Hydromodification Susceptibility Documentation Report and Mapping: Santa Ana Region

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1 INTRODUCTION

This documentation report is part of the larger study for Riverside County Flood Control and Water Conservation District (District) to develop the Watershed Action Plan as required by the current Riverside County Santa Ana Region (SAR) Municipal Separate Storm Sewer System (MS4) Permit Order No. R8-2010-0033, NPDES No. CAS 618033 (MS4 Permit). This project includes the expansion of existing SAR maps to include lined and unlined channels and streams within the SAR Permit area with the goal of identifying those segments of existing stream channels that may be vulnerable to development impacts as required by the MS4 Permit.

1.1 Background

The Riverside SAR MS4 Permit identifies that the District and cities within the SAR (Permittees) shall develop a Watershed Action Plan (WAP) to address the entire Permit Area (see Figure 1). The District is the Principal Permittee for coordination of compliance with the MS4 Permit and is engaged in developing the components of the WAP on behalf of the Permittees. According to Section I of the MS4 Permit, as of 2006 the population of the Permit Area is approximately 1.2 million, occupying an area of approximately 1,396 square miles. The Permittees' MS4s include an estimated 59 miles of above ground channels and 75 miles of underground storm drain channels. The MS4 Permit regulates urban and stormwater runoff from the urban areas within the Santa Ana Regional Water Quality Control Board's jurisdiction, which makes up approximately nineteen percent (19.1%) of the County. All other portions of Riverside County are regulated by the San Diego or Colorado River Basin Regional Water Quality Control Boards.

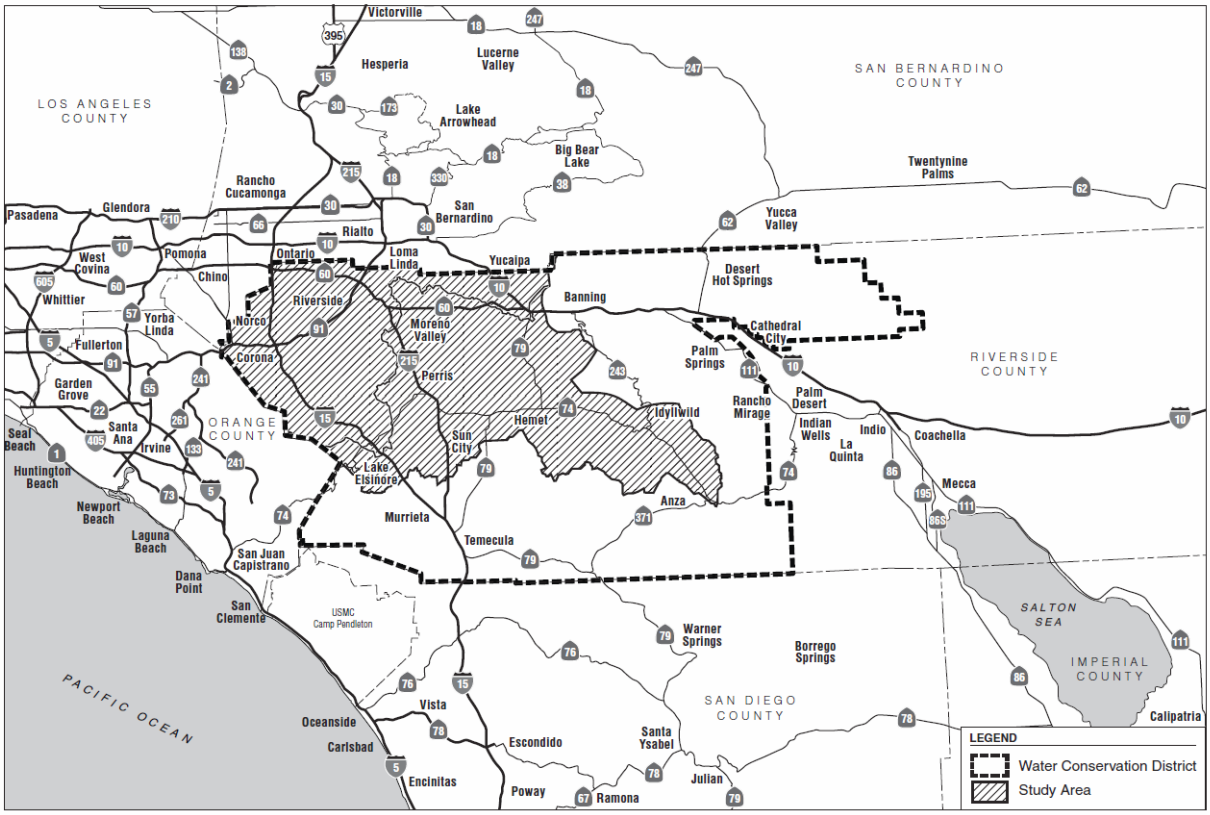
The WAP will assist the Permittees, as well as the development and environmental communities in the SAR, to integrate water quality and water conservation policies. It also encourages the capture and infiltration of stormwater into groundwater basins and the recharge of Lake Elsinore with treated runoff. According to Section XII.B of the MS4 Permit, the objective of the WAP is to address watershed scale water quality impacts of urbanization in the Permit Area associated with Urban Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs), stream system vulnerability to Hydromodification from Urban Runoff, cumulative impacts of development on vulnerable streams, preservation of Beneficial Uses of streams in the Permit Area, and protection of water resources, including groundwater recharge areas.

