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Hydromodification Management Plan Evaluation Program

In Compliance with Order No. R9-2010-0016, this HMP Evaluation Program has been developed by RBF Consulting in collaboration with the Riverside County Copermittees.

DRAFT

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Introduction

The Santa Margarita Region (SMR) Hydromodification Management Plan (HMP) Evaluation Program is established to assess the effectiveness of the implementation of the SMR HMP that will manage increases in runoff discharge rates and duration from all Priority Development Projects (PDPs). The overall goal of the HMP Evaluation Program is to ensure that the dynamic equilibrium of streams within the Santa Margarita Watershed is not impacted by runoff from PDPs.

This HMP Evaluation Program defines both a hydromodification monitoring approach and a performance protocol as required by Provisions F.1.h.(1)(e) and F.1.h.(1)(m) of San Diego Regional Board Water Quality Control Board (SDRWQCB) Order No. R9-2010-0016 as these relate to PDPs to meet the range of runoff flows identified under Provision F.1.h.(1)(b) which states:

> Identify a range of runoff flows[16] based on continuous simulation of the entire rainfall record (or other analytical method proposed by the Copermittees and deemed acceptable by the San Diego Water Board) for which Priority Development Project post-project runoff flow rates and durations must not exceed pre-development (naturally occurring) runoff flow rates and durations by more than 10 percent, where the increased flow rates and durations will result in increased potential for erosion or other significant adverse impacts to beneficial uses. The lower boundary of the range of runoff flows identified must correspond with the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks. The identified range of runoff flows may be different for specific watersheds, channels, or channel reaches. In the case of an artificially hardened (concrete lined, rip rap, etc.) channel, the lower boundary of the range of runoff flows identified must correspond with the critical channel flow that produces the critical shear stress that initiates channel bed movement or that erodes the toe of channel banks of a comparable natural channel (i.e. non-hardened, pre-development).

Provision F.1.h.(1)(e) requires the definition of a protocol to evaluate the potential hydrograph change impacts to downstream watercourses from PDPs to meet the range of runoff flows identified under Provision F.1.h.(1)(b). The defined performance protocol addresses the requirements of Provisions F.1.h.(1)(m) which states:

> Include a description of monitoring and other program evaluations to be conducted to assess the effectiveness of implementation of the HMP. Monitoring and other program evaluations must include an evaluation of changes to physical (e.g., cross-section, slope, discharge rate, vegetation, pervious/impervious area) and biological (e.g., habitat quality, benthic flora and fauna, IBI scores) conditions of receiving water channels as areas with Priority Development Projects are constructed (i.e. pre- and postproject), as appropriate.

This includes a description of inspections and maintenance of hydrologic controls and sediment supply management measures, as well as a protocol to address potential hydromodification impacts. Per Provision F.1.h.(1)(m), the performance protocol must include an evaluation of changes to physical features of the receiving streams water and area of the PDP (cross-section, slope, discharge rate, pervious/impervious area) and biological conditions of the receiving streams (vegetation, habitat quality, benthic flora and fauna, Index of Biological Integrity (IBI) scores) downstream of the areas where PDPs are developed.

The hydrologic and sediment supply performance standards established in the associated SMR HMP are based on the most recent state of the hydromodification management science (SCCWRP, 2012). The level of understanding of the variables influencing the geomorphologic and biological changes in streams receiving runoff from PDPs may be best reduced through monitoring. The implementation of the hydromodification monitoring approach along with the performance protocol will operate on the basis of adaptive management principles. The frequency and geographical distribution of the proposed monitoring actions is optimally selected upon identification of the scientifically observed seasonal and geographical patterns of hydromodification and in-stream biological activity. A key consideration of the evaluation program is to distinguish hydromodification impacts, if any, that are caused by PDPs from those, if any, that have been created by the construction of upstream dams or their operation, agricultural developments, significant storm events or other stressors in the SMR.

The philosophy of the HMP Evaluation Program is to build upon existing water quality monitoring stations that meet a specific sitting criteria located throughout the SMR and expand monitoring to simplified cross-section surveys that will be used to track the geomorphic evolution or stability of the stream. Additional monitoring stations may be selected, if necessary, by the Copermittees to account for both temporal and spatial variability, and assess the effectiveness of the SMR HMP to hydromodification associated with PDPs.

The findings of the HMP Evaluation Program may trigger refinements improving the hydrologic and sediment performance standards, to manage the impacts of PDPs on the geomorphology and the biological integrity of receiving streams.

