May 15, 2009

Via electronic mail

Executive Officer and Members of the Board
California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Re: Comments on Revised Tentative Order No. R9-2009-0002

Dear Mr. Robertus and Members of the Board:

We write on behalf of the Natural Resources Defense Council (NRDC) and our over 100,000 California members. We have reviewed the Revised Tentative Order No. R9-2009-0002, NPDES Permit No. CAS0108740— the latest draft of the Waste Discharge Requirements for Discharges of Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watershed of the County of Orange, the Incorporated Cities of Orange County, and the Orange County Flood Control District Within the San Diego Region ("South Orange County") NPDES Permit, released on March 13, 2009. We appreciate the opportunity to submit the following comments on the Revised Tentative Order ("Tentative Order" or "Permit").

I. Introduction.

We are disappointed with the Tentative Order. It is inconsistent with state and federal law in absolute terms and does not adequately respond to comments from both EPA and NRDC or reflect the direction of the Board at the conclusion of the last hearing. With respect to low impact development ("LID"), it continues to pursue highly flawed approaches that are vague and ambiguous and fail to implement the federal maximum extent practicable standard. Indeed, the flaws in the LID approach are even more apparent in contrast to the recent adoption by the Los Angeles Regional Water Quality Control Board of LID provisions which require onsite retention of the 85th percentile design storm. The requirements imposed by the Los Angeles Regional Board also require offsite mitigation when onsite compliance is not feasible. Notably, NRDC, other environmental groups, and all of the permittees in Ventura County *supported* these provisions. During the South Orange County permit workshop held on May 6, staff provided

some indication that further modifications of the permit would be forthcoming to make it both clearer and consistent with the federal MEP standard. We strongly encourage this direction.[1]

II. Summary of Comments.

Our concerns relate to various components of the Tentative Order, most notably the Development Planning Component and its LID provisions. Summarized below are the areas that need particular attention:

- The Tentative Order lacks a clear performance standard—tied to onsite retention of stormwater—that requires robust implementation of LID techniques;
- The Tentative Order contains unlawfully vague and general new development and redevelopment provisions;
- The control measures included in the Development Planning Component do not meet the "maximum extent practicable" ("MEP") standard of the Clean Water Act, especially given other stormwater control measures being implemented in California and around the U.S.;
- The control measures in the Tentative Order do not constitute "best management practices," as required by law;
- The Tentative Order would allow unlawful waivers from hydraulic sizing criteria and does not adequately require mitigation for non-complying projects;

[1] The changes reflected in the May 5, 2009 errata sheet ("Tentative Updates") move the Tentative Order toward the type of numeric performance standard that is necessary for LID implementation. However, various problems remain and need to be addressed. First, revised Section F.1.d.(4)(c) does not clearly require onsite retention (through infiltration, harvesting and reuse, or evapotranspiration) and states only that LID BMPs must "capture" the design storm volume. The word "capture" should be replaced with "retain onsite." Furthermore, several of the BMPs described as "LID" BMPs are not, in fact, LID BMPs and should not count toward LID obligations. The new provision also requires conventional treatment control (pursuant to Section F.1.d.(6)) for "[a]ny volume, over and above the design capture volume, that is not captured by the LID BMPs." This makes little sense, however, because the design capture volume for LID BMPs is exactly the same as the treatment control volume of Section F.1.d.(6), so we cannot understand when this treatment provision would ever apply and it muddies the requirement. Overall, these changes are a step in the right direction, but the provision requires clarification and revision to serve as an appropriate and legally adequate numeric performance standard. We have commented in this letter only on the previously noticed version of the Tentative Order because the errata sheet implies that its changes are not yet intended to be incorporated into the Tentative Order.

- The Tentative Order precludes meaningful Regional Board and public review of critical aspects of the Permit;

- The hydromodification provisions are inadequate to prevent adverse geomorphological changes;

- The Tentative Order's applicability criteria for the Development Planning Component must be significantly lowered to meet the MEP standard;

- The Tentative Order needs to clarify that waste load allocations from adopted TMDLs are enforceable Permit limitations and/or will be included in the Permit;

- The Tentative Order allows the discharge of pollutants from new dischargers and sources;

- The Tentative Order fails to prohibit all non-stormwater discharges; and

- The Permit application does not include an assessment of the likely effectiveness of the control measures imposed.

All of these problems need to be addressed before the Tentative Order will pass legal muster under the Clean Water Act and effectively move South Orange County toward compliance with water quality standards.

III. Standards Governing the Adoption of the Tentative Order by the Regional Board.

In considering the Tentative Order, the Regional Board must not only ensure compliance with substantive legal standards, but it must also ensure that it complies with well-settled standards that govern its administrative decision-making. The Tentative Order must be supported by evidence that justifies the Regional Board's decision to include, or not to include, specific requirements. The Regional Board would be abusing its discretion if the Tentative Order ultimately fails to contain findings that explain the reasons why certain control measures and standards have been selected and others omitted. Abuse of discretion is established if "the respondent has not proceeded in the manner required by law, the order or decision is not supported by the findings, or the findings are not supported by the evidence." (Cal. Code Civ. Proc. § 1094.5(b); *see also Zuniga v. Los Angeles County Civil Serv. Comm'n* (2006) 137 Cal.App.4th 1255, 1258 (applying same statutory standard).) "Where it is claimed that the findings are not supported by the evidence, … abuse of discretion is established if the court determines that the findings are not supported by the weight of the evidence." (*Phelps v. State Water Resources Control Bd.* (2007) 157 Cal.App.4th 89, 98-99.)

The administrative decision must be accompanied by findings that allow the court reviewing the order or decision to "bridge the analytic gap between the raw evidence and ultimate decision or order." (*Topanga Ass'n for a Scenic Cmty. v. County of Los Angeles* (1974) 11 Cal.3d 506, 515.) This requirement "serves to conduce the administrative body to draw

legally relevant sub-conclusions supportive of its ultimate decision … to facilitate orderly analysis and minimize the likelihood that the agency will randomly leap from evidence to conclusions." (*Id.* at 516.) "Absent such roadsigns, a reviewing court would be forced into unguided and resource-consuming explorations; it would have to grope through the record to determine whether some combination of credible evidentiary items which supported some line of factual and legal conclusions supported the ultimate order or decision of the agency." (*Id.* at 517 n.15.) Currently, the Tentative Order's provisions are not supported by the necessary evidence, as discussed below, and the Regional Board has failed to explain its decision not to adopt control measures and standards that have been adopted by other jurisdictions and proven by scientific studies to be more effective than the control measures and standards in the Tentative Order. The lack of substantial evidence to support the Tentative Order renders it unlawful. (*See, e.g.*, *Bangor Hydro-Elec. Co. v. F.E.R.C.* (D.C. Cir. 1996) 78 F.3d 659, 664.)

IV. The Tentative Order is Inadequate to Control Stormwater Pollution from New Development and Redevelopment and Fails to Ensure Compliance with the Minimum Requirements of State and Federal Law.

The Tentative Order's Development Planning Component remains legally inadequate and is not based on the evidence in the record before the Regional Board. As currently written, the Tentative Order does not require any specific level of LID implementation and would, as explained below, essentially allow the Copermittees to regulate themselves and to grant wholesale waivers of otherwise universally applicable SUSMP sizing criteria. There is no stated analysis that supports the staff's proposals or provides even a general assessment of the water quality impact of the proposed approach. Furthermore, the Tentative Order's Development Planning Component fails to address the known water quality problems that staff articulate in the Fact Sheet (See, e.g., Revised Fact Sheet for Tentative Order 2008-001, at 26) and falls well below many other stormwater permits and regulatory documents around the country. In all of these respects, staff have failed to adequately respond to the issues raised when the last draft of the Permit was rejected by the Regional Board, and the revisions in the current draft do not address the fundamental weaknesses of the Tentative Order.

The Development Planning Component is particularly critical for addressing the root causes of stormwater pollution, which is why we have focused significant attention in our comments here and in our previous letter on these requirements. As the U.S. EPA has noted:

> Most stormwater runoff is the result of the man-made hydrologic modifications that normally accompany development. The addition of impervious surfaces, soil compaction, and tree and vegetation removal result in alterations to the movement of water through the environment. As interception, evapotranspiration, and infiltration are reduced and precipitation is converted to overland flow, these modifications affect not only the characteristics of the developed site but also the watershed in which the development is located. Stormwater has been identified as one of the leading sources of pollution for all waterbody types in the United

States. Furthermore, the impacts of stormwater pollution are not static; they usually increase with more development and urbanization.[2]

A. The Standard of Practice in the U.S. Requires the Imposition of Low Impact Development Techniques Implemented with Clear Metrics for New Development and Redevelopment Activities.

LID has been established as a *superior and practicable* strategy[3] and, therefore, must be required. Accordingly, the United States Environmental Protection Agency ("EPA") has called upon Regional Boards across California to prioritize the implementation of LID, recently threatening to "consider objecting to the [San Francisco Bay region's] permit" if it does not include "additional, prescriptive requirements" for LID.[4] Along with the prioritization of LID implementation, "EPA's primary objective for incorporating LID into renewed MS4 permits, especially for those that represent the third or fourth generation of permits regulating these discharges, is that the permit must include clear, measurable, enforceable provisions for implementation of LID…. [P]ermit[s] should [also] include a clearly defined, enforceable process for requiring off-site mitigation for projects where use of LID design elements is infeasible."[5] In North Orange County, EPA likewise observed that "the permit must include clear, measurable, enforceable provisions for implementation of LID…. We would not support replacing [volume retention-based] approaches with qualitative provisions that do not include measurable goals."[6]

Other government agencies in California and around the U.S. have come to the same conclusions. The California Ocean Protection Council, for instance, strongly endorsed LID last year by "resolv[ing] to promote the policy that new developments and redevelopments should be designed consistent with LID principles" because "LID is a practicable and superior approach … to minimize and mitigate increases in runoff and runoff pollutants and the resulting impacts on downstream uses, coastal resources and communities."[7] In Washington State, the Pollution

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[2] U.S. Environmental Protection Agency (December 2007) *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, at v.

[3] California Ocean Protection Council (May 15, 2008) *Resolution of the California Ocean Protection Council Regarding Low Impact Development*, at 2.

[4] Letter from Douglas E. Eberhardt, EPA, to Dale Bowyer, San Francisco Bay Regional Water Quality Control Board (April 3, 2009), at 1.

[5] *Id.* at 1-2.

[6] Letter from Douglas E. Eberhardt, EPA, to Michael Adackapara, Santa Ana Regional Water Quality Control Board (February 13, 2009), at 2-3.

[7] California Ocean Protection Council (May 15, 2008) *Resolution of the California Ocean Protection Council Regarding Low Impact Development*, at 2.

Control Hearings Board has found that LID techniques are technologically and economically feasible and must, therefore, be required in MS4 permits.[8] The National Academy of Sciences recently issued a comprehensive report with the same recommendation for stormwater management programs: "Municipal permittees would be required under general state regulations to make [LID] techniques top priorities for implementation in approving new developments and redevelopments, to be used unless they are formally and convincingly demonstrated to be infeasible."[9]

Critically, as demonstrated in the EPA comments quoted above, the prioritization of LID practices is insufficient by itself to meet the MEP standard and *must* be paired with a measurable requirement for the implementation of LID. Since its inception, the MS4 permitting program has been seriously hampered by a pervasive absence of numeric performance standards for the implementation of best management practices ("BMPs") such as LID. For this reason, in December 2007, the State Water Resources Control Board commissioned a report which found that "[t]he important concept across all of [the] approaches [described in the report] is that the regulations established a *performance requirement* to limit the volume of stormwater discharges."[10] The report also noted that "[m]unicipal permits have the standard of Maximum Extent Practicable (MEP) which lends itself more naturally to specifying and enforcing a level of compliance for low impact development."[11] Another study, completed for the Ocean Protection Council, recommended the following standard: "Regulated development projects shall reduce the percentage of effective impervious area to less than five percent of total project area by draining stormwater into landscaped, pervious areas."[12]

While we appreciate the fact that the Tentative Order does require some undefined level of LID implementation unless the Copermittee makes a finding of infeasibility, the Tentative Order remains legally insufficient due to the lack of a numeric performance requirement for LID,

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[8] *Puget Soundkeeper Alliance et al. v. State of Washington, Dept. of Ecology, et al.* (2008) Pollution Control Hearings Board, State of Washington, No. 07-021, 07-026, 07-027, 07-028, 07-029, 07-030, 07-037, Phase I Final, at 6, 46, 57-58.

[9] National Academy of Sciences, Committee on Reducing Stormwater Discharge Contributions to Water Pollution, National Research Council (2008) *Urban Stormwater Management in the United States*, at 500.

[10] State Water Resources Control Board (December 2007) *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption*, at 23 (emphasis added) (hereinafter "SWRCB LID Report").

[11] *Id.* at 4.

[12] Ocean Protection Council of California (January 2008) *State and Local Policies Encouraging or Requiring Low Impact Development in California*, at 27.

the availability of all-encompassing waivers from treatment standards, the improper placement of and failure to define the Tentative Order's 5% "effective impervious area" ("EIA") limitation, and the ill-conceived nature of other provisions. These problems with the Development Planning Component, elaborated below, need to be remedied before the Tentative Order will meet the Clean Water Act's MEP standard for pollutant reduction.

B. The New Draft of the Tentative Order Does Not Contain—Nor Does it Justify the Lack of—Specific Standards for LID Implementation, which Rendered the Previous, Rejected Draft of the Permit Unapprovable.

