Low Impact Development (LID) Best Management Practices (BMP) Design Manual

LONG BEACH
DEVELOPMENT SERVICES
BUILDING A BETTER LONG BEACH

The Low Impact Development (LID) Best Management Practices (BMP) Design Manual, 2nd edition, reflects the LID requirements that went into effect on February 19, 2013 and revisions that take effect in December 2013.

The is LID regulation was adopted by the City of Long Beach on November 16, 2010 as Chapter 18.74 of the Long Beach Municipal Code and approved by Ordinance No. ORD-10-0035; and amended on November 12, 2013 by Ordinance No. ORD-13-0024.

The design manual was created by the City of Long Beach Department of Development Services in collaboration with the Department of Public Works and the Office of Sustainability. The Building Official shall prepare, maintain, and update, as deemed necessary and appropriate, the LID BMP Design Manual to include LID standards and practices and standards for stormwater pollution mitigation. The LID Best Management Practices Manual shall also include technical feasibility and implementation parameters, alternative compliance for technical infeasibility, as well as other rules, requirements and procedures as the City deems necessary.

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ACRONYMS AND ABBREVIATION

ASCE	American Society of Civil Engineers
BMP	Best Management Practices
CGPL	California General Plan Law
CEQA	California Environmental Quality Act
CLBDHHS	City of Long Beach Department of Health and Human Services
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
C&A	Covenant and Agreement
EAF	Environmental Assessment Form
EIR	Environmental Impact Report
EPA	United States Environmental Protection Agency
ESA	Environmentally Sensitive Area
ETWU	Estimated Total Water Use
HC	Hydrocarbons
LBWD	Long Beach Water Department
LID	Low Impact Development
LOR	LID Observation Report
MAWA	Maximum Applied Water Allowance
MEP	Maximum Extent Practicable (statutory standard)
MND	Mitigated Negative Declaration
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
O&G	Oil and Grease
O&M	Operation and Maintenance
RGO	Retail Gasoline Outlets
RWQCB	Los Angeles Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWM	Storm Water Management
SWRCB	State Water Resources Control Board (California)
SWPPP	Storm Water Pollution Prevention Plan
SUSMP	Standard Urban Stormwater Mitigation Plan
WEF	Water Environment Federation
WPD	Watershed Protection Division

SECTION 1: INTRODUCTION

1.1 BACKGROUND

Urban runoff discharged from municipal separate storm sewer systems (MS4) have been identified by local, regional, and national research programs as one of the principal causes of water quality impacts in most urban areas. Urban runoff potentially contains a host of pollutants such as trash and debris, bacteria and viruses, oil and grease, sediments, nutrients, metals, and toxic chemicals.

These contaminants can adversely affect receiving and coastal waters, associated biota, and public health. Land development and construction activities significantly alter drainage patterns and contribute pollutants to urban runoff primarily through erosion and removal or change of existing natural vegetation. When homes, shops, work places, recreational areas, roads, parking lots, and structures are built, increased flows are discharged into local waterways. As the amount of impervious surface increases, water that once percolated into the soil now flows over the land surface. Accordingly, increases in impervious surfaces can increase the frequency and intensity of stormwater flows through a watershed. Flow from rainstorms and other water uses wash rapidly across the impervious landscape, scouring the surface of various kinds of urban pollutants such as automotive fluids, cleaning solvents, toxic or hazardous chemicals, detergents, sediment, metals, bacteria, pesticides, oil and grease, and food wastes. These pollutants, unfiltered and unfettered, flow through the MS4 infrastructure and ultimately contaminate receiving waters.

Low Impact Development (LID) is smart, stormwater management that promotes the use of small-scale, natural drainage features to slow, clean, infiltrate and capture rainfall. It's an economical and efficient way to replenish local aquifers, reduce pollution, increase the reuse of water and improve the quality of our beaches and waterways.

1.2 LOW IMPACT DEVELOPMENT REGULATION

The LID objective of controlling and maintaining flow rate is addressed through land development and stormwater management techniques that imitate the natural hydrology (or movement of water) found on the site. Using site design and best management practices that allow for storage and retention, infiltration, filtering, and flowrate adjustments achieves the goals of LID, advances sustainability, and reduces the overall cost of stormwater management.

On November 16, 2010, the City adopted the LID regulations under Ordinance No. ORD-10-0035 with the stated purpose of:

- Requiring the use of LID standards and practices in future developments and redevelopments to encourage the beneficial use of rainwater and urban runoff;
- Reducing stormwater/urban runoff while improving water quality;
- Promoting rainwater harvesting;
- Reducing offsite runoff and providing increased groundwater recharge;
- Reducing erosion and hydrologic impacts downstream; and
- Enhancing the recreational and aesthetic values in our communities.

Amendments adopted by the City of Long Beach on November 12, 2013 included:

- Revised definitions for "development" and "redevelopment";
- Any development or redevelopment project involving the grinding/overlaying and replacement of existing parking lots shall be exempted from LID requirements;
- Any development or redevelopment projects located in the Port of Long Beach Harbor District shall comply with LID Best Management Practices (BMP) alternatives as stated in the Port of Long Beach Post-Construction Design Guidance Manual; and,
- The Director of Development Services was given the authority to make a hardship determination and to allow for modifications to the LID provisions.

LID regulation applies to all development and redevelopment in the City of Long Beach, except for the following projects:

- A development or redevelopment that does not require a building permit;
- A development or redevelopment creating, adding, or replacing less than 500 square feet of impervious surface area;
- A development or redevelopment involving only emergency construction activity required to immediately protect public health and safety;
- A development or redevelopment involving the grinding/overlaying and replacement of existing parking lots;
- A development or redevelopment involving only re-striping of permitted parking lots;
- A redevelopment resulting in land disturbing activities or replacement of 50% or less of an existing building, structure, or impervious surface area;
- An infrastructure project within the public right-of-way;
- A development or redevelopment involving only activity related to gas, water, cable, or electricity services on private property;
- A project involving only exterior movie and television production sets, or facades on existing developed site; or
- A development or redevelopment where LID requirements are technically infeasible.

1.3 DESIGN MANUAL PURPOSE AND SCOPE

The purpose of this design manual is to assist developers in complying with the requirements of the LID Ordinance.

The design manual summarizes the City's project review and permitting process, identifies prescriptive or design measures, and references source and treatment control BMP information. It provides guidance for individuals involved in development and redevelopment projects, which are defined as follows:

Development – any construction to build any new public or private residential projects (whether single-family, multi unit or planned unit development); new industrial, commercial, retail and other non-residential projects, including public agency projects; new impervious surface area; or mass grading for future construction.

Examples:

- New two story single family dwelling (4613 sqft) with attached two-car garage (530 sqft) and 2nd floor deck (240 sqft).

- New 2-story, Type II-B, 49,180 sq ft commercial building for office.

Redevelopment – land-disturbing activities that result in the replacement of more than fifty percent (50%) of an existing building, structure or impervious surface area on an already developed site.

Examples:

- Remove and replace 600 sqft of floor area of existing one story single family dwelling (1000 sqft).

- Rebuild 30,000 sqft of office space for an existing 1-story, Type II-B, 49,180 sqft commercial building.

The target audience for this design manual includes developers, designers, contractors, homeowners, and City staff that are engaged in plan-checking, permitting, and inspections related to land development activities. This design manual also contains the necessary forms and worksheets that developers, designers, consultants, contractors, and homeowners need to complete and have approved.

SECTION 2: PROJECT REVIEW AND PERMITTING PROCESS

2.1 PLAN APPROVAL PROCESS

The requirement to incorporate LID standards into the design plans of development and redevelopment projects to mitigate stormwater quality impacts is implemented through the City's plan review and approval process. During the review process, plans will be reviewed for compliance with the City's General Plan, zoning ordinances, and other applicable local ordinances and codes, including LID and stormwater requirements. Plans and specifications will be reviewed to ensure that the appropriate BMPs are incorporated to address stormwater pollution prevention goals. The reviewer will also determine if project designs need to be modified to address stormwater pollution prevention and Water Quality objectives.

Development and redevelopment projects are mainly processed through the Departments of Development Services and Public Works. The Development Services' Planning Bureau processes entitlement approvals, which require discretionary action. The Development Services' Building and Safety Bureau processes building/grading permits. The Public Works Engineering Bureau processes permits for drainage and work in the public right of way.

2.1.1 Planning Bureau Process

Development or redevelopment projects, as defined under Section 1.2, that require a discretionary Planning Permit (Site Plan Review, Standards Variance, Administrative/Conditional Use Permit, etc) and/or CEQA analysis (Categorical Exemption, Mitigated Negative Declaration, Environmental Impact Report) shall comply with the City's Stormwater LID Ordinance. Requirements of the City's Stormwater LID Ordinance, if not otherwise required, would appear as project conditions of approval of mitigation measures.

Planning Permits

Adopted administrative procedures require certain applications to undergo an enhanced level of Planning review. These entitlement requests precede building permit submittal and require approval by a discretionary body, such as the Site Plan Review Committee, Planning Administrator, Planning Commission, or City Council. Projects receiving discretionary approval are more often than not subject to conditions. A condition of approval requiring compliance with Stormwater LID requirements will be attached to applicable discretionary projects.

CEQA Analysis

Under CEQA provisions, all Planning Permit requests require some level of environmental clearance. Environmental analysis takes the form of a Categorical Exemption, Mitigated

Negative Declaration (MND), or Environmental Impact Report (EIR). While the majority of discretionary requests are deemed Categorically Exempt, others require an enhanced level of environmental review in the form of an MND or EIR. For these projects, mitigation measures are incorporated. Compliance with Stormwater LID requirements will be attached as a mitigation measure to applicable projects.

2.1.2 Building and Safety Bureau Process

Applicants must submit design plans to the Building and Safety Bureau for review and approval prior to issuance of building/grading permits. The Building and Safety staff will determine if the project can utilize the prescriptive methods or if it requires an engineered design. Applicable projects will be referred to the Department of Public Works for review and approval, if required (see Section 2.1.3) upon completion of review. Building and Safety staff issues the applicant a "Plan Check Correction List" that identifies all of the outstanding approvals required from City agencies. A building/grading permit will be issued once all corrections have been completed and approvals from applicable City agencies are obtained, including the incorporation of LID and stormwater requirements onto the design plans.

To assist the residents in small-scale residential development/redevelopment projects (4 units or less), Appendix A contains prescriptive methods detailing BMPs to be incorporated into the design plans. The advantage of the prescriptive methods is they were developed as pre-approved designs; therefore, use of these methods for small-scale residential development/redevelopment projects can dramatically reduce plan preparation and review time.

Outlined below are some guidelines for applicants to follow in submitting design plans for review and approval.

Review the following minimum submittal requirements for Small Scale Residential Developments (4 units or less):

- **Step One** - Submit design plans

  The applicant submits the design plans to the Building and Safety Bureau. During the plan submission and review process, Building and Safety staff will refer projects needing discretionary action to the Planning Bureau for additional processing.

  - One (1) set of full plans (plot, site, elevation, plumbing, architectural, and landscape plans).
  - Plans must include at least the following:
    - Location, size, and capacity of the prescriptive BMPs selected on the design plans; and

- Landscaping areas.

- Two or more signed Small Scale Residential Prescriptive Measure forms (Appendix A)
- Draft Covenant & Agreement (C&A) Form (Appendix C) with an Operation & Maintenance Plan, as discussed in Section 2.1.2.

- **Step Two -** Issue Building and/or Grading Permit

  Once all items on the "Plan Check Correction List" have been completed and all other City agency approvals received, including LID requirements, the Building and Safety staff issues the building and/or grading permit.

Review the following minimum submittal requirement for all other projects (Residential developments 5 units or more, all commercial/industrial projects):

To ensure compliance with all applicable codes, it is recommended that the registered design professional (i.e., architect, civil engineer, plumbing engineer, and/or landscape architect) coordinate at the early stage of the project design. Building and Safety's Plumbing and Public Works' plan-checking staffs are available for consultation regarding the applicable requirements based on the project concept.

