# 2. PREVIOUS WORK PRODUCTS AND ACTIVITIES

This report is a synthesis of work conducted by SCVURPPP Co-permittee staffs, Program staff, consultants, and selected experts. The development of the Final HMP Report is based on the completion and knowledge gained from previous tasks. Products of these tasks include: the HMP Work Plan; a literature review; a technical memorandum on the assessment method for the HMP; and application of the assessment method to three test watersheds. Seven additional technical memoranda were prepared by the Program and its consultants that describe analyses of exempt area criteria, potential HMP standards, range of geomorphically significant flows, and on-site runoff management measures and costs. These work products and activities are summarized in the following sections and form the basis of the remaining chapters of this report.

## 2.1 HMP WORK PLAN

The HMP Work Plan developed by SCVURPPP, provided in Appendix A (GeoSyntec, 2002), consists of the following tasks. Where appropriate, the section in the permit provision addressed by the task is noted in parentheses.

1. Develop a problem statement and goals;
2. Review literature and data source availability (*Provision C.3.f.iv.1*);
3. Characterize stream conditions and future development patterns (*Provision C.3.f.ii*);
4. Develop a conceptual model of processes affecting stream stability;
5. Select HMP assessment method;
6. Compile available data and apply the HMP assessment method;
7. Develop guidance for management measures, including recommended cost effective solutions to address the impact on streams (*Provision C.3.f.iv.5, C.3.f.v, C.3.f.vi, C.3.f.vii*);
8. Develop an implementation strategy and process for continuous improvement
9. Convene an Expert Panel; and
10. Involve the public.

The problem statement and goals are presented in Chapter 1 of this report. The literature review, conceptual model, HMP assessment method, expert panel and public involvement tasks are described in the following sections. The remaining chapters in this report present the synthesis of all of the completed Work Plan tasks.

## 2.2 LITERATURE REVIEW

A review of the current literature[1] was one of the first steps required by the NPDES permit in addressing the hydromodification problem and identifying solutions because hydromodification is a relatively new subject for most stormwater practitioners and because early attempts by others at finding solutions have failed. In addition to meeting the permit requirements, the literature review has the following purposes:

- Provide the technical basis for the selection and application of methods for assessing hydromodification, for developing control measures and developing an implementation plan.
- Educate those who will be approving the HMP (e.g., Program Co-permittees, RWQCB) and those who will have to implement the plan (Co-permittees and development community).

Over 50 articles were reviewed that addressed the following topics: 1) the natural hydrologic and geomorphic processes important for addressing hydromodification, 2) the effects of urbanization on hydrology and geomorphology, 3) the available assessment tools that can be used to address hydromodification, and 4) management strategies that Co-permittees can use to implement the HMP. Information from these articles pertaining to the SCVURPPP HMP is summarized in the *Hydromodification Management Plan Literature Review* (GeoSyntec Consultants, 2002), which is included in its entirety in Appendix B. A summary of the key findings of the literature review is presented below.

### Hydrologic Processes

Urbanization causes increases in drainage infrastructure density (rain gutters, curbs/gutters, drainage pipes), and increases in the percent imperviousness and connectivity of impervious areas. Urbanization also may result in soil compaction, removal of native vegetation, and reductions in the width of riparian corridors. Increases in impervious surface increase peak flows (especially for more frequent events), runoff volume, the duration of smaller flow events, and the frequency and duration of sediment transporting flow events. Seasonal flow regimes may also change with urbanization. Dry season baseflows can decrease where the loss of infiltration is significant, which may limit riparian vegetation. Dry season baseflows can also increase in areas where excess irrigation is significant, compared to normal dry season flows, and alter wetland and riparian hydro-periods.

### Geomorphic Processes

Fluvial geomorphology deals with forms and characteristics of stream channels and the processes that create them. Over time and before human disturbances, channel planform, slope, and cross sectional dimensions evolved to balance stream flow energy and the need to transport sediment load. A natural stream channel is “stable” when its cross section, planform, and profile features

[1] *Hydromodification Management Plan Literature Review* (GeoSyntec Consultants) was completed and submitted to the Regional Board on September 13, 2002.

are in dynamic equilibrium such that the stream does not aggrade, degrade, or change in geometry or meander pattern during the present climatic regime.

Increases in impervious surfaces and the associated changes in runoff have the potential to destabilize streams. The degree of change is highly variable and depends on the characteristics of the watershed and the land development. The increased frequency and duration of runoff associated with increases in imperviousness lead to increases in the amount of "work done" (erosive forces applied over time) on the stream bed and banks. This in turn can cause increases in stream depth ("incision"), erosion of stream banks, increased sediment transport, and sediment deposition in downstream segments closer to the Bay.

### HMP Assessment Methods

Several assessment tools that can be combined to formulate an HMP assessment method are summarized. These tools include stream classification, empirical methods, mapping and modeling. An HMP assessment method must incorporate factors that describe the characteristics of watersheds, stream types, development style, and existing riparian conditions. Watershed and stream channel characterization is the first step towards any assessment addressing the physical and ecological conditions of a watershed and stream network. The watershed scale characterization helps focus attention on the processes impacted by development and the actual causes of the observed impacts rather than focusing in on the symptoms, such as bank failures. Historical information can be used to help explain the observed physical and ecological processes and existing stream channel conditions and to verify assumptions about the expected channel response.

The current direction of research is to utilize simplified methods, or indices that can be used to distinguish between eroding or non-eroding, or stable and unstable channel conditions. Indices, such as ratios of stream power, are attractive because they are simple to use and inexpensive to apply. Indices of stability, energy, or erodibility must be referenced to the erodibility of the most sensitive boundary condition (e.g., bed vs. bank stability).

### Management Strategies

Management strategies described in the literature often integrate a series of progressive control measures including land use planning, distributed on-site control measures, regional facilities, and stream restoration.

Typical elements of such strategies are as follows:

1. Optimize site-design to preserve the natural hydrologic conditions and protect sensitive hydrologic features, sediment source characteristics and sensitive habitats. Avoid, to the extent possible, the need to mitigate for hydromodification.
2. Minimize the effects of development through strategic design (e.g., reduce connected impervious surfaces) and through the implementation of environmentally sensitive on-site distributed Best Management Practices (BMPs) (e.g., wetlands, swales, infiltration gardens, etc.).
3. Manage the stream corridor itself by implementing in-stream controls, such as grade controls, biotechnical bank stabilization controls, and other restoration measures.

Provide allowances for the modified stream flow characteristics and enhance the beneficial uses of streams.

4. In some cases, a regional stormwater management system may be cost effective. These strategies could include regional floodplain management, secondary collection and drainage systems, and large-scale detention and infiltration basins.

**Available Local Data**

The literature review summarizes the available local data that can be useful in addressing hydromodification, implementing an HMP assessment method, and identifying solutions. Local programs and plans identified and reviewed in the process of developing the HMP include:

- SCVWD Fisheries and Aquatic Habitat Collaborative Effort;
- SCVURPPP Coyote Watershed Pilot Assessment;
- Santa Clara Basin Watershed Management Initiative (SCBWMI) Pilot Watershed Assessment;
- Surface Water Ambient Monitoring Program (SWAMP)/Regional Monitoring and Assessment Strategy (RMAS);
- SCVURPPP Multi-Year Monitoring Plan;
- SCVWD flood protection projects;
- SCVWD Stream Maintenance Program;
- Alum Rock Park Riparian Management Plan; and
- SCVWD GIS data.

## 2.3 CONCEPTUAL MODEL

The information obtained during the literature review was formulated into a *Conceptual Model*[2] of the hydrologic and geomorphic processes and attributes that are considered most important when addressing hydromodification. The Conceptual Model is presented in Figure 2-1. The process begins with the regional factors of climate, geology, and physiography, which in turn affect the amount of runoff and sediment sources discharged to stream channels. Land use, soil and vegetation characteristics ultimately affect the proportion of rainfall that infiltrates the ground or runs off the surface. The nature of the local climate, geology, and physiography affect the frequency and type of sediment supplied to the stream system. The increased energy imposed on the stream channel as a result of hydromodification affects sediment transport and causes streambed incision and erosion of stream banks, which lead to adjustment in the channel's geometry, planform and slope. The HMP assessment methodology and control measures are developed on the basis of the processes and linkages shown in the conceptual model.

[2] *Hydromodification Management Plan Literature Review*, GeoSyntec Consultants, 2002.

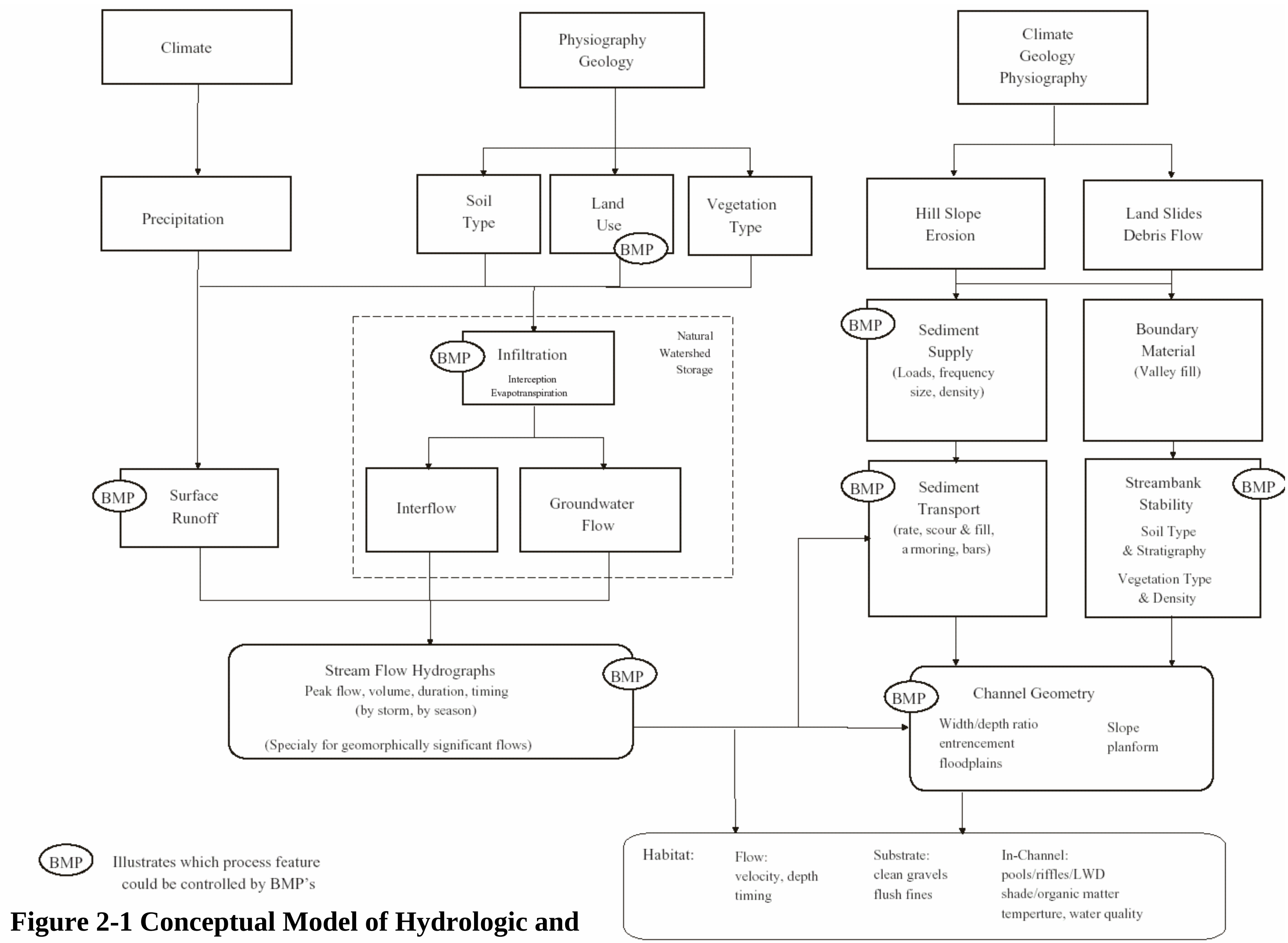


**Figure 2-1 Conceptual Model of Hydrologic and Geomorphic Processes**

## 2.4 SCVURPPP HMP ASSESSMENT METHOD

The literature review and conceptual model described above were used to guide the consultant team in the development of the HMP assessment method[3] that was used in the Santa Clara Basin to evaluate effects of hydromodification from existing and future development. The HMP assessment method was developed to evaluate changes in hydrology and associated stream channel conditions and predict the potential for erosion and deposition or other impacts attributed to hydromodification from urban development. The HMP assessment method consists of four major elements or phases: 1) problem area and reach characterization, 2) geomorphic/historic assessment, 3) hydrologic/hydraulic modeling, and 4) stability assessment. Figure 2-2 illustrates the HMP assessment method graphically and shows the sequence and links between phases.

The assessment focuses primarily on the physical characteristics of stream systems, which are interrelated with water quality and ecology in determining the health of the riparian corridor.

The reader should refer to the literature review for more background information and reference material regarding the development of the HMP assessment method.

### Problem Area and Reach Characterization

The purposes of this element are to characterize features of the watersheds and stream channels within the Santa Clara Basin, to understand the nature and extent of problem areas in stream reaches, and to explain existing conditions. During this phase, stream segments within the Santa Clara Basin that are currently subject to erosion and/or deposition, and those segments that could potentially be affected by future development will be identified.

Permit Provision C.3.f requires that the HMP assessment method address changes in watershed hydrology from urbanization. The assessment must distinguish between urbanizing impacts and impacts caused by past land use practices and changes in drainage patterns. This element provides the foundation for evaluating how past hydrology has changed, how modified flow pathways have affected channel form and stability, and what that means in terms of how to address hydromodification. Review of aerial photography of pre-urban versus urban periods provides a cost effective way to evaluate changes in stream channels. This element helps plan the field survey and stability assessment. From this information, geomorphic reaches are defined with similar stream channel conditions and hydrographic segments where substantial changes in stream flows occur (e.g., between major outfalls).

[3] Technical Memorandum #1: *Recommended Assessment Method for Developing the Hydromodification Management Plan, Including Data Requirements* was completed in October 2002 and presented to Regional Board staff on December 5, 2002. Appendix C

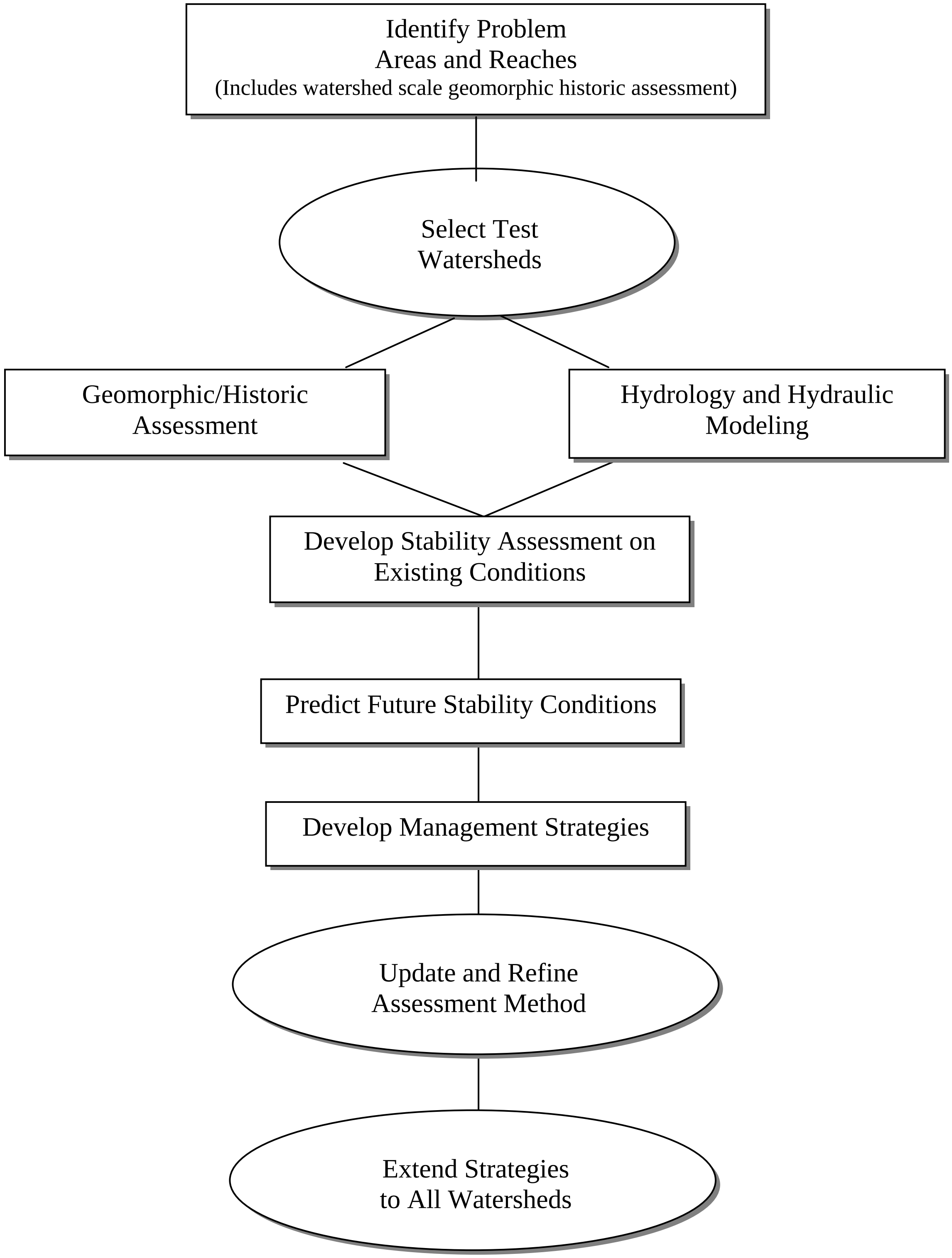


**Figure 2-2**

**Overview of the Recommended HMP Assessment Method**

### Geomorphic/Historic Assessment

The goal of the geomorphic/historic assessment is to characterize features of the Santa Clara Basin watersheds and stream channels necessary to understand the nature and extent of the problem areas and stream reaches, explain the existing conditions, and to correctly interpret results and formulate solutions. The objectives of the geomorphic/historic assessments are to describe:

1. The geologic and geomorphic characteristics of the watersheds and stream networks;
2. The dominant physical processes that seem to be controlling stream attributes and erosion historically and at present; and
3. The extent and modes of failure for observed eroding channel banks and beds. Geomorphic reaches are defined using broadly similar influences that affect channel form and processes (e.g., vegetation, geology, topography, level of upstream development).

The extent and modes of failure for observed eroding channel banks and beds. Geomorphic reaches are defined using broadly similar influences that affect channel form and processes (e.g., vegetation, geology, topography, level of upstream development). An evaluation of historical conditions can be conducted using a wide range in levels-of-effort and detail. The HMP assessment method calls for the collection of the following data to meet the above objectives:

- Stream planform, longitudinal profile, cross sectional geometry, and bed and bank characteristics, to describe the existing morphology of the stream channel system.
- Data on channel sinuosity, cross-sections, channel slopes, headcuts, nick points, bed material size and field measured bankfull discharge.
- Locations of significant bed and bank erosion, bank height and side slope, estimate of bank material, vegetation type and density, to evaluate bank stability.

### Hydrologic/Hydraulic Modeling

In traditional water resources engineering practice, stream flow analysis has been conducted using measured flow records (if a gaging station exists), regional regression equations, or numerical rainfall-runoff models. For analysis and design in flood hazard management, "event-based" models using design storms are commonly used. These provide conservative estimates of floods ranging from the 2- to 100-year event. While these are useful for flood hazard characterization, they do not capture the wider effects of hydromodification. In particular, event based models do not simulate the changes in soil moisture over time resulting from back-to-back storms, or from early to late winter. To quantify these differences, the HMP assessment method incorporates both a traditional event-based model and a continuous simulation model approach. The model results are used as input to the stability assessment.

### Stability Assessment

The stability assessment combines information from the above elements to predict stream channel erosion and instability. The methodology is based on the premise that a balance among flow energy, sediment loads, and channel resilience exists naturally and must be maintained in order for the stream network to remain stable. Fundamental principles of stability, dynamic equilibrium and work from the science of fluvial geomorphology are incorporated, including how these factors are affected under urbanized watershed conditions. By applying this method and establishing management criteria, the intent is to maintain the sediment transport and erosion processes, not eliminate them. The stability assessment measures the potential for erosion using an index that represents the long-term work done by flow energy in excess of the amount required to transport the available sediment load.

## 2.5 TEST WATERSHEDS

Using the Basin-wide information compiled during the identification of problem areas and reaches described above, the Program and consultant team selected three subwatersheds to develop, test, and verify the HMP assessment method. Within the Santa Clara Basin, one subwatershed was selected from each of the three major regions. The first test subwatershed, the Lower Silver-Thompson Creek Subwatershed, was used to test the applicability and usefulness of the recommended HMP assessment method tools and parameters. It was also used to develop, test and verify the HMP assessment method itself and determine whether existing erosion and deposition could be predicted correctly with the method. The Draft Interim HMP Report (July 2003) summarized the application of the HMP assessment method to the Lower Silver-Thompson Creek subwatershed, which was selected as the first test watershed.[4] The remaining two subwatersheds were used to verify that the method works on watersheds with different characteristics. The reasons for selecting these subwatersheds and the results of the assessments are summarized in Chapter 3 of this report.

## 2.6 EXPERT PANEL

An Expert Panel was convened to review and provide input on several key documents during the HMP development process. The purpose of the Expert Panel is to help ensure that the HMP is scientifically defensible and embodies a sound approach to hydromodification management. The Expert Panel consists of Professor Brian Bledsoe, Colorado State University; Professor Tom Dunne, UC Santa Barbara; and Professor Matt Kondolf, UC Berkeley. The panel has reviewed the Literature Review (September 2002), Technical Memorandum #1 - *HMP Assessment Method* (October 2002), the *Hydromodification Management Plan, Draft Interim Report, Assessment of the Lower Silver–Thompson Creek Subwatershed.* (July 2003), *Hydromodification Management Plan Report – Public Review Draft* (June 2004), and specific technical aspects of the HMP assessment method approach according to their areas of expertise. In addition, Mr. Craig MacRae, P.E. of Aquifor Beech Limited, and Professor Ted Hromadka, Ph.D., P.E., California State University, Fullerton, also provided valuable input on several elements of the methodology. Table 2-1 summarizes the activities of the Expert Panel and other reviewers. A summary of the Expert Panel comments is provided in Appendix D.

[4] *Hydromodification Management Plan, Draft Interim Report, Assessment of the Lower Silver–Thompson Creek Subwatershed,* submitted by SCVURPPP to the RWQCB in July 2003.

**Table 2-1**
**Work Conducted By Expert Panel and Other Professionals**

| Topic | EXPERT PANEL | | | Personal Communication | |
|---|---|---|---|---|---|
| | **Brian Bledsoe, Ph.D.** | **Tom Dunne, Ph.D.** | **Matt Kondolf, Ph.D.** | Craig MacRae | Ted Hromadka, Ph.D. |
| Literature Review | Yes | Yes | Yes | - | - |
| Tech Memo #1: HMP assessment method | Yes | - | Yes | - | - |
| Interim Draft HMP Report (July 2003) | Yes | Yes | Yes | - | - |
| Public Review Draft HMP Report (June 2004) | Yes | Yes | No | - | - |
| Use of Index Method | Yes | - | - | Yes | - |
| Simple Approach, Discrete Events | Yes | - | - | - | Yes |
| Critical Shear Stress for Bank Material | - | - | - | Yes | - |
| Layout of Cross Sections for Stability Assessment | - | - | - | Yes | - |

## 2.7 PUBLIC INVOLVEMENT

Regional Board staff, other Bay Area stormwater programs, and members of the Santa Clara Basin Watershed Management Initiative (WMI) have been kept informed of HMP progress through periodic presentations. Regional Board staff attended each of these briefings. In addition, Regional Board staff participated on SCVURPPP's HMP Work Group and had the opportunity to review draft work products and provide input.

Public meetings were held during the summer and fall of 2004 to get input from the development community (developers and engineering consulting firms) on the Public Review Draft HMP Report (June 29, 2004). These meetings also served to update and get input from BASMAA and WMI members on the HMP. Comments received were incorporated into the Revised Public Review Draft HMP Report released on November 4, 2005. Following the release of the Revised Public Review Draft, several additional public meetings were held.

A summary of the groups receiving presentations on the HMP development and report is presented below:

| Groups Receiving Presentations/Briefings | Date |
|---|---|
| • WMI's Watershed Assessment Subgroup and Flood Management Subgroup | November 18, 2002<br>July 31, 2004 |
| • Bay Area Stormwater Management Agencies Association's (BASMAA's) New Development Committee and Regional Board staff. | December 5, 2002.<br>August 5, 2004 |
| • SCVURPPP's C3 Provision Oversight Ad Hoc Task Group and Regional Board staff | April 26, 2004 |
| • SCVURPPP's Management Committee and Regional Board staff | April 29, 2004 |
| • City of San Jose Developer Roundtable Meetings (for Development Community and Municipal Staff) | August 5, 2004<br>August 12, 2004 |
| • SCVURPPP's C3 Provision Oversight Ad Hoc Task Group (Management Committee invited) | November 22, 2004 |
| • WMI's Watershed Assessment and Monitoring Subgroup and Flood Management Subgroup | January 18, 2005 |

## 2.8 EVALUATION OF EXEMPTION FOR INFILL PROJECTS IN HIGHLY DEVELOPED WATERSHEDS

Provision C.3.f.ii states that HMP controls do not apply to "*construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal.*" To develop a guideline for identifying "infill projects in highly developed watersheds", the Program formed an Exempt Areas Subgroup of the HMP Work Group, which explored two approaches for defining highly developed watersheds, the percent imperviousness approach and the percent developed or "build-out" approach.

Percent Imperviousness Approach

An initial approach explored by Program staff and the Exempt Areas Subgroup was to propose that catchments with existing percent imperviousness above a certain threshold be exempted from HMP controls.

Program staff analyzed GIS data to map areas with different percentages of impervious cover. The data used to evaluate existing impervious area came from a catchment level analysis calculated by Dave Mattern (Mattern & Associates, contractor to SCVWD) using current (2002) and fine resolution (1-meter satellite imagery) data (Mattern & Associates, 2003). The catchment level of analysis was employed because it could take into account the stream segment into which a development project would ultimately discharge (i.e., the location of the outfall for the specific catchment). Program staff also mapped the predicted changes in percent imperviousness (i.e., difference between existing and future imperviousness) by catchment, using estimates of future imperviousness prepared by Mattern & Associates for the SCVWD hydrologic modeling efforts.

Mattern & Associates estimated the future impervious surface area by applying estimated future percentages of imperviousness to various planning land use categories within the watersheds, based on General Plan information. Because the way land use categories and land use areas were defined varied among cities (e.g., some included roads and highways and some did not), separate evaluations of expected impervious area percentages were done for each city. Areas of the same land use type that were considered to be fully developed were aggregated to determine the average existing impervious area for that land use. To be considered fully developed, a threshold criterion was established for each land use type, and only those areas that equaled or exceeded the threshold were used to compute the average imperviousness. For example, the threshold for Industrial Park land use in San Jose was 70%. The average percent impervious for Industrial Park land use blocks currently at or above 70% was 81% (range was 70% to 96%). A value of 85% was selected to represent future imperviousness in all Industrial Park land use blocks. Those land use areas that were considered fully developed and were less than 85% impervious now were assumed to increase to 85% impervious in the future.

While this approach may be valid for the development of the District's hydrologic model, many Subgroup members felt that this was a conservative approach and was probably overestimating future imperviousness and future runoff peaks and volumes. The approach also did not take into account that some land use types may have lower percentages of impervious area in the future, due to incorporation of site design measures.

The Exempt Areas Subgroup decided that the percent imperviousness approach could not be supported for the following three reasons:

1. Due to the high variability of catchment imperviousness and the changes in imperviousness, it was difficult to reach consensus on translating catchment level information to a guideline for identifying a highly developed watershed. References identified by Program staff that relate percent imperviousness in a watershed to expected changes in stream habitat were not appropriate for evaluating effects on stream erosion potential.
2. The Subgroup, with the exception of the District, did not support using the estimates of future imperviousness for the exempt areas analysis, because of some of the assumptions made in developing these data for the District's model (described above).
3. The percent imperviousness approach does not adequately represent the expected level of future development in an area. This approach is misleading in areas containing dedicated open space, parks, school grounds, etc. that are not expected to develop further (i.e., catchments that contain open space and parks have a low percent imperviousness and do not appear to be highly developed).

<u>Percent Developed Approach</u>

A second method that was explored for defining highly developed watershed is the percent developed or percent "build-out" approach. This approach is based on the definition of "highly developed" that Co-permittees already use for a variety of land use decisions. The approach defines a highly developed watershed as one in which the area of developed land equals or exceeds a certain percentage of total watershed area. The developed area is the total watershed area minus the amount of undeveloped land in the watershed or subwatershed as identified on a Co-permittee's vacant land inventory map or database.

Program staff initially worked with City of San Jose staff to apply this approach within that city's boundary. The working definition of undeveloped land for this analysis is as follows:

> Undeveloped Land – land without improvements (i.e., curb and gutter, sidewalks, structures, etc.). Parking lots, parks, designated open space, cemeteries, golf courses, etc. that have been developed according to the designated zoning for the parcel are not considered undeveloped land.

City staff used a GIS to calculate the percentage of developed land at three different scales of drainage area: catchment, subwatershed, and watershed. The coverages for the catchment and subwatershed boundaries were obtained from the District. The City of San Jose Vacant Land Inventory was used to identify areas within the City that represent undeveloped land. These areas were intersected with each of the three drainage area data sets to identify the percentage of drainage area that contains undeveloped land (or conversely, percent developed land). City staff presented maps showing the ranges of percent-developed land for all three scales of drainage area. The Subgroup agreed that the subwatershed drainage area provided the most useful scale at which to identify percent-developed land area, as there was too much variability within the catchment level data to develop a consistent guideline for the highly developed area of a city.

The results of the percent-developed analysis at the subwatershed scale for San Jose are presented on Figure 2-3. Vacant parcel data were then collected from the other Co-permittees and a countywide map (i.e., a map of the SCVURPPP permit area, not including South County) was developed showing percent buildout by subwatershed (see Figure 5-2 in Chapter 5).

The Subgroup, with the exception of the District, supported the percent developed approach because it best represents the amount of expected additional development in a subwatershed and the likelihood that the additional development will cause a significant impact on streams. It is consistent with the term "highly developed" (not highly impervious) watershed used in the permit and findings[5].

As a result of these analyses, the Program proposed that a subwatershed that is 90% built-out, using the method described above, be considered a highly developed watershed.

Hybrid Approach

Regional Water Board staff, in their comments on the June and November 2004 drafts of the HMP Report, expressed concerns about the percent buildout approach and requested that percent imperviousness be considered as part of the criteria for determining an infill project in a highly developed watershed. Board staff suggested that an appropriate threshold of subwatershed or catchment imperviousness for exemption from HMP requirements was 70% or greater. Program

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[5] Permit Finding #12 states that "transit village type developments within 1/4 mile of transit stations, and within the 80% developed urban core of cities, are unlikely to fall under the requirements of C.3.f. and the HMP. This is due to the fact that significant change in impervious surface or significant change in stormwater runoff volume or timing is unlikely in this circumstance, because the development would be within a largely already paved catchment, and on a site that is largely already paved or otherwise impervious."

and Co-permittee staffs worked with Regional Board staff to develop a "hybrid" approach combining the percent buildout and percent imperviousness approaches.

The hybrid approach approved by the Program Management Committee and included in guidelines for HMP applicability in this report (Chapter 5) is described below:

- A project must be both an "infill project" and in a "highly developed watershed" to be exempt from HMP requirements.
- "Highly developed watershed" is defined as a subwatershed that is 90% or more built-out based on vacant parcel data for that area.
- The definition of "infill" is based on the percent imperviousness of the subwatershed in which the project is located. Infill projects include:

  a. All projects in subwatersheds with 65% or more of impervious surface[6]; or

  b. Projects less than 50 acres (total size) in subwatersheds with less than 65% of impervious surface.

  Note that these projects are still subject to the stormwater treatment requirements of Provision C.3 and will be encouraged to incorporate site design, source control, and treatment control measures that have flow control benefits.

To illustrate the hybrid approach, a draft countywide (Santa Clara Valley) map combining the percent build-out and percent imperviousness data was developed, and is presented in Chapter 5 (Figure 5-2). The map files and associated metadata have been provided to the Co-permittees for use in their GIS systems to allow more accurate determination of specific project locations on the map. The Program will continue to work with Co-permittees to verify and correct potential inaccuracies in the map and make additional updates as needed.

[6] The study that provided satellite imagery data on impervious surface in the Valley was conducted by the Water District as part of agricultural water consumption investigations, and the study was conducted in June and July, 2002, when there was significant vegetation and crop growth as well as tree cover present. As a result, estimates of impervious surfaces in urban areas were less than actual values. Therefore, the impervious surface threshold was adjusted to 65% to include all of downtown San Jose and downtown areas in other cities.

## Percent Developed Land
## San Jose by Subwatershed

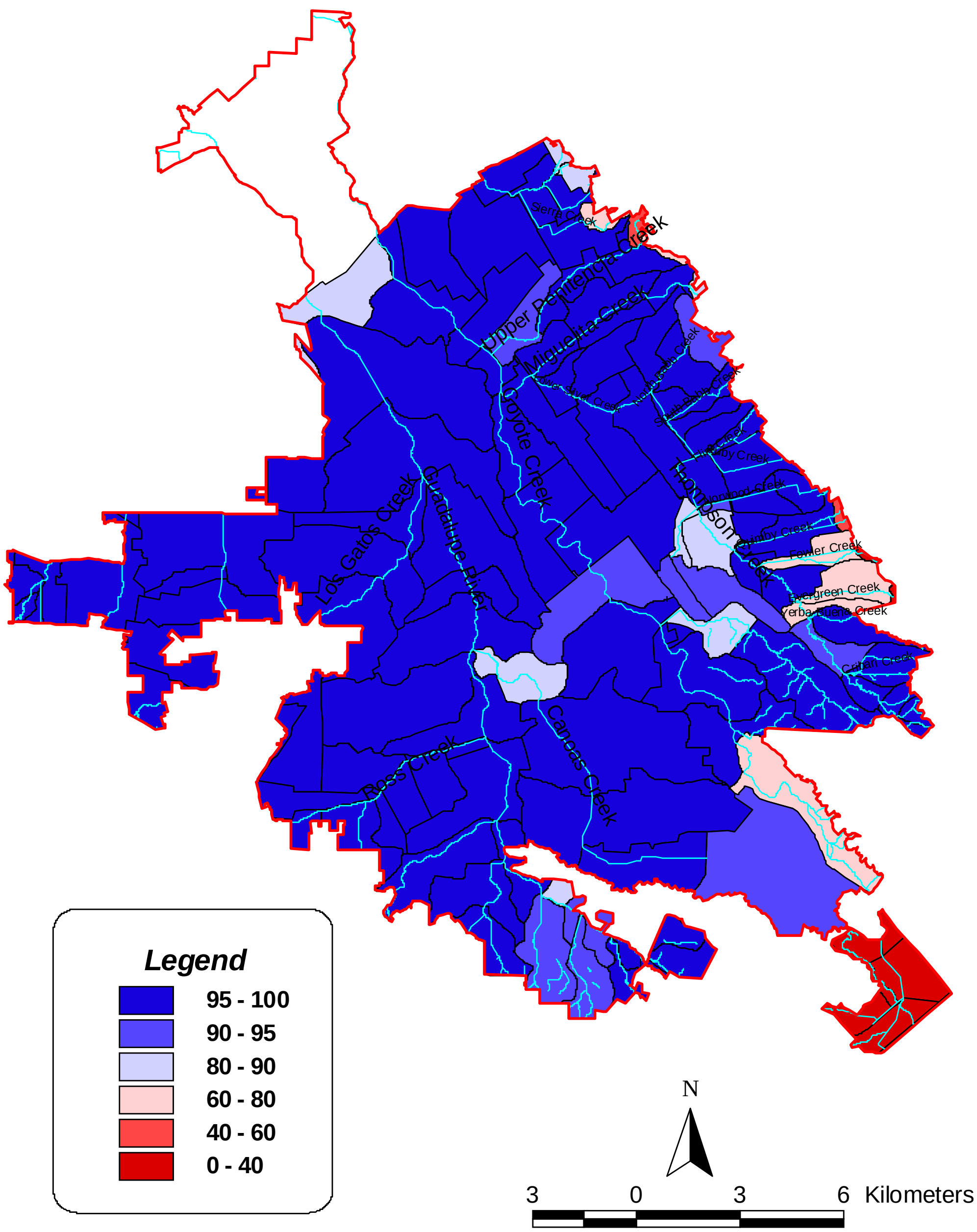


**Figure 2.3 Percent Developed Land in San Jose, by Subwatershed**