As noted in our January 24, 2008, letter, which we incorporate by reference herein, the previous draft of the Tentative Order was rife with vague and unenforceable provisions.[13] Some of these provisions have been improved in the new draft, but many remain unacceptable. This is particularly problematic where the Tentative Order fails to establish the necessary numeric performance standards which would ensure that the most effective, pollution-reducing BMPs—*i.e.*, LID practices—are implemented to the maximum extent practicable.[14]

These flaws are all the more apparent because they stand in contrast to recently adopted LID requirements for Ventura County, adopted on May 7, 2009, by the Los Angeles Regional Water Quality Control Board. The new Ventura County MS4 permit requires that 95% of the volume from the 85th percentile storm be retained onsite through infiltration, harvesting and reuse, or evapotranspiration. If full onsite management of the design storm volume is technically infeasible, the retention obligation may be reduced, but offsite mitigation with equivalent results must be performed (or funds must be contributed to a public mitigation fund in an amount sufficient to offset the project's onsite non-compliance).[15] Notably, this requirement resulted from a collaboration and agreement between NRDC, Heal the Bay, and all of the Ventura County permittees. This is the type of performance standard that is lacking in the Tentative Order.

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[13] Letter from NRDC to John Robertus, San Diego Regional Water Quality Control Board (January 24, 2008) (hereinafter "January 24th Letter").

[14] We have recommended the establishment of a 3% EIA limitation, based on watershed science and the research of national stormwater expert, Dr. Richard Horner. Currently, the Tentative Order does not include an EIA limitation for LID implementation—it does, however, include a 5% EIA limitation as an "interim requirement" to address hydromodification. As explained below, this is not the appropriate use of an EIA limitation, and the Tentative Order, furthermore, does not include a definition of EIA that would require the proper implementation of this type of numeric performance standard.

[15] Los Angeles Regional Water Quality Control Board (May 7, 2009), Ventura County Municipal Separate Storm Sewer System Permit, Order No. 09-xxx, NPDES Permit No. CAS004002, ¶ 5.E.III.

1. The Development Planning Component's Provisions Remain Unlawfully Vague and General.

The Tentative Order's LID provisions are still a collection of largely hortatory provisions with no specific measurable outcome. Unfortunately, even the vast majority of the revisions to the Development Planning Component fall into this category, requiring only "assessments" of LID practices or applying LID requirements only "where applicable and feasible." Narrative and subjective terms are, thus, still prominent, *e.g.*: "The following LID BMPs … shall be implemented … *where applicable and feasible*," (Tentative Order ¶ F.1.c.(2)), "Buffer zones for natural water bodies, *where feasible*," (Tentative Order ¶ F.1.c.(3)), "*Where feasible*, landscaping with native or low water species shall be preferred," (Tentative Order ¶ F.1.c.(7)), "The review … must include an *assessment* of techniques to infiltrate, filter, store, evaporate, or detain runoff," (Tentative Order ¶ F.1.d.(4)(a)(iv)), "*[W]here feasible* the Copermittee must take appropriate actions," (Tentative Order ¶ F.1.d.(4)(a)(vi)), "[D]rain *a portion* of impervious areas," (Tentative Order ¶ F.1.d.(4)(b)(ii)), etc. Such vague provisions would not enable the Regional Board or the Copermittees to measure the outcomes of, or to enforce, the Tentative Order's requirements since implementation could vary enormously.

2. The Tentative Order Needs Revision to Establish an Onsite Retention Standard that Will Guide the Implementation of LID Practices.[16]

The Tentative Order fails to set a specific numeric performance standard for the implementation of LID at Priority Development Projects. As a result, provided that a project installs some *de minimis* LID features, it would comply with the Tentative Order. In effect, LID features would not have to be sized to accommodate any meaningful quantity of stormwater. This is completely contrary to the exhortations of expert agencies and scientists, as described above, or the standard now adopted by the Los Angeles Regional Water Quality Control Board for Ventura County.

[16] We advocate the implementation of LID practices because LID practices retain stormwater onsite through infiltration, harvesting and reuse, or evapotranspiration, thus ensuring that pollutant loads do not reach receiving waters. Others have advanced interpretations of "LID" that include the use of treat-and-discharge systems—these systems are not as effective as retention practices because the discharged water may still contain pollution, even if it is significantly attenuated. Our interpretation of "LID" is consistent with the U.S. EPA's: "LID comprises a set of approaches and practices that are designed to reduce runoff of water and pollutants from the site at which they are generated. By means of infiltration, evapotranspiration, and reuse of rainwater, LID techniques manage water and water pollutants at the source and thereby prevent or reduce the impact of development on rivers, streams, lakes, coastal waters, and ground water." U.S. Environmental Protection Agency (December 2007) *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, at iii.

The specific provisions that fail to establish the necessary, numeric performance standard are the "Low Impact Development Site Design BMP Requirements," which were revised in the current draft. (Tentative Order ¶ F.1.d.(4)(a).) These provisions merely state that "[e]ach Copermittee must require LID storm water practices or make a finding of infeasibility for each Priority Development Project." (Tentative Order ¶ F.1.d.(4)(a)(i).) Nowhere in this section, however, or anywhere in the Development Planning Component is there a requirement that establishes a level of implementation for LID practices. Indeed, the closest thing to a numeric performance standard is the section on "Treatment Control BMP Requirements," which merely mirrors the SUSMP criteria of the State Board's *Bellflower* decision.[17] (Tentative Order ¶ F.1.d(6).) These are not referenced or included as a numeric performance standard in the LID provisions, though, which contain instead the various vague requirements listed above. In terms of requiring onsite retention through LID implementation, the Tentative Order is far from meeting the MEP standard because the Tentative Order merely mandates that "[t]he review of each Priority Development Project must include an assessment of techniques to infiltrate, filter, store, evaporate, or detain runoff close to the source of runoff." (Tentative Order F.1.d.(4)(a)(iv).) This amounts to no requirement at all for onsite retention.

The Tentative Order should state:

> *Copermittees must require that each Priority Development Project retain onsite—through infiltration, evapotranspiration, or harvesting and reuse—the design storm volume listed in Section F.1.d.(6)(a)(i).*

Onsite retention standards of this form are becoming prevalent across the country, as discussed below, and since their implementation is not only feasible, but will result in better stormwater pollution reduction, the Permit cannot meet the Clean Water Act's MEP standard without such a performance requirement. As currently written, the Tentative Order's provisions do no more than encourage the implementation of some, non-hydraulically-sized LID features—just as the last draft of the permit did.

At Priority Development Projects where the traditional SUSMP hydraulic sizing criteria are waived (a major problem with the Tentative Order, discussed below), moreover, *no* BMPs have to be properly sized to treat stormwater runoff, so—once again—*de minimis* implementation of stormwater BMPs (not even necessarily LID) arguably would satisfy the Tentative Order's requirements. This is a nonsensical and unworkable structure, and it is an unlawful result for all of the reasons identified in this letter and previously outlined in our January 24th Letter.

Overall, the few LID treatment measures listed above and included in the Tentative Order do not fix the Tentative Order's lack of specific LID implementation parameters. While NRDC and EPA both highlighted this problem during the last round of comments on the Tentative

[17] State Water Resources Control Board (2000) Water Quality Order No. 2000-11, at 15-18.

Order,[18] Regional Board staff have not adequately revised the Tentative Order to address this paramount concern. Instead, nearly everything is left to the discretion of the Copermittees, which violates federal law, as discussed below.[19]

C. The Tentative Order's Post-Construction Provisions Do Not Meet the Clean Water Act's "Maximum Extent Practicable" Standard for Stormwater Pollution Reduction.

Our previous comment letter discussed various failings of the Tentative Order that prevent it from meeting the MEP standard. Little has changed from the prior draft of the Tentative Order, unfortunately, and the Tentative Order's Development Planning Component provisions are still far from legally adequate.

1. The MEP Standard Requires that the Tentative Order Impose Far More Stringent Stormwater Control Measures and Performance Criteria.

Section 402(p) of the Clean Water Act establishes the MEP standard as a requirement for pollution reduction in stormwater permits. (33 U.S.C. § 1342(p)(3)(B)(iii).) Regional Board staff have failed to implement this standard effectively, and currently the Permit does little more than pay lip service to superior stormwater management practices commonly implemented around the country. Nonetheless, "the phrase 'to the maximum extent practicable' does not permit unbridled discretion. It imposes a clear duty on the agency to fulfill the statutory command to the extent that it is feasible or possible." (*Defenders of Wildlife v. Babbitt* (D.D.C. 2001) 130 F.Supp.2d 121, 131 (internal citations omitted); *Friends of Boundary Waters Wilderness v. Thomas* (8th Cir. 1995) 53 F.3d 881, 885 ("feasible" means "physically possible").) As one state hearing board held:

> [MEP] means to the fullest degree technologically feasible for the protection of water quality, except where costs are wholly disproportionate to the potential benefits…. This standard requires more of permittees than mere compliance with water quality standards or numeric effluent limitations designed to meet such standards…. The term "maximum extent practicable" in the stormwater context implies that the mitigation measures in a stormwater permit must be more than simply adopting standard practices. This definition applies particularly in areas where standard practices are already failing to protect water quality….

(*North Carolina Wildlife Fed. Central Piedmont Group of the NC Sierra Club v. N.C. Division of Water Quality* (N.C.O.A.H. October 13, 2006) 2006 WL 3890348, Conclusions of Law 21-22 (internal citations omitted).) The North Carolina board further found that the permits in question violated the MEP standard both because commenters highlighted measures that would reduce

[18] E-mail from Eugene Bromley, EPA, to Jeremy Haas, San Diego Regional Water Quality Control Board (January 24, 2008), at 1-2.

[19] *See* section II.F of our January 24th Letter regarding impermissible self-regulatory systems.

pollution more effectively than the permits' requirements and because other controls, such as infiltration measures, "would [also] reduce discharges more than the measures contained in the permits." (*Id.* at Conclusions of Law 19.)

Similarly, in South Orange County, an onsite retention standard based on the effective impervious area of a site would be a technologically feasible approach that would reduce stormwater discharges and pollution far more than the non-specific measures contained in the Tentative Order.[20] We have even called to the Regional Board's attention an EPA study which found that LID practices are frequently *less costly* than conventional stormwater BMPs.[21] Regional Board staff have offered no justification for ignoring our and EPA's comments regarding the need for a specific, enforceable, numeric performance standard and no evidence that meeting our proposed onsite retention standard of 3% EIA would be infeasible, assuming that—as we have suggested—the Tentative Order includes an appropriate infeasibility provision tied to a technically equivalent alternative compliance requirement. Indeed, the Tentative Order's inclusion of a 5% EIA limitation (albeit inadequately defined) for hydromodification purposes strongly implies that Regional Board staff, too, believe that this standard could be feasibly implemented in South Orange County.

2. Other Stormwater Permits and Regulatory Documents Around the Country Have Adopted Stronger, Practicable Requirements for the Implementation of Post-Construction Stormwater BMPs, and the Tentative Order—with No Justification—Lags Far Behind these Precedents.

In the years since the last iteration of the South Orange County Permit, stormwater treatment technology has metamorphosed. In addition to new, clear, effective LID requirements adopted by the Los Angeles Regional Water Quality Control Board, summarized below, communities around the country have adopted or are considering provisions that far exceed those in the draft permit in terms of clarity and environmental performance. The Development Planning Component, as currently drafted, however, differs little in substance from—and scarcely accomplishes more than—the last iteration of the Permit and merely includes hortatory language regarding the implementation of LID. (*Compare* Revised Tentative Order 2008-001 (December 12, 2001) ¶ D.1. *with* Tentative Order ¶ F.1.) The Tentative Order could allow significant portions of the stormwater that falls on a site to be treated with relatively ineffective BMPs before flowing to receiving waters. The widespread implementation of other far more stringent requirements listed below—as well as the technical analyses conducted by Dr. Horner,

[20] R. Horner, *Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices ("LID") for Ventura County* (February 2007); R. Horner, *Investigation of Low-Impact Site Design Practices for the San Diego Region* (2008).

[21] U.S. Environmental Protection Agency (December 2007) *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, at iv, 2, 27. *See also* ECONorthwest (November 2007) *The Economics of Low-Impact Development: A Literature Review*.

based on other southern California localities, including San Diego County—creates a presumption that such requirements would be practicable in South Orange County.

Many jurisdictions outside of South Orange County have recognized the paramount importance of mandating onsite retention of a certain quantity of stormwater since onsite retention prevents *all* pollution in that volume of rainfall from being discharged to receiving waters:

- **Ventura County:** Retain onsite at least 95% of the rainfall that results from the 85th percentile storm; offsite mitigation is allowed if complete onsite retention is technically infeasible, but offsite mitigation must provide equivalent results and can only substitute for approximately 25% of the onsite retention volume;[22]

- **Anacostia, Washington, D.C.:** Retain onsite the first one inch of rainfall and provide water quality treatment for rainfall up to the two-year storm volume; offsite mitigation is allowed when onsite retention is infeasible, but only at a ratio of either 1:1.5 (for physical offsets) or 1:2 (for in-lieu fee payments);[23]

- **Central Coast, California (RWQCB, Phase II):** Limit EIA at development projects to no more than 5% of total project area (interim criteria); establish an EIA limitation between 3% and 10% in local stormwater management plans (permanent criteria);[24]

- **Federal Buildings over 5,000 square feet** (under EPA's draft guidance for implementation of the Energy Independence and Security Act of 2007): Manage onsite (*i.e.*, prevent the offsite discharge of) the 95th percentile storm through infiltration, harvesting, and/or evapotranspiration;

- **Pennsylvania:** Capture at least the first two inches of rainfall from all impervious surfaces and retain onsite at least the first one inch of runoff (through reuse, evaporation, transpiration, and/or infiltration); at least 0.5 inches must be infiltrated;[25]

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[22] Los Angeles Regional Water Quality Control Board, Order No. 09-xxx, NPDES No. CAS 004002, (adopted May 7, 2009), at ¶ III.1-2 (New Development/Redevelopment Performance Criteria).

[23] Anacostia Waterfront Corporation (June 1, 2007) Final Environmental Standards, at 16; *See also*, State Water Resources Control Board (December 2007) A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption, at 20-21.

