Urban Runoff Management

MANAGEMENT OBJECTIVE – IMPROVE WATER QUALITY

Photo caption. Low impact development for urban runoff.

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Chapter 19. Urban Runoff Management

Urban runoff management is a broad series of activities to manage both storm water and dry weather runoff. Dry weather runoff occurs when, for example, excess landscape irrigation water flows to the storm drain. Traditionally, urban runoff management was viewed as a response to flood control concerns resulting from the effects of urbanization. Concerns about the water quality impacts of urban runoff have led water agencies to look at watershed approaches to control runoff and provide other benefits (see Box 19-2, Objectives of Urban Runoff Management), resulting in urban runoff management now being linked to other resource management strategies including Pollution Prevention, Land Use Planning and Management, Watershed Management, Urban Water Use Efficiency, Recycled Municipal Water, Recharge Area Protection, and Conjunctive Management.

Urban Runoff Management in California

The traditional approach to runoff management views urban runoff as a flood management problem where water needs to be conveyed as quickly as possible from urban areas to waterways in order to protect public safety and property. Consequently, precipitation-induced runoff in the urban area has been viewed as a waste, and not a resource.

Urbanization alters flow pathways, water storage, pollutant levels, rates of evaporation, groundwater recharge, surface runoff, the timing and extent of flooding, the sediment yield of rivers, and the suitability and viability of aquatic habitats. The traditional approach to managing urban and storm water runoff has generally been successful at preventing flood damage, but has several disadvantages. In order to convey water quickly, natural waterways are often straightened and lined with concrete, resulting in a loss of habitat and impacts to natural stream physical and biological processes. Urbanization creates impervious surfaces resulting in the loss of infiltration of storm water into subsurface aquifers. These impervious surfaces collect pollutants that are washed off to surface waters during rain events. The impervious surfaces also increase runoff volumes and velocities, resulting in streambank erosion, and potential flooding problems downstream. Because of the emphasis on removing the water quickly, the opportunity to use storm-generated runoff for multiple benefits is reduced.

A watershed approach for urban runoff management tries to emulate and preserve the natural hydrologic cycle that is altered by urbanization. The watershed approach consists of a series of best management practices (BMPs) designed to reduce the pollutant loading and reduce the volumes and velocities of urban runoff discharged to surface waters. These BMPs may include facilities to capture, treat, and recharge groundwater

Box 19-1 Acronyms and Abbreviations

af	acre-feet
BMP	best management practices
CWA	federal Clean Water Act
LID	low impact development
NPDES	National Pollutant Discharge Elimination System
NPS	non-point source
Prop.	ballot proposition
Regional Water Boards	Regional Water Quality Control Boards
SMURRF	Santa Monica Urban Runoff Recycling Facility
State Water Board	State Water Resources Control Board
SWMP	Storm Water Management Programs
TMDL	total maximum daily loads
USEPA	US Environmental Protection Agency
USGS	US Geological Survey

with urban runoff, public education campaigns to inform the public about storm water pollution for the proper use and disposal of household chemicals, and technical assistance and storm water pollution prevention training.

Methods for recharging groundwater with urban runoff include having roof runoff drain to vegetated areas or collect roof runoff in cisterns or rain barrels for later onsite use, draining runoff from parking lots, driveways, and walkways into landscape areas with permeable soils, using dry wells, and permeable surfaces. Infiltration may require the use of source control and pretreatment before infiltration. Infiltration enables the soil to naturally filter many of the pollutants found in runoff and reduces the volume and pollutant load of the runoff that is discharged to surface waters. The watershed approach will not prevent, nor should it prevent, all urban runoff from entering waterways. Elements of the traditional conveyance and storage strategy are still needed in order to protect downstream beneficial uses and water rights. In addition to infiltration of storm water, the watershed approach consists of structural controls that can be used to capture the storm water runoff and "meter" its release to surface waters in order to mimic the hydrograph that existed before development occurred, or "harvest" storm water for later use (e.g., irrigation).