1 Watershed History and Historical Hydromodification Impacts

The Southern California Coastal Water Research Project (SCCWRP) characterizes the Santa Margarita Hydrologic Unit as one of the largest unregulated rivers in Southern California (SCCWRP, 2007). The mainstem of the Santa Margarita River begins at the confluence of Temecula Creek and Murrieta Creek, in Southern Riverside County, and flows southwest successively through Temecula Canyon, a large floodplain in Camp Pendleton Marine Corps Base, and ultimately discharges into the Pacific Ocean. The Santa Margarita Watershed drains a tributary area of 746-square miles and is physiologically split into a mountainous highland, and broad flat topped sea terrace. The boundary between the upper drainage basin and the coastal drainage basin transitions at the border between Riverside County and San Diego County. The portion of the Upper Santa Margarita River Watershed located in Riverside County is referred to as the Santa Margarita Region (SMR). Several structural and hydrologic elements of the SMR have historically impacted downstream waterbodies. The intent of this section is not to quantify these impacts, but rather to describe the existence of these historical stressors.

1.1 State Water Project and Water Reservoirs

The Upper Santa Margarita Watershed includes two major basins, drained by Temecula and Murrieta Creeks. Over 50% of the Santa Margarita River Watershed has been controlled by the construction of Vail Dam and Skinner Reservoir in 1949 and in 1974, respectively. Vail Dam and Skinner Reservoir created significant storage capacity in the upper watershed.

In 1960, the Metropolitan Water District (MWD) contracted for additional water supplies from the State Water Project (SWP) operated by the State of California Department of Water Resources (DWR). In 1972, the SWP began bringing water from the wet climate of Northern California to the dry climate of Southern California. In 1974, the 44,200 acre-feet Lake Skinner was formed by construction of a dam on Tucalota Creek. The reservoir is supplied by the Colorado River Aqueduct and the SWP, and feeds the Skinner Filtration Plant that distributes potable water to more than 2.5 million residents in Riverside County and San Diego County.

Vail Lake is a 49,370 acre-feet reservoir located at the confluence of Temecula Creek, Wilson Creek, and Kolb Creek. The reservoir was historically built in 1949 by the original owners of Vail Ranch to develop an irrigation system for expanding their agricultural activities. The reservoir has been operated since 1978 by the Rancho California Water District to help replenish local groundwater.

Vail Lake and Skinner Lake are solely operated based on water supply and groundwater recharge considerations, and not for flood control purposes. The storage capacity of each reservoir induces a mitigation of peak flow rates and durations during storm events. The potential increases in flood flows resulting from development are offset by the storage effect of the reservoirs (PWA, 2004). The decrease in baseflow and increase in the severity and frequency of extremely low flow events has, however, impacted instream habitat and riparian ecosystems. Restoration of these habitats would result from the implementation of flow management strategies for the reservoirs, including the restoration of historical baseflow conditions. The SMR MS4 Copermittees do not, however, have jurisdiction over the management of the reservoirs. Secondly, the retention of surface flow and coarse sediment fluxes from Tucalota Creek and Temecula Creek may have altered the original dynamic equilibrium of downstream waterbodies.