As part of the WAP, the Permittees are required to develop a Hydromodification Management Plan (HMP) which includes the delineation of the existing unarmored or soft-armored stream channels in the Permit Area that are identified to be vulnerable to Hydromodification from New Development and Significant Redevelopment projects.

1.2 Hydrologic Condition of Concern (HCOC)

The findings of the MS4 Permit (Section II.G) indicate that an HCOC exists when a site's hydrologic regime is altered and there are significant impacts on downstream stream channels and aquatic habitats, alone or in conjunction with impacts of other projects. Significant development has taken place in Riverside County in the last decade and urban development generally increases runoff volume, velocity, of runoff and the amount of Pollutants in the runoff.

Figure 1: Location Map



Unmitigated high volumes and velocities of discharges from MS4 facilities associated with New Development into natural watercourses from developed areas without needed controls can alter the natural rate of change of a stream and may adversely impact aquatic ecosystems and stream habitat and may cause stream bank erosion and physical modifications. These changes are the result of Hydromodification.

According to Section XII.E.9 of the Permit, a New Development and Significant Redevelopment project does not cause a HCOC if any one of the following conditions is met:

1. The project disturbs less than one acre and is not part of a common plan of development.
2. The volume and the time of concentration of stormwater runoff for the post-development condition is not significantly different from pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant). This may be achieved through Site Design and Treatment Control BMPs.
3. All downstream conveyance channels to an Adequate Sump (e.g., Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River or other lake, reservoir or natural resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected; or not identified in the Permittees' Hydromodification sensitivity maps required in Section XII.B, and no sensitive stream habitat areas will be affected.
4. The Permittees may request a variance from these criteria based on studies conducted by the Southern California Monitoring Coalition (SMC), Southern California Coastal Watershed Research Project (SCCWRP), California Association of Stormwater Quality Agencies (CASQA), or other regional studies.

1.3 Goals and Objectives

The goal of this study was to conduct a screening level analysis to identify and map stream channel segments that may be vulnerable to Hydromodification as required by the MS4 Permit. The purpose of mapping the susceptible stream channel segments was to develop a comprehensive map of the MS4 Permit area to assist the District, Co-Permittees, and project proponents to determine whether or not a project will drain to a potentially susceptible stream channel segment and may be subject to the HCOC requirements.

The study was divided into eight tasks:

1. Research and data collection;
2. Delineate and map existing stream channel segments;
3. Define and categorize groups of existing stream channel segments based on common characteristics;
4. Verify groups using provided data and site visits;
5. Identify an appropriate definition for an "engineered and regularly maintained" stream channel segment;
6. Conduct Susceptibility Assessment of the stream channels to identify segments that may be susceptible to Hydromodification;
7. Delineate and map existing hydrology watershed boundaries to stream channel segments that may be susceptible to Hydromodification; and
8. Create the comprehensive HCOC Applicability Map of the MS4 Permit area.

