TECHNICAL MEMORANDUM

Hydromodification Assessment

Prepared for:

San Bernardino County
Flood Control District

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1 INTRODUCTION

This technical memorandum is part of the larger study for San Bernardino County Flood Control District to develop the Watershed Action Plan as required by the current San Bernardino County MS4 Permit Order No. R8-2010-0036, NPDES No. CAS 618036.

1.1 Background

According to the County of San Bernardino (County) Stormwater Plan Proposal Summary, the County is a member of a broad, multi-stakeholder task force established to develop a regional Watershed Action Plan (WAP) that will assist its cities, water agencies, and watermasters, as well as its development and environmental communities to integrate water quality and water supply policies and encourage the capture and infiltration of stormwater into groundwater basins. The objective of the WAP is to improve integration of water quality, stream protection, storm water management, water conservation and re-use, and flood protection, with land use planning and development processes. The WAP builds upon the requirements of the recently adopted San Bernardino County Municipal Separate Storm Sewer System (MS4) permit for the county and its cities (permittees).

According to the MS4 permit, the permittees serve a population of approximately 1.5 million, occupying an area of approximately 620 square miles (see Figure 1). The permittees MS4 systems include an estimated 378 miles of aboveground channels and 485 miles of underground storm drain channels. The MS4 regulates urban and storm water runoff from the areas within the Santa Ana Regional Board's jurisdiction, which makes up approximately seven percent (7%) of the County. All other areas are under either the Colorado River Basin Regional Board or Lahontan Regional Board.