1.2 Existing Surface Water and Groundwater Conditions

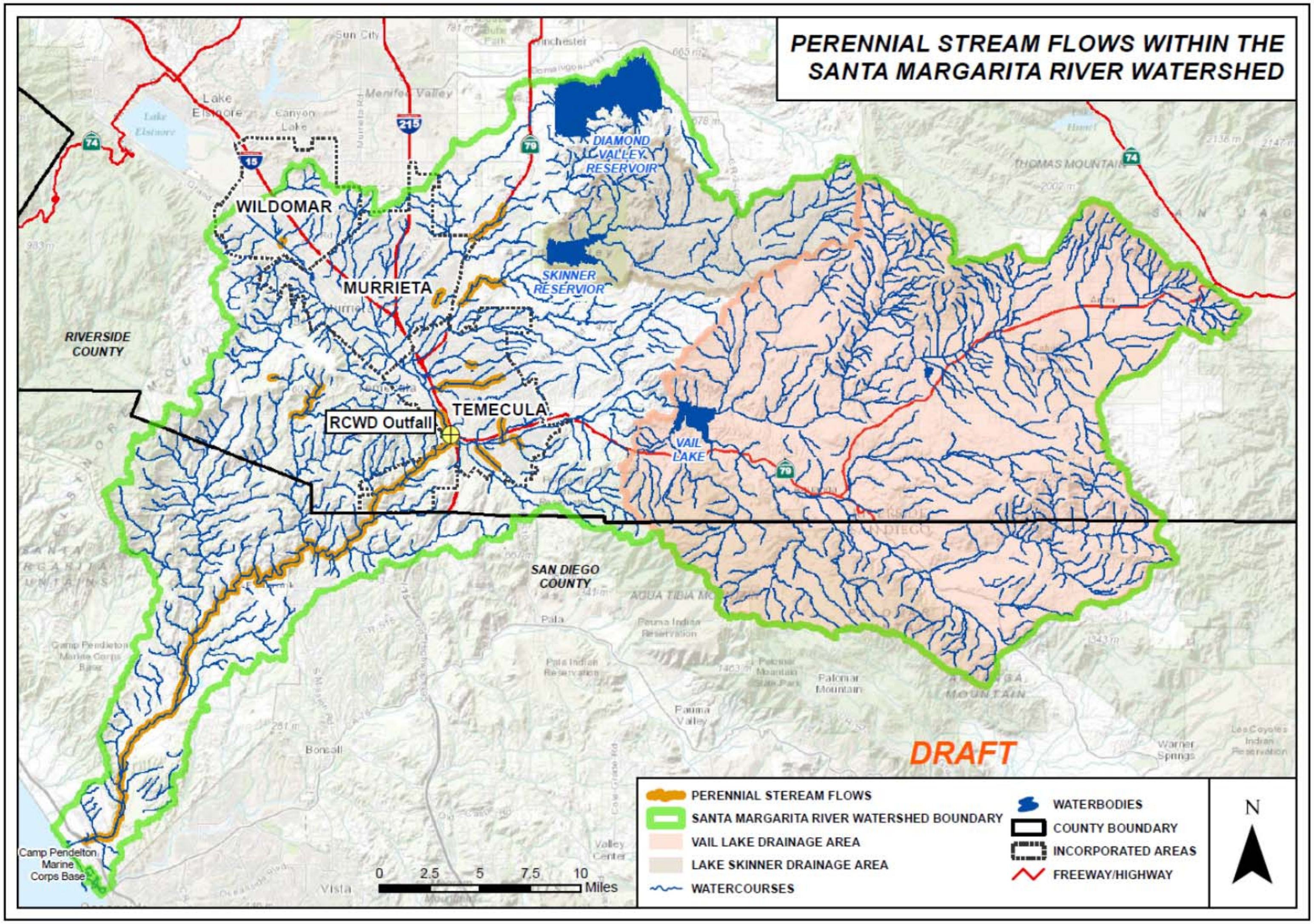
Murrieta and Temecula Creeks are perennial interrupted streams. Perennial flows disappear by seeping into the sands and gravels and resurfacing upstream of the confluence of Murrieta and Temecula Creeks (2007 DAMP). The creeks in the urbanized areas of the watershed, located primarily in the valley, are ephemeral and flows are observed only during and immediately after significant storm events. During major storms, after initial wetting, periods of intense rainfall result in rapid increases in streamflow in steep foothill and mountain areas. Runoff in streams in the watershed is derived primarily from rainfall, and as a result, stream flow exhibits monthly and seasonal variations similar to those shown by the precipitation records. Absence of snow pack in the tributary watershed results in a rapid decrease in stream flow at the conclusion of the winter precipitation season. Following severe storms, discharge in the larger streams often increases in a few hours from practically no flow to a rate of thousands of cubic feet per second. Stream flows vary greatly from month to month and from season to season.

As of May 2013, the District's Watershed Protection Division is in the process of preparing a map of the SMR identifying the drainage system and those limited segments that may exhibit perennial flows. A preliminary version of the map that was completed based on a reconnaissance survey during the wet season (early April 2013) is shown in **Error! Reference source not found.**. Based on the preliminary reconnaissance, it was determined that 96.9% of the stream segments in the SMR are ephemeral. A final map will be completed upon performing a field reconnaissance in the fall to identify dry-weather flows. It is anticipated that the percentage of ephemeral stream segments in the SMR will increase based on the fall reconnaissance.

1.3 Historical Urbanization in the SMR

In addition to Riverside County unincorporated land, Wildomar, Temecula, and Murrieta are the only three cities that are located within the SMR. The Riverside County Drainage Area Management Plan (2007 DAMP) assumes that 92% of the SMR remained undeveloped as of 2010. Much of the remaining SMR lands will ultimately be incorporated into the Western Riverside County Multi-Species Habitat Conservation Plan (MSHCP), which requires the ongoing conservation of 500,000 acres within the County. For the average annual event, it is estimated that approximately 89% of the volume of runoff in the SMR is due to nonurban land uses not regulated under the federal storm water program (2007 DAMP).

Figure 1 – Map of Perennial Flows within the Santa Margarita Region



2 Technical Concepts

Monitoring measures aim at identifying a potential response of stream segments to an altered flow regime, if any, or other physical and watershed constraints. Response from a stream segment may be assessed through the monitoring of two types of field indicators: 1) an evaluation of the stream physical habitat; and 2) a morphologic assessment of identified cross-sectional transects. This section provides a technical justification to using both field indicators.

2.1 HMP Monitoring Measures

Instream Biological Conditions

Biological communities provide a direct representation of the health of stream segments. This is explained by the fact that biological indicators integrate exposure over time and respond to cumulative stressors. The IBI integrates several populations of organisms, and as such the combination of organisms offers a differential sensitivity to stressors, allowing for early detection of potential degradation (SCCWRP, 2011). Due to the climate of the SMR, an B-IBI will be used in assessing the biological health of stream segments. The benthic macro invertebrate IBI was specifically developed for the semiarid and populous southern California coastal region, identified as the SoCal B-IBI (2005). The SoCal B-IBI metric may only be performed within a set index period, typically from May to July, and only if water present (SCCWRP, 2013). As identified in Section 1.2, the majority of streams within the SMR are, however, ephemeral, which significantly limit the applicability of SoCal B-IBI scores to assess the biological health of stream segments.