[24] Central Coast Regional Water Quality Control Board, Letter from Roger Briggs re Notification to Traditional, Small MS4s on Process for Enrolling under the State's General NPDES Permit for Storm Water Discharges (Feb. 15, 2008) (hereinafter "Central Coast Phase II Letter").

[25] Pennsylvania Department of Environmental Protection (December 30, 2006) *Pennsylvania Stormwater Best Management Practices Manual*, Chapter 3, at 7.

- **Philadelphia, PA:** Infiltrate the first one inch of rainfall from all impervious surfaces; if onsite infiltration is infeasible, the same performance must be achieved offsite;[26] and

- **West Virginia:** Retain onsite the first one inch of rainfall from a 24-hour storm preceded by 48 hours of no measurable precipitation.[27]

Other Phase I MS4 permits within California (beyond the abovementioned Ventura County MS4 permit), despite their problems, are also heading in this direction. The North Orange County draft permit, for instance, establishes a hierarchy of options (from onsite to regional systems) that each require onsite retention—or biofiltration through LID[28]—of the 85th percentile design storm volume.[29] With such precedents in California and in other parts of the country, the Tentative Order's failure to adopt a numeric performance standard beyond the bare-bones SUSMP hydraulic sizing criteria is particularly remarkable. The decision to waive these bare-bones criteria without even requiring offsite mitigation, as discussed below, evidences an even more flagrant disregard for the MEP standard.

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[26] City of Philadelphia, Philadelphia Stormwater Regulations § 600.5; City of Philadelphia (2006) *Philadelphia Stormwater Management Guidance Manual: Version 2.0,* at 1-1, Appendix F.4.1.

[27] State of West Virginia (December 11, 2008) Department of Environmental Protection, Division of Water and Waste Management, Draft General National Pollution Discharge Elimination System Water Pollution Control Permit, NPDES Permit No. WV0116025 at 13-14 (hereinafter "West Virginia Draft Permit").

[28] We have supported a retention-based standard in North Orange County, whose latest draft permit would allow biofiltration through LID features to satisfy the permit's water quality requirements for new development and redevelopment projects if infiltration, evapotranspiration, and reuse were all infeasible. We do not support the inclusion of biofiltration as one of the permissible means of meeting the performance standard and would urge that offsite mitigation be required whenever any portion of the design storm volume is discharged (after appropriate biofiltration).

[29] Santa Ana Regional Water Quality Control Board (May 1, 2009) Draft Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and The Incorporated Cities of Orange County within the Santa Ana Region Areawide Urban Storm Water Runoff, Order No. R8-2009-0030, NPDES Permit No. CAS618030, at 53-54.

D. The Tentative Order's Site Design Provisions Cannot Be Considered "Best Management Practices" Under the Clean Water Act.

As detailed in our January 24th Letter, the provisions of the Tentative Order, which remain largely unchanged from previous drafts, are insufficient to constitute "best management practices" ("BMPs"), as required by the Clean Water Act. To reiterate our comments briefly, the Tentative Order, at most, sets forth ideas around which a proposed management program and articulated BMPs could be developed, which is required in the *application* for an MS4 permit. (*See* 40 C.F.R. § 122.26.) Missing are the actual BMPs and accompanying performance standards that must be described in the Tentative Order. The closest the Tentative Order comes to identifying actual BMPs is the list of general LID design practices in Section F.1.d.(4)(b). (Tentative Order ¶ F.1.d.(4)(b).) However, these design measures need not be hydraulically sized to treat any particular amount of stormwater. This is tantamount to no requirement at all and does not satisfy EPA's counsel that, among other components, BMPs must be attached to measurable goals that include "a quantifiable target to measure progress toward achieving the activity or BMP."[30] As the examples from EPA's guidance document—included in our January 24th Letter—highlight, merely outlining a general technique with no quantifiable requirement for implementation does not satisfy the Clean Water Act's mandates.

The State Water Board has also voiced its support for establishing numeric requirements that apply to stormwater BMPs, stating that, "[t]he addition of measurable standards for designing the BMPs provides additional guidance to developers and establishes a clear target for the development of the BMPs."[31] Despite pointing out the necessity of such targets to the Regional Board in our last comment letter, the Tentative Order's site design requirements still fail to include more than a requirement for some undetermined amount of LID implementation. As a result, the provisions of the Tentative Order fail to satisfy EPA regulations and guidance and are invalid under the Clean Water Act.

E. The Tentative Order's Waiver Provisions Would Allow Unlawful Exemptions from Hydraulic Sizing Criteria, Fail to Require Mitigation for Non-Complying Projects, and Will Not Ensure Meaningful Reduction of Pollution from Sites that Receive Waivers.

The Tentative Order's waiver section sets forth a skeletal process for allowing projects not to comply with the Permit's already lacking requirements whenever Copermittees deem compliance "infeasible," yet this section would not require any equivalent performance through offsite mitigation or maximize the implementation of stormwater management practices, as required by the MEP standard. Indeed, there are no criteria established by the Tentative Order to determine what constitutes "infeasibility" that would allow for waivers, and there is no evidence

[30] U.S. EPA, NPDES: Part 2. Process for Developing Measurable Goals Under a General Permit (October 30, 2007).

[31] State Water Resources Control Board (2000) Water Quality Order No. 2000-11, at 17.

in the record to demonstrate that any sites are incapable of meeting the barebones SUSMP sizing criteria. We suggest instead the establishment of an *onsite retention* standard, such as 3% EIA, with the option for *onsite treatment* paired with *offsite mitigation* in situations of technical infeasibility. This type of standard has been adopted in wide-ranging locations around the US, including last week in Ventura County, as mentioned above, and we have submitted expert reports analyzing its feasibility in various locations around California.[32] The waiver section provides the perfect opportunity to adopt far more robust and appropriate requirements regarding offsite mitigation when onsite compliance is infeasible, but despite facts in the record to support such requirements, the Tentative Order has created a blanket waiver of the state-law-backstop hydraulic sizing criteria without even addressing why this is necessary.

1. The Tentative Order's Waiver Provisions Contravene Federal and State Law and Are Ill-Conceived.

Through the waiver provision, Priority Development Projects can receive a waiver from "the requirement of implementing treatment BMPs with numeric sizing criteria if infeasibility can be established." (Tentative Order ¶ F.1.d.(7).) Projects receiving waivers must consider all available treatment BMPs;[33] however, because the Tentative Order does not define infeasibility, the determination of what is infeasible is left entirely to the Copermittees, which amounts to impermissible self-regulation, as discussed in this letter and in our previous comment letter. In other words, the Tentative Order, as written, could allow qualifying projects to install treatment systems that are incapable of handling more than one milliliter of rainfall, yet this would constitute compliance with the Tentative Order. No offsite mitigation would be required because the waiver provision leaves it to the discretion of the Copermittees to "collectively or individually develop a program [for] a storm water mitigation fund." (Tentative Order ¶ F.1.d.(7)(b).) This is an unlawful result.

Federal law and state law require that all Priority Development Projects, some of which would be exempted from hydraulic sizing criteria by the Tentative Order, meet certain minimum standards. Federal regulations mandate that MS4 permits impose requirements to reduce the discharge of stormwater pollution from new development and redevelopment projects. (40 C.F.R. § 122.26.) The State Water Board—through the *Bellflower* decision—has gone further and established the SUSMP hydraulic sizing criteria as a compliance floor for all Priority Development Projects.[34] A permit cannot meet the MEP standard if it does not impose these criteria to reduce stormwater pollution, yet these criteria are exactly what the Tentative Order

[32] *See, e.g.*, R. Horner, *Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices ("LID") for Ventura County* (February 2007); R. Horner, *Investigation of Low-Impact Site Design Practices for the San Diego Region* (2008).

[33] The Tentative Order, problematically, does not even clearly state that all feasible BMPs must be implemented.

[34] State Water Resources Control Board (2000) Water Quality Order No. 2000-11, at 15-18.

waives entirely for projects that meet the Copermittees' own definition of "infeasibility." This is unlawful. Certainly, what constitutes MEP now is not a lesser standard than what constituted MEP nearly a decade ago.

2. The Requirements for Priority Development Projects that Receive Waivers Are Unlawfully Lax.

For projects that receive waivers of hydraulic sizing criteria, the Tentative Order would apparently require no stormwater management at all except perhaps whichever BMPs the Copermittee has—at its own discretion—found to be feasible. (Tentative Order ¶ F.1.d.(7).) As mentioned above, there is no obligation to undertake offsite mitigation because the requirement to contribute funds for offsite mitigation remains at the discretion of the Copermittees; moreover, the offsite mitigation funding option is tied to avoided cost and thus bears no relationship to water quality results. (Tentative Order ¶ F.1.d.(7)(b).) This runs counter to the several nationwide examples cited above, where offsite mitigation is required in proportion to the extent of onsite non-compliance. It also runs counter to U.S. EPA's recent advice on other MS4 permits in California: "We … recognize that there may be situations where achievement of specified volumetric criteria for management of stormwater via LID design elements may be infeasible due to physical site constraints. The permit should include a clearly defined, enforceable process for requiring off-site mitigation for projects where use of LID design elements is infeasible."[35] "[T]he permit could require the retention of stormwater at an offsite location corresponding to 1.5 times the volume which cannot be practically managed via LID."[36]

Without remedying these very substantial deficiencies in the waiver provisions, the Tentative Order would unlawfully allow many Priority Development Projects to do far less than is required to meet the MEP standard. As mentioned elsewhere in this letter, these deficiencies also hamstring the Tentative Order's ability to move South Orange County toward compliance with water quality standards in the area's many impaired watersheds. We strongly urge the Regional Board to redraft the Permit such that all Priority Development Projects must meet an onsite retention-based, numeric performance standard (*e.g.*, 3% EIA, properly defined) and, where onsite compliance is technically infeasible, provide offsite mitigation that achieves at least equivalent water quality results (*e.g.*, require the contribution of in-lieu funds sufficient to retain 1.5 times the design storm volume not retained onsite).

[35] Letter from Douglas E. Eberhardt, EPA, to Dale Bowyer, San Francisco Regional Water Quality Control Board (April 3, 2009), at 2.

[36] Letter from Douglas E. Eberhardt, EPA, to Tracy Woods, Los Angeles Regional Water Quality Control Board (April 9, 2009), at 2.

F. The Tentative Order's Failure to Include Clear Control Measures Unlawfully Precludes Meaningful Review by the Regional Board and by the Public.

As discussed in our previous comment letter, the general lack of guidance and requirements for Regional Board and public review of relevant standards and documents in the Tentative Order's provisions would allow the Copermittees to make essentially all meaningful decisions related to stormwater mitigation by themselves. The particularly important provisions of the Development Planning Component that now fail to require Regional Board and public review include:

- Updates to Local SSMPs to comply with the Permit (F.1.d.);
- Copermittee review of local codes and ordinances to remove barriers to LID implementation (F.1.d.(4)(a)(vi));
- Waivers of numeric sizing criteria (F.1.d.(7)(a));
- Development of programs to require the contribution of funds for offsite mitigation (F.1.d.(7)(b));
- LID Site Design BMP Substitution Programs (F.1.d.(8)); and
- Copermittee requirements in SSMPs or WQMPs that establish hydromodification criteria (F.1.h.).

Under *Environmental Defense Center, Inc. v. U.S. E.P.A.*, the type of self-regulatory system established by the Tentative Order is unlawful, as explained in our January 24, 2008, letter. (*See* 344 F.3d, at 854-56.) To reiterate here, *Environmental Defense Center, Inc.* highlights the legal necessity of public involvement and meaningful regulatory entity review during the permitting process: "[S]tormwater management programs that are designed by regulated parties must, in every instance, be subject to meaningful review by an appropriate regulating entity…. Congress identified public participation rights as a critical means of advancing the goals of the Clean Water Act in its primary statement of the Act's approach and philosophy." (344 F.3d at 856.) The Tentative Order, in contrast, would preclude both because neither the public nor the Regional Board could currently determine what the likely result of the Tentative Order's provisions would be—the meaningful requirements, such as what percentage of a Priority Development Project's stormwater runoff will be treated with LID techniques and how infeasibility will be determined, are left entirely to the discretion of the Copermittees. Thus, the public and the Regional Board have no way to "ensure that each [MS4 permit] program reduces the discharge of pollutants to the maximum extent practicable," as required by *Environmental Defense Center, Inc.* (*Id*.) This must be remedied in subsequent drafts of the Permit.

G. The Hydromodification Provisions Need Revision to Meet the Clean Water Act's MEP Standard and to Ensure that No Adverse Geomorphological Impacts Will Result from Stormwater Discharges.

1. The Interim Hydromodification Control Provisions Establish the Wrong Baseline for Analysis.[37]

The Tentative Order includes three requirements for interim hydromodification control criteria, and project applicants can meet the third requirement through three different means. The first and second of these three means improperly establish the "pre-construction" or "pre-project" condition as the baseline for analysis and comparison. (Tentative Order ¶ F.1.h.(6)(a)(iii).) This standard is acceptable only for new development on land that has remained in its natural state until the time of construction, but it is wholly unacceptable for infill and redevelopment projects where the land has already been developed.

Because of the prevalence of now-antiquated stormwater management practices that focused on peak flow and not on matching discharge rates and durations, *pre-construction* or *pre-project* rates and durations for infill and redevelopment sites will almost always represent measurements that we now want to avoid. Imagine, for example, the redevelopment of a 1950s-era surface parking lot: under the Tentative Order's standard, a developer could comply with the permit by doing essentially nothing to mitigate the effects of hydromodification—after all, a parking lot constructed in the 1950s would shunt all runoff directly to storm drains as rapidly as possible, resulting in the early, high peak flows that are at the root of the hydromodification problem. Nonetheless, under the Tentative Order, this unnatural "pre-construction" or "pre-project" hydrograph would be the standard against which the new project would be measured.

