LOS PEÑASQUITOS LAGOON TMDL – WATERSHED PHASE I SEDIMENT SOURCE IDENTIFICATION STUDY

Final Report
June 2, 2009

Prepared For:
Storm Water Pollution Prevention Program
Storm Water Department
City of San Diego

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Prepared By:

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LIST OF ACRONYMS

Caltrans	California Department of Transportation
cfs	cubic feet per second
cy	cubic yard
ft	foot, feet
HA	hydrologic area
LPL	Los Peñasquitos Lagoon
LPLF	Los Peñasquitos Lagoon Foundation
MES	mass emission station
Order	San Diego Regional Water Quality Control Board Investigation Order R9-2006-0076
Regional Board	Regional Water Quality Control Board
State Water Board	State Water Resource Control Board
TMDL	total maximum daily load
TSS	total suspended solids
TWAS	Temporary Watershed Assessment Site
WESTON	Weston Solutions, Inc.

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

The purpose of this report is to provide a Phase I Sediment Source Identification Study (Phase I Source Study) to facilitate compliance with the Total Maximum Daily Load (TMDL) being developed for the Los Peñasquitos Lagoon (LPL), a Clean Water Act (CWA) 303(d) impaired water body listed for sedimentation/siltation. This Phase I Source Study includes a visual survey of likely sources of sediment loading from the Carroll Canyon subwatershed, Los Peñasquitos subwatershed, and within peripheral drainages located along the lagoon boundaries and serves as a Tier II watershed activity identified in the City's Strategic Plan for Watershed Activity Implementation (Strategic Plan) (WESTON, 2007b). Source studies are needed to identify Tier I pollution prevention and source control Best Management Practices (BMPs), develop conceptual designs for Tier II Low Impact Development (LID) BMPs and Tier III Treatment BMPs.

This Phase I Source Study builds upon the findings of the 2007-2008 TMDL Monitoring for Sedimentation/Siltation in the Los Peñasquitos Lagoon Report (TMDL Monitoring Report) conducted on behalf of the City of San Diego by Weston Solutions, Inc., in accordance with the San Diego Regional Water Quality Control Board's Investigation Order R9-2006-0076 (Order). The TMDL Monitoring Report identified Carroll Canyon, one of the three main tributaries to LPL, as the primary contributor of sediment to the lagoon because of its steep drainage area, incised canyons, higher proportion of impervious surfaces due to industrial land use, concrete-lined channel, and limited vegetation. The TMDL Monitoring Report found the following:

- Carroll Canyon Creek demonstrated a much shorter response time to rain events as well as higher peak flows compared to the other two main lagoon tributaries.
- Carroll Canyon Creek had the highest mean and maximum concentration of Total Suspended Solids (TSS) when compared to the other lagoon tributaries.
- Sedimentation within the lagoon mouth was a result of near-shore marine processes rather than deposition of sediment transported to the lagoon from the watershed (WESTON, 2009a).

The following objectives were developed for this Phase I Source Study:

- Identify sources of sediment in Carroll Canyon.
- Identify factors influencing erosion and sediment transport.
- Coordinate with inspection and dry weather programs.
- Identify watershed activities to meet future load reductions.

<u>Relevance to Current City Efforts</u>:
This Phase I Source Study complements other City of San Diego plans, programs, and cost reduction efforts that include the following:

- Strategic Plan and Sustainable Canyons.
- Standard Urban Storm Water Mitigation Plan (SUSMP).
- Watershed Urban Runoff Management Program (WURMP).
- Jurisdictional Urban Runoff Management Program (JURMP).
- Compliance with Total Maximum Daily Load (TMDL) requirements.
- Potential to reduce costs associated with deferred maintenance.

Results and Key Findings

- Sediment loading from the Carroll Canyon and peripheral drainages is representative of a natural system modified by hydromodification that accelerates the process.
- Within the Carroll Canyon subwatershed, large areas of impervious surfaces associated with industrial land use above canyon walls and along Carroll Canyon Creek direct large volumes of storm water runoff into the MS4.
- MS4 outfalls within Carroll Canyon release storm water into steep incised canyons that direct focused storm water flows into narrow, undeveloped natural drainages, resulting in the scouring of canyon walls and stream banks, as well as increased sediment transport because flows cannot dissipate spatially as occurs within the lower Los Peñasquitos subwatershed.
- Cement channelization of the lower reach of Carroll Canyon Creek results in quicker response times to storm water runoff and significantly higher peak flows when compared to the other two main tributaries (Carmel and Los Peñasquitos Creeks) to the lagoon.
- Evidence of multiple pollutants near and below City MS4 outfalls.
- Sedimentation in City-owned structures results in increased maintenance costs and increased vulnerability of private property and City infrastructure to flooding.
- Coordination between City departments and divisions, as well as with other stakeholder groups (e.g., Caltrans, State Parks) will likely be needed to provide cost-effective maintenance of flow and sediment abatement structures.

Key Recommendations

This Phase I Source Study identifies Tier I, Tier II, and Tier III BMPs to reduce sediment loads in the short-, mid-, and long-term. Key recommendations to be pursued in the short-term include:

- Tier I – Coordinate the consolidation and tracking of data, activities, load reductions, and effectiveness of storm water program efforts.
- Tier I – Continued coordination between source identification studies and inspection activities under the WURMP and JURMP programs in addition to National Pollutant Discharge Elimination System (NPDES) and TMDL water quality monitoring activities.
- Tier II – Develop a sediment loading model and storm flow analysis for Carroll Canyon to facilitate the design and implementation of cost-effective BMPs to reduce hydromodification impacts resulting in sediment loading.
- Tier II – Explore the feasibility of developing a Sediment Control and Peak Flow Management Program to facilitate intra-City coordination as well as coordination between other key stakeholders within the Los Peñasquitos Watershed.

Benefits to the City

This Phase I Source Study will provide the following benefits to the City:

- Supports NPDES permit requirements and future TMDLs requirements for the lagoon and Los Peñasquitos Watershed.
- Identifies sediment contributions by jurisdiction to facilitate sediment load reductions to LPL and potential cost sharing through effective stakeholder coordination.
- Ability to influence third-party TMDL development.
- Improves grant opportunities through source identification and BMP development.
- Identifies operation and maintenance needs and the potential for addressing deferred maintenance costs through the implementation of storm water BMPs.

Summary Photos

Figure ES-1. Eroded Gully in Los Peñasquitos Canyon

Figure ES-2. Eroded Brow Ditch in Carroll Canyon

Figure ES-3. Sediment Deposition in Carroll Canyon Creek Cement Channel

1.0 INTRODUCTION

1.1 Background

The Los Peñasquitos Watershed is located within west–central San Diego County and includes portions of the City of San Diego, the City of Poway, the City of Del Mar, and unincorporated areas of San Diego County (Figure 1-1). The watershed extends from the foothills east of the City of Poway to the coastal plain where the watershed drains into Los Peñasquitos Lagoon (LPL) before flowing into the Pacific Ocean through a narrow mouth at Torrey Pines State Beach. The entire watershed is approximately 60,419 acres of which 59,212 is composed of the drainage areas of Los Peñasquitos Creek, Carmel Creek (north of Los Peñasquitos Creek), Carroll Canyon Creek (south of Los Peñasquitos Creek), and the LPL, a 320-acre coastal lagoon that is part of the Torrey Pines State Reserve.

Both the LPL and its watershed are part of the Los Peñasquitos Watershed Hydrologic Unit (HU) 906. The San Diego Basin Plan divides HU 906 into two hydrologic areas (HAs): Miramar Reservoir (HA 906.10) and Poway (HA 906.20). The Miramar Reservoir HA comprises the western portion of the HU and contains the drainage areas of Carmel Creek and Carroll Creek as well as the lower portion of Los Peñasquitos Creek. The Poway HA, located to the east, is covered entirely by the upper Los Peñasquitos Creek Watershed (Figure 1-1). The total acreage comprising each of these HAs is listed in Table 1-1. The drainage areas for each major creek are shown in Figure 1-2.

Table 1-1. Creek Drainage Area Acreages

Drainage Area	HA	Acres
Carmel Creek	906.10	11,180
Los Peñasquitos	906.10 and 906.20	37,028
Carroll Canyon Creek	906.10	11,004
	Total Acres	**59,212**

The City of Poway, the City of Del Mar, the City of San Diego (City), the County of San Diego, and the California Department of Transportation have been identified by the San Diego Regional Water Quality Control Board (Regional Board) as dischargers (Dischargers) under the total maximum daily load (TMDL) for sediments into LPL. The Regional Board is developing the sediment/siltation TMDL based on the CWA 303(d) listing of the lagoon for impairments due to sediment/siltation. The purpose of the TMDL is to meet the water quality objectives sediment/siltation for the lagoon and to restore its beneficial uses.

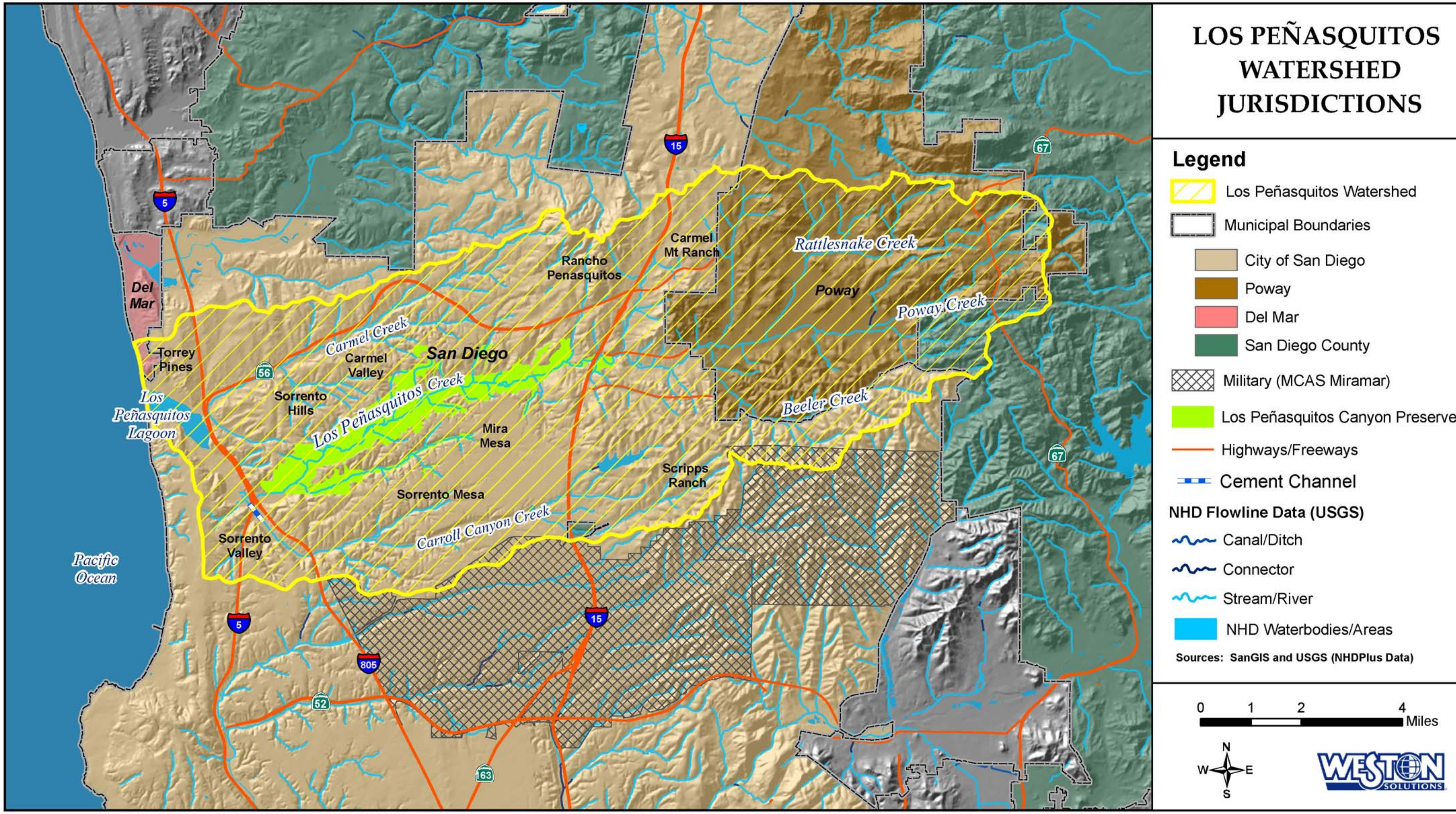

Figure 1-1. Los Peñasquitos Watershed Jurisdictions

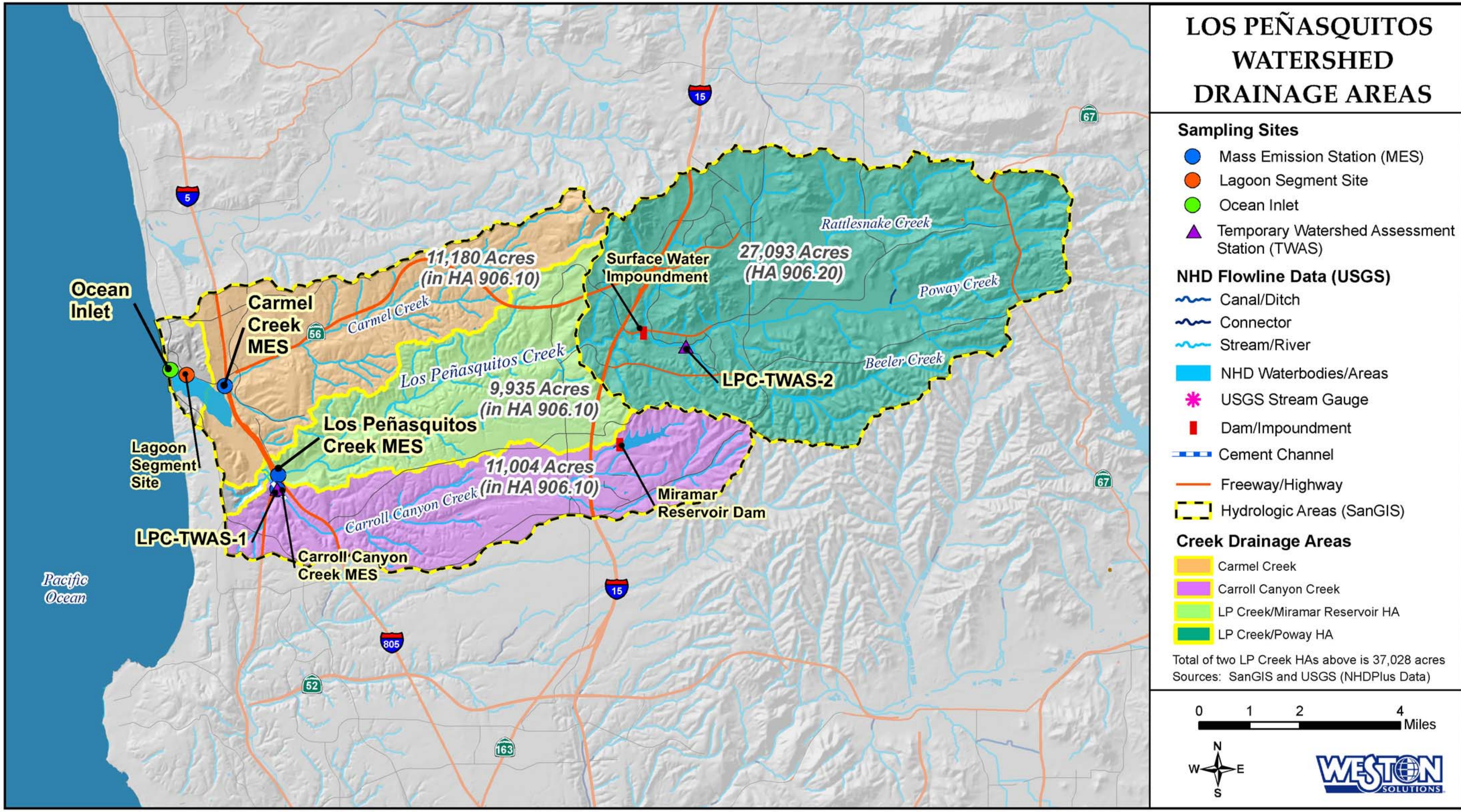

Figure 1-2. Los Peñasquitos Watershed Drainage Areas

As part of the TMDL development, the San Diego Regional Water Quality Control Board (Regional Board) required the identified Dischargers to conduct monitoring of the lagoon under Investigation Order No. R9-2006-076 (Investigation Order). The Monitoring Program focused on water quality and sediment characteristics in the lagoon and from the three tributaries into the lagoon. The data obtained from the Investigation Order are to be used to further develop the TMDL model that will assign load allocations to each Discharger. The Regional Board is currently assessing the TMDL development schedule and is in discussion with Dischargers regarding steps forward.

Based on the results of the Investigation Order, storm flows from the Carroll Canyon subwatershed appear to represent the majority of sediment loading to the lagoon. This conclusion is based on measured total suspended solids (TSS) concentrations and storm flows monitored during the 2007–2008 Wet Weather Season. The results of the Investigation Order are presented on Figure 1-3 and Figure 1-4. As presented on Figure 1-3, the mean concentration of TSS for all the three storms monitored were higher at the Carroll Canyon monitoring site compared to the Los Peñasquitos Creek and Carmel Creek sites. Figure 1-4 represents the estimated portion of the sediment load from wet weather flows from each of the three tributaries to the lagoon. The results identify Carroll Canyon as the largest portion of the overall sediment load. The results and findings of the Investigation Order are presented in the TMDL Monitoring for Sedimentation/Siltation in Los Peñasquitos Lagoon Report (TMDL Monitoring Report) (WESTON, 2009a).

Based on these findings, the City has determined that additional investigations are needed to identify the potential sources of sediment loading from Carroll Canyon. In addition, the location of the sampling points for the Los Peñasquitos Creek and Carmel Creek drainage areas require further assessment to better evaluate the sediment load data. As discussed in the TMDL Monitoring Report (WESTON, 2009a), the location of the monitoring sites above and below the existing sediment management basins and restoration projects will likely provide a more complete picture of sediment loading from these tributaries to the lagoon. The sampling location for Carroll Canyon is above the existing sediment detention area that is located upstream of the lagoon.

The additional investigations planned by the City include a two-phase Source Study in the Carroll Canyon subwatershed. Phase I consists of a visual survey for evidence of sediment loading within the subwatershed, including inspections of larger storm sewer outfalls into the canyons. Phase II of the source investigation is a water quality sampling program and modeling effort to identify significant sources of sediment and loading potential to the creek and lagoon. The modeling component of the Phase II will assess the effectiveness of various solutions to address the identified sources.

WESTON has been contracted by the City to conduct the first phase of this Source Study, termed a Phase I Source Investigation Study (Phase I Investigation) that focuses on sediment sources in the Carroll Canyon subwatershed. The Phase I Investigation will build upon the results of the Investigation Order and will focus on sources of sediment and siltation, as well as other potential threats to water quality problems in accordance with the Integrated Watershed Approach presented in the Strategic Plan for Watershed Activity Implementation (Strategic Plan) (WESTON, 2007b).

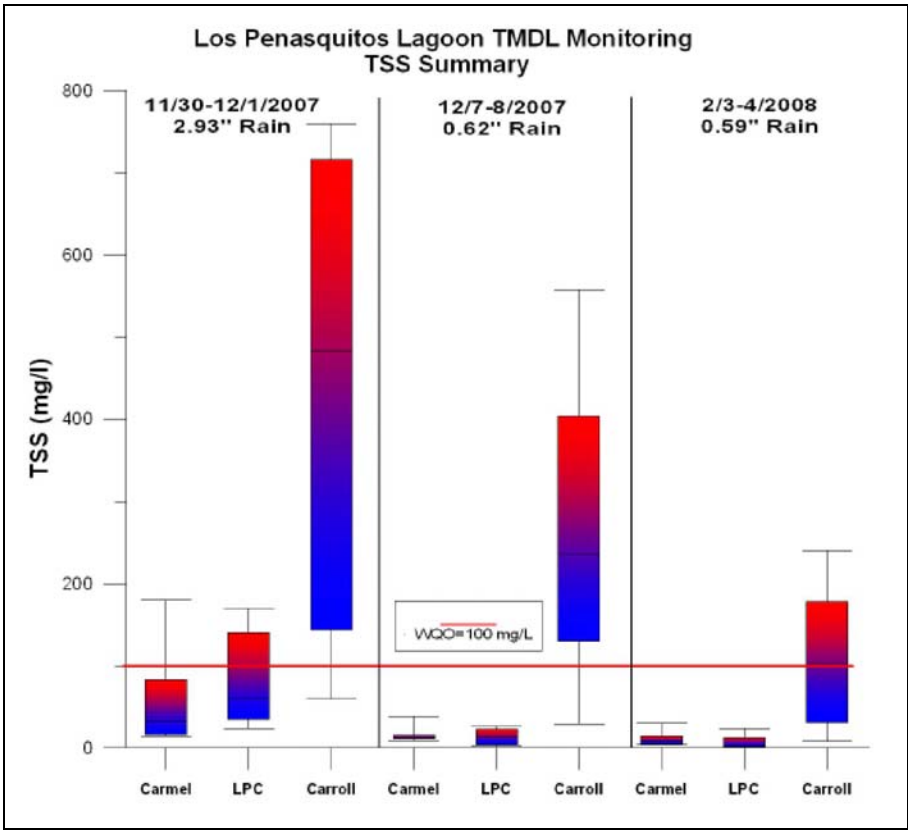

Figure 1-3. Box and Whisker Plots of Creek TSS Concentrations in Storm Flows from across Three Monitored Storm Events

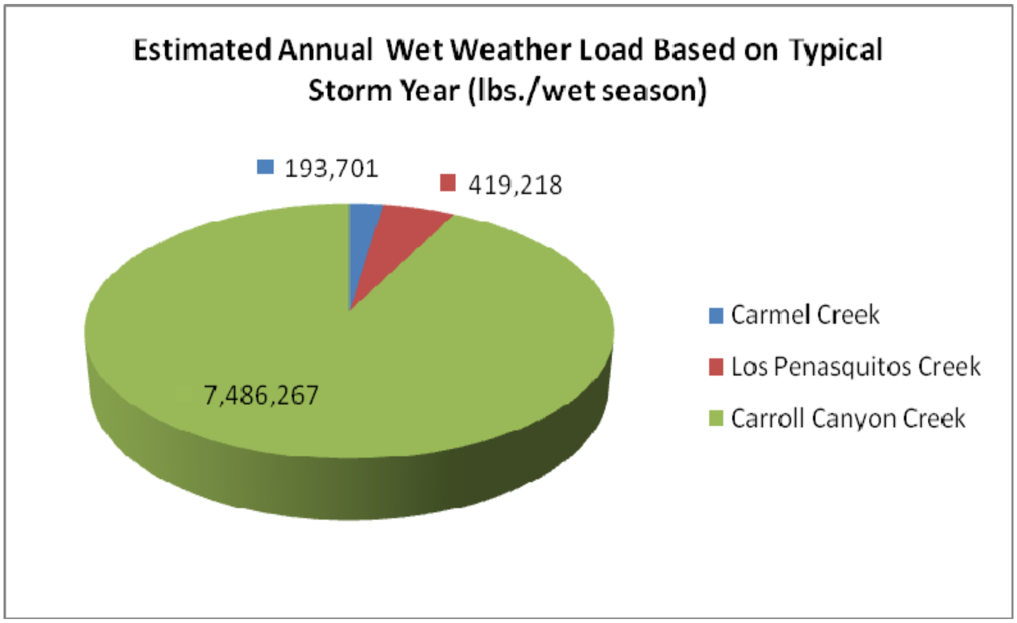

Figure 1-4. Estimated TSS Wet Weather Annual Load to Los Peñasquitos Lagoon from Watershed Inputs

Potential sources of sediment and siltation in Carroll Canyon may include hydromodification of natural drainages and channels located between the Municipal Separate Storm Sewer System (MS4) outfalls and Carroll Canyon Creek. Hydromodification of natural drainages and channels from increased and sustained peak flows due to urbanization is more likely in the Carroll Canyon subwatershed due to the greater percentage of impervious surfaces associated with industrial and commercial development in this subwatershed compared to the other subwatersheds, as shown on Figure 1-5 and Figure 1-6. In addition, the impervious areas in the lower reaches of the Carroll Canyon Creek drainage area are located relatively closer to the receiving water (i.e., Carroll Canyon Creek) than in the other subwatersheds. The proximity of impervious surfaces to Carroll Canyon Creek likely results in higher peak flows entering the creek, lowering the time of concentration of storm flows, and less time for sediments to settle out prior to entering the receiving waters. Furthermore, the channelization of Carroll Canyon Creek (Figure 1-7) reduces the time of concentration for storm flows within the creek that may be otherwise slowed down by natural vegetation and a wider flood plain present in the Los Peñasquitos subwatershed. These likely sources will be investigated as part of the Phase I Investigation and targeted for Phase II sampling where evidence of sediment loading is observed.

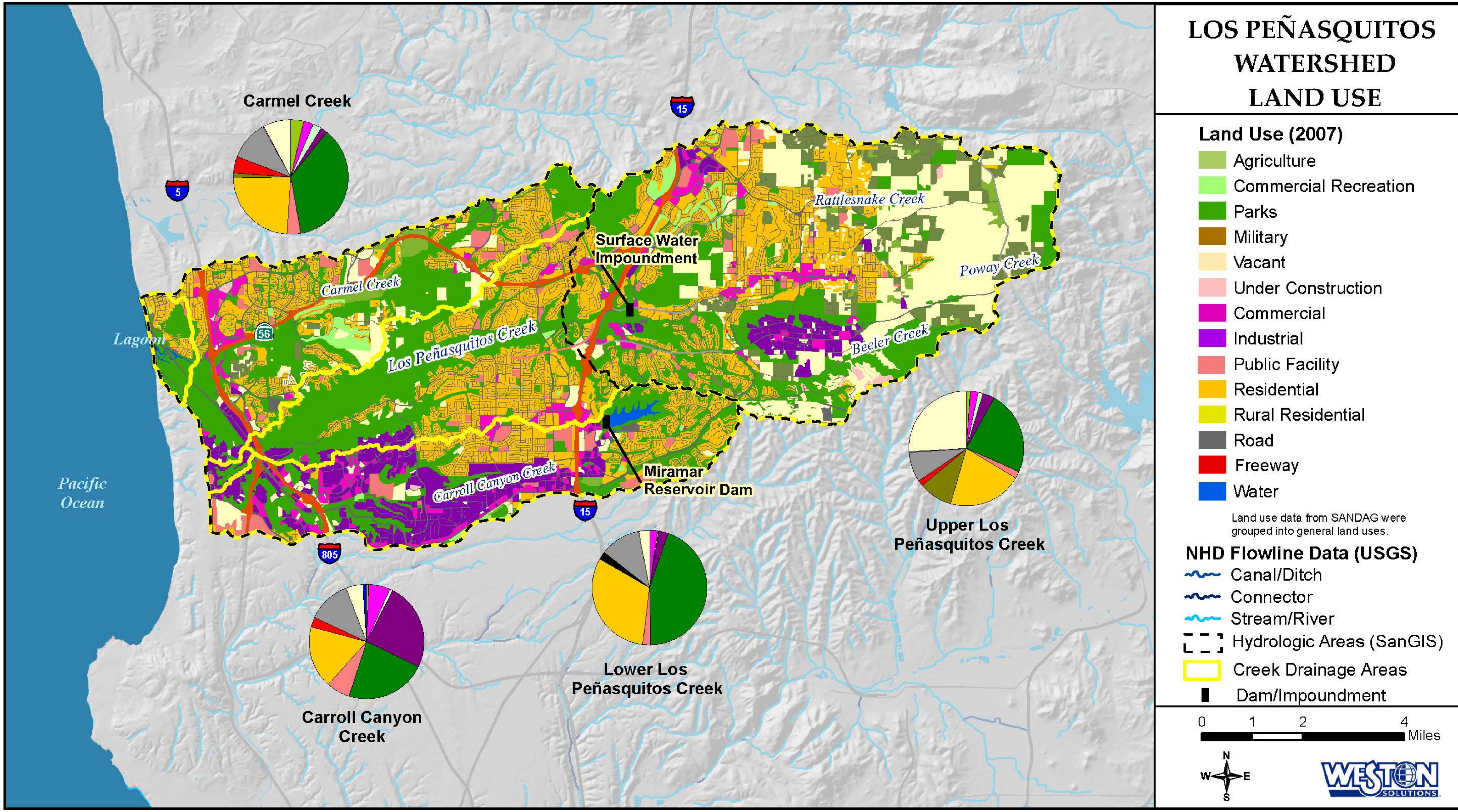

Figure 1-5. Los Peñasquitos Watershed Land Use

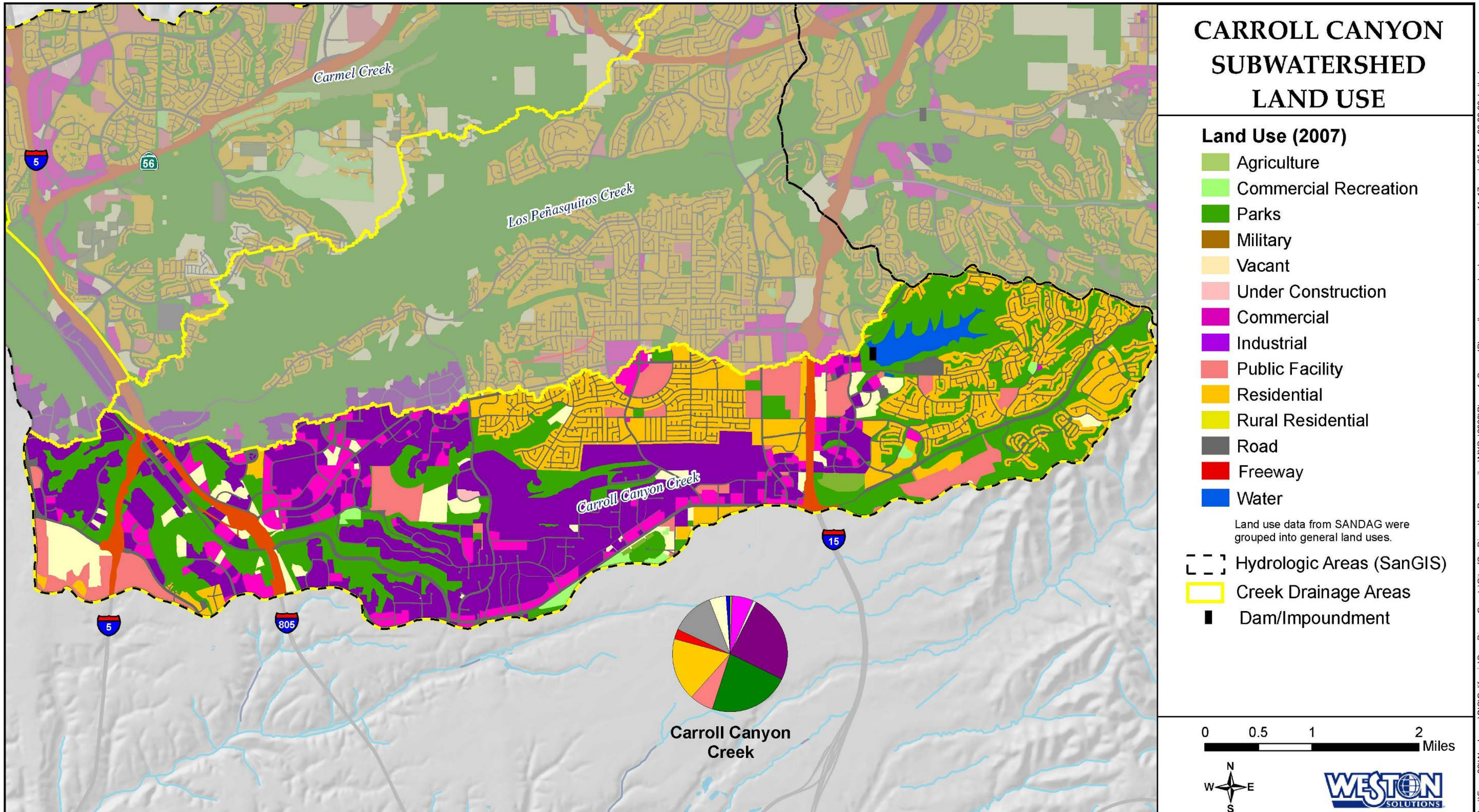

Figure 1-6. Carroll Canyon Subwatershed Land Use

Figure 1-7. Concrete Channel at Carroll Canyon Creek

In addition to the likely source of sediment from hydromodification of natural drainage areas and channels, there are potential non-point sources of sediment loading discharging to the MS4 within the subwatershed. The Strategic Plan identified high-priority sources of threats to water quality for Los Peñasquitos Watershed. Of these high-priority sources, Table 1-2 lists those sources rated as high-level threats for sediment loading in the Los Peñasquitos Watershed per the Baseline Long-Term Effectiveness Assessment (WESTON, 2007b). As part of this Phase I investigation, a number of these sources will be investigated for evidence of sediment loading. Additionally, Phase I investigations will examine aggregate mining and concrete/asphalt production facilities, if accessible to reconnaissance teams. Observations will be recorded and the sources ranked for potential sediment loading. Sources that are ranked highest will be targeted for Phase II sampling.

Table 1-2. Priority Sources of Sediment in Los Peñasquitos Watershed

Source	Priority Level
Residential areas and activities – landscaping	High
Commercial landscaping	High
Golf courses, parks, and recreational facilities	High
Roads, streets, highways, and parking facilities	High
Animal-related facilities	Medium
Municipal facilities and activities	Medium
Construction sites / general contractors	Medium
Auto-related facilities	Low

The proposed Phase I investigation includes a visual survey of likely sources of sediment loading due to hydromodification of natural drainages and channels and targeted likely potential sources within the Carroll Canyon subwatershed. This Phase I source study is a Tier II watershed activity identified in the City's Strategic Plan (WESTON, 2007b). Source studies are needed to identify Tier I pollution prevention and source control best management practices (BMPs). The data obtained from this Phase I Investigation will also be used to develop conceptual designs for Tier II low impact development (LID) BMPs that may reduce storm water volume and Tier III erosion and sediment control BMPs.

The outcome of this Phase I Investigation will be a summary report of the field survey, including the findings of the field effort, conclusions regarding the identified high sediment loading sources, and recommendations for an integrated tiered BMP strategy for Carroll Canyon to reduce sediment loadings. The findings will also be used to develop the scope for the Phase II investigation that will include flow monitoring, water quality sampling and modeling sediment transport to refine the findings and BMP recommendations of the visual survey conducted for Phase I.

1.2 Project Purpose and Objectives

Project Purpose

The purpose of the Phase I Investigation is to visually identify potential sources of sediment loading from the Carroll Canyon subwatershed, which was identified as the largest contributor of sediment loading to LPL based on the results of the Investigation Order. Los Peñasquitos Canyon and peripheral drainages to LPL will also be investigated. The outcome of the Phase I Investigation is a report summarizing the findings and recommendations for integrated tiered BMP solutions, and will help define the scope of the Phase II investigation and sediment transport modeling.

Secondary goals of this project are to assess the findings of the Investigation Order with regard to location of the sampling sites and to evaluate the current management of the sediment basins in providing siltation control for the lagoon.

Project Objectives

1. Characterize the geology and topography of the watershed and how these physical properties of the watershed contribute to sediment impacts to the lagoon.

2. Identify historical and current potential sources in the watershed contributing to sediment impacts to the lagoon.

3. Characterize the current status of desilting basins and other related structures (e.g., energy dissipaters, outfall structures, and storm drains), and determine if current maintenance issues and/or specific structures contribute to sedimentation in the lagoon and surrounding habitat.

4. Recommend BMPs to address the upcoming sediment/siltation TMDL currently being developed and NPDES requirement for hydromodification.

1.3 Study Questions

The scope of the Phase I Investigation has been developed around project objectives and the key study questions developed from these objectives. The following section presents the key study questions and the anticipated findings.

1. **What is the geology and topography of the watershed, and how do these physical properties of the watershed contribute to sediment impacts to the lagoon?**

   ***Anticipated Findings* –** The geology and topography of the watershed lend themselves to a natural erosion and downstream sedimentation during storm events due to runoff from mesa tops that move highly erosive soils through natural drainages to receiving areas.

2. **a) Where are the current areas of concern with regard to potential sediment sources and structures in the watershed that contribute to sediment loadings to the lagoon?**

   ***Anticipated Findings* –** Areas of concern include:

   - Canyon outfalls releasing storm runoff into focused areas in unimproved lands, resulting in scouring of erosive sediment types and deposition into the MS4 or directly into LPL.
   - Large areas of impervious surfaces located on mesa tops focusing runoff into natural drainages and/or canyon outfalls.
   - Large areas of impervious surfaces near receiving waters (e.g., Carroll Canyon Creek) directing storm runoff through the MS4 and into the creek, resulting in increased response times and peak flows.
   - The cement channel in Carroll Canyon Creek, further increasing sediment transport capacity of this creek.

   b) Could the current management operations be improved in a cost-effective manner to provide sediment load reductions in the near-term while longer term sustainable solutions are implemented in the watersheds?

   ***Anticipated Findings* –** Management operations could be improved through stakeholder coordination to facilitate access to facilities and problem areas as well as permit acquisition.

3. **What are the recommendations for integrated tiered BMPs to reduce sediment input to LPL?**

   ***Anticipated Findings* –** The City should continue sediment maintenance activities in the lower reaches of the subwatersheds while it pursues upstream activities to reduce sediment at its sources (e.g., connect outfalls to the creek with energy dissipaters, implement LIDs to capture runoff or detain flows on site for reuse) and address elevated flow rates in Carroll Canyon Creek.

1.4 Compliance with City Programs and Plans

The Phase I Investigation complies with the following City Programs and Plans:

- Urban Runoff Management Plan (URMP).
- Standard Urban Storm Water Mitigation Plan (SUSMP).
- Strategic Plan for Watershed Activity Implementation (Strategic Plan).
  - Sustainable Canyons.
- Watershed Urban Runoff Management Program (WURMP).
- Jurisdictional Urban Runoff Management Program (JURMP)
- TMDL

Please refer to Appendix A for additional information as to how the Phase I Investigation complies with City programs and plans.

2.0 WATERSHED DESCRIPTION

2.1 Los Peñasquitos Lagoon

LPL is a 320-acre coastal lagoon and is part of the Torrey Pines State Reserve in northern San Diego County. LPL receives freshwater inputs from an approximately 60,080-acre watershed composed of three major canyons (Carroll Canyon, Los Peñasquitos Canyon, and Carmel Canyon), which constitute approximately 59,212 acres of the watershed. Both the lagoon and its watershed are part of the Los Peñasquitos Watershed Management Area. Given the status of "preserve" by State Parks, the LPL is one of the few remaining native salt marsh lagoons in California, providing a home for several endangered species (e.g., least Bell's vireo, Belding's savannah sparrow, light-footed clapper rail, and salt marsh daisy). The lagoon also serves as a stopover for the Pacific Flyway, offering migratory birds a safe place to rest and feed as well as providing refuge for coastal marine species that use the LPL to feed and hide from predators. Listed as a Critical Coastal Area, the LPL is the closest lagoon to the only two Areas of Special Biological Significance located within San Diego, the San Diego Marine Life Refuge and the San Diego–La Jolla Ecological Reserve. LPL is currently under consideration for National Estuarine Research Reserve status under the National Oceanic and Atmospheric Administration (NOAA) as well as a Wetland of International Significance under the United Nations' Ramsar Program.

2.2 Los Peñasquitos Watershed

The Los Peñasquitos Watershed is located within west–central San Diego County and includes portions of the City of San Diego, the City of Poway, the City of Del Mar, and unincorporated areas of San Diego County (Figure 1-1). The watershed extends from the foothills east of the City of Poway to the coastal plain where the watershed drains into LPL before flowing into the Pacific Ocean through a narrow mouth at Torrey Pines State Beach. Both LPL and its watershed are part of the Los Peñasquitos Watershed Hydrologic Unit (HU) 906. The San Diego Basin Plan divides HU 906 into two hydrologic areas (HAs): Miramar Reservoir (HA 906.10) and Poway (HA 906.20). The Miramar Reservoir HA comprises the western portion of the HU and contains the drainage areas of Carmel Creek and Carroll Creek as well as the lower portion of Los Peñasquitos Creek. The Poway HA, located to the east, is covered entirely by the upper Los Peñasquitos Creek Watershed (Figure 1-1). The drainage areas for each major creek are quantified in Table 1-1 and shown on Figure 1-2.

The three creek drainage areas flow to LPL with Carmel Creek emptying directly into the northeast portion of the lagoon, while Carroll Creek and Los Peñasquitos Creek merge at a confluence in Sorrento Valley, also known as Soledad Canyon, and flow into the lagoon from the south. For the purposes of this report, Sorrento Valley is considered an extension of the Carroll Canyon subwatershed.

Historical monitoring reports indicate that only Los Peñasquitos Creek, the largest of the three tributaries, had year-round flows into LPL while both Carmel Creek and Carroll Canyon Creek were ephemeral in nature, flowing only during the wet winter and spring months (Williams, 1996). In 1995, all three tributaries began to flow year round, creating a scenario where sediment transport capacity from the main tributaries increased due to reduced percolation as ground water became charged and surface soils saturated within the previously dry creek beds (Williams, 1996; Williams, 1997; Williams, et al., 1998; Williams et al., 1999; Ward et al., 2000; Greer, 2001; West and Cordery, 2002; White and Greer, 2002; West and Cordery, 2003; West and Cordery, 2004; Crooks et al., 2005; Crooks et al., 2007; Crooks et al. 2008).

2.2.1 Carmel Valley Subwatershed

The northernmost subwatershed in the Los Peñasquitos Watershed, Carmel Valley is only slightly larger than Carroll Canyon (11,004 acres) at 11,180 acres and approximately one-third the size of Los Peñasquitos Canyon (37,028 acres) (Table 1-1). It is an elongated drainage that follows a westerly direction with headwaters at Black Mountain at an elevation of 1,550 feet (ft). It flows westward from Black Mountain for approximately 10 miles until it passes under I-5 and into LPL through a triple 12x10 ft reinforced concrete box (RCB) at an elevation of approximately 6 ft (Figure 1-2) (Kimley-Horn, 2003). The western edge of this subwatershed receives an average of 10 inches of precipitation per year, while Black Mountain receives an average of 12 inches per year (Kimley-Horn, 2003). The major tributary streams within this drainage area include Deer Canyon, Shaw Valley, El Camino Canyon, and Bell Valley.

Recent development in this subwatershed has increased fresh water flows into LPL, resulting in the presence of large stands of vegetation (e.g., *Typha*) in the northeastern portion of the lagoon (Greer, 2001; White and Greer, 2002; Coastal Environments, 2003d). The stands of *Typha* and manmade structures implemented during the development of Carmel Valley Restoration and Enhancement Project (CVREP) along Carmel Creek have reduced the sediment loading to LPL at this time. Sediment loads that enter LPL from this tributary appear to be trapped by the stand of cattails located in the northeastern portion of the lagoon (Greer, 2001; White and Greer, 2002).

2.2.2 Carroll Canyon Subwatershed

The Carroll Canyon subwatershed is the smallest of the three drainage areas and forms the southern edge of the Los Peñasquitos Watershed. The headwaters for this drainage are located near the Miramar reservoir (elevation of 971 ft), which is used for storage of imported water and only provides a small amount of water to this drainage (Kimley-Horn, 2003). Carroll Canyon Creek flows westward for most of its length before it turns northward to join Los Peñasquitos Creek in Sorrento Valley at an elevation of approximately 9.5 ft above the mean lower low water (MLLW). This subwatershed receives approximately 10.8 inches of rainfall per year.

This subwatershed is composed of narrow, incised canyons that empty into a larger, flat area before the creek channel incises as it moves downstream from this terrace (Kimley-Horn, 2003). Once the creek enters Sorrento Valley, it enters a cement channel that is approximately 0.5 miles in length before it joins Los Peñasquitos Creek and then enters LPL. This topography lends to faster response times to rainfall and higher peak flows within Carroll Canyon Creek because water cannot disperse horizontally as is the case in lower Los Peñasquitos subwatershed, which has a wider flood plain.

2.2.3 Los Peñasquitos Canyon Subwatershed

The Los Peñasquitos subwatershed is the largest of the three main tributaries encompassing over 37,000 acres, more than both Carmel Valley and Carroll Canyon combined. It extends eastward to the City of Poway and westward to Sorrento Valley, where it joins Carroll Canyon Creek before entering LPL. This subwatershed receives between 10 to 16 inches of precipitation a year and has two distinct sub-drainage environs identified as two separate hydrologic areas (906.1 and 906.2) (Figure 1-2).

The upper drainage of the Los Peñasquitos Canyon subwatershed (HA 906.2) is located primarily within the City of Poway's jurisdiction and receives 12 to 14 inches of rain per year. Elevation in the upper drainage varies from over 2,000 ft to 400 ft. This part of the Los Peñasquitos subwatershed is composed of a wide valley with steep mountain gullies. The active flood plain is poorly defined in this portion of the canyon and the main creek channel is cut into cohesive sands and clays and its banks are generally sloping and well vegetated (Kimley-Horn, 2003). This characteristic of the main creek channel is also found in the three main tributary streams in the upper watershed: Rattlesnake Creek, Poway Creek, and Beeler Creek.

The lower drainage of Los Peñasquitos Canyon subwatershed (HA 906.1) is located within the City of San Diego's jurisdiction. The elevation of this portion of the Los Peñasquitos subwatershed varies from 1,000 ft in the east to 10 ft in the west where it joins Carroll Canyon Creek in Sorrento Valley. While the eastern portion of the lower drainage is composed of a narrow main canyon with deeper cut creek channel, the western half of the lower drainage opens into a wider flood plain and the creek channel becomes wider and shallower, allowing water to disperse horizontally during peak flows. However, in the most western portion of the lower drainage, Los Peñasquitos Creek has been channelized with rip rap along the creek banks as a result of historic agricultural and ranching land use that no longer exists. Lopez Canyon is the largest of the sub-drainages located in the lower portion of the Los Peñasquitos subwatershed and extends east to Blythe Road and joins Los Peñasquitos Canyon approximately 0.75 miles east of Sorrento Vista Parkway.

3.0 METHODS

Methods employed during this Phase I Investigation are in accordance with the Los Peñasquitos Lagoon TMDL-Watershed Phase I Sediment Source Identification Study Final Work Plan approved and submitted to the City's Storm Water Department on December 10, 2008. The approved methods are presented in Appendix B for consultation and review. Changes to the methods after the submission of the final work plan are explained below.

3.1 Adjacency Analysis

Although an adjacency analysis was listed as a method to help determine priority areas of concern with regard to potential sediment sources within the watershed that contribute to sediment impacts to receiving waters (i.e., creeks, LPL), it was not used during this investigation. This is mostly because adjacency analysis is used to address sheet flows entering natural drainages from large impervious surfaces of mixed land use with the aim of associating specific land use types to impacts related to this specific type (sheet flow) of urban runoff. After investigating over 50 sites it was determined that sheet flow occurred only at specific locations within Carroll Canyon where there was only one type of land use (e.g., residential, commercial, or industrial). Therefore, the project manager decided that use of adjacency analysis would not be cost effective since it was apparent that differentiating urban runoff input from different types of land use would not be needed or practical for the purposes of this investigation.

3.2 Areas of Concern now referred to as Priority Areas

Upon further consideration of appropriate terminology to be used in this investigation and report, it was determined that the term "areas of concern" was not appropriate because it did not adequately describe the areas requiring further investigation and/or development of BMPs. Therefore, the term "priority areas" will be used instead because it better describes such areas, as well as links these areas with the need to prioritize action efforts needed to reduce sediment loading and the potential for multiple constituents of concern.

4.0 RESULTS

4.1 Land Use and Hydromodification

Land use plays an important role with regard to influencing sediment loading in the Los Peñasquitos Watershed. Land use within the watershed has altered natural landscapes, tributary characteristics, and native habitats since the late 1700s (Mudie et al., 1974). However, recent development within the Los Peñasquitos Watershed seems to have had the greatest impacts to the geomorphology of the watershed and peripheral drainages to LPL (Prestegaard, 1979; SANDAG, 1982; Greer, 2001; White and Greer, 2002; Kimley-Horn 2003; Coastal Environments; 2003d; Coastal Environments, 2003e). As mentioned in the TMDL Monitoring Report, the large areas of industrial land use within the Carroll Canyon subwatershed could account for the relatively high rate of sediment loading from this subwatershed when compared to Los Peñasquitos subwatershed, which is primarily open space bordered by residential. This is due to the inability of storm water to infiltrate soils and/or be absorbed by vegetation, as occurs in open space and, to an extent, in residential areas. Rather, storm water is collected on impervious surfaces and then drains to the nearest MS4, resulting in larger volumes of relatively sediment-free storm water entering the MS4 and then discharged into canyons. Reduced concentrations of sediment within storm water runoff discharged into canyons could account for some degree of erosion within the drainages due to "hungry water," a concept used to describe water that has a high potential for downstream scour due to the lack of sediment within the water itself, which increases the carrying capacity of the flow. However, it appears that hydromodification within the subwatershed, in the form of increased volume and velocity of storm water discharged into steep drainages via the MS4, may play a more dominant role in the case of the Carroll Canyon subwatershed. This was observed in the data generated by the TMDL Monitoring report, where Carroll Canyon Creek greatly surpassed Los Peñasquitos Creek with regard to transport of total suspended solids, even though the latter has a much bigger drainage area and sediment availability (Weston, 2009a). Furthermore, it could be argued that the geology of the subwatershed does not necessarily lend to sediment loading from above the canyons, because mesa tops tend to be relatively flat and conducive to ponding under natural conditions due to reduced percolation capacity, as evidenced by the widespread presence of vernal pools before the existing development on the mesa tops within the subwatershed.

4.2 Geology and Topography of the Study Area

As described in the TMDL Monitoring Report, the geology of the Los Peñasquitos Watershed indicates large portions of the soils within the watershed have moderately to highly erodible soils. Figure 4-1 displays the soil erodibility factor (K-factor) from the Soil Survey Geographic (SSURGO) Database (USDA, 1973) for soils in the Los Peñasquitos Watershed. K-factors in just the Carroll Canyon subwatershed are shown in Figure 4-2 and peripheral drainages in Figure 4-3. The K-factor is one of five inputs to the Revised Universal Soil Loss Equation (RUSLE) and represents both the susceptibility of soil to erosion and the rate of runoff. Soils with low K values (<0.2) tend to resist detachment (e.g., clays) and/or due to low runoff potential (coarse-textured soils). Medium-textured soils, such as silt loams, have moderate K values (approximately 0.25-0.4) because they are moderately susceptible to detachment and can produce moderate runoff. Light-textured soils, such as those with high silt content, have the highest K values (>0.4), and are easily detached, tend to crust, and produce high rates of runoff (Institute of Water Research, 2002).

The geology in the area of the LPL is described by the Torrey Pines Association (Torrey Pines Association Web site, 2008, http://www.torreypine.org/geology/geology.html) and includes, from oldest to most recent, the Delmar Formation, the Torrey Sandstone, the Linda Vista Formation, and the Bay Point Formation. The Delmar Formation is mostly a greenish–yellow mudstone and siltstone and is somewhat resistant to erosion. Next is the Torrey Sandstone, mostly quartz with some feldspar, usually white but often stained light brown by iron oxide from the rocks above. The rock was deposited as a sandbar. The loose sand was cemented later by calcite from water flowing through the sand. The Linda Vista Formation is the hard red rock on top of the Torrey Sandstone. It resists erosion more than the Torrey Sandstone under it so it acts as a cap rock, protecting the softer rock beneath and lending to the natural runoff and sedimentation processes within the watershed. The Bay Point Formation is made of poorly cemented, light brown sandstone and make up the scenic badland formations observed in the area. The Torrey Pines Association notes that erosion of these sediment formations is primarily a natural process that occurs as a function of rainfall, wind, and biological activities such as root prying and animal burrowing.

While the K-factor does seem to play a major role in the natural erosion processes occurring in the watershed, it appears to only be one component of the current sediment loading regime under the modified conditions due to urbanization of the watershed. As the watershed was built out, large exposed areas of sediment that could provide potential sources of sediment during storm events were replaced by development or covered by landscaping and habitat conversion. As both volume and velocity of storm water increase due to urbanization and the MS4, topography and hydromodification begin to play more important roles in terms of sediment loading from the natural drainages within the Los Peñasquitos Watershed, especially within the Carroll Canyon subwatershed.

The topography within the Los Peñasquitos Watershed is similar to other coastal drainages in San Diego in which the north slopes, also referred to as south-facing slopes, of these drainages tend to be rounded and grassy because they are exposed to the sun's heat for most of the day, and in particular the extreme heat of the midday sun, which tends to inhibit vegetation growth. On the other hand, the southern slopes, or northern-facing slopes, of the drainages tend to be steeper and covered with chaparral as these slopes tend to be cooler and exposed only to direct sunlight in the early morning and early evening hours. The Carroll Canyon subwatershed is characterized by deep, incised canyons that lend to steeper drainages when compared to the other two subwatersheds (Figure 4-4). As shown in Figure 4-5, the western half of Carroll Canyon has numerous slopes of 25% or greater, many of which are relatively close to Carroll Canyon Creek. This somewhat contrasts with the western half of Los Peñasquitos Canyon, in which there exists slopes of 25% or greater, but they tend to be farther away from the creek. It should be noted that Lopez Canyon, a sub-drainage to Los Peñasquitos Canyon, somewhat resembles Carroll Canyon in that most of its slopes of 25% or greater are located near the canyon floor, where an ephemeral drainage exists.

Under natural conditions (i.e., where hydromodification is not present), the differences between northern and southern slopes lends to increased erosion on the northern slopes because there is less vegetation density and coverage to impede slopewash, a general term to refer to colluviums found at the base of a slope as a result of natural erosion and down-slope movement of sediment. The effects of slopewash from northern slopes over a long period of time often results in the creek beds being forced over to the southern sides of the drainages as slope particles fill in the valley from the north, resulting in asymmetric valleys and steep southern slopes that do not erode as quickly due to vegetation that is better established.