- **Step One** - Identify appropriate BMPs

  Identify, evaluate, and incorporate into the design plans the appropriate BMPs for the project listed in Section 3.1 (LID) of this design manual.

  Approval for development projects and building/grading permits will not be granted/issued until appropriate and applicable LID and stormwater BMPs are incorporated into the design plans. Also, a plumbing permit from the Building and Safety Bureau will be required for certain treatment control BMPs such as grease traps, sump pumps, and clarifiers. For all projects other than small scale residential developments (4 units or less), if an infiltration BMP is chosen for treatment control, a soils report to address the feasibility of infiltration will be required to be submitted with the design plans for review and approval.

  For development or redevelopment projects located in the Port of Long Beach Harbor District, as designated in Title 21-Zoning Regulations, the site shall comply with LID BMP alternatives as stated in the Port of Long Beach Post-Construction Design Guidance Manual.

Step Two– Submit LID design plans for review

- One (1) set of full plans (plot, site, grading, civil, elevation, architectural, structural, plumbing, and landscape plans).
- Plans must be designed by a registered design professional.
- Plans must include, but not limited to, at least the following:
  - Location of all BMPs on the design plans, including elevations and drainage patterns.
  - Detailed drawings of all BMPs, including model, size, and capacity.
  - Stenciling note and/or detail.
  - Trash enclosure location and details.
  - Landscaping areas.
- Flow calculations identifying flow rate or volume of stormwater runoff that must be treated (see Appendix D). Submit the manufacturer's product specifications to verify that the selected BMP model can adequately handle the design flow rate.
- Soils Report (if infiltration is proposed, Appendix E)
- Draft Covenant & Agreement (C&A) Form (Appendix C) with an Operation & Maintenance Plan as discussed in Section 2.1.2.

➢ **Step Three** – Issue Building and/or Grading Permit

Once all items on the "Plan Check Correction List" have been completed and all other City agency approvals received, including any additional LID and stormwater requirements imposed by Public Works, the Building and Safety staff issues the building and/or grading permit.

Additional Information Regarding Draft Covenant & Agreement, Operation & Maintenance Plans:

A Covenant and Agreement (C&A), signed by the legal owner or authorized agent of the property document, for the project (except for one- or two-family dwellings) shall be submitted, along with the design plans showing the project's stormwater measures, during the plan review and approval process. Once the plans have been approved, the C&A shall be recorded with the County Recorder. A sample form of the C&A and instruction on how to record the document is provided in Appendix C. Provide a copy of the recorded C&A Building and Safety Bureau staff. The City will withhold the grading and/or building permit for the permit application until this requirement is satisfied.

Maintenance is crucial for proper and continuous operation, effectiveness, and efficiency of a structural or treatment control BMP. The cost of long-term maintenance should be evaluated during the BMP selection process. By signing a maintenance form, the legal property owner affirms he/she will perform regular and long-term maintenance of all BMPs installed onsite. For residential properties where the structural or treatment control BMPs are located within a common area and will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants and restrictions (CC&Rs). The C&A is bound to the property and transfers to the new owner with any subsequent sale of the property. It should be noted that an original copy of the letter of authority should be submitted for individuals signing the C&A form that are not the property owners. Attached to the C&A will be an Operation and Maintenance (O&M) Plan (see Appendix C for a sample) describing the BMP operation and maintenance procedures, employee training program and duties, operating schedule, maintenance frequency, routine service schedule, and other activities. A maintenance log shall be maintained at the facility to document all of the activities mentioned above. These documents may be inspected by the City of Long Beach at any time and shall be made available to the City upon request.

2.1.3 Department of Public Works Process

Applicants will be directed by Building and Safety staff to go to the Public Works Plan Check Coordinator on the 9th Floor of City Hall to determine if plan review by the Department of Public Works is required or not. If a plan review is not required, the Plan Check Coordination will complete the Project Submittal Checklist to indicate to the Building and Safety Bureau that a plan review is not required. Should a plan review be required, the applicant will need to follow the process described below.

- **Step One** - Submit design plans

  The applicant submits the design plans to the Public Works Plan Check Coordinator. During the plan submission and review process, the Plan Check Coordinator will determine which sheets need plan review and assess the number of sheets to be checked in order to determine the plan check fee. The fee will need to be paid prior to the plan review.

  The Plan Check Coordinator will hand the applicant a form containing the number of sheets to be checked and the type of plan review needed (ie., grading, LID etc.,). The applicant will be directed to the 10th floor with the form to have the Public Work attendant write up the invoice for payment after which the applicant will take it to the cashier on the 4th Floor for payment. The applicant shall provide a copy of the receipt to the Plan Check Coordinator to complete the plan submittal process.

  The applicant will be required to submit the following items:

- One (1) set of full plans (plot, site, elevation, utility, mechanical, plumbing, and landscape plans).
- Plans must include at least the following:
  - Location, size, and capacity of the prescriptive BMPs selected on the design plans; and
  - Landscaping areas.

➢ **Step Two** - Resubmit design plans

The applicant will be notified when to pick up the reviewed plans and to make any corrects resulting from the plan check review. A "Pink Sheet" will be issued by the Plan Check Coordinator and/or Staff to the applicant containing a list of all required items to be corrected in order to acquire approval by Public Works. After the correction are made, the applicant will need to resubmit the design plans with the Pink Sheet showing that all correction have been done. This process will be repeated until all corrections have been made.

Upon approval of the design plans, the Plan Check Coordinator will stamp and sign the plans. The applicant will then be directed to the Building and Safety Bureau for further processing. The Building and Safety Bureau will issue the building/grading permit when all applicable requirements or City agency approvals are obtained.

2.2 INSPECTION PROCESS

To ensure that all LID and stormwater related BMPs are constructed and/or installed in accordance with the approved design plans, the City requires a LID Observation Report (LOR) to be submitted to the Building and Safety Bureau prior to the issuance of the Certificate of Occupancy or building final for all BMP installations on private properties. Public Works inspection shall be required for all BMP installations in the public right of way prior to the issuance of the Certificate of Occupancy or building final.

All residential developments of 5 units or more and all commercial/industrial projects reviewed and approved will require a LOR which shall be prepared, signed, and stamped by the registered design professional (i.e., a California-licensed civil engineer, or architect) responsible for the design of the LID design plans, certifying that:

1. He/she is the registered professional for the approved LID design plans; and
2. He/she or the designated staff under his/her responsible charge has performed the required site visits at each significant construction stage and at completion to verify that the BMPs shown on the approved design plans have been constructed and installed in accordance with the approved LID design plans.

An original LOR needs to be submitted and not a photocopy. The Certificate of Occupancy or Building Final will be issued by the Building and Safety Bureau after all required documents are submitted and verified by staff. At the stage, the project has been determined, through the normal inspection process to be built in accordance with the approved plan, including the construction and/or installation of appropriate LID and/or stormwater-related BMPs, to comply with all applicable codes, ordinances, and other laws.

SECTION 3: STORMWATER MANAGEMENT MEASURES

3.1 LOW IMPACT DEVELOPMENT (LID) PLAN

Project applicants for developments and redevelopments will be required to incorporate stormwater mitigation measures into their design plans and submit the plans to the City for review and approval. The design plans will be subjected to a review process as indicated in Section 2, prior to the issuance of approvals for building and/or grading permits.

Projects that are part of a larger common plan of development involving five units or more will be subject to the requirements for "All Other Development", as set forth in Section 3.1.3. This includes projects that are subject to one common grading permit and projects that have phased schedules or are intended to be sectioned-off for sale to individual homeowners.

Applicants for all development and redevelopment projects will also be required to incorporate the following performance measures and practices into their design plans.

Conserve Natural Areas

Each project site possesses unique topographic, hydrologic and vegetative features, some of which are more suitable for development than others. Locating development on the least sensitive portion of a site and conserving naturally vegetated areas can minimize environmental impacts in general and stormwater runoff impacts in particular.

If applicable and feasible for the given site conditions, the following measures are required and should be included in the project site layout:

1. Concentrate or cluster improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state;
2. Limit clearing and grading of native vegetation at the site to the minimum area needed to build the home, allow access, and provide fire protection;
3. Maximize trees and other vegetation at the site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought-tolerant plants; and
4. Preserve riparian areas and wetlands.

Protect Slopes and Channels

Erosion of slopes and channels can be a major source of sediment and associated pollutants, such as nutrients, if not properly protected and stabilized.

Slope protection practices must conform to design requirements or standards set forth by local permitting agency erosion and sediment control standards and design standards. The post-construction design criteria described below are intended to enhance and be consistent with these local standards.

1. Slopes must be protected from erosion by safely conveying runoff from the tops of slopes.
2. Slopes must be vegetated with first consideration given to native or drought-tolerant species.

The following measures should be implemented to provide erosion protection to unlined receiving streams on the project site. Activities and structures must conform to applicable permitting requirements, standards and specifications of agencies with jurisdiction (e.g., U.S. Army Corps of Engineers, California Department of Fish and Game, or RWQCB).

1. Utilize natural drainage systems to the maximum extent practicable, but minimize runoff discharge to the maximum extent practicable.
2. Stabilize permanent channel crossings.
3. Install energy dissipaters, such as rock riprap, at the outlets of storm drains, culverts, conduits or channels that discharge into unlined channels.

Provide Storm Drain System Stenciling and Signage

Storm drain message markers or placards are required at all storm drain inlets such as catch basins and floor drains within the boundary of the project (only required for residential developments 5 units or more, all commercial/industrial projects). The marker should be placed in clear sight for anyone approaching the inlet. All storm drain inlet locations must be identified on the development site map.

A sample of the approved Storm Drain message placards is shown on Appendix F.

3.1.2 SMALL SCALE RESIDENTIAL DEVELOPMENT PROJECTS (4 UNITS AND LESS)

The majority of small-scale residential projects are not required to complete formal hydrologic analysis. The basic objectives of small-scale residential projects include reducing a site's impervious surfaces, improving a site's ability to infiltrate stormwater, conserving stormwater runoff for other on-site water demand uses, and reducing negative impacts downstream.

REQUIREMENTS:

i. Development less than one acre, or redevelopment that alters more than 50% of existing buildings, structures, or impervious surfaces of an existing developed site, shall implement at least two adequately sized LID BMP alternatives; or

ii. Development that is one acre or larger, the development shall comply with the standard and requirements of Section 3.1.3 – All Other Development

BEST MANAGEMENT PRACTICES (BMPS):

Upon filing an application for a building and/or grading permit with the Building and Safety Bureau, a separate plot plan identifying the LID BMPs that are used (including size) and drainage area tributary to each BMP shall be shown in accordance with the prescriptive methods.

The LID BMPs, listed below and presented in Appendix A, have been established as prescriptive LID improvement features to be employed on a qualifying small-scale project. The BMPs are presented with the intent of providing self-contained BMP background context and sizing requirements to facilitate a permit applicant to follow and comply with the City of Long Beach's LID Ordinance. Applicants may choose from two or more of the prescriptive BMPs to comply with the ordinance. Any remaining runoff that cannot feasibly be managed onsite must be mitigated by paying an offsite runoff mitigation fee in the manner and amount set forth in the schedule of fees and charges established by City Council resolution pursuant to Section 18.74.050.B of the Long Beach Municipal Code.

The prescriptive small scales BMPs are as follows:

1. Rain Barrels & Small Cisterns
2. Permeable Pavements (or Porous Pavement Systems)
3. Planter Boxes
4. Rain Gardens
5. Dry Wells
6. Tree Planting

See Figure 3.1 and Table 3.1, which demonstrates the use of all six of these small scale residential BMPs at a residence.

