Chapter 6

Hydromodification Management Requirements for PDPs

The purpose of hydromodification management requirements for PDPs is to minimize the potential of storm water discharges from the MS4 from causing altered flow regimes and excessive downstream erosion in receiving waters. Hydromodification management implementation for PDPs includes two components: 1) protection of critical coarse sediment yield areas, and 2) flow control for post-project runoff from the project site. For PDPs subject to hydromodification management requirements, this Chapter provides guidance to meet the performance standards for the two components of hydromodification management.

The civil engineer preparing the hydromodification management study for a project will find within this Chapter and Appendix G of this manual, along with watershed-specific information in the WMAA, all necessary information to meet the Permit standards. Should unique project circumstances require an understanding beyond what is provided in this manual, then consult the March 2011 Final HMP, which documents the historical development of the hydromodification management requirements.

Guidance for flow control of post-project runoff is based on the March 2011 Final HMP, with modifications in this manual based on updated requirements in the Permit. The March 2011 Final HMP was prepared based on the 2007 Permit, not the Permit that drives this manual. In instances where there are changes to hydromodification management criteria or procedures based on the Permit, the criteria and procedures presented in this manual supersede the March 2011 Final HMP.

Protection of critical coarse sediment yield areas is a new requirement of the Permit and is not covered in the March 2011 Final HMP. The standards and management practices for protection of critical coarse sediment yield areas are presented here in the manual.

6.1 Hydromodification Management Applicability and Exemptions

As noted in Chapter 1, Section 1.6, a project may be exempt from hydromodification management requirements if it meets any one of the following conditions:

- The project is not a PDP;
- The proposed project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayment's, or the Pacific Ocean;
- The proposed project will discharge runoff directly to conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayment, or the Pacific Ocean; or
- The proposed project will discharge runoff directly to an area identified by the Copermittees as appropriate for an exemption by the WMAA for the watershed in which the project resides.

The above criteria reflects the latest list of exemptions that are allowed under the Permit and therefore supersedes criteria found in earlier publications.

Exempt water storage reservoirs and lakes in San Diego County are shown in the WMAA for each watershed. To qualify for the potential exemption, the outlet elevation of the storm water conveyance system discharging to the water storage reservoir or lake must be at or below either the normal operating water surface elevation or the reservoir spillway elevation, and properly designed energy dissipation must be provided.

6.2 Protection of Critical Coarse Sediment Yield Areas

When hydromodification management requirements are applicable according to Section 6.1, the applicant must determine if the project will impact any areas that are determined to be critical coarse sediment yield areas. A critical coarse sediment yield area is an area that has been identified as an active or potential source of coarse sediment to downstream channel reaches. Potential critical coarse sediment yield areas for each watershed management area are delineated in the associated WMAA.

If potential critical coarse sediment yield areas are identified within the project drainage boundaries based on the maps included in the WMAA, the areas should be assumed to be critical coarse sediment yield areas requiring protection unless further study determines either: (1) based on detailed project-level verification of Geomorphic Landscape Units (GLUs) described in Section 6.2.1, the areas are not actually potential critical coarse sediment yield areas, or (2) based on the flow chart in Section 6.2.2, the receiving water system is not sensitive to reduction of coarse sediment yield, or (3) based on detailed investigation described in Section 6.2.3, the areas are not producing sediment that is critical to receiving streams.

For projects with critical coarse sediment yield areas identified within the project drainage boundaries, Section 6.2.4 provides management measures for areas that are onsite, and Section 6.2.5

provides management measures for areas that are offsite and draining through the project. If no potential critical coarse sediment yield areas are identified within the project drainage boundaries, no measures for protection of critical coarse sediment are necessary. The project will require measures for flow control only (see Section 6.3).

The first step to determine if the project will impact any critical coarse sediment yield areas is to consult the map included in the WMAA. The outcome of that initial analysis will determine the need for subsequent analysis as follows:

- If the project is shown to not impact any potential critical coarse sediment yield areas according to the WMAA map, typically no further analysis is required. This includes reviewing the entire drainage area draining through the project site for nearby potential critical coarse sediment yield areas where the runoff will travel through the project site. Because the WMAA maps are macro-level maps that may not represent project-level detail, the City Engineer may require additional project-level investigation described in Section 6.2.1 even when the maps included in the WMAA do not indicate the presence of potential critical coarse sediment yield areas.
- If the project is shown to impact potential critical coarse sediment yield areas according to the WMAA map, then the applicant may conduct one or further analyses described in Sections 6.2.1, 6.2.2, and 6.2.3. The additional analyses are optional. The result of any of the additional analyses may invalidate the finding or modify the finding of the WMAA map, or it may confirm the finding of the WMAA map.
- If it is determined that the project will impact critical coarse sediment yield areas after the applicant has exercised all elected options for further analyses, then management measures described in Sections 6.2.4 and 6.2.5 are required.

6.2.1 Verification of GLUs Onsite

The Potential Critical Coarse Sediment Yield Area maps in the WMAAs identify areas that are considered potential critical coarse sediment yield areas based on their GLU. A GLU is a combination of slope, geology, and land cover. A regional-level WMAA was prepared that determined GLUs that are considered to be potential critical coarse sediment yield areas. These GLUs are areas with a combination of open (undeveloped) land cover, high relative sediment production based on a normalized revised universal soil loss equation analysis, and coarse grained geologic material (material that is expected to produce greater than 50% sand when weathered).