Under modified conditions (i.e., with hydromodification present) within the watershed, southern slopes and their drainages have become more problematic with regard to sediment loading. This is due to larger volumes of storm water collected off impervious surfaces enter the MS4 system and then flow toward the outlet structures, often located along canyon walls or within the upper drainages. When discharged into the canyon, runoff velocity increases as water moves down the canyon wall due to the gradient changes. If storm water is released from outfalls along the canyon wall, gullies or large slumps can be created, which often lead to increased sediment loading to receiving areas below the outfall. When storm water is discharged from outfalls located within the upper drainage, it can scour the immediate area below the outfall when flows overwhelm energy dissipaters and/or existing vegetation below the outfall.

However, even when the flow's initial energy is successfully dissipated at or just below the outfall, scouring can still occur as water moves down the drainage, due to the steep grades often found in north-facing drainages. North-facing drainages, much like north-facing slopes, seem to have much steeper grades, possibly because of the relative lack of erosion due to slopewash over geologic time as compared to south-facing drainages. In these steep drainages, the threshold slope (approximately a 0.5% decrease in grade), also referred to as the transition point for scour, that determines the critical velocity for potential downstream scour tends to occur more frequently than in other drainages. This was evident in the drainage below Autoport Mall, described in Subsection 4.3.3.2, where it appeared that thick vegetation below the outfall would dissipate the energy of most flows discharged from this outfall. However, upon visual inspection of the lower drainage from a nearby ridge, large scour marks were evident even though there were no other major MS4 outlets above them. Review of the topography of this drainage indicates that the threshold slope for scour is exceeded for the entire drainage before it reaches Carroll Canyon Creek (Figure 4-6). This presents a challenge with regard to reducing sediment loading within the drainage if reducing runoff volume, rather than just velocity, is not addressed. This is because storm water flows that have only been slowed by engineered structures and/or existing vegetation at the outfall can still scour the lower drainage as velocity is increased due to grades within the drainage that exceed the threshold slope.

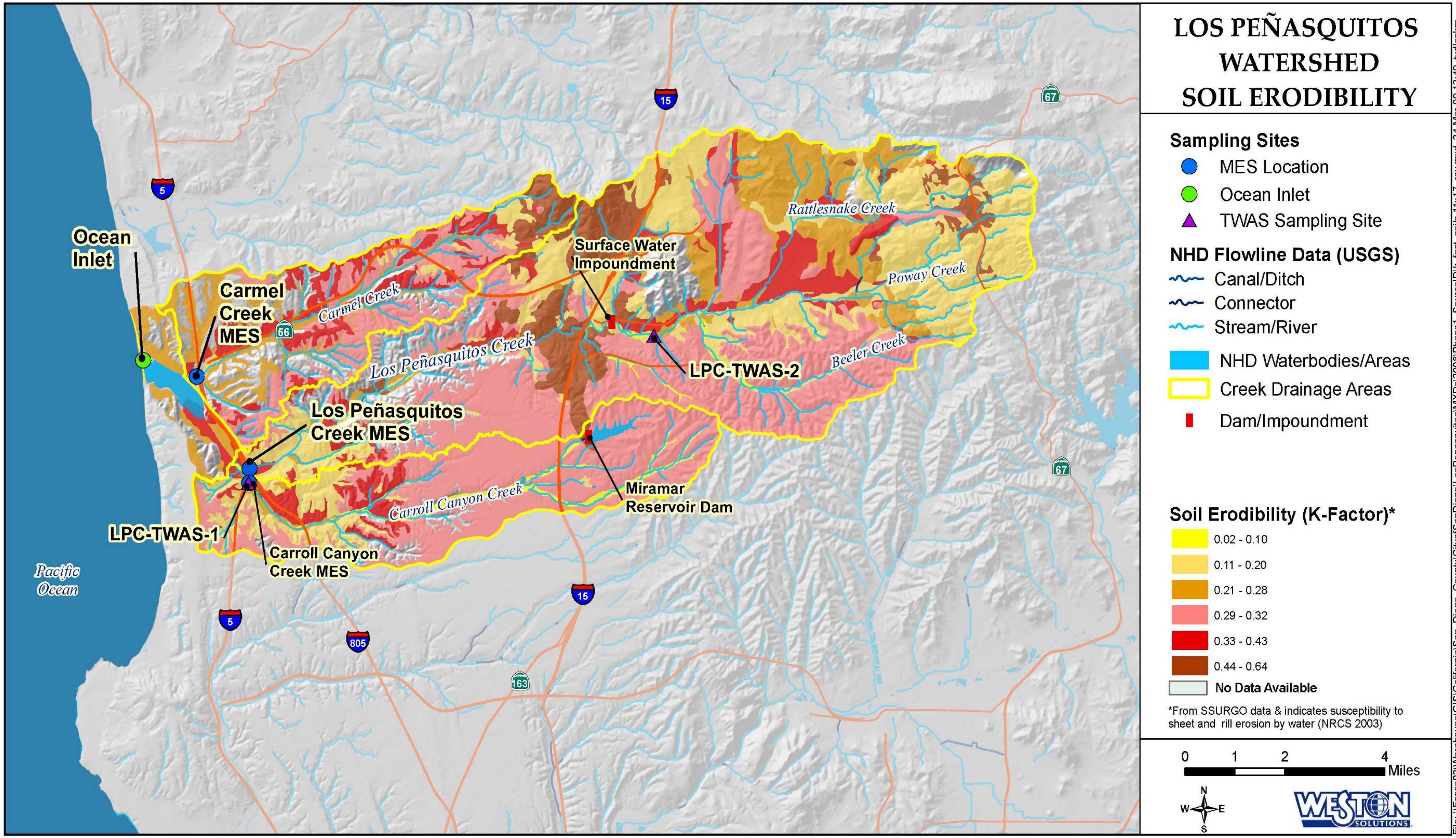

Figure 4-1. Soil Erodibility in the Los Peñasquitos Watershed

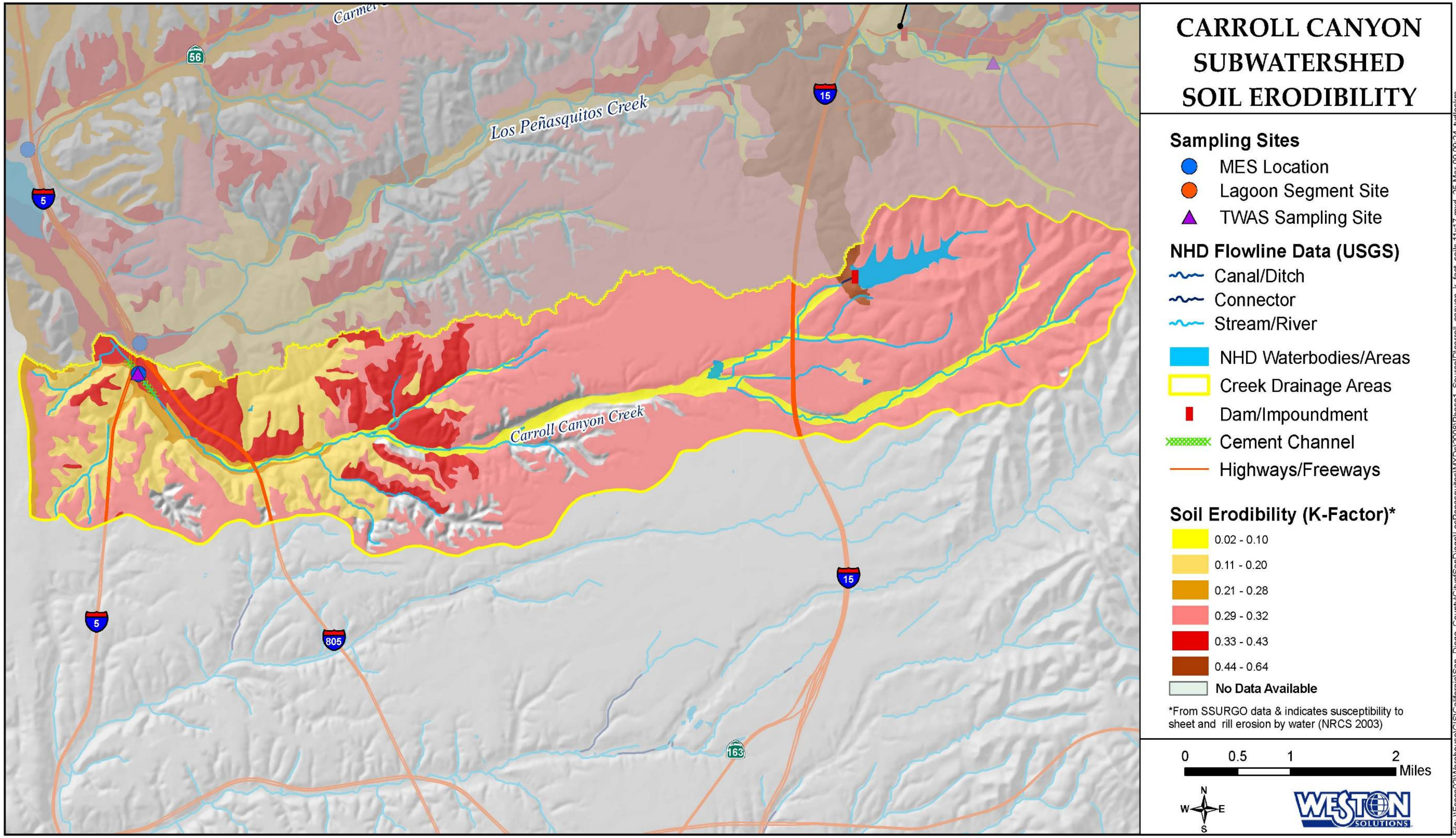

Figure 4-2. Soil Erodibility in the Carroll Canyon Subwatershed

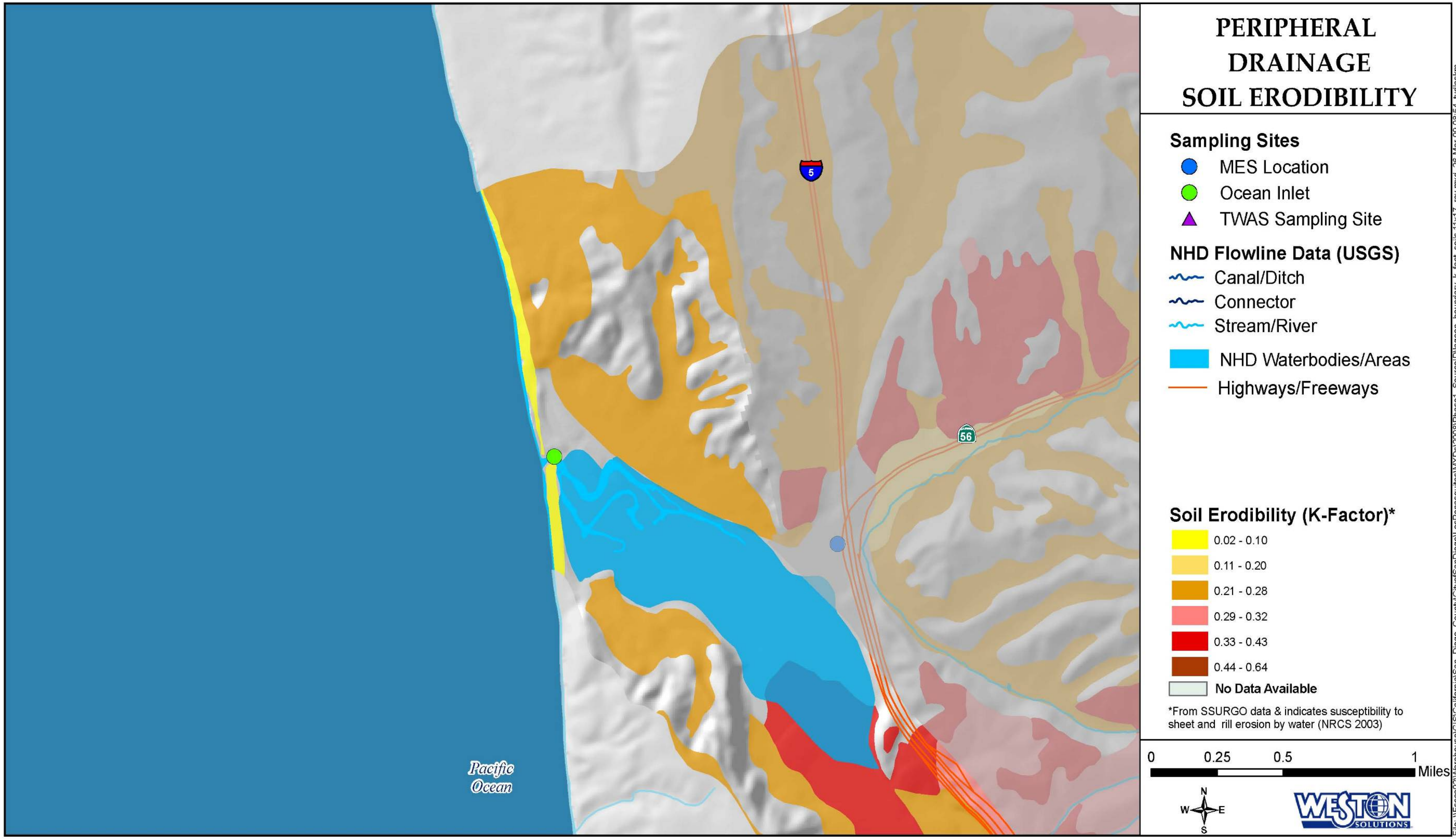

Figure 4-3. Soil Erodibility in the Peripheral Drainages

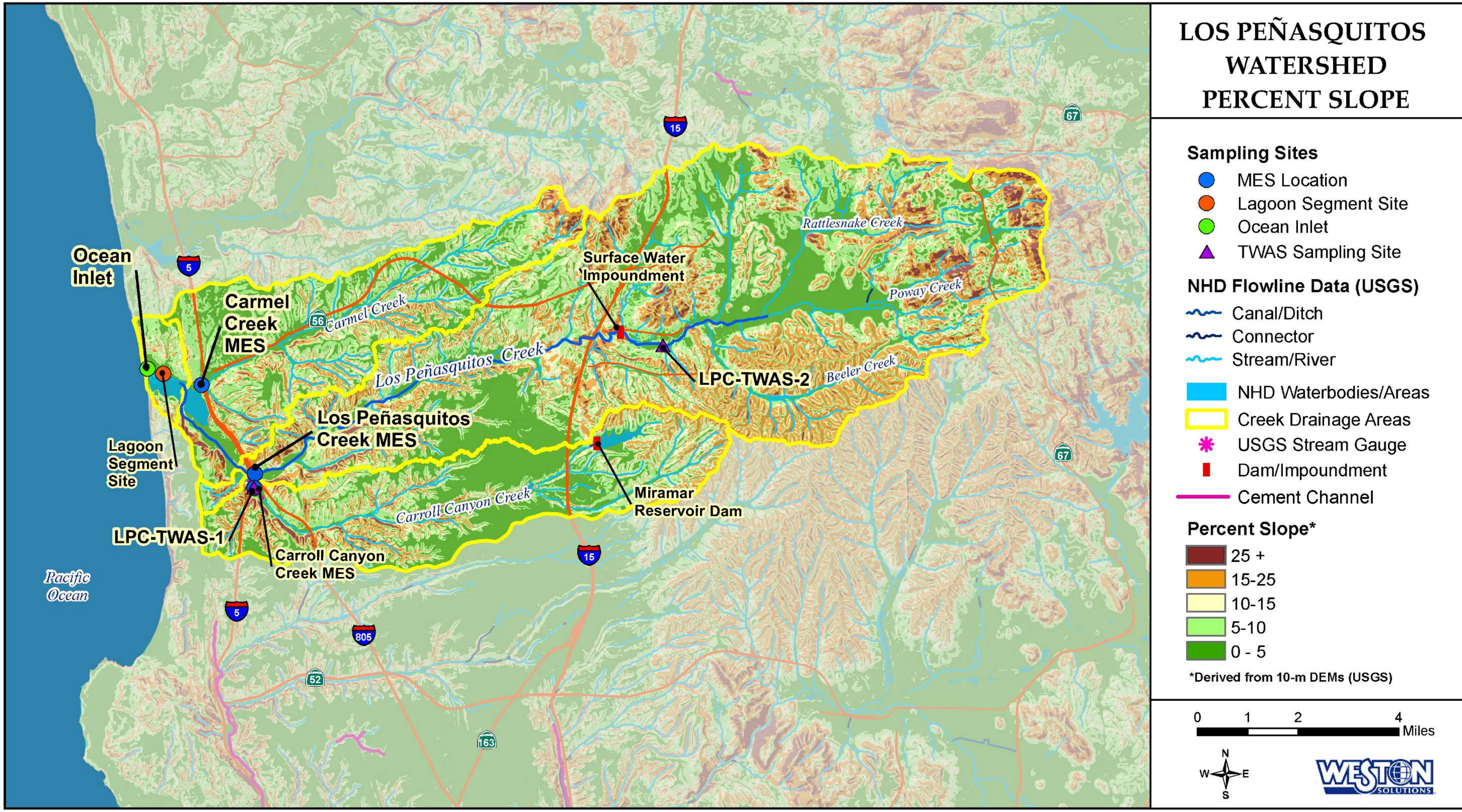

Figure 4-4. Percent Slope in Los Peñasquitos Watershed

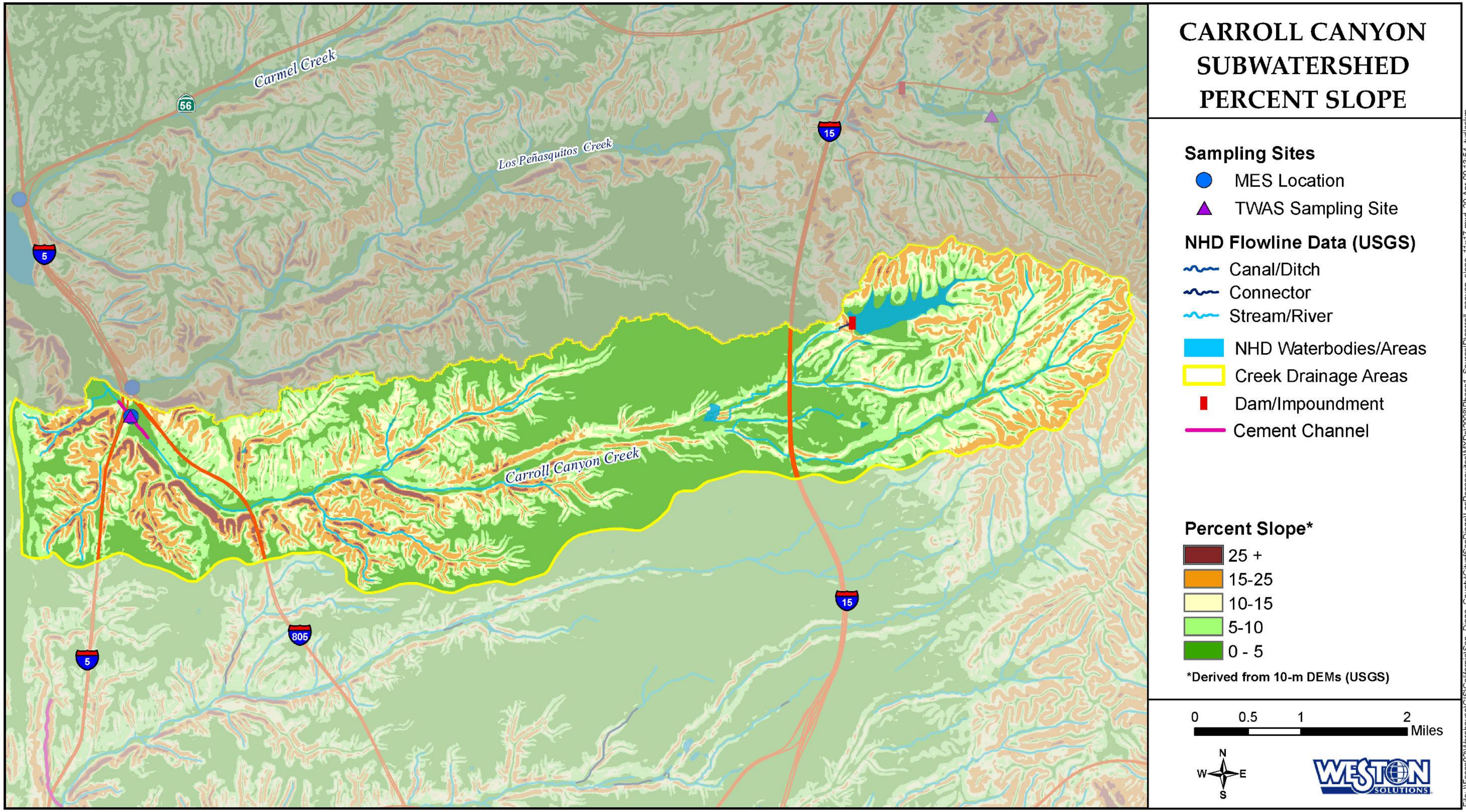

Figure 4-5. Percent Slope in Carroll Canyon Subwatershed

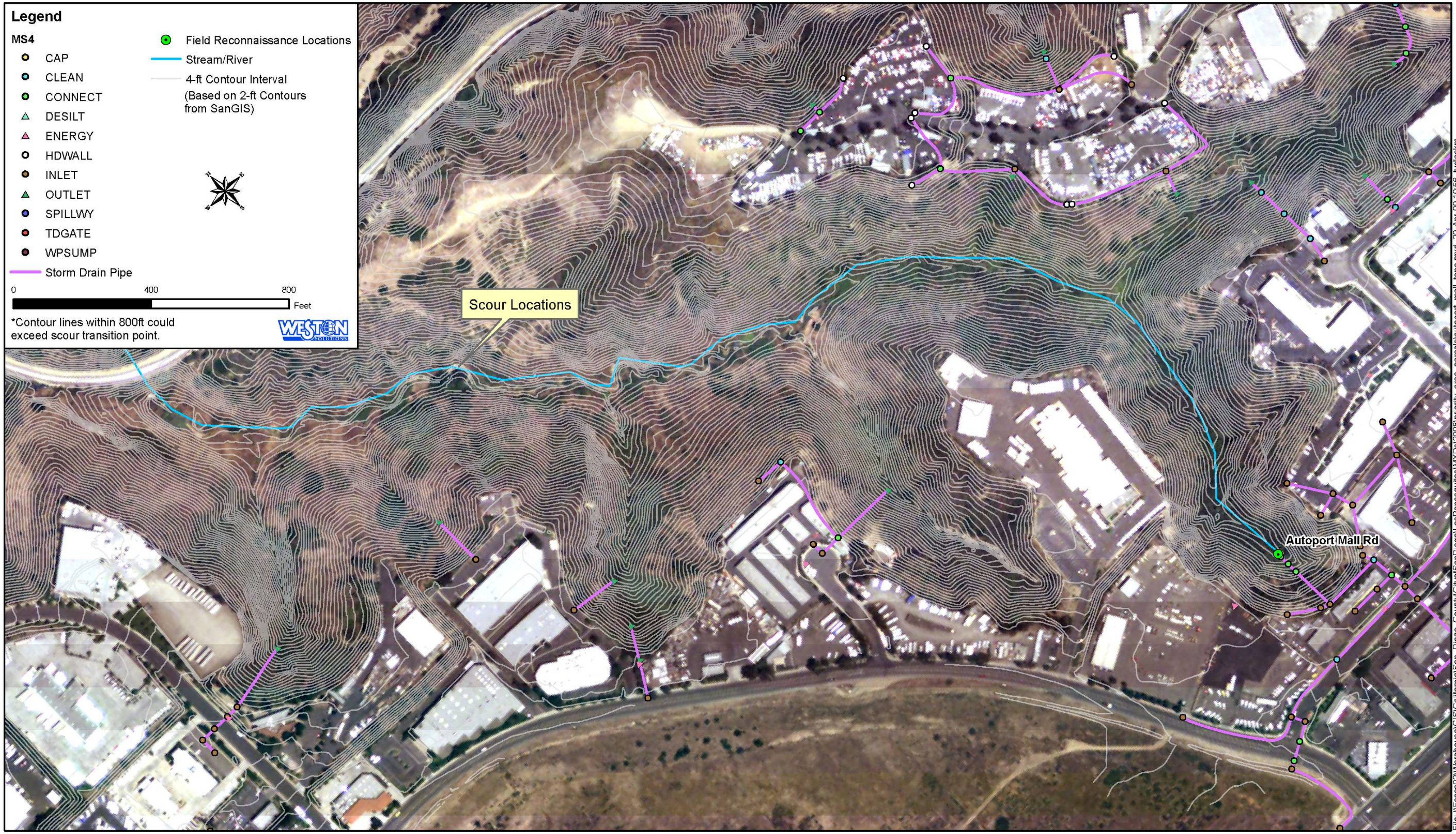

Figure 4-6. Topography of the Autoport Mall Drainage

4.3 Priority Areas – Sediment Loading

Priority areas within the peripheral drainages to LPL, the Los Peñasquitos subwatershed, and Carroll Canyon subwatershed were selected to facilitate the City's efforts to coordinate load reduction efforts with other dischargers within the Los Peñasquitos Watershed as identified by the Regional Board, and to reduce potential sources of sediment within the City's jurisdiction through the implementation of BMPs. Locations were determined using several criteria that included the following:

- Review of historical data and reports, as well as input from specific stakeholders (e.g., State Parks, Los Peñasquitos Lagoon Foundation) that have a history of resource and land management within the study area.
- Review of maps that included aerial photos, topography, drainages, land use, soil K-factors, MS4, and landownership.
- Review of High- and Medium-Priority Sources of Sediment for Los Peñasquitos as identified in the Strategic Plan and updated priority investigation lists provided by the City of San Diego's Storm Water Department under its JURMP and WURMP.
- Best professional judgment from the investigation team that has over 35 years of combined experience conducting monitoring and survey efforts in the Los Peñasquitos Watershed.

The investigation team visited over 50 sites within Carroll Canyon and peripheral drainages near the lagoon boundaries. These sites included MS4 structures (e.g., storm drain outfalls, energy dissipaters, brow ditches, detention basins) with the potential of either being sources of sediment due to deferred maintenance or conduits of storm water that led to downstream sediment loading as a result of hydromodification. Also inspected were specific land use activities (e.g., aggregate mining, a cemetery) occurring within Carroll Canyon that the City deemed potential priority threats to water quality, with regard to primarily sediment. However, except for the Hanson Aggregate Facility (Hanson) and the Torrey Villas Resort Apartments, manmade erosion as a result of over irrigation and other land use activities appears to play only a minor role when compared to impacts generated by hydromodification and the function of large impervious areas draining to specific MS4 outlets that release storm water into steep canyon drainages. Photo-documentation and field notes were used to record findings at these sites. Furthermore, WESTON inspected as well as observed maintenance issues affecting MS4 structures that may contribute to downstream sediment loading. Examples that will be discussed later in the report include: brow ditches below Torrey Villas Resort Apartments, Caltrans MS4 outlet along Sorrento Valley Road, potential sewer line break in the Torrey Pines State Reserve Extension and the culvert at Carroll Road..