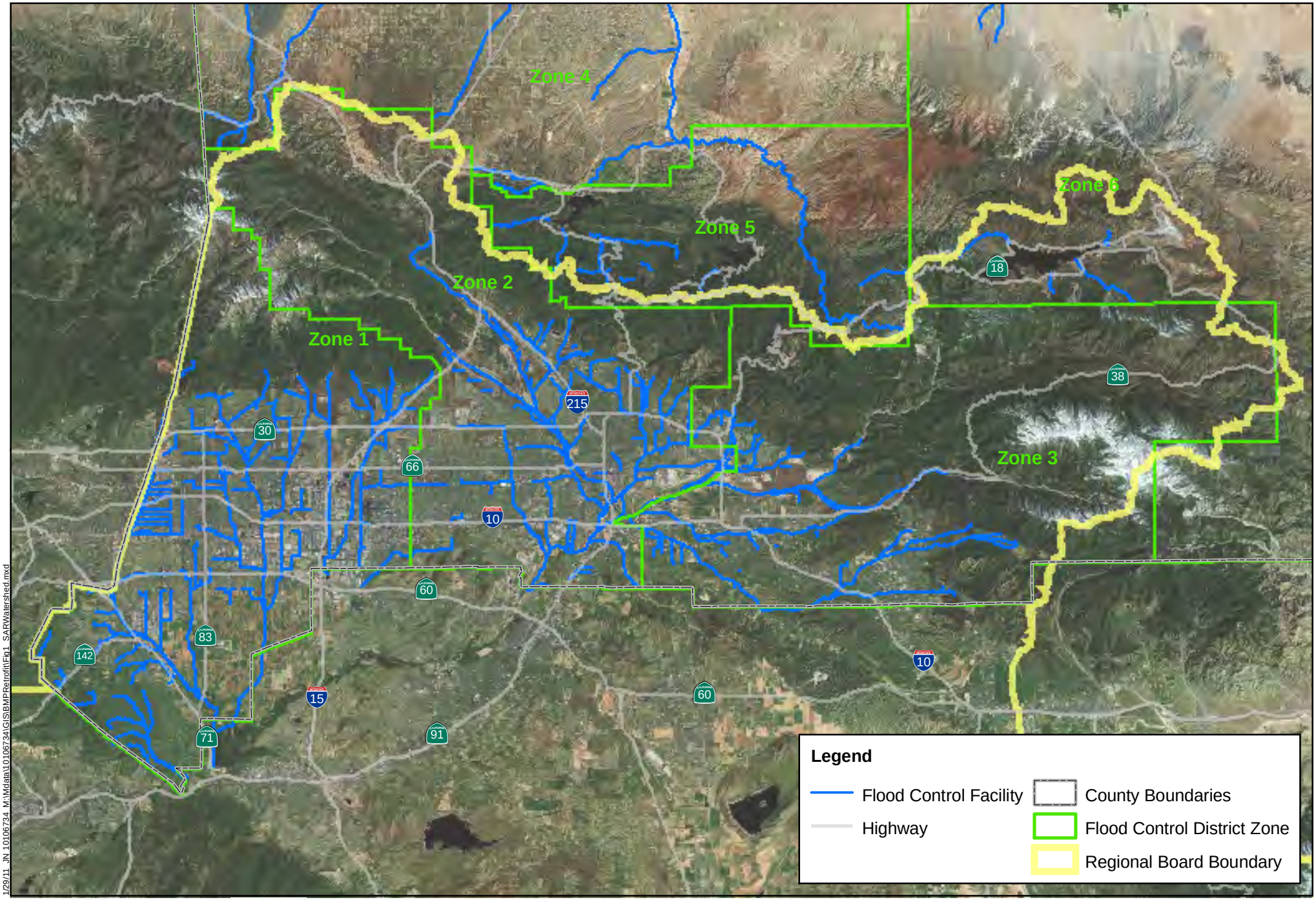
1.2 Purpose

This memorandum examines the thresholds for determining whether a creek is subject to significant impacts from hydromodification due to future development, and identifies areas on a watershed basis that drain to a creek reach that is subject to the affects of hydromodification. The MS 4 permit indicates that a hydrologic condition of concern (HCOC) exists when a sites hydrologic regime is altered and there are likely to be significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts from other projects.

This memorandum provides the procedures for determining if a stream reach is subject to adverse impacts from hydromodification and identifies the drainage areas tributary to those streams that are determined to be at-risk.

San Bernardino County has previously experienced significant development within the Santa Ana River watershed, especially in the western portions of the county. For the permitted area, the remaining natural streams in the mountain areas, and the non engineered, hardened, and maintained (non-EHM) systems in the lightly urbanized and undeveloped portions of the watershed are most likely to experience adverse impacts from hydromodification as a result of new development or significant redevelopment projects.

Several criteria were identified and examined to determine if certain portions of a natural stream or non-EHM facility were not subject to significant adverse impacts from hydromodification due to significant reduction of flow due to detention basins, their inclusion as part of large watershed areas/rivers, downstream drainage influenced by downstream detention basins, and other factors. The results of this assessment will be use to determine which areas are subject to the HCOC requirements in the MS4 permit. The areas will be included in the County's HCOC Map/Watershed Geodatabase.



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0 5 10
Miles

Sources: Caltrans; ESRI; SB DPW; SB Permittees; Microsoft Satellite Imagery

SAN BERNARDINO - HYDROMODIFICATION ASSESSMENT

Figure 1: Santa Ana River Watershed - County of San Bernardino

2 HYDROMODIFICATION EXEMPTION CRITERIA

Hydromodification exemption criteria were identified and evaluated to determine if hydromodification from a new or significant redevelopment project would not result in significant impacts to the downstream watercourse on a watershed wide basis. Factors considered as part of this assessment included: controlled release points, large rivers, areas within Prado Basin, and other factors.

2.1 Controlled Release Points

A controlled release point (CRP) is a detention or debris basin that provides significant regional flood protection for the downstream watershed areas and mitigates flows for the hydrologic conditions or concern such that any new or significant redevelopment upstream of the basins will not cause a significant change in the flow conditions downstream of the basin. For this study, we have defined a CRP as providing significant attenuation for storm events down to the 2-year return frequency storm identified in the MS4 permit.

2.2 Large Rivers

As the size of a watershed increases, the potential for hydromodification impact of development within the watershed decreases. Therefore large rivers are less likely to experience hydromodification impacts. However, the definition of a "large river" is subjective. For the purposes of this assessment the team sought a simplified, repeatable method for defining "large rivers". The threshold used is described in the Ventura County MS4 Permit Order No. 09-0057 NPDES No. CS004002 Part 4, Section E.3.a(2) Exemptions to Hydromodification Controls. The text of the permit is provided below:

> (D) Projects that have any increased discharge go directly or via a storm drain to a sump, lake, area under tidal influence, into a waterway that has a 100-year peak flow (Q100) of 25,000 cfs or more, or other receiving water that is not susceptible to Hydromodification impacts;

Therefore, all watershed areas contributing flow to a downstream river with an 100-year existing flowrate of 25,000 cfs and having a continuous Engineered Hardened and Maintained (EHM) flood control system connecting the watershed area to the channel with 25,000 cfs, would be excluded from the HCOC requirements.

2.3 Areas within Prado Basin

The flood control pool of Prado Basin provides a control for sub regional channels that discharge directly to the pool, rather than to the Santa Ana River. Several flood control pools have been defined within the basin. Two important lines are considered for this assessment: the 566 elevation and the 10-year storm pool. The 566 elevation is significant because watershed areas within the 566 contour are being acquired for flood control purposes as part of the raising of the dam embankment. Therefore, future significant development below the 566 elevation will not be allowed.