Instead of requiring projects not to exceed pre-construction or pre-project runoff rates and durations, the Tentative Order should require projects not to exceed *pre-development* runoff rates

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[37] While we appreciate the addition of an EIA limitation to the Tentative Order, this standard has been included in the wrong section of the Permit. The purpose of an EIA limitation is to protect water quality through the onsite retention of stormwater, which in turn prevents pollutants from flowing offsite. As an ancillary benefit, meeting a retention-based EIA limitation will undoubtedly help projects achieve hydromodification goals, but the implementation of LID practices through such a standard is not adequate in itself to address hydromodification. As Dr. Mark Gold of Heal the Bay has observed, the LID approach is designed to capture and infiltrate, evapotranspire, or reuse the runoff generated by the 85th percentile storm. This EIA-focused approach will have negligible impact on flows generated by the 10 year, 50 year, or 100 year storms. These larger storms cause severe erosion, sedimentation, and damage to riparian and wetland ecological communities. The EIA limitation should, instead, be written into the LID provisions as a numeric performance standard, and the Permit should clearly describe that only through the proper sizing of retention-based BMPs (infiltration, evapotranspiration, and reuse) can impervious surfaces be considered "disconnected" for the purposes of meeting the EIA limitation.

and durations. This will ensure that hydromodification criteria result in measurable progress and stream geomorphology benefits, rather than the institutionalization of detrimental, antiquated stormwater management practices. Technical experts and other jurisdictions have supported this type of standard. The Southern California Coastal Water Research Project, for instance, suggests that "attempting to have the post-development condition match *pre-development* runoff magnitude and duration should be an initial consideration for all circumstances."[38] And Los Angeles County has implemented the following standard: "Mimic *undeveloped* stormwater and urban runoff rates and volumes in any storm event up to and including the '50-year capital design storm event.'"[39]

To address the technical inadequacy of the Tentative Order's hydromodification provisions, the first and second options under the third interim requirement should be changed to reference "pre-development" conditions as the baseline. (Tentative Order ¶ F.1.h.(6)(a)(iii).) Without this revision, the hydromodification provisions will not meet the MEP standard of the Clean Water Act and will not necessarily ensure the health of aquatic ecosystems and the maintenance of stream geomorphology.

2. <u>The Requirements for Addressing Hydromodification Do Not Establish a Clear Standard for the Copermittees to Meet through their Hydromodification Management Plans.</u>

We remain very concerned about the vagueness of the (non-interim) requirements to address hydromodification, and we incorporate our prior comments here by reference. The revisions to these provisions have failed to establish a clear standard that the Copermittees must implement—the closest the new language comes to establishing such a standard is Section F.1.h.(4)(c), but the Tentative Order does not unequivocally state that maintaining Erosion Potential at 1 is obligatory. The Tentative Order should be rewritten to make this a requirement.

H. The Tentative Order's Applicability Criteria Are Unlawfully Weak and Must Set Significantly Lower Thresholds to Meet the MEP Standard.

The Tentative Order's applicability criteria stand out as exceptionally weak compared to other Phase I MS4 permits in California and must be revised accordingly. The current criteria could hardly be construed as meeting the MEP standard since both the San Francisco Bay and North Orange County Phase I MS4 permits under consideration for adoption, for instance, contain more stringent applicability criteria, generally setting thresholds at 5,000 square feet or,

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[38] SCCWRP, *Managing Runoff to Protect Natural Streams: the Latest Developments on Investigation and Management of Hydromodification in California* (Dec. 2005), at 11 (emphasis added).

[39] Los Angeles County Department of Regional Planning, LID Ordinance (effective Jan. 1, 2009), amending Los Angeles County Code § 12.84.440 (emphasis added).

at most, 10,000 square feet.[40] The particularly problematic thresholds in the Tentative Order are: the catchall of one acre or whatever the Copermittees collectively identify as an equivalent threshold, (Tentative Order ¶ F.1.d.(1)(c)), the residential threshold of 10 or more dwelling units, the commercial and industrial development thresholds of one acre, and the lack of any automotive repair shop size threshold at all. (Tentative Order ¶ F.1.d.(2).) The Permit should set the catchall at or below 10,000 square feet, commensurate with other California MS4 permits and with the significant, cumulative impacts that projects under one acre can have, while specific land uses that generate especially high levels of pollution should be subject to lower thresholds.

V. The Tentative Order Fails to State Explicitly that Waste Load Allocations from Adopted TMDLs Must Be Enforceable Permit Limitations or Will Be Included in the Permit.

TMDLs establish wasteload allocations ("WLAs")—or the maximum amount of a pollutant that each point source discharger may release into a particular waterway—that constitute a form of water quality-based effluent limitation. (*See* 33 U.S.C. 1313(d)(4)(A); 40 C.F.R. § 130.2.) Once a TMDL has been adopted, NPDES permits are required to include WLAs and to contain effluent limitations and conditions consistent with the assumptions and requirements of the TMDL from which they are derived. (40 C.F.R. § 122.44(d)(1)(vii)(B).)

The Regional Board has adopted two TMDLs for the Orange County Permittees: for Indicator Bacteria Project I – Beaches and Creeks in the San Diego Region, and for Indicator Bacteria Baby Beach in Dana Point Harbor and Shelter Island Shoreline Park in San Diego Bay. However, to date, neither has been approved by the State Board, the Office of Administrative Law ("OAL"), or the U.S. EPA. As such, there are no TMDLs currently in effect for Orange County in Region 9.[41] However, the Tentative Order and Fact Sheet state that "[w]ater quality-based effluent limits for storm water discharges have been included within this Order if the TMDL has received all necessary approvals." (Tentative Order Fact Sheet, at 20-21; *see also* Tentative Order, at Finding E.12.) The Tentative Order then states that "[a]dopted TMDLs will be addressed as Cleanup and Abatement Orders (CAOs) subject to approval and adoption by the Regional Board in a public process," (Tentative Order, at Finding E.12), and that the Tentative Order will "incorporate adopted TMDL WLAs as numeric limits on a pollutant by pollutant, watershed by watershed basis. Reduction schedules and monitoring requirements will be inserted into this Order as individual Cleanup and Abatement Orders." (Tentative Order ¶ I.)

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[40] Tentative Order R8-2009-0030, NPDES Permit No. CAS618030, Orange County Draft MS4 Permit, at 47-49; Tentative Order R2-2009-00XX, NPDES Permit No. CAS612008, San Francisco Bay Draft MS4 Permit, at 16-19.

[41] To the extent that the Fact Sheet states that "[n]on storm water dry weather TMDLs have been included in this Order as WQBELs under Section C of the Tentative Order: Non-Storm Water Dry Weather Numeric Effluent Limits," the basis for these numeric effluent limitations should be clearly identified in both the Fact Sheet and Tentative Order. (Tentative Order Fact Sheet, at 21; see discussion on non-stormwater discharges, Section VII, *infra*.)

We believe that a superior approach would be to include the WLAs identified in the two adopted TMDLs in the Permit at adoption, with a provision that the WLAs—as well as any interim or early TMDL requirements based on compliance schedules contained in the TMDLs[42]—are to come into effect for the Copermittees upon completion of the approval process by the State Board, the OAL, and the U.S. EPA. Through inclusion of the WLAs at this stage, the Regional Board can ensure that the permit remains consistent with the assumptions and requirements of the TMDL upon its approval, and that the imposition of adopted WLAs and compliance therewith are clearly identified as a stated condition of the permit. Given that the U.S. EPA has stated that MS4 permits should "explicitly state that the wasteload allocations (WLAs) established by . . . TMDLs are intended to be enforceable permit effluent limitations and that compliance is a permit requirement,"[43] the Tentative Order should be revised to include the adopted TMDLs rather than provide for their delayed incorporation at some unspecified later date.

VI. The Tentative Order Allows the Discharge of Pollutants from New Dischargers and Sources.

Approval of the Tentative Order will authorize the discharge of pollutants to impaired water bodies from "new sources" or "new dischargers" in violation of the CWA's implementing regulations. 40 C.F.R. § 122.4(i) explicitly prohibits discharges from these sources, stating that:

> No permit may be issued:
>
> … (i) To a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards. The owner or operator of a new source or new discharger proposing to discharge into a water segment which does not meet applicable water quality standards or is not expected to meet those standards … and for which the State or interstate agency has performed a pollutants load allocation for the pollutant to be discharged, must demonstrate, before the close of the public comment period, that:
>
> (1) There are sufficient remaining pollutant load allocations to allow for the discharge; and

[42] See Letter from Douglas E. Eberhardt, EPA, to Dale Bowyer, San Francisco Regional Water Quality Control Board (April 3, 2009), at 6 (highlighting importance of including requirements to meet TMDL WLAs and other requirements even if extending beyond the term of the Permit).

[43] Letter from Douglas E. Eberhardt, EPA, to Michael Adackapara, Santa Ana Regional Water Quality Control Board (February 13, 2009), at 3.

> (2) The existing dischargers into that segment are subject to compliance schedules designed to bring the segment into compliance with applicable water quality standards.

(40 C.F.R. § 122.4(i).) Under 40 C.F.R. § 122.2, a "new discharger" is defined as "any building, structure, facility, or installation: (a) From which there is or may be a 'discharge of pollutants;' . . . (c) Which is not a 'new source;' and (d) Which has never received a finally effective NDPES permit for discharges at that 'site.'" (40 C.F.R. § 122.2.) A "new source" is defined as "any building, structure, facility, or installation from which there is or may be a 'discharge of pollutants . . .'" that may be subject to applicable standards of performance under section 306 of the Clean Water Act. (40 C.F.R. § 122.2.) Thus, the Tentative Order may not authorize the development or redevelopment of any building or structure, including, without limitation, a new subdivision, industrial facility, or commercial structure, within the Copermittees' jurisdiction, if runoff from the new discharge adds any pollutant to discharges from the MS4 that "will cause or contribute to the violation of water quality standards" for a water body impaired for that pollutant. Furthermore, the applicant for the permit must prove the availability of any exception to this provision, as set forth above.

In *Friends of Pinto Creek v. U.S. E.P.A.*, the Ninth Circuit Court of Appeals vacated an NPDES permit issued by the U.S. EPA to a new discharger on the grounds that the Copermittees' "discharge of dissolved copper into a waterway that is already impaired by an excess of the copper pollutant" would violate the CWA. ((9th Cir. 2007) 504 F.3d 1007, 1011.) Citing 40 C.F.R. § 122.4(i), the court stated that "[t]he plain language of the first sentence of the regulation is very clear that no permit may be issued to a new discharger if the discharge will contribute to the violation of water quality standards." (*Id*. at 1012.) The court noted that a single exception to this rule exists where a TMDL has been performed, and the "new source can demonstrate that, under the TMDL, the plan is designed to bring the waters into compliance with applicable water quality standards." (*Id.*) Thus, where no TMDL has been completed for a specified water body and pollutant, new discharges that add pollutants that will cause or contribute to a violation of water quality standards are prohibited absolutely. Additionally, the court in *Friends of Pinto Creek* observed that unless a TMDL explicitly provides that existing discharges into the impaired water body are "subject to *compliance schedules* designed to bring the segment into compliance with applicable water quality standards," issuance of a permit for new discharge is also prohibited under 40 C.F.R. § 122.4(i). (*Id*. at 1013.) In effect, a permit for new discharges may not be issued, even when a TMDL for the relevant pollutant exists, unless it firmly establishes that "there are sufficient remaining pollutant load allocations under existing circumstances." (*Id*. at 1012.)

For the reasons set forth above, under the holding of *Friends of Pinto Creek*, the Regional Board is prohibited from approving a permit that allows new sources or dischargers of any pollutant to waterbodies already impaired by that pollutant, unless the Tentative Order demonstrates that an existing TMDL specifically provides sufficient waste load allocations for the discharge.

According to the Fact Sheet, "Multiple water bodies in Orange County have been identified as impaired and placed on the [Federal Clean Water Act] Section 303(d) list" of impaired water bodies, and the "Regional Board has 78 current 303(d) listings for which TMDLs must be . . . developed." (Tentative Order Fact Sheet, at 19.)[44] As the permit identifies under Tables 2a and 2b, receiving waters under the Permit's jurisdiction are impaired for, among other pullutants, bacteria, phosphorous, toxicity, chloride, sulfates, and pesticides. (Tentative Order, Finding C.7.) The Tentative Order explicitly states that "runoff discharges are causing or contributing to water quality impairments, and are a leading cause of impairments in Orange County," (Tentative Order, Finding C.9), and that "runoff discharges continue to cause or contribute to violations of water quality standards as evidenced by the Copermittees monitoring results." (Tentative Order, Finding D.2.b.) Specifically, the Permit states that "the Copermittees' water quality monitoring data . . . documents [sic] persistent violations of Basin Plan water quality objectives for various runoff-related pollutants [including] fecal coliform bacteria, total suspended solids, turbidity, metals, etc." and in some cases "[p]ersistent toxicity." (Tentative Order, Finding C.9; *see also* finding E.11.)

These concerns are elaborated in the 2006 Report of Waste Discharge ("ROWD") for the Copermittees, which states that "[t]hree years of monitoring data show that there is a . . . subset of coastal drains that display persistent exceedences of AB411 standards and for which there is a statistically significant relationship between bacterial indicator levels in drain discharge and [pollution in] the surf zone."[45] The ROWD also demonstrates that California Toxics Rule criteria are exceeded for metals, which may include copper, nickel, and zinc, in both wet and dry weather conditions.[46]

The Tentative Order's findings are further borne out by research that has consistently "identified stormwater runoff as a major contributor to water quality degradation in urbanizing watersheds."[47] Studies have repeatedly shown that "[s]tormwater runoff typically contains dozens of pollutants that are detectable at some concentration," including "sediment, nutrients, metals, hydrocarbons, bacteria and pathogens, organic carbon, MTBE, pesticides, and deicers."[48] In particular, studies show that "[m]icrobial pollution" such as bacteria, protozoa, and viruses "is

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[44] See 2006 CWA Section 303(d) List of Water Quality Limited Segments.

[45] Orange County Watershed and Coastal Resources Division (August 18, 2006) Report of Waste Discharge, at section ROWD 11.0 WQ Monitoring (SDR) 11-17.

[46] Id. at 11-24 – 11-25.

[47] Earl Shaver et al. (2007) *Fundamentals of Urban Runoff Management: Technical and Institutional Issues*, North American Lake Management Society, at 3-46.

[48] Center for Watershed Protection (March 2003) *Impacts of Impervious Cover on Aquatic Systems*, at 55.

almost always found in stormwater runoff;"[49] that "insecticides such as diazinon and malathion were commonly found in surface water and stormwater in urban areas … with urban runoff being the primary transport mechanism into urban streams;"[50] that "zinc, copper and cadmium pollution [were] found in urban runoff;"[51] and, that "cars and other vehicles contributed 75 percent of the total copper load to the lower San Francisco Bay through runoff."[52]

New discharges will only increase the mass of these pollutants entering impaired receiving waters. In fact, the Tentative Order explicitly acknowledges that "[d]evelopment and urbanization increase pollutant loads and volume," (Tentative Order, Finding D.2.g), and that "[u]rban development creates new pollution sources as human population density increases and brings with it proportionately higher levels of car emissions, car maintenance wastes, municipal sewage, pesticides, household hazardous wastes, pet wastes, trash, etc." (Tentative Order finding C.11.) These conclusions are echoed by the U.S. EPA, which states that "the impacts of stormwater pollution are not static; they usually increase with more development and urbanization."[53]

As no TMDLs have been adopted and formally approved by the State Board and U.S. EPA for South Orange County, any water bodies in the region identified by the Regional Board and U.S. EPA as impaired by pollutants, including bacteria, pesticides, phosphorous, toxicity, chlorides, or sulfates, are not subject to a TMDL with mandated compliance schedules. Any new discharge of these pollutants to such a water body resulting from increased urbanization would violate the terms of 40 C.F.R. § 122.4(i) and the court's holding in *Friends of Pinto Creek.* Such discharges must be prohibited.

Even if a TMDL adopted by the Regional Board were to come into effect during the term of the Tentative Order, following the court's holding in *Friends of Pinto Creek*, the permit could allow new dischargers or sources of pollutants to be approved only in the event that the applicable TMDL explicitly establishes that (1) existing discharges into the impaired water body are "subject to *compliance schedules* designed to bring the segment into compliance with applicable water quality standards," and (2) additional allocations are available for the specified water body. (*Friends of Pinto Creek*, 504 F.3d at 1013.) Absent an approved TMDL in effect

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[49] *Id*. at 3-49.

[50] Earl Shaver et al. (2007) *Fundamentals of Urban Runoff Management: Technical and Institutional Issues*, North American Lake Management Society, at 3-54.

[51] Earl Shaver et al. (2007) *Fundamentals of Urban Runoff Management: Technical and Institutional Issues*, North American Lake Management Society, at 3-48.

[52] NRDC, *Stormwater Strategies: Community Responses to Runoff Pollution*, at Chapter 2, *available at* http://www.nrdc.org/water/pollution/storm/stoinx.asp.

[53] U.S. Environmental Protection Agency (December 2007) *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, at v.

for a specific waterbody and meeting these conditions, there is no authority for the Regional Board to issue the Tentative Order. In order to be lawful, the Tentative Order must establish measures to ensure that stormwater discharges, from existing or future sources, do not cause or contribute to identified impairments, and the Tentative Order has not done so.

We stress that these concerns highlight the need for the Tentative Order to contain both clearly articulated performance standards for LID-based retention of stormwater onsite and strict limitations on the use of alternative compliance measures in order to address water quality problems associated with urban runoff. One critical means of ensuring that runoff from new sources or dischargers will not contribute additional pollutants to an impaired waterbody is to mandate the proper implementation of LID practices through the imposition of either an EIA standard or an equivalent onsite-retention standard.

VII. The Tentative Order Fails to Include Provisions that Effectively Prohibit all Non-Stormwater Discharges, as Required by the Clean Water Act.

A. The Tentative Order Is Inconsistent with the Clean Water Act and Regulations.

Federal law requires that MS4 permits "shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers." (33 U.S.C. § 1342(p)(3)(B)(ii).) However, the Tentative Order and Tentative Order Fact Sheet state that "the federal regulations . . . included a list of specific non-storm water discharges that 'need not be prohibited.'" (Tentative Order Fact Sheet at 15.) This exception violates the clear language of the CWA and its implementing regulations. Section 402(p)(3)(B)(ii) of the CWA requires that permits for discharge from municipal sewers "effectively prohibit non-stormwater discharges," 33 U.S.C. § 1342(p)(3)(B)(ii), and does not create any authorization for exemption of such discharges.

The Tentative Order states that "[n]on-storm water discharges, per CWA 402(p)(3)(B)(ii) are to be effectively prohibited unless specifically exempted." (Tentative Order, Finding C.14.) The Tentative Order states that the "following categories of non-storm water discharges are not prohibited unless a Copermittee or the Regional Board identifies the discharge category as a source of pollutants to waters of the U.S. For such a discharge category, the Copermittee must either prohibit the discharge category or develop and implement appropriate control measures to prevent the discharge of pollutants to the MS4 and report to the Regional Board pursuant to Section K.1 and K.3 of this Order." (Tentative Order ¶ B.1.) However, section 402(p) places a clear, mandatory duty on the Copermittee to prohibit non-stormwater discharges to the MS4 system. The Copermittee, or Regional Board, has no discretion to deviate from this requirement. In ascertaining the meaning of a statute, construction must begin with the text. (*Duncan v. Walker* (2001) 533 U.S. 167, 172.) "If there is no ambiguity, then we presume the lawmakers meant what they said, and the plain meaning of the language governs." (*Day v. City of Fontana* (2001) 25 Cal.4th 268, 272.) There is no ambiguity present in the CWA's requirement that a permit "effectively prohibit nonstormwater discharges," and the Tentative Order's provision of categorical exceptions stands in clear violation of its terms.

Neither the CWA, nor its implementing regulations under 40 C.F.R. § 122.26(d)(2)(iv)(B)(1) allow exemptions from the prohibition against non-stormwater discharges, as the Fact Sheet implies. (Tentative Order Fact Sheet, at 10.) The regulations set forth the circumstances under which the Copermittee must specifically design a program to prevent certain illicit discharges: "the following category of non-storm water discharges or flows shall be addressed where such discharges are identified by the municipality as sources of pollutants to waters of the United States." The cited regulation, providing for an enforcement program to "prevent illicit discharges," does not support the construction, seemingly implemented by the Tentative Order, that certain specified categories of non-stormwater discharges "are not prohibited unless" they are identified as a source of pollution. (Tentative Order ¶ B.2.) Indeed, the interpretation adopted in the Tentative Order, allowing for categorical exemptions for non-stormwater discharges, is not found in the plain language of the regulation, and the Tentative Order's provisions would place the regulations in direct conflict with the overlying statute. As written, the entire scheme of the Tentative Order is inconsistent with both the regulations and the statute that they purport to implement.

B. The Permit Implies that Pollutants in Non-Stormwater Discharges Are Permissible So Long As They Do Not Exceed Numeric Effluent Limitations.

In an attempt to "assure non-storm water dry weather discharges from the Orange County MS4 into receiving waters are not causing, threatening to cause or contributing to a condition of pollution or nuisance and to protect designated Beneficial Uses," (Tentative Order ¶ C.1), the Tentative Order incorporates "Non storm water dry weather TMDLs . . . in this Order as WQBELs." (Tentative Order Fact Sheet, at 21.) Generally speaking, we approve of the Regional Board's use of numeric limits to assure that water quality standards are met, and of including provisions that Copermittees must monitor progress toward and attain numeric standards for discharges from the MS4 system. While this provision represents a positive step toward preventing illicit discharges of non-stormwater to the MS4 system, the appropriate means of implementing the requirements of section 402(p) is not through the use of "dry weather TMDLs,"[54] but by effectively prohibiting discharges of non-stormwater altogether.

To the extent that the Regional Board will incorporate numeric limitations on pollutants in non-stormwater discharges, Section C must, at a minimum, be revised to assure that the permit does not allow for non-stormwater discharges containing any quantity of pollution to occur, as opposed to only prohibiting those discharges that exceed the numeric limits. The Tentative Order states that Copermittees "shall monitor for and attain the non-storm water dry weather numeric limits" incorporated into the Order as a means of compliance. (Tentative Order ¶ C.5.)

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[54] The Fact Sheet does not identify a specific dry weather TMDL adopted by the Regional Board or U.S. EPA as the basis for the limits contained in Section C, nor is a dry weather TMDL for Orange County listed on the Regional Board's TMDL webpage. (http://www.swrcb.ca.gov/rwqcb9/water_issues/programs/tmdls/index.shtml.) If the Regional Board is establishing the identified numeric limitations based on Water Quality Standards in the Basin Plan, as opposed to WLAs contained in a specific, adopted TMDL, the Tentative Order and Fact Sheet should be revised to properly identify the source of the WQBELs.

Under 40 C.F.R. § 122.26(d)(2)(iv)(B)(1), the Tentative Order must prohibit the discharge of any pollutant in non-stormwater discharges to waters of the United States, not just pollutants that exceed the numeric standards identified in Section C. In order to avoid confusion, the language of Section C must be revised to explicitly state: (1) that compliance with the Tentative Orders' numeric limitations does not constitute compliance with the CWA's requirement that non-stormwater discharges be "effectively prohibit[ed]," or (2) that categories of non-stormwater discharge which the Regional Board believes are exempt from this prohibition may not discharge any pollutants, regardless of whether they exceed numeric limitations.

Though we question the Regional Board's authority to exempt any categories of non-stormwater discharge from section 402(p)'s prohibition against discharges to the MS4 system, we note with approval the Tentative Order's decision to remove landscape irrigation, irrigation water and lawn watering from the list of exempt discharges, effectively prohibiting discharge from these sources. (Tentative Order ¶ B.2.) Lawn irrigation has been identified as a "hot spot" for nutrient contamination in urban watersheds—lawns "contribute greater concentrations of Total N, Total P and dissolved phosphorus than other urban source areas … source research suggests that nutrient concentrations in lawn runoff can be as much as four times greater than other urban sources such as streets, rooftops or driveways."[55] Given the strong evidence that these discharges are consistent sources of pollution to the MS4 system and waters of the United States within the Copermittees' jurisdictions (see Tentative Order Fact Sheet at 5, 8-13, 22), we strongly support the Regional Board's decision in this regard.

In total, the Tentative Order's approach does not uphold the CWA's mandate that Copermittees "effectively prohibit non-stormwater discharges into the storm sewers." (33 U.S.C. § 1342(p)(3)(B)(ii).) Given the evidence that pollution from non-storm discharges constitutes a serious and ongoing problem in receiving waters under the jurisdiction of the Copermittees, we underscore that, as with our comments in Section IV, these concerns emphasize the need for LID-based, onsite stormwater retention requirements, since these approaches will reduce non-stormwater runoff from new development to zero when properly implemented.

VIII. The Permit Application Is Incomplete for Failure to Include an Assessment of Controls.

A permit application for discharge from a large- or medium-sized MS4 must contain an assessment of controls, including "[e]stimated reductions in loadings of pollutants from

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[55] Center for Watershed Protection (March 2003) *Impacts of Impervious Cover on Aquatic Systems* at 69; see also H.S. Garn (2002) *Effects of lawn fertilizer on nutrient concentration in runoff from lakeshore lawns, Lauderdale Lakes, Wisconsin*. U.S. Geological Survey Water-Resources Investigations Report 02-4130 (In an investigation of runoff from lawns in Wisconsin, runoff from fertilized lawns contained elevated concentrations of phosphorous and dissolved phosphorous); Orange County Watershed and Coastal Resources Division (August 18, 2006) Model Aliso Creek Watershed Action Plan, at 2-13 ("Based on other studies performed in Orange County, it is suspected that organophosphate pesticides may be a significant component of aquatic toxicity in the Aliso Creek storm samples.")

discharges of municipal storm sewer constituents from municipal storm sewer systems expected as the result of the municipal storm water quality management program." (40 C.F.R. § 122.26(d)(2)(v).) Neither the application, the Tentative Order, the Tentative Order Fact Sheet, nor other supporting documents include any required information or other discussion of the amount of pollution that will be reduced through its controls. The approval of the Tentative Order without this information fundamentally violates basic precepts of administrative procedure, not only because required evidence in the record is lacking, but also because the findings and related subfindings in the record are therefore devoid of necessary guideposts as to why and how provisions were included or rejected. The Tentative Order does not provide sufficient evidence to demonstrate that the management practices included in the Tentative Order are adequate to meet relevant requirements and water quality standards.

The U.S. EPA has previously released guidance purporting to "allow[] permitting authorities to develop flexible reapplication requirements that are site-specific." (61 F.R. 41698.) However, nothing in the CWA's implementing regulations permits such flexibility, and this or other guidance cannot reduce or remove the regulatory requirement that the Tentative Order include estimated reductions in pollutant loadings. It is axiomatic that where agency guidance is inconsistent with an unambiguous statutory scheme or its enabling regulations, the regulations must govern. (*See, e.g.*, *Christensen v. Harris County* (2000) 529 U.S. 576, 588 ("To defer to the agency's position would be to permit the agency, under the guise of interpreting a regulation, to create *de facto* a new regulation"); *Davis v. Florida Power & Light Co.* (11th Cir. 2000) 205 F.3d 1301, 1307 (rejecting agency policy guidance as inconsistent with its overlying statutory scheme).) In order for the Tentative Order application to meet the requirements of the CWA, the Tentative Order must include an estimate of the pollutant load reduction that it is expected to achieve.