The maps included in the WMAA are macro-level maps that may not represent project-level detail. If the WMAA maps indicate the presence of potential critical coarse sediment yield areas within the project site, detailed project-level review of GLUs onsite may be performed to verify the presence or absence of potential critical coarse sediment yield areas within the project site. Some jurisdictions may require verification of GLUs for all projects (including projects where the WMAA maps do not indicate the presence of potential critical coarse sediment yield areas).

The following data are needed to verify the GLUs onsite:

- Project boundary
- Classification of pre-project slopes within the project boundary into four (4) categories defined in Appendix H

- Classification of underlying geology within the project boundary into seven (7) categories defined in Appendix H
- Classification of pre-project land cover within the project boundary into six (6) categories defined in Appendix H. In this context, use "pre-project" land cover, including any existing impervious areas. Assumption of "pre-development" land cover is not required for GLU analysis

Intersect the geologic categories, land cover categories, and slope categories within the project boundary to create GLUs. This is a similar procedure to intersecting land uses with soil types to determine runoff coefficients or runoff curve numbers for hydrologic studies, but there are three categories to consider for the GLU analysis (slope, geology, and land cover), and the GLUs are not to be composited into a single GLU. When GLUs have been created, determine whether any of the GLUs listed in Table 6-1 are found within the project boundary. The GLUs listed in Table 6-1 are considered to be potential critical coarse sediment yield areas.

TABLE 6-1. Potential Critical Coarse Sediment Yield Areas

GLU	Geology	Land Cover	Slope (%)
CB-Agricultural/Grass-3	Coarse Bedrock	Agricultural/Grass	20% - 40%
CB-Agricultural/Grass-4	Coarse Bedrock	Agricultural/Grass	>40%
CB-Forest-2	Coarse Bedrock	Forest	10 – 20%
CB-Forest-3	Coarse Bedrock	Forest	20% - 40%
CB-Forest-4	Coarse Bedrock	Forest	>40%
CB-Scrub/Shrub-4	Coarse Bedrock	Scrub/Shrub	>40%
CB-Unknown-4	Coarse Bedrock	Unknown	>40%
CSI-Agricultural/Grass-2	Coarse Sedimentary Impermeable	Agricultural/Grass	10 – 20%
CSI-Agricultural/Grass-3	Coarse Sedimentary Impermeable	Agricultural/Grass	20% - 40%
CSI-Agricultural/Grass-4	Coarse Sedimentary Impermeable	Agricultural/Grass	>40%
CSP-Agricultural/Grass-4	Coarse Sedimentary Permeable	Agricultural/Grass	>40%
CSP-Forest-3	Coarse Sedimentary Permeable	Forest	20% - 40%
CSP-Forest-4	Coarse Sedimentary Permeable	Forest	>40%
CSP-Scrub/Shrub-4	Coarse Sedimentary Permeable	Scrub/Shrub	>40%

If none of the GLUs listed in Table 6-1 are present within the project boundary, no measures for protection of critical coarse sediment yield areas onsite are necessary. If one or more GLUs listed in Table 6-1 are present within the project boundary, they shall be considered critical coarse sediment yield areas and protected with measures described in Section 6.2.4, or the project applicant may elect to continue to Section 6.2.2 to determine whether downstream systems would be sensitive to reduction of coarse sediment yield from the project site. If any of the GLUs listed in Table 6-1 are present offsite within area that drains through the project site, see Section 6.2.5 for management measures for critical coarse sediment yield areas offsite and draining through the project.

6.2.2 Downstream Systems Sensitivity to Coarse Sediment

If it has been determined that potential critical coarse sediment yield areas exist within the project site, the next step is to determine whether downstream systems would be sensitive to reduction of coarse sediment yield from the project site. Protection of critical coarse sediment yield areas is a necessary element of hydromodification management because coarse sediment supply is as much an issue for causing erosive conditions to receiving streams as are accelerated flows. However, not all downstream systems warrant preservation of coarse sediment supply. In some cases, downstream systems are negatively impacted by coarse sediment. For example, existing MS4 systems that cannot convey coarse sediment and become clogged, resulting in urban flood hazards and on-going maintenance needs. In some cases, downstream channels are aggrading with undesirable results (e.g. impacts to habitat or urban flooding). Use Figure 6-1 and the associated node descriptions to determine whether downstream systems require protection.

A checklist based on Figure 6-1 is provided in Appendix I. If, based on Figure 6-1, downstream systems do not warrant preservation of coarse sediment supply, no measures for protection of critical coarse sediment yield areas are necessary. If, based on Figure 6-1, downstream systems must be protected, continue to Section 6.2.3 for optional additional analysis that may refine the extents of critical coarse sediment yield areas onsite, and Section 6.2.4 for management measures.