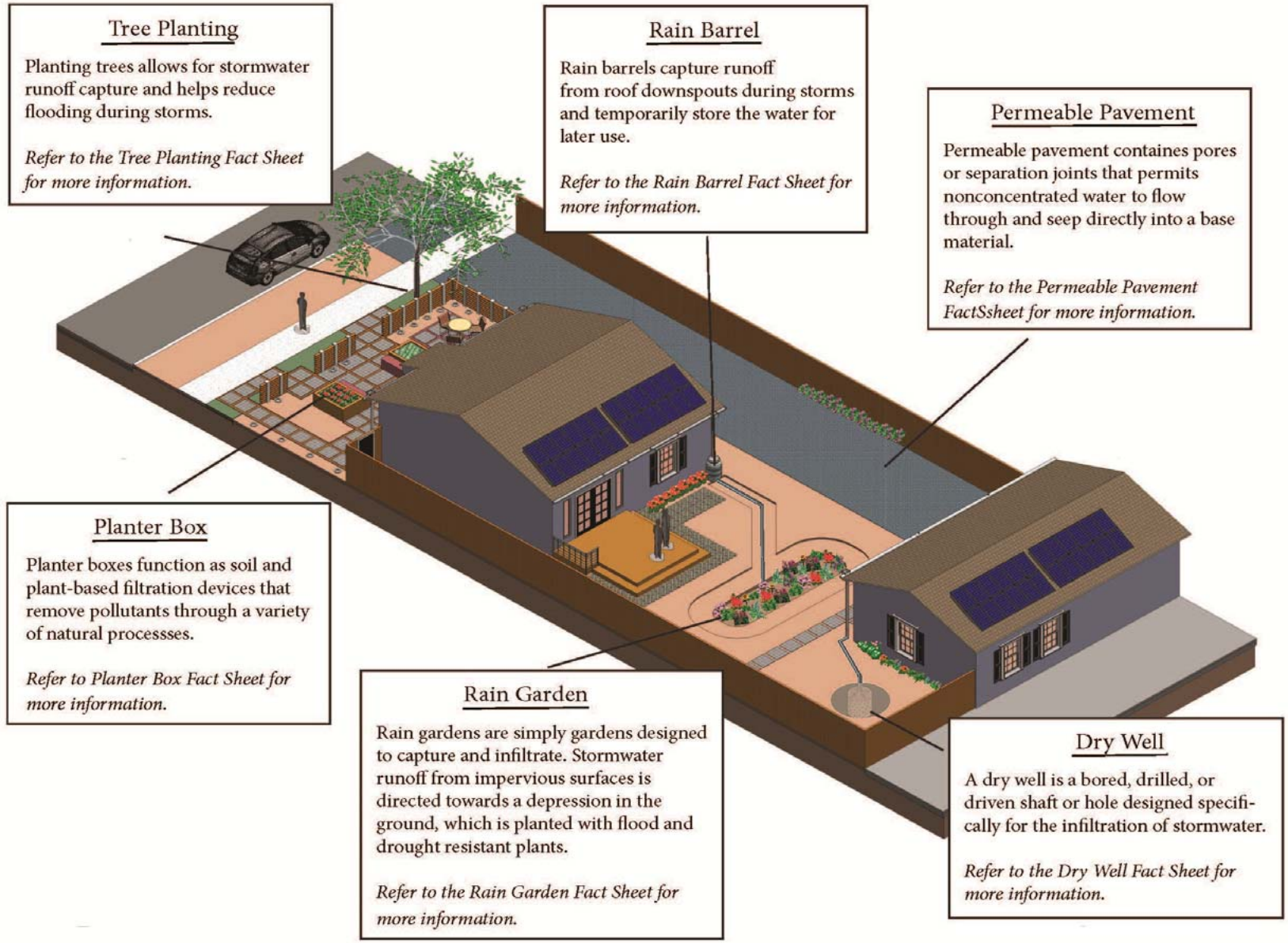
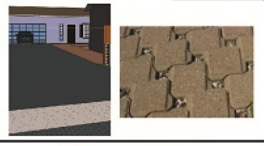


Figure 3.1- Small Scale Residential BMP Schematic

Table 3.1- Small Scale Residential BMP Prescriptive Options

LID Stormwater Comprehensive

Rain Barrel		Rain barrels capture runoff from roof downspouts during storms and temporarily store the water for later use.
Tree Planting		Planting trees allows for stormwater runoff capture and helps reduce flooding during storms.
Planter Box		Planter boxes function as soil and plant-based filtration devices that remove pollutants through a variety of natural processes.
Permeable Pavement		Permeable pavement contains pores or separation joints that permits nonconcentrated water to flow through and seep directly into a base material.
Rain Garden		Rain gardens are simply gardens designed to capture and infiltrate. Stormwater runoff from impervious surfaces is directed towards a depression in the ground, which is planted with flood and drought resistant plants.
Dry Well		A dry well is a bored, drilled, or driven shaft or hole designed specifically for the infiltration of stormwater.

3.1.3 ALL OTHER DEVELOPMENTS

Any development or redevelopment project (residential developments of 5 units or more and nonresidential developments) that does not meet the requirements of Section 3.1.2 – Small Scale Development Projects, shall comply with this section:

REQUIREMENTS:

1. Residential development that is one acre or greater or has 5 units or more, the entire site shall comply with the standards and requirements of Section 3.1.3;

2. Development or where redevelopment results in an alteration of more than 50% of existing buildings, structures, or impervious surfaces of an existing developed site, the entire site shall comply with the standards and requirements of Section 3.1.3;

3. For development or redevelopment projects located in the Port of Long Beach Harbor District as designated in Title 21-Zoning Regulations, the site shall comply with LID BMP alternatives set forth in the Port of Long Beach Post-Construction Design Guidance Manual.

A LID Plan shall be prepared to comply with the following:

1. Stormwater runoff will be infiltrated, evapotranspired, and/or captured and used through stormwater management techniques as identified in Section 4.1. The onsite stormwater management techniques must be properly sized, at a minimum, to infiltrate, evapotranspire, store for use, without any stormwater runoff leaving the site to the maximum extent feasible, for at least the volume of water produced by the water quality design storm event that results from:

    i. The 85th percentile 24-hour runoff event determined as the maximized capture stormwater volume for the area using a 48- to 72-hour drawdown time, from the formula recommended in Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual of Practice No. 87, (1998); or

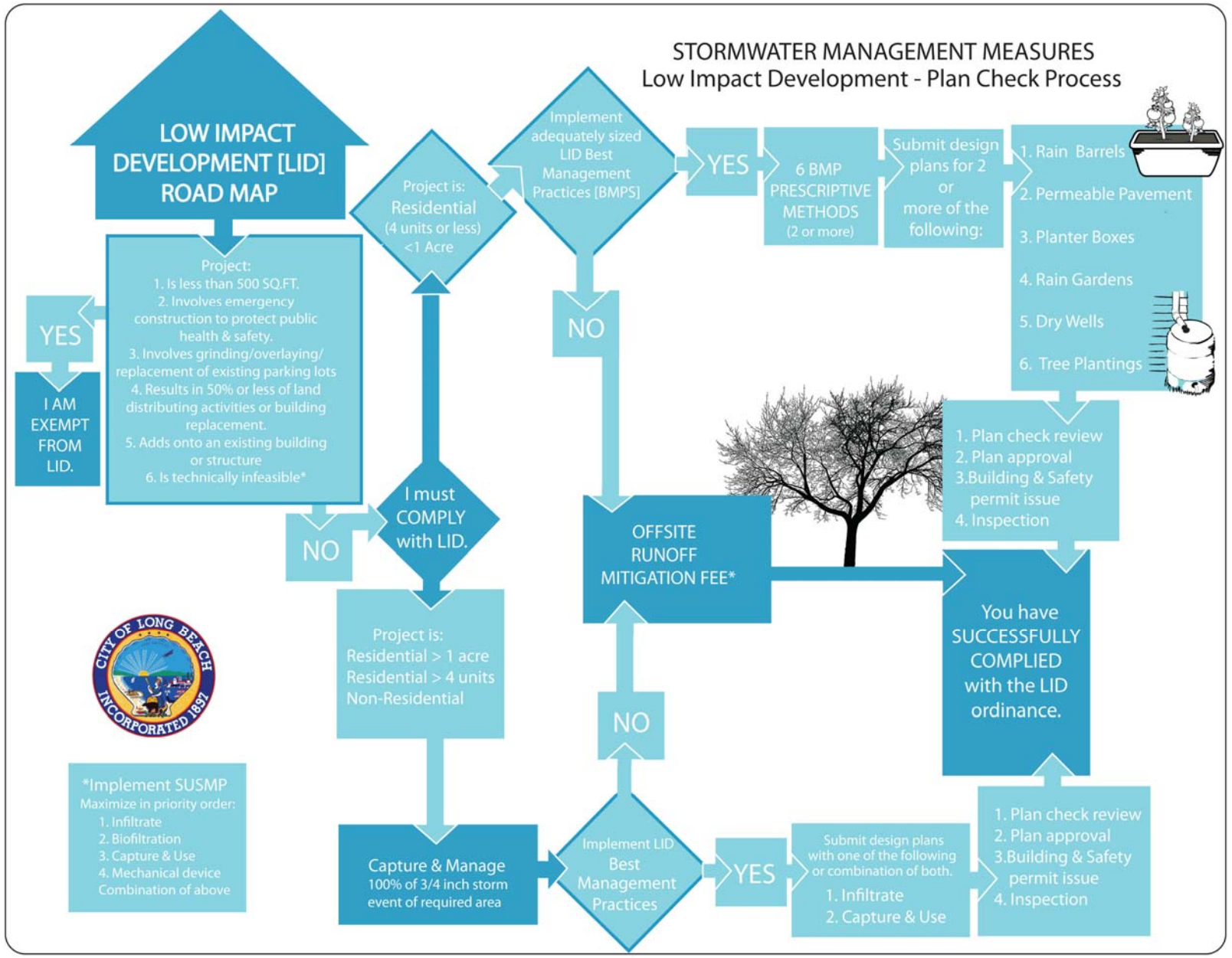
    ii. The volume of annual runoff based on unit basin storage water quality volume, to achieve 80 percent or more volume treatment by the method recommended in the California Stormwater Best Management Practices Handbook – Industrial/Commercial, (2003); or

    iii. The volume of runoff produced from a 0.75-inch storm event.

2. Pollutants shall be prevented from leaving the development site for a water quality design storm event as defined above.

3. Hydromodification impacts shall be minimized to natural drainage systems.

If partial or complete onsite compliance of any type is technically infeasible, the project Site and LID Plan shall be required to comply with, at a minimum, all applicable SUSMP requirements in order to maximize onsite compliance. Any remaining runoff that cannot feasibly be managed onsite must be mitigated with the offsite runoff mitigation fee requirements of Section 5.0. Figure 3.2 is a schematic, which depicts the design requirements for both small-scale residential projects, and depicts the design requirements for all other developments.


STORMWATER MANAGEMENT MEASURES
Low Impact Development - Plan Check Process
LOW IMPACT DEVELOPMENT [LID] ROAD MAP
Project:
1. Is less than 500 SQ.FT.
2. Involves emergency construction to protect public health & safety.
3. Involves grinding/overlaying/ replacement of existing parking lots
4. Results in 50% or less of land distributing activities or building replacement.
5. Adds onto an existing building or structure
6. Is technically infeasible*
YES
I AM EXEMPT FROM LID.
NO
I must COMPLY with LID.
Project is: Residential (4 units or less) <1 Acre
Implement adequately sized LID Best Management Practices [BMPS]
YES
6 BMP PRESCRIPTIVE METHODS (2 or more)
Submit design plans for 2 or more of the following:
1. Rain Barrels
2. Permeable Pavement
3. Planter Boxes
4. Rain Gardens
5. Dry Wells
6. Tree Plantings
NO
OFFSITE RUNOFF MITIGATION FEE*
1. Plan check review
2. Plan approval
3.Building & Safety permit issue
4. Inspection
You have SUCCESSFULLY COMPLIED with the LID ordinance.
Project is:
Residential > 1 acre
Residential > 4 units
Non-Residential
NO
Capture & Manage
100% of 3/4 inch storm event of required area
Implement LID Best Management Practices
YES
Submit design plans with one of the following or combination of both.
1. Infiltrate
2. Capture & Use
1. Plan check review
2. Plan approval
3.Building & Safety permit issue
4. Inspection
*Implement SUSMP
Maximize in priority order:
1. Infiltrate
2. Biofiltration
3. Capture & Use
4. Mechanical device
Combination of above
CITY OF LONG BEACH
INCORPORATED 1897

3.2 STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP)

Any project that cannot comply with the LID requirements in Section 3.1 shall be required to comply with, at a minimum, all applicable SUSMP requirements in order to maximize onsite compliance.

