County Red-Book Number
    b. Physical Characteristics (width, depth, shape, material)
    c. Maintenance Responsibility
    d. EHM, Low/Med/High Susceptibility to Hydromodification
    e. Facilities draining to a HCOC
2. Local and Regional Drainage Boundaries
3. Controlled Release Points
4. Sensitive species and Protected Habitat areas from the County of San Bernardino General Plan, State Department of Fish and Game, and the Federal Fish and Wildlife Service
5. Potential stormwater recharge areas and/or reservoirs
6. Groundwater basins including groundwater surface contours
7. Groundwater contamination plumes
8. NRCS Soil Classifications

9. 303(d) listed water bodies, addressed TMDLs, and associated pollutants
10. Regional and Sub-Regional BMP Facilities

Additional reference material is provided in the form of links to supporting documentation. These mainly include:

1. Construction and As-build Drawing documents by facility
2. Relevant Stormwater and Groundwater Documents and Studies collected to support the WAP
3. System-wide Retrofit Opportunity Exhibits and Study linked to individual identified sites
4. System-wide Restoration Opportunity Exhibits and Study linked to individual identified sites
5. Hydromodification Field Observation Exhibits and Study linked to individual identified sites

4.4.2 Maintenance and Enhancement Schedule

Over the course of the development of the Watershed Geodatabase, the Stormwater Program collected or commissioned the creation of various data layers that are pertinent to the WAP. One of the main objectives of the Watershed Geodatabase is to develop and implement a plan to keep the reference material provided on the site up to date. This data maintenance plan will assist with identifying data layers that are included in the Watershed Geodatabase, the source of the data, the party responsible for data maintenance, the frequency of maintenance, and the last time the data layer was updates. Further, since many of these layers are maintained simultaneously by multiple agencies, this data maintenance plan will identify a specific source and maintenance responsibility to determine best maintenance practices and eliminate duplication of effort. The data maintenance plan indicates that the Stormwater Program will evaluate and update as necessary each of the data layers with a minimum frequency of semiannually unless a specific data set has a known longer update cycle.

In collecting the required data layers, the Stormwater Program's consultants coordinated with the County's Information System Department and Public Works Survey Department to collect various data layers relevant to the project at hand. The consultants obtained much of the needed base layers to assist with the project overtime since project initiation in 2006. The consultants revaluated the data in the first quarter of 2010 to organize, update and clean up data to be suitable to support the WAP. The Public Works Survey Department worked closely with the consultant's GIS Department to provide updated data layers that would replace all outdated data. During the process of collecting updated data, the updates were noted and tracked to load and document the most current data available.

Throughout the course of the Watershed Geodatabase development, the consultants made multiple contacts with various agencies and districts to collect the data needed. San Bernardino County provided the bulk of applicable data and is the prime source for downloads and updates as needed. The consultants also made contact with each of the MS4 Copermittees throughout the County. The Cities provided data as available for their jurisdiction and as appropriate to the

needs of the project. Groundwater agencies such as the Chino Basin Watermaster and San Bernardino Valley Municipal Water District were among some of the other agencies contacted to obtain the relevant information. Overall, the requests and collection of data was a large cooperative effort and all involved parties were responsive.

The data included in the Watershed Geodatabase consists of base layers such as parcels, street centerlines, County and City boundaries, County maintained roads and County and Flood Control District parcels all of which come from the County. The County also provided species and habitat data sourced from the county approved General Plan, the California Department of Fish and Game, and Federal Department of Fish and Wildlife. In addition, the County provided maintained drainage facilities and water storage facilities. The various agencies and districts provided layers such as ground water contours, plumes, storm drain systems, water utilities, and land use. RBF downloaded NRCS soils, aquifer and 303d listed water bodies from various resource agencies.

A strategic method was implemented for review and data organization to ensure data quality. The data layers were thoroughly examined and compared to existing layers to verify changes and location. Once the data was reviewed, the data was recorded stating the provider, date modified, date to be updated, type of file and size. A structured file system was created for the data received, organized by data type, this assisted the various groups to easily find what was needed to develop the Watershed Geodatabase. The data was also used to perform various commissioned studies to support the WAP including retrofit opportunities, restoration opportunities, and causes of stream degradation. The data layers presented on the site and maintained in support of the WAP are shown in Table 1.

