

# EVALUATION OF RAINFALL-RUNOFF RELATIONSHIPS TO INFORM DEVELOPMENT OF AN INCENTIVE PROGRAM FOR STORMWATER POLLUTION REDUCTION IN SOUTH COAST WATERSHEDS

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## **Problem Statement**

Polluted runoff, or stormwater, is the single biggest source of pollution to southern California's coastal waters.<sup>1</sup> During every significant storm, rainwater runs over dirty streets, rooftops, parking lots and lawns and picks up a wide variety of pollutants, including disease-causing pathogens, gasoline and lubricants, pesticides, fertilizers, animal waste, trash, nutrients, sediment and heavy metals. During dry weather, activities such as lawn watering and car washing send polluted water down storm drains. This polluted runoff flows directly to our creeks and eventually the ocean, threatening stream ecosystems, marine life and triggering health warnings ("beach advisories") at popular recreation areas.

Beach advisories not only warn of a public health threat, but they also harm our local economy, which is heavily dependent on coastal and beach-related tourism. The region also has several waterbodies that are listed on the State's 303(d) List of Water Quality Limited Segments. Urban runoff is implicated as a likely source of the impairment of many of these waterbodies.

Stormwater pollution will become even more of a challenge as the region becomes more densely urbanized and the percentage of land covered by paved, or "impervious" surfaces increases. Unlike natural areas covered with soil and vegetation, which absorb water and filter pollutants, impervious surfaces (i.e. roads, parking lots, sidewalks, driveways and roofs) prevent rain from soaking into the ground, instead forcing it to run off and be transported quickly down storm drains and into local waterways. Studies have shown that when 10 percent of a watershed is covered with impervious surfaces, stream ecosystems begin to show evidence of change, and coverage of more than 30 percent is often associated with significant degradation. Developed urban watersheds in southern Santa Barbara County have impervious surface coverage ranging from 20-40 percent.<sup>2</sup>

In April 2003, the State Water Board adopted the state-wide General Permit for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (MS4s), as required by US EPA's Phase II NPDES stormwater permit regulations. Urban areas with MS4s serving populations of 50,000-100,000 must now obtain coverage under the permit by developing and implementing Storm Water Management Programs (SWMPs) describing how they will reduce the discharge of pollutants in stormwater to the "maximum extent practicable," protect water quality, and satisfy relevant Clean Water Act requirements.<sup>3</sup> Santa Barbara County and the Cities of Goleta and Santa Barbara are currently finalizing their SWMPs. However, the regulations do not require retrofitting and other physical changes to areas of existing development.

## **Project Significance**

Implementing the SWMPs is an iterative process intended to reduce "non-point source" pollution entering surface water bodies over several years. Counties, cities and other entities will be required to formulate and implement best management practices (BMPs) that will reduce pollutants discharged to surface waters. To this end, regulatory agencies and urban planners are increasingly looking to the use of "structural BMPs" (basically design of roads, homes and commercial areas) to preserve infiltration and contact with vegetation to reduce the mobilization of pollutants in runoff. Permeable pavement

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<sup>1</sup> State Water Resources Control Board and California Coastal Commission. Nonpoint Source Program Strategy and Implementation Plan, 1998-2013. January 2000.

<sup>2</sup> Questa Engineering Corporation. Existing Conditions Study of the Arroyo Burro, Mission, Sycamore, and Laguna Creek Watersheds, 2004/2005.

<sup>3</sup> State Water Resources Control Board Water Quality Order No. 2003-0005-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004, Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems. 2003.

and “disconnecting” impermeable surfaces with plantings are examples of BMPs that are gaining increased attention. Permeable pavement is a unique cement-based product with a porous structure that allows water to pass directly through the pavement and into the soil naturally. It removes pollutants from stormwater by filtering it through the ground while replenishing the aquifer. Its widespread use, along with strategically placed plantings, could result in both significant improvements in water quality and reductions in the quantity of stormwater runoff.

### **Project Objectives**

The proposed project’s overall objective is to lay the groundwork for an innovative incentive program that will encourage the modification or replacement of impermeable surfaces in areas of existing residential and commercial development. If feasible, local land use authorities could develop and implement incentive programs to reduce the amount of impervious surface in key South Coast watersheds (thereby reducing the quantity and improving the quality of runoff to local waterways), and create a model program that can be scaled up and replicated in other communities. The information could be used to improve design of new development and re-development projects as well. However, some objective evaluation needs to be performed to establish the amount of area that needs to be made (or remain) permeable to improve runoff characteristics. (This approach has been generally adopted in so-called “low impact development” approaches in communities in other regions.)

To achieve these objectives, the proposed project would involve surveying the universe of available rainfall-runoff simulation models and selecting one that can evaluate rainfall-runoff relationships in selected catchments and associated pollutant loadings given a set of existing conditions, based on assumptions regarding certain levels of reductions in impervious surface coverage. The outcome of the modeling is the ability to calculate the amount of impervious surface coverage in a given watershed that would need to be reduced in order to effect meaningful change in peak flow, duration of bank full-flow and pollutant loading. Specifically, this modeling effort would inform the implementation of stormwater management efforts by enabling pollutant loading estimates to be made and the feasibility of conversion/modification of hardscape to permeable/disconnected surfaces to be evaluated using specific criteria (i.e. percentage change in runoff per percentage conversion of hardscape to permeable surface).

### **Tasks related to overall project objective**

- Researching what similar projects have been implemented by other municipalities, contacting the managers of similar projects identified in this research and gathering information about applicability to the South Coast area. This will enable an incentive program to be modeled after others that have proven successful.
- Convening stakeholder meetings with Santa Barbara County Project Clean Water (PCW) and Planning and Development staff, Owen Dell (a local landscape architect at the forefront of implementing low impact development elements, including permeable pavement, into landscape design), local environmentally-conscious contractors (such as Allen & Associates), and other interested parties to brainstorm about goals and strategies for the incentive program, and to identify target audience(s) and priority watersheds.
- Convening meetings with PCW staff and consulting with engineering and stormwater management experts to develop a scope for the customized rainfall-runoff model described above, as well as a set of criteria for selecting which watershed to be modeled (i.e. mixed land uses, size, land use data, and the extent of existing BMP implementation).
- Developing, running, calibrating and verifying the model. In the longer term, the results of model runs will be used to establish goals for the percentage reduction in impervious surface cover in priority watersheds that an incentive program would seek to achieve.
- Designing and conducting a survey of local residents and developers to quantify their willingness to pay for permeable pavement and assess their level of interest in taking advantage of different types of incentives to install or retrofit it in residential and commercial driveways, parking lots and sidewalks. This information will also aid in the design of the incentive program by helping to establish what types and levels of incentives our target audiences would be most likely to take advantage of.
- Researching different types of permeable surfaces (i.e. porous asphalt, pervious concrete, turf block, and gravel) and approximate cost differentials between these technologies and traditional concrete or asphalt.

### **Background Information**

The County’s draft SWMP includes an evaluation of incentives for conversion of impermeable surfaces as one BMP it will implement, and the modeling exercise outlined above will provide an important basis on which to set the objectives for an incentive program. The SWMP suggests that incentives the County could implement include “fast-tracking” of

projects through design review, reduction in permit fees, or direct financial incentives, depending on the nature of the project. Innovative projects can also be tracked and used as case studies for the design/development community.

Channelkeeper and Project Clean Water have discussed this proposed project at length, and it fits in with Channelkeeper's work to address stormwater pollution in the watersheds emptying into the Santa Barbara Channel. Channelkeeper has received partial funding to undertake related efforts from the Environment Now Foundation, so some funding would be available for a Bren student's summer internship and/or other parts of this proposal should it be selected as a Group Project.

### **Stakeholders**

Project Clean Water, Santa Barbara County Planning and Development, landscape architects (i.e. Owen Dell, County Landscape & Design), local home and land owners, developers, water-contact recreationalists.

### **Possible Approach and Available Data**

In 2004, the County of Santa Barbara completed a project to map imperviousness at a parcel-level to target priority areas for future BMP implementation. The project correlated highly impervious areas with land use and zoning information, topography, and storm drain infrastructure data, and used remote sensing combined with traditional GIS approaches to develop a database tool.

Santa Barbara County already possesses the key inputs needed to run the model and is willing to provide access and assistance with it. The existing data inputs held by the County include land use categories, topography, imperviousness, rainfall intensity and duration, County facility drop inlets and outfalls, storm drain system map, subcatchment area boundaries, contours of land surface, slope, characteristic width of overland flow (i.e. road width), and roughness coefficients. Temperature, wind speed and other weather data are available through the National Weather Service.

We would have access to the County's above-described data and existing database tool and would use them to put together a metric to quantify what threshold conditions would result in positive changes to runoff characteristics for a representative catchment. The resulting metric would allow better planning for retrofit projects (i.e. installation of permeable pavement) in existing development and improve project conditioning for new development.

This project will provide crucial tools and information now needed by local municipalities and other interested parties to prioritize areas on a catchment scale for potential BMP projects to reduce stormwater pollution, including but not limited to a program to incentivize the use of permeable pavement in commercial and residential developments in the Santa Barbara area. Ultimately, this will not only benefit water quality in the South Coast, but will also provide a model for other municipalities seeking innovative means of bringing the urban runoff problem under control while also engaging local citizens in positive solutions.

### **Deliverables:**

- Calibrated, customized rainfall-runoff model for a key South Coast watershed, focusing on a particular catchment (subwatershed).
- Final report that summarizes the results of the above efforts, identifies options and makes recommendations as to how an incentive program to modify impermeable surfaces should be structured and implemented in the South Coast.

### **References**

California Stormwater Quality Association (CASQA), New Development and Redevelopment Handbook, January 2003, at <http://www.cabmphandbooks.com/Development.asp>.

Central Coast Regional Water Quality Control Board, Staff Report for October 22, 2004 Board Meeting, Agenda Item 18: Permeable Surfaces Improve Water Quality, at <http://www.swrcb.ca.gov/rwqcb3/Board/Agendas/102204/ItemReports/Item18/documents/Item18staffrpt.pdf>

County of Santa Barbara Storm Water Management Program, December 31, 2005, at [www.countyofsb.org/project\\_cleanwater](http://www.countyofsb.org/project_cleanwater).

US Environmental Protection Agency, Storm Water Technology Fact Sheet: Porous Pavement, September 1999. EPA 832-F-99-023.