This report documents the methodologies used to determine whether an existing stream channel segment may be susceptible to Hydromodification due to future development. It discusses the delineation of the

existing stream channel segments and the watershed areas in the MS4 Permit area. It also provides two maps: Existing Stream Channel Delineation Map and HCOC Applicability Map as required by Sections II.G.10 and XII.B.4 of the MS4 Permit.

2 EXISTING CHANNEL DELINEATION MAP

This section discusses how the existing stream channels were delineated. It also discusses the grouping system used for the stream channel segments and provides the Existing Stream Channel Delineation Map, see Map 1.

2.1 Research and Data Collection

Data requests were provided to the Permittees (see Table 1) to assist in the collection of background data needed for the delineation of existing channels. The information collected from the Permittees included: aerial photographs, topography, as-built plans, Geographic Information System (GIS) data bases, drainage studies, Federal Emergency Management Agency (FEMA) floodplain studies, and more. The data provided by the Permittees was reviewed and verified for accuracy.

Table 1: Permittees

Principal Permittee	RCFC&WCD (District)	
Co-Permittees	1. Beaumont	9. Lake Elsinore
	2. Calimesa	10. Menifee
	3. Canyon Lake	11. Moreno Valley
	4. Corona	12. Norco
	5. County of Riverside	13. Perris
	6. Eastvale	14. Riverside
	7. Hemet	15. San Jacinto
	8. Jurupa Valley	

2.2 Delineation of Existing Stream Channels

The goal of this task was to delineate all regional stream channels (above and below ground) within the Permit Area. Local stream channels were also mapped if it was found pertinent to determining if a subwatershed drained to a stream channel segment potentially vulnerable to Hydromodification or if "all downstream conveyance channels to an Adequate Sump that will receive runoff from the project" are not vulnerable to Hydromodification.

The existing stream channels were predominately delineated using the District's GIS shapefile called: RCFC_FACILITIES_LINE. This shapefile provided GIS linework for all District above and below ground stream channels. Below ground stream channels are channel segments that convey stormwater in underground drainages structures. Typical underground drainage structures are made of reinforced concrete, corrugated metal, or material of equivalent shear resistance.

Additional stream channels were delineated using GIS shapefiles provided by the Co-Permittees and National Hydrography Dataset (NHD). This additional data was used to fill in gaps found in heavily urbanized and natural areas.

The shapefiles were verified through an investigation of as-built plans and aerial photography. Some stream channel delineations were added solely based on the aerial photography investigation. Any stream channel delineations in question were verified by site visits.

2.3 Existing Stream Channel Groups

To complete the initial mapping, the existing stream channels were categorized into five groups to better describe the individual stream channel segments by common traits. The groups are described below:

1. **Engineered, Fully Hardened and Maintained (EFHM):** This group includes constructed facilities that are fully armored (e.g., concrete, soil cement, riprap rock, etc.) on three sides and verified by as-builts, aerial photographs and/or a site visit. This group includes piped and boxed stream channel segments. The facility must also be maintained and designed based on an engineering criteria (e.g., a specific storm event.)

2. **Engineered, Partially Hardened and Maintained (EPHM):** This group includes constructed facilities that have some armoring (e.g., concrete, soil cement, riprap rock, turf reinforcing mats, etc.) on less than three sides and verified by as-builts, aerial photographs and/or a site visit. The armoring can include bank and/or invert lining that has been placed based on engineering criteria. The facility must also be maintained.

3. **Engineered, Earthen and Maintained (EEM):** This group includes constructed facilities that do not contain armoring but have been engineered to be stable systems and are verified by as-builts. The facility must also be maintained. This group is intended to be channel segments constructed for flood conveyance, which generally have a design capacity in excess of a 10-year storm event.

4. **Not Engineered and Earthen (NEE):** This group includes constructed facilities that are modified by anthropogenic activities, which may include floodplain encroachments by development, culverts, bridges, privately owned bank and/or invert stabilization (such as riprap or other forms of bank protection, roads, etc.) and other man-made modifications to the natural channel system that are not necessarily continuous or designed to meet any specific engineering standard, but have modified the natural hydrologic characteristics of the facility. The improvements may or may not be maintained.