Table 1: WAP Data Layers

Description	Source	Responsibility	Update Frequency	Last Modified
Parcels	County	County GIS	Every 2 weeks	6/1/2010
Street Centerlines	County	County GIS	Bi-Annually	6/1/2010
Street Centerlines w/in each City	RBF	Stormwater Program	Bi-Annually	10/1/2010
City Boundaries	County	County GIS	Bi-Annually	4/1/2010
County Boundaries	County	County GIS	Bi-Annually	8/5/2008
County Maintained Roads	County	County GIS	Bi-Annually	8/5/2008
County Owned Parcels	County	County GIS	Bi-Annually	11/8/2007
2006 303d Listed Rivers in SB Co	CA.GOV - SWRCB	Stormwater Program	Every 2 years	9/15/2010
2006 303d Listed Waters in SB Co	CA.GOV - SWRCB	Stormwater Program	Every 2 years	9/15/2010
Flood Control District Zone Boundaries	County	County GIS	As Needed	8/5/2008
Arroyo Toad	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Ash-Gray Indian Paintbrush	US Fish & Wildlife Service	County GIS	Annually	12/26/2007
Bear Valley Sandwort	US Fish & Wildlife Service	County GIS	Annually	12/26/2007
Bonytail Chub	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
California Gnatcatcher	US Fish & Wildlife Service	County GIS	Annually	12/19/2007
California Taraxacum	US Fish & Wildlife Service	County GIS	Annually	8/14/2008
Cushenbury Buckwheat	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Cushenbury Milkvetch	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Cushenbury Oxytheca	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Desert Tortoise	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Least Bell's Vireo	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Kangaroo Rat	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Mountains Bladderpod	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Mountain Yellow Legged Frog	US Fish & Wildlife Service	County GIS	Annually	9/14/2006
Parish Daisy	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Razorback Sucker	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
San Bernardino Bluegrass	US Fish & Wildlife Service	County GIS	Annually	8/14/2008
Santa Ana Sucker	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
Southern Mountain Wild-Buckwheat	US Fish & Wildlife Service	County GIS	Annually	12/26/2007
Southwestern Willow Flycatcher	US Fish & Wildlife Service	County GIS	Annually	6/24/2010
General Plan Bald Eagle Habitat	US Fish & Wildlife Service	County GIS	Annually	8/5/2008
General Plan Mojave Ground Squirrel	County	County GIS	Annually	7/30/2008
General Plan Desert Tortoise Habitat	County	County GIS	Annually	7/30/2008
Highways	County	County GIS	Annually	8/5/2008
Watersheds in San Bernardino	County	Multiple Sources	Annually	11/18/2004
Potentially Sensitive Areas	US Fish & Wildlife Service	County GIS	Annually	7/30/2008
Southern Rubber Boa	US Fish & Wildlife Service	County GIS	As Needed	7/30/2008
Delhi Sands	US Fish & Wildlife Service	County GIS	As Needed	7/30/2008
Street Network	County	County GIS	Annually	12/1/2010
Thomas Brothers Index	RBF	Stormwater Program	Annually	7/30/2008
USGS Quads	National Geographics	Stormwater Program	Annually	7/30/2008
Aquifer	U.S. Geological Survey	Stormwater Program	Annually	3/20/2010
BMP	RBF	Stormwater Program	Annually	1/1/2011
City Storm Drain	Co-Permittees	Cities & Stormwater Program	Annually	11/6/2008
Contours	SBVWD & CBWM	SBVWD, CBWM & Stormwater Program	Annually	8/1/2007
Control Release Points	RBF	County GIS & Stormwater Program	In work - Irregular	1/1/2011
Drainage Course	County	County GIS & Stormwater Program	Annually	5/11/2010
Hydromodification	RBF	Stormwater Program	Annually	1/1/2011
Plumes	SBVWD & CBWM	SBVWD, CBWM & Stormwater Program	Annually	8/1/2007
Reports	Various Cities, County, Agencies	Stormwater Program	Bi-Annually	1/1/2011
Restoration Opportunities	RBF	Stormwater Program	Annually	1/1/2011
Retrofit Opportunities	RBF	Stormwater Program	Annually	1/1/2011
Septic Tank Inventory	County Assessor's Office	Stormwater Program & County GIS	Bi-Annually	12/3/2010
Hydromod Field Observations	RBF	Stormwater Program	Annually	1/1/2011
Soils	NRCS	Stormwater Program	Annually	1/1/2011
Water Storage Facility	County	County GIS & Stormwater Program	Annually	5/11/2010

The data maintenance methodology has includes three methods for delivering updates to the Stormwater Program for inclusion in the Watershed Geodatabase. They are as follows:

1) When possible, data will remain at its source (such as in the San Bernardino County GIS) and a network link will be developed over the Internet to allow this layer to be viewed as a service within the Watershed Geodatabase. This approach, also known as a "Mash-Up," is the most reliable method, because it leaves responsibility for update in the hands of the owner of the original dataset and no additional activity is required on the behalf of the Stormwater Program to update the Watershed Geodatabase. Changes that occur on the source are immediately reflected on the Watershed Geodatabase. Likely candidates for this method include the aerial photography, streets base map, and parcel layers as they are maintained continuously by the County, which can provide a reliable service to which to connect.
2) When a data service is not available or not possible, the Stormwater Program will seek to accomplish a database synchronization process using ArcSDE. This process synchronizes the changes or "deltas" in the database, including geographic updates without the need for a wholesale replacement of the dataset. This will make the updates quick and simple and provide the most efficient method for updating the Watershed Geodatabase when the source is also using ArcSDE and is willing to participate in this update process.
3) The third update method consists of a standard manual update using a file geodatabase, personal geodatabase, or shapefile as available. This method will be employed for datasets not maintained at the County, and from state and federal sources for which this is the primary method for data transfer.

The Stormwater Program and consultants have diligently created updated and imported metadata for the existing data layers in the Watershed Geodatabase. Metadata is a vital part of data maintenance and critical to the end-users. A brief description of the data, key words, publication date, and person by whom the data was received or created was incorporated into the metadata. Over the course of the development of the WAP, the metadata has been updated, and it will continue to be current. The data dictionary, which includes this metadata, is provided in Appendix G, and the metadata has been included in the Watershed Geodatabase simply by clicking on any data layer in the table of contents.

4.4.3 Coordination with Regional Board Staff and Agency/Stakeholder Outreach and Coordination

Throughout the development of the Watershed Geodatabase, the Principal Permittee and stormwater program consultants have been making presentations on the progress of the Watershed Geodatabase including the functionality and the available information. These Stakeholder Meetings, Workshops, MS4 Management Meetings, Webinars, and Regional Board presentations have included Regional Board staff from the Stormwater, TMDL, and Watershed Planning / Program Services Sections as well as other resource agencies. The Watershed Geodatabase has been online and evolving and is now available at its permanent address of http://sbcounty.permitrack.com/WAP. With the public availability of the Watershed Geodatabase, these regulators continue to have the ability to

- verify attributes of the Geodatabase, including drainage feature stability / susceptibility / risk assessments; and
- satisfy its intended use of supporting regulatory processes, such as WQMP approvals, CWA Section 401 Water Quality Standards Certifications (401 Certifications), and LID BMP feasibility evaluations.

Following this submittal, the Stormwater Program will seek to prepare additional targeted presentations and training opportunities for the Regional Board staff and for other resource agencies and stakeholders to solicit input for improvements and additional data and functionality. Feedback from Regional Board and resource agencies will be compiled and implemented in conjunction with Phase 2 development as appropriate. The Stormwater program will continue to invite and encourage participation and comments from resource conservation districts, water and utility agencies, state, federal agencies, non-governmental agencies, and other interested parties in the development and use of the Watershed Geodatabase.

4.5 Hydromodification Assessment

The Hydromodification Assessment Technical Memorandum, provided in Appendix B, examines the thresholds for determining whether a creek is subject to hydromodification impacts due to future development. Hydromodification impacts are the response of drainage to changes in runoff and sediment. The impacts are difficult to quantify, because over time, significant changes in water flow and sediment load have lead to a sediment imbalance resulting in erosional changes to drainages. It was concluded that the following three criteria would exclude portions of the watershed from potential hydromodification impacts: areas downstream of controlled release points (CRPs), tributary areas downstream of large rivers with a flowrate of more than 25,000 cfs, and areas downstream of elevation 514 in Prado Basin. The excluded portions are mostly concentrated at the downstream ends of sub-regional channels and areas draining directly to the Santa Ana River. The majority of the upper watersheds that are tributary to non-EHM channels have been identified as areas requiring projects to consider hydromodification controls.