Urban runoff management has become more important and more controversial over the last decade as municipal governments have been held increasingly responsible for pollutants washed from developed and developing areas within their jurisdictions into the storm sewer system and discharged into waterways. Unlike pollution from industrial and sewage treatment plants, pollutants in urban runoff and storm water runoff come from many diffuse sources (see Box 19-3) and are typically not treated prior to discharge to surface waters. As rainfall or snowmelt moves over the urban landscape, it picks up and carries away natural and human-made pollutants, finally depositing them into

Box 19-2 Objectives of Urban Runoff Management

- Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization
- Protection of environmental quality and social well-being
- Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial ecosystems
- Minimization of soil erosion and sedimentation problems
- Maintenance of the pre-development hydrologic conditions
- Protection and augmentation of groundwater supplies
- Control and management of runoff to reduce or prevent flooding
- Management of aquatic and riparian resources for active and passive pollution control

lakes, rivers, wetlands, coastal waters, and, potentially, into groundwater. Pollution associated with discharges from a storm sewer system can also occur from non-storm event activities, such as movement by wind, flows from landscape irrigation, improper disposal of trash or yard waste, illegal dumping, and leaky septic systems.

Runoff in the urban environment, both storm-generated and dry weather flows, has been shown to be a significant source of pollutants to the surface waters of the nation. As a result, the 1987 amendments to the federal Clean Water Act (CWA) required that discharges from municipal separate storm sewer systems serving a population of 100,000 or more must be in compliance with requirements contained in National Pollutant Discharge Elimination System (NPDES) permits. The US Environmental Protection Agency (USEPA) promulgated regulations for these discharges in 1990. These regulations were subsequently amended in 1999 to require that municipal separate storm sewer systems that served populations fewer than 100,000 and located in an urbanized area were subject to requirements contained in an NPDES permit. In California, the authority to regulate urban and storm water runoff under the NPDES system has been delegated by USEPA to the State Water Resources Control Board (State Water Board) and the nine Regional Water Quality Control Boards (Regional Water Boards).

Under the initial NPDES permits issued in the 1990s, municipalities were required to develop and implement a plan to reduce the discharge of pollutants into waterways, including the discharges from areas of new development and significant redevelopment. For the new and redevelopment projects, the permit requirements were generally met through the implementation of BMPs that addressed discharges taking place during the construction activity, but did not address discharges occurring after construction was completed (post-construction controls). Since the first municipal storm water permits were adopted, it has become clear, with continued beach closures and other pollution problems associated with urban runoff, that post-construction controls, retrofit and

Box 19-3 Examples of Pollution in the Urban Environment

- Herbicides and pesticides from landscaped areas (residential and commercial), golf courses, city parks, etc.
- Oil, grease, and heavy metals from normal vehicle use (automobiles, trucks, and busses) that accumulate on streets, roads, highways, driveways, and parking lots (leaks and drips, brake pad dust, tire wear, etc.)
- Sediment from improperly managed construction activities
- Litter and green waste
- Bacteria from improperly maintained septic systems, encampments; and waste from pets and wildlife
- Nutrients from application of excess fertilizers on landscaped areas (home, commercial, parks, etc.)
- Illegal dumping of material into the storm sewer system – used crankcase oil, anti-freeze, pesticide container rinse water, etc.
- Atmospheric deposition
- Natural catastrophes
- Building maintenance – pressure washing of lead-based paints, rinsing of walkways, etc.
- Sanitary sewer overflows
- Illegal cross connections with the sanitary sewer systems

more advanced measures will be required in some areas to comply with water quality regulations (see Box 19-3).

The State and Regional Water Boards seek opportunities for managing urban runoff that will result in multiple benefits. Low Impact Development (LID) is one such collection of management techniques that has multiple benefits. LID is a sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional storm water management, which collects and conveys storm water runoff through storm drains, pipes, or other conveyances to a centralized storm water facility, LID takes a different approach by using site design and storm water management to maintain the site's pre-development runoff rates and volumes. The goal of LID is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall. LID has been a proven approach in other parts of the country and is seen in California as an alternative to conventional storm water management. The Water Boards are advancing LID in California in various ways.