Results for the Los Peñasquitos subwatershed were generated from efforts carried out by Los Peñasquitos Lagoon Foundation (LPLF) and its consultant, Kimley-Horn and Associates during a sediment source investigation study in 2003/2004. From these efforts, a map highlighting areas of erosion and other concerns within the Los Peñasquitos subwatershed was developed, as well as photo-documentation of examples of erosion and sedimentation within this subwatershed.

4.3.1 Priority Areas - Peripheral Drainages to Los Peñasquitos Lagoon

While peripheral drainages to Los Peñasquitos Lagoon do not contribute sediment loading to the same degree as Los Peñasquitos subwatershed, their proximity to the lagoon as the receiving water body warranted a field investigation given the easy access when compared to the rest of the watershed. These drainages can be divided into three main areas: northern boundary, eastern boundary, and southern boundary. Relevant jurisdictions are presented in Figure 4-7.

4.3.1.1 Northern Boundary (Torrey Pines State Reserve Extension)

Located just north of LPL and above Torrey Point Road, the Torrey Pines State Reserve Extension (Reserve Extension) is the largest of the drainages located along the northern boundary of LPL. It includes over 180 acres of undeveloped property containing high-quality Torrey Pines woodland habitat. An extension of the Torrey Pines State Reserve, this area is owned and managed by State Parks and is a peripheral drainage to LPL (Figure 4-8). Both private and public development along the boundaries of the Reserve Extension have led to impacts related to storm water being released through the City of San Diego’s MS4 at the Reserve Extension’s northern edge and potentially augmented by a broken sewer line (clay pipe) and/or water line (blue pipe) (Figure 4-9). Since there were no odors near the broken sewer line during the field inspection, it is not clear whether the sewer line is currently active or offline and potentially serving as a conduit for storm water runoff. Flows entering this gully move southerly toward the lagoon via an eroded gully (Figure 4-10). Sediment is washed down this gully during storm events and deposited at the southern end of the gully just above Torrey Point Road at an earthen basin next to private property and a storm drain that leads to LPL (Figure 4-11).

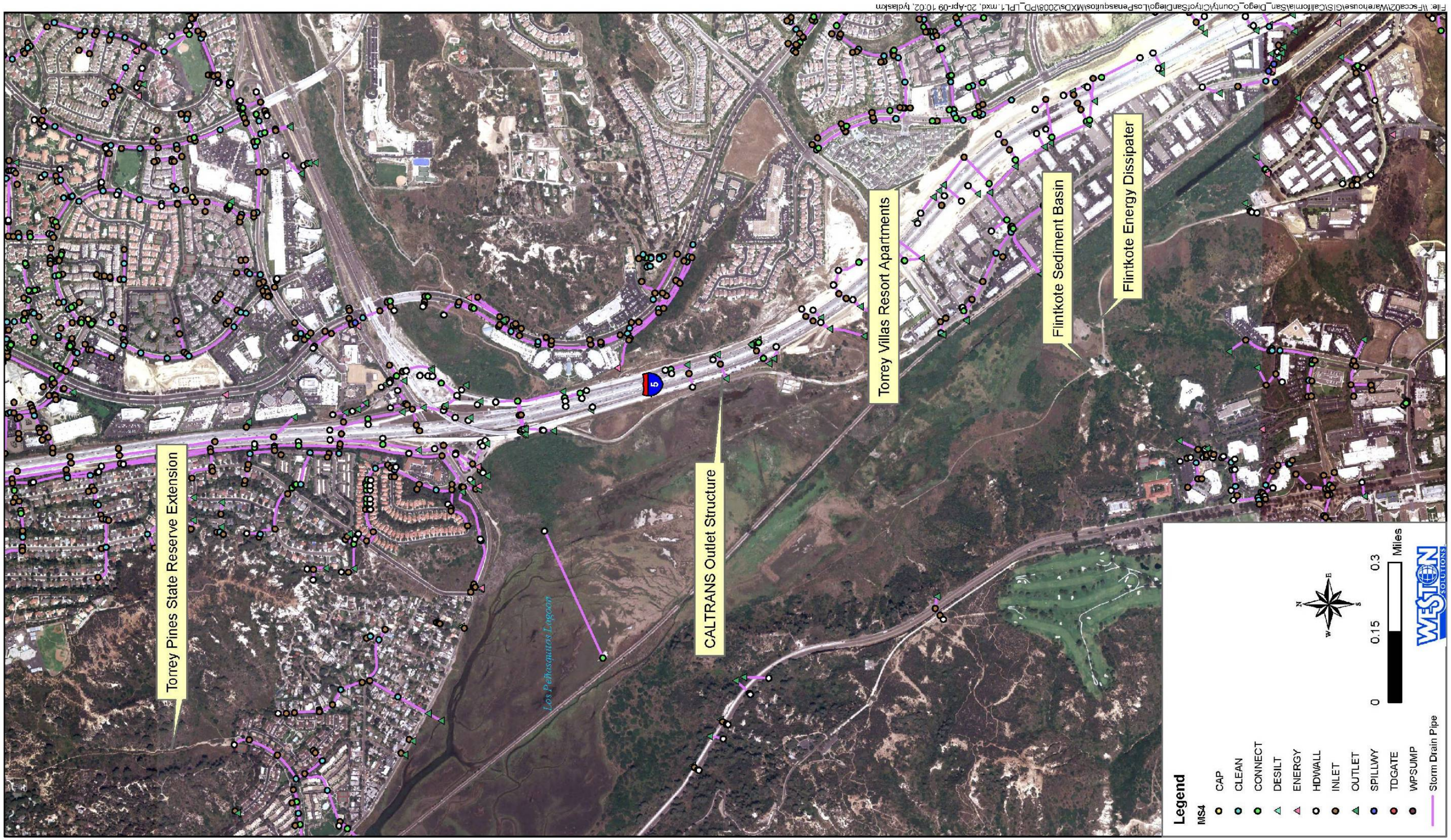

Figure 4-7. Peripheral Drainages to Los Peñasquitos Lagoon

Figure 4-8. Parcel Information and MS4 for Torrey Pines Reserve Extension

Figure 4-9. MS4 Point of Discharge

Figure 4-10. Eroded Gully

Figure 4-11. Sediment Basin (view looking into and above the basin)

Approximately 15 gabion structures were constructed within the main gully in the late 1970s by State Parks to decrease storm runoff velocities and sediment transport. However, these structures have been only moderately successful in reducing peak flows due to the highly erosive nature of the soil types found in the Reserve Extension. In many cases, the structures have been bypassed as peak flows erode the banks of the gully, effectively circumventing the structures (Figure 4-12). Recent site inspections and surveys by State Parks staff and engineering consultants have led to the consideration of an alternative that would remove the gabions and replace them with native vegetation and an energy dissipater at the bottom of the gully. However, this alternative has not been developed to the conceptual level. Additional photos of this site are presented in Appendix C.

Figure 4-12. Failed Gabions within the Torrey Pines Reserve Extension

4.3.1.2 Eastern Boundary

Located along the closed portion of Sorrento Valley Road and just east of I-5, this drainage is anthropomorphic in nature in that it consists of runoff from Interstate 5 and nearby developed lots. While this area contributes the least amount of sediment to the lagoon when compared to the other areas investigated, the lack of maintenance of several structural BMPs provides a source of sediment and debris that is in some cases only 20 ft from the lagoon and, therefore, potentially creating threats to lagoon water quality.

Caltrans MS4 Outlet Structures from I-5

These structures are all within the Caltrans easement along Sorrento Valley Road and capture storm runoff from I-5 and consist primarily of small detention basins with energy dissipaters (Figure 4-13). Discussions with State Parks staff that work at the Torrey Pines State Reserve indicate that these structures are seldom if ever maintained by Caltrans. One such structure, shown in Figure 4-14, has been a chronic problem with regard to storm water discharges, sediment deposition, and trash commonly found along freeways.

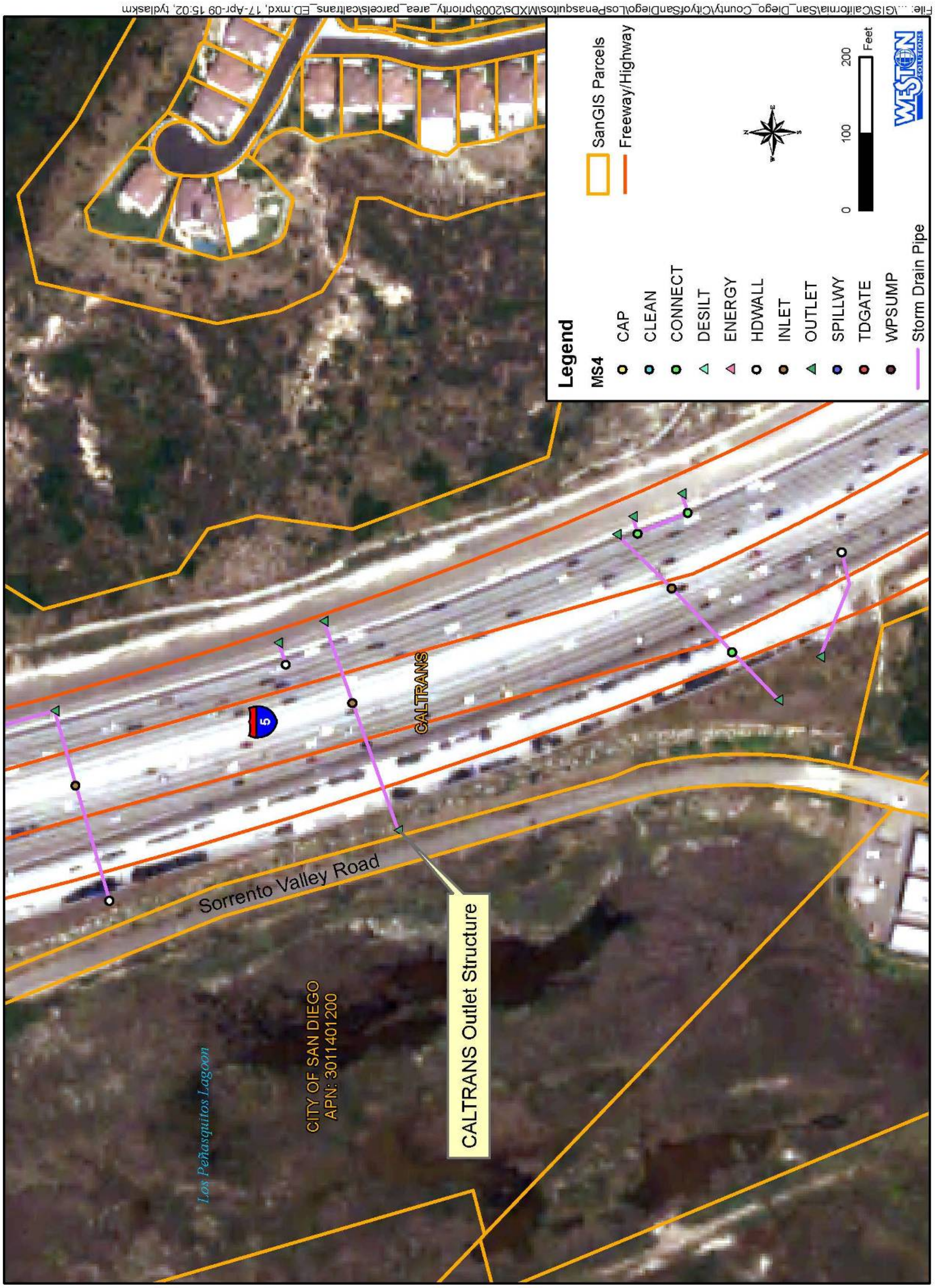

Figure 4-13. Parcel Information and MS4 for Caltrans Outlet Structure

Figure 4-14. Caltrans Detention Device from I-5, Sorrento Valley Road

Torrey Villas Resort Apartments

Located along the eastern side of I-5, just south of Black Mountain Road, this area is located within a City-owned parcel (APN 3100402600) and consists of three steep, unvegetated areas just below the Torrey Villas Resort Apartments that reside on parcels owned by the Irvine Co. LLC (Figure 4-15). Field investigation of this location revealed that the northern exposures have been eroded by runoff potentially associated with storm runoff and/or irrigation of landscapes above the exposures. Inspection of the brow ditches, culverts, and detention basins revealed considerable sediment deposition (Figure 4-16), though not to the magnitude of other potential sources within the watershed. However, the highly visible nature of this location and proximity to Carroll Canyon Creek might make this effort appealing to the City with regard to its sediment abatement efforts.

Figure 4-15. Parcel Information and MS4 for Torrey Villas Resort Apartments

Figure 4-16. Erosion and Deposition below Torrey Villas Resort Apartments

4.3.1.3 Southern Boundary

The peripheral drainages along the southern boundary of LPL consist primarily of two main drainages above Flinkote Avenue, which is located on State Parks land within the Torrey Pines State Reserve (Figure 4-17). These drainages have a relatively steep gradient (15 to 25% slope) and erosive soils (K-factor of 0.33 to 0.43) that help contribute large, localized loads of sediment due to storm water discharges from private properties above the canyon walls. The resulting hydromodification has created a large slump along the canyon wall that provides a steady source of sediment during storm events. Sediment loads from these drainages are deposited into two structures that have been installed below the canyon wall, which are described in Subsection 4.4.3.1.

4.3.2 Priority Areas - Los Peñasquitos Subwatershed

4.3.2.1 Los Peñasquitos Canyon and Lopez Canyon

As mentioned in Subsection 2.2.3, Los Peñasquitos Canyon is divided into an upper and lower watershed. While this subwatershed does not currently contribute sediment loading to the same degree as Carroll Canyon, it should still be considered for future source identification studies not covered under this Phase I Investigation. This is mostly because of the possibility that the current load allocations from Los Peñasquitos Canyon have been temporarily reduced due to the implementation of El Cuervo Norte BMP, described further in Subsection 4.4.1.1. Additionally there is the large, dense stand of *Typha*, commonly referred to as cattails, present just upstream of the mass loading station (MLS) located at the base of this tributary. El Cuervo Norte helps reduce sediment loads by diverting peak flows from the main portion of Los Peñasquitos Creek into a braided network of channels before it rejoins the creek downstream. However, the future benefits afforded by El Cuervo Norte depend on whether its diversion channels continue to function to the capacity of effectively diverting flows away from the main channel of Los Peñasquitos Creek. *Typha* serves as a biofilter during low to medium flows within Los Peñasquitos Creek in which TSS is removed from the water column before it can enter LPL. However, the stand of *Typha* at the base of Los Peñasquitos Creek could present a risk to neighboring properties because it impedes flows from the creek, which could increase vulnerability of a nearby business park to flooding, resulting in the City having to remove this vegetation from the creek bed.

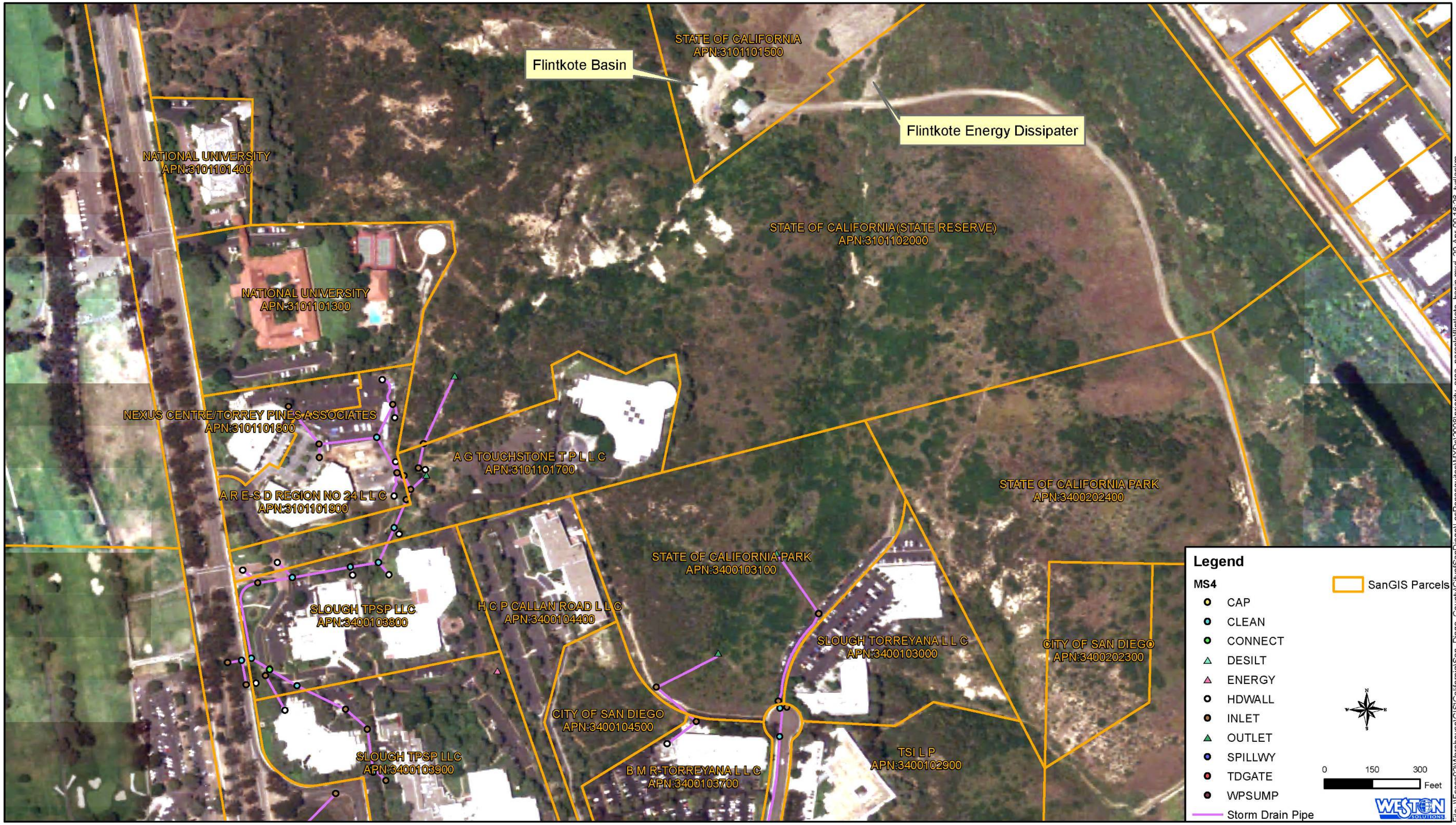

Figure 4-17. Parcel Information and MS4 for Flintkote Basin and Energy Dissipater

Prior to the implementation of El Cuervo Norte in 2005, the LPLF conducted visual surveys of Los Peñasquitos subwatershed that included both Los Peñasquitos Canyon and Lopez Canyon (Hastings, 2004). These surveys were conducted to find potential sources of sediment within this subwatershed to facilitate future restoration efforts designed to control sediment at its source. Figure 4-18 provides some examples of erosion within the Los Peñasquitos subwatershed and Figure 4-19 provides a summary of these efforts with additional photos provided in Appendix D.

Figure 4-18. Examples of Erosion (i.e., gullies) within Los Peñasquitos Subwatershed

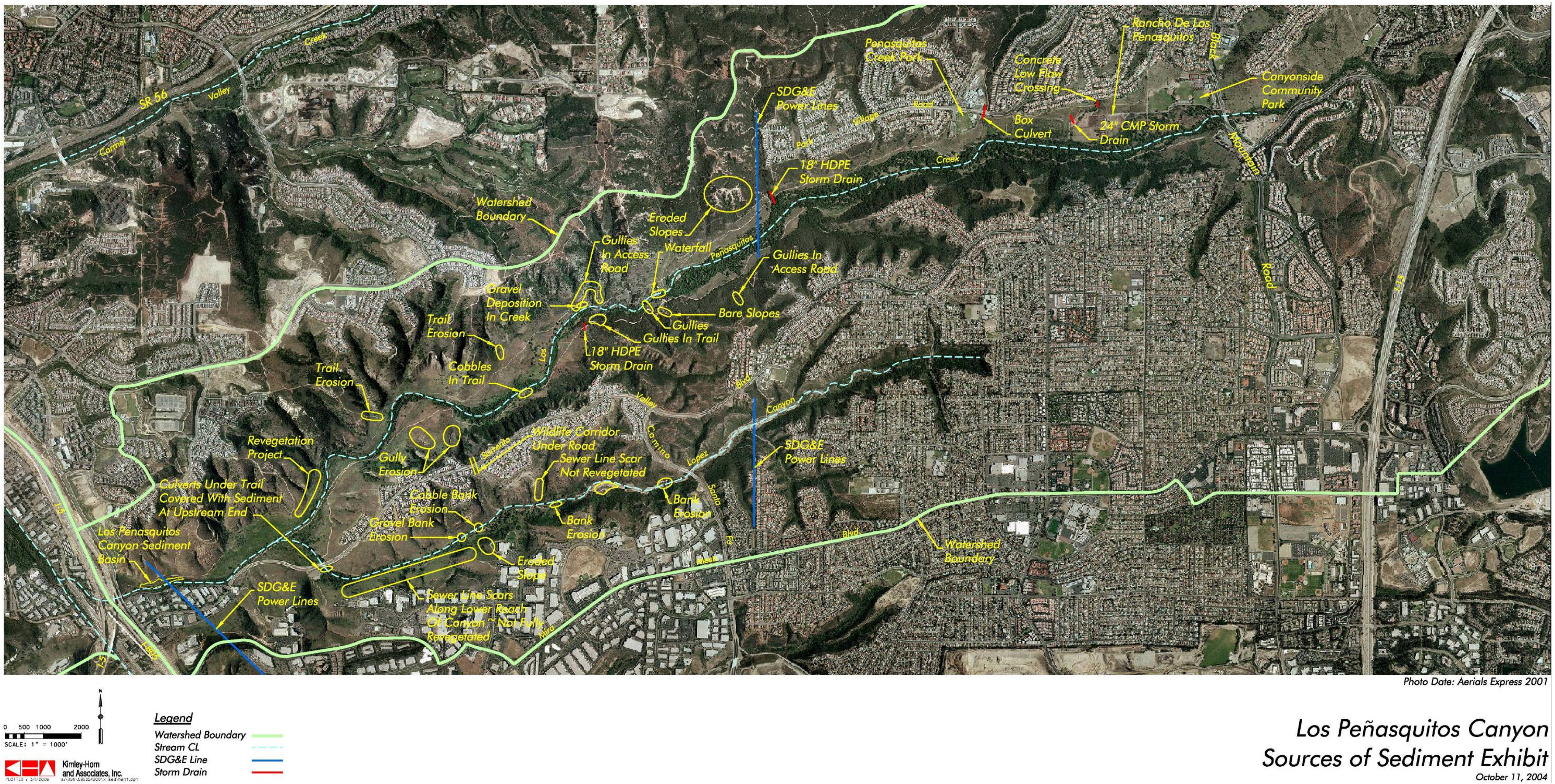

Figure 4-19. Los Peñasquitos Canyon, Sources of Sediment (Kimley Horn & Associates, 2004)

4.3.3 Priority Areas - Carroll Canyon Subwatershed

It was determined that the best approach to identify priority areas in this subwatershed (Figure 4-20) would be to examine the main contributors to sediment loading:

- Carroll Canyon Creek.
- MS4 outfalls and their drainages.
- Land use and activities that contribute to sedimentation.

4.3.3.1 Carroll Canyon Creek

Carroll Canyon Creek is the main tributary within the Carroll Canyon subwatershed. As it enters the lower portion of Carroll Canyon, it transforms from an earthen channel with vegetation in the creek bed to a cement channel designed for flood control. The cement section runs for about 0.5 mile and then reverts to an earthen channel just before the confluence with Los Peñasquitos Creek (Figure 4-21). This short section of cement channel appears to increase the sediment transport capacity within the creek based upon sediment deposition characteristics observed on-site during field investigations. As the channel transitions to cement, vegetation bends in the direction of the creek's flow and the cement channel is clearly visible, indicating that flow velocity at this location has increased to prevent sediment deposition (Figure 4-22).