4.6 Channel Assessment and Classification

As part of the WAP, a Hydrologic Conditions of Concern (HCOC) Map/Watershed Geodatabase is required that incorporates the delineation of existing unarmored or soft-armored drainages in the permitted area that are vulnerable to geomorphology changes due to hydromodification and those channels and streams that are engineered, hardened, and maintained. The Channel Assessment and Classification Technical Memorandum, provided in Appendix C, discusses how the existing drainages were classified using the San Bernardino County Flood Control District System Index and the Rapid Stream Risk Classification method created by WEST Consulting, Inc. The existing watersheds were delineated and the drainages were broken into six classifications based on the two methodologies:

- Engineered, Hardened, and Maintained (EHM)
- Non-EHM, Low Risk;

- Non-EHM, Medium Risk;
- Non-EHM, High Risk;
- Non-EHM, Default High Risk;
- Santa Ana River.

4.7 Causes of Stream Degradation

As part of the WAP, the permittees are required to identify potential causes of identified stream degradation including a consideration of sediment yield and balance on a watershed or subwatershed basis. The Causes of Degradation Technical Memorandum, provided in Appendix D, investigates three major watersheds within the County of San Bernardino: San Antonio Watershed, Cucamonga Watershed and Live Oak Watershed and determines how degradation has occurred as the watersheds have matured. Aerial photographs, site visits and a GIS-based desktop study developed by SCCWRP were used to analyze the watersheds. The memorandum concluded that there were three main causes for the degradation: the watersheds were dominated by Cenozoic Sedimentary Rocks – Alluvium, which is vulnerable to erosion; the watersheds have been developed causing a sediment imbalance; and basins have been constructed preventing the transport of sediment from the upstream reaches of the watersheds.

4.8 System-wide Evaluation Retrofit Opportunities

The destruction and degradation to the environment and natural resources caused by land development activities over the past few generations through recent years is becoming increasingly apparent. Modern day community planning and land development techniques cause immediate detrimental affects to streams, water quality, and native vegetation and habitat. RBF performed this system-wide evaluation on behalf of the County of San Bernardino and its Permittees to preserve or restore the structure and function of natural streams, and protect surface and groundwater quality to the MEP. To begin addressing the impacts of development on vulnerable streams and the surrounding environment, as part of the development of the WAP, a system-wide evaluation of the watershed was implemented to identify BMP retrofit opportunities for joint or coordinated development planning. There were 144 potential BMP retrofit opportunities identified within the permitted area. This section briefly describes the methodology for the identification of these potential opportunities.

Developing an approach for the identification and prioritization of retrofitting opportunities, approaches used by other jurisdictions, as well as RBF's expertise in this area, were considered. The approaches used by other jurisdictions included the Natural Treatment System developed by the Irvine Ranch Water District and input from the Orange County Permittees.

The initial approach involved understanding and identifying which jurisdictions and stream segments will benefit and contribute the most to the WAP and TMDL requirements. Understanding which jurisdictions were located within the watershed enables a cooperative strategy to involve neighboring jurisdictions and municipalities to potentially work together to

implement an effective plan. Understanding TMDL requirements enables a focused plan to effectively meet the water quality requirements.

Within the Santa Ana River watershed, all publicly owned parcels were open to identification as potential retrofit sites, including stormwater conveyance systems, parks, open space, or other recreational areas. Parcels located adjacent to major storm drains downstream of large developed drainage areas were preferred because of the water quality treatment benefit and relatively low capital cost due to minimal storm drain improvements. Depending on the size of the drainage area, each site was identified as a Regional or Sub-regional site. Regional sites had large tributary areas and Sub-regional sites had relatively smaller tributary areas. Land use within the drainage area, soils, slopes, existing structural and utility impacts, environmental constraints, and hydraulic feasibility were all considered in determining which BMPs might be appropriate for each of the sites.

In order to develop recommendations for specific BMP types, each individual site would need to be analyzed and prioritized. A few additional concerns that will impact this prioritization are tributary area treated, dual-use aesthetics, and vector concerns. Additional analysis, such as water quality/watershed modeling, field verification, planning and constructability considerations, conceptual designs, permitting, cost analysis, operation and maintenance requirements, adverse affects on primary flood control/drainage function, and funding. Potential BMP types for this evaluation are constructed wetlands/wet basins, extended detention basins, bioretention, media filters, and infiltration basins.

In order to evaluate each site and its surroundings, aerial imagery from Google Earth, County of San Bernardino aerial photography (2009), U.S. Department of Agriculture Farm Service Agency aerial photography (2009), Google Street View Imagery (2010), topography from National Geographic Society, and information provided by municipalities and stakeholders were used.