5. **Natural (NAT):** This group includes stream channel facilities that are in a natural state, where the geometry has not been modified. The stream channel facility may or may not be maintained.

2.4 Categorization of Existing Stream Channel Groups

A desktop study was conducted to categorize each individual stream channel segment into one of the above groups. The desktop study included an examination of as-built plans and aerial photography. The segments that were in question were field verified. Field verification included visiting an accessible location along the segment of stream channel. Photographs and notes were taken in regards to the stream channel segment condition and armoring.

Any stream channel facilities that could not be accessed and/or were still in question were discussed and verified with the Permittee with jurisdictional responsibility for the facility.

3 SUSCEPTIBILITY ASSESSMENT

This section discusses the definition for an "engineered and regularly maintained" stream channel and the characteristics of stream channels that are identified to be not susceptible to adverse impacts from Hydromodification.

3.1 Definition for "Engineered and Regularly Maintained"

To satisfy Condition iii from Section XII.E.9.b of the MS4 Permit (refer to Section 1.2 of this Report), an "engineered and regularly maintained "stream channel must be defined. The basic definition is a stream channel facility constructed for storm water conveyance that is owned and maintained by a responsible agency and is not susceptible to adverse impacts from Hydromodification, but a more comprehensive definition is hard to establish because it is subjective. After careful consideration, this study has combined the five stream channel groups (EFHM, EPHM, EEM, NEE, and NAT) into two categories: Potentially Susceptible and Not Susceptible to Hydromodification. The groups themselves can then be used as the term's definition.

The five groups were combined into the two categories as shown below:

1. Not Susceptible

    a. EFHM – The risk for adverse impacts caused by Hydromodification is insignificant due to the armoring of the stream channel segment and the engineered design which would prevent erosion and degradation of the channel.

    b. EPHM - The risk for adverse impacts caused by Hydromodification is very low due to the partial armoring of the stream channel segment and the engineered design which would significantly lower the risk of erosion and degradation of the channel.

    c. EEM - The risk for adverse impacts caused by Hydromodification is low due to the engineered design of the stream channel segment which would lower the risk of erosion and degradation of the channel.

2. Potentially Susceptible

    a. NEE – It cannot be verified that the stream channel segment could handle the changes in runoff volume and duration associated with New Development or Significant Redevelopment without degradation. The risk for adverse impacts caused by Hydromodification is potentially significant. Future technical studies could determine the level of risk of Hydromodification in individual stream channel segments.

    b. NAT – The findings of the MS4 Permit indicate that these stream channel segments are vulnerable to Hydromodification resulting from runoff from New Development or Significant Redevelopment. The risk for adverse impacts caused by Hydromodification is potentially significant. The level of risk may be determined through future technical studies.

3.2 Adequate Sump

An Adequate Sump is a large river, reservoir or basin that provides significant regional flood protection for the downstream watershed areas and mitigates flows such that any New Development or Significant Redevelopment project upstream will not cause a significant change in the downstream flow conditions.

The MS4 Permit identifies Prado Dam, Lake Elsinore, Canyon Lake, and the Santa Ana River as Adequate Sumps.

The Permittees reserve the right to add additional facilities if they are identified to meet the above definition of an Adequate Sump. Mystic Lake, and Lake Matthews have been identified as reservoirs and basins that meet the Adequate Sump criteria. In the future, additional updates to the associated maps may be required in order to reflect the identification of additional Adequate Sumps.

3.3 San Jacinto River

Based on the hydrology assessment and analysis of the 3.8 mile reach of the San Jacinto River upstream of Canyon Lake, it has been determined that the San Jacinto River is a natural resistant feature that exhibits the following characteristics:

- Drainage area higher than 100 square-miles and a 100-year peak discharge higher than 20,000 cfs;
- The natural hydrology and sediment loading of different watercourses within the SAR are significantly impacted by the upstream impoundments, which regulate downstream flow;
- Permittees participate in the National Flood Insurance Program and enforce a floodplain management ordinance to regulate development in mapped flood hazard areas; and
- The low-gradient of this segment of the San Jacinto River are results in deposition of coarse-grained sediments.