LID can be used to benefit water quality, address the modifications to the hydrologic cycle and be a means to augment local water supply through either infiltration or water harvesting. In light of this, the Water Boards are incorporating the principals of LID

Box 19-4 Implementation Plan for Urban Runoff Management Programs

Implementation of Urban Runoff Management Programs will require local agencies to:

- Promote coordination of interagency programs that protect water quality from urban runoff pollution.
- Reduce the potential for contamination of surface and groundwater that results from uncontrolled or poorly-controlled urban runoff practices.
- Develop tools to assess the effectiveness of urban water pollution programs.
- Increase the availability of regulatory and guidance documents and/or instructional workshops to demonstrate effective urban runoff pollution control programs and policies.
- Reduce the number of uncontrolled urban runoff pollution sources by increasing the number of municipalities, industries and construction sites that utilize Non-Point Source (NPS) management measures and fit under the permitted State Storm Water Program.
- Develop and implement watershed-based plans, including TMDLs and Storm Water Management Programs (SWMPs), in order to identify and address impacts from urban land use.

into the permits now being issued, and are funding projects that highlight LID using the various voter-approved bond funds.

The State and Regional Water Boards are also required under the federal CWA section 303(d) and federal regulations (40 C.F.R. § 130) to prepare a list of and set priorities for water bodies requiring total maximum daily loads (TMDLs) because they do not meet water quality standards. The section 303(d) list was last revised in 2006. Federal regulations require the section 303(d) list to be updated every two years. TMDLs represent the total pollutant load a water body can assimilate before the water body's beneficial uses are considered to be impaired and water quality standards are no longer met. Through the process to establish the 303(d) list of impaired water bodies, urban runoff has often been found to be a source of pollutants contributing to the impairment.

NPDES permits now issued to local agencies for discharges of storm water require the implementation of specific measures to reduce the amount of pollutants in urban runoff. Permits for discharge to listed water bodies having a TMDL must be consistent with the wasteload allocations in a TMDL. Under California law, TMDLs include implementation plans for meeting water quality standards. The implementation plans allow for time to implement control strategies to meet water quality standards.

Potential Benefits of Urban Runoff Management

The primary benefits from urban runoff management are to reduce surface water pollution and improve flood protection. Additional benefits may be to increase water

supply through groundwater recharge in areas with suitable soil and geological conditions, and where pollution prevention programs are in place to minimize the impact on groundwater. Groundwater recharge and storm water retention sites can also be designed to provide additional benefits to wildlife habitat, parks, and open space.

Underground facilities can store runoff and release it gradually to recharge a groundwater aquifer or release it to surface waters in a manner that mimics the natural hydrologic cycle. Captured storm water can also be used as a source of irrigation water rather than using potable water. For instance, a school campus can solve its flooding problem and develop a new sports field at the same time. These may provide secondary benefits to the local economy by creating more desirable communities. By keeping runoff onsite, storm drain systems can be downsized, reducing installation and maintenance costs of such systems. A watershed planning approach to manage urban runoff allows communities to pool economic resources and obtain broader benefits to water supply, flood control, water quality, open space, and the environment. Statewide information on the benefits of increased management of urban runoff is not available, although examples from local efforts exist.

The Fresno-Clovis metropolitan area has built an extensive network of storm water retention basins that not only recharges more than 70 percent of the annual storm water runoff (17,000 acre feet) and removes most conventional storm water pollutants, but also recharges excess Sierra snowmelt during the late spring and summer (27,000 acre-feet). Los Angeles County recharges an average 210,000 acre-feet (AF) storm runoff a year, which reduces the need for expensive imported water. Agencies in the Santa Ana watershed recharge about 78,000 AF of local storm runoff a year. The Los Angeles and San Gabriel Watershed Council has estimated that if 80 percent of the rainfall that falls on just a quarter of the urban area within the watershed (15 percent of the total watershed) was captured and reused, total runoff would be reduced by about 30 percent. That translates into a new supply of 132,000 AF of water per year or enough to supply 800,000 people for a year.

The City of Santa Monica is an example of a municipality that is taking a watershed approach to managing urban runoff. Santa Monica's primary goal is to treat and reuse all dry weather flows. This turns a perceived waste product into a local water resource so that beach water quality is protected and the local nonpotable water supply is augmented. However, if dry weather discharges are necessary, the city's secondary goal is to release only treated runoff into waterways. Both goals improve water quality of the Santa Monica Bay. The city's goals promote development such that urbanization works with nature and the hydrologic cycle.