Even if the guidance were not in direct conflict with the regulations, the guidance does not in itself specifically exempt permits from including this information. The guidance states that "as a practical matter, *most* first-time permit application requirements are unnecessary for purposes of second round MS4 permit application;" it does not state that all such information is unconditionally unnecessary. (61 F.R. 41698 (emphasis added).) The omitted pollutant reduction estimates represent a fundamentally different type of information from that required by *most* of the other provisions of 40 C.F.R. § 122.26(d)(2), such as identifying already identified "major outfalls," for which repeating the exercise "would be needlessly redundant," especially "where it has already been provided and has not changed." (61 F.R. 41698.) Instead, the required pollutant load reduction estimates are self-evidently relevant to crafting and assessing the core requirements of the new permit. Such estimates are an essential means of determining whether or not the permit will ensure that water quality standards will be met and what improvements can be expected; they are not merely an administrative detail that has no effect on the permit's functionality.

The missing information is further indispensable when, as here, the Tentative Order and the provisions included in it represent a substantial change from the previously adopted Permit.[56]

[56] Order No. R9-2002-001, NPDES Permit No. CAS0108740, Orange County MS4 Permit.

Indeed, the Tentative Order itself notes that "[t]he Order contains new or modified requirements that are necessary to improve Copermittees' efforts to reduce the discharge of pollutants in runoff to the MEP and achieve water quality standards." (Tentative Order, Finding D.1.c.) Given changes from the prior Permit, the necessity of basing the Tentative Order on information about its estimated efficacy should be clear. The Tentative Order and application must be revised to include the required estimates.

IX. Conclusion.

For the many aforementioned reasons, the Tentative Order is unlawful under federal and state law. It is not yet legally adequate and needs revision—as well as more thorough documentation— to pass legal muster under the Clean Water Act's MEP standard and to produce the significant reductions in stormwater pollution that are feasible and necessary to meet water quality standards. We urge the Regional Board to reject the Tentative Order, once again, and to provide staff with clear direction on the modifications that are required, as discussed above.

Sincerely,

David S. Beckman
Bart Lounsbury
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Natural Resources Defense Council

INVESTIGATION OF THE FEASIBILITY AND BENEFITS OF LOW-IMPACT SITE DESIGN PRACTICES ("LID") FOR THE SAN DIEGO REGION

By Richard R. Horner [†]

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INTRODUCTION

This purpose of this study is to investigate the relative impact of three levels of storm water treatment best management practices (BMPs) on certain water quality and water reuse factors: basic "treat-and-release" BMPs (e.g., drain inlet filters, CDS units), commonly used BMPs that expose runoff to soils and vegetation (extended-detention basins and biofiltration swales and filter strips), and low-impact design (LID) practices. Low-impact methods reduce storm runoff and its contaminants by decreasing their generation at sources, infiltrating into the soil or evaporating storm flows before they can enter surface receiving waters, treating flow remaining on the surface through contact with vegetation and soil, or a combination of these strategies. Soil-based LID practices often use soil enhancements such as compost, and thus improve upon the performance of more traditional basins and biofilters. The factors considered in the investigation are runoff volume, pollutant loading, and the availability of water for infiltration or other reuse. In order to assess the differential impact of storm water reduction approaches on these factors, this study examines six case studies typical of development in the San Diego region that would require Standard Urban Stormwater Management Plans (SUSMPs).

With respect to each of the six development models, three assessments were undertaken. To establish a baseline, for each case study annual storm water runoff volumes were estimated, as well as concentrations and mass loadings of four pollutants: (1) total suspended solids (TSS), (2) total recoverable copper (TCu), (3) total recoverable zinc (TZn), and (4) total phosphorus (TP). These baseline estimates were based on the anticipated land use and cover with no storm water management efforts.

Two sets of calculations were then conducted using the parameters defined for the six case studies. The first group of calculations estimated the extent to which the basic BMPs reduce runoff volumes and pollutant concentrations and loadings, and what impact, if any, such BMPs have on recharge rates or water retention on-site. The second group of calculations estimated the extent to which commonly used soil-based BMPs and low-impact site design strategies ameliorate runoff volumes and pollutant concentrations and loadings, and the effect such techniques have on recharge rates.

The assessment of basins, biofiltration, and low-impact design practices analyzed the expected infiltration capacity of the case study sites. It also considered related LID techniques and practices, such as source reduction strategies, that work in concert with infiltration to serve the goals of: (1) preventing increase in annual runoff volume from the pre- to the post-developed state, (2) preventing increase in annual pollutant mass loadings between the two development states, and (3) avoiding exceedences of California Toxics Rule (CTR) acute saltwater criteria for copper and zinc.

The results of this analysis show that in developments implementing no post-construction BMPs, storm water runoff volume and pollutant loading are substantially increased and recharge rates are substantially decreased compared to pre-development conditions. Second, developments implementing basic post-construction treatment BMPs achieve reduced pollutant loading compared to developments with no BMPs, but storm water runoff volume and recharge rates are similar to developments with no BMPs. Third, developments implementing traditional basins and biofilters, and even more so low-impact post-construction BMPs, achieve significant reduction of pollutant loading and runoff volume as well as greatly enhanced recharge rates compared to both developments with no BMPs and developments with basic treatment BMPs.

This report covers the methods employed in the investigation, data sources, and references for both. It then presents the results, discusses their consequences, and draws conclusions, and makes recommendations relative to utilizing low-impact site design practices in SUSMPs.

CASE STUDIES

Four case studies were derived directly from building permit records for development projects in the City of San Marcos: a multi-family residential complex (MFR), a relatively small-scale (23 homes) single-family residential development (Sm-SFR), a restaurant (REST), and an office building (OFF). The records provided data on total site areas, numbers of buildings, building footprint areas (including porch and garage for Sm-SFR), and numbers of parking spaces associated with the development projects. While the building permit records made no reference to features such as roadways, walkways, and landscaping normally associated with development projects, these features were taken into account in the case studies through some reasonable assumptions, as detailed below. Larger developments were not represented in the sampling of building permits from the San Marcos database. To take larger development projects into account in the subsequent analysis, two larger scale case studies were hypothesized: a relatively large single-family residential development (Lg-SFR) and a sizeable commercial retail installation (COMM). The Lg-SFR scenario assumed 1000 homes, and scaled up all land use estimates from the Sm-SFR case in the ratio of 1000:23. The hypothetical COMM scenario consisted of a building with a 2-acre footprint and 500 parking spaces. As with the smaller-scale cases, these hypothetical developments were assumed to have roadways, walkways, and landscaping, which were also handled as follows.

Parking spaces were estimated to be 176 sq ft in area, which corresponds to 8 ft width by 22 ft length dimensions. Code requirements vary by jurisdiction, with the tendency now to drop below the traditional 200 sq ft average. About 180 sq ft is common, but various standards for full- and compact-car spaces, and for the mix of the two, can raise or lower the average (http://nemo.uconn.edu/publications/tech_papers/tech_paper_5.pdf). The 176 sq ft size is considered to be a reasonable value for conventional practice.

Roadways and walkways assume a wide variety of patterns, of course. Exclusive of the two SFR cases, simple, square parking lots with roadways around the four sides and square buildings with walkways also around the four sides were assumed. Roadways and walkways were taken to be 20 ft and 6 ft wide, respectively.

Single-family residences were assumed each to have a driveway 20 ft wide and 30 ft long. It was further assumed that each would have a sidewalk along the front of the lot, which was calculated to be 5749 sq ft in area. Assuming a square lot, the front dimension would be 76 ft. A 40-ft walkway was included within the property. Sidewalks and walkways were taken to be 4 ft wide.

Exclusive of the COMM case, the total area for all of these impervious features was subtracted from the total site area to estimate the pervious area, which was assumed to have conventional landscaping cover (grass, small herbaceous decorative plants, bushes, and a few trees). For the hypothetical COMM scenario, the hypothetical total impervious cover was enlarged by 10 percent to represent the landscaping, on the belief that a typical retail commercial establishment would typically be mostly impervious.

Table 1 summarizes the characteristics of the six case studies. The table also provides the recorded or estimated areas in each land use and cover type.

Table 1. Case Study Characteristics and Land Use and Land Cover Areas

	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
San Marcos permit nos.	24718	30315-30337	31515	35339	Hypoth.	Hypoth.
San Marcos permit date	3/5/04	3/5/04	3/11/04	5/16/06	-	-
No. of buildings	11	23	1	1	1000	1
Total area (ft^2)	476982	132227	33669	92612	5749000	226529
Roof area (ft^2)	184338	34949	3220	7500	1519522	87120
Parking spaces	438	-	33	37	-	500
Parking area (ft^2)	77088	-	5808	6512	-	88000
Access road area (ft^2)	22212	-	6097	6456	-	23732
Walkway area (ft^2)	33960	10656	1362	2078	463289	7084
Driveway area (ft^2)	-	13800	-	-	600000	-
Landscape area (ft^2)	159384	72822	17182	70066	3166190	20594

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial

METHODS OF ANALYSIS

Annual Storm Water Runoff Volumes

For each case study site the annual surface runoff volumes produced were estimated for both pre- and post-development conditions. Runoff volume was computed as the product of annual precipitation, contributing drainage area, and a runoff coefficient (ratio of runoff produced to rainfall received). For impervious areas the following equation was used: $C = 0.009\ I + 0.05$, where I is the impervious percentage. This equation was derived by Schueler (1987) from Nationwide Urban Runoff Program data (U.S. Environmental Protection Agency 1983). With I = 100 percent for fully impervious surfaces, C is 0.95.

The basis for pervious area runoff coefficients was the Natural Resource Conservation Service's (NRCS) Urban Hydrology for Small Watersheds (NRCS 1986, as revised from the original 1975 edition). This model estimates storm event runoff as a function of precipitation and a variable representing land cover and soil, termed the curve number (CN). Larger events are forecast to produce a greater amount of runoff in relation to amount of rainfall because they more fully saturate the soil. Therefore, use of the model to estimate annual runoff requires selecting some event or group of events to represent the year. Jurisdictions under the San Diego municipal storm water permit generally perform water quality analyses with respect to the 85th percentile rainfall quantity (the 85th percentile rainfall is the amount exceeding the precipitation in 85 percent of all events over time). That event was used in the analysis here for the relative comparison between pre- and post-development and applied to deriving a runoff coefficient for annual estimates, recognizing that smaller storms would produce less and larger storms more runoff. This meteorological statistic for San Marcos is 0.75 inch of rainfall (http://www.co.san-diego.ca.us/dpw/watersheds/pubs/susmp_85precip.pdf).

To select CN for the pre-development case, an analysis performed in the area of the Cedar Fire in San Diego was used in which CN was determined before and after the 2003 fire (http://www.ufei.org/files/pubs/SanDiegoUrbanEcosystemAnalysis-PostCedarFire.pdf). Here, CN = 83 was estimated for the pre-existing land cover, which was generally chaparral. For post-development landscaping, CN = 86 was selected based on tabulated data in NRCS (1986) and professional judgment.

Pre- and post-development runoff quantities were computed with these CN values and the 85th percentile rainfall, and then divided by the rainfall to obtain runoff coefficients. The results were 0.07 and 0.12, respectively. Finally, total annual runoff volumes were estimated based on an average annual precipitation of 10.26 inches (http://www.wrcc.dri.edu/cgi-bin/cliMONtpre.pl?casand).

Storm Water Runoff Pollutant Discharges

Annual pollutant mass discharges were estimated as the product of annual runoff volumes produced by the various land use and cover types and pollutant concentrations typical of those areas. Again, the 85th percentile precipitation event was used as a basis for volumes. Storm water pollutant data have typically been measured and reported for general land use types (e.g., single-family residential, commercial). However, an investigation of low-impact site design of the type this study sought to conduct demands data on specific land coverages. The literature offers few data on this basis. Those available and used herein were assembled by a consultant to the City of Seattle for a project in which the author participated. They appear in Attachment A (Herrera Environmental Consultants, Inc. undated).

Pollutant concentrations expected to occur typically in the mixed runoff from the several land use and cover types making up a development were estimated by mass balance; i.e., the concentrations from the different areas of the sites were combined in proportion to their contribution to the total runoff.

The Effect of Conventional Treatment BMPs on Runoff Volume, Pollutant Discharges, and Recharge Rates

The first question in analyzing how BMPs reduce runoff volumes and pollutant discharges was, What BMPs are being employed in San Diego SUSMPs? The currently applicable SUSMP program associated with the San Diego County MS4 permit provides regulated entities with a large number of choices. These options include manufactured BMPs, such as drain inlet inserts (DIIs) and continuous deflective separation (CDS) units. Developments may also select such non-proprietary devices as extended-detention basins (EDBs) and biofiltration swales and filter strips. EDBs hold water for two to three days for solids settlement before releasing whatever does not infiltrate or evaporate. Biofiltration treats runoff through various processes mediated by vegetation and soil. In a swale, runoff flows at some depth in a channel, whereas a filter strip is a broad surface over which water sheet flows. Each of these BMP types was applied to each case study.

The principal basis for the analysis of BMP performance was the California Department of Transportation's BMP Retrofit Pilot Program (Caltrans, 2004), performed in San Diego and Los Angeles Counties. One important result of the program was that BMPs with a natural surface infiltrate and evaporate (probably, mostly infiltrate) a substantial amount of runoff, even if conditions do not appear to be favorable for an infiltration basin. On average, the EDBs, swales, and filter strips respectively lost 40, 50 and 30 percent of the entering flow before the discharge point. DIIs and CDS units do not contact runoff with a natural surface, and therefore do not reduce runoff volume.

The Caltrans program further determined that BMP effluent concentrations were usually a function of the influent concentrations and developed equations for the functional relationships in these cases. BMPs generally reduced influent concentrations proportionately more when they were high. In a relatively few situations influent concentrations were constant at an "irreducible minimum" level regardless of inflow concentrations.