Under the existing and future hydrologic conditions, there will be no scouring of the bed and bank of the stream. The additional lines of evidence show that the San Jacinto River is not an HCOC:

- The river has the characteristic geomorphology of a large river, including a flat slope and a wide alluvial floodplain;
- A review of historical aerial photographs did not identify lateral migration of the streambed, even though historical urbanization has occurred;
- The production of bed sediment occurs in the San Jacinto Mountain, thus future development in the alluvial floodplain will not impact the production and conveyance of bed sediment to the downstream reaches;
- Field observations did not identify erosion within the bed and banks of the channel. Deposition of sediment within the streambed indicated that the stream exhibits aggradation;
- Dense vegetation is present within the streambed, particularly within the low-flow channel. The vegetation provides a higher resiliency to erosive forces.
- Bed sediment is composed of coarse sand and very fine gravel, which are typical of large rivers in alluvial floodplain environment. The bed is predominantly composed of very fine gravel (D50 = 6mm), which provides a high resiliency to erosive forces; and
- The rapid stream assessment concluded that the 3.8-mile segment has a low-risk for future erosion.

The San Jacinto Assessment and is included as Attachment A.

4 APPLICABILITY CRITERIA

This section describes the HCOC applicability criteria and discusses the methodology for determining watershed areas where HCOC requirements may be applicable. The results of the HCOC Applicability Assessment are used to develop a comprehensive map of the MS4 Permit area which identifies those areas that are tributary to potentially susceptible stream channel segments and where runoff from New Development or Significant Redevelopment may cause a HCOC. The HCOC Applicability Map (see Map 2) provides a delineation of the potentially susceptible stream channel segments and the watershed areas that are applicable to the HCOC requirements.

4.1 Delineation of Existing Hydrology Watershed Boundaries

The existing hydrology watershed boundaries were delineated using a desktop approach. The NHD GIS shapefile called: NHDArea, provided GIS linework for the Santa Ana River Basin watershed. The NHD data was compared with Drainage Area Plans and GIS data provided by the Permittees (drainage areas and local system storm drain data) and USGS topography.

The watershed boundaries were simplified using the collected data to delineate areas tributary and adjacent to stream channel segments that are not potentially susceptible to Hydromodification.

4.2 HCOC Applicability Map

The Permit Area has been divided into two different watershed areas: Applicable and Not Applicable. The Not Applicable watershed areas would potentially be excluded from the HCOC requirements. New Development and Significant Redevelopment projects in the "applicable areas" shall continue to determine applicability in accordance with the HCOC requirements in Section XII.E.9 of the MS4 Permit.

- Applicable Watershed Areas – Watershed areas that drain to susceptible stream channels, where future New Development and/or Significant Redevelopment projects may adversely impact downstream erosion, sedimentation, or stream habitat by increasing the volume and/or duration of storm runoff. This includes watershed areas tributary to:
    - Non-Engineered, Earthen Stream Channels (NEE); and
    - Natural Stream Channels (NAT).
    - New Development and Significant Redevelopment projects that are located within an Applicable Watershed Area should reference the HMP or WQMP for the specific qualifying criteria to meet the HCOC requirements.
- Not Applicable Watershed Areas - Watershed areas that drain directly to an Adequate Sump (e.g., Santa Ana River, Lake Elsinore, Canyon Lake, and Prado Dam) or naturally resistant feature such as the San Jacinto River (see Section 3.3) via a drainage facility that is not susceptible to Hydromodification.
    - Not Susceptible drainage facilities fall under the term "Engineered and Regularly Maintained" per the Permit and includes:
        - Engineered, Fully Hardened and Maintained Drainage Facilities (EFHM);
        - Engineered, Partial Hardened and Maintained Drainage Facilities (EPHM); and
        - Engineered, Earthen and Maintained Drainage Facilities (EEM).

- For New Development or Significant Redevelopment projects in a Not Applicable watershed area, if the site does not drain directly to a mapped stream channel, then the project must show that all downstream conveyance channels to the mapped segment are "engineered and regularly maintained" facilities. Refer to the HMP or WQMP for the specific qualifying criteria to meet the HCOC requirements.

MAP 1

MAP 2

Attachment A