At the "lot" or home-owner level, LID techniques and practices can be used to reduce/retard the amount of runoff being generated or runoff can be harvested and stored for later use on-site. These techniques and practices include but are not limited to rain barrels (cisterns), rain gardens, swales, trench drains, land grading, permeable pavers, tree-box filters, and green roofs. For further discussion, see the Land Use Planning and Management resource management strategy, Chapter 24 in this volume. A recent

Box 19-5 Recent Efforts to Quantify Benefits of Low Impact Development

Low Impact Development (LID) practices that emphasize infiltrating storm water to recharge groundwater supplies or capturing rooftop runoff in rain barrels and cisterns for onsite use can be used to increase access to safe and reliable sources of water for end-users, while reducing the amount of energy consumed and greenhouse gas (GHG) emissions generated by supplying the water. Analysis by the Natural Resources Defense Council and University of California at Santa Barbara demonstrates that implementing LID practices at commercial and residential development and redevelopment, in urbanized southern California and limited portions of the San Francisco Bay area, has the potential to increase water supplies by 229,000 – 405,000 acre-feet (af) per year by 2030. The water savings at these locations translate into electricity savings of 573,000 - 1,225,500 megawatt-hours (MWh), avoiding the release of 250,500 – 535,000 metric tons of CO_2 per year, as the increase in energy-efficient local water supply from LID results in a decrease in need to obtain water from energy-intensive imported sources of water such as the California State Water Project or energy-intensive processes such as ocean desalination.

The study analyzed GIS-based land use data, water supply patterns, and the energy consumption of water systems in California in order to estimate the water supply, energy use, and GHG emissions benefits of LID on a regional basis, under a conservative set of assumptions. The ranges presented for each benefit reflect a set of variables and input values used to create low and high estimates of potential savings. The study considered the percent of impervious surface cover in the landscape, density of development, average annual rainfall, soil type and infiltrative capacity, residential and commercial development rates, energy intensity of current imported and local water supply sources, effects of evapotranspiration, and local conditions such as the presence of contamination or of shallow groundwater that may affect groundwater recharge.

As the study included only a subset of urban areas within California, and incorporated only residential and commercial development, the true value of LID is likely higher than the results indicate. For example, the analysis did not incorporate the vast majority of existing development that could be retrofitted using LID practices. Additionally, expanding analysis of LID benefits to include industrial, government and public use, and transportation development in southern California alone has the potential to yield an additional 75,000 af of water savings per year by 2030, with corresponding reductions in energy use and CO_2 emissions. Finally, opportunity to implement LID practices that infiltrate or capture storm water exists statewide. Even greater overall water supply, energy use, and GHG emissions reductions benefits would result from full application of LID and other green infrastructure techniques throughout all of California.

The NRDC-UCSB research demonstrates that LID offers important opportunities to address vital issues of water quality and quantity, while simultaneously addressing climate change and its impacts on California. The results from this analysis suggest that LID is a worthy investment to meet many of the challenges faced by local agencies and communities.

analysis aimed at quantifying the benefits of LID techniques was conducted by the Natural Resources Defense Council and University of California at Santa Barbara and is summarized in Box 19-5; the full report is included in Volume 4 (NRDC et al., 2009).

Potential Costs of Urban Runoff Management

Information is not available on statewide costs to implement urban runoff management activities. The State Water Board contracted with the Office of Water Programs, California State University, Sacramento, to survey six communities to estimate the costs

of complying with their NPDES storm water permits (CSUS, 2005). While this may address the cost for a municipality to comply with specific programmatic elements of an NPDES permit, it may not be the most applicable for looking at watershed programs seeking multiple benefits.

The City of Santa Monica illustrates the costs of managing urban runoff from the perspective of treating dry weather flows. The city has a storm water utility fee that generates about $1.2 million annually, and has been in place since 1995. These funds are used for various programs to reduce or treat runoff. These funds go to the Urban Runoff Management Coordinator for the maintenance of the storm drain system and to help support other city staff that conduct runoff work. Additional funds are spent by other divisions to perform runoff management such as street sweeping, some trash collection, sidewalk cleaning, and purchase and maintenance of equipment. The city has also received five grants totaling more than $3.5 million for the installation of structural BMP systems, all of which will require long-term maintenance and monitoring by the city. The culmination of the city's program is the $12 million Santa Monica Urban Runoff Recycling Facility (SMURRF), a joint project of the cities of Santa Monica and Los Angeles. The SMURRF project is a state-of-the-art facility that treats dry weather runoff water before it reaches Santa Monica Bay. Up to 500,000 gallons per day of urban runoff generated in parts of the cities of Santa Monica and Los Angeles can be treated by conventional and advanced treatment systems at the SMURRF.