- Figure 6-1, Node 1 – Determine what type of system receives the project site runoff: does the project connect to an existing hardened MS4 system or discharge to an un-lined channel?
- Figure 6-1, Node 2 – If the project discharges runoff to an existing hardened MS4 system, determine whether the system can convey sediment (self-cleaning system) or will trap (sink) sediment. Existing systems with very low slope, constrictions, existing treatment control (pollutant control) BMPs, or existing detention basins typically will trap sediment, which can result in flooding and increased maintenance costs. When existing systems will trap sediment, measures to allow coarse sediment to be conveyed into the MS4 system are not recommended. Consult the City Engineer to determine if existing MS4 systems are impacted by sediment, and any other criteria defined by the City Engineer.
- Figure 6-1, Node 3 – If the existing MS4 system can convey coarse sediment (self-cleaning system, e.g. velocity will be greater than 6 feet per second in a 2-year storm event), determine what type of system receives the runoff.
- Figure 6-1, Node 4 – Un-lined channels shall be assumed to require protection of coarse sediment supply unless the channel has been identified by the City's maintenance records as impacted by deposition of sediment, and any other criteria defined by the City Engineer.

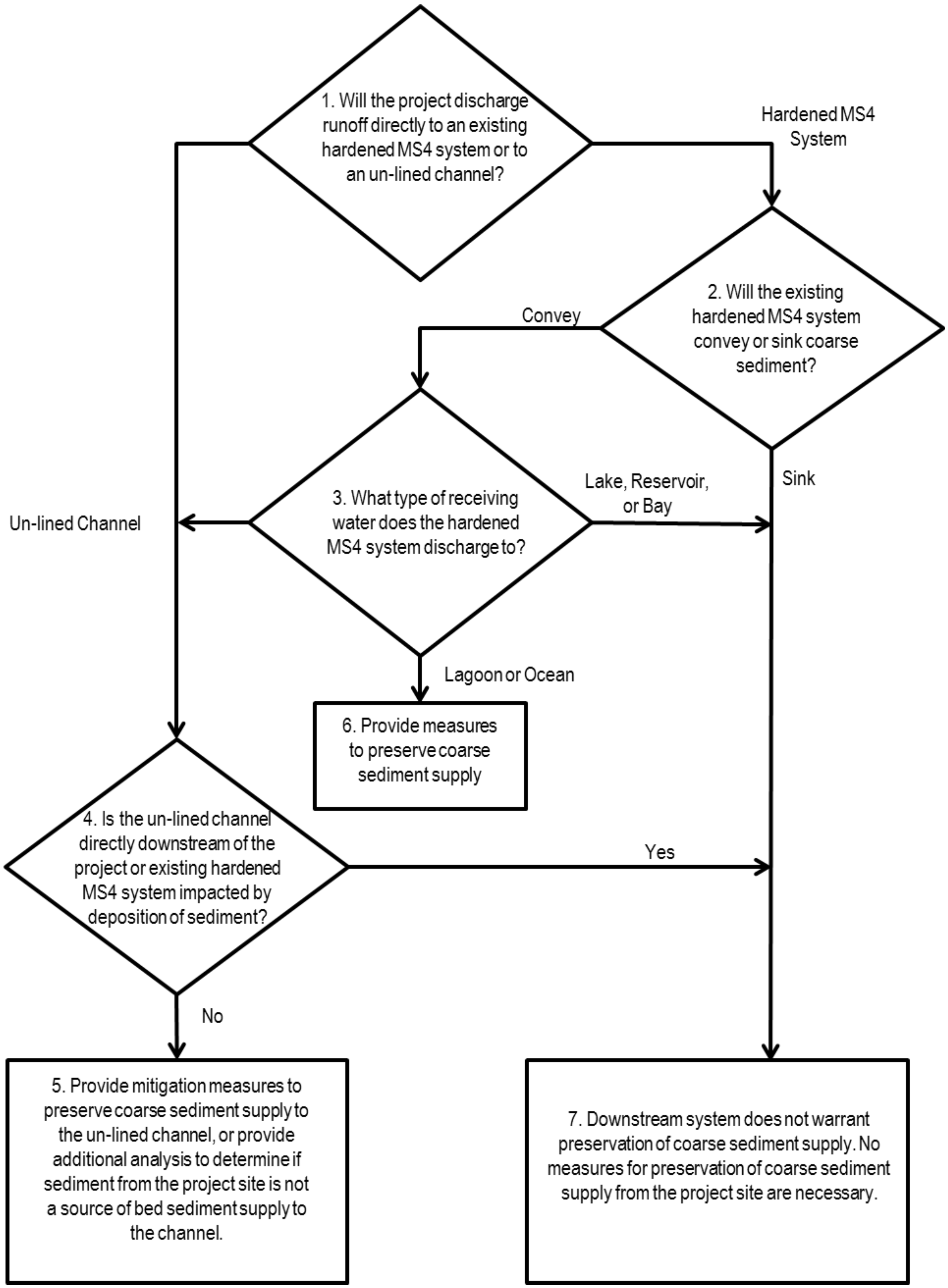

FIGURE 6-1. Evaluation of Downstream Systems Requirements for Preservation of Coarse Sediment Supply

6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite

When it has been determined based on the GLU analysis that potential critical coarse sediment yield areas are present within the project boundary, and it has been determined that downstream systems require protection, additional analysis may be performed that may refine the extents of actual critical coarse sediment yield areas to be protected onsite.