The end product of the Identification of Retrofitting Opportunities work effort will not be a defined implementation plan or water quality capital improvement program. Instead, the outcome of this study will be the presentation and explanation of a logical, iterative process used to develop a list of sites throughout the County where there appear to be opportunities to further pursue regional projects for water quality improvement.

4.9 System-wide Evaluation of Restoration Opportunities

Along with potential retrofit sites, identifying opportunities to restore existing engineered channels to their most natural condition possible is also a goal. Engineered channels can be lined with concrete and or rock or be unlined. Typically, engineered channels convey runoff to downstream conveyance systems as fast as possible. This provides no water quality or environmental benefit. In some cases, it actually increases pollutant levels when erosion takes place. Past construction of engineered channels was implemented without considering the negative affects caused by increased velocity. Increased velocities increase the potential for erosion, which immediately degrades water quality and lessens the conveyance capacity of the channel, ultimately causing potential damage to the downstream storm drains and adjacent communities.

The WAP requires conducting a system wide evaluation to identify opportunities to address stream segments vulnerable to hydromodification impacts. Identifying restoration opportunities for hardened and engineered streams and channels, along with contributing jurisdictions were a priority in this evaluation.

Channel restoration sites were identified by examining aerial photographs and visual inspections of major channel segments. Only channel segments that the Flood Control District owned or had easements for were included in this assessment, as implementing retrofit projects in privately-owned channels would be more time consuming and costly.

The first step, using Google Earth aerial photographs, enabled us to locate existing flood control channels that fit certain criteria. Channels which were hardened or engineered, vulnerable to hydromodification, had sufficient room to widen, not subject to significant capital costs, and which restoration of the channel would not adversely affect the primary conveyance of the facility.

The second step involved field visits in order to conduct a visual inspection. Visual inspections were necessary to understand the channels geometric configuration and overall condition of the channel and its banks. Cross-sections were measured and sketched, pictures were taken, and field forms were completed to document all of this along with any additional important information that was not available on the aerial maps. Field visits were also very helpful in discovering sites that were not visible in the aerial maps. Field visits also made it feasible to confirm which sites were appropriate restoration candidates.

Removal of channel lining reduces the conveyance capacity of the channel, which is generally impractical. Therefore, the focus of the assessment was primarily on unlined (earthen) channel segments**.** Unlined channels were assessed on their potential to reduce channel erosion and/or create vegetated wetland areas. Reducing channel erosion reduces the amount of sediment discharged to receiving waters. Reduction of erosion and the amount of sediment within the runoff reduces the potential to negatively impact nearby infrastructure (e.g., roads, buildings, etc.). Reduced erosion also alleviates the harmful impacts it has on native vegetation and habitat. Vegetated wetland areas increase habitat value and receiving water quality by reducing pollutants normally transported within sediment-laden runoff. Reduced sediment and fines allows sunlight to penetrate through the water, creating a better living environment for native habitat. Increased surface water quality increases the groundwater quality as well. Since introducing a vegetated lining on an unlined channel may reduce flood conveyance capacity by loss of channel depth or increased channel roughness, the potential to create a wetland/planted area was limited to those channel segments where there appeared to be sufficient right-of-way to accommodate an increased channel width. RBF identified 20 potential restoration sites during this system-wide evaluation on behalf of the County of San Bernardino and Permittees.

4.10 WAP Phase I Tasks Relationships

All of the WAP Phase I tasks have a progression in development of the WAP and some have specific interrelationships. The WAP workshops and identification of WAP linkages and other relevant watershed efforts were critical in the development of the WAP Program Specific Objectives. These objectives provide the roadmap to moving forward with further development

and implementation of the WAP. The watershed geodatabase is a tool that can be used to help achieve the objectives of the WAP where detailed watershed information can be accessed by all of the watershed stakeholders. This access to information will be critical to achieving the objectives of the WAP.

The specific studies are the first steps in both understanding some of the watershed processes and identifying potential locations for watershed restoration and water quality improvement. The hydromodification assessment examines the thresholds for determining whether or not a creek is subject to hydromodification impacts due to future development. This is integrated into the geodatabase and helped to identify those potential restoration opportunities for channels subject to hydromodification. The channel assessment discusses how the existing drainages were classified and also helped to identify locations for restoration opportunities and the classifications have been incorporated into the geodatabase.

The causes of stream degradation will help to identify where there are issues in the watershed and what efforts can be put in place to reduce these causes. The technical memorandum for causes of stream degradation investigates three major watersheds within the County of San Bernardino: San Antonio Watershed, Cucamonga Watershed and Live Oak Watershed and determines how degradation has occurred as the watersheds have matured. This information can to understand the processes of degradation throughout the watershed so that approaches can be developed to reduce the causes through proper development planning.

