## Hydrograph Modification Management Standard

All projects subject to this standard[1] shall ensure estimated post-project runoff peaks and durations do not exceed estimated pre-project peaks and durations if increased stormwater runoff peaks or durations could cause erosion or other significant effects on beneficial uses.[2]

By allowing no increase or impact from any individual project (or only *de minimis* increase or impact), the standard is intended to ensure that beneficial uses are reasonably protected from the potential cumulative effects of foreseeable future development in the same watershed. In addition, each of the following methods and criteria for demonstrating compliance with the standard is defined using conservative criteria (e.g., by using an upward bias when assessing and estimating potential impacts of hydrograph modification and a downward bias when estimating the effectiveness of hydrograph modification management measures). Finally, the methods and criteria emphasize distributed, infiltration-based IMPs that mimic natural infiltration processes, minimizing the potential for cumulative impacts.

## Demonstrating Compliance with the Standard

Applicants may demonstrate compliance with the standard by demonstrating any one of the following:

1. **No increase in directly connected impervious area.** The applicant may compare the project design to the pre-project condition and show the project will not increase directly connected impervious area and also will not facilitate the efficiency of drainage collection and conveyance. The comparison shall include all of the following:
    a. Assessment of site opportunities and constraints to reduce imperviousness and retain or detain site drainage.
    b. Description of proposed design features and surface treatments used to minimize imperviousness.
    c. Inventory and accounting of existing and proposed impervious areas.
    d. Design details and descriptions to show which proposed areas are “self-retaining” or drain to stormwater treatment facilities. “Self-retaining” areas do not contribute to directly connected impervious area. Impervious areas draining to stormwater treatment facilities are considered directly connected.
    e. A qualitative comparison of pre-project to post-project efficiency of drainage collection and conveyance. Stormwater treatment integrated management practices (IMPs) such as those in the *Stormwater C.3*

[1] Subject to definitions and limitations in C.3.c.i of Water Board Order R2-2003-0022.

[2] This is a restatement of Water Board Order R2-2003-0022, Provision C.3.f.i.

*Guidebook* increase time of concentration, particularly for smaller storms, and are considered to substantially reduce drainage efficiency.

2. **Implementation of hydrograph modification IMPs.** The applicant may select and size IMPs to manage hydrograph modification impacts, using the design procedure, criteria, and sizing factors specified by the Contra Costa Clean Water Program and incorporated in the Program's *Stormwater C.3 Guidebook*.

3. **Estimated post-project runoff durations and peak flows do not exceed pre-project durations and peak flows.** The applicant may use a continuous simulation hydrologic computer model such as USEPA's Hydrograph Simulation Program—Fortran (HSPF) to simulate pre-project and post-project runoff, including the effect of proposed IMPs, detention basins, or other stormwater management facilities. To use this method, the applicant shall compare the pre-project and post-project model output for a rainfall record of at least 30 years, using limitations and instructions provided by the Contra Costa Clean Water Program, and shall show the following criteria are met:

    a. For flow rates from one-half the pre-project 2-year runoff event (0.5Q2) to Q2, post-project runoff durations shall not exceed pre-project runoff durations. For flow rates above Q2, post-project durations may exceed pre-project durations no more than 10% of the time.

    b. For flow rates from 0.5Q2 to Q2, the post-project peak flows shall not exceed pre-project peak flows. For flow rates from Q2 to Q10, post-project peak flows may exceed pre-project flows by up to 10% for a 1-year frequency interval. For example, post-project flows could exceed pre-project flows by up to 10% for the interval from Q9 to Q10 or from Q5.5 to Q6.5, but not from Q8 to Q10.

4. **Projected increases in runoff peaks and durations will not accelerate erosion of receiving stream reaches.** The applicant may show that, because of the specific characteristics of the stream receiving runoff from the project site, or because of proposed stream restoration projects, or both, there is little likelihood that the incremental increase in flow due to the project could increase the net rate of stream erosion to the extent that beneficial uses would be significantly impacted. To use this option, the applicant shall evaluate the receiving stream to determine the relative risk of erosion impacts and take the appropriate actions as described below:

    a. **"Low Risk."** In a report or letter report, signed by an engineer or qualified environmental professional, the applicant shall show that all downstream channels between the project site and the Bay/Delta fall into one of the following "low-risk" categories.

i. Enclosed pipes.

ii. Channels with continuous hardened beds and banks engineered to withstand erosive forces and composed of concrete, engineered riprap, sackcrete, gabions, mats, etc. This category excludes channels where hardened beds and banks are not engineered continuous installations (i.e., have been installed in response to localized bank failure or erosion).

iii. Channels subject to tidal action.

iv. Channels shown to be aggrading, i.e., subject to the accumulation of sediments.

b. **"Medium Risk."** Medium risk channels are those where the boundary shear stress could exceed critical shear stress as a result of hydrograph modification, but where either the sensitivity of the boundary shear stress to flow is low (e.g., an oversized channel with high width to depth ratios) or where the resistance of the channel materials is relatively high (e.g. cobble or boulder beds and vegetated banks). In "medium-risk" channels, accelerated erosion due to increased watershed imperviousness is not likely but is possible, and the uncertainties can be more easily and effectively addressed by mitigation than by additional study.

In a preliminary report, the applicant's engineer or qualified environmental professional will apply the Program's methods and criteria to show all downstream reaches between the project site and the Bay/Delta are either at "low-risk" or "medium-risk" of accelerated erosion due to watershed development. In a following, detailed report, a qualified stream geomorphologist[3] will use the Program's criteria, available information, and current field data to evaluate each "medium-risk" reach. For each "medium-risk" reach, the report shall show one of the following:

i. A detailed analysis, using the Program's criteria, showing the particular reach may be reclassified as "low-risk."

ii. A detailed analysis, using the Program's criteria, confirming the "medium-risk" classification, and:

1. A preliminary plan for a mitigation project to stabilize stream beds or banks, improve stream functions, and/or improve habitat values, and

2. A commitment to implement the mitigation project timely in connection with the proposed development project

[3] Typically, detailed studies will be conducted by a stream geomorphologist retained by the lead agency (or, on the lead agency's request, another public agency such as the Contra Costa County Flood Control and Water Conservation District) and paid for by the applicant.

(including milestones, schedule, cost estimates, and funding), and

3. An opinion and supporting analysis by one or more qualified environmental professionals that the expected environmental benefits of the mitigation project substantially outweigh the potential impacts of an increase in runoff from the development project, and
4. Communication, in the form of letters or meeting notes, indicating consensus among staff representatives of regulatory agencies having jurisdiction that the mitigation project is feasible and desirable. (This is a preliminary indication of feasibility required as part of the development project Stormwater Control Plan. All applicable permits must be obtained before the mitigation project can be implemented.)

c. **"High Risk."** High-risk channels are those where the sensitivity of boundary shear stress to flow is high (e.g., incised or entrenched channels, channels with low width-to-depth ratios, and narrow channels with levees) or where channel resistance is low (e.g., channels with fine-grained, erodible beds and banks, or with little bed or bank vegetation). In a "high-risk" channel, it is presumed that increases in runoff flows will accelerate bed and bank erosion.

To implement this option (i.e., to allow increased runoff peaks and durations to a high-risk channel), the applicant must perform a comprehensive analysis to determine the design objectives for channel restoration and must propose a comprehensive program of in-stream measures to improve channel functions while accommodating increased flows. Specific requirements are developed case-by-case in consultation with regulatory agencies having jurisdiction. The analysis will typically involve watershed-scale continuous hydrologic modeling (including calibration with stream gauge data where possible) of pre-project and post-project runoff flows, sediment transport modeling, collection and/or analysis of field data to characterize channel morphology including analysis of bed and bank materials and bank vegetation, selection and design of in-stream structures, and project environmental permitting.

The Program plans to develop an assessment of one watershed, and further recommendations for future comprehensive watershed assessments, later in 2005.