The Surface Water Ambient Monitoring Program (SWAMP) established alternative bioassessment procedures that may be applied to ephemeral or intermittent stream segments. Alternative terrestrial procedures include investigating, in addition to the morphologic assessments detailed hereafter, substrate composition, canopy cover, riparian vegetation, instream habitat complexity, and human influence. Changes in the hydrologic and sediment supply regimes of an urban stream typically result in the destruction of valuable streamside or riparian habitat and tree cover, and disruption of habitat (USEPA, 2008). Selected alternative terrestrial procedures derive from the physical habitat assessment methods developed by Kaufmann et al. (1994), which are currently used as the standard method of stream habitat collection by the USEPA in its Environmental Monitoring and Assessment Program (EMAP) (USEPA, 1999).

A brief description of each applicable physical habitat metric is provided, as follows:

- **Substrate composition** - Changes in substrate size distributions are often indicative of catchment and streamside disturbances that alter hillslope erosion or mobilize sediment. Accumulations of fine substrate particles also fill the interstices of coarser bed materials, reducing habitat space and its availability for benthic fish and macroinvertebrates

(USEPA, 1999). The Wolbman pebble count technique along with visual assessment is a well-established and efficient method for estimating the particle size distribution. The presence of coarse particular organic matter (CPOM) should also be quantified by the scientist (Ode et al., 2007).

- **Riparian vegetation** - Riparian canopy over a stream is important not only for its role in moderating stream temperatures through shading, but also as an indicator of conditions that control bank stability and the potential for inputs of coarse and fine particulate organic material (USEPA, 1999). Types, density, and coverage of the canopy should be classified into three categories (groundcover, lower canopy, and upper canopy) based on the scientist's observations within the defined riparian zone.
- **Instream habitat complexity for aquatic fauna** – The instream habitat complexity consists of identifying and quantifying the presence of typical channel features that provide good information about the general condition and complexity of the stream channel. Channel features that may be evaluated for the purposes of the HMP Evaluation Program include boulders, woody debris, undercut banks, overhanging vegetation, live tree roots, and artificial structures.
- **Human influence** – Field evaluations should identify the presence and proximity of significant types of human activities in the stream riparian area, including land use, infrastructure, and other influences.

Specific physical habitat assessment procedures are fully characterized in the SWAMP Bioassessment Procedures Report (Ode et al., 2007).

Temporal Evolution of Channel Morphology

The most direct method to assess changes due to scour or deposition is to physically measure the pre-project and post-project cross-sections, and determine if the channel is filling, incising and/or widening over time. This is accomplished by conducting geomorphic assessments and stream channel surveys downstream of a planned development before and after construction. In addition to physical measurements, comparison of current and historical photos, aerial photography, and site inspection for signs of channel degradation can provide important supporting evidence.

2.2 Temporal and Spatial Variability of Monitoring Locations

Temporal Variability

The single most important factor affecting the temporal variability inherent to measuring stream aggradation and degradation is variable inter-annual rainfall frequency and intensity. Droughts in California can last years, with little to no rainfall occurring in Southern California. During El Niño years, anomalously high storm frequencies and intensities can result in sudden geomorphic changes. Rainfall intensity also varies intra-annually. Accordingly, the value of the monitoring program will be derived only over the long-term. Significant trends may require many years to identify. Physical habitat metrics may be a correlating variable to geomorphic changes in streams. As identified in Section 2.1, physical habitat metrics should be evaluated on an individual basis that reflects the flow conditions (perennial, intermittent, or ephemeral) of the evaluated stream segment.

Spatial Variability

Physical habitat metrics and cross-sectional transects of a representative set of stream segments is important to capture the range of watershed conditions and biological health of the SMR. Other important factors that reflect stream responses to hydromodification include channel grade, watershed area, and stream sinuosity. In addition to channel and watershed features, location within the watershed is an important consideration. Monitoring stations should be located in the headwaters or upper portion of representative subwatersheds within the SMR. Representative monitoring stations should ideally:

- Be located just downstream (or within the domain of influence as defined in Appendix C of the SMR HMP) of a PDP of sufficient size, so that hydromodification effects from the PDP can be isolated to the maximum extent practicable.
- Not be influenced by other confounding variables such as dam operation, runoff retention basins, Caltrans runoff, or agricultural development and operation. Specifically, stream segments that are located downstream of Vail Lake and Skinner Reservoir are not ideal locations for the investigations. As identified in Section 1.1, the presence of water retention projects and SWP basins have altered the hydrologic and sediment supply regimes of the receiving streams, which are located in the developed portion of the SMR.

Headwaters in representative SMR subwatersheds provide more definitive measures of HMP effectiveness because they can more directly correlate effects to specific PDPs.

Middle watershed and lower watershed sites would be influenced by confounding variables (such as mass wasting and other existing development projects) in the watershed. Mass wasting or slope failure occurs on stream banks subject to weathering, increased water content, changes in vegetation cover, and overloading. Therefore, middle and lower watershed monitoring sites would require much more time to assess overall program effectiveness, if achievable.

The concept of providing hydromodification effectiveness measurements in the watershed headwaters is supported by SCCWRP. Research by SCCWRP has shown that hydromodification effects of a development project may become muted with increasing distance from the development site (defined by SCCWRP as the Domain of Effect). To the extent practicable, monitoring locations as described in the HMP Evaluation Program will be distributed throughout the SMR to provide for representative geographic and climatic variability.

3 Approaches Selected to Assess HMP Effectiveness

The philosophy of the evaluation program is to build upon existing water quality monitoring stations located throughout the SMR that meet the sitting criteria defined in Section 2.2 in an effort to develop the most efficient alternative for the Copermittees. Monitoring at selected water quality monitoring stations may be expanded to simplified cross-section surveys that will analyze the geomorphic evolution or stability of the stream. Additional monitoring stations may be selected, if necessary, by the Copermittees to account for both temporal and spatial variability and assess the effectiveness of the SMR HMP to hydromodification associated with PDPs.

The HMP Evaluation Program extends for a period of five years. A period of five years is necessary to implement the hydromodification monitoring stations, analyze the data, and account for spatial and temporal variability of the conditions in the SMR. Implementation of the HMP Evaluation Program will be discussed in the SMR Annual Reports. Analytical data will be submitted to the Regional Board at the end of the evaluation period, tentatively in Fall 2019.

An examination of the riparian physical habitats alternative terrestrial methods will be conducted to assess both biological and geomorphologic health of the streams. Biological organisms provide key insight into the overall health of a stream. Benthic communities should be monitored once a year, preferably in late spring, at identified monitoring locations of perennial or intermittent flow meeting the requirements for bioassessment protocol. Other ephemeral locations should also be monitored based on terrestrial methods once a year, preferably in the spring. Additionally, channel assessment cross-sections at selected locations, coincident with the SoCal B-IBI sampling or terrestrial assessment locations, will be selected.

The SMR Copermittees seek well-established methods to implement the HMP Evaluation Program. Where applicable, stream bioassessment for the purpose of HMP effectiveness should be coupled with the existing SWAMP Bioassessment Protocol (CMP Vol. III, 2012).

Considering the constraints and technical approach detailed above, the following approaches are recommended for HMP monitoring:

- Evaluate the HMP effectiveness by monitoring identified physical habitat metrics at the selected locations. Physical habitat metrics provide essential information to the overall health of a stream, and observed changes may be the precursor to an impacted or improved stream. Physical habitat metrics should be monitored once a year, preferably in late spring, at defined monitoring stations.
- Complete a stream channel survey at each of the selected cross-sectional transects annually. The stream channel survey consists of collecting topographic and bathymetric measurements along each cross-section to characterize morphology and longitudinal slope of the stream segment. Surveys may be performed by field measurements, aerial and ground-based photogrammetry, laser scanning or an alternatively acceptable surveying technique. Aerial photogrammetry can specifically be used to evaluate floodplain width, planform changes, channel migration, and floodplain obstructions or

constrictions (SCCWRP, 2013). Four parameters will be surveyed: 1) the floodprone width; 2) the bankfull width; 3) the bankfull depth; and 4) the longitudinal slope. Each surveyed stream segment will be subsequently classified per the simplified Rosgen system of channel classification (Rosgen, 1996). Figure 2 shows the different types of channels per Rosgen channel classification (Rosgen, 1996).

Figure 2: Simplified Rosgen Channel Classification

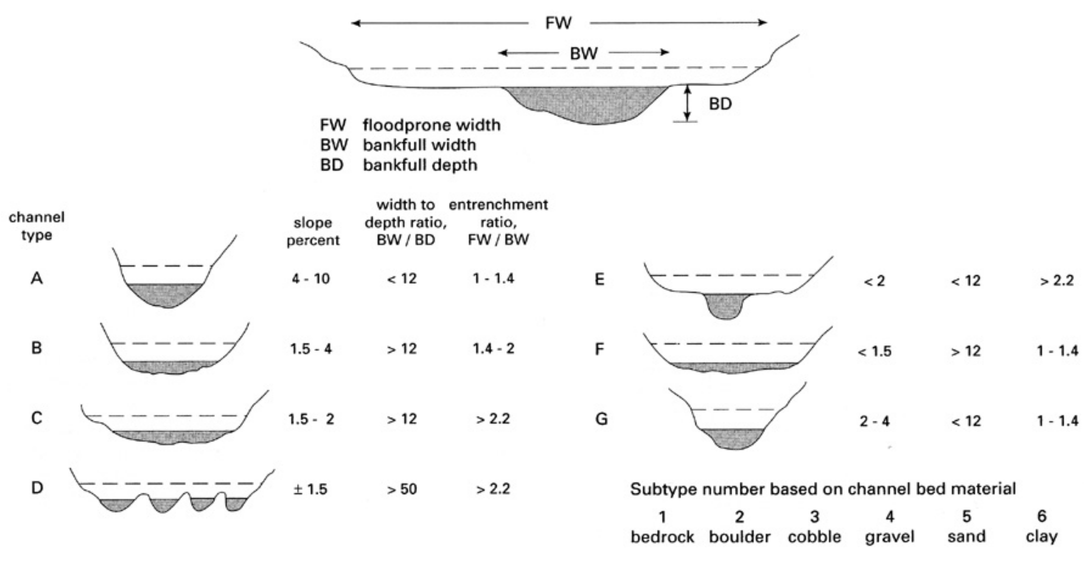
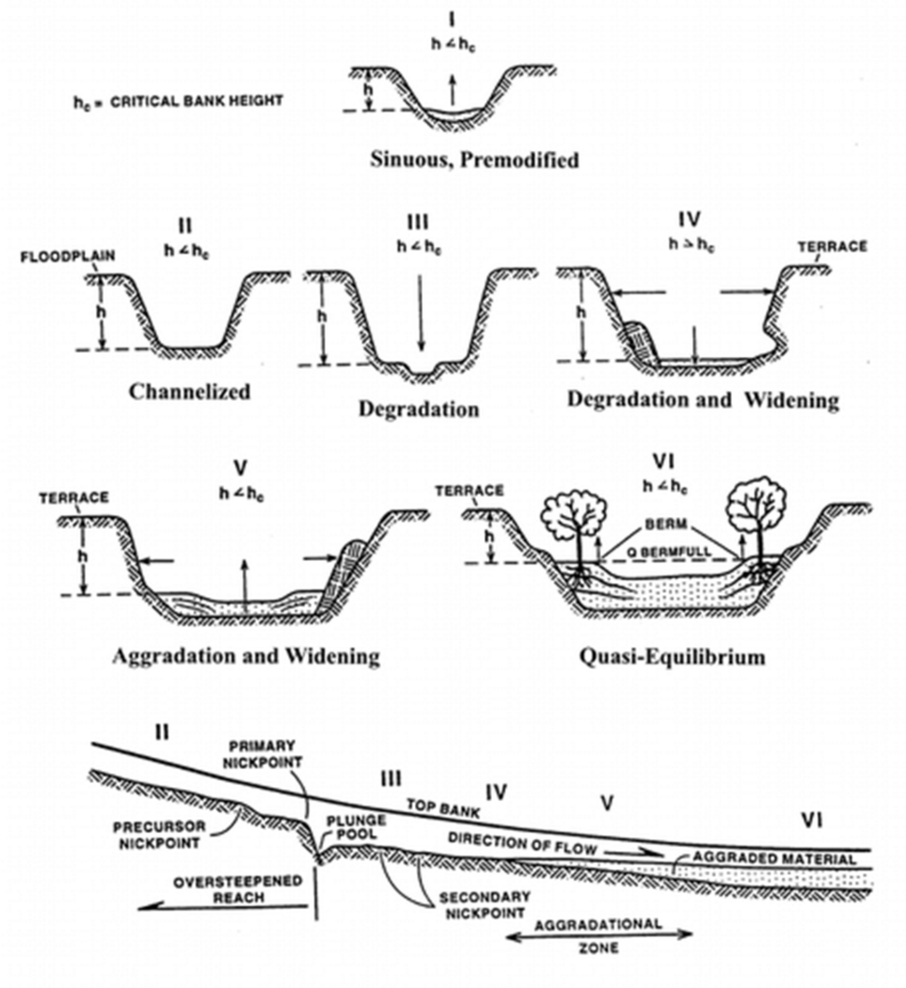


Figure 1.12 The Rosgen system of channel classification.

(Rosgen, 1996)

The temporal evolution in geomorphology, if any, of the surveyed stream segment will be compared to the six-stage Channel Evolution Model defined by Simon, as well as the previous year cross-section data, to correlate any potential impacts of urbanization to this change of stream channel geomorphology (Simon et al., 1992). The geomorphologic evolution of a stream segment, if any, will also be compared to the annual bioassessment or alternative terrestrial evaluation to determine if the observed aggradation or degradation is associated with changes in the benthic macro invertebrate communities. Figure 3 illustrates the six-stage sequence of incised channel evolution (Simon et al., 1992). A stream segment will be considered stable over time if features of the stream segment (such as dimension, pattern, and profile) are maintained, and the stream system neither aggrades nor degrades. The channel classification procedure is described in more detail in Appendix F of the SMR HMP.

Figure 3: Six-Stage Channel Evolution Model



(Simon et al, 1992)

Monitoring headwaters of representative subwatersheds within the SMR - Upper watershed monitoring (channel surveys) is recommended to eliminate confounding lower watershed variables that would skew the analysis and minimize the potential for reaching meaningful conclusions.

Monitor representative locations, including one reference station - The reference monitoring station would be located in a portion of the study area for which no upstream development (existing or future) is anticipated, preferably where historical bioassessment or alternative terrestrial evaluation has been carried out. Data from the reference stations may be used to supplement pre-project condition data obtained at the representative monitoring sites, since the amount of pre-project condition data that can be obtained at such sites is dependent on the land development process. The number of representative stations selected by the Copermittees should balance the need to characterize spatial variability.

4 HMP Effectiveness Evaluation

The effectiveness of the HMP is to be evaluated into two main elements:

1) BMP inspections and maintenance
2) Performance protocol

4.1 BMP Inspections and Maintenance

One key component of the implementation of the HMP is to ensure hydrologic controls and sediment supply management measures (site design avoiding streams identified as significant sources of sediment supply) that are identified in Section 2 of the SMR HMP perform effectively. PDPs are conditioned to verify inspections and maintenance operations as defined in Chapter 5 of the 2013 SMR WQMP. The list of such inspections and maintenance operations will be included in the project-specific WQMP submitted by the PDP applicant. Regular maintenance activities ensure the long-term performance of hydromodification BMPs at mitigating flow rates and durations.

4.2 Performance Protocol

As defined in Section 3, stream channel section surveys to be performed using pertinent surveying techniques and evaluation of identified physical habitat metrics are to be monitored on a regular basis at representative locations in the SMR. If a significant degradation of the evaluated stream segment is detected, a hydrologic analysis will be performed. A significant degradation of the stream segment will be subjectively interpreted by the analyst as a sudden decline in bioassessment or alternative metrics, or a rapid change of the morphology of the channel (cross-section) that follows Simon's CEM. A drastic change in physical habitat metrics may indicate that flow conditions have consequently changed. A significant improvement of the bioassessment or alternative metrics may validate the approach taken in the HMP.

The hydrologic analysis, if required, shall determine if the significant degradation of the monitored stream segment is associated to geomorphically significant flows (10% of the 2-year storm event to the 10-year storm event) or if it was caused by flows outside the critical range (a relatively rare storm event) or by other variables identified by the analyst. The geographic location of the evaluated stream segments should meet the sitting criteria identified in Section 2.2, thus should minimize the influence of confounding variables on the hydrology and sediment supply in the evaluated stream segment. A significant difference between the expected and the observed flow duration curves for the identified flow range would automatically trigger a performance protocol.

The performance protocol consists of investigating the tributary area of the impacted stream segment to identify the potential source(s) for the degradation of the biological health and/or the morphology of the stream segment. The analyst may investigate the following potential sources:

- If the stream degradation was caused by flows outside the critical range (a relatively rare storm event), the extensive hydrologic analysis may terminate and no further investigation is needed. Since the advent of the MS4 Permit, the 1993, 2005, and 2010 storm events would notably qualify as relatively rare storm events.
- If the stream degradation was caused by other unexpected stressors identified by the analyst, their impact to the flow and sediment supply regimes through the evaluated stream segment should be documented.
- Hydrologic controls and sediment supply management measures of one or several PDPs will be examined to determine if they are under-performing due to a lack of maintenance or poor design. In this case, the lack of performance may appear to be directly responsible for the drastic change in stream conditions (bioassessment or equivalent terrestrial metrics, morphology). Rehabilitation of the stream segment may be required.
- The hydrologic control and sediment supply standards identified in the SMR HMP are not effective at mitigating the effects of hydromodification from PDPs. If sufficient monitoring data has been collected, the analyst should identify the range of flows that is geomorphically significant for the evaluated stream segment, and/or the supply of bed sediment necessary to achieve the dynamic equilibrium of the stream segment.

It is expected that initial conclusions regarding the effectiveness of the HMP will be drawn after a minimum of five years of observations.

5 Summary and Conclusions

The SMR HMP Evaluation Program, scheduled for initial implementation by the SMR MS4 Copermittees over a five-year period, will include the following specific activities:

Baseline Monitoring Plan

- Identification and installation of representative monitoring stations that meet the sitting criteria identified in Section 2.2.
- Evaluation of historical data at representative monitoring stations, if available
- Perform annual geomorphic assessments and bioassessments per the methods identified in Section 2.2 and Section 3.
- Implementation of the SMR HMP will be discussed in the SMR Annual Report (FY2014–FY2019).
- HMP Effectiveness Evaluation Summary (to be submitted in 2019 SMR JRMP Annual Report)

Monitoring Stations

- Monitoring locations – Stations will be located in receiving waters that have potential impacts from, but not limited to: PDPs, HCOC, and BMPs. One monitoring reference station is required to help establish baseline monitoring data.

Bioassessment

- Annual SoCal B-IBI sampling, where applicable, or alternative terrestrial bioassessment, preferably during spring season – similar to annual bioassessment and SWAMP (2014–2019)

Channel Assessments

- Initial geomorphic assessment at each monitoring location (2014-2015)
- Baseline cross-section surveys at each monitoring location (2014-2015)
- Annual geomorphic assessments and cross-section survey at each monitoring location to assess channel condition and response (2015–2019)

Aerial photogrammetry, and/or cross-section surveys, or other appropriate surveying techniques, will consist of recording, on an annual basis, the vertical elevations of all significant geomorphic features (bankfull, bank top, bank toe, bar tops, edge of water, thalweg, bank failure, and others) and of all changes in slope breaks at the monumented cross-sections. Annual geomorphic assessments consist of characterizing, on an annual basis, the rate of change, if any, of bed material encountered, vegetation, and bed and bank lateral and longitudinal profiles that are derived from cross-section surveys. The rate of bed material encountered may be characterized on the basis of the temporal change in the median grain size of bed sediment, or d_{50}, that is determined from Wolbman Pebble Count procedures. The geomorphic survey will also be coupled with monitoring data from the bioassessment stations to ensure that the HMP is effective in protecting the geomorphic and biological integrity of receiving streams.

The approach of the SMR HMP Evaluation Program is conceptualized and summarized in Figure 4.

Figure 4: SMR HMP Evaluation Program Schematic

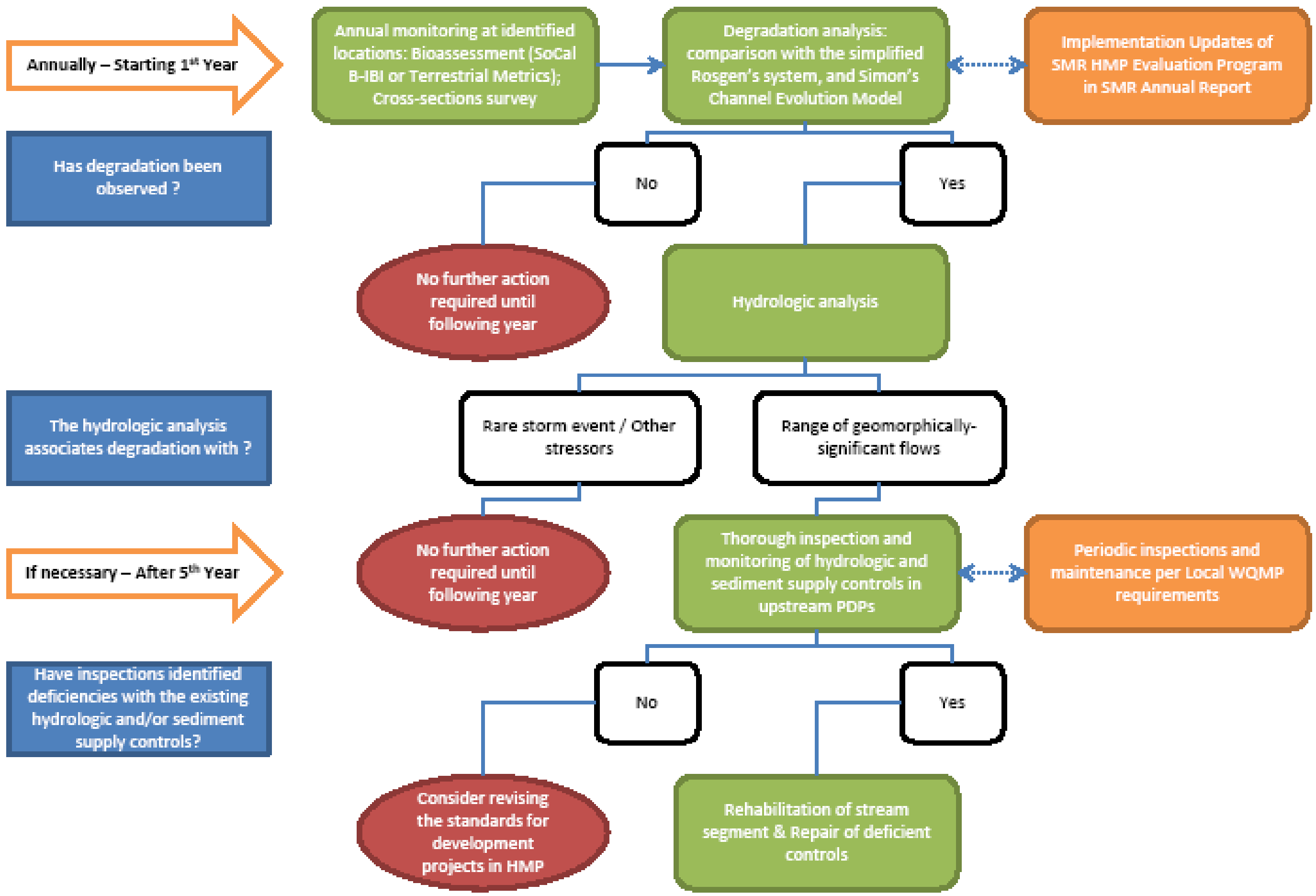


Figure 4 - SMR HMP Evaluation Program Schematic