The restoration opportunities evaluation looks at channels that are subject to hydromodification and where there is a potential to restore the channel through implementation of an in-stream project. The retrofit opportunities evaluation has identified potential locations where water quality impacts can be mitigated through regional BMPs. The retrofit locations can be used to mitigate specific water quality issues for a site depending on what the specific need is for that site. Both the retrofit and restoration opportunities represent potential restoration in the watershed. The results of these efforts have been integrated into the watershed geodatabase which can help with future watershed planning efforts.

The WAP Phase I Tasks should be considered a first step in development of the WAP. These tasks will be used in Phase II of the WAP and in long-term implementation of the WAP and restoration of the watershed.

5 WAP Implementation

5.1 Phase II Recommendations

5.1.1 Watershed Action Plan and Watershed Geodatabase Integration

The San Bernardino County Flood Control District has established a broad, multi-stakeholder task force to develop a regional **Watershed Action Plan** ("WAP") that will assist its cities, water agencies, and watermasters, as well as its development and environmental communities to integrate water quality and water supply policies and encourage the capture and infiltration of storm water into groundwater basins. The WAP will establish a model that can be used throughout the Santa Ana Watershed and the State of California.

The Watershed Action Plan will develop and implement the **Interactive Watershed Geodatabase**. This web-based interactive planning tool will assist applicants and agencies in planning resource efficient development that meets permit levels through the integrated use of both Low Impact Development (LID) strategies and Regional Plan. The integration of the Watershed Action Plan and the Watershed Geodatabase will be developed in coordination with groundwater managers and water masters, so that the water supply and associated environmental and public benefits are recognized and incorporated into region-wide planning efforts. The Watershed Geodatabase will be useful not only for new development, but for identifying opportunities for infill development and retrofit of existing hardscapes that will provide valuable storm water capture and related water quality, flood control, and environmental benefits.

The principles of this integration will build upon and leverage a) data and on-line platforms compiled by San Bernardino County as part of mapping efforts related to hydrologic conditions of concern (stream erosion and hydromodification), b) studies conducted by water masters such as those in the Chino Basin that highlight benefits and opportunities associated with infiltration of storm water (water quality and water resources), c) GIS-based tools and technologies developed by storm water agencies, consulting professionals, and the non-profit environmental sector, d) land use data developed by planning agencies, e) monitoring data, and f) other potential data sources.

It is the intent of the Stormwater Program to use the geodatabase as much as feasible to aid in integration of the WAP with other storm water efforts and processes within the watershed, such as the SWQSTF, MSWMP, WQMP, implementation of LID, and TMDL Implementation plans. An example of this integration will include the ability to use the information in the Watershed Geodatabase to provide significant input to aid in the development of a site specific WQMP. A user who selects a site can be presented with relevant input and supporting reference materials regarding the suitability of the site for onsite infiltration, opportunities for LID, relevant and preferred BMPs and identify downstream HCOC issues and retrofit and restoration opportunities. By using the data maintained in the Watershed Geodatabase, the user can be presented with a template of information to aid in the development of a consistent and complete WQMP making

for streamlined review and approval processes and furthering the goals of the overall watershed on a project-by-project basis.

5.1.2 Hydromodification Monitoring Plan and Hydromodification Management Plan

The development of the Hydromodification Management Plan and the Hydromodification Monitoring Plan should be based on the significant amount of information that has already been developed in this arena in California. The San Diego Permittees expended a significant amount of resources in development of their HMP. Orange County is currently developing its HMP, and SCCWRP has developed numerous technical papers related to hydromodification. The geographic differences in San Diego and Orange County are insignificant; so much of the information that has been developed with these programs can be used in the development of the San Bernardino HMP. The HMP should use the information that has already been developed so that the limited resources of the program can be best allocated and used for other improvements to water quality.

The Hydromodification Monitoring Plan should also be as simple as possible with answering the key questions about hydromodification. The logical step for monitoring would be annual geomorphic assessment of key "indicator" streams, looking for changes associated with hydromodification over time. A sample number of streams should be monitored that represent various sized watersheds in representative locations. Both the HMP and the Hydromodification Monitoring Plan should use the information that has been developed in the HCOC mapping effort, which provides a significant amount of baseline line information. Ultimately, the HMP and the Hydromodification Monitoring Plan should be based on the existing science and efforts that have already been developed in Southern California.