For this study the 10-year storm pool was chosen as the point at which sub-regional channel erosion becomes influenced by the water surface in Prado Dam, therefore, upstream

development as little impact on the hydromodification of the sub-regional channel. The Prado Basin 10-year storm pool is elevation 514.

2.4 Other Factors

Other factors considered in the hydromodification assessment include the number of subregional basins within the watershed, presence of upstream debris basins, and the percentage of land still available for development. There is no specific number of sub-regional basins or debris basins, or percentages of developable land available to verify that development within the watershed would have minimal impacts on downstream hydromodification. For planning purposes based on engineering judgment it can be assumed that if there is a large number of sub-regional basins, with upstream debris basins and little developable land remaining that the potential for further downstream hydromodification is minimal. For this assessment, watersheds in this category will require further hydrology studies to verify whether or not these areas are subject to the HCOC requirements of the permit.

3 HYDROMODIFICATION ASSESSMENT

3.1 Controlled Release Point

Only two regional flood control basins were considered controlled release points, they are the Seven Oaks Dam and Prado Dam, which are both part of the Santa Ana River Mainstem Project constructed and operated by the US Army Corps of Engineers.

Seven Oaks Dam controls releases to the Santa Ana River as the river leaves the San Bernardino Mountains. Therefore, Seven Oaks Dam controls hydromodification impacts from the dam outlet until the first major stream confluence (Mill Creek) downstream of the dam.

Prado Dam controls releases to the Santa Ana River into Orange County. All of the channels studied as part of this HCOC study are tributary to the Santa Ana River between Seven Oaks and Prado Dam. Prado Dam controls hydromodification impacts downstream of the dam.

3.2 Large River Criteria

In order to determine which rivers would constitute large rivers (flowrates more than 25,000 cfs), several sources were investigated, including:

- US Army Corps of Engineers, Feature Design Memorandum #2 Seven Oaks Dam Floodway Delineation, August 1991
- US Army Corps of Engineers, Santa Ana River Phase II General Design Memorandum Volume 7 Hydrology, dated August 1988.
- US Army Corps of Engineers, San Antonio and Chino Creeks Channel Feasibility Study, dated August 1998.
- Federal Emergency Management Agency, Flood Insurance Study: San Bernardino County, California and Incorporated Areas, dated August 2008.

Based on the available studies, the rivers lists in Table 1 were identified to meet the flow rate criteria. The locations at which the river exceeds the discharge is also listed.

Table 1: Large Rivers within San Bernardino County

River Name	Concentration Point	100-year Flowrate (cfs)
Santa Ana River	At Prado	161,500
	At Warm Springs	140,000
	At Mill Creek	25,000
Mill Creek	At Santa Ana River	33,000
Warm Springs	At Santa Ana River	67,000
Lytle Creek	Glen Helen Parkway	28,000
Cajon Creek	Glen Helen Parkway	35,800
Cucamonga Channel	At Merrill Avenue	32,000
San Antonio Creek	At Soquel Canyon	25,200

3.3 Areas within Prado Basin

Two channels within San Bernardino County are controlled by the 10-year flood control pool (Elevation 514) at Prado Dam: Cucamonga Channel and San Antonio Channel. Below elevation 514, the tributary watershed no longer impacts the hydromodification potential, the hydromodification is controlled by the Prado Dam pool. The 514 elevation points are shown on the map in the conclusion.

3.4 Other Factors

The two drainages that were identified to have significant numbers of sub-regional detention and debris basins are Cucamonga Creek and San Antonio Creek. The Table 2 summaries the parameters that may impact whether the stream is subject to significant adverse impacts from hydromodification:

Table 2: Summary of Parameters

Creek	Number of Detention Basins	Number of Upstream Debris Basins	% of Watershed Available for Future Development
Cucamonga/Mill	15	8	24
San Antonio/Chino	3	1	26

For the purposes of this assessment the watershed areas tributary to portions of San Antonio/Chino Creek that did not meet the large river criteria, and are considered subject to further hydromodification impacts. However, future detailed hydrology studies may reveal that development of the remainder of the watershed does not significantly impact downstream erosion as a result of the attenuation and flow modification resulting from the combination of debris and detention basins.