The GLU analysis that identifies potential critical coarse sediment yield areas does not define whether the areas are actually producing sediment that is critical to receiving streams. The GLU analysis identifies "potential" areas, which will be assumed to be critical unless further investigation determines the sediment is not critical to the receiving stream. Sediment that is critical to receiving streams is the sediment that is a significant source of bed material to the receiving stream (bed sediment supply).

Section 2.3.i of the "Santa Margarita Region HMP," dated May 2014 (herein "May 2014 SMR HMP"), provides methods of analysis to determine whether a portion of the site is a significant source of bed material to the receiving stream ("Step 1" of the May 2014 SMR HMP's three-step process for compliance with the sediment supply performance standard). The analysis will identify areas that are a significant source of bed sediment supply to the receiving stream, or eliminate areas that are not expected to be a significant source of bed sediment supply to the receiving stream. A civil engineer designing a PDP in San Diego may opt to prepare this analysis to refine the extents of actual critical coarse sediment yield areas to be protected onsite, using the worksheets that were developed for the Santa Margarita Region Water Quality Management Plan Template. A copy of the relevant portion of the May 2014 SMR HMP is included in Appendix H of this manual. For additional information, consult the May 2014 SMR HMP.

Areas that are not expected to be a significant source of bed sediment supply to the receiving stream do not require protection. If it is determined that the potential critical coarse sediment yield areas are producing sediment that is critical to receiving streams, or if the optional additional analysis presented above has not been performed, the project must provide management measures for protection of critical coarse sediment yield.

6.2.4 Management Measures for Critical Coarse Sediment Yield Areas Onsite

The following are management measures for protection of critical coarse sediment yield areas onsite:

1. Avoid disturbing critical coarse sediment yield areas, or
2. Subject to jurisdiction approval, provide project-specific onsite measures if critical coarse sediment yield areas will be disturbed.

6.2.4.1 Avoidance of Critical Coarse Sediment Yield Areas

Avoidance of critical coarse sediment yield areas is the preferred management measure.

The civil engineer shall designate onsite areas that are to be avoided (undisturbed) for the purpose of preserving coarse sediment yield. When feasible, the same areas should be considered as potential habitat preservation areas. If undisturbed critical coarse sediment yield areas will drain through developed portions of the project, these undisturbed areas must not be routed through detention basins or other facilities with restricted outlets that will trap sediment. The project's storm water conveyance system shall be designed to bypass these areas to ensure that critical coarse sediment can be discharged to receiving waters, such that there is no net impact to the receiving water. The bypass shall be designed with sufficient capacity and slope to convey sediment from undisturbed areas and not result in sediment accumulation on developed areas of a site.

6.2.4.2 Project-Specific Onsite Measures

If it is determined that avoidance of critical coarse sediment yield areas is infeasible, the City Engineer may allow the civil engineer to propose project-specific onsite measures to ensure that critical coarse sediment can be discharged to receiving waters, such that there is no net impact to the receiving water.

For example, adjusting the post-project flow duration curve to maintain pre-project conditions in the receiving channel with the expected change in bed sediment supply from the site. The following text excerpted from pages 32-33 of the May 2014 SMR HMP provides potential methods of analysis:

> "Alternatively, the User may propose adjusting the flow duration curve to maintain pre-project conditions in the receiving channel with the expected change in Bed Sediment Supply discharge from the project site. The erosion potential (total sediment transported in the proposed condition vs. the baseline) should be modeled and used to adjust the flow duration curve to ensure a condition that does not vary more than 10% from the natural condition. Bledsoe (2002) introduced the index of stream erosion potential (Ep), which compares the erosive power of pre- and post-development streamflows. This index allows comparison of sediment-transport relationships to ensure that an erosion potential that is comparable to pre-development conditions is achieved. Changes in Total Sediment Supply after development are accounted for by changing the target Ep from 1.0 (proposed is the same as pre-project) in proportion to the change in Bed Sediment Supply (post-development/pre-development), calculated using the six steps above. This option may not be practical when changes in Bed Sediment Supply are relatively large (greater than 50%). The User should determine, using best professional judgment, if the alternative modeling approach is applicable."
>
> "The alternative modeling approach must include the following:
>
> 1 Continuous hydrologic simulation for the project baseline condition and proposed condition over the range of flow values up to the pre-project 10-year event;
> 2 Sediment transport model of the receiving channel for the PDP baseline condition and proposed condition;
> 3 Analysis of the change in Bed Sediment Supply from the PDP baseline condition to the proposed condition;
> 4 Explanation of method used to control the discharge from the PDP to account for changes in the delivered Bed Sediment Supply; and
> 5 Summary report."
>
> "The User must demonstrate through a channel stability impact assessment that the changes to both the amount of Bed Sediment Load being transported and the amount of sediment supplied to the receiving channel will maintain the general trends of aggradation and degradation in the different impacted channel reaches, which are representative of the pre-

development geormorphologic state of a channel. Typical channel sediment continuity analysis procedures may be performed using moveable bed fluvial models such as HEC-6t or equivalent."

"Receiving channel monitoring may be required for the project site to verify that the PDP does not result in long-term changes to the receiving channel. The User should make a recommendation if long-term monitoring is required, for concurrence by the Copermittee with jurisdiction over the project site. Some of the considerations in assessing the need for a long-term monitoring program are:

1. Total area of the watershed at the PDP discharge point vs. the PDP area;
2. Condition and type of receiving channel;
3. Magnitude of change in Bed Sediment Supply to the receiving channel;
4. Relief of the land on the project site;
5. Number of channels (density) potentially delivering Bed Sediment Supply to the receiving channel, and the delivery ratio; and
6. Soil characteristics on the project site."

The project-specific onsite measures described above may be approved subject to the discretion of the City Engineer. Applicants considering such measures should consult the City Engineer to determine study requirements.

6.2.5 Management Measures for Critical Coarse Sediment Yield Areas Offsite and Draining Through the Project

Critical coarse sediment yield areas that are offsite and draining through the project also require attention in the project design.

When critical coarse sediment yield areas are identified adjacent to the project site (e.g. hillsides that will drain through the site), protection of these areas is similar to protection of undisturbed critical coarse sediment yield areas onsite. These areas must not be routed through detention basins or other facilities with restricted outlets that will trap sediment. The project storm water conveyance system shall be designed to bypass these areas to ensure that critical coarse sediment can be discharged to receiving waters, such that there is no net impact to the receiving water. The bypass shall be designed with sufficient capacity and slope to convey sediment from undisturbed areas and not result in sediment accumulation atop developed areas of a site.

6.3 Flow Control for Hydromodification Management

PDPs subject to hydromodification management requirements must provide flow control for post-project runoff to meet the flow control performance standard.

This is typically accomplished using structural BMPs that may include any combination of infiltration basins; bioretention, biofiltration with partial retention, or biofiltration basins; or detention basins. This Section will discuss design of flow control measures for hydromodification management. This Section is intended to be used following the source control and site design processes described in Chapter 4 and the storm water pollutant control design process described in Chapter 5.

The flow control performance standard is as follows (adapted from the March 2011 Final HMP, with modifications to meet the requirements of the Permit):

1 For flow rates ranging from 10 percent, 30 percent or 50 percent of the pre-development 2-year runoff event ($0.1Q_2$, $0.3Q_2$, or $0.5Q_2$) to the pre-development 10-year runoff event (Q_{10}), the post-project discharge rates and durations shall not deviate above the pre-development rates and durations by more than 10 percent over and more than 10 percent of the length of the flow duration curve. The specific lower flow threshold will depend on the erosion susceptibility of the receiving stream for the project site (see Section 6.3.4).

2 For flow rates ranging from the lower flow threshold to Q_5, the post-project peak flows shall not exceed pre-development peak flows. For flow rates from Q_5 to Q_{10}, post-project peak flows may exceed pre-development flows by up to 10 percent for a 1-year frequency interval. For example, post-project flows could exceed pre-development flows by up to 10 percent for the interval from Q_9 to Q_{10} or from $Q_{5.5}$ to $Q_{6.5}$, but not from Q_8 to Q_{10}.

In this context, Q_2 and Q_{10} refer to flow rates determined based on continuous simulation hydrologic modeling. The range from a fraction of Q_2 to Q_{10} represents the range of geomorphically significant flows for hydromodification management in San Diego. The upper bound of the range of flows to control is pre-development Q_{10} for all projects. The lower bound of the range of flows to control, or "lower flow threshold" is a fraction of pre-development Q_2 that is based on the erosion susceptibility of the stream and depends on the specific natural system (stream) that a project will discharge to. Tools have been developed in the March 2011 Final HMP for assessing the erosion susceptibility of the stream (see Section 6.3.4 below for further discussion of the lower flow threshold).

When selecting the type of structural BMP to be used for flow control, consider the types of structural BMPs that will be utilized onsite for pollutant control.

Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMPs. For example, a full infiltration BMP that infiltrates the DCV for pollutant control could include additional storage volume above or below ground to provide either additional infiltration of storm water or control of outflow for hydromodification management. If possible, the structural BMPs for pollutant control should be modified to meet flow control performance standards in addition to the pollutant control performance standards. See Section 6.3.6 for further discussion of integrating structural BMPs for pollutant control and flow control.

6.3.1 Point(s) of Compliance

For PDPs subject to hydromodification management requirements, the flow control performance standard must be met for each natural or un-lined channel that will receive runoff from the project.

This may require multiple structural BMPs within the project site if the project site discharges to multiple discrete outfalls. When runoff is discharged to multiple natural or un-lined channels within a project site, each natural or un-lined channel must be considered separately and points of compliance (POCs) for flow control must be provided for each natural or un-lined channel, including situations where the channels will confluence before leaving the project boundary. When runoff from the project site does not meet a natural or un-lined channel onsite, instead traveling some distance downstream of the project in storm drain systems or lined channels prior to discharge to natural or un-lined channels, the POC(s) for flow control analysis shall be placed at the project boundary (i.e., comparing the pre-development and post-project flows from the project area only, not analyzing the total watershed draining to the offsite POC), unless the project is draining to and accommodated by an approved master planned or regional flow control BMP.

For individual projects draining to approved master planned or regional flow control BMPs, the POC for flow control analysis may be offsite of the specific project application.

In these instances, the individual project draining to a master planned or regional flow control BMP shall reference the approved design documents for the BMP, and shall demonstrate that either (a) the individual project design is consistent with assumptions made for imperviousness and features of the project area when the master planned or regional BMP was designed, or (b) the master planned or regional BMP still meets performance standards when the actual proposed imperviousness and features of the project area are considered.

6.3.2 Offsite Area Restrictions

Runoff from offsite undeveloped areas should be routed around structural BMPs for flow control whenever feasible.

Methods to route flows around structural BMPs include designing the site to avoid natural drainage courses, or using parallel storm drain systems. If geometric constraints prohibit the rerouting of flows from undeveloped areas around a structural BMP, a detailed description of the constraints must be submitted to the City Engineer.

Structural BMPs for flow control must be designed to avoid trapping sediment from natural areas regardless of whether the natural areas are critical coarse sediment yield areas or not.

Reduction in coarse sediment supply contributes to downstream channel instability. Capture and removal of natural sediment from the downstream watercourse can create "hungry water" conditions and the increased potential for downstream erosion. Additionally, coarse or fine sediment from natural areas can quickly fill the available storage volume in the structural BMP and/or clog a small flow control outlet, which can cause the structural BMP to overflow during events that should have been controlled, and will require frequent maintenance. Failure to prevent clogging of the principal control orifice defeats the purpose of a flow control BMP, since basin inflows would simply overtop the control structure and flow unattenuated downstream, potentially worsening downstream erosion.

6.3.3 Requirement to Control to Pre-Development (Not Pre-Project) Condition

The Permit requires that post-project runoff must be controlled to match pre-development runoff conditions, not pre-project conditions, for the range of flow rates to be controlled.

Pre-development runoff conditions are defined in the Permit as "approximate flow rates and durations that exist or existed onsite before land development occurs."

- **Redevelopment PDPs:** Use available maps or development plans that depict the topography of the site prior to development, otherwise use existing onsite grades if historic topography is not available. Assume the infiltration characteristics of the underlying soil. Use available information pertaining to existing underlying soil type such as soil maps published by the Natural Resource Conservation Service (NRCS). Do not use runoff parameters for concrete or asphalt to estimate pre-development runoff conditions.

- **New development PDPs:** The pre-development condition typically equates to runoff conditions immediately before project construction. However if there is existing impervious area onsite, as with redevelopment, the new development project must not use runoff parameters for concrete or asphalt to estimate pre-development runoff conditions.

When it is necessary for runoff from offsite impervious area (not a part of the project) to co-mingle with project site runoff and be conveyed through a project's structural flow control BMP, the offsite impervious area may be modeled as impervious in both the pre- and post- condition models. A project is not required to provide flow control for storm water from offsite. This also means that for redevelopment projects not subject to the 50% rule (i.e., redevelopment projects that result in the creation or replacement of impervious surface in an amount of less than 50% of the area of impervious surface of the previously existing development), comingled runoff from undisturbed portions of the previously existing development (i.e., areas that are not a part of the project) will not require flow control. Flow control facilities for comingled offsite and onsite runoff would be designed to process the total volume of the comingled runoff through the facility, but would provide mitigation for the excess runoff (difference of developed to pre-developed condition) based on onsite impervious areas only. The project applicant must clearly explain why it was not feasible or practical to provide a bypass system for storm water from offsite. The City Engineer may request that the project applicant provide a supplemental analysis of onsite runoff only (i.e., supplemental model of the project area only).

6.3.4 Determining the Low Flow Threshold for Hydromodification Flow Control

The range of flows to control for hydromodification management depends on the erosion susceptibility of the receiving stream.

The range of flows to control is either:

- $0.1Q_2$ to Q_{10} for projects discharging to streams with high susceptibility to erosion (and this is the default range of flows to control when a stream susceptibility study has not been prepared),
- $0.3Q_2$ to Q_{10} for projects discharging to streams with medium susceptibility to erosion as determined by a stream susceptibility study approved by the City Engineer, or
- $0.5Q_2$ to Q_{10} for projects discharging to streams with low susceptibility to erosion as determined by a stream susceptibility study approved by the City Engineer.

The project applicant may opt to design to the default low flow threshold of 0.1Q2, or provide assessment of the receiving stream ("channel screening" a.k.a. "geomorphic assessment"), which may result in a higher low flow threshold of 0.3Q2 or 0.5Q2 for project hydromodification management.

Use of a higher low flow threshold of 0.3Q2 or 0.5Q2 must be supported by a Channel Screening Report. Channel screening is based on a tool developed by the Southern California Coastal Water Research Project (SCCWRP), documented in SCCWRP's Technical Report 606 dated March 2010, "Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility." The SCCWRP channel screening tool considers channel conditions including channel braiding, mass wasting, and proximity to the erosion threshold. SCCWRP's Technical Report 606 is included in Appendix B of the March 2011 Final HMP, and can also be accessed through SCCWRP's website. The result of applying the channel screening tool will be classification of high, medium, or low susceptibility to erosion, corresponding to low flow thresholds of 0.1Q2, 0.3Q2, and 0.5Q2, respectively, for the receiving stream. Note that the City Engineer may require that the channel screening study has been completed within a specific time frame prior to their review, and/or may apply a sunset date to their approval of a channel screening study.

The receiving stream is the location where runoff from the project is discharged to natural or un-lined channels.

The receiving stream may be onsite or offsite. The POC for channel screening is the point where runoff initially meets an un-lined or natural channel, regardless of whether the POC for flow control facility sizing is at or within the project boundary or is offsite. A project may have a different POC for channel screening vs. POC for flow control facility sizing if runoff from the project site is conveyed in hardened systems from the project site to the un-lined or natural channel. The erosion susceptibility of the receiving stream must be evaluated at the POC for channel screening, and for an additional distance known as the domain of analysis, defined in SCCWRP's Technical Report 606.

6.3.5 Designing a Flow Control Facility

Flow control facilities for hydromodification management must be designed based on continuous simulation hydrologic modeling.

Continuous simulation hydrologic modeling uses an extended time series of recorded precipitation data and evapotranspiration data as input and generates hydrologic output, such as surface runoff, groundwater recharge, and evapotranspiration, for each model time step. Using the continuous flow output, peak flow frequency and duration statistics can be generated for the pre-development and post-project conditions for the purpose of matching pre-development hydrologic conditions in the range of geomorphically significant flow rates. Peak flow frequency statistics estimate how often flow rates will exceed a given threshold. Flow duration statistics determine how often a particular flow rate is exceeded. To determine if a flow control facility meets hydromodification management performance standards, peak flow frequency and flow duration curves must be generated and compared for pre-development and post-project conditions.

Flow control facilities may be designed using either sizing factors presented in Appendix B of this manual, or using project-specific continuous simulation modeling. The sizing factors were developed based on unit-area continuous simulation models. This means the continuous simulation hydrologic modeling has already been done and the project applicant needs only to apply the sizing factors to the project's effective impervious area to size a facility that meets flow control performance standards. The sizing factor method is intended for simple studies that do not include diversion, do not include significant offsite area draining through the project from upstream, and do not include offsite area downstream of the project area. Use of the sizing factors is limited to the specific structural BMPs for which sizing factors were prepared. Project-specific continuous simulation modeling offers the most flexibility in the design, but requires the project applicant to prepare and submit a complete continuous simulation hydrologic model for review.

6.3.5.1 Sizing Factor Method

A project applicant may use sizing factors that were created to facilitate sizing of certain specific BMPs for hydromodification management.

Unit runoff ratios for determination of pre-development Q_2 and sizing factors for certain specific structural BMPs were previously developed based on continuous simulation hydrologic modeling of hypothetical unit watersheds. Details and descriptions for the sizing factors and specific BMPs are presented in the "San Diego BMP Sizing Calculator Methodology," dated January 2012, prepared by Brown and Caldwell (herein "BMP Sizing Calculator Methodology"). Although the sizing factors were developed under the 2007 Permit, the unit runoff ratios and some sizing factors developed for flow control facility sizing may still be applied. Users should note that due to the Permit requirement to control flow rates to pre-development condition instead of pre-project condition, unit runoff ratios for "impervious" soil cover categories from Table 1-6 of the BMP Sizing Calculator Methodology shall not be used when determining pre-development Q_2. Sizing factors are to be applied to the effective impervious area draining to the facility. Calculations may be prepared using either the BMP Sizing Spreadsheet that was developed by the County of San Diego and is available on the Project Clean Water website, or using hand calculations. Refer to Appendix G.2 of this manual for guidance to use the sizing factor method.

6.3.5.2 Project-Specific Continuous Simulation Modeling

A project applicant may prepare a project-specific continuous simulation model to demonstrate compliance with hydromodification management performance standards.

This option offers the most flexibility in the design. In this case, the project applicant shall prepare continuous simulation hydrologic models for pre-development and post-project conditions, and compare the pre-development and post-project (with hydromodification flow control BMPs) runoff peaks and durations until compliance with the flow control performance standards is demonstrated. The project applicant will be required to quantify the long term pre-development and post-project runoff response from the site and establish runoff routing and stage-storage-discharge relationships for the planned flow control BMPs. There are several available hydrologic models that can perform continuous simulation analyses. Refer to Appendix G.1 of this manual for guidance for continuous simulation hydrologic modeling.

6.3.6 Integrating HMP Flow Control Measures with Pollutant Control BMPs

Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s) or by a series of structural BMP(s).

The design process should start with an assessment of the controlling design factor, then the typical design process for an integrated structural BMP or series of BMPs to meet two separate performance standards at once involves (1) initiating the design based on the performance standard that is expected to require the largest volume of storm water to be retained, (2) checking whether the initial design incidentally meets the second performance standard, and (3) adjusting the design as necessary until it can be demonstrated that both performance standards are met. The following are recommendations for initiating the design process:

- **Full infiltration condition:** retention for pollutant control performance standard is the controlling design factor. For a system that is based on full retention for storm water pollutant control, first design an initial retention area to meet storm water pollutant control standards for retention, then check whether the facility meets flow control performance standards. If the initial retention facility does not meet flow control performance standards: increase the volume of the facility, increasing retention if feasible or employing outflow control for runoff to be discharged from the facility; as needed to meet the flow control performance standards.
- **Partial infiltration condition:** retention for pollutant control performance standard is the controlling design factor. For a system that is based on partial retention for storm water pollutant control, first design the retention area to maximize retention as feasible. Then design an additional runoff storage area with outflow control for runoff to be discharged from the facility; as needed to meet the flow control performance standards. Then address pollutant control needs for the portion of the storm water pollutant control DCV that could not be retained onsite.
- **No infiltration condition:** flow control for hydromodification management standard is the controlling design factor. For a system that is based on biofiltration with no infiltration for storm water pollutant control, first design the facility to meet flow control performance standards, then check whether the facility meets biofiltration design standards for storm water pollutant control. If the flow control biofiltration facility does not meet performance standards for storm water pollutant control by biofiltration, increase the volume of the biofiltration facility as needed to meet pollutant control performance standards, or identify other methods to address pollutant control needs for the portion of the storm water pollutant control DCV that could not be processed with biofiltration onsite.

When an integrated structural BMP or series of BMPs is used for both storm water pollutant control and flow control for hydromodification management, separate calculations are required to demonstrate that pollutant control performance standards and hydromodification management standards are met.

When an integrated structural BMP or series of BMPs is proposed to meet the storm water pollutant control and flow control for hydromodification management obligations, the applicant shall either:

- Perform separate calculations to show that both hydromodification management and pollutant control performance standards are met independently by using guidance from Appendices B and G. Calculations performed shall be documented in the SQWMP. **Or**
- Develop an integrated design that meets the separate performance standards presented in Chapter 2 for both hydromodification management and pollutant control. In this option the BMP requirements to meet the pollutant control performance standard are optimized to account for the BMP storage provided for flow control, and vice versa. Calculations performed to develop an integrated design shall be documented in the SQWMP. Project approval when this option is selected is at the discretion of the City Engineer.

6.3.7 Drawdown Time

The maximum recommended drawdown time for hydromodification management facilities is 96 hours based on Section 6.4.6 of the March 2011 Final HMP.

This is based on instruction from the County of San Diego Department of Environmental Health for mitigation of potential vector breeding issues and the subsequent risk to human health. This standard applies to, but is not limited to, detention basins, underground storage vaults, and the above-ground storage portion of LID facilities. When this standard cannot be met due to large stored runoff volumes with limited maximum release rates, a vector management plan may be an acceptable solution if approved by the governing municipality.

In cases where a Vector Management Plan is necessary, it shall be incorporated into the SWQMP as an attachment. A Vector Management Plan will only be accepted after the applicant has proven infeasibility of meeting the required drawdown time using any and all allowable BMPs. The information included in the plan will vary based on the nature, extent and variety of potential vector sources. It is recommended that preparers consult with the Department of Environmental Health Vector Control Program for technical guidance. Plans should include the following information at a minimum:

- Project identification information;
- A description of the project, purpose of the report, and existing environmental conditions;
- A description of the management practices that will be employed to minimize vector breeding sources and any associated employee education required to run facilities and operations;
- A discussion of long term maintenance requirements;
- A summary of mitigation measures;
- References; and
- A list of persons and organizations contacted (project proponents are expected to obtain review and concurrence of proposed management practices from Department of Environmental Health Vector control program staff prior to submission).

The property owner and applicant must include and sign the following statement: "The measures identified herein are considered part of the proposed project design and will be carried out as part of project implementation. I understand the breeding of mosquitoes is unlawful under the State of California Health and Safety Code Section 2060-2067. I will permit the Vector Surveillance and Control program to place adult mosquito monitors and to enforce this document as needed."

Refer to the sources below for additional guidance:

Report Guidance- http://www.sandiegocounty.gov/dplu/docs/Vector_Report_Formats.pdf

Department of Environmental Health Vector Control Program Department of Environmental Health - http://www.sandiegocounty.gov/deh/pests/vector_disease.html

It should be noted that other design factors may influence the required drawdown when hydromodification management BMPs are integrated with storm water pollutant control BMPs. Since hydromodification flow control BMPs are designed based on continuous simulation modeling, which is based on a continuous rainfall record and analyzes a continuous inflow and outflow of the BMPs, inter-event drawdown time and availability of the BMP for subsequent event inflow has been accounted for in the sizing. Therefore, drawdown recommendations for hydromodification management are based on public safety, not availability of the BMP for the next inflow event. Storm water pollutant control BMPs are designed on a single-event basis for a DCV (the 85^{th} percentile storm event). Some of the design standards presented in Chapter 5 or Appendix B require that the pollutant control portion of the BMP drain within a specific time frame to ensure the pollutant control portion of the BMP is available for subsequent storm events. When hydromodification management BMPs are integrated with storm water pollutant control BMPs, the designer must evaluate drawdown time based on both standards.

6.4 In-Stream Rehabilitation

An alternative to onsite flow control for post-project runoff may be in-stream rehabilitation.

If there is an Alternative Compliance Program in place, the project applicant may be allowed to participate in an in-stream rehabilitation project in lieu of implementing onsite flow control BMPs. Refer to section 1.8 and Alternative Compliance Program guidance document to determine if this option is available in the project watershed.