5.1.3 Watershed Geodatabase Training and Outreach Recommendations

The development of the Watershed Geodatabase has proceeded with the goal of providing a useful and comprehensive reference tool that is easy to use. Design guidelines were employed which should allow a novice user to access most of the site's functionality without any training. Further, since the Watershed Geodatabase is browser-based, no additional software need be purchased and installed in order to use the application. (The Microsoft Silverlight browser plug-in is required. Silverlight is free and usually takes less than a minute to download and install). In addition, a comprehensive help document and quick start guide are included in the site. However, in order to access some of the more advanced functions and to aid the user in understanding the content of the reference data and supporting studies, some additional training and outreach is being contemplated.

Following submittal of the Phase 1 WAP and announcement to the interested stakeholders for online access to the submitted WAP Watershed Geodatabase, the Stormwater Program proposes a series of Webinars as the most effective means of presenting the functionality of the Watershed Geodatabase and its supporting reference material, as well as to provide an opportunity to ask questions. The webinars will be conducted online, and each should last approximately 30 to 45 minutes to provide all the information needed for users to make effective use of the online

resource. The number and schedule for these Webinars is still to be determined. Additional training opportunities in person and online may be provided as necessary.

5.1.4 Regional Treatment BMPs Regulatory Approval

Regional treatment BMPs are an important tool in the water quality improvement toolbox. They will play a significant role in regional retrofit programs, implementation of TMDLs, hydromodification management, and the LID offset program. The factors that should be considered in approval of regional BMPs should include location, type, effectiveness for the target pollutants of concern, tributary drainage area, site constraints, engineering design details, operation and maintenance requirements, monitoring protocol, adjacent land uses, and funding sources. One of the issues associated with regional BMPs is that discharge is, in some cases, required to meet all Basin Plan water quality standards. Some BMPs are designed for treatment of a defined set of pollutants and so may not be able to treat all of the pollutants that are associated with the influent water. While regional BMPs should not contribute pollutants to the discharge in exceedance of the influent, they should not be required to treat all pollutants to Basin Plan standards. The approval process for Regional BMPs should be coordinated with Orange and Riverside Counties to ensure consistency throughout the Santa Ana River Watershed.

5.1.5 Retrofit Recommendations

The technical memorandum for the System-wide Evaluation to Identify Retrofit Opportunities is provided in Appendix E. The purpose of the system-wide evaluation was to identify opportunities to retrofit the existing conveyance systems, parks, and other recreational areas with water quality protection measures. The desktop investigation identified 144 sites potential BMP retrofit sites. The next step in the retrofit process is to evaluate the sites to identify their specific purpose. The purpose of each site will need to be evaluated in the context of the water quality improvement needs of the sub-watershed and watershed. These needs may include TMDL implementation, hydromodification management, offsite mitigation for LID, or general water quality improvement. Evaluation of these needs should come in the form of specific individual retrofit studies focused on 1) TMDLs; 2) Hydromodification Management; and 3) a LID Offset Program. Detailed recommendations of these studies are provided in the retrofit technical memorandum.

5.2 Long-Term WAP Program Implementation

The WAP is designed to be a living document so that as more information is developed in the watershed, more barriers to watershed protection principles are identified, and innovative ideas to achieving the WAP objectives are identified, they can be incorporated into the document. Achieving the objectives of the WAP will take time and effective coordination among the County, the Copermittees, and watershed stakeholders to effectively implement the WAP program. The WAP objectives have been defined, and as the WAP is further developed, implementation will occur through the identification of action steps to achieve the objectives identified and objectives yet to be developed. Further development of the WAP and implementation of the WAP must also include coordination with Orange and Riverside Counties.

This Tri-County coordination will allow for successful implementation of watershed protection principles in a cost-effective manner throughout the Santa Ana River Watershed.

5.2.1 LIP Coordination

The framework that provides the foundation for implementation of the MS4 Permit requirements is described in the Municipal Stormwater Management Plan (MSWMP). The Local Implementation Plan (LIP), a requirement of the MS4 Permit (*Section*s *III.A.2.a; III.B1*), describes how the County and Co-Permittees implements the requirements of the MS4 Permit within its own jurisdiction. Accordingly, the MSWMP and the LIP are the principal documents that comprehensively translate the MS4 Permit requirements into actions that manage water quality in the local MS4. Following completion of the WAP, the model LIP will be revised as needed to incorporate the mechanisms, procedures, and/or programs that will be implemented by the County and the Co-permittees to ensure stormwater management procedures are coordinated through implementation of the WAP.