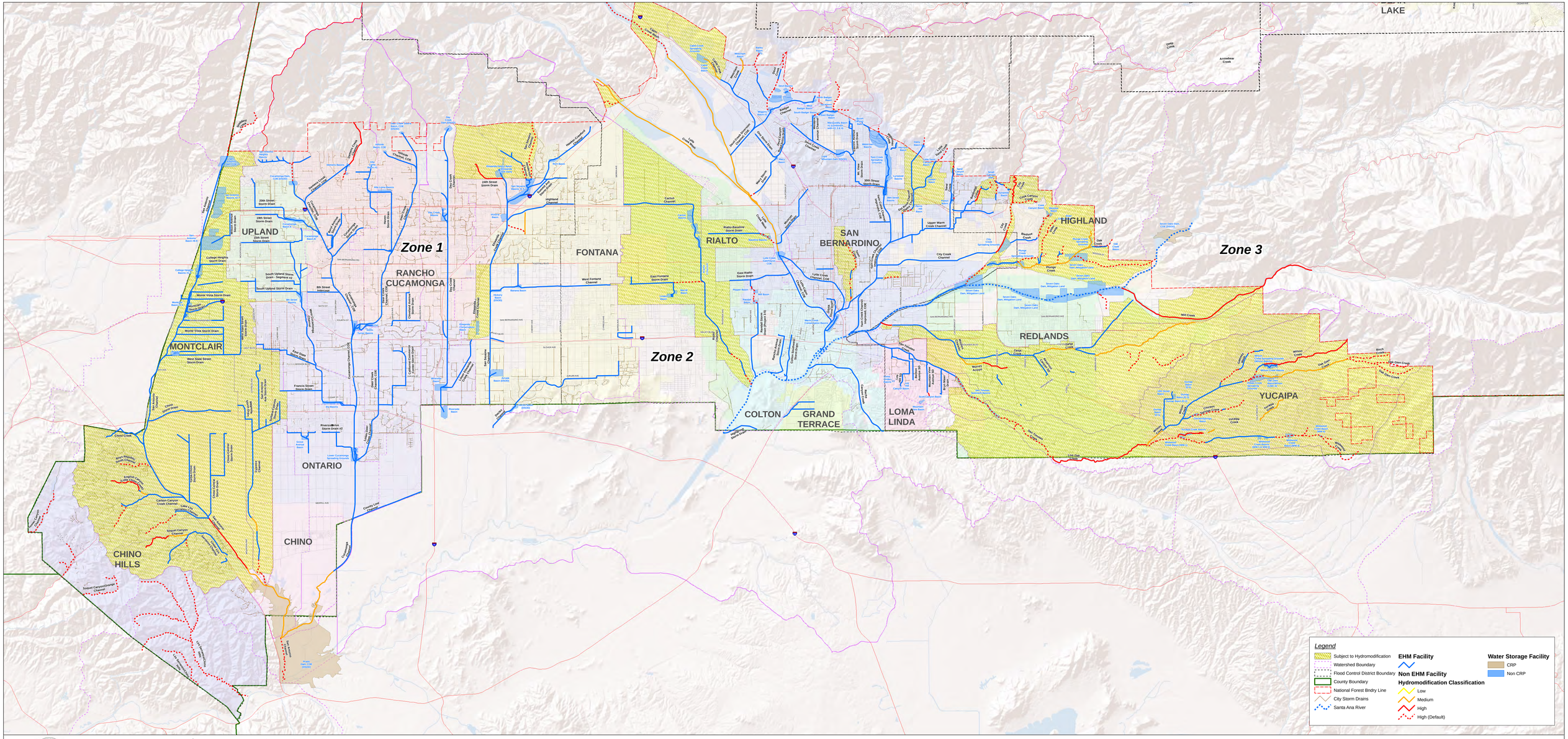
4 CONCLUSIONS

The hydromodification exemption criteria identified and evaluated as part of this memorandum were used to determine if a non-EHM facility was potentially subject to significant adverse impacts as a result of new or significant redevelopment projects within its tributary watershed. The following three criteria where used to exclude portions of the watershed from potential hydromodification impacts:

1. Areas downstream of controlled release points (CRPs),
2. Tributary areas downstream of large rivers with flow more than 25,000cfs, and
3. Areas downstream of elevation 514 in Prado Basin.

The watershed map (located in the map pocket) shows the watershed areas determined to have insignificant impacts to the downstream rivers as a result of hydromodification from new or significant redevelopment projects (see shaded areas). These areas are mostly concentrated at the downstream ends of sub-regional channels (ex. Cucamonga Channel, San Antonio Channel), areas only tributary to EHM channels, and areas draining directly to the Santa Ana River. The majority of the upper watersheds that are tributary to non-EHM channels have been identified as areas requiring projects to comply with the HCOC requirements of the permit (unshaded areas on map).

MAP



San Bernardino County Flood Control Facilities in Zones 1, 2, & 3

Hydromodification Map