Project applicants will be required to incorporate stormwater mitigation measures into their design plans and submit the plans to the City for review and approval. The design plans will be subjected to a review process as indicated in Section 2, prior to the issuance of approvals for building and/or grading permits.

3.3 SITE SPECIFIC MITIGATION

Site Specific project applicants will be required to submit to the City a design plan that incorporates appropriate stormwater mitigation measures and details the source and treatment control BMPs, and must also submit the O&M plan for the treatment control BMPs. All maintenance agreements should refer the Covenant and Agreement forms in Appendix C. The design plans will be subject to the review and approval process described in Section 2, prior to the issuance of building or grading permits.

3.4 SOURCE CONTROL MEASURES

Source control measures are low-technology practices designed to prevent pollutants from contacting stormwater runoff or to prevent discharge of contaminated runoff to the storm drainage system. This section addresses site-specific source control measures consisting of specific design features or elements. These control measures have been developed for specific types of sites or activities that have been identified as potential significant sources of pollutants in stormwater. Each of the measures specified in this section should be implemented in conjunction with any other operational source control measure such as good housekeeping, and employee training to optimize pollution prevention.

The measures addressed in this section apply to both stormwater and non-stormwater discharges. Non-stormwater discharges are the discharge of water runoff from over irrigation, draining of swimming pools, washdowns and/or any other water produce and found to run over land and into the municipal separate storm sewer system (MS4) such as gutters, catch basins storm water floor drains stormwater channels, ditches and outfalls. Discharges of stormwater and non-stormwater to the MS4 or a water body may be subject to local, state, or federal permitting prior to discharge. The Long Beach Public Works Storm Water Management (SWM) should be contacted prior to any discharge. Discuss the matter with the SWM Staff if you are uncertain as to which agency should be contacted.

Some of the measures presented in this section require connection to the sanitary sewer system. Connection and discharge to the sanitary sewer system without prior approval or obtaining the required permits is prohibited. Contact the Long Beach Water Department

(LBWD) staff at 562-570-2300 to obtain information regarding obtaining sanitary sewer permits from the Sanitation Districts of Los Angeles County. Discharges of certain types of flows to the sanitary sewer system may be cost prohibitive and may not be allowed. The designer is urged to contact the LBWD prior to completing site and equipment design of the facility.

Site-specific source control measures and associated design features specified for various sites and activities are summarized in Table 3.2.

The source control measures and the site-specific requirements that are discussed in this section should be incorporated in the design plans when appropriate. The C&A should also make a reference to any long-term operational plans such as a Stormwater Pollution Prevention Plan (SWPPP) to commit the facility to these measures.

Table 3.2: Summary of Site-Specific Source Control Measure Design Features

Site-Specific Source Control Measure	**DESIGN FEATURE OR ELEMENT**						
	Signs, placards, stencils	Surfacing (compatible, impervious)	Covers, screens	Grading/berming to prevent run-on	Grading/berming to provide secondary containment	Sanitary sewer connection	Emergency Storm Drain Seal
Storm Drain Message and Signage (S-1)	X						
Outdoor Material Storage Area Design (S-2)	X	X	X	X	X		X
Outdoor Trash Storage and Waste Handling Area Design (S-3)	X	X	X	X		X	
Outdoor Loading/Unloading Dock Area Design (S-4)	X	X	X	X	X		
Outdoor Repair/Maintenance Bay Design (S-5)	X	X	X	X	X		X
Outdoor Vehicle/Equipment/ Accessory Washing Area Design (S-6)	X	X	X	X	X	X	X
Fueling Area Design (S-7)	X	X	X	X	X		X

SECTION 4: BMP SELECTION

4.1 BMP SELECTION

BMPs shall be designed to manage and capture stormwater runoff. Infiltration systems are the first priority type of BMP improvements as they provide for percolation and infiltration of the stormwater into the ground, which not only reduces the volume of stormwater runoff entering the MS4, but also, in some cases, can contribute to groundwater recharge.

Each type of BMP shall be implemented to the maximum extent feasible when determining the appropriate BMPs for a project.

1. Infiltration Systems
2. Stormwater Capture and Use
3. Combination of Above

If partial or complete onsite compliance of any type is technically infeasible, the project Site and LID Plan shall be required to comply with, at a minimum, all applicable SUSMP requirements in order to maximize onsite compliance. Any remaining runoff that cannot feasibly be managed onsite must be mitigated with the offsite mitigation fee outlined in Section 5.0.

4.2 INFILTRATION FEASIBILITY SCREENING

The implementation of infiltration BMPs may be deemed infeasible at a project site due to existing site conditions. To assist in the determination of compliance feasibility, a categorical screening of specific site information shall be carried out to assess site conditions.

The first category of screening shall consist of specific site conditions, which if present at the site, would deem the specified BMP-type "feasible". The second category of screening shall consist of specific site conditions, which if present at the site, would deem the BMP-type "potentially feasible". Project locations passing this screening category may still be able to utilize the screened compliance measure, though the implementation of such a measure may require supplementary actions as approved by the City. The third category of screening shall consist of site conditions, which if present at the site, would deem a specified BMP-type "infeasible". This type of screening can generally be carried out in the pre-planning stage of a project. These categorical screenings must be verified by a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer or geologist.

To assist in the determination of site feasibility for infiltration BMPs, Table 4.1 has been created.

	Category 1 Screening (Feasible)	**Category 2 Screening (Potentially Feasible)**	**Category 3 Screening (Infeasible)**
Description	☐ Underlying Groundwater ☐ Depth of bottom of infiltration facility to seasonal high groundwater is > 10 ft ☐ Site Soils ☐ Infiltration rate (K_{sat}) is > 0.5 in/hr ☐ Geotechnical hazards ☐ Site Surroundings ☐ Buildings or structures are at least 25 ft away from the potential infiltration BMP ☐ Site is not located within the designated hillside grading area. ☐ No continuous presence of dry weather flows	1. Underlying Groundwater ❑ Depth from bottom of infiltration facility to seasonal high groundwater is ≤ 10 ft ❑ Unconfined aquifer is present with beneficial uses that may be impaired by infiltration. Full treatment required if this is the case ❑ Groundwater is known to be polluted. 2. Site Soils ❑ Infiltration rate is ≤ 0.5 in/hr but potential connectivity to higher K_{sat} soils is feasible ❑ Geotechnical hazards such as liquefaction are a potential near the site 3. Site Surroundings ❑ Buildings or structures are within 10 to 25 ft of the potential infiltration BMP ❑ High-risk areas such as service/gas stations, truck stops, and heavy industrial sites. Full treatment is required if this is the case, or high-risk areas must be separate from stormwater runoff mingling	1. Underlying Groundwater ❑ Depth from bottom of infiltration facility to seasonal high groundwater is ≤ 5 ft ❑ Sites with soil and/or groundwater contamination** Infiltration is not feasible 2. Site Soils ❑ Infiltration rate is ≤ 0.3 in/hr and connectivity to higher K_{sat} soils is infeasible ❑ Geotechnical hazards such as liquefaction, collapsible soils, or expansive soils exist 3. Site Surroundings ❑ Site is located on a fill site ❑ Site is located on or within 50 feet upgradient of a steep slope (20% or greater) and has not been approved by a professional geotechnical engineer or geologist
Instructions	If all of the above boxes are checked, they shall be confirmed by a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer or geologist, verifying that infiltration BMPs are feasible at the site*. Otherwise, proceed to Category 2 screening.	If all of the above boxes are checked, or if corresponding boxes in Category 1 are checked in combination with the above boxes, a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer or geologist shall be carried out to approve infiltration measures*. Otherwise, proceed to Category 3 screening.	If any of the above boxes are checked, a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer or geologist shall be submitted to prove infiltration practices are not feasible. *

Table 4.1: Infiltration Feasibility Screening

* Geotechnical Reports shall be reviewed by Building and Safety Bureau and Public Works Department. See Geotechnical Report Requirements herein.

** The presence of soil and/or groundwater contamination and/or the presence of existing or removed underground storage tanks shall be documented by CEQA or NEPA environmental reports, approved geotechnical reports, permits on file with the City, or a review of the State of California's Geotracker website.

Assessing Site Infiltration Feasibility

Assessing a site's potential for implementation of Low Impact Development Best Management Practices (LID BMPs) and infiltration BMPs requires both the review of existing information and the collection of site-specific information. Available information regarding site layout and slope, soil type, geotechnical conditions, and local groundwater conditions should be reviewed as discussed below. In addition, soil and infiltration testing is required to be conducted to determine if stormwater infiltration is feasible and to determine the appropriate design parameters for the infiltration BMP.

Geotechnical Considerations and Report Requirements:

A geotechnical report will be required for projects that will incorporate infiltration as part of the drainage system. Geotechnical reports shall be signed by a professional Geotechnical or Civil Engineer licensed in the State of California and/or a Certified Engineering Geologist.

Site Conditions
Slope:

The site's topography should be assessed to evaluate surface drainage, topographic high and low points, and to identify the presence of steep slopes that qualify as hillside locations, all of which have an impact on what type of infiltration BMPs will be most beneficial for a given project site. Stormwater infiltration is more effective on level or gently sloping sites. On hillsides, infiltrated runoff may seep a short distance down slope, which could cause slope instability depending on the soil or geologic conditions, or result in nuisance seepage. Appendix E provides general guidance.

Soil Type and Geology:

The site's soil types and geologic conditions should be determined to evaluate the site's ability to infiltrate stormwater and to identify suitable, as well as unsuitable locations for locating infiltration-based BMPs.

In addition, available geologic or geotechnical reports on local geology should be reviewed to identify relevant features such as depth to bedrock, rock type, lithology, faults, and hydrostratigraphic or confining units. These geologic investigations may also identify shallow water tables and past groundwater issues that are important for BMP design. Appendix E provides general guidance.

Groundwater Considerations:

The depth to groundwater beneath the project during the wet season may preclude infiltration. A minimum of five feet of separation to the seasonal (December through April) high ground water level and mounded groundwater level is required.

Infiltration on sites with contaminated soils or groundwater that could be mobilized or exacerbated by infiltration is not allowed, unless a site-specific analysis determines the infiltration would be beneficial. A site-specific analysis may be conducted where groundwater pollutant mobilization is a concern to allow for infiltration-based BMPs. Areas with known groundwater impacts include sites listed by the RWQCB's Leaking Underground Storage Tanks (LUST) program and Site Cleanup Program (SCP). The California State Water Resources Control Board maintains a database of registered contaminated sites through their 'Geotracker' Program. Registered contaminated sites can be identified in the project vicinity when the site address is typed into the "map cleanup sites" field. Mobilization of groundwater contaminants may also be of concern where contamination from natural sources is prevalent (e.g., marine sediments, selenium rich groundwater, to the extent that data is available). Appendix E provides general guidance.

Managing Offsite Drainage:

Locations and sources of offsite run-on to the site must be identified early in the design process. Offsite drainage must be considered when determining appropriate BMPs for the site so that the drainage can be managed. By identifying the locations and sources of offsite drainage, the volume of water running onto the site may be estimated and factored into the siting and sizing of onsite BMPs. Vegetated swales or storm drains may be used to intercept, divert, and convey offsite drainage through or around a site to prevent flooding or erosion that might otherwise occur.

4.3 CAPTURE AND USE FEASIBILITY SCREENING

Capture and use, commonly referred to as rainwater harvesting, collects and stores stormwater for later use, thereby reducing the quantity of stormwater runoff. Partial capture and use can also be achieved as part of a treatment train by directing the overflow to a bioretention system to provide additional volume reduction and water quality treatment in instances where the quantity of runoff from a storm event exceeds the volume of the collection tank.

In the City of Long Beach, the use of collected stormwater will primarily be limited to irrigation of landscaped surfaces. However, as new guidelines and guidance becomes available the potential for other uses of collected stormwater will be considered. Capture and use BMPs that are designed with the intent to use captured stormwater for indoor or consumptive purposes will be reviewed on a case-by-case basis to ensure that all Clean Water treatment, plumbing, and Health and Safety codes are met.

At a minimum, capture and use BMPs must be designed and maintained to ensure adequate capacity is available to capture the stormwater quality design volume within 3 days of a storm event that is forecasted to have a 50% or greater probability of providing precipitation. Precipitation forecast information must be obtained from the National Weather Service Forecast Office (e.g. by entering the zip code of the developments location at http://www.srh.noaa.gov/forecast). BMPs sized to capture only the runoff produced from the 0.75 inch storm event, or BMPs designed to capture less than this volume if being used in conjunction with other BMPs, must therefore drawdown their entire captured volume within 3 days of a storm event. Capture and use BMPs designed for storm events larger than 0.75 inches are not required to disperse their entire captured volume within 3 days of capture; rather, the requirement mandates that enough water be dispersed from the BMP to ensure that adequate capacity is available to capture the next storm event up to 0.75 inches.

In instances where the quantity of runoff from the 0.75 inch storm event exceeds the volume of the collection tank, partial capture and use can also be achieved as part of a treatment train by directing the overflow to stable vegetated areas where erosion or suspension of sediment is not a factor or through a high flow biotreatment BMP to provide additional volume reduction and water quality treatment. Overflow from the tank into the storm drain system is not allowed.

The implementation of capture and use BMPs may be deemed infeasible at a project site due to existing site conditions. To assist in the determination of compliance feasibility, a categorical screening of specific site information shall be carried out to assess site conditions. This screening approach follows the same general guidelines as those designed for the infiltration feasibility screening. Table 4.2 has been created to help determine site feasibility for capture and use BMPs.

	Category 1 Screening (Feasible)	**Category 2 Screening (Potentially Feasible)**	**Category 3 Screening (Infeasible)**
Description	1. Landscaped Area ☐ Landscaped area categorization of 1 exists in accordance with Table 4.3 ☐ Captured volume equal to or less than the Estimated Total Water Usage (ETWU) from October 1 - April 30. 2. Site Soils ☐ Geotechnical hazards are not a potential near the site 3. Vector Control ☐ Approved vector control measures will be implemented	1. Landscaped Area ☐ Landscaped area categorization of 2 exists in accordance with Table 4.3 ☐ Captured volume greater than the Estimated Total Water Usage (ETWU) from October 1 - April 30. 2. Site Soils ☐ Geotechnical hazards such as liquefaction are a potential near the site ☐ Soil hydraulic conductivities are sufficient for the designed water application rate; if not, soil amendments will be implemented	1. Landscaped Area ☐ Landscaped area categorization of 3 exists in accordance with Table 4.3 2. Site Soils ☐ Geotechnical hazards such as landsliding, collapsible soils, or expansive soils exist 3. Site Surroundings ☐ Site is located on or within 50 feet of a steep slope (20% or greater) as determined by the Department of Building and Safety; irrigation within 3 days of a rain event could cause geotechnical instability
Instructions	If all of the above boxes are checked, they shall be confirmed by a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional civil engineer, geotechnical engineer, geologist, or landscape architect, verifying that capture and use BMPs are feasible at the site.* Otherwise, proceed to Category 2 screening.	If all of the above boxes are checked, or if corresponding boxes in Category 1 are checked in combination with the above boxes, a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional civil engineer, geotechnical engineer, geologist, or landscape architect, shall be carried out to approve capture and use measures.* Otherwise, proceed to Category 3 screening.	If any of the above boxes are checked, a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer, geologist, or landscape architect shall be submitted to prove capture & use practices are not feasible. *

Table 4.2: Capture and Use Feasibility Screening

* Geotechnical Reports shall be reviewed by the Building and Safety Bureau and Public Works Department. See Geotechnical Report Requirements contained in the Infiltration Feasibility section.

Table 4.3 has been created to help determine site feasibility for capture and use BMPs based on the local infiltration rate as well and the percent of the project that is landscaped. The table is to be used in conjunction with Table 4.2 to determine site feasibility.

Table 4.3: Landscaped Area Categorization

	Percent of Project that is Landscaped					
Local Infiltration Rate	0-5%	5-10%	10-20%	20-30%	30-50%	>50%
0.3 - 0.5 in/hr	2	2	2	1	1	1
0.2 - 0.3 in/hr	3	2	2	2	1	1
0.1 - 0.2 in/hr	3	3	2	2	2	1
0 - 0.1 in/hr	3	3	3	2	2	2

Assessing Site Capture and Use Feasibility

As with infiltration BMPs, assessing a site's potential for implementation of capture and use BMPs requires both the review of existing information and the collection of site-specific information. Available information regarding the site's landscaped area should be reviewed as discussed below. In addition, human health concerns should be prioritized, particularly with regards to vector control issues arising from the addition of standing water on site.

Landscaped Area Assessment

For capture and use BMPS, captured rainfall is stored during rain events and used for irrigation purposes at a later time, thereby offsetting potable water demand and reducing pollutant loading to the storm drain system. Therefore, sufficient landscaped area with appropriate water demand is needed for the captured runoff to be directed to. A properly sized cistern should be able to contain the runoff generated from the design storm event and discharge that water for irrigation use within a specified drawdown time.

In the City of Long Beach, cisterns will primarily be sized to capture the runoff generated from the 0.75-inch storm while meeting the drawdown time requirement. A site's landscaped area must therefore be able to retain this volume of water within the appropriate drawdown time. Depending on the type of irrigation application that is desirable at a site, two different methods exist to determine if a site has adequate landscaped cover for capture and use feasibility:

1. For sites with sufficient agronomic demand to meet or exceed the captured supply of stormwater within the drawdown time, Category 1 Feasibility may apply. Agronomic demand must be calculated and reported by a professional landscape architect or qualified professional.
2. For sites with sufficient landscaped area and dispersal capacity (i.e. ability to receive irrigation water without generating runoff) to meet or exceed the captured supply of stormwater within the drawdown time, Category 2 Feasibility may apply. The dispersal capacity can be assumed to be equal to the infiltration capacity of the site

soil for simplicity. The infiltration rate must be calculated and reported by a professional landscape architect, civil engineer, geotechnical engineer, or geologist.

The above criteria must be assessed assuming that no irrigation occurs within the first 24 hours immediately following a storm. This means that a drawdown time of 72 hours must consider only 48 hours of active application. Agronomic demands and infiltration rates must be assessed within 3 days of a storm event to account for resulting diminished demands.

BMPs designed for extended holding times shall be reviewed on a case-by-case basis for feasibility. A site not meeting the minimum landscaped area criteria is not feasible for capture and use BMPs (See Table 4.3 in conjunction with Table 4.2).

City of Long Beach, Department of Health and Human Services, Bureau of Environmental Health Requirements

Projects that are implementing rainfall or urban runoff capture and distribution systems must obtain approval from the City of Long Beach, Department of Health and Human Services (CLBDHHS), Bureau of Environmental Health.

Vector Control Considerations

A vector is any insect, arthropod, rodent, or other animal that is capable of harboring or transmitting a causative agent of human disease. In the City of Long Beach, the most significant vector population related to stormwater is mosquitoes.

Vector sources occur where conditions provide habitat suitable for breeding, particularly any source of standing water. This means that stormwater BMPs, especially those of the capture-and-use type, can be breeding grounds for mosquitoes and other vectors resulting in adverse public health effects related to vectors and disease transmission. Because of this, efforts shall be made to design capture-and-use BMPs that do not facilitate the breeding of vectors. Vectors should be considered during the preparation of stormwater management and maintenance plans and during preconstruction planning to avoid creating possible public health hazards.

Plan submittal and review will focus on projects which integrate oversized capture and use BMPs designed to hold captured stormwater for longer than 72 hour periods. These projects will require additional treatment such as filtration or disinfection to protect the collection tanks from fouling, to prevent the breeding of vectors, and/or to improve the quality of water for reuse applications. These BMPs must have appropriate vector control measures incorporated into the design of the system to exclude vector access and breeding (i.e., observation access for vector inspection and treatment, physical barriers to exclude mosquitoes). These BMPs must be approved by the CLBDHHS Bureau of Environmental Health and, where applicable for projects on the east side of the City, by the Greater Los Angeles County Vector Control District. If vector breeding is taking place at a commercial or

residential site, as a result of contained stormwater or inadequately maintained BMPs, immediate corrective actions will be required to protect public health.

Cross Connection and Potable Water Protection Considerations (please contact LBWD regarding this topic.)

The CLBDHHS Bureau of Environmental Health is mandated by California Health & Safety Code Section 116800-116820 to protect public health by preventing the contamination of potable water supplies. Potable water supplies are defined as water that is fit for consumption by humans and other animals. While various types of infiltration BMPs (i.e. basins, trenches, dry wells) are very important and successful in Low Impact Development projects, careful review of water quality impacts on groundwater and potable water supplies is required by the CLBDHHS for these projects. Plan submittal and review will focus on projects that integrate below grade pipelines, pumps, and large capacity holding tanks.

4.4 INFILTRATION BMPS

Infiltration refers to the physcial process of percolation, or downward seepage, of water through a soil's pore space. As water infiltrates, the natural filtration, adsorption, and biological decomposition properties of soils, plant roots, and micro-organisms work to remove pollutants prior to the water recharging the underlying groundwater. Infiltration BMPs include infiltration basins, infiltration trenches, infiltration galleries, bioretention without an underdrain, dry wells, and permeable pavement. Infiltration can provide multiple benefits, including pollutant removal, peak flow control, groundwater recharge, and flood control. However, conditions that can limit the use of infiltration include soil properties, proximity to building foundations and other infrastructure, geotechnical hazards (e.g., liquefaction, landslides), and potential adverse impacts on groundwater quality (e.g., industrial pollutant source areas, contaminated soils, groundwater plumes)[1]. To ensure that infiltration would be physcially feasible and desireable (i.e., not have adverse impacts), a categorical screening of site feasibility criteria must be completed prior to the use of infiltration BMPs following the guidelines presented in Section 4.2.

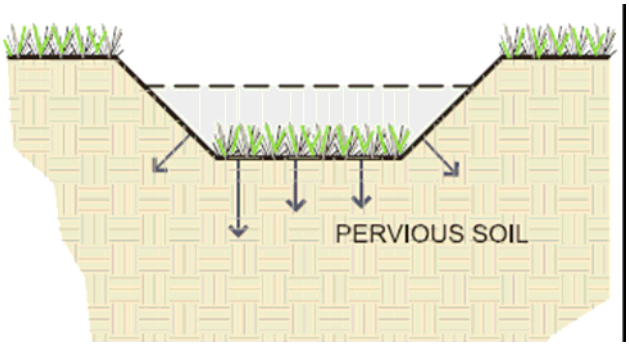
4.4.1 Infiltration BMP Types

Surface Infiltration BMPs

These BMPs rely on infiltration in a predominantly vertical (downward) direction and depend primarily on soil characteristics in the upper soil layers. These infiltration BMPs include:

Infiltration Basins

An infiltration basin consists of an earthen basin constructed in naturally pervious soils with a flat bottom typically vegetated with dry-land grasses or irrigated turf grass. An infiltration basin functions by retaining the design runoff volume in the basin and allowing the retained runoff to percolate into the underlying native soils over a specified period of time.



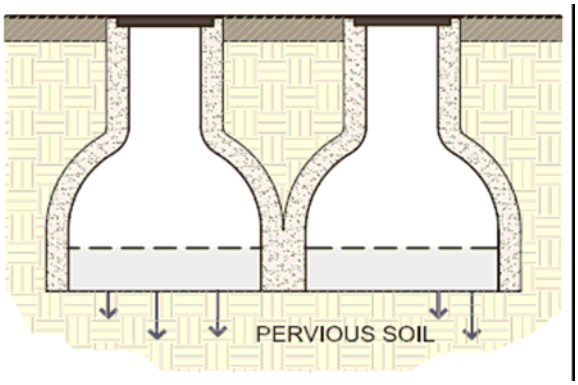
Infiltration Trenches

Infiltration trenches, which are similar to basins, are long, narrow, gravel-filled trenches, often vegetated, that infiltrate stormwater runoff from small drainage areas. Infiltration trenches may include a shallow depression at the surface, but the majority of runoff is stored in the void space within the gravel and infiltrates through the sides and bottom of the trench.

1 Depending on the design of the infiltration practice, Federal Underground Injection Control (UIC) Rules (40 CFR 144) may apply, which may further restrict the use of infiltration facilities in some locations.

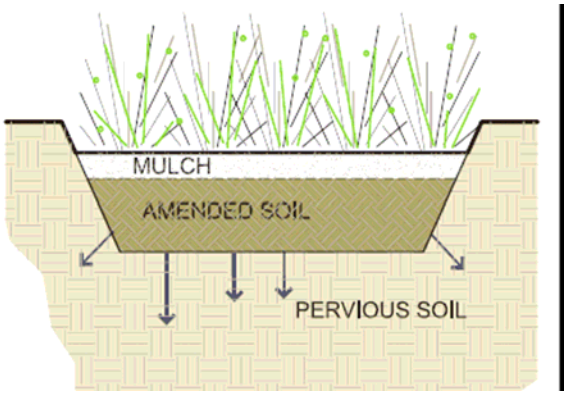
Infiltration Galleries

Infiltration galleries are open-bottom, subsurface vaults that store and infiltrate stormwater. A number of vendors offer prefabricated, modular infiltration galleries that provide subsurface storage and allow for infiltration. Infiltration galleries come in a variety of material types, shapes and sizes.



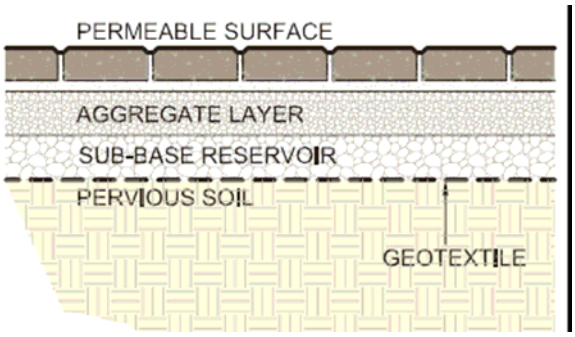
Bioretention

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, plantings, and, optionally, a subsurface gravel reservoir layer.



Permeable Pavements

Permeable (or pervious) pavements contain small voids that allow water to pass through to a stone base. They come in a variety of forms; they may be a modular paving system (concrete pavers, modular grass or gravel grids) or poured-in-place pavement (porous concrete, permeable asphalt). All permeable pavements with a stone reservoir base treat stormwater and remove sediments and metals to some degree by allowing stormwater to percolate through the pavement and enter the soil below.

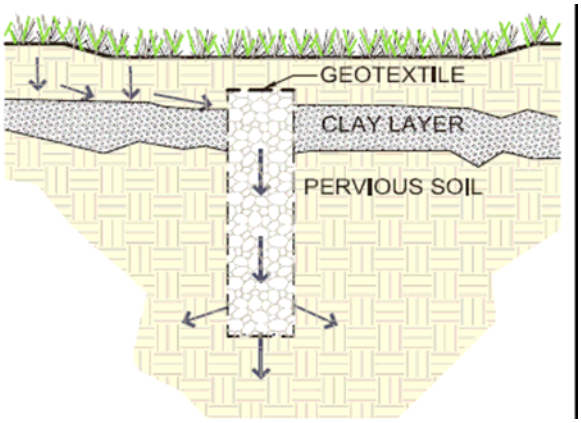


Multi-Directional Infiltration BMPs

These BMPs take advantage of the hydraulic conductivities (K_{sat}) of multiple soil strata and infiltration in multiple directions. They may be especially useful at locations where low K_{sat} values are present near the surface and soils with higher permeabilities exist beneath. A Multi-Directional Infiltration BMP may be implemented to infiltrate water at these lower soil layers, thus allowing infiltration to occur at sites that otherwise would be infeasible. These infiltration BMPs typically have smaller footprints and include, but are not limited to:

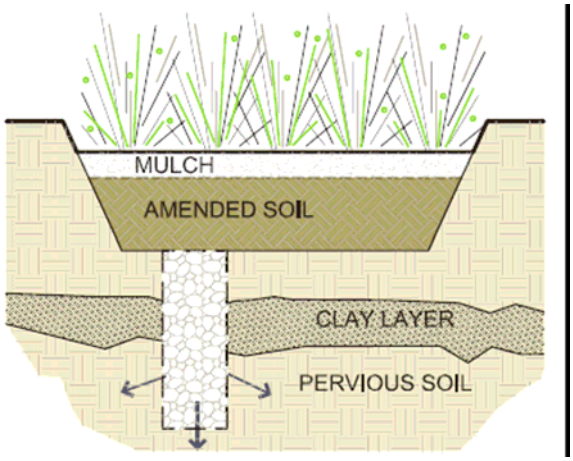
Dry Wells

A dry well is defined as an excavated, bored, drilled, or driven shaft or hole whose depth is greater than its width. Drywells are similar to infiltration trenches in their design and function, as they are designed to temporarily store and infiltrate runoff, primarily from rooftops or other impervious areas with low pollutant loading. A dry well may be either a drilled borehole filled with aggregate or a prefabricated storage chamber or pipe segment.



Hybrid Bioretention/Dry Wells

A bioretention facility with dry wells is useful in areas with low surface-level hydraulic conductivities that would normally deem a bioretention BMP infeasible but have higher levels of permeability in deeper strata. By incorporating drywells underneath the bioretention facility, water is able to be infiltrated at deeper soil layers that are suitable for infiltration, if present. This hybrid BMP combines the aesthetic and filtration qualities of a bioretention facility with the enhanced infiltration capabilities of a dry well.



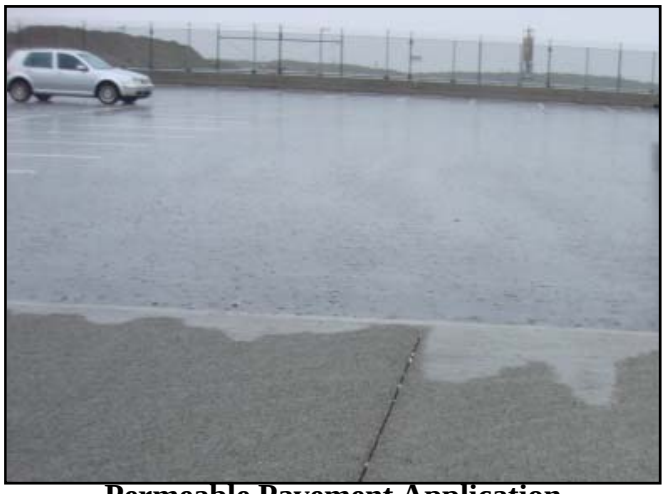
4.4.2 Siting Requirements and Opportunity Criteria

Drainage areas implementing infiltration BMPs must pass the Category 1 or Category 2 Screening in accordance with the siting requirements set forth in Table 4.1. This screening process must be approved by a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional geotechnical engineer or geologist.

Additionally, drainage areas that will result in high sediment loading rates to the infiltration facility shall require pretreatment to reduce sediment loads and avoid system clogging. Examples of appropriate pretreatment may include: sedimentation/settling basins, baffle boxes, hydrodynamic separators, media filters, vegetated swales, or filter strips.

4.4.3 Design Criteria and Requirements

Unless specifically stated, the following criteria and requirements listed below are required for the implementation of all infiltration BMPs. Provisions not met must be approved by the City of Long Beach.



Permeable Pavement Application
Los Angeles World Airports Parking

- Infiltration BMPs have been designed and constructed to promote uniform ponding and infiltration.
- Where necessary, a sediment forebay or separate pretreatment unit (e.g. vegetated swale, filter strip, hydrodynamic device, etc.) is located between the inlet and infiltration BMP. The sediment forebay has a volume greater than or equal to 25% of the total design volume.
- Sediment forebay has a minimum length to width ratio of 2:1 and is designed to conduct flow to the infiltration BMP.
- Any embankment slopes (interior and exterior) are not steeper than 3:1 (H:V) unless approved by the City of Long Beach.
- The bottom of the infiltration bed is native soil and has been over-excavated to at least one foot in depth. It is recommended that the excavated soil be amended with 2 – 4 inches of coarse sand (e.g., 2 – 5 mm sand) before being replaced uniformly without compaction.
- The hydraulic conductivity (Ksat) of the subsurface layers is sufficient to ensure the maximum drawdown time of 48 hours.
- Where Ksat values are greater than 2.4 in/hr, pretreatment is provided to address pollutants of concern prior to infiltration to protect groundwater quality; pretreatment may be considered to be addressed in the amended media or sand layers within the BMP if provided.
- Provided overflow safely conveys flows to the downstream stormwater conveyance system, an additional BMP, or an alternatively acceptable discharge point.
- Where the infiltration system is placed underground, an observation well is provided for inspection/mainteance purposes.
- Porous pavement facilities consist of various layers of material. The top layer consists of either asphalt or concrete with a percentage of voids of at least 15%. This layer is followed by a stone reservoir layer or a thick layer of aggregate with 25-

35% voids. Two transition layers are also present. The depth of each layer and the specific materials used shall be determined by a licensed civil engineer.

- Dry wells shall be filled with washed 3/4 – 1 inch crushed rock, recycled concrete aggregate, or open-graded gravel (i.e. gravel with a small percentage of small particles). If a perforated pipe has been installed in the well, perforations are 3/8" and are smaller than the fill gravel. A woven geotextile shall be placed over the top of the drywell to prevent sediment clogging.

4.4.4 Soil and Vegetation Requirements

Soil and vegetation to be incorporated in infiltration facilities shall be selected by a licensed landscape architect. In general, drought and flood resistant plant species native to California should be selected when possible. Soil media should be selected to not restrict performance requirements. Selected soils shall therefore have a higher hydraulic conductivity than the underlying soil, shall be able to support the selected plant palette, and shall be graded to provide adequate filtration as to not clog underlying soils.

4.4.5 Construction Requirements

To preserve and avoid the loss of infiltration capacity, the following construction guidelines shall be adhered to:

- The entire area draining to the infiltration facility is stabilized before construction of the infiltration facility begins, or a diversion berm is placed around the perimeter of the infiltration site to prevent sediment entrance during construction.
- Infiltration BMPs shall not be used as sediment control facilities during construction.
- Compaction of the subgrade with vehicles and/or equipment is minimized. If the use of heavy equipment on the base of the facility cannot be avoided, the infiltrative capacity shall be restored by tilling or aerating prior to placing the infiltrative bed.

Underground Infiltration Units
Lowe's, Pacoima

- Where pervious pavement is to be installed, installation of the pavement shall be scheduled as the the last installation at a development site. Vehicular traffic is prohibited for at least 2 days following installation. Site materials shall not stored on pervious pavement.

4.4.6 Operations and Maintenance

- Frequent inspections of the infiltration facilities shall occur to ensure that surface ponding infiltrates into the subsurface completely within the design drawdown time following storms. If vector breeding is taking place at a site as a result of contained stormwater or inadequately maintained BMPs, the CLBDHHS Bureau of Environmental Health has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).
- Regular inspections shall take place to ensure that the pretreatment sediment removal BMP/forebay is working efficiently. Sediment buildup exceeding 50% of the forebay sediment storage capacity shall be removed.
- The infiltration facility shall be maintained to prevent clogging. Maintenance activities include checking for debris/sediment accumulation and removal of such debris.
- Facility soil (if applicable) shall be maintained. Flow entrances, ponding areas, and surface overflow areas will be inspected for erosion periodically. Soil and/or mulch will be replaced as necessary to maintain the long-term design infiltration rate for the life of the project.
- Site vegetation shall be maintained as frequently as necessary to maintain the aesthetic apperance of the site as well as the filtration capabilities (where applicable). This includes the removal of fallen, dead, and/or invasive plants, watering as necessary, and the replanting and/or reseeding of vegetation for reestablishment as necessary.
- Pervious pavement areas that are damaged or clogged shall be replaced/repaired per manufacture's recommendation as needed.

4.5 CAPTURE AND USE BMPS

Underground Cistern
Photo Credit: TreePeople

Capture and Use refers to a specific type of BMP that operates by capturing stormwater runoff and holding it for efficient use at a later time. On a commercial or industrial scale, capture and use BMPs are typically synonomous with cisterns, which can be implemented both above and below ground. Cisterns are sized to store a specified volume of water with no surface discharge until this volume is exceeded. The primary use of captured runoff is for subsurface drip irrigation purposes. The temporary storage of roof runoff reduces the runoff volume from a property and may reduce the peak runoff velocity for small, frequently occurring storms. In addition, by reducing the amount of stormwater runoff that flows overland into a stormwater conveyance system, less pollutants are transported through the conveyance system into local streams and the ocean. The onsite use of the harvested water for non-potable domestic purposes conserves City-supplied potable water and, where directed to unpaved surfaces, can recharge groundwater in local aquifers.

4.5.1 Siting Requirements and Opportunity Criteria

Drainage areas implementing capture and use BMPs must pass the Category 1 or Category 2 Screening in accordance with the siting requirements set forth in Section 4.3. This screening process must be approved by a site-specific geotechnical investigation report and/or hydrologic analysis conducted and certified by a State of California registered professional civil engineer, geotechnical engineer, geologist, or other qualified professional and shall be approved by the City prior to approval of the Design and Construction of the BMP.

4.5.2 Irrigation / Dispersial of Captured Stormwater

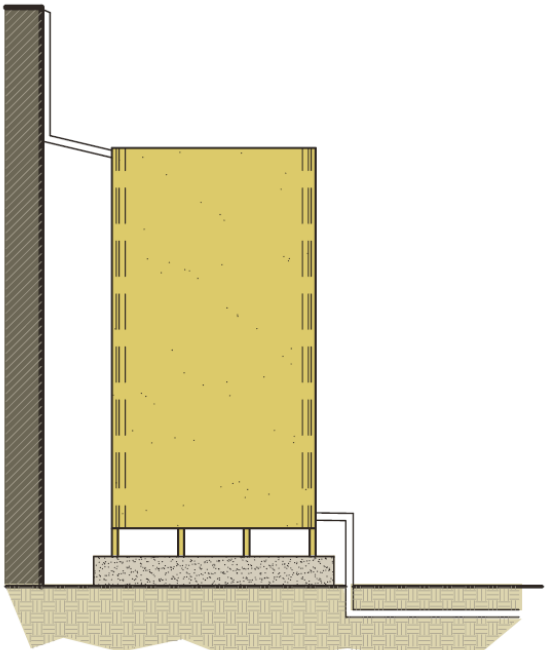
If a developer desires to hold harvested stormwater for an extended period of time, for the purpose of irrigation during dry periods, calculations in line with the California Department of Water Resources Model Water Efficent Landscape Ordinance AB 1881 shall be provided. Captured stormwater should be used to offset the potable irrigation demand that would occur during the rain season (October 1 – April 30, 7 months). If the volume of captured stormwater exceeds the Estimated Total Water Use for the rain season ($ETWU_7$),excess stormwater shall, at a minimum:

1. Establish a schedule to release captured stormwater over landscaping, and;
2. Ensure the BMP is designed and maintained to ensure adequate capacity and is available to capture the stormwater quality design volume within 3 days of a likely storm event.

4.5.3 Design Criteria and Requirements

Unless specifically stated, the following criteria and requirements listed below are required for the implementation of all capture and use BMPs. Provisions not met must be approved by the City of Long Beach.

- Fertilizers, pesticides, or herbicides on landscaped areas shall be minmized.
- Above-ground cisterns are secured in place and designed to meet seismic requiremnts for tanks.
- Overflow outlet is provided upstream of the tank inlet and is designed to disperse overflow onsite. Dispersial and overflow must be through an approved landscape areas where erosion or suspension of sediment is minimized, or through a high flow biotreatment BMP. Overflow from the tank into the storm drain system is not allowed.



Cistern Example
Image Credit: AHBE Landscape Architects

- For landscape applications, a subsurface drip irrigation system, a pop up, or other approved irrigation system, has been aproved and installed to adequately discharge the captured water[2].
- If a pumping system is used, a reliable pump capable of delivering 100% of the design capacity is provided. Pump is accessible for maintenance. Pump has been selected to operate within 20% of its best operating efficiency. A high/low-pressure pump shut off system is installed in the pump discharge piping in case of line clogging or breaking.
- If an automated harvesting control system is used, it is complete with a rainfall or soil moisture sensor. The automated system has been programmed to not allow for continuous application on any area for more than 2-hours.
- Dispersion is directed so as not to knowingly cause geotechnical hazards related to slope stability or triggering expansive (clayey) soil movement.
- Cisterns do not allow UV light penetration to prevent algae growth.
- Cistern placement allows easy access for regular maintenance. If cistern is undergrond, manhole shall be accessible, operational, and secure.

2 If alternative distribution systems (such as spray irrigation) are approved, the City will establish guidelines to implement these new systems.

- Refer to the CLBDHHS Bureau of Environmental Health for additional guidelines and requirements.
- Provide observation access for vector inspection and treatment.

4.5.4 Operations and Maintenance

- Cistern components, including spigots, downspouts, and inlets will be inspected 4 times annually to ensure proper functionality. Parts will be repaired or replaced as needed.
- Cisterns and their components will be cleaned as necessary to prevent algae growth and the breeding of vectors.
- Dispersion areas will be maintained to remove trash and debris, loose vegetation, and rehabilitate any areas of bare soil.
- Effective energy dissipation and uniform flow spreading methods will be employed to prevent erosion and facilitate dispersion.
- Cisterns will be emptied as necessary to prevent vector breeding, unless exclusion devices are implemented to prevent vector access. If vector breeding is taking place at a site as a result of contained stormwater or inadequately maintained BMPs, the CLBDHHS Bureau of Environmental Health, has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).

4.6 BIOFILTRATION BMPS

Projects that have demonstrated they cannot manage 100% of the water quality design volume onsite through infiltration and/or capture and use BMPs may manage the remaining volume through the use of a high removal efficiency biofiltration/biotreatment BMP. A high removal efficiency biofiltration/biotreatment BMP shall be sized to adequately capture 1.5 times the volume not managed through infiltration and/or capture and use.

Bioretention (Planter Boxes)
Photo Credit: City of Los Angeles

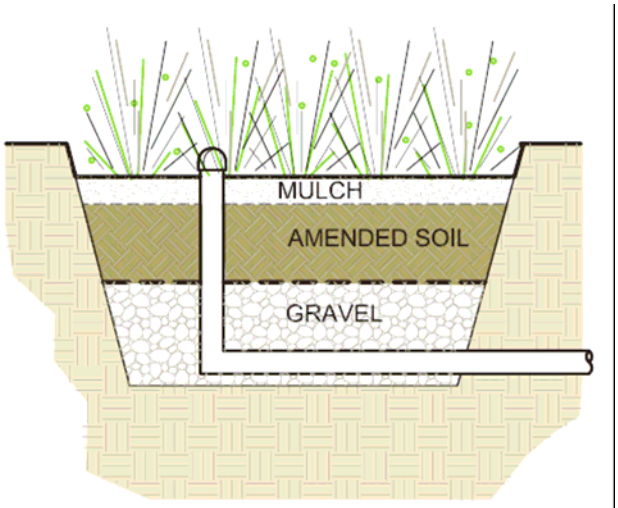
Biofiltration BMPs are landscaped facilities that capture and treat stormwater runoff through a variety of physical and biological treatment processes. Facilities normally consist of a ponding area, mulch layer, planting soils, plants, and in some cases, an underdrain. Runoff that passes through a biofiltration system is treated by the natural adsorption and filtration characteristics of the plants, soils, and microbes with which the water contacts. Biofiltration BMPs include vegetated swales, filter strips, planter boxes, high flow biotreatment units, bioinfiltration facilities, and bioretention facilities with underdrains. Biofiltration can provide multiple benefits, including pollutant removal, peak flow control, and low amounts of volume reduction through infiltration and evapotranspiration.

4.6.1 Biofiltration BMP Types

Biofiltration BMPs rely on various hydraulic residence times and flow-through rates for effective treatment. As a result, a variety of BMPs are available.

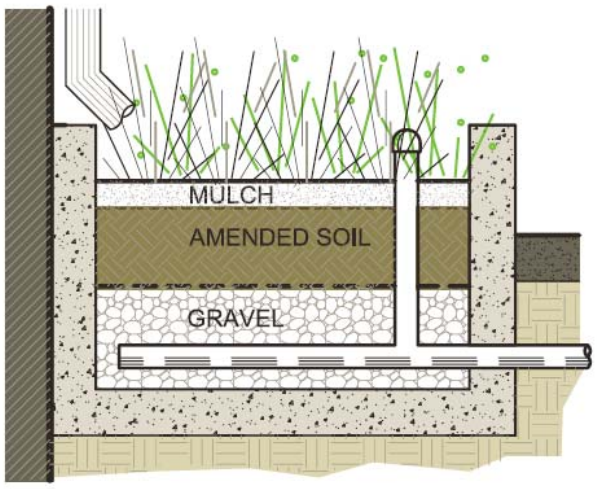
Bioretention with Underdrain

Bioretention facilities are landscaped shallow depressions that capture and filter stormwater runoff. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Because they are not contained within an impermeable structure, they may allow for infiltration. For sites not passing the infiltration feasibility screening for reasons other than low infiltration rates (such as soil contamination, expansive soils, etc.), an impermeable liner may be needed to prevent incidental infiltration.



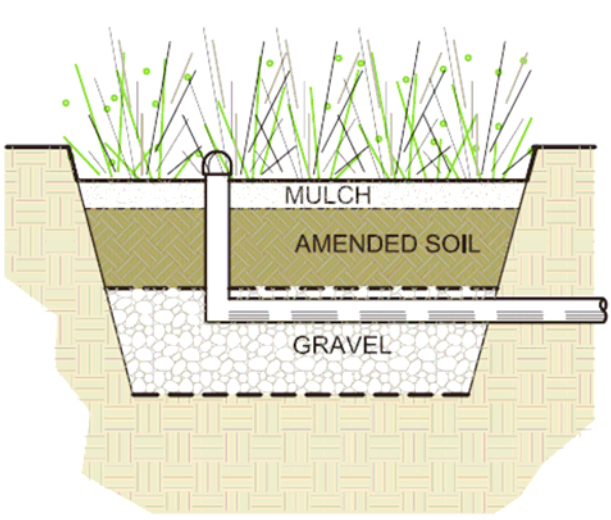
Planter Boxes

Planter boxes are bioretention treatment control measures that are completely contained within an impermeable structure with an underdrain (they do not infiltrate). They are similar to bioretention facilities with underdrains except they are situated at or above ground and are bound by impermeable walls. Planter boxes may be placed adjacent to or near buildings, other structures, or sidewalks.

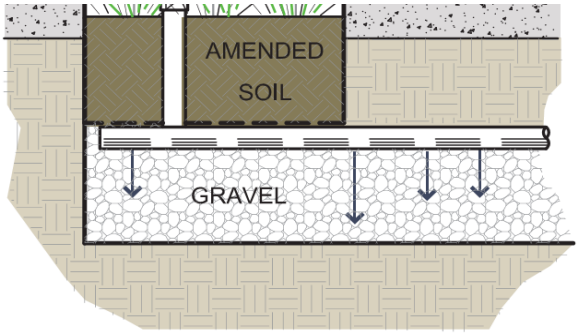


Bioinfiltration

Bioinfiltration facilities are designed for partial infiltration of runoff and partial biotreatment. These facilities are similar to bioretention devices with underdrains but they include a raised underdrain above a gravel sump designed to facilitate infiltration and nitrification/denitrification. These facilities can be used in areas where there are little to no hazards associated with infiltration, but infiltration screening does not allow for infiltration BMPs due to low infiltration rates or high depths of fill.

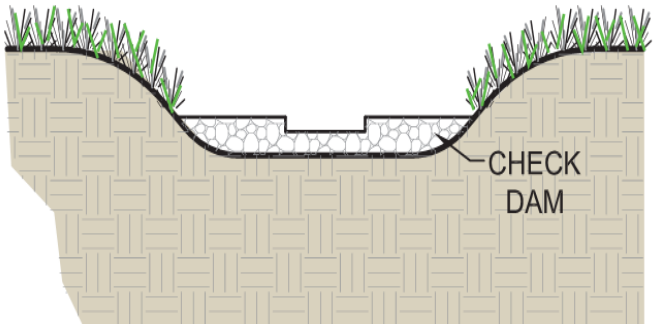


High-Flow Biotreatment with Raised Underdrain



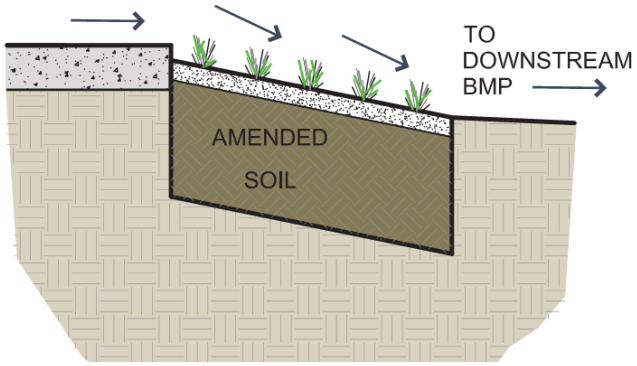
High-flow biotreatment devices are proprietary treatment BMPs that incorporate plants, soil, and microbes engineered to provide treatment at higher flow rates and with smaller footprints than their non-proprietary counterparts. Like bioinfiltration devices, they should incorporate a raised underdrain above a gravel sump to facilitate incidental infiltration where feasible. They must be shown to have pollutant removal efficiencies equal to or greater than the removal efficiencies of their non-proprietary counterparts. Proof of this performance must be provided by adequate third party field testing.

Vegetated Swales



Vegetated swales are open, shallow channels with dense, low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff to downstream discharge points. An effective vegetated swale achieves uniform sheet flow through the densely vegetated area for a period of several minutes. The vegetation in the swale can vary depending on its location and is the choice of the designer. Most swales are grass-lined.

Filter Strips (to be used as part of a treatment train)



Filter strips are vegetated areas designed to treat sheet flow runoff from adjacent impervious surfaces such as parking lots and roadways, or intensive landscaped areas such as golf courses. While some assimilation of dissolved constituents may occur, filter strips are generally more effective in trapping sediment and particulate-bound metals, nutrients, and pesticides. Filter strips are more effective when the runoff passes through the vegetation and thatch layer in the form of shallow, uniform flow. Filter strips are primarily used to pretreat runoff before it flows to an infiltration BMP or another biofiltration BMP.

4.6.2 Siting Requirements and Opportunity Criteria

Sites with plans to implement high removal efficiency biofiltration/biotreatment systems for the management of stormwater must first be screened for infiltration and capture and use BMP feasibility. Biofiltration should be implemented to treat all runoff onsite to the maximum extent feasible at sites incapable of implementing infiltration and/or capture and use BMPs as a result of the feasibility screening process set forth in this handbook.

Sites implementing biofiltration BMPs must have sufficient area available to ensure that BMPs produce adequate contact time for filtration to occur. For biofiltration BMPs with underdrains, sufficient vertical relief must exist to permit vertical percolation through the soil media to the underdrain below. For biofiltration BMPs with incidental infiltration, it must be demonstrated that there are no hazards associated with infiltration (i.e. infiltration screening does not allow for infiltration BMPs due to low infiltration rates or high depths of fill).

4.6.3 Design Criteria and Requirements

Unless specifically stated, all criteria and requirements listed below are required for the implementation of all biofiltration BMPs. Provisions not met must be approved by the City of Long Beach.

- Where applicable, biofiltration BMPs shall be constructed with a minimum planting soil depth of 2 feet (3 feet preferred) and topped with 3 inches of mulch.
- Where applicable, biofiltration BMPs shall be designed to drain below the planting soil in less than 48 hours and completely drain from the underdrains in 96 hours.
- Underdrains shall be constructed of slotted PVC pipe, sloped at a minimum 0.5% and placed per Table 4.5 requirements. Underdrains drain freely to a downstream stormwater conveyance system, an additional BMP, or an alternatively acceptable discharge point.

Bioretention in a Parking Lot
Photo Credit: Geosyntec Consultants

- If system is online, an overflow is present. The overflow safely conveys flows to the downstream stormwater conveyance system, an additional BMP, or an alternatively acceptable discharge point.
- Inflow to swales shall be directed towards the upstream end of the swale.
- Bioinfiltration BMPs and high-flow biotreatment BMPs designed for secondary infiltration shall pass the infiltration feasibility screening for all hazardous criteria. If necessary, weep holes shall be used to increase infiltration.
- Swales shall be constructed with a bottom width between 2- and 10-feet. Check dams shall be incorporated at the appropriate distances. Check dams are 12-inches in height and include a 6-inch deep notch in the middle of the check dam that is 1-2 feet wide. Each check dam extends across the entire width of the swale's base.
- Filter strips shall be constructed to extend across the full width of the tributary area. They shall be designed with sufficient slope in the flow direction to prevent ponding.

They shall have a minimum length of 4 ft in the flow direction when sized for pretreatment purposes.

4.6.4 Soil and Vegetation Requirements

Soil and vegetation to be incorporated in biofiltration facilities shall be selected by a licensed landscape architect. In general, drought and flood resistant plant species native to Southern California should be selected when possible. Soil media should be selected to facilitate vigorous plant growth and not restrict performance requirements. Where the project receiving waters are impaired for nutrients, media should be selected to minimize the potential for leaching of nutrients from biofiltration systems.

4.6.5 Operations and Maintenance

Biofiltration areas require annual plant, soil, and mulch layer maintenance to ensure optimum infiltration, storage, and pollutant removal capabilities. In general, biofiltration maintenance requirements are typical landscape care procedures. The following operations and maintenance practices will be adhered to:

- Facility soil will be maintained. Flow entrances, ponding areas, and surface overflow areas will be inspected for erosion periodically. Soil and/or mulch will be replaced as necessary to maintain an infiltration rate at or near the initial $K_{sat,design}$value for the duration of the project.
- Site vegetation will be maintained as frequently as necessary to maintain fire protection, public safety, and the aesthetic appearance of the site as well as the filtration capabilities. This includes the removal of fallen, dead, and/or invasive plants, watering as necessary, and the replanting and/or reseeding of vegetation for reestablishment as necessary. Swales and filters will be mowed as necessary.
- BMP inlets will be inspected and maintained to ensure even flow enters the facility. Sediment collecting at the inlet will be removed as necessary.
- Proprietary devices will be inspected and maintained in accordance with the requirements of the manufacturer.

SECTION 5: OFFSITE MITIGATION FEE

5.1 OFFSITE MITIGATION FEE

Permit applicants who seek to engage in Development or Redevelopment as defined in the LID Ordinance by obtaining a building permit and do not demonstrate complete onsite compliance as described in the LID Best Management Practice Manual shall be required to comply with one or a combination of the following for the remaining runoff that cannot feasibly be managed onsite:

1. An Offsite Runoff Mitigation Fee pursuant to LBMC Subsection 18.74.050.B shall be paid to the City of Long Beach's Stormwater Pollution Abatement Fund for offsite mitigation, as described in the LID Best Management Practices Manual. The funding will be applied towards the construction of an offsite mitigation project(s) within the same sub-watershed that will achieve at least the same level of water quality protection as if all of the runoff was retained onsite.

2. To provide an incentive for onsite management of storm water runoff, Development and Redevelopment projects will receive the following reduction in the Offsite Runoff Mitigation Fee based on the percentages of storm water runoff that is managed on site through infiltration, evapotranspiration, and/or capture and use:

Stormwater Runoff Managed Onsite	Fee Reduction
Between 90% and 99%	75%
Between 75% and 89%	50%
Between 50% and 74%	25%

3. A Multi-Phased Project must design a system acceptable to satisfy these standards and requirements for the entire Site during the first phase and will implement these standards and requirements for each phase of Development or Redevelopment projects of the Site during the first phase or prior to commencement of construction of a later phase, to the extent necessary to treat the stormwater from such later phase.

5.2 TECHNICAL INFEASIBILITY

When the onsite LID requirements are technically infeasible, the infeasibility shall be demonstrated in the submitted LID plan and shall be reviewed in consultation with the Building Official. The technical infeasibility may result from conditions that may include, but are not limited to:

1. Locations where seasonal high groundwater is within 10 feet of surface grade;

2. Locations within 100 feet of a groundwater well used for drinking water;

3. Brownfield Development sites or other locations where pollutant mobilization is a documented concern;

4. Locations with potential geotechnical hazards; or

5. Locations with impermeable soil type as indicated in applicable soils and geotechnical reports.

Should LID requirements be determined technically infeasible, the Development or Redevelopment project shall be exempt from LID regulations. However, to maximize onsite compliance, a Development or Redevelopment project shall be required to comply with, at a minimum, all applicable National Pollutant Discharge Elimination System (NPDES) and Standard Urban Stormwater Mitigation Plan (SUSMP) requirements of Chapter 18.61 of the Long Beach Municipal Code (LBMC).

SECTION 6: HARDSHIP DETERMINATION

6.1 HARDSHIP DETERMINATION

Whenever there are practical difficulties involved in carrying out the LID Regulations, the Director shall have the authority to grant modifications to the provisions for individual cases, provided the Director shall first find that special individual reason makes the strict letter of the LID Regulations impractical and the modification is in compliance with the intent and purpose of these regulations and that such modification does not lessen the goals of LID, sustainability or increase the overall cost of stormwater management.

Appendix A: Small Scale Residential Prescriptive Measures

Small Scale Residential LID BMP Measures

Dry Well Fact Sheet

Dry-Well systems present an easy to install and sustainable solution for storm water control. This Best Management Practices water run-off choice is known as the “invisible” solution - it’s underground!

Is a Dry Well Feasible at My Residence?

Dry wells are appropriate where the following site characteristics are present:

- Roof areas with downspouts or other impervious areas are required.
- Sites must have soils suitable for infiltration, with a minimum saturated hydraulic conductivity of 0.3 in/hr.
- Dry wells should be installed at least 25 feet from building foundations and 10 feet from property lines, or have an approved impermeable liner installed to prevent infiltration under these facilities.
- An overflow area that will not run onto neighboring properties is required.

How Large Does My Dry Well Need to Be?

A dry well should be sized to capture the runoff produced from the design storm over the connected impervious area, with account taken for any gravel or fill material that is used. This will ensure the capture and infiltration of the design storm volume. The following table should be used as minimum sizing guidance for dry wells.

Contributing Area (sq. ft.)	Dry Well Volume—Without Fill (gallons)	Dry Well With Gