

1. INTRODUCTION

1.1 PROBLEM STATEMENT

Urbanization is defined as the transformation of land into residential, commercial, and industrial properties, and associated drainages, roads, sewers and other community planned infrastructure. Urbanization modifies natural watershed and stream processes by altering the terrain, modifying the vegetation and soil characteristics, introducing pavement and buildings, installing drainage and flood control infrastructure, and altering the condition of stream channels through straightening, deepening, and armoring. These changes affect hydrologic characteristics in the watershed (rainfall interception, infiltration, runoff and stream flows), and affect the supply and transport of sediment in the stream system. The change in runoff characteristics from a watershed caused by changes in land use conditions (i.e. urbanization) is defined as hydromodification.

As the total area of impervious surfaces increases in previously undeveloped areas, infiltration of rainfall decreases, causing more water to run off the surface as overland flow at a faster rate. Storms that previously didn't produce runoff under rural conditions can produce erosive flows. The increase in the volume of runoff and the length of time that erosive flows occur ultimately intensify sediment transport, causing changes in sediment transport characteristics and the hydraulic geometry (width, depth, slope) of channels.

The larger runoff durations and volumes and the intensified erosion of streams impair the beneficial uses of the stream channels. These types of changes have been documented in the Bay Area on Wildcat Creek, San Antonio Creek, Novato Creek, San Pedro Creek, and others.¹

The Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, as part of the Bay Area National Pollutant Discharge Elimination System (NPDES) stormwater permits, is requiring stormwater programs to develop and implement hydromodification management plans

¹ GeoSyntec Consultants, Inc., *Hydromodification Management Plan Literature Review*, 2002. (Appendix B)

(HMPs) and to implement associated management measures. Many factors and processes interact to influence hydromodification; however this document focuses on the changes in the volume, magnitude, and duration of runoff resulting from the increases in impervious surfaces and drainage networks associated with urbanization.

1.2 PERMIT REQUIREMENTS

The first Bay Area permit to include the new requirements was that of the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program). SCVURPPP is comprised of the thirteen cities of Santa Clara Valley, Santa Clara County, and the Santa Clara Valley Water District (SCVWD), all of which are Co-permittees, also referred to as Dischargers. The RWQCB's Order 01-119 (October 2001) amended Provision C.3 of SCVURPPP's reissued NPDES permit (Order 01-024, February 2001) to incorporate specific new development and redevelopment requirements, including the HMP requirements. The requirements apply to development projects that exceed certain thresholds of impervious surface area.

Provision C.3.f of the NPDES permit, *Limitation on Increase of Peak Stormwater Runoff Discharge Rates*, (in Attachment 1-1), describes the HMP requirements. Under Provision C.3.f, the Co-permittees are required to develop an HMP to describe how they plan to manage increases in the magnitude, volume, and duration of runoff from "Group 1"² new development and significant redevelopment projects in order to protect streams from increased potential for erosion or other adverse impacts.

In implementing the HMP, runoff controls³ must be designed so that post-project runoff shall not exceed estimated pre-project rates, durations, and volumes from the development site (Provision C.3.f.i). Runoff controls are not required for projects that discharge stormwater runoff where the potential for erosion, or other impacts to beneficial uses, is minimal. Such situations may include: discharges into creeks that are concrete-lined or significantly hardened (e.g., with rip-rap, sack concrete, etc.) downstream to their outfall in San Francisco Bay; underground storm drains discharging to the Bay; and construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal (Provision C.3.f.ii).

Provisions C.3.f.vi.5 and C.3.f.vii of the permit allow hydromodification impacts to be addressed by using strategies other than on-site runoff controls, or in combination with on-site controls. These strategies may allow increases in flow rates, durations, and volumes from a development site, subject to the implementation of specified best management practices (BMPs) and land use planning practices that will accommodate expected stream changes without harming beneficial uses (e.g., increases in the cross-sectional area of a stream channel). BMPs may also be regional projects that mitigate the impacts of more than one new development or redevelopment project.

The translation of these requirements into HMP standards and performance criteria is presented in Chapter 5.

² Group 1 projects are public and private projects that create one (1) acre (43,560 square feet) or more of impervious surface over the entire project site, including roof area, streets and sidewalks. See full definition in Attachment 1-1.

³ This document uses the term runoff controls or flow controls to refer to Best Management Practices (BMPs) that reduce impacts of runoff volume, rate, and duration. Runoff controls that remove pollutants from stormwater will be referred to as treatment controls.

1.3 GOALS AND OBJECTIVES

The goal of the SCVURPPP Hydromodification Management Plan is to protect the physical, chemical, and biological functions of stream systems in urbanizing areas. In order to meet this goal and the NPDES Permit requirements, the following project objectives have been defined:

1. Develop a watershed-based approach to address the impacts of hydromodification on the beneficial uses of streams.
2. Develop, test, and apply an assessment method to evaluate potential hydrograph changes and impacts to stream channels from proposed projects, and identify where such changes can cause increased erosion of creek beds and banks, silt pollutant generation, or other impacts to beneficial uses.
3. Develop design criteria, control measures, and guidance on management strategies to address hydromodification and identified impacts.
4. Develop guidance for Co-permittees to manage the impacts of hydromodification on streams through the implementation of an HMP.
5. Develop an approach for measuring the effectiveness of the runoff controls and management strategies, and continuously improving the HMP as needed.

These objectives form the basis of the SCVURPPP HMP Work Plan, described in Chapter 2.

1.4 ORGANIZATION AND CONTENTS OF THE HMP REPORT

This report is organized into the following six chapters.

Chapter 1: Introduction

This chapter begins with the problem statement for the project including a discussion of the effects of development or urbanization on streams, the definition of hydromodification, the regulatory requirements for the HMP, and the goals and objectives of the HMP.

Chapter 2: Previous Submittals and Activities

This report is developed on a foundation of previously completed tasks. These tasks produced a work plan, goals and objectives, a literature review, a conceptual model, an assessment method, an application of the assessment method to three test watersheds, and an evaluation of the criteria for exemption of infill projects in highly developed watersheds. The activities and work products from these tasks are summarized in this chapter. The activities included providing opportunities for public involvement and review of work products by a panel of experts in the field.

Chapter 3: Stream Assessment

This chapter provides a discussion of the assessment method and summarizes the application of the assessment method to the Thompson Creek, Ross Creek, and San Tomas Creek subwatersheds. The chapter describes the geomorphic assessments (field measurements and observations), hydrologic/hydraulic modeling, and stability analyses conducted for the subwatersheds and compares the results.

Chapter 4: Technical Analyses of Hydromodification Controls

This chapter presents a summary of the technical analyses performed to evaluate methods of hydromodification control, which provide the basis for the hydromodification control standards and performance criteria in Chapter 5.

Chapter 5: Hydromodification Control Standard and Performance Criteria

Hydromodification control standards will be used by local agencies to manage hydro-modification impacts of development projects. The hydromodification control standard, management objective, and performance criteria that will be applied to new development and redevelopment projects covered by the HMP requirements of Permit Provision C.3.f are provided in this chapter. In addition, guidelines are provided that Co-permittees can use to identify project types and/or areas within the Santa Clara Basin that may be exempt from hydromodification controls under Permit Provision C.3.f.ii.

Chapter 6: Guidance for Selection and Design of Hydromodification Control Measures

This chapter provides a discussion of the selection and sizing of hydromodification controls. Hydromodification controls are measures designed to meet hydromodification control standards. Hydromodification controls can be classified into the following categories: on-site project controls; regional controls; and in-stream controls. On-site controls can include site design and treatment measures that reduce runoff and flow control facilities such as detention/retention and infiltration facilities that are engineered to meet a specified discharge performance. The chapter ends with descriptions of three example projects for which flow control facilities are sized.

Chapter 7: HMP Implementation Guidance

This chapter provides guidelines to Co-permittees and the development community for implementing the SCVURPPP Hydromodification Management Plan in compliance with Permit Provision C.3.f. The guidelines cover:

- Implementation Options
- Process for Evaluating Hydromodification Impacts and Requirements for Development Projects
- Incorporating HMP Requirements into Local Approval Processes
- Land Use Planning Measures
- Opportunities for Watershed Master Planning for Hydromodification, Water Quality, and Flood Management
- Inspection and Maintenance Requirements
- Monitoring and Reporting Requirements
- Program Evaluation and Continuous Improvement

Appendices

Supporting technical documents are provided in Appendices to this report. The Appendices are contained in a second volume and available on the SCVURPPP website at www.scvurppp.org

Permit Provisions C.3.f.iv and C.3.f.vi state required and optional elements, respectively, of the SCVURPPP HMP. Table 1-1 lists these elements and where they are addressed in this HMP Report.

**Table 1-1
HMP ELEMENTS AND REFERENCES**

Provision No.	Description of Element	Location in Report
Required Elements		
C.3.f.iv.1	A review of pertinent literature.	Section 2.2 (summary)
C.3.f.iv.2	A protocol to evaluate potential hydrograph change impacts to downstream watercourses from proposed projects.	Section 2.4 (summary), Chapter 3; Chapter 4 Section 7.3
C.3.f.iv.3	An identification of the rainfall event or range of events below which peak flow management standards will apply.	Section 4.3
C.3.f.iv.4	A description of how the Dischargers will incorporate these requirements into their local approval process or the equivalent.	Section 7.4
C.3.f.iv.5	Guidance on management practices and measures to address identified impacts.	Chapter 6
Optional Elements		
C.3.f.vi.1	Evaluation of the cumulative impacts of urbanization of a watershed on stormwater discharge and stream morphology in the watershed.	Chapter 3
C.3.f.vi.2	Evaluation of stream form and condition, including slope, discharge, vegetation, underlying geology, and other information as appropriate.	Section 3.3
C.3.f.vi.3	Implementation of measures to minimize impervious surfaces and directly connected impervious area in new development and redevelopment projects.	Sections 6.1 and 6.2 Sections 7.2 and 7.3
C.3.f.vi.4	Implementation of measures including stormwater detention, retention, and infiltration.	Chapter 6
C.3.f.vi.5	Implementation of land use planning measures (e.g.: stream buffers, restoration in advance of development, revegetation) to allow expected changes in stream channel cross-sections, stream vegetation, and discharge rates, velocities, and/or duration without adverse impacts to stream beneficial uses.	Section 7.5

ATTACHMENT 1-1

- Definition of Group 1 Projects
- Provision C.3.f of the NPDES permit
Limitation on Increase of Peak Stormwater Runoff Discharge Rates

Attachment 1-1

Definition of Group 1 Projects

DETERMINING THE APPLICABILITY OF PROVISION C.3 TO NEW PROJECTS AND REDEVELOPMENT PROJECTS

The amount of impervious surface created or replaced as part of a development project determines whether it falls under the requirements of Provision C.3 and the extent of the Provision C.3 requirements. Project applications submitted and deemed complete prior to October 15, 2003¹ do not have to comply with Provision C.3 requirements. Project applications submitted after October 15, 2003 are evaluated as Provision C.3 Group 1 projects.

Group 1 Projects. Group 1 projects consist of all new public and private projects that create one (1) acre (43,560 square feet) or more of impervious surface collectively over the entire project site, including roof area, streets and sidewalks. Also, significant redevelopment projects that result in the addition or replacement of impervious surface area that combined totals 1 acre (43,560 square feet) or more qualify for Group 1 status. If more than fifty percent (50%) of the existing impervious surface area is replaced or added, the entire project is included in the design of treatment measures. If less than fifty percent (50%), only that affected portion must be included in treatment design. Excluded from this category are interior remodels and routine maintenance or repair, including roof or exterior surface replacement and repaving.

Group 2 Projects. Group 2 projects consist of public and private projects that create 10,000 square feet or more of impervious surface. Comments from and discussions with Regional Board staff have determined that the HMP requirements only apply to Group 1 projects (1 acre or more of impervious surface) and do not apply to Group 2 projects.²

Projects Exempt from Provision C.3 Requirements. The table below provides a description of the land uses that are exempt from Provision C.3 requirements.

Projects Exempt from Provision C.3

Land Use Category	Exempted Land Use
Commercial, industrial, or residential developments.	Construction of one single-family home that is not part of a larger common plan of development, with the incorporation of appropriate pollutant source control and design measures, and using landscaping to appropriately treat runoff from roof and house-associated impervious surfaces (e.g., runoff from roofs, patios, driveways, sidewalks, and similar surfaces).
Street, road, highway, and freeway projects that are under the Dischargers' jurisdiction.	Sidewalks, bicycle lanes, trails, bridge accessories, guardrails, and landscape features that are part of a street, road, highway or freeway project. Note, these are <u>not</u> exempt when part of commercial, industrial or residential developments.
Significant Redevelopment projects	Interior remodels and routine maintenance or repair, such as roof or exterior surface replacement, pavement resurfacing, repaving and road pavement structural section rehabilitation within the existing footprint, and any other reconstruction work within a public street or road right-of-way where both sides of that right-of-way are developed.

¹ Including those developments with previous entitlements or development agreements.

² 1) Letter to Mr. David Chesterman, SCVURPPP Management Committee Chair, from Shin-Roei Lee, Division Chief of South Bay Watershed Division, San Francisco Bay Regional Water Quality Control Board re Comments on the Hydromodification Management Plan Report, Public Review Draft, August 25, 2004; 2) Jan O'Hara, at San Jose Developers Roundtable Meeting, August 12, 2004.

Provision C.3.f of the NPDES permit

f. Limitation on Increase of Peak Stormwater Runoff Discharge Rates:

- i. The Dischargers shall manage increases in peak runoff flow and increased runoff volume, for all Group 1 Projects, where such increased flow and/or volume can cause increased erosion of creek beds and banks, silt pollutant generation, or other impacts to beneficial uses. Such management shall be through implementation of a Hydrograph Modification Management Plan (HMP). The HMP, once approved by the Regional Board, will be implemented so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where the increased stormwater discharge rates and/or durations will result in increased potential for erosion or other adverse impacts to beneficial uses, attributable to changes in the amount and timing of runoff. The term duration in this section is defined as the period that flows are above a threshold that causes significant sediment transport and may cause excessive erosion damage to creeks and streams.
- ii. This requirement does not apply to new development and redevelopment projects where the project discharges stormwater runoff into creeks or storm drains where the potential for erosion, or other impacts to beneficial uses, is minimal. Such situations may include discharges into creeks that are concrete-lined or significantly hardened (e.g., with rip-rap, sackrete, etc.) downstream to their outfall in San Francisco Bay, underground storm drains discharging to the Bay, and construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal. Guidelines for identification of such situations shall be included as a part of the HMP. However, plans to restore a creek reach may re-introduce the applicability of HMP controls, and would need to be addressed in the HMP.
- iii. The HMP may identify conditions under which some increases in runoff may not have a potential for increased erosion or other impacts to beneficial uses. Reduced controls or no controls on peak stormwater runoff discharge rates and/or durations may be appropriate in those cases, subject to the conditions in the HMP. In the absence of information demonstrating that changes in post-development runoff discharge rates and durations will not result in increased potential for erosion or other adverse impacts to beneficial uses, the HMP requirements shall apply.
- iv. The HMP proposal shall include:
 1. A review of the pertinent literature;
 2. A protocol to evaluate potential hydrograph change impacts to downstream watercourses from proposed projects;
 3. An identification of the rainfall event below which these standards and management requirements apply, or range of rainfall events to which this limitation applies;
 4. A description of how the Dischargers will incorporate these requirements into their local approval processes, or the equivalent; and

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5. Guidance on management practices and measures to address identified impacts.
 - v. The identified maximum rainfall event or rainfall event range may be different for specific watersheds, streams, or stream reaches. Individual Dischargers may utilize the protocol to determine a site- or area-specific rainfall event standard.
 - vi. The HMP's evaluation protocols, management measures, and other information may include the following:
 1. Evaluation of the cumulative impacts of urbanization of a watershed on stormwater discharge and stream morphology in the watershed;
 2. Evaluation of stream form and condition, including slope, discharge, vegetation, underlying geology, and other information, as appropriate;
 3. Implementation of measures to minimize impervious surfaces and directly connected impervious area in new development and redevelopment projects;
 4. Implementation of measures including stormwater detention, retention, and infiltration;
 5. Implementation of land use planning measures (e.g., stream buffers and stream restoration activities, including restoration-in-advance of floodplains, revegetation, use of less-impacting facilities at the point(s) of discharge, etc.) to allow expected changes in stream channel cross sections, stream vegetation, and discharge rates, velocities, and/or durations without adverse impacts to stream beneficial uses;
 6. A mechanism for pre- vs. post-project assessment to determine the effectiveness of the HMP and to allow amendment of the HMP, as appropriate; and,
 7. Other measures, as appropriate.
 - vii. **Equivalent limitation of peak flow impacts:** The Dischargers may develop an equivalent limitation protocol, as part of the HMP, to address impacts from changes in the volumes, velocities, and/or durations of peak flows through measures other than control of those volumes and/or durations. The protocol may allow increases in peak flow and/or durations, subject to the implementation of specified BMPs and land planning practices that take into account expected stream change (e.g., increases in the cross-sectional area of stream channel) resulting from changes in discharge rates and/or durations, while maintaining or improving beneficial uses of waters.
 - viii. The Dischargers as a group shall complete the HMP according to the schedule below. All required documents shall be submitted acceptable to the Executive Officer, except the HMP, which shall be submitted for approval by the Regional Board. Development and implementation status shall be reported in the Dischargers' Annual Reports, which shall also provide a summary of projects incorporating measures to address this section and the measures used.
 1. March 1, 2002: Submit a detailed workplan and schedule for completion of the literature review, development of a protocol to identify an appropriate

limiting storm, development of guidance materials, and other required information;

2. September 15, 2002: Submit literature review;
3. March 1, 2003: Submit a draft HMP, including the analysis that identifies the appropriate limiting storm and the identified limiting storm event(s) or event range(s);
4. October 15, 2003: Submit the HMP for Regional Board approval; and,
5. Upon adoption by the Regional Board, implement the HMP, which shall include the requirements of this measure. Prior to approval of the HMP by the Regional Board, the early implementation of measures likely to be included in the HMP shall be encouraged by the Dischargers.

Deadline Extensions

By a letter dated May 12, 2003³, the Regional Board Executive Officer authorized extension of three specified deadlines in Order 01-119 (Provision C.3.f.viii) as shown below, in order to be consistent with other stormwater permits adopted in 2002-2003.

Provision	Activity	Original Deadline	New Deadline
C.3.c.i	Require stormwater treatment BMPs at Group 1 Projects	July 15, 2003	October 15, 2003
C.3.c.ii	Require stormwater treatment BMPs at Group 2 Projects in addition to Group 1 Projects	October 15, 2004	April 15, 2005
C.3.f	Submit final HMP for Regional Board approval	October 15, 2003	January 15, 2004

³ Letter to Mr. Beau Goldie, SCVURPPP Management Committee Chair, from Loretta Barsamian, Executive Officer, Regional Water Quality Control Board, San Francisco Bay Region, re: Extension of Specified Deadlines in Order 01-119, May 12, 2003.