Major Issues Facing Urban Runoff Management

Lack of Integration with Other Resource Management Strategies

Land use planning is not conducted on a watershed basis. Many agencies spend millions of dollars annually addressing urban runoff problems with very little interagency coordination (both within the municipality and with other neighboring municipalities) even though downstream communities can be impacted by activities upstream. In other words, internal communications within local government can be improved to ensure that program goals and direction of one branch do not conflict with those of another; and local governments need to communicate with one another to ensure that land use planning on a regional level is complementary across jurisdictional boundaries.

Solutions to managing urban runoff are closely tied to many interrelated resource management strategies including land use planning, watershed planning, water use efficiency, recycled water, protecting recharge areas, and conjunctive management. How and why water is used in the urban environment needs to be considered comprehensively within a watershed.

Lack of Funding

The two main aspects of implementing urban runoff management measures are source control, including education, and structural controls. In highly urbanized areas, major costs for structural control include purchasing land for facilities and constructing,

operating and maintaining treatment facilities. Local municipalities have limited ability to pay for retrofitting existing developed areas within existing budgets. Some are concerned about the economic impacts of raising taxes and requiring residents and businesses to pay for retrofitting existing development. The provisions of Prop. 218 have limited local municipalities' ability to increase fees to pay for services required to implement robust urban runoff management programs.

Effects of Urban Runoff on Groundwater Quality

The movement of pollutants in urban runoff is a concern. Urban runoff contains chemical constituents and pathogenic indicator organisms that could impair water quality. Studies by EPA (USEPA, 1983) and the US Geological Survey (Schroeder, 1993) indicate that all monitored pollutants stayed within the top 16 centimeters of the soil in the recharge basins. The actual threat to groundwater quality from recharging urban runoff is dependent on several factors, including soil type, source control, pre-treatment, solubility of pollutants, maintenance of recharge basins, current and past land use, depth to groundwater, and the method of infiltration used.

Nuisance Problems/Other Concerns

The presence of standing water in recharge basins and other drainage and storage structures can lead to vector problems, such as mosquitoes and the transmission of West Nile Virus. The California Department of Public Health has developed guidelines that address the issue of vector control in basins. These same concerns also apply to the onsite capture of runoff for later use.

Infiltration is being encouraged by a number of state agencies and has been found to be an effective means of dealing with surface water pollution and the excess volumes and velocities of runoff created in the urban environment. However, it is also acknowledged that infiltration is not appropriate in all circumstances. Examples of this would be the widespread use of infiltration in a brownfield development or infiltrating large amounts of water in hillside developments where slope stability may be an issue.

Protecting Recharge Areas

Local land use plans often do not recognize and protect groundwater recharge and discharge areas. Areas with soil and geologic conditions that allow groundwater recharge should be protected where appropriate. If development does occur in these areas, the amount of impervious cover should be minimized and infiltration of storm water should be encouraged on both a regional scale as well as at the "lot" level. The Los Angeles and San Gabriel Rivers Watershed Council prepared a Water Augmentation Study which looked at the results of storm water infiltration and the impact on groundwater (LASGRWC, 2008). Refer to the Recharge Areas Protection, Chapter 25 in Volume 2, for additional information.

Misperceptions

The general public may not always understand that urbanization and life in an urbanized environment is a source of pollution. The public may not realize that they are both the source/cause of pollution in the urban environment and the solution. Elected officials do not always understand the links between land use management and other resource management strategies and how these affect water quality. There is a lack of understanding that decisions made, short-term and long-term, can either enhance or exacerbate the problems associated with pollutants in the urban environment.

Existing Codes

There are current codes and ordinances within State and local government that could conflict with some of the goals of managing urban runoff. Dry weather flows have been shown to be significant sources of pollution, with one of the primary dry weather flows being runoff associated with landscape irrigation and lawn watering. Reduction/elimination of these flows not only provides a water quality benefit, but also reduces the amount of potable water that is being used in a community. However, some municipalities have "green lawn" ordinances and compliance oftentimes leads to runoff. Other codes require minimum street widths that can inhibit the minimization of impervious surfaces.

Recommendations to Promote Urban Runoff Management

State

State agencies should:

1. Coordinate their efforts to decide how urban runoff management should be integrated into their work plans.

2. Coordinate their efforts to develop a single message to the public and local government regarding managing urban runoff through the use of low impact development techniques.