Local Implementation planning provides the critical role of translating watershed protection principles into measurable actions that may be adopted by all stakeholder agencies. The focus towards an updated Local Implementation Plan through the efforts of the Watershed Action Plan Task Force Members will ensure consistency in approach and a set of approaches that can be adopted at a local level with the Permittee and co-Permittees alike. The results of the County efforts, in conjunction with the watershed stakeholders and the Regional Board, will be adoptable to local requirements based on the application of LID principles while maintaining consistency throughout the county in a manner that will address the Permit requirements.

5.2.2 Regional BMP Project Opportunities

Once the specific retrofit studies identified as recommendations for Phase II of the WAP are completed and the needs of the sub-watersheds and watershed are identified, the regional BMP project opportunities identified through the retrofit system-wide evaluation can be prioritized for implementation. Once these retrofit studies are complete, the BMPs that best meet the prioritized need can be selected for the identified BMP retrofit sites. The next step would be to prioritize the identified sites for potential implementation. Suitability, constructability, and performance of each individual site and the needs assessment can be evaluated during the prioritization process. A non-exhaustive list of factors that may be included in the prioritization process is as follows:

- Ability to accommodate a BMP with best pollutant removal capability for the pollutants of concern
- Ability to accommodate a BMP for the specific needs of the site per the needs assessment
- Tributary drainage area treated
- Pollutant removal
- Planning and constructability

- Reduction of environmental impact
- BMP maintenance considerations
- Lifecycle Cost

Before final selection and implementation of these identified potential retrofit locations can occur, benefits to the watershed must be assessed (described in the next section). After this assessment of watershed benefits and prioritization is performed, a project-specific detailed design and engineering analysis must be accomplished to demonstrate that the original uses (such as flood control and drainage) of the facility are not compromised. Cost estimating, environmental, and regulatory permit work must also be conducted, and property or lease restrictions must be investigated to ensure that there are no requirements that would preclude implementation of a potential BMP retrofit project (e.g., a park parcel with narrowly-defined recreational use restrictions).

5.2.3 Watershed Benefit Estimation

Understanding the watershed benefits of any implementation strategy is critical before decisions are made about implementation of regional BMPs. Pollutant removal and hydromodification reduction impacts may be evaluated through the development of water quality/watershed modeling to provide a better understanding of the benefits that different BMP placement strategies will have upon receiving waters. The watershed priorities can be factored in, and multiple implementation scenarios can be developed, where watershed benefits can be assessed. The locations that will provide the greatest water quality and watershed benefits can then be identified and prioritized for construction. The costs of implementation of regional BMPs must also be assessed, and funding must be secured.

5.2.4 Funding

Funding for all aspects of WAP implementation needs to be developed so that the objectives of the WAP can be realized. A detailed funding structure should be developed so that WAP initiatives can move forward and regional BMPs can be built. As the WAP is further developed and WAP implementation commences, each element of the WAP should have funding analysis performed. This funding analysis will help to prioritize WAP initiatives and implementation of regional BMPs. A detailed funding structure will better position the WAP Task Force to apply for and receive grants. Having a detailed funding structure is essential to successful implementation of the WAP.

5.2.5 WAP Administration and Tracking

Administration and oversight of the WAP should continue through the WAP Task Force Committee. The future role of the WAP Task Force Committee should also include oversight of program assessment of the WAP. WAP program assessment is a critical component to ensure that the objectives of the WAP are being met. The WAP Task Force Committee should develop guidance for the frequency and details of the WAP program assessment.

The WAP is designed to be a living document, and updates to the documents should and will occur at identified intervals. New information in the watershed, results of the WAP program assessment, and recommendations from the program assessment, as well as new WAP initiatives, should be incorporated into the WAP. This will ensure that the WAP continues to be the guiding document to achieving effective integrated watershed management in the Santa Ana River Watershed.

Appendices

Appendix A: Stakeholder Workshop Notes

Appendix B: Hydromodification Assessment Technical Memo

Appendix C: Channel Assessment and Classification Technical Memorandum

Appendix D: Causes of Degradation Technical Memorandum

Appendix E: System-wide Evaluation to Identify Retrofit Opportunities Technical Memorandum

Appendix F: System-wide Evaluation to Identify Restoration Opportunities Technical Memorandum

Appendix G: Watershed Geodatabase Data Dictionary