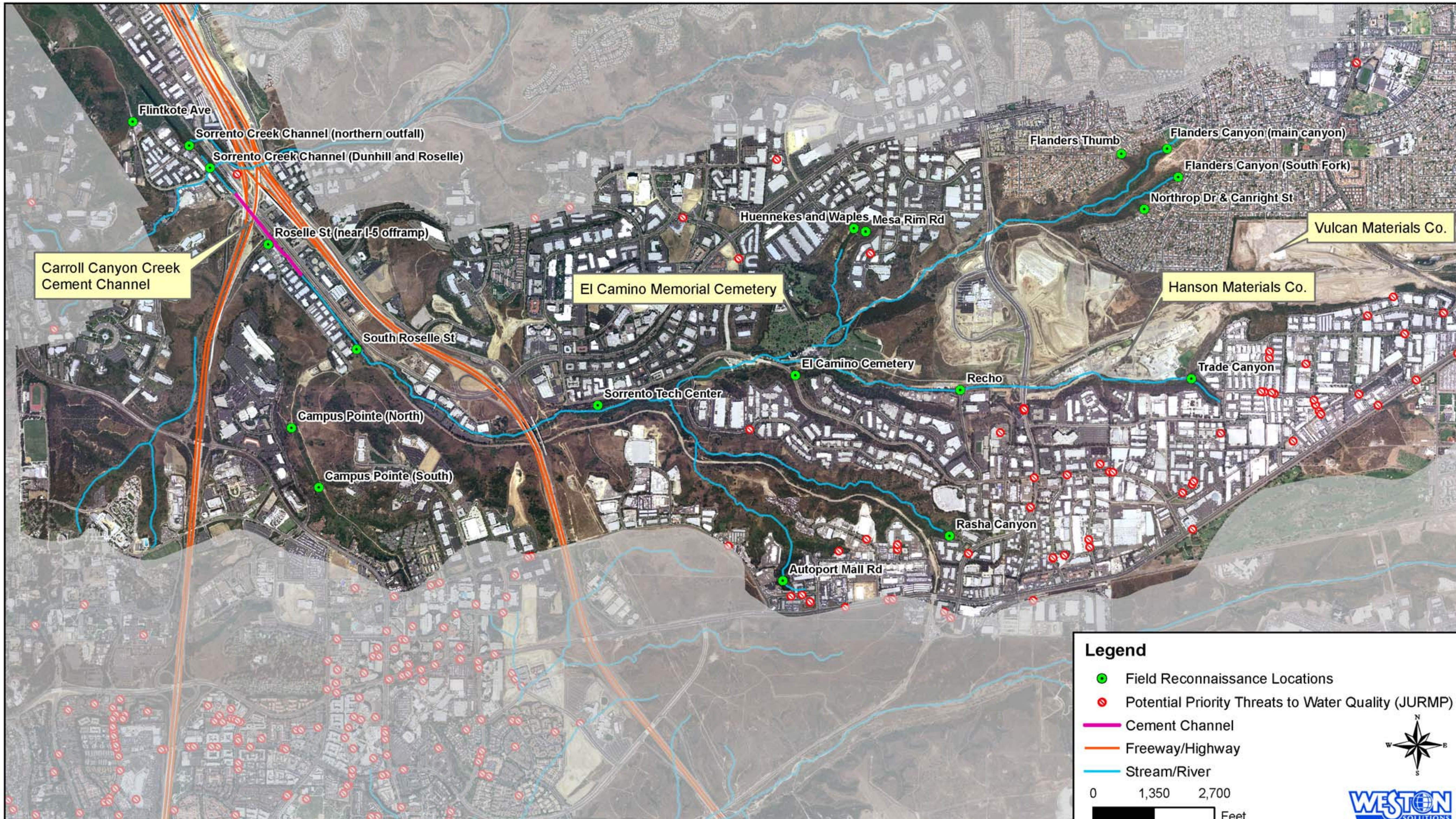

Figure 4-20. Map of Priority Areas within Carroll Canyon

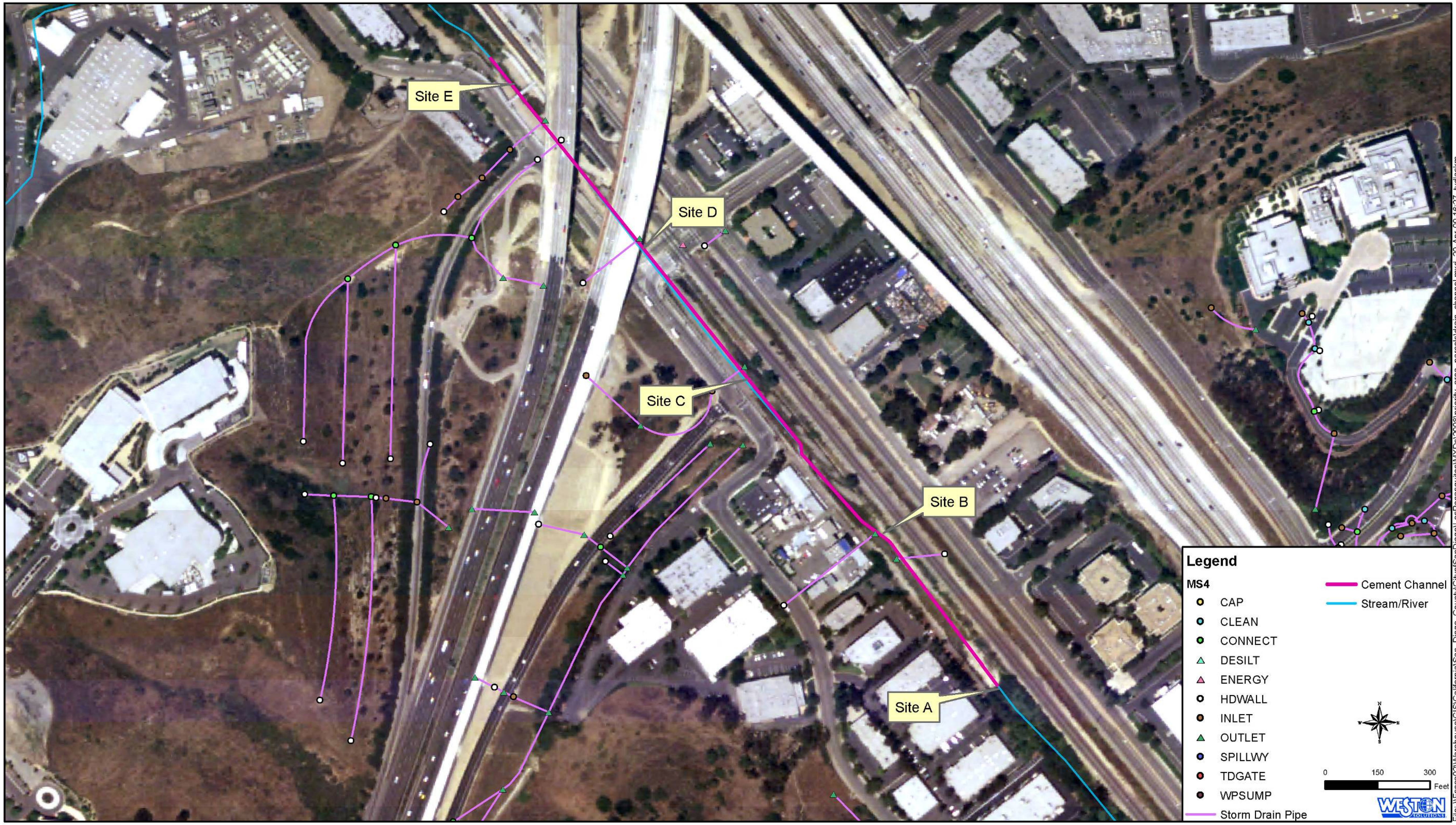

Figure 4-21. Photo Sites, Cement Channel in Carroll Canyon Creek

Figure 4-22. East of Site A

Just downstream of this location, islands of vegetation, large cobbles, and debris were present, indicating that flow velocity had decreased somewhat to allow for some deposition, but flows still had enough velocity to strip the channel down to its cement foundation (Figure 4-23).

Figure 4-23. Site B

Moving farther downstream, the cement channel is barely visible due to the deposition of smaller sized cobbles, indicating that flow velocities are still decreasing slightly, but not enough for the finer sediments that are being carried downstream toward LPL (Figure 4-24 photos from C).

Figure 4-24. Site C

As the cement channel crosses under I-5, sediment deposition of finer grains and light vegetation establishment was evident (Figure 4-25), indicating that flow velocity has decreased, quite possibly due to the end of the cement channel and the transition back to a vegetated channel downstream.

Figure 4-25. Site D

Just downstream of this site and near the Sorrento Valley Coaster Railway Station, vegetation becomes reestablished within the creek bed (Figure 4-26). While this indicates a further decrease in flow velocity within the creek, evidence of wrack washed up on an access ramp (Figure 4-27) shows that flow velocity is still prominent before it leaves the cement channel and enters the lagoon approximately 0.4 mile downstream.

Figure 4-26. Site E

Figure 4-27. Site E, Wrack Deposition on Access Ramp

4.3.3.2 MS4 Outfalls and Drainages

Since the Carroll Canyon subwatershed was the main focus of this investigation and the MS4 was believed to play a major role in sediment loading to LPL, an assessment matrix was developed to combine quantitative data with qualitative data to help qualify and rank priority areas related to the MS4. An example of this matrix and of matrices completed for priority areas within the Carroll Canyon subwatershed are presented in Appendix E. Only the top-priority areas determined to meet the criteria present on the assessment matrix were scored and ranked. From the 50 MS4 outfall sites, 19 were assessed using the matrix and then 17* were ranked according to the cumulative score that considered the following criteria:

- Elevation.
- Surface area of area that drains into the MS4.
- Size of outfall pipe.
- Sediment availability.
- Evidence of scouring.
- Proximity to receiving waters.
- Evidence of and/or potential for multiple pollutants.
- Slope of canyon wall.
- Cement conduits connected to the outfall.
- Integrity of outfall.
- Soil Erodibility (K-Factor).
- Evidence of established vegetation in the channel below the outfall.
- Presence/effectiveness of energy dissipaters.
- X factor (to include those factors not captured by the previous criteria).

* Three MS4 outfalls were not ranked because upon site investigation, they did not connect to either Carroll Creek or a tributary to Carroll Creek (i.e., Campus Pointe north and south outfalls).

The following subsection provides a description of the top five priority areas with regard to sediment sources within the Carroll Canyon subwatershed as a result of hydromodification in which storm water is discharged from MS4 outfalls into natural, “unimproved” drainages, causing erosion of creek beds and banks as well as canyon walls in some cases that results in sediment transport to downstream receiving waters that eventually empty into Carroll Canyon Creek. A ranking of these priority areas is provided in Table 4-1. The assessment matrixes for these sites are provided in Appendix F.

Table 4-1. Priority Areas – MS4 Outfalls

Rank	Score	Carroll Canyon Priority Areas - MS4 Outfalls
1	**529**	**Trade Canyon**
2	**525**	**Roselle Street (near I-5 offramp)**
3	**514**	**Flintkote Avenue**
4	**442**	**Autoport Mall**
5	**440**	**Rasha Canyon**
6	397	Flanders Canyon (Main Canyon)
7	395	Sorrento Canyon Tech Center
8	361	Sorrento Creek Channel (Dunhill & Roselle)
9	355	Huenneken & Waples
10	320	South Roselle Street
11	319	El Camino Memorial Cemetery Access Road Entrance
12	317	Northrop Dr & Canright St
13	312	Recho Street
14	302	Mesa Rim
15	291	Sorrento Creek Channel (Northern Outfall)
16	258	Flanders Canyon (South Fork Canyon)
17	156	Flanders Canyon (Thumb)

Trade Canyon Outfall (32°53'30.24" N, 117°09'21.42" W)

Trade Canyon, named for the nearest street (Trade Place), is located just south of the Hanson Materials Facility (Hanson) and below Loma Commerce Center LLC and Trepte Industrial Park LTD properties (Figure 4-28). It ranked highest on the priority area list, just above the Roselle site. This is due to its receiving high scores (i.e., 40 to 50 out of 50) for the following criteria in which high scores indicate a high potential for sediment loading:

- *Slope Factor.* While there was not a large discrepancy between the elevation of the canyon top and where the MS4 outfall was located within the drainage, the distance between the two was relatively short, resulting in a steep gradient that has a potential to augment the velocity of storm water flows before they are released into the natural drainage.
- *Cement Conduits.* This location had one main outlet structure with several cement brow ditches leading to the drainage, with the capacity for minor to medium level flows. Evidence of severe undercutting of one of the brow ditches and scouring near the outfall implies large flows of storm water runoff aside from what is transported through the main outfall (Figure 4-29).
- *Size of Outfall.* The main outfall located within this natural drainage was a 5-ft cement box structure with an energy dissipater (Figure 4-30), though it was apparent from the bent vegetation below the outfall that the energy dissipater was not adequately abating flow velocities, but redirecting them.
- *Evidence of Scouring.* This site had major evidence of scouring and bent vegetation, indicating high-velocity flows from the main outfall and minor outfalls.

- Evidence of Multiple Pollutants. Investigation of this site revealed both the presence and potential for multiple pollutants. Trash, oil, and nutrient loading were observed immediately below the outfall. Bacteria and vector (mosquito larvae) should also be considered because the main outfall contained deep impoundments of water, which were also present downstream of the outfall. Furthermore, an illicit discharge down one of the cement brow ditches, potentially from one of the Trepte Industrial Properties, was observed during the site inspection (Figure 4-29 A).
- X factor. This site scored high under this criterion in order to account for the degraded structural integrity of the brow ditches leading to this drainage, creating the potential to offset deferred maintenance costs. Furthermore, 11 businesses within the drainage area of this MS4 are defined as potentially high- and medium-priority threats to water quality due to sediment under JURMP and WURMP inspection programs (Figure 4-31).

Before further development of the structural BMP for this location is pursued, three important issues that face this site may need to be explored: landownership, correcting the MS4 map provided by SanGIS, and the high potential for multiple pollutants.

Currently, the upper portion of the drainage that is suitable for a structural BMP for this site is within the Hanson land parcel (Figure 4-32) and may require coordination and/or negotiations with Hanson if a BMP is to be implemented at this location. Potential issues could involve: the vulnerability of nearby berm that separates an area used by Hanson for cement mixing, expanding existing easements, and access for construction and maintenance efforts.

Furthermore, the MS4 map for this location may need to be updated because the map incorrectly shows storm drain pipes extending to the main outlet and outfall structures that do not exist. Since engineering design work requires accurate mapping of MS4 structures to facilitate BMP design and location, this should be considered before the development of a concept design for this location.

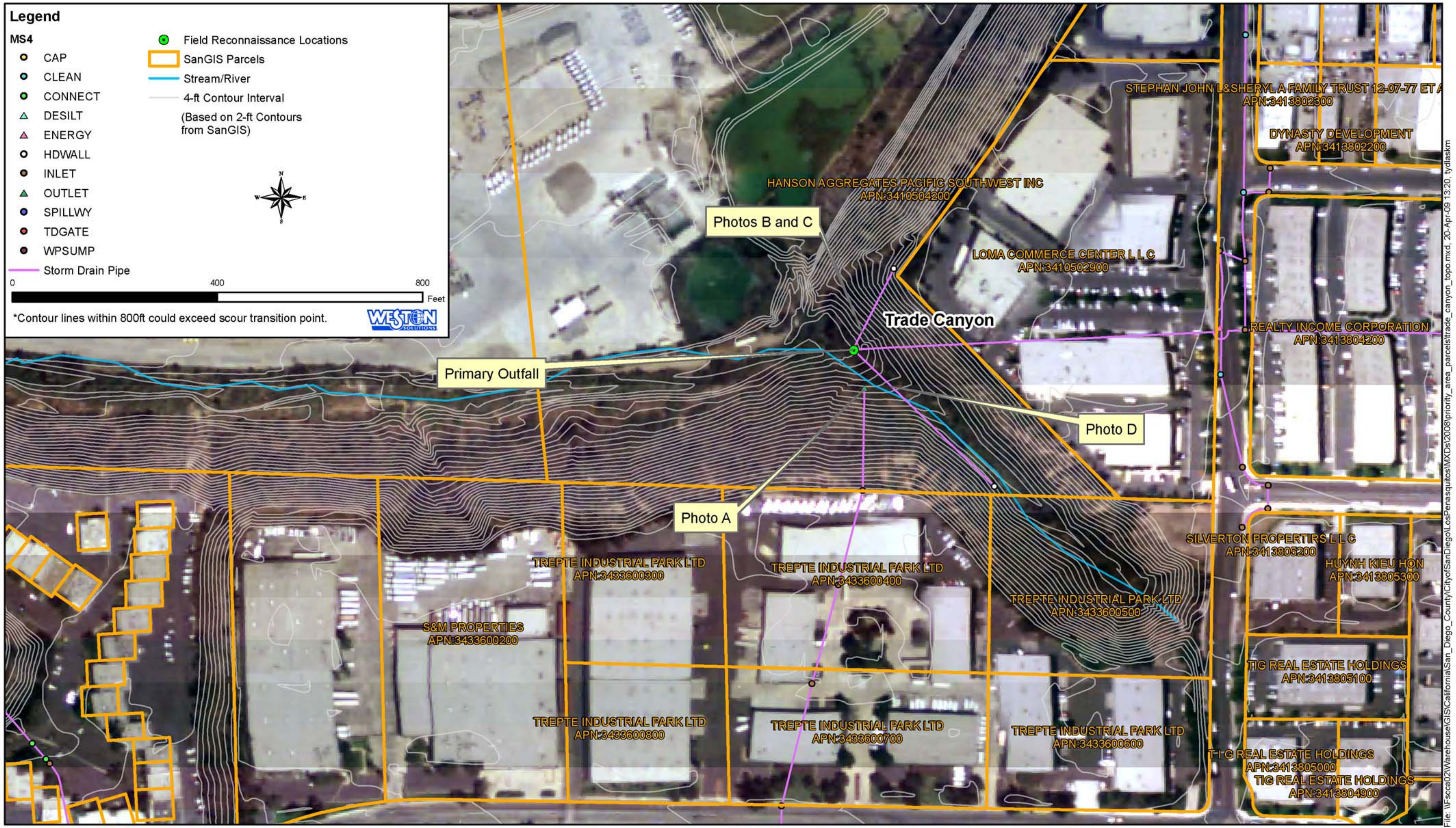

Figure 4-28. Topography and Photo Locations for Trade Canyon Outfall

Figure 4-29. Photos of Brow Ditches in Trade Canyon

Figure 4-30. Photos of MS4 Outfall in Trade Canyon

Figure 4-31. MS4 above Trade Canyon Outfall

Figure 4-32. Parcel Information and MS4 for Trade Canyon

Roselle Street Drainage (32°.53'58.34" N, 117°13'22.31" W)

Roselle Street ranked second on the list of priority areas when considering sediment loading to Carroll Canyon Creek from MS4 outfalls located in natural canyon drainages (Figure 4-33 and Figure 4-34). This is due to its receiving high scores (i.e., 40 to 50 out of 50) for the following criteria in which high scores indicate sediment loading potential:

- *Elevation.* The Roselle outfall receives runoff from two natural drainages located at approximately 330 to 400 ft above sea level at its highest point that merge into a single drainage at approximately 255 ft before descending to where it enters Carroll Canyon Creek at 45 ft. The single drainage also receives storm water runoff via the MS4 from impervious areas located approximately 260 to 330 ft above sea level that drop down to the drainage at locations that are approximately 100 to 130 ft above sea level.
- *Size of outfall.* Flows from this drainage enter Carroll Canyon Creek through three 8-ft by 3.5-ft box outfalls (Figure 4-35).
- *Sediment availability.* This site had considerable sediment availability, as evidenced by the natural drainage receiving storm water flows measuring approximately 2.2 miles before reaching Carroll Canyon Creek.
- *Sediment availability/K-factor.* The lower portion of the natural drainage had a relatively high K-factor (i.e., 0.44 to 0.64), indicating that the soils were highly erosive.
- *Evidence of Scouring.* Slumping of the channel bank in the lower portion of the drainage was observed approximately 165 ft from the outfall located at Carroll Canyon Creek. Access to higher portions of the drainage was not possible due to thick vegetation and constrained access along a heavily used road (I-5 off ramp) (Figure 4-36).
- *Proximity to Receiving Waters.* This site ranked high with regard to this criterion because it outlets directly into the portion of Carroll Canyon Creek that is a cement channel, thereby increasing the potential of sediment from this outfall entering LPL during peak flows (Figure 4-35).
- *Energy Dissipaters.* Rip rap had been placed in the channel bed in an attempt to reduce the velocity of flows before they reached the Carroll Canyon Creek. However, slumping of the channel bank below the rip rap indicates that the rip rap does not adequately reduce storm water flows at the lower portion of the drainage.
- *X Factor.* This area has been an issue with regard to sedimentation in the past, and the proximity to LPL also played a role in this location receiving a high score under this criterion, as all load-reduction efforts are focused on reducing loads entering LPL.

Figure 4-33. Topography and MS4 of Upper Portion of Roselle Drainage

Figure 4-34. Topography and MS4 of Upper Portion of Roselle Drainage

Figure 4-35. Roselle Street Drainage Outfall at Carroll Canyon Creek

Figure 4-36. Photos of Drainage and Scour in the Lower Drainage

Before further development of the structural BMP for this location is pursued, three important issues that face this site may need to be explored: landownership, correcting the MS4 map provided by SanGIS, and the potential for multiple pollutants.

Currently, the lower portion of the drainage that is suitable for a structural BMP for this site is within the Caltrans right of way as it borders I-5 and an off-ramp from I-5 to Roselle Street (Figure 4-37 and Figure 4-38). Coordination and/or negotiation with Caltrans may be necessary if a BMP is to be implemented at this location to determine whether easements could be expanded for construction and maintenance needs and the potential for increased vulnerability of the nearby roadways, which includes a freeway off-ramp, to flooding and/or undercutting.

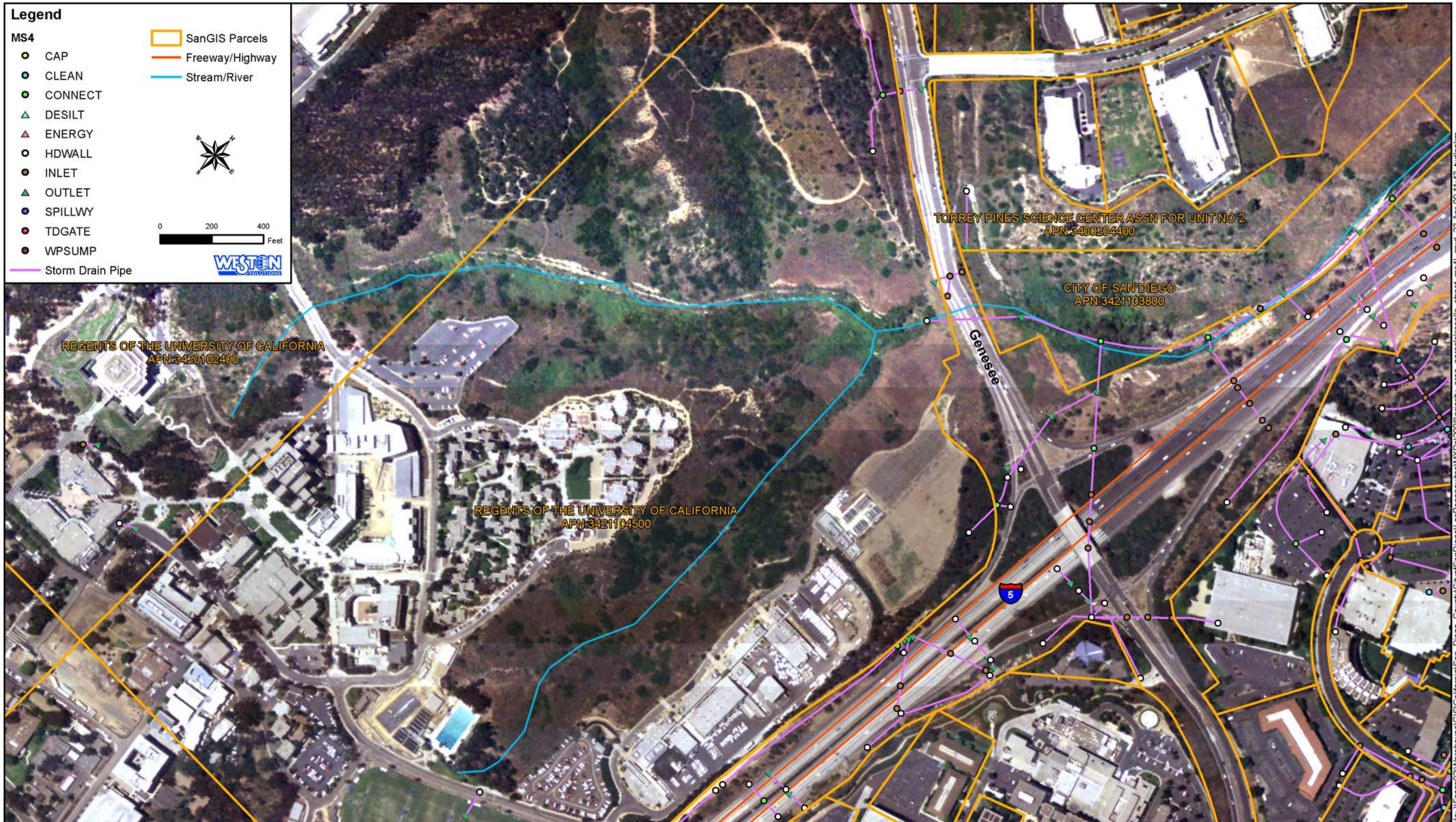

Figure 4-37. Parcel Information and MS4 for the Upper Portion of the Roselle Drainage

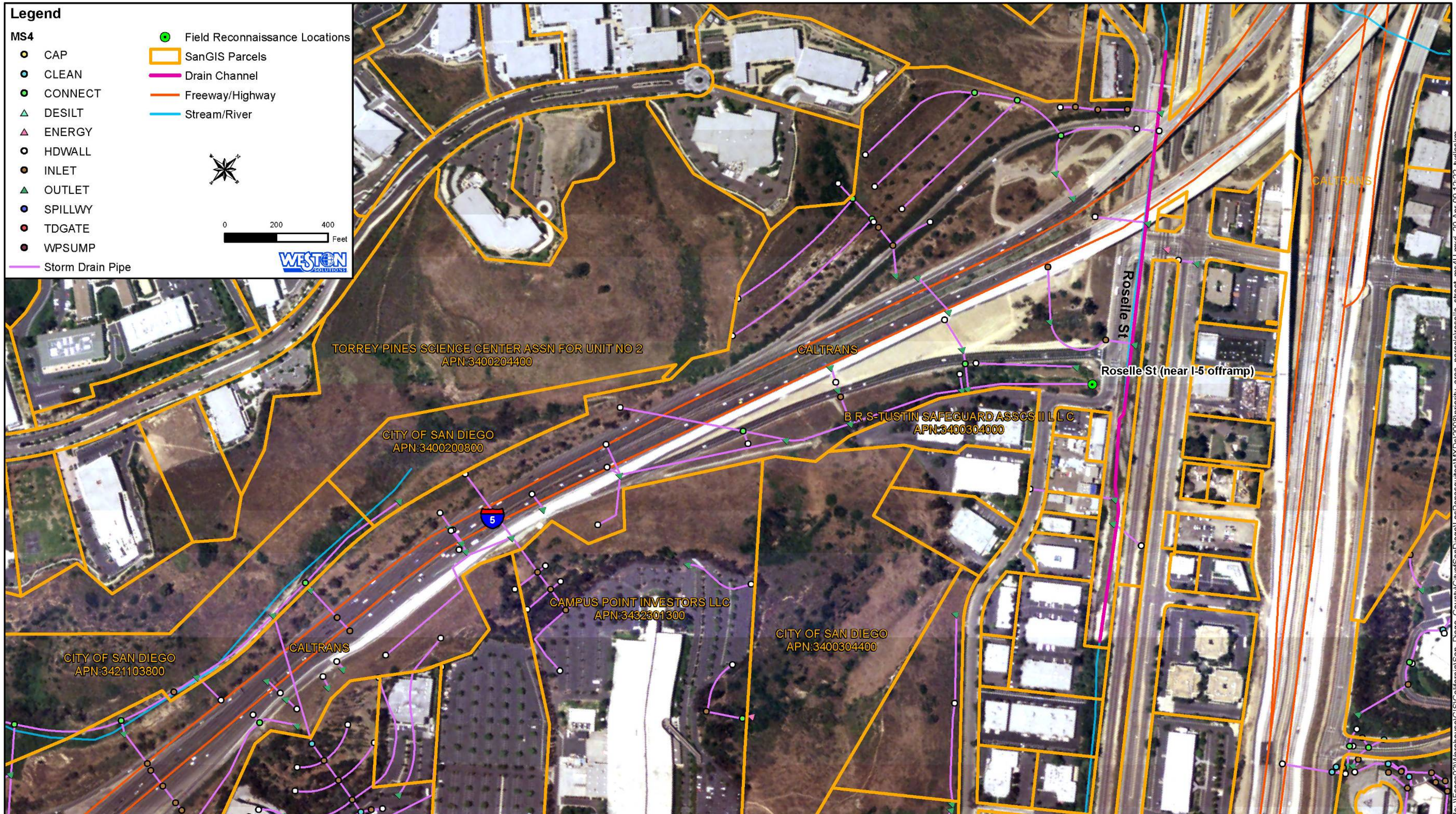

Figure 4-38. Parcel Information and MS4 for the Lower Portion of the Roselle Drainage

Furthermore, the MS4 map for this location may need to be revised because the map incorrectly shows storm drain pipes extending to the creek outfall when this location is actually an earthen drainage ditch with slight modifications (e.g., rip rap). Since engineering design work requires accurate mapping of MS4 structures to facilitate BMP design and location, this should be considered before further development of the current concept design for this location.

Flintkote Avenue Drainage (32°.54'24.99" N, 117°13'58.46" W)

Flintkote Avenue was determined to be the third highest priority area with regard to controlling sediment before it can enter LPL. This is due to its receiving high scores (i.e., 40 to 50 out of 50) for the following criteria in which high scores indicate sediment loading potential:

- *Elevation.* The Flintkote Avenue outfall receives runoff from two natural drainages located at approximately 330 ft above sea level at its highest point that merge into a single drainage at approximately 90 ft before descending to where it deposits sediment onto Flintkote Avenue at approximately 32 ft above sea level and onto a parcel owned by the Coastal Conservancy that borders Carroll Canyon Creek (also termed Sorrento Creek at this portion of the tributary) (Figure 4-39).
- *Integrity of Outfall.* The main outfall located in the southern sub-drainage has been undermined by scouring, resulting in additional sediment loading. The eroded gully under the outfall and just below it is approximately 10 to 12 ft deep and incised.
- *Sediment Availability/K-Factor.* Soil types within this drainage have a moderately high K-Factor rating (i.e., 0.33-0.43) that leads to increased sediment loading when combined with the steep portion of the upper drainage and hydromodification issues caused by impervious surfaces draining to a specific MS4 outlet located at the top of the drainage. There are also areas of exposed sediment (Figure 4-40) that could contribute to loading at this location.
- *Energy Dissipaters.* While there have been attempts to reduce flow velocities coming from the drainages through the placement of rip rap within the main gully, it appears that they are not adequate. Furthermore, flows that reach the lower portion of the drainage are carried by a cement brow ditch that runs down to Flintkote Avenue. Inspection of this site after rain events shows that sediment travels down the brow ditch and fills up a box culvert at the base of the brow ditch, resulting in flows of sediment that cross the road and deposit onto the Conservancy-owned parcel (Figure 4-41).
- *X-factor.* This site ranked high under this criterion for the following reasons: 1) Its proximity to LPL; 2) it drains an area with five businesses identified by JURMP and WURMP inspection programs as potentially high threats to water quality for sediment; and 3) it presents a safety and access issue because the road is blocked even during minor rain events.

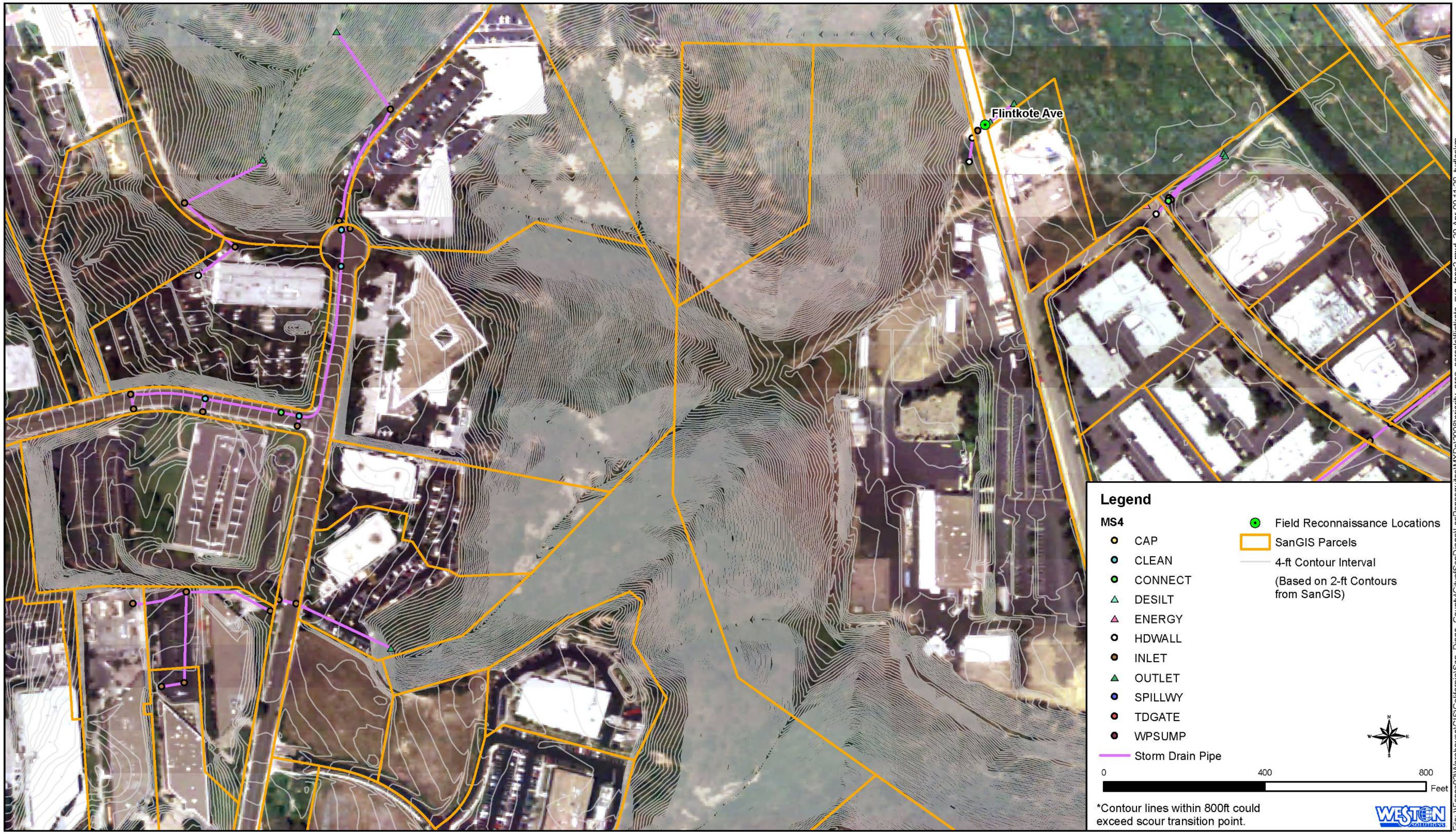

Figure 4-39. Topography and MS4 for Upper Portion of the Flintkote Ave. Drainage

Figure 4-40. Photos of Exposed Sediment within the Drainage

Figure 4-41. Photos of Deposition on Flintkote Avenue

Before further development of the structural BMP for this location is pursued, three important issues that face this site may need to be explored: landownership, easements, and the potential for multiple pollutants.

The lower portion of the drainage area is located within the private parcel owned by Lindbergh Properties Inc., that is home to one of the General Atomic facilities. The upper portion of the drainage area is owned by State Parks, the City of San Diego, and several private landowners that include TSI LP, Pharmingen, Altman Investments, and La Jolla Spectrum Association (Figure 4-42). Addressing sediment loading from this drainage may involve consideration of the following factors: hydromodification from privately owned land along the ridge, sediment sources within "unimproved land," and potential areas for structural BMP implementation located on private land.

The presence of a sewer line and maintenance road within the main drainage at this location indicates that the City's Metro Wastewater Department has an easement at this location. Any work within this drainage will most likely involve the department's participation to provide assurance that its sewer line will not be vulnerable to flooding or undercutting, as well as to coordinate access during construction and maintenance activities.

Autoport Mall Canyon Outfall (DW063) (32°.52'48.59" N, 117°10'56.84" W)

Autoport Mall Canyon Outfall, named by the WESTON team for the nearest road (Autoport Mall) located near the outfall, ranked fourth on the priority area list. This is due to its receiving high scores (i.e., 40 to 50 out of 50) for the following criteria in which high scores indicate sediment loading potential:

- <u>Elevation.</u> This outfall receives drainage from an area with an elevation of 330 to 400 ft above sea level. Though the outfall is located at approximately 320 ft, the drainage itself descends to approximately 200 ft before it connects to the drainage below the Rasha Canyon Outfall and continues to join Carroll Canyon Creek at approximately 140 ft.
- <u>Slope Factor.</u> While there was not a large discrepancy between the elevation of the canyon top and where the MS4 outfall was located within the drainage, the distance between the two was relatively short, resulting in a steep gradient that has a potential to augment the velocity of storm water flows before they are released into the natural drainage. Furthermore, the drainage below this outfall had a relatively steep grade that appears to exceed 0.5%, the threshold slope at which erosion occurs within drainages, for the entirety of this drainage before it joins the drainage below the Rasha Outfall and proceeds to Carroll Canyon Creek (Figure 4-43).
- <u>Evidence of Scouring.</u> While the area around the outfall was heavily vegetated and exhibited indications of high-energy flows (e.g., bent vegetation, trash deposited in upper tree branches), there did not exist evidence of heavy scouring immediately below this outfall (Figure 4-44). However, there were signs of large areas of cutting in the lower portion of the drainage, which could be the result of high-energy flows caused by water moving down the steep grade of this drainage.
- <u>Energy Dissipaters.</u> There was not a great deal of scouring evident just below this outfall, potentially due to the thick vegetation that impeded visual surveys (Figure 4-45).

- *Evidence of Multiple Pollutants.* Brow ditches choked with cobble, broken concrete, and assorted trash (appears to be a minor dump site). This outfall is also located below several automotive shops, which could contribute to polluted runoff to this drainage (Figure 4-46 and Figure 4-47). Furthermore, this outfall has been identified during dry-weather sampling programs as a location with high levels of turbidity, bacteria and other pollutants.
- *X-factor.* While there was not a great deal of scour evident near the outfall (note, this area was choked with vegetation), signs of large slumping of the drainage banks (see photos) were evident downstream. Since soil types are not highly erosive in this drainage (K-factor of .02-0.1), the evidence of scour indicates that this drainage experiences high-energy flows during storm events and/or erosion within the drainage is a function of the steep grade as shown in Figure 4-43.

Figure 4-42. Parcel Information and MS4 for Flintkote Avenue

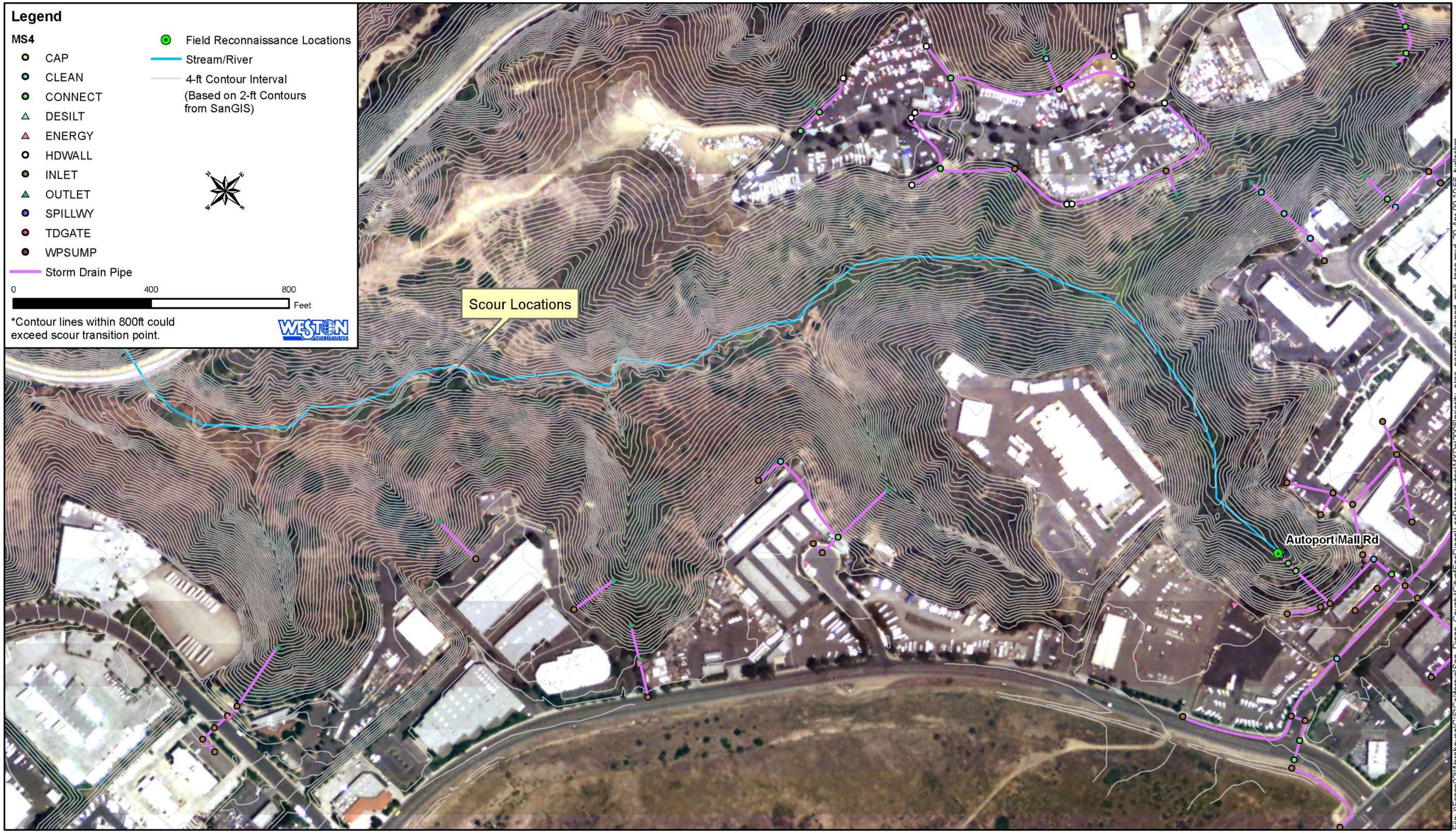

Figure 4-43. Topography and MS4 of Autoport Mall Drainage

Figure 4-44. Evidence of Scour in the Drainage below the Autoport Mall Outfall

Figure 4-45. Photos of the MS4 Outfall at Autoport Mall Road

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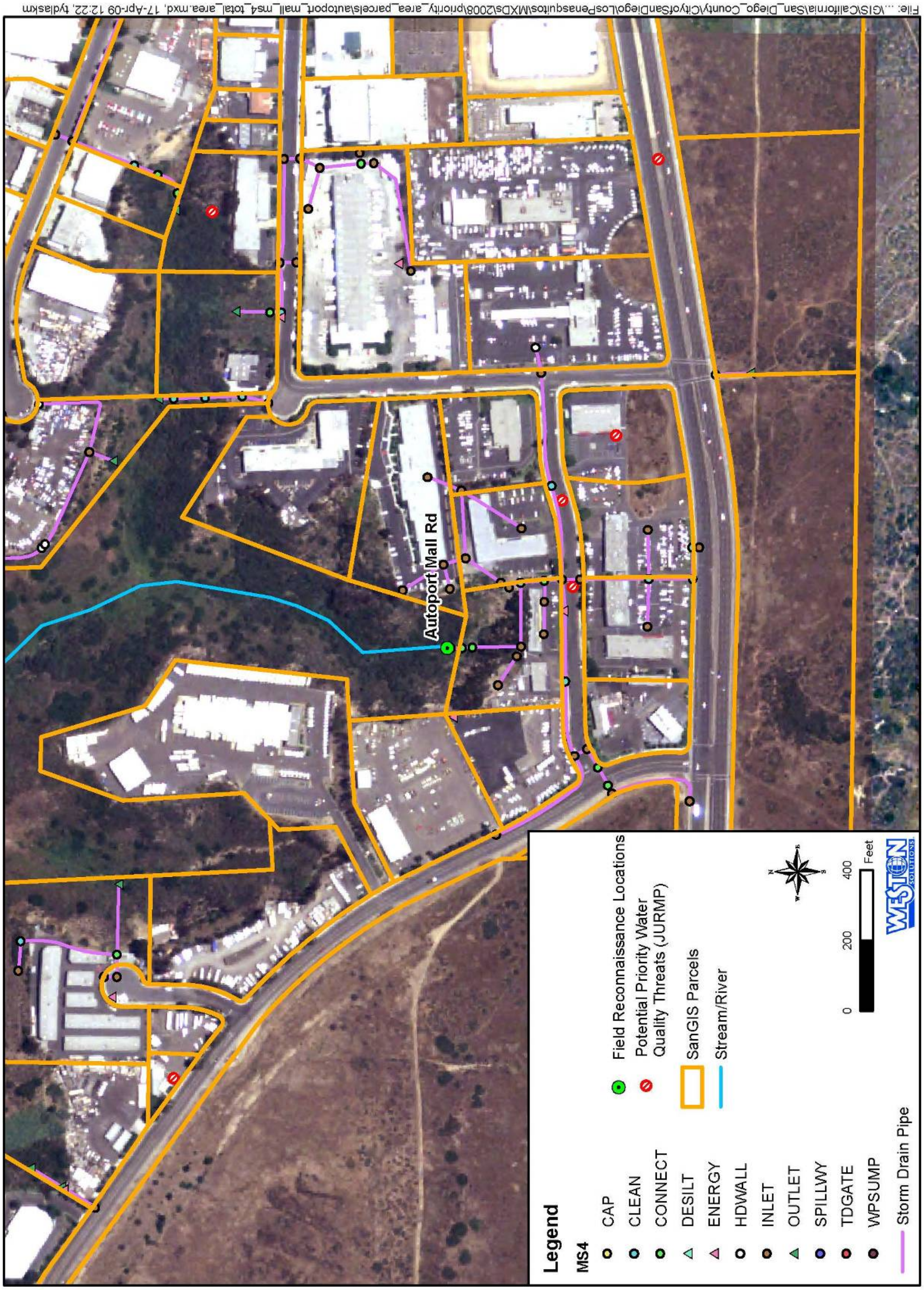

Figure 4-46. MS4 above Autoport Mall Outfall

Figure 4-47. Photos of Potential Multiple Pollutants and Trash at the Outfall

Before further development of the structural BMP for this location is pursued, three important issues that face this site may need to be considered: landownership, thick vegetation, and the potential for multiple pollutants.

As shown in many of the drainages within the Carroll Canyon subwatershed, land is owned by private entities, making sediment load reduction efforts within the drainages potentially a challenge (Figure 4-48). In the case of this location, the upper drainage, including the location of the outfall, is owned by Eastgate Miramar Associates (i.e., APN 3432601700). The lower portion of this drainage that contains the large areas of scour as shown in Figure 4-44, is also owned by Eastgate Miramar Associates (i.e., APN 3430104300) as shown in Figure 4-48, which could present challenges with regard to implementing structural BMPs (e.g., grade controls, flow-reducing gabions) within the lower portion of the drainage.

Thick vegetation made inspection of the outfall at Autoport Mall difficult (Figure 4-45 and Figure 4-47). Brush management will probably be needed to adequately inspect and photo-document this location, however, the thick vegetation may be protecting the area immediately below the outfall from scour due to stabilization of the soils by root systems and acting as an energy dissipater as the biomass impedes flow velocity of storm water discharges.

Rasha Canyon Outfall (DW065) (32°.52'55.22" N, 117°10'24.56" W)

Rasha Canyon, named for the nearest road (Rasha Street) located near the outfall, ranked fifth on the priority area list, just below Autoport Mall Outfall. This is due to its receiving high scores (i.e., 40 to 50 out of 50) for the following criteria in which high scores indicate sediment loading potential:

- *Elevation.* This outfall receives drainage from an area with an elevation of approximately 330 ft above sea level. Though the outfall is located at approximately 280 ft, the drainage itself descends to approximately 200 ft before it connects to the drainage below the Autoport Mall Canyon Outfall and continues to join Carroll Canyon Creek at approximately 140 ft (Figure 4-49 and Figure 4-50).

- *Slope Factor.* While there was not a large discrepancy between the elevation of the canyon top and where the MS4 outfall was located within the drainage, the distance between the two was relatively short, resulting in a steep gradient that has a potential to augment the velocity of storm water flows before they are released into the natural drainage.
- *Surface Area for Drainage.* This outfall receives drainage from a relatively large area composed mostly of impervious surfaces due to industrial and commercial land use, which increases the potential for this outfall to receive large volumes of storm water runoff, as shown in Figure 4-51.

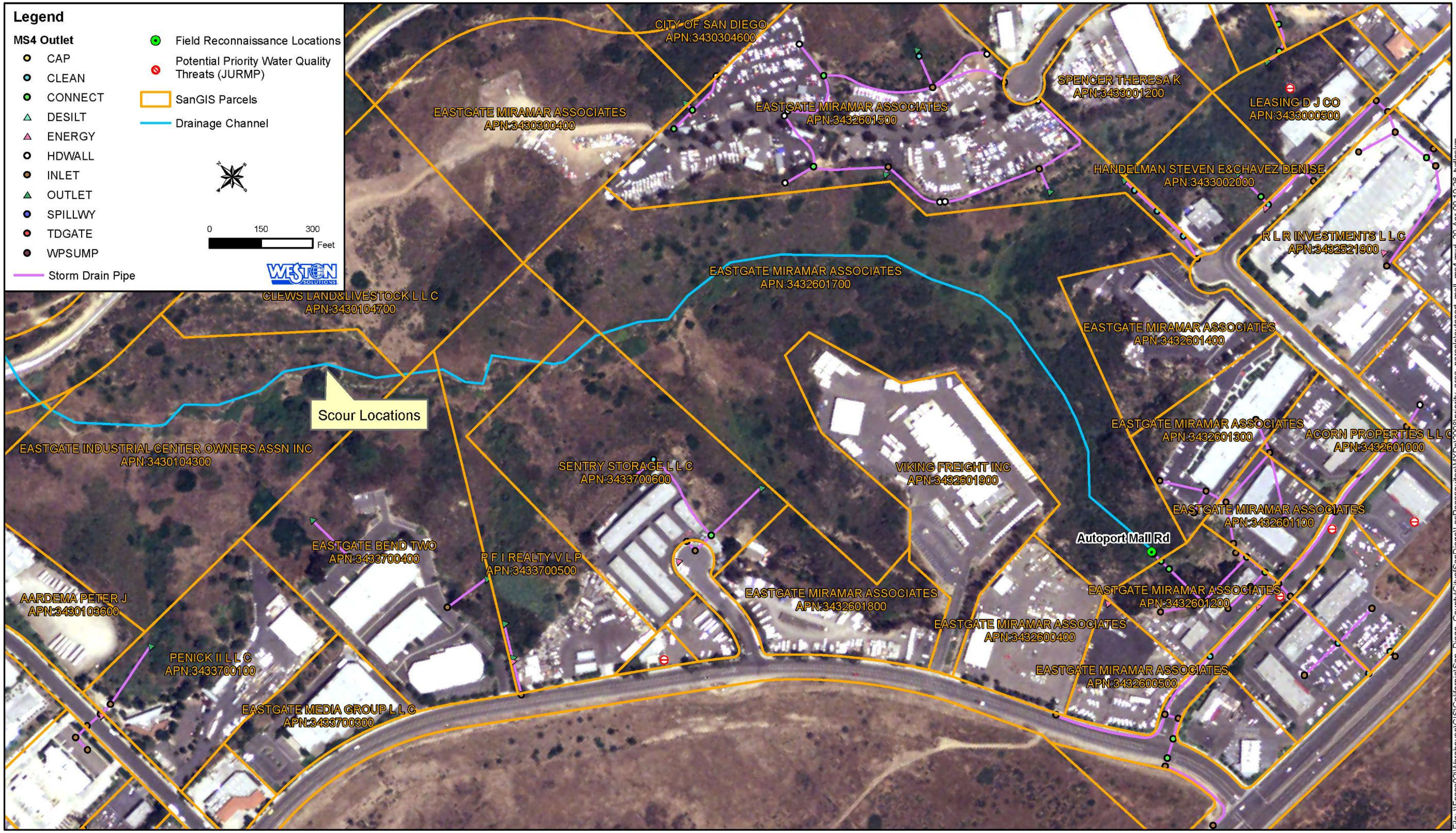

Figure 4-48. Parcel Information and MS4 for Autoport Mall Drainage

Figure 4-49. Topography and MS4 of Upper Portion of Rasha Drainage

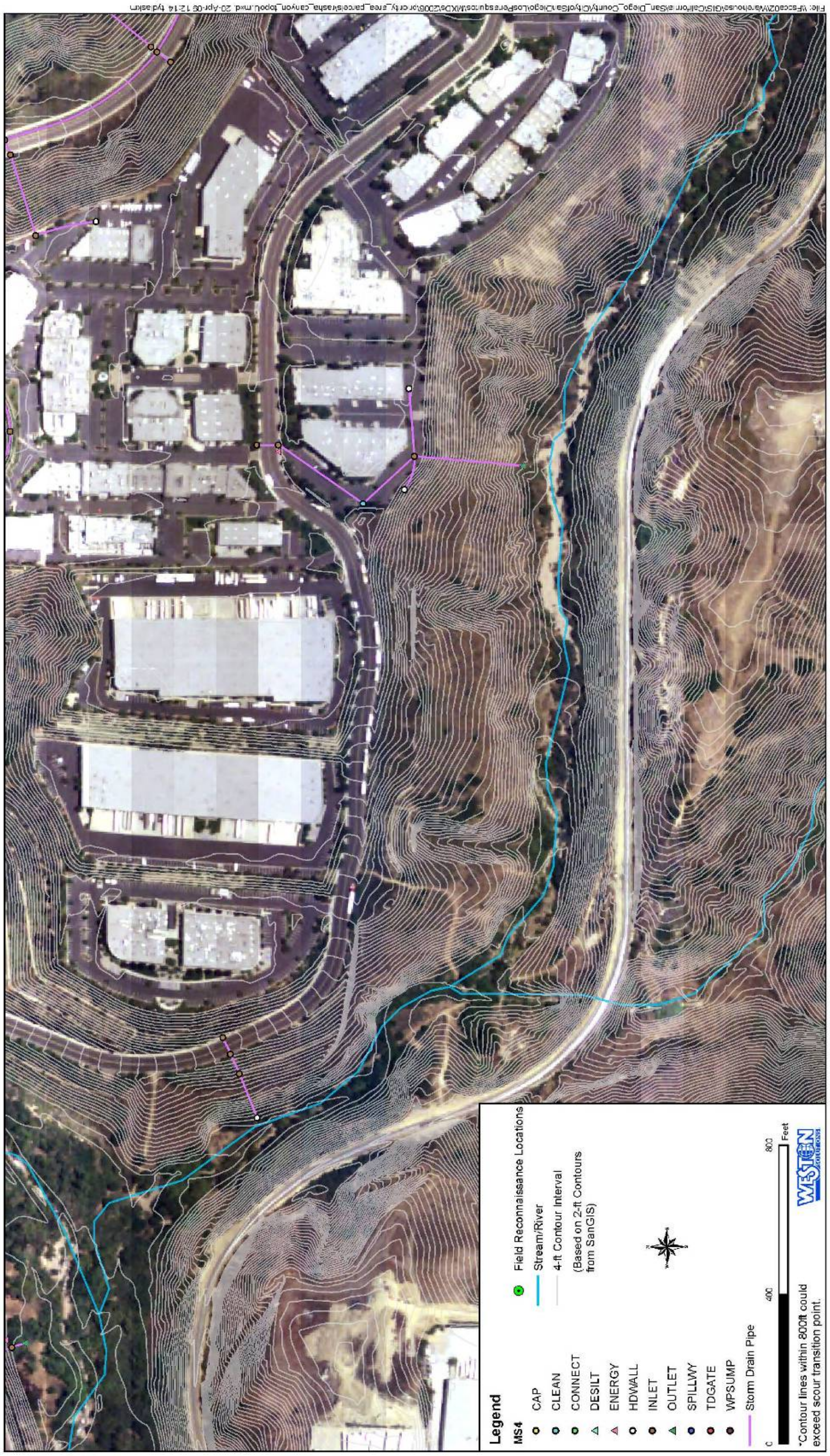

Figure 4-50. Topography and MS4 of Lower Portion of Rasha Drainage

Figure 4-51. MS4 Drainage to Rasha Outfall

- *Cement Conduits to Outfall.* Several cement brow ditches and peripheral drainages connect to this site's main outlet structure, thereby increasing the potential for this outfall to receive large volumes of storm water runoff.
- *Size of Outfall.* The outfall at this site was relatively large, measuring approximately 7 ft in diameter. Previous visits to this outfall have indicated that this outfall experiences very large, high-energy flows during storm events.
- *Sediment availability/K-factor.* The lower portion of the natural drainage, along the northern slope, had a relatively high K-factor (i.e., 0.44 to 0.64), indicating that the soils were highly erosive and could provide a source for sediment as storm water flows move down the canyon. Access to this portion of the drainage was not possible, nor were there any viewing points from other canyon tops to further investigate this possibility.
- *X-factor.* This area scored high on this criterion due to detections of bacteria and nutrients, and general chemistry observed during monitoring efforts conducted during the San Diego County Municipal Copermittees Urban Runoff Monitoring Program. A unique opportunity to remove a large area of exotic vegetation at this site exists, which could potentially render implementation of a structural BMP at this site self-mitigating.

Before further development of the structural BMP for this location is pursued, three important issues that face this site might need to be explored: landownership, thick vegetation, and the potential for multiple pollutants.

While the outfall appears to be located on City property, it neighbors two privately owned parcels that could become included and/or impacted by the project footprint should a structural BMP be implemented at this site. Access for construction and maintenance would probably involve the alteration (e.g., construction of an access road) and resultant impacts to these properties if the easements are not sufficient. However, this drainage provides the best opportunity for the implementation of a structural BMP when compared to other drainages because the City owns almost the entire drainage before it connects to the drainage below the Autoport Mall Outfall (Figure 4-52 and Figure 4-53).

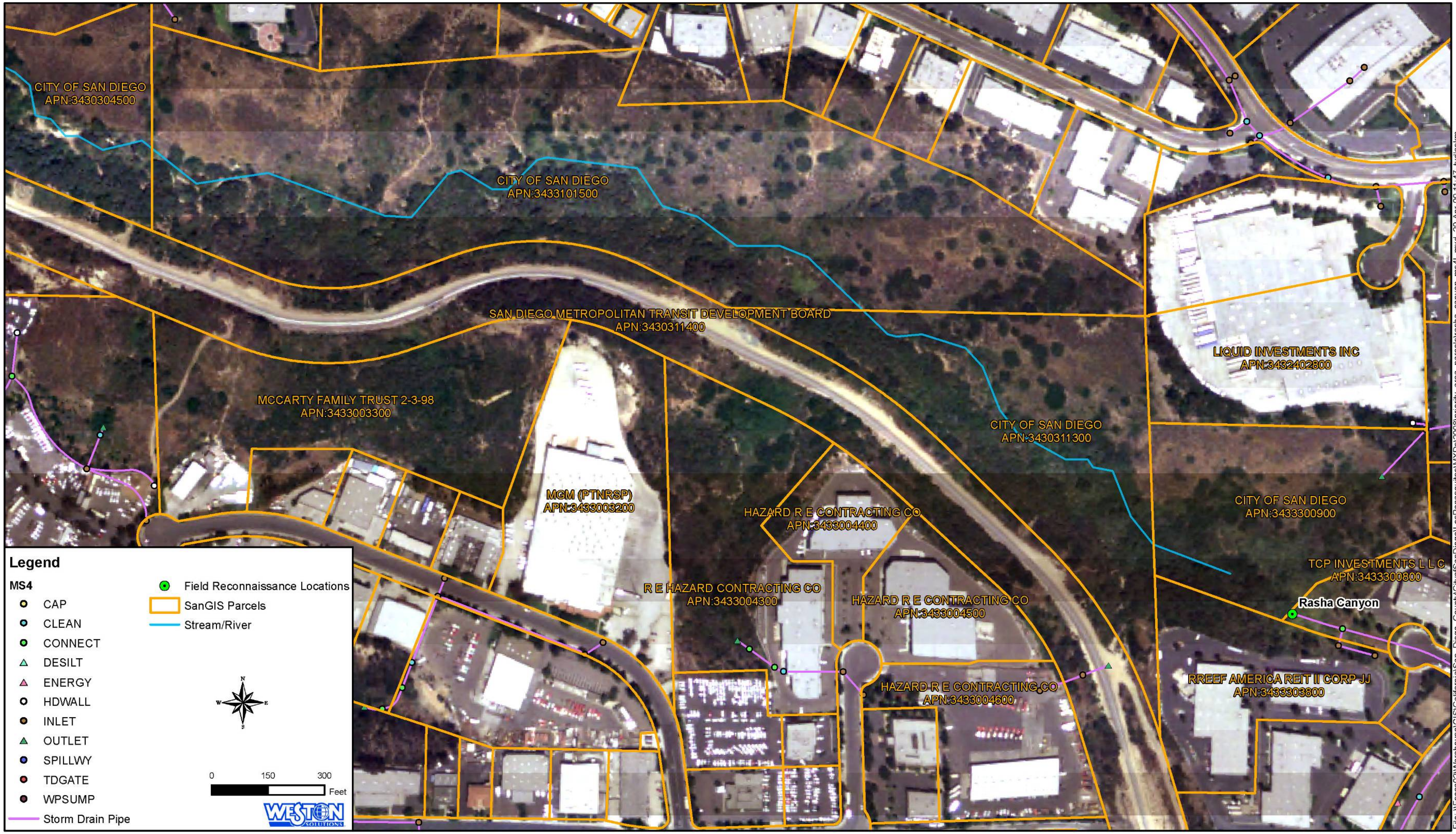

Figure 4-52. Parcel Information and MS4 for the Upper Portion of Rasha Drainage

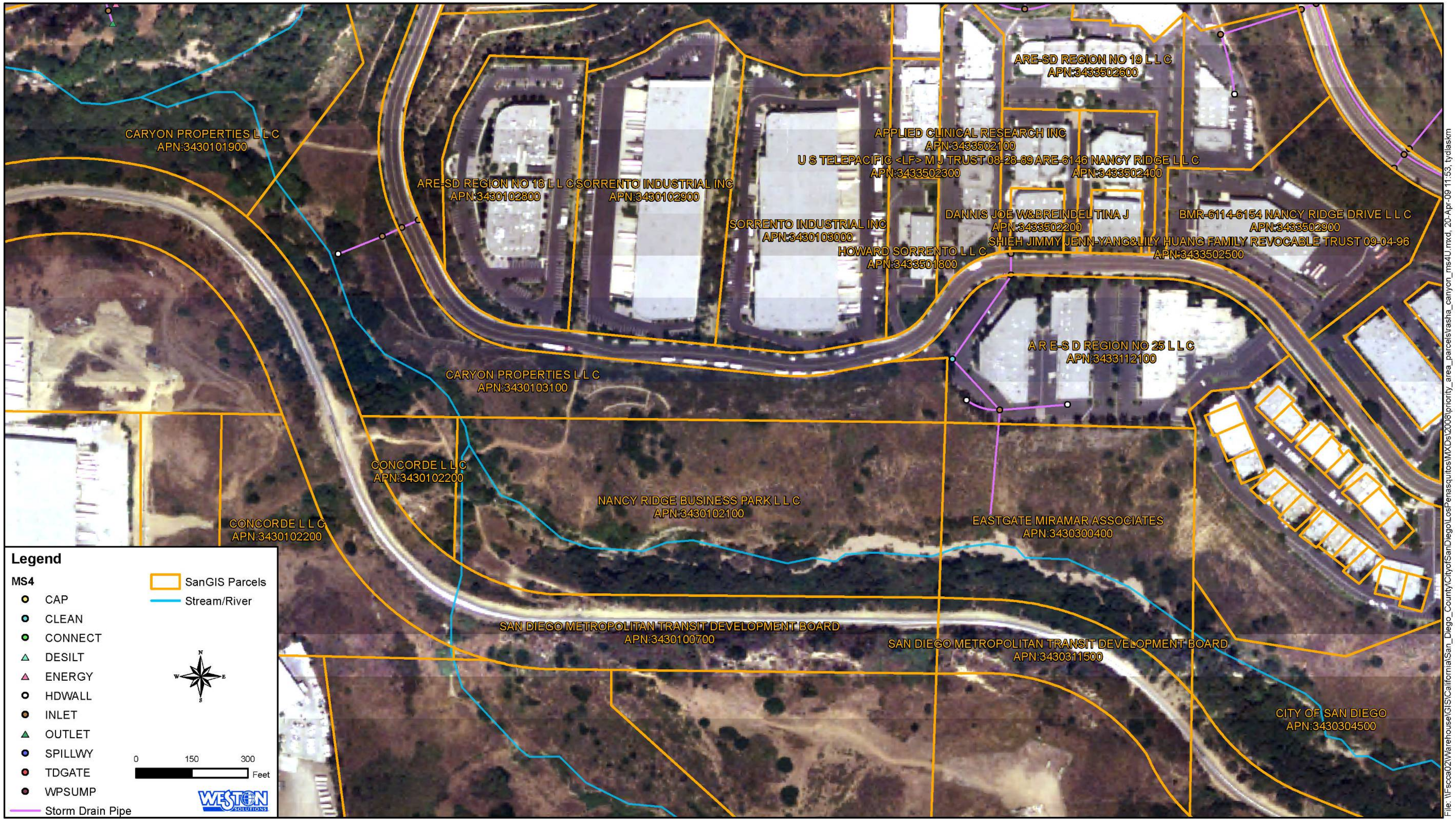

Figure 4-53. Parcel Information and MS4 for the Lower Portion of Rasha Drainage

Access to this area is highly problematic due to a thick stand of Pampas Grass (*Cortaderia selloana*) that dominates this site. However, this species is nonnative, and thereby could present self-mitigation opportunities to reestablish native vegetation such as the coastal sage scrub. Any clearing and grubbing of this species should consider its seedbank dispersal properties, and optimal times to prevent redistribution of this invasive species within the project area and adjoining lands.

4.3.3.3 Land Use and Activities

The Strategic Plan identified high-priority sources of threats to water quality for Los Peñasquitos Watershed as related to land use and activities (Table 4-2) (WESTON, 2007b). Of these high-priority sources, it was determined that inspection should focus more on industrial and commercial land uses as they were identified in the TMDL Monitoring Report as potentially significant contributors to sediment loading in Carroll Canyon. Using inventory spreadsheets of potential threats to water quality generated by the City's JURMP, WESTON developed a summary spreadsheet of 22 potential sites within the Carroll Canyon subwatershed that were mapped to provide their location within this subwatershed to display potential areas of overlap with regard to MS4 outfalls, major drainages, and proximity to receiving waters (Appendix G). Considering the magnitude of specific land use activities within Carroll Canyon, it was determined that field inspections of two large aggregate mining and processing facilities and a cemetery located along Carroll Canyon Creek would be more cost effective than inspecting each facility listed on the summarized inventory spreadsheet.

Table 4-2. Priority Sources of Sediment in Los Peñasquitos Watershed

Source	Priority Level
Residential areas and activities – landscaping	High
Commercial landscaping	High
Golf courses, parks, and recreational facilities	High
Roads, streets, highways, and parking facilities	High
Animal-related facilities	Medium
Municipal facilities and activities	Medium
Construction sites/general contractors	Medium
Auto-related facilities	Low

Hanson Materials Company - Aggregate Mining and Materials Facility in Carroll Canyon
Located between Miramar Road and Mira Mesa Boulevard, just east of Camino Santa Fe, this site has been mined continuously since the 1950s. Originally owned and operated by the Fenton Materials Company (Fenton), the mining and materials production facility, as well as the land, was sold to Hanson Materials Company (Hanson) in 1998. Hanson operates the aggregate mining and materials production facility that provides asphalt, concrete, sand, and related products to the development community under Conditional Use Permit (CUP) No. 86-0803 that was originally issued to Fenton in 1986, modified and reissued as CUP No. 89-0585 and then

later transferred to Hanson. CUP No. 89-0585 is set to expire on March 1, 2015, and includes provisions for the mandatory 5-year review of the CUP to be performed by the City. In addition to the CUP, the Hanson facility at Carroll Canyon is subject to the State Surface Mining and Reclamation Act (SMARA), which requires that the property be inspected by the lead agency (i.e., City of San Diego) annually to confirm compliance with the approved Reclamation Plan, with the costs associated with this inspection to be borne by Hanson (City of San Diego, 2001).

While there does not exist conclusive evidence that shows this facility contributes to sediment loading to the nearby creek, it is apparent that the magnitude and nature of this operation may lead to added scrutiny (Figure 4-54). A site visit to this location revealed unmaintained rumble strips and entrance area covered in dust, such that trucks passing in and out of the complex would suspend dust into the air that could be deposited near storm drains or within the nearby creek. Furthermore, several large piles of aggregate material (different-sized particles) and dirt access roads/work areas are present near Carroll Canyon Creek, without silt fencing or other BMPs to protect water quality (Figure 4-55 and Figure 4-56), as well as sediment conveyance structures that span the creek (Figure 4-57). However, a recent inspection of the facility revealed that this operation did not impact water quality, as shown in the inspection report presented in Appendix H.

Mineral extraction and materials production at the Hanson facility in Carroll Canyon will likely increase because of recent and pending closures of several North County aggregate and asphalt facilities that will render the Hanson facility in Carroll Canyon one of three remaining aggregate and asphalt sources within San Diego County (Engineering and General Contractors Association, 2004).

Figure 4-54. Overview of the Western Portion of the Hanson Facility in Carroll Canyon

Figure 4-55. Aggregate Stockpiles near a Tributary to Carroll Canyon Creek

Figure 4-56. Sediment and Gravel Piles along the Channel of Carroll Canyon Creek

Figure 4-57. Aggregate Conveyance Crossing Carroll Canyon Creek

Vulcan Materials Company - Aggregate Mining Facility in Carroll Canyon

Located just east of the Hanson facility, Vulcan Materials Company (Vulcan) operates an aggregate mining and materials production facility that provides asphalt, concrete, sand, and related products to the development community.

Inspection of the Vulcan Facility revealed that this site would probably not contribute significantly to sediment loading into Carroll Canyon Creek. Structural BMPs designed to reduce runoff to Carroll Canyon Creek and control dust (e.g., rumble strips) appeared intact and well maintained. Furthermore, it appears that the facility's mining operations and detention ponds occur in areas that are below the creek bed, which would prevent runoff from these sites from entering Carroll Canyon Creek (Figure 4-58).

Figure 4-58. Mining Operations at Vulcan's Carroll Canyon Facility

El Camino Memorial Cemetery

Located off of Carroll Road, the El Camino Memorial Cemetery was identified as a potentially high threat to water quality by the City under its JURMP and WURMP. Overall, this land use activity did not appear to present threats to Carroll Canyon Creek with regard to sediment. The property appeared to be well vegetated in that there were no visible areas of exposed sediment other than from grave excavation and sediment stockpiles. While the sediment stockpiles, used for fill material at the cemetery, located near Carroll Canyon Creek lacked silt fencing or other temporary devices used to contain runoff during storm events at the time of inspection, an earthen berm located between the sediment piles and the creek seemed to be providing adequate water quality protection (Figure 4-59).

Figure 4-59. Sediment Stockpiles near Carroll Canyon Creek

4.4 Potential Sediment Load Reduction Opportunities to Meet TMDL Requirements

Based upon results from the historical analysis and data review, WESTON compiled a list of current and potential sediment reduction activities occurring within the Los Peñasquitos Watershed. This could assist in meeting initial load reduction requirements within the short-term until source abatement efforts that reduce sediment loading from the watershed can be implemented. Figure 4-60 and Figure 4-61 present the locations for the potential sediment load reduction opportunities described in this subsection. While the Torrey Villas Resort Apartments site was included in Figure 4-60, it was not referred to in this section because it would only contribute to minor load reductions when compared to the other alternatives for sediment load reductions to receiving waters. However, this location might be considered due to its high visibility and proximity to Carroll Canyon Creek.

4.4.1 Los Peñasquitos Subwatershed

4.4.1.1 El Cuervo Norte Wetland Mitigation Project

The City of San Diego has been active in restoration activities within the watershed that have been designed to reestablish native vegetation as mitigation for the City's construction of State Route 56 that connects I-5 with I-15. In 2003, the City of San Diego began implementation of the El Cuervo Norte Project that created 9 acres of wetland and restored 14.3 acres of degraded wetland habitat. The El Cuervo Norte Project diverts flows from a channelized portion of Los Peñasquitos Creek into a constructed system of braided stream channels (Dudek, 2003). While it was designed to restore wetland habitat, an indirect benefit of this project is that it helped to reduce downstream sedimentation rates by reducing stream velocities and allowing sediment to settle within a natural basin located in the western portion of the project area, which could help account for the reduced peak flows, lengthened response times, and lower TSS concentrations described in the TMDL Monitoring Report since Los Peñasquitos Creek was identified as the main contributor of sediment to LPL in a study conducted prior to the implementation of El Cuervo Norte.

El Cuervo Norte could provide load reduction opportunities. Currently, maintenance responsibilities for the El Cuervo Norte site are held by the City's Department of Park and Recreation, though it is not clear if maintenance activities are occurring or if there is currently a need. Maintenance of the diversion channels may be necessary to continue the ability of this site to reduce flows and downstream sedimentation. Dredging of the detention pond could also improve the functioning of this area with regard to sediment abatement and provide quantifiable load reductions by tracking the amount of sediment removed. However, implementing this alternative will probably require coordination and/or negotiations with the Department of Park and Recreation with regard to what type of maintenance activities would be appropriate as well as under what conditions, understanding that the Department of Park and Recreation may be more focused on preservation of habitat in open space and access to the public, rather than reducing sediment loads to LPL.

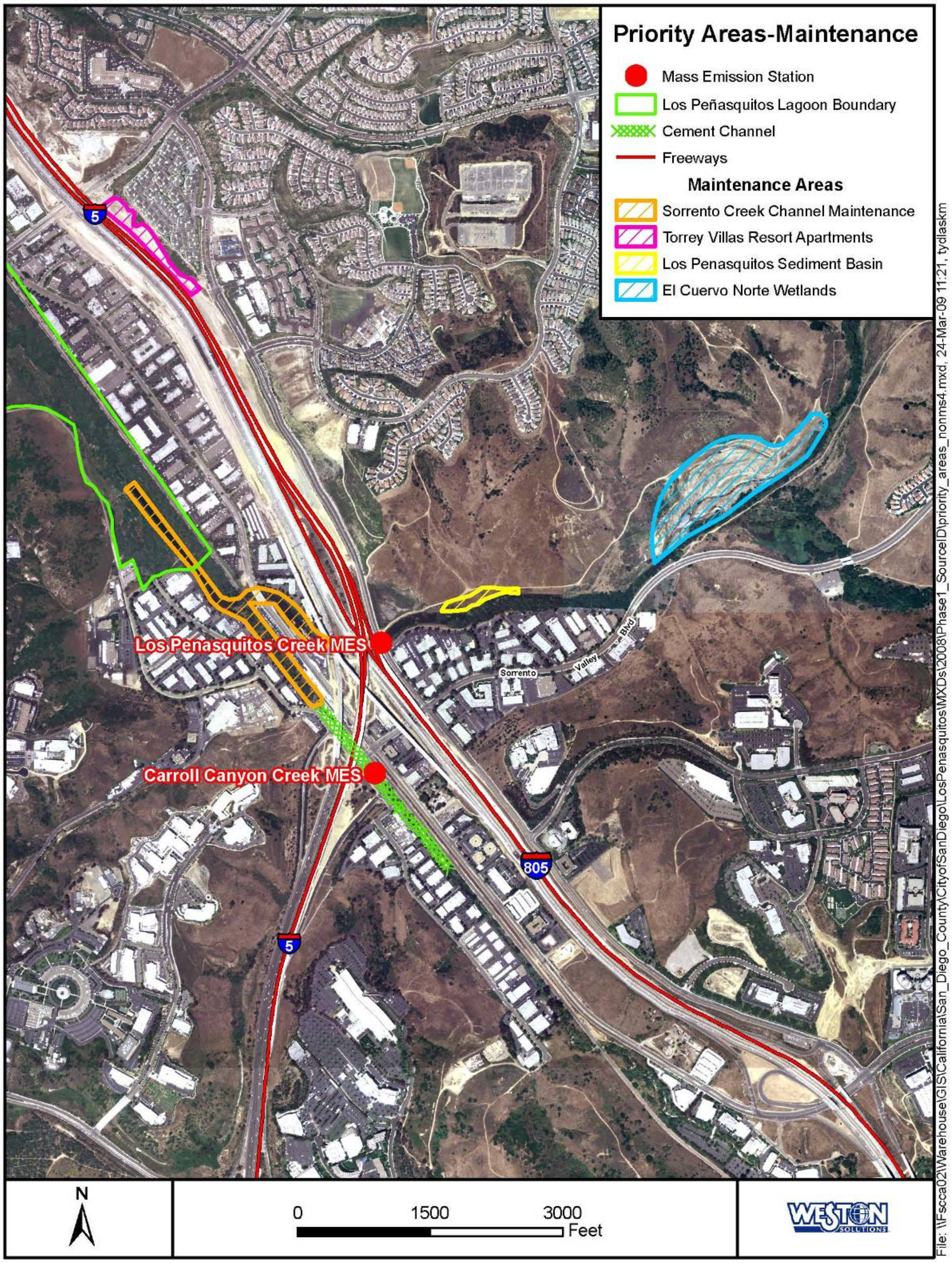

Figure 4-60. Potential Priority Maintenance Areas - Western Portion of the Watershed

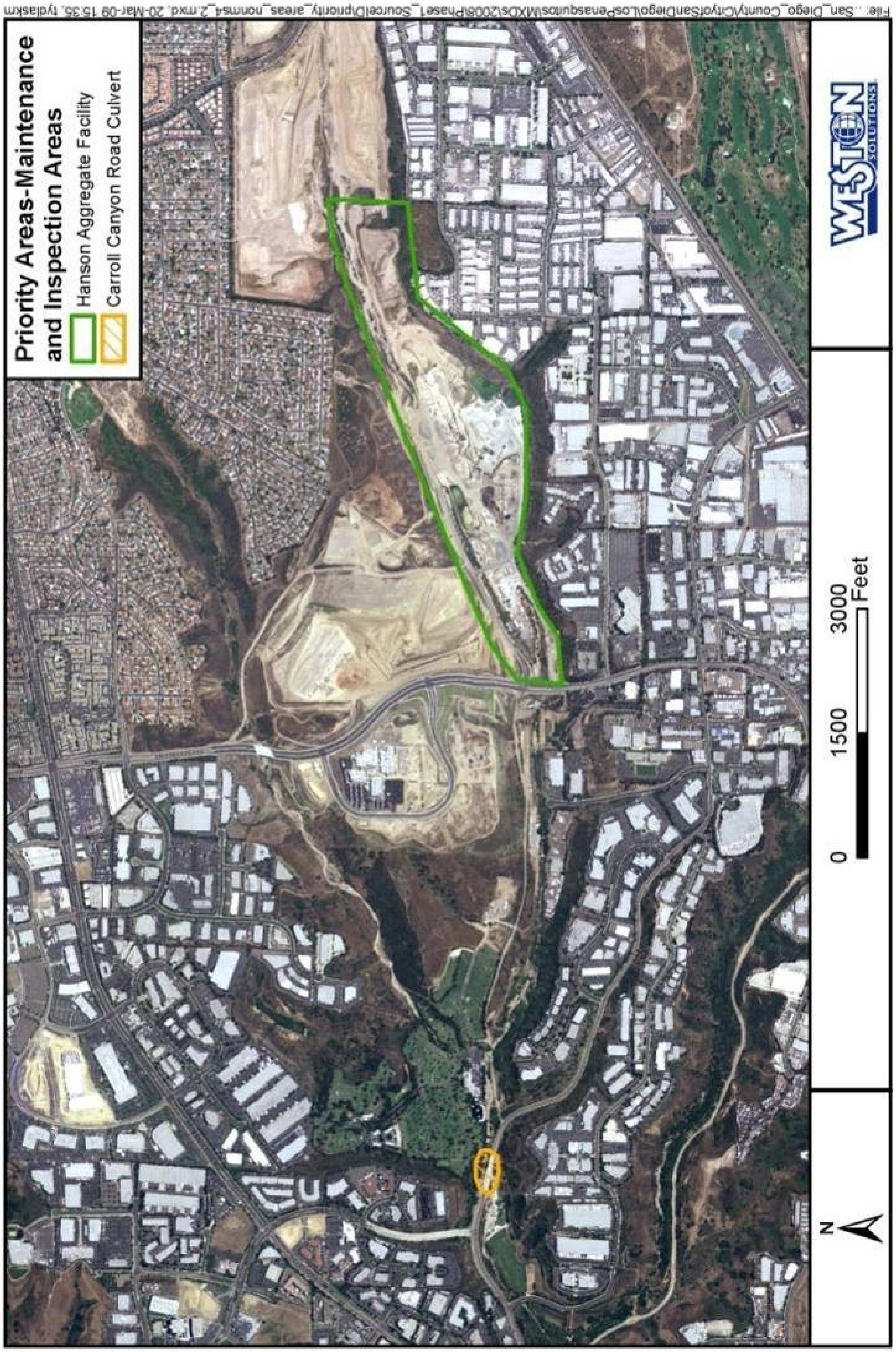

Figure 4-61. Potential Priority Maintenance Areas - Eastern Portion of the Watershed

4.4.1.2 Los Peñasquitos Lagoon Sediment Basin

LPLF, in conjunction with the State Coastal Conservancy (Conservancy), the City of San Diego, State Parks, and the Regional Board, has worked toward the creation of a restoration project designed to abate sediment input from Los Peñasquitos Creek. Funded through State Proposition 13 and 40 bond-funded restoration grants and the Conservancy's Wetland Recovery Project, LPLF proceeded to re-characterize the hydrology and sediment transport of the three main tributaries that empty into Los Peñasquitos Lagoon with the goal of creating sediment management alternatives for each tributary (Kimley-Horn, 2003). In 2004, a site was selected along a stretch of Los Peñasquitos Creek at the western edge of the subwatershed for a sediment basin with a capacity of 10,000 cubic yards (cy) designed to intercept sediment flows during 2-year to 5-year storm events. A long-term maintenance agreement with the City of San Diego was approved by City Council in July 2008. Basin construction is currently on hold due to the freeze of all State-administered grants funded by bond monies. However, efforts are currently being pursued to release these funds or find alternative funding opportunities through Federal Stimulus Packages with the hope that construction will commence in late September 2009 and conclude in December 2009, with the basin becoming operational by winter 2010.

The Los Peñasquitos Lagoon Sediment Basin could provide a more realistic, cost- effective form of load reduction than the El Cuervo Norte Mitigation site. This is mostly because this basin will be located at the western edge of Los Peñasquitos Canyon and is designed to facilitate maintenance activities that involve sediment removal. The City adopted an ordinance in 2008 to facilitate the monitoring and maintenance of this basin for the long-term and includes agreements between the Storm Water Department, Department of Park and Recreation, State Coastal Conservancy, and the Los Peñasquitos Lagoon Foundation. Furthermore, this basin could provide a safe alternative for sediment load reduction should El Cuervo Norte's diversion channels cease to function and/or the stand of *Typha* is removed to reduce the threat of flooding to nearby private property and infrastructure. While the basin is not expected to be filled during a normal storm season, it does have the capacity to detain 10,000 cy of sediment.

4.4.2 Carroll Canyon Subwatershed

4.4.2.1 Sorrento Creek Channel Maintenance Project

The City of San Diego conducts a sediment maintenance program at the confluence of Los Peñasquitos and Carroll/Sorrento creeks (Sorrento Creek Channel Maintenance Project) (Figure 4-60). This program is designed to remove vegetation and sediment from the creek beds to prevent backflows during storm events and reduce vulnerability to flooding for nearby buildings located in Pacific Sorrento Business Park. The initial efforts consisting of vegetation and sediment removal are believed to have occurred in 1998 and 2001, but are not well documented. Efforts to determine dates and volumes of dredge material removed by the City of San Diego Streets Division were unsuccessful. The most recent sediment removal effort occurred in September 2003. The September 2003 effort removed an estimated 26,928 cy of sediment from four areas: Carroll Creek (576 cy), Los Peñasquitos (6,960 cy), Sorrento Creek Desilting Basin (8,748 cy), and Sorrento Creek Confluence (10,644 cy) (San Diego, City of, 2003; Dudek, 2004). Recent efforts have focused on vegetation removal between September and October 2004, when it was determined that sediment removal would not be needed. Furthermore, the methods for sediment removal were modified in 2005 to reduce impacts to surrounding habitat caused by the maintenance project. Before 2005, the City of San Diego created in-channel access routes for equipment (i.e., a long-reach excavator and 10 to 20 trucks) using 20,000 cy of fill (San Diego, City of, 2005). The revised method would no longer use the in-channel access route and instead would involve the use of a hydraulic dredge floating on a barge. It is not clear whether the revised method for excavating sediment from the creek will reduce overall environmental impacts to the project area or replace impacts caused by the existing method with a new suite of impacts related to hydraulic dredging. However, the modified method proposes to save the City $1.1 million by reducing the cost from the old method ($3.8 million) to $2.7 million. The City of San Diego has not implemented this revised method but is in the process of permit application and has near-term future plans for implementing the project (Ibid). It is not clear whether the old or modified method has been proposed to permitting applications.

If the creek maintenance project could be moved upstream, to the cement channel, operation costs and impacts to habitat could be potentially reduced in comparison to the existing method. Access to the cement creek bed for large equipment would be available via a cement ramp at the train station and sediment could be stockpiled and potentially dewatered within the creek bed until it could be removed for disposal. However, moving the existing maintenance project upstream may have to coincide with diverting storm flows away from below-grade outfalls located within the current project area, as they may be contributing to the flooding issues to the surrounding properties due to backflow during storm events.

4.4.2.2 Hanson Material Company's Aggregate Facility in Carroll Canyon

Shown in Figure 4-61 and Figure 4-62, Hanson Material Company's (Hanson) Aggregate Facility could present numerous opportunities to reduce sediment loading to Carroll Canyon Creek. Potential opportunities include the following:

- Revising the inspection methods and approach to better capture activities and circumstances that could contribute to sediment loading to Carroll Canyon Creek.
- Designing and implementing a monitoring program to quantify sediment loads entering Carroll Canyon Creek from the Hanson facility.
- Negotiating an agreement with Hanson to use its land within the Trade Canyon Outfall drainage for the implementation of a Tier III treatment BMP.

Developing a monitoring program to assess sediment loading from this facility might help to quantify the potential contribution of sediment loads to Carroll Canyon Creek from this facility. Data generated during this program may facilitate future management efforts needed to meet load reductions from this area of the subwatershed. Some of these management efforts could include the following:

- Revising the Storm Water Pollution Prevention Plan for the facility.
- Assessing a storm water fee to provide funding for sediment load reductions off-site.
- Revising the industrial discharge permit requirements.
- Providing incentive to negotiate agreements between the City and Hanson.

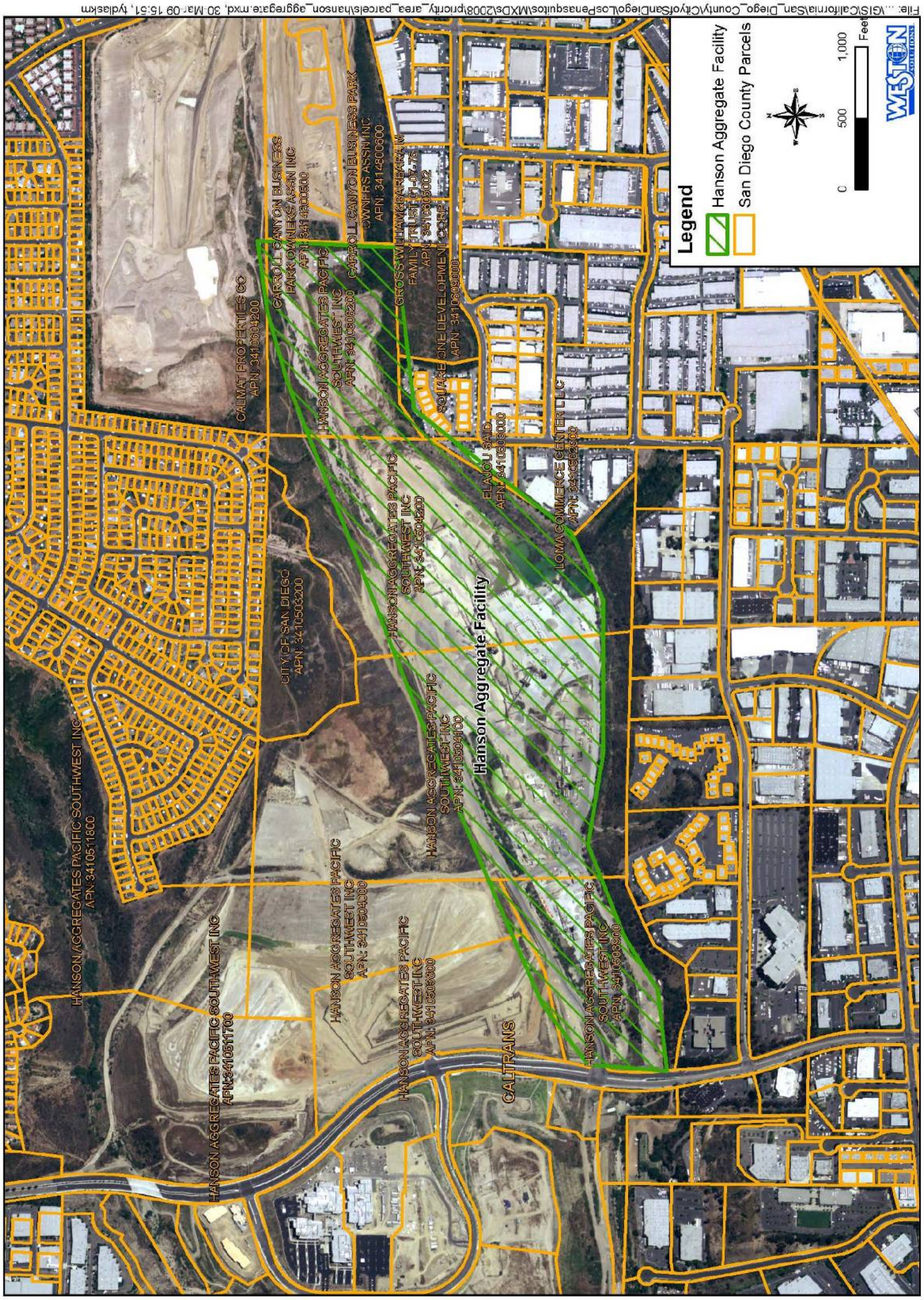

Figure 4-62. Hanson Materials Aggregate Facility

The Trade Canyon Outfall drainage presents a unique opportunity to implement a Tier III treatment BMP to address sediment loading, hydromodification, and multiple constituents of concern that could be impacting water quality in both Carroll Canyon Creek and potentially LPL. However, Hanson owns the entire parcel where this outfall is located. While a utility easement could potentially be used to maintain this MS4 outlet and the brow ditches nearby, there will most likely need to be negotiated agreements made with Hanson to implement such a BMP. It is expected that such an agreement would involve at least the following components:

- Use of the land for BMP implementation.
- Access for both construction and maintenance of the BMP.
- Safeguarding the nearby earthen berm that separates the facility's concrete mixing and loading station from the drainage.

The City does not own the land upon which the Hanson facility operates, preventing the opportunity of negotiating improvements to water quality protection through the renewal of the land lease. However, CUP No. 89-0585, issued to Hanson by the City, is set to expire on March 2015. This could provide the City with the opportunity to review and potentially modify the CUP during the mandatory 5-year review process set by City Council. Furthermore, assuming that the City is the lead agency under State Surface Mining and Reclamation Act (SMARA), the City may inspect the Hanson facility annually to confirm compliance with the approved Reclamation Plan, a requirement under SMARA, with the costs associated with this inspection to be borne by Hanson. Reclamation Plans are required for all surface mining operations that disturb greater than 1 acre or move more than 1,000 cy and must be approved prior to any mining activities. The Reclamation Plan covers existing operations as well as the transition from the current land use to an alternative use (e.g., residential) once the mine activities cease. Key components of the Reclamation Plan generally include the following components:

- Adverse environmental effects are prevented or minimized and mined lands are reclaimed to a useable condition readily adaptable for alternate land use.
- Production and conservation of minerals are encouraged, while considering recreation, watershed, wildlife, aesthetic, range, and forage values.
- Residual hazards to public health and safety are eliminated.

4.4.2.3 Carroll Road Culvert

The Carroll Road Culvert (Figure 4-61) presents an opportunity to remove loads of sediment at a relatively low cost while protecting infrastructure from flooding and sediment deposition. Should the City need to meet TMDL load reductions in the future, this site could provide quantifiable reductions of sediment loads. As shown in Figure 4-63 and Figure 4-64, this location is susceptible to flooding, most likely attributed to the heavy deposition of sediment, including cobble and debris. The investigation of this site revealed that the culvert was almost entirely blocked by sediment and debris, as well as sediment deposition on Carroll Road.

Figure 4-63. Sediment Deposition within the Culvert and along Carroll Road

Figure 4-64. Deposition Area at Carroll Canyon Road Culvert

4.4.3 Peripheral Drainages

4.4.3.1 Los Peñasquitos Lagoon – Flintkote Sediment Basin and Energy Dissipater

The Flintkote Basin and Energy Dissipater Project was initiated in 1998 by State Parks and the City of San Diego and was partially funded through a Caltrans Environmental Enhancement and Mitigation Program (EEMP). The project was designed to address both storm runoff and sediment flows from the canyon located behind and above the old State Parks superintendent's home located along Flintkote Avenue on the southeastern edge of Los Peñasquitos Lagoon. Development along the canyon rim in the 1990s created impervious surfaces and manmade drainage systems that resulted in increased storm water runoff into the canyon that scoured natural drainage areas and generated large sediment flows into the lagoon area below the canyon walls. State Parks and the City of San Diego worked together to design and implement an energy dissipater and a separate sediment basin to mitigate these impacts. Both structures were located below the canyon walls and along the affected drainage areas to intercept storm water and sediment before it could reach the lagoon. The pre-construction stage (e.g., site reconnaissance and basin design) of the project was initiated in spring 2005. The project was completed in 2006 and is functioning according to design and expectations.

4.4.3.2 Los Peñasquitos Lagoon Ocean Inlet Maintenance Program

Though not located within a peripheral drainage to LPL, this ocean inlet maintenance program addresses the problem of sediment loading to the lagoon from the sources located along the coastline and within the near-shore environs of the ocean. This maintenance program's location warrants its inclusion in the "Peripheral Drainages Section" of this report because the program's footprint extends to the periphery of the lagoon (i.e., Torrey Pines State Beach).

Since 1985, the LPLF has conducted mechanized lagoon mouth openings at the ocean inlet in response to degraded water quality within lagoon channels during extended mouth closures. The frequency of these openings depends on several factors, including long-shore sediment transport, wave activity, rainfall, and water quality conditions set by the program's Coastal Development Permit. However, monitoring of the mouth openings since the 1960s have shown that LPLF must open the mouth mechanically at least one time per year and as often as three times (Coppock et al., 1985; Boland, 1993; Wells, 2000; Coastal Environments, 2002; Coastal Environments, 2003a; Coastal Environments, 2003b; Coastal Environments, 2003c; Coastal Environments, 2004; Coastal Environments, 2005; Coastal Environments, 2006; Coastal Environments, 2007; Coastal Environments, 2008a; Coastal Environments, 2008b; Hastings, 2007). Mouth openings range from breaches of the lagoon mouth to large-scale excavations with all methods using heavy equipment (e.g., excavators, front loaders, and dump trucks). Breaches occur during the winter months in response to extended mouth closures that result in degraded lagoon water quality below conditions set by the program's Coastal Development Permit. Small-scale openings of this style are typically completed within 1 day and remove approximately 2,000 to 3,000 cy of sediment to reestablish tidal mixing. This type of opening is considered more cost effective than the larger emergency opening during the winter months when the North Pacific storm track is active, and the potential for large storm- driven waves still persists, making the lagoon mouth vulnerable to repeated closings. Larger emergency openings tend to occur in the late spring and are designed to ensure that the lagoon mouth remains open during the summer months when water quality is more vulnerable to degradation due to increased surface temperatures. Studies of the lagoon mouth maintenance program have found that the lagoon mouth is less vulnerable to closures during summer months since long-shore transport and wave activity have less impact to the inlet when compared to winter months (Boland, 1993). Late-spring emergency openings take approximately 5 to 8 days of excavation and remove approximately 12,000 to 30,000 cy of sediment from the mouth area. Spoils for both types of openings consist of approximately 92 to 95% sand, which is placed on the beach approximately 300 yards south of the inlet and along the median high-tide mark (Coastal Environments, 2008b; Hastings, 2007).

While the recent TMDL Monitoring Report found that sediment loading impacting the lagoon mouth area was from near-shore marine origins and not from the watershed, it is not clear whether the dischargers identified by the Regional Board for this watershed will be held accountable for sediment loading at the lagoon mouth. Whether or not the City is required to maintain the lagoon's ocean inlet as a requirement of the TMDL, funding these openings may provide a reliable, quantifiable method for meeting load reduction requirements to be set by the TMDL. Furthermore, this operation has been fully permitted.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations provided in this report are based upon the results of reviews of historical data, reports, and maps, as well as field investigations to visually identify potential sources of sediment loading from the Carroll Canyon subwatershed and peripheral drainages near the lagoon boundaries.

5.1 Conclusions

The reduction of sedimentation/siltation is currently a management priority within the Los Peñasquitos Watershed and Los Peñasquitos Lagoon. Sedimentation associated with urban encroachment can impact lagoon and riparian habitat by reducing tidal mixing, changing hydrological circulation patterns, narrowing lagoon channels, raising lagoon elevations, degrading water quality, and altering native vegetation. The results from the TMDL Monitoring Report indicated that storm flows from the Carroll Canyon subwatershed appear to represent the majority of sediment loading to the lagoon based upon the measurements of TSS concentrations and storm flows monitored during the 2007-08 Wet Weather Season.

Based on these findings, it was determined that additional investigations were needed to identify potential sources of sediment loading from Carroll Canyon Creek. The additional investigations planned by the City include a two-phase sediment source study in the Carroll Canyon subwatershed. Phase I of this source study would consist of a visual survey for evidence of sediment loading within the Carroll Canyon subwatershed, including inspections of larger storm water outfalls that outlet storm water into natural drainages, many of them canyons. Phase II of the source investigation would involve a monitoring program (e.g., water quality and flow) and a modeling effort to identify prominent sources of sediment and loading potential to the creek and lagoon. This report covers the Phase I source identification study.

The topography and geomorphology of Los Peñasquitos Watershed create a natural process of erosion and sedimentation. Storm water runs off of the mesa tops and into the canyons, removing erosive soils and pushing them toward the lagoon through natural drainages and tributaries. This is evident in the history of the watershed as Los Peñasquitos Lagoon was once a large embayment that has been transformed over time into a coastal salt marsh. However, this natural process has been altered by urbanization as a result of hydromodification.

Hydromodification in the Los Peñasquitos Watershed, and most notably within the Carroll Canyon subwatershed, is a function of large areas of impervious surfaces created by residential and industrial land use and the MS4 system designed to protect private property and infrastructure by efficiently removing storm water and releasing it into the canyons and creeks through outfalls. Before urbanization of the watershed, the majority of erosion within the canyons occurred due to sheet flows and rills on south facing slopes. These slopes were more vulnerable to erosion as they tend to be exposed to direct sunlight at midday, which translates to less vegetation (density and coverage) as the plant and soils are baked by the sun’s heat. This accounts for the more gradual slopes on south-facing canyon walls as sediment moved from the top of the canyons and down to the creeks during storm events due to slopewash. Conversely, north-facing slopes that experience temperatures and sunlight in ranges more conducive to vegetation growth tend to be heavily vegetated and, as a result, more steep than south-facing slopes. This is due to the soil stability caused by root systems and ground cover that reduce the potential for scour and slumping during rain and storm runoff.

Understanding that the natural process of erosion and sedimentation in the Los Peñasquitos Watershed has been altered by hydromodification, it should be pointed out that with the exception of specific land use activities (e.g., aggregate mining), it appears that the majority of sediment entering the tributaries to LPL does not come from the MS4, but originates within the drainages below the MS4 outfalls. Urbanization may have altered the natural system of erosion and sedimentation to the point that north-facing slopes have become just as problematic as south-facing slopes and, in some cases, more of an issue with regard to sediment loading, as evidenced in Los Peñasquitos subwatershed and portions of the Carroll Canyon subwatershed. While soil erodibility played a more dominant role for sediment loading under natural conditions (i.e., without hydromodification), high-energy flows of storm water runoff from MS4 outfalls and steep gradients within certain drainages appear to dominate the system now. The steep gradients often present along north-facing slopes and their drainages lend to higher energy flows than found at south-facing slopes as storm water flows gather energy as they move down the steep canyon walls, overwhelming vegetation and scouring drainage channels below the outfalls. Within Carroll Canyon, 10 of the 16 priority areas identified in Table 4-1 are predominantly north-facing drainages (i.e., Trade Canyon Outfall, Roselle Drainage, Flintkote Avenue, Rasha Canyon Outfall, Autoport Mall Canyon Outfall, both Sorrento Creek outfalls, Northrop Canyon Outfall, Recho Street Outfall, Flanders Canyon Outfall in the southern fork). The vulnerability of north-facing drainages is compounded when they serve a large drainage area of primarily impervious surfaces, as evident at the Trade Canyon Outfall, Roselle Drainage, and Rasha Canyon Outfall that represent three of the top four priority areas.

Addressing sediment load reductions to LPL through the implementation of Tier II and Tier III BMPs within the canyons may require coordinated efforts within the City as well as with stakeholder groups that include fellow dischargers (e.g., Caltrans and State Parks) as well as private landowners (e.g., Hanson) and regulators (e.g., Department of Fish and Game and Regional Board). This is mostly due to the complicated nature of the issue involving storm water runoff from private and public land along mesa tops and creek channels that enters the MS4 and is then released into natural, “unimproved” drainages, resulting in scouring and downstream sediment loading to tributaries to LPL. Further complicating the issue is that many of the unimproved drainages are owned by private entities, and that ownership is often fragmented between different private entities. This creates a suite of management problems with regard to access, authority, available land for Tier II and Tier III BMP implementation, and who (e.g., landowner(s) at discharge point or where sediment is being scoured) is responsible for the sediment loads.

There exists numerous opportunities if agreements can be made between the groups affected by the sediment problem. Currently, load reductions could be addressed through on-going efforts at Sorrento Creek, El Cuervo Norte, and Los Peñasquitos Lagoon Sediment Basin. However, these operations tend to be expensive (e.g., maintaining Sorrento Creek alone costs between $2.7 to $3.8 million per effort, not including costs associated with permitting) and may not be a long-term feasible approach if sediment loading can be addressed within the upper watershed. The Phase II Source Investigation will provide the necessary data and recommendations to allow the verification of the priority areas identified within this study and allow a more focused approach on key areas and stakeholder coordination in order to comply with future load reductions in the mid- and long-term.

5.2 Recommendations: Tiered BMP Approach

This Phase I Source Study identifies Tier I, Tier II, and Tier III BMPs to reduce sediment loads in the short-, mid- and long-term. Figure 5-1 provides a summary of the recommendations provided by this study. For a more in-depth description of the recommendation, please refer to the tables in Appendix I.

Key recommendations to be pursued in the short-term include the following:

- Tier I – Coordinate and consolidate data, track activities, load reductions, and effectiveness of storm water program efforts to integrate multiple efforts within the City and its consultants, as well as with stakeholder groups.

- Tier I – Coordinate WURMP/JURMP with Source Studies to improve the effectiveness of monitoring, inspections, and enforcement actions in reducing pollutant loads by focusing efforts toward priority areas, augmenting monitoring efforts, generating complementary data, and reducing the potential for duplicating monitoring efforts (e.g., sending two monitoring teams to monitor the same outfall).

- Tier I – Identify prior and ongoing issues related to water quality impacts associated with land use and activities occurring within the watershed and coordinate enforcement actions with the appropriate regulatory agency (e.g., Regional Board).

- Tier II – Develop the appropriate sediment loading model for Carroll Canyon based upon previous and ongoing monitoring and source identification studies. This model will facilitate future management efforts, guide design, operation and maintenance efforts for Tier I and Tier III BMP development, and BMP implementation within this subwatershed.

- Tier II – Explore the feasibility of developing a Sediment Control and Peak Flow Management Program to facilitate intra-City coordination as well as coordination between other key stakeholders (e.g., dischargers, landowners) within the Los Peñasquitos Watershed. This program should involve a management entity that could facilitate agreements between affected agencies and groups to circumvent problems created by overlapping jurisdictions, gaps between jurisdictions, funding, access, and available land for both structural BMP construction and mitigation.

- Tier III – Pursue negotiations and agreements with Caltrans for the development, permitting, and implementation of a treatment BMP at Roselle Street. This will probably be necessary before any further action is taken at this site because of its location within the Caltrans right-of-way and because it borders a freeway off-ramp.

- Tier III – Pursue negotiations and agreements with Hanson for the development, permitting, and implementation of a treatment BMP at the Trade Canyon site within Carroll Canyon. This will probably be necessary before any action is taken at the project site on property owned by Hanson.

- Update and revise the Strategic Plan with regard to sediment and the identification of priority sources of sediment within the Los Peñasquitos Watershed, as well as within other watersheds. Some of the high-priority sources listed for sediment (e.g., landscaping in residential and commercial areas) relate more to runoff and potential nutrient loading than actual sources sediment. Many of the priority sources listed in the Strategic Plan would be better defined as having the potential to contribute to pollutants (e.g., metals, nutrients, pesticides) that are stored and transported by sediment, rather than actual sources of sediment.

	Short Term (1-5 Years)	Mid Term (5-15 Years)	Long Term (15-25 Years)
Tier 1: Source Control			
Watershed	BMP Effectiveness Assessment	BMP Effectiveness Assessment	BMP Effectiveness Assessment
	Coordinate Inspection and Enforcement Activities	Coordinate Inspection and Enforcement Activities	Coordinate Inspection and Enforcement Activities
Carroll Canyon Subwatershed	Targeted Outreach - Runoff Reduction	Targeted Inspections and Enforcement	Targeted Inspections and Enforcement
	Targeted Outreach - LID Construction	Enforcement Referrals	Enforcement Referrals
	Targeted Inspections and Enforcement	Municipal Code Modification	Municipal Code Modification (if not implemented already)
	Special Studies - Toxic Sediment De-listing 303(d) for Soledad Canyon		
	Enforcement Referrals		
Tier 2: Reduction			
Watershed	Special Study - Feasibility Analysis: Sediment Control and Peak Flow Management Program	Development of Sediment Control and Peak Flow Management Program	Implementation of Sediment Control and Peak Flow Management Program
	BMP Effectiveness Assessment	BMP Effectiveness Assessment	BMP Effectiveness Assessment
	Special Studies - Asset Assessment	Develop Concept Designs for Tier 2 BMPs	
		Final Design, Permitting and Implementation of Tier 2 BMPs in prioritized areas	
Carroll Canyon Subwatershed	Sorrento Creek Maintenance Project (Permitting and Implementation)	Continue Sorrento Creek Maintenance Project (if still needed)	Continue Sorrento Creek Maintenance Project (if still needed)
	Targeted Outreach - Runoff Reduction Incentive Program	Monitor and maintain Green Mall	Monitor and maintain Green Mall
	LID Phase 1 (Final Design, Permits, Implementation)	LID Phase 2	Monitor and maintain LIDs and structural BMPs
	Special Studies - Feasibility Analysis: Flow Diversions in Sorrento Valley	Develop Concept Designs for Tier 2 BMPs	
	Special Studies - Monitoring Flow at Priority Outfalls and Drainages	Final Design, Permitting and Implementation of Tier 2 BMPs in prioritized areas.	
	Special Studies - Model Sediment Loading		
	Special Studies - Design Storm		
	Special Studies - Storm Flow Analysis		
Los Peñasquitos Subwatershed	Monitor and Maintain Los Peñasquitos Creek Sediment Basin	Monitor and Maintain Los Peñasquitos Creek Sediment Basin	Monitor and Maintain Los Peñasquitos Creek Sediment Basin
	Special Studies - Sediment Source and Phosphorus Loading Study	Special Studies - Develop Load Reduction Alternatives for Phosphorus	Implement the best load reduction alternative(s) for phosphorus
Tier 3: Treatment			
Watershed	BMP Effectiveness Assessment	BMP Effectiveness Assessment	BMP Effectiveness Assessment
		Develop Concept Designs for Tier 3 BMPs	Develop Concept Designs for Tier 3 BMPs
		Final Design, Permitting and Implementation of Tier 3 BMPs in priority areas	Final Design, Permitting and Implementation of Tier 3 BMPs in priority areas
Carroll Canyon Subwatershed	Roselle Street BMP (Concept Design, Permitting, Implementing)	Monitor and Maintain Roselle Street BMP	Monitor and Maintain Roselle Street BMP
	Trade Canyon BMP (Concept Design, Final Design, Permitting, Implement)	Monitor and Maintain Trade Canyon BMP	Monitor and Maintain Trade Canyon BMP
	Flintkote Road BMP (Concept Design, Final Design, Permitting, Implement)	Monitor and Maintain Flintkote Road BMP	Monitor and Maintain Flintkote Road BMP
	Maintain Los Peñasquitos Sediment Basin		Monitor and Maintain Tier 3 BMPs implemented during this phase

Figure 5-1. Summary of Recommendations

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