3. Coordinate their efforts to develop appropriate site design requirements that can be incorporated into either local building codes or statewide building standards.

4. Lead by example by incorporating low impact development into projects to showcase the use, utility and cost of the features. Site design should be given the same attention that indoor environmental quality, energy usage, etc., are given in the design, funding and construction of public projects.

5. Encourage public outreach and education about the benefits and concerns related to funding and implementation of urban runoff measures.

6. Provide leadership in the integration of water management activities by assisting, guiding, and modeling watershed and urban runoff projects.

7. Work with local government agencies to evaluate and develop ways to improve existing codes and ordinances that currently stand as barriers to implementing and funding urban runoff management.

8. Provide funding and develop legislation to support development of urban runoff and watershed management plans, enable local agencies and organizations to pursue joint venture, multipurpose projects, and collect information on regional urban runoff management efforts.

9. Assist agencies with developing recharge programs with appropriate measures to protect human health, the environment, and groundwater quality.

10. Work with federal policy makers and industry to create research and development incentives and to develop standards to reduce urban runoff from transportation-related sources including lubricant systems, cooling systems, brake systems, tires, and coatings.

11. Maintain a publicly accessible clearinghouse of information regarding practices that can be used to address water quality issues associated with urban runoff management.

12. Work with local government to seek legislative solutions to the limitations imposed by Proposition 218.

Local Agencies and Governments

Local agencies and governments should:

13. Design recharge basins to minimize physical, chemical, or biological clogging, periodically excavate recharge basins when needed to maintain infiltration capacity, develop a groundwater management plan with objectives for protecting both the available quantity and quality of groundwater, and cooperate with vector control agencies to ensure the proper mosquito control mechanisms and maintenance practices are being followed.

14. Seek opportunities to include low impact development techniques in public works projects.

15. Work with the development community to identify opportunities to address urban runoff management, including low impact development, in development and redevelopment projects.

16. When developing Urban Runoff Management Plans:
    a. Understand how land use affects urban runoff.
    b. Communicate with other municipalities regarding how land use will change the hydrologic regime on a regional basis and how this change is being addressed.
    c. Look for opportunities to require features that conserve, clean up, and reduce urban runoff in new development, and in more established areas when redevelopment is proposed.
    d. Be aware of technological advances in products and programs through communications with other municipalities, branches of local government and with professional organizations.
    e. Learn about urban runoff and watershed ordinances already in place. For example, the City of Santa Monica and the Fresno Metropolitan Flood Control District already have extensive urban runoff management programs in place.
    f. Integrate urban runoff management with other resource management strategies including Pollution Prevention, Land Use Planning and Management, Watershed Management, Urban Water Use Efficiency, Recycled Municipal Water, Recharge Areas Protection, and Conjunctive Management and coordinate both within and across municipal boundaries.
    g. Be sensitive to the fact there are going to be sites where it is not appropriate to infiltrate urban runoff and storm water flows.
    h. Integrate urban runoff management with development goals and strategies in the community

17. Communicate with citizens about pollution of urban runoff and what can be done about it.

18. Create lists of locally accepted practices that could be used at the homeowner level to address urban runoff.

19. Review codes and ordinances to determine if there are impediments to managing urban runoff and amend these as needed or appropriate.

20. Coordinate urban runoff management with local water purveyors to ensure the goals and activities of each complement rather than conflict.

21. Seek opportunities to provide incentives for the installation of low impact development features at the lot level for new and existing developments.

References

[CSUS]. California State University, Sacramento, Office of Water Programs. 2005. NPDES Stormwater Cost Survey. Sacramento (CA): State Water Resources Control Board. 296 p. Contract 02-189-250-0. Available at: http://www.owp.csus.edu/research/npdes/costsurvey.pdf

Dallman, S; Piechota, T. 1999. Stormwater: asset not liability. Los Angeles: Los Angeles and San Gabriel Rivers Watershed Council. 41 p. Available at: http://www.lasgrwc.org/publications/Stormwater.pdf

Kayhanian, M; Johnston, J; Yamaguchi, H; Borroum, S. 2001. Caltrans stormwater management program. Stormwater Journal. (2). Available at: http://www.stormh2o.com/march-april-2001/caltrans-stormwater-management.aspx

Lehner, P; George, P; Aponte, C; Cameron, DM; Frank, AG. 1999. Stormwater strategies: community responses to runoff pollution with additional case studies on low impact development. 2001 Oct. San Francisco (CA): Natural Resources Defense Council. Available at: http://www.nrdc.org/water/pollution/storm/stoinx.asp

[LASGRWC]. Los Angeles and San Gabriel Rivers Watershed Council. 2008. Water Augmentation Study: Research, Strategy, and Implementation. Draft Final 2009 Oct 30. Los Angeles: The Los Angeles and San Gabriel Rivers Watershed Council. 99 p. Available at: http://www.lasgrwc2.org/programsandprojects/was.aspx

Low Impact Development Center. 2007. A review of low-impact development policies: removing institutional barriers to adoption. Sacramento (CA): California State Water Resources Control Board Stormwater Program and the Water Board Academy. 27 p. Project Officer: Greg Gearheart, PE.

[NRDC et al.]. National Resources Defense Council; University of California, Santa Barbara. 2009. A clear blue future. How greening California cities can address water resources and climate challenges in the 21st century. New York: National Resources Defense Council. 53 p. Technical Report. Available at: http://www.nrdc.org/water/lid/files/lid.pdf

Pitt, R; Clark, S; Parmer, K. 1994. Potential groundwater contamination from intentional and nonintentional stormwater infiltration. Project Summary. Cincinnati (OH): US Environmental Protection Agency, Risk Reduction Engineering Laboratory, Office of Research and Development. 7 p. EPA/600/SR-94/051. Available at: http://purl.access.gpo.gov/GPO/LPS35032

Santa Ana Watershed Project Authority, Planning Department. 2005. Santa Ana integrated watershed plan 2005 update. Riverside (CA): Santa Ana Watershed Project Authority. 183 p. Available at: http://www.sawpa.org/

Santa Monica [City of]. 2005. Working for a cleaner bay. Santa Monica (CA): Santa Monica [City of]. 16 p. Available at: http://www.swrcb.ca.gov/water_issues/programs/climate/docs/resources/sm_2005runoffbrochure.pdf

Santa Monica [City of]. 2009. Stormwater best management practices for new developments. Santa Monica (CA): Santa Monica [City of]. 2 p. Available at: http://www.swrcb.ca.gov/water_issues/programs/climate/docs/resources/sm_bmpbrochurejan09.pdf

Schroeder, RA. 1993. Potential for chemical transport beneath a storm-runoff recharge (retention) basin for an industrial catchment in Fresno, California. Sacramento (CA): US Geological Survey. 38 p. Water-resources investigations report no 93-4140.

State Water Resources Control Board; California Coastal Commission; Nonpoint Source Interagency Coordinating Committee. 2003. Nonpoint Source Program Five-Year Implementation Plan July 2003 through June 2008. Sacramento (CA): State Water Resources Control Board. 423 p. Available at: http://www.waterboards.ca.gov/water_issues/programs/nps/docs/5yrplan/nps5yrplan_20032008.pdf

[USEPA]. US Environmental Protection Agency, Water Planning Division. 1983. Results of the nationwide urban runoff program. 2 v. Washington (DC): US Environmental Protection Agency, Risk Reduction Engineering Laboratory, Office of Research and Development. 200 p. 832R83112. Available at: http://yosemite.epa.gov/water/owrccatalog.nsf/065ca07e299b464685256ce50075c11a/62b29cd72280166085256b0600724ce9!OpenDocument

Legal

[CWA]. federal Clean Water Act. Title 33 United States Code section 1251 et seq. (1972).

[Prop. 218]. The Right to Vote on Taxes Initiative. Citizen's initiative passed by voters. Added Article XIII C and D to the California Constitution. (1996).

40 Code of Federal Regulations part 130. Federal CWA section 303(d) requirement that the State and Regional Water Boards prepare a list of and set priorities for water bodies requiring total maximum daily loads (TMDLs) because they do not meet water quality standards.

Personal Communications

Hildebrand, Gary (Los Angeles County, Department of Public Works). 2003. Personal Communication. May.

Rourke, Daniel (Fresno Metropolitan Flood Control District). 2003. Personal Communication. August.

Shapiro, Neal (City of Santa Monica). 2003. Personal Communication. August.