In analyzing the effects of BMPs on the case study sites' runoff, the first step was to reduce the runoff volumes estimated with no BMPs by the fractions observed to be lost in the pilot study. The next task was estimating the effluent concentrations from the relationships in the Caltrans report. The final step was calculating discharge pollutant loadings as the product of the reduced volumes and predicted effluent concentrations. As before, typical pollutant concentrations in the mixed runoff were established by mass balance.

Estimating Infiltration Capacity of the Case Study Sites

Infiltrating sufficient runoff to maintain pre-development hydrologic characteristics and prevent pollutant transport is the most effective way to protect surface receiving waters. Successfully applying infiltration requires soils and hydrogeological conditions that will pass water sufficiently rapidly to avoid overly lengthy ponding, while not allowing percolating water to reach groundwater before the soil column captures pollutants.

The study assumed that infiltration would occur in surface facilities and not in below-ground trenches. The use of trenches is certainly possible, and was judged to be an approved BMP by Caltrans after the pilot study. However, the intent of the investigation was to determine the ability of pervious areas to manage the site runoff. It determined what contribution these areas could make in their original condition, and then assessed how they could serve further if soils were modified using a low-impact site design technique.

The chief basis for this aspect of the work was an assessment of infiltration capacity and benefits for Los Angeles' San Fernando Valley (Chralowicz et al. 2001). The Chralowicz study posited providing 0.1-0.5 acre for infiltration basins to serve 5 acres of contributing drainage area. At 2-3 ft deep, it was estimated that such basins could infiltrate 0.90-1.87 acre-ft/year of runoff in San Fernando Valley conditions. Soils there are generally various loam textures with infiltration rates of approximately 0.5-2.0 inches/hour. Soils are similar in the San Marcos area (http://websoilsurvey.nrcs.usda.gov/app), thus making the conclusions of this study applicable for these purposes. This information was used to estimate how much of each case study site's annual runoff would be infiltratable and if the pervious portion would provide sufficient area.

Volume and Pollutant Source Reduction Strategies

As pointed out earlier, the essence of low-impact site design is reducing runoff problems before they can develop, at their sources, or exploiting the infiltration and treatment abilities of soils and vegetation. If these abilities are not adequate to preserve pre-development hydrology and prevent runoff from causing or contributing to violations of water quality standards, then the choice is to practice source reduction, upgrade infiltration and treatment capabilities, or both.

Soils can be upgraded to store runoff until it can infiltrate, evaporate, or transpire from plants through compost addition, a standard low-impact site design technique. Bioretention cells with these upgraded soils can be built to hold runoff and effect its

transfer to the subsurface zone, another standard low-impact tool. Of course, the space needed must be available to do so. This phase of the analysis determined for the case study sites if that space would indeed be available, assuming the soils and vegetation could be built up to use it effectively.

Source reduction can be accomplished through low-impact site design in various ways. Conventional pavements can be converted to porous asphalt or concrete or replaced with concrete or plastic unit pavers or grid systems. Of course, the soils must be capable of infiltrating the runoff passing through and may require renovation of the same type as discussed for bioretention. Water can also be "harvested," that is, captured and stored for reuse in irrigation or gray water systems. Many successful systems of this type are in operation, for example Natural Resources Defense Council offices, Santa Monica, CA; King County Administration Building, Seattle, WA; two buildings on the Portland State University campus, Portland, OR. Harvesting is a standard technique for Leadership in Energy and Environmental Design (LEED) buildings (http://www.poweryourdesign.com/LEEDGuide.pdf). Runoff from roofs and parking lots can be harvested, with the former being somewhat easier because of the possibility of avoiding pumping to use the water and fewer pollutants. The investigation concluded by determining how harvesting could contribute to storm water management for case study sites where infiltration capacity, available space, or both appeared to be limited.

RESULTS OF THE ANALYSIS

1. "Base Case" Analysis: Development Without Traditional BMP or LID Approaches

Comparison of Pre- and Post-Development Runoff Volumes

Table 2 presents a comparison between the estimated runoff volumes generated by the respective case study sites in the pre- and post-development conditions, assuming implementation of no BMPs on the developed sites. On sites dominated by impervious land cover, most of the infiltration that would recharge groundwater in the undeveloped state is expected to be lost to surface runoff after development. This greatly increased surface flow would raise peak flow rates and volumes in receiving water courses, raise flooding risk, and transport pollutants. Only the office building, the plan for which retained substantial pervious area, would not lose half or more of the pre-development recharge.

Table 2. Pre- and Post-Development Without BMPs: Distribution of Surface Runoff Versus Recharge to Groundwater

Annual Volume (acre-ft)	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Precipitation[b]	9.35	2.59	0.66	1.82	113	4.44
Pre-development runoff[c]	0.65	0.18	0.05	0.13	8	0.31
Pre-development recharge[d]	8.69	2.41	0.61	1.69	105	4.13
Post-development impervious runoff[c]	5.91	1.11	0.31	0.42	48	3.83
Post-development pervious runoff[c]	0.37	0.17	0.04	0.16	7	0.05
Post-development total runoff[c]	6.29	1.28	0.35	0.58	56	3.88
Post-development recharge[d]	3.06	1.31	0.31	1.23	57	0.56
Post-development recharge loss (% of pre-development recharge)	5.63 (65%)	1.10 (46%)	0.30 (49%)	0.46 (27%)	48 (46%)	3.57 (86%)

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial
[b] Volume of precipitation on total project area
[c] Quantity of water discharged from the site on the surface
[d] Quantity of water infiltrating the soil; the difference between precipitation and runoff

Pollutant Concentrations and Loadings

Table 3 presents the pollutant concentrations from the literature and loadings calculated as described for the various land use and cover types represented by the case studies. Landscaped areas are expected to release the highest TSS concentration, although relatively low TSS mass loading because of the low runoff coefficient. The highest copper concentrations and loadings are expected from parking lots. Roofs, especially commercial roofs, top the list for both zinc concentrations and loadings. Landscaping would issue by far the highest phosphorus, although access roads and driveways would contribute the highest mass loadings.

Table 3. Pollutant Concentration and Loading for Case Study Land Use and Cover Types

	Concentrations					Loadings		
Land Use	TSS (mg/L)	TCu (mg/L)	TZn (mg/L)	TP (mg/L)	Lbs. TSS/ acre-year	Lbs. TCu/ acre-year	Lbs. TZn/ acre-year	Lbs. TP/ acre-year
Residential roof	25	0.013	0.159	0.11	55	0.029	0.350	0.242
Commercial roof	18	0.014	0.281	0.14	40	0.031	0.619	0.309
Access road/driveway	120	0.022	0.118	0.66	264	0.048	0.260	1.455
Parking	75	0.036	0.097	0.14	165	0.079	0.214	0.309
Walkway	25	0.013	0.059	0.11	55	0.029	0.130	0.242
Landscaping	213	0.013	0.059	2.04	59	0.004	0.016	0.568

The CTR acute criteria for copper and zinc are 0.0048 mg/L and 0.090 mg/L, respectively. It may be seen in Table 3 that all developed land uses are expected to discharge copper above the criterion, based on the mass balance calculations using concentrations from Table 3. Any surface release from the case study sites would violate the criterion at the point of discharge, although dilution by the receiving water would lower the concentration below the criterion at some point. Even if copper mass loadings are reduced by BMPs, any surface discharge would exceed the criterion initially, but it would be easier to dilute below that level. In contrast, runoff from some land covers would not violate the acute zinc criterion. Because of this difference, the evaluation considered whether or not the zinc criterion would be exceeded in each analysis, whereas there was no point in this analysis for copper. There are no equivalent water quality criteria for TSS and TP; hence, their concentrations were not further analyzed in the different scenarios.

Table 4 follows with the overall loadings, as well as zinc concentrations, expected to be delivered from the case study developments should they not be fitted with any BMPs. As Table 4 shows, all cases are forecast to exceed the 0.090 mg/L acute zinc criterion, and the retail commercial development does so by a wide margin. Because of its size, the large residential development dominates the mass loading emissions.

Table 4. Case Study Pollutant Concentration and Loading Estimates Without BMPs

	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
TZn (mg/L)	0.127	0.123	0.128	0.133	0.123	0.175
Lbs. TSS/year	920	241	87	169	10461	594
Lbs. TCu/year	0.32	0.051	0.022	0.032	2.24	0.25
Lbs. TZn/year	2.16	0.423	0.121	0.210	18.38	1.84
Lbs. TP/year	4.58	1.66	0.50	1.24	72.35	2.34

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial

2. "Traditional SUSMP" Analysis: Effects of Basic Treatment BMPs

Post-Development Runoff Volumes

The current SUSMP program permits regulated parties to select from a range of BMPs in order to treat or infiltrate a given quantity of annual rainfall. According to Regional Board staff and third party reviews of the program (Tetra Tech, Inc. 2005), a wide variety of BMPs are selected. Many projects rely on drain inlet inserts, CDS units, and similar manufactured BMPs. Regulated entities currently can select these or other "treat-and-release" techniques in order to satisfy the current San Diego County MS4 Permit. As a category, such treatment BMPs do not permit any collected runoff contact with soils. Therefore, they discharge as much storm water runoff as equivalent sites with no BMPs, and afford zero savings in recharge.

Effects of BMPs on Pollutant Discharges

Table 5 presents estimates of zinc effluent concentrations and mass loadings of the various pollutants discharged from four types of conventional treatment BMPs. The "basic" BMPs in this table, the CDS units, are not expected to drop any of the concentrations sufficiently to meet the acute zinc criterion at the discharge point. The loading reduction results show the CDS unit always performing below 50 percent and most often in the vicinity of 20 percent, with zero copper reduction.

The Caltrans study (2004) produced less data on drain inlet insert performance. These devices were found to reduce pollutant mass loadings by the following amounts (average of the performance of two models): TSS—8.5 percent, TCu—1.0 percent, and TZn—1.5 percent.

3. LID Analysis: Relative Effect of Conventional Soil-Based BMPs and Low-Impact Development Approaches

Annual surface runoff and recharge predicted to occur with the three soil-based BMP types commonly employed in California were estimated. An assumption was full service of all portions of the case study sites with one of these practices. Although the analysis assumed use of one or another of the BMP types throughout each site, a project designer could elect to use more than one BMP to serve different portions. Table 6 gives the estimates, along with the savings in recharge afforded by the LID site design techniques relative to a condition with no BMPs. The percentages of savings exactly reflect the degree of infiltration observed in the Caltrans pilot study: 40, 50, and 30 percent, respectively, for EDBs, swales, and filter strips.

Table 5. Case Study Pollutant Concentration and Loading Estimates With BMPs

	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Effluent Concentrations:						
CDS TZn (mg/L)[a]	0.095	0.095	0.098	0.102	0.095	0.131
EDB TZn (mg/L)[a]	0.085	0.086	0.084	0.084	0.086	0.098
Swale TZn (mg/L)	0.055	0.054	0.055	0.056	0.054	0.068
Filter strip TZn (mg/L)	0.039	0.039	0.039	0.041	0.039	0.048
Loading Reductions:						
CDS TSS loading reduction	15.7%	19.9%	22.0%	24.0%	19.9%	16.9%
CDS TCu loading reduction	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CDS TZn loading reduction	22.7%	22.4%	22.9%	23.1%	22.4%	25.1%
CDS TP loading reduction	30.6%	41.5%	40.7%	45.9%	41.5%	20.3%
EDB TSS loading reduction	68.1%	73.7%	79.0%	81.1%	73.7%	71.7%
EDB TCu loading reduction	61.9%	55.7%	66.2%	63.0%	55.7%	66.8%
EDB TZn loading reduction	59.7%	59.6%	60.4%	61.9%	59.6%	66.6%
EDB TP loading reduction	61.9%	69.7%	69.1%	72.9%	69.7%	54.5%
Swale TSS loading reduction	68.8%	71.1%	73.1%	73.9%	71.1%	69.4%
Swale TCu loading reduction	72.5%	68.5%	78.2%	73.3%	68.5%	75.8%
Swale TZn loading reduction	78.4%	78.1%	84.3%	78.8%	78.1%	80.7%
Swale TP loading reduction	66.3%	70.7%	67.2%	76.2%	70.7%	55.0%
Filter strip TSS loading reduction	69.9%	75.4%	80.6%	82.6%	75.4%	72.3%
Filter strip TCu loading reduction	74.4%	69.1%	78.2%	75.4%	69.1%	78.7%
Filter strip TZn loading reduction	78.3%	77.9%	78.4%	78.7%	77.9%	80.9%
Filter strip TP loading reduction	48.4%	53.1%	63.7%	59.8%	53.1%	34.6%

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial
CDS— continuous deflective separation unit; EDB—extended-detention basin

Effects of BMPs on Pollutant Discharges

Table 5 presents estimates of zinc effluent concentrations and mass loadings of the various pollutants discharged from the EDBs, swales, and filter strips. Effluents from each case study site are expected to fall below the CTR acute zinc criterion if treated with swales or filter strips. All but the large commercial site would meet the criterion with EDB treatment. These infiltration-oriented BMPs, swales, filters, and EDBs, if fully implemented and well maintained, are predicted to prevent the majority of the pollutant masses generated on most of the development sites from reaching a receiving water. Only total phosphorus reduction falls below 50 percent for two case studies. Mass loading reductions range above 80 percent for the EDB, swale, and filter strip.

Table 6. Distribution of Surface Runoff Versus Recharge to Groundwater With BMPs

Annual Volume (acre-ft)	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Total runoff with EDBs[a, b]	3.77	0.77	0.21	0.35	33	2.33
Recharge with EDBs[c]	5.58	1.83	0.45	1.46	79	2.11
Recharge savings with EDBs[d]	2.52	0.51	0.14	0.23	22	1.55
Total runoff with swales[b]	3.14	0.64	0.17	0.29	28	1.94
Recharge with swales[c]	6.20	1.95	0.49	1.52	85	2.50
Recharge savings with swales[d]	3.14	0.64	0.17	0.29	28	1.94
Total runoff with filter strips[b]	4.40	0.89	0.24	0.41	39	2.72
Recharge with filter strips[c]	4.95	1.70	0.42	1.41	74	1.72
Recharge savings with filter strips[d]	1.89	0.38	0.10	0.18	17	1.16

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial; EDBs—extended-detention basins
[b] Quantity of water discharged from the site on the surface
[c] Quantity of water infiltrating the soil; the difference between precipitation and runoff
[d] Difference between recharge with and without BMP (the latter from Table 2)

Expected Infiltration Capacities of the Case Study Sites

Table 7 summarizes the results of the infiltration analysis. The first inquiry on this subject sought to determine how much of the total annual runoff each property is expected to infiltrate. Based on the findings of Chralowicz et al. (2001), it was assumed that a site in the size range 0-5 acres could infiltrate 0.9-1.9 acre-ft/year with an infiltration device of feasible size, one in the range 5-10 acres could recharge 1.8-3.8 acre-ft/year, etc. As shown in the table, three of the six sites should be able to infiltrate the full annual runoff volume. The remainder could recharge to the ground about half or somewhat more of the annual production. These figures pertain to infiltrating in the native soils, with no soil improvements through composting such as often performed in low-impact site design.

Next, it was sought to determine whether the sites, as planned, have sufficient pervious area for surface infiltration facilities. Again, the results of Chralowicz et al. (2001) were used, and it was assumed that infiltration would take 0.1-0.5 acres on a site of 0-5 acres total area, 0.2-1.0 acres on a 5-10 acre property, etc. A site low in the range would likely need a smaller infiltration area than one higher in the size range. Five of the six case study sites clearly have more pervious area than required for infiltration facilities. The commercial retail development was the only development project that came close to lacking sufficient pervious area.

Table 7. Summary of Infiltration Analysis

	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Total annual runoff (acre-ft)	6.29	1.28	0.35	0.58	56	3.88
Project area (acres)	11.0	3.0	0.8	2.1	132	5.2
Infiltration capacity (acre-ft)	2.7-5.7	0.9-1.9	0.9-1.9	0.9-1.9	24-51	1.8-3.8
Infiltration assessment	~Half+	All	All	All	~Half+	~Half+
Infiltration area needed (acres)	0.3-1.5	0.1-0.5	0.1-0.5	0.1-0.5	2.7-14	0.2-1.0
Pervious area available (acres)	3.7	1.7	0.4	1.6	72.7	0.5
Adequate area?	Yes	Yes	Yes	Yes	Yes	Maybe

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial

As Table 7 shows, the case study sites offer considerable promise to manage storm water by infiltration. For any development project at which infiltration-oriented BMPs are

considered, it is important that infiltration potential be carefully assessed using site-specific soils and hydrogeologic data. In the event such an investigation reveals a marginal condition (e.g., hydraulic conductivity, spacing to groundwater) for infiltration basins, soils could be enhanced to produce bioretention zones to assist infiltration.

Volume and Pollutant Source Reduction Through Low-Impact Site Design

The preceding analysis showed that half the sites potentially could infiltrate all runoff produced in an average year, and also have the land to do so. The other three could recharge half or more of the runoff, and at least two have adequate land. One goal of this exercise was to identify alternatives that would reduce runoff production in the first place. It was hypothesized that implementation of source reduction techniques could allow all of the case study sites to infiltrate all of the remaining runoff. Additionally, runoff volume reduction would commensurately decrease pollutant mass loadings.

This analysis considered scenarios in which all roof runoff is either harvested and stored for some beneficial use or is spread over lawns or into the soil via roof downspout infiltration trenches. The former option is probably best suited to cases like the retail and office buildings, while distribution on or in the soil would fit best with residences and relatively small commercial developments like the restaurant. Table 8 shows the consequences of preventing roofs from generating runoff.

With the subtraction of roof runoff, all sites have the capacity to infiltrate all of the annual runoff volume. Comparison of the third and last rows of the table indicates the significant role of roof runoff, especially in the residential cases. With roof runoff included, the only case that was doubtful in having enough pervious area for full infiltration was the commercial case study site. Harvesting runoff from its 2-acre roof brings it into the situation of having sufficient land. These results show that a combination of roof runoff source reduction and land treatment of the remaining runoff for maximum infiltration appears to be an entirely feasible plan to manage storm water from a range of typical San Diego area developments.

Table 8. Summary of Roof Runoff Source Reduction Analysis

	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Annual impervious (minus roof) runoff (acre-ft)	2.48	0.46	0.25	0.28	19.8	2.21
Annual pervious runoff (acre-ft)	0.37	0.17	0.04	0.16	7.5	0.05
Total annual runoff (minus roof) (acre-ft)	2.85	0.63	0.29	0.44	27.3	2.26
Project area (acres)	11.0	3.04	0.77	2.13	132	5.20
Infiltration capacity (acre-ft)	2.7-5.7	0.9-1.9	0.9-1.9	0.9-1.9	24-51	1.8-3.8
Infiltration assessment	All	All	All	All	All	All
Total annual runoff (with roof) (acre-ft)	6.29	1.28	0.35	0.58	56	3.88

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial

Table 9 summarizes the water retention and reuse benefits of the full LID approach involving infiltration by design, supplemented by harvesting from roofs in the MFR, Lg-SFR, and COMM cases. Infiltration contributes to the groundwater resource, while harvesting captures water for use in such applications as irrigation and gray water distribution systems. LID methods offer significant benefits relative to no BMPs in all cases. These benefits are particularly impressive with relatively high site imperviousness, such as in the MFR and COMM cases.

Table 9. Comparison of Water Captured Annually (in acre-ft) from Development Sites for Beneficial Use With a Full LID Approach Compared to Development Without Any BMPs

Water Capture	MFR[a]	Sm-SFR[a]	REST[a]	OFF[a]	Lg-SFR[a]	COMM[a]
Without BMPs[b]	3.06	1.31	0.31	1.23	57	0.56
With full LID approach[c]	9.35	2.59	0.66	1.82	113	4.44
LID benefit[d]	6.29	1.28	0.35	0.58	56	3.88

[a] MFR—multi-family residential; Sm-SFR—small-scale single-family residential; REST—restaurant; OFF—office building; Lg-SFR—large-scale single-family residential; COMM—retail commercial
[b] Water incidentally infiltrated on pervious areas remaining on the development site and recharged to groundwater
[c] Water either entirely infiltrated in BMPs and recharged to groundwater or partially harvested from roofs and partially infiltrated in BMPs
[d] Water capture for which LID approaches are directly responsible; the difference between capture with the full LID approach and without BMPs

SUMMARY AND CONCLUSIONS

This paper demonstrated that common San Diego area residential and commercial development types subject to SUSMPs are likely, without storm water management, to reduce groundwater recharge from the predevelopment state by approximately half in most cases to a much higher fraction with a large ratio of impervious to pervious area. With no treatment, runoff from these developments is expected to exceed CTR acute copper and zinc criteria at the point of discharge and to deliver large pollutant mass loadings to receiving waters.

Many San Diego SUSMP projects have been getting mostly traditional commercially manufactured filtration and hydrodynamic BMPs for storm water management. Such BMPs are included in the SUSMP menu of options currently, and they do have some beneficial impact on runoff quality compared to development without BMPs. However, they are not optimal solutions. These devices do not stem the loss of groundwater recharge, still allow zinc as well as copper water quality criteria violations from all development types analyzed, and capture relatively small fractions of the pollutant mass loadings produced in urban areas.

Conventional soil-based BMP solutions that promote and are component parts of low-impact development approaches, by contrast, regain 30-50 percent of the recharge lost in development without storm water management. It is expected they generally would release effluent that meets the acute zinc criterion at the point of discharge, although it would still exceed the copper limit. Excepting phosphorus, it was found that these BMPs would capture and prevent the movement to receiving waters of the majority of the pollutant loadings considered in the analysis.

It was found that the loam soils typical of the San Marcos area, where the case studies were set, should infiltrate at least half of all the runoff produced in an average year, and all of it for some development types and site designs. Soil enhancement (typically, with

compost) can advance infiltration and lower its risk of failure. Using additive LID approaches, including specifically subtracting the roof runoff by harvesting it for reuse or distributing it in the soil with infiltration trenches, reduces overall runoff sufficiently to conclude that all development examples assessed could infiltrate their surface runoff production.

RECOMMENDATIONS

Low-impact site design techniques emphasize runoff volume and pollutant reduction at their sources and management of runoff and pollutants through vegetation and soil treatment. This type of treatment can infiltrate and evaporate much or even all of the runoff produced in design events. This report shows low-impact site design techniques to be capable of regaining the groundwater recharge lost in development to a greater extent than conventional BMPs. At the same time LID techniques substantially preserve pre-development hydrologic conditions and prevent most or all pollutant transport to receiving waters.

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ATTACHMENT A

Pollutant Concentrations for Urban Source Areas (Herrera Environmental Consultants, Inc. undated)

Source Area	Study	Location	Sample Size (n)	TSS (mg/L)	TCu (ug/L)	TPb (ug/L)	TZn (ug/L)	TP (mg/L)	Notes
Roofs									
Residential	Steuer, et al. 1997	MI	12	36	7	25	201	0.06	2
Residential	Bannerman, et al. 1993	WI	~48	27	15	21	149	0.15	3
Residential	Waschbusch, et al. 2000	WI	25	15	n.a.	n.a.	n.a.	0.07	3
Residential	FAR 2003	NY		*19*	*20*	*21*	*312*	*0.11*	4
Residential	Gromaire, et al. 2001	France		*29*	*37*	*493*	*3422*	*n.a.*	5
Representative Residential Roof Values				**25**	**13**	**22**	**159**	**0.11**	
Commercial	Steuer, et al. 1997	MI	12	24	20	48	215	0.09	2
Commercial	Bannerman, et al. 1993	WI	~16	15	9	9	330	0.20	3
Commercial	Waschbusch, et al. 2000	WI	25	18	n.a.	n.a.	n.a.	0.13	3
Representative Commercial Roof Values				**18**	**14**	**26**	**281**	**0.14**	
Parking Areas									
Res. Driveways	Steuer, et al. 1997	MI	12	157	34	52	148	0.35	2
Res. Driveways	Bannerman, et al. 1993	WI	~32	173	17	17	107	1.16	3
Res. Driveways	Waschbusch, et al. 2000	WI	25	34	n.a.	n.a.	n.a.	0.18	3
Driveway	FAR 2003	NY		*173*	*17*		*107*	*0.56*	4
Representative Residential Driveway Values				**120**	**22**	**27**	**118**	**0.66**	
Comm./ Inst. Park. Areas	Pitt, et al. 1995	AL	16	110	116	46	110	n.a.	1
Comm. Park. Areas	Steuer, et al. 1997	MI	12	110	22	40	178	0.2	2
Com. Park. Lot	Bannerman, et al. 1993	WI	5	58	15	22	178	0.19	3
Parking Lot	Waschbusch, et al. 2000	WI	25	51	n.a.	n.a.	n.a.	0.1	3
Parking Lot	Tiefenthaler, et al. 2001	CA	5	36	28	45	293	n.a.	6
Loading Docks	Pitt, et al. 1995	AL	3	40	22	55	55	n.a.	1
Highway Rest Areas	CalTrans 2003	CA	53	*63*	*16*	*8*	*142*	*0.47*	7
Park and Ride Facilities	CalTrans 2003	CA	179	*69*	*17*	*10*	*154*	*0.33*	7

Comm./ Res. Parking	FAR 2003	NY		*27*	*51*	*28*	*139*	*0.15*	4
Representative Parking Area/Lot Values				**75**	**36**	**26**	**97**	**0.14**	
Landscaping/Lawns									
Landscaped Areas	Pitt, et al. 1995	AL	6	33	81	24	230	n.a.	1
Landscaping	FAR 2003	NY		*37*	*94*	*29*	*263*	n.a.	4
Representative Landscaping Values				**33**	**81**	**24**	**230**	**n.a.**	
Lawns - Residential	Steuer, et al. 1997	MI	12	262	n.a.	n.a.	n.a.	2.33	2
Lawns - Residential	Bannerman, et al. 1993	WI	~30	397	13	n.a.	59	2.67	3
Lawns	Waschbusch, et al. 2000	WI	25	59	n.a.	n.a.	n.a.	0.79	3
Lawns	Waschbusch, et al. 2000	WI	25	122	n.a.	n.a.	n.a.	1.61	3
Lawns - Fertilized	USGS 2002	WI	58	n.a.	n.a.	n.a.	n.a.	2.57	3
Lawns - Non-P Fertilized	USGS 2002	WI	38	n.a.	n.a.	n.a.	n.a.	1.89	3
Lawns - Unfertilized	USGS 2002	WI	19	n.a.	n.a.	n.a.	n.a.	1.73	3
Lawns	FAR 2003	NY	3	*602*	*17*	*17*	*50*	*2.1*	4
Representative Lawn Values				**213**	**13**	**n.a.**	**59**	**2.04**	

Notes:

Representative values are weighted means of collected data. Italicized values were omitted from these calculations.

1 - Grab samples from residential, commercial/institutional, and industrial rooftops. Values represent mean of DETECTED concentrations

2 - Flow-weighted composite samples, geometric mean concentrations

3 - Geometric mean concentrations

4 - Citation appears to be erroneous - original source of data is unknown. Not used to calculate representative value

5 - Median concentrations. Not used to calculate representative values due to site location and variation from other values.

6 - Mean concentrations from simulated rainfall study

7 - Mean concentrations. Not used to calculate representative values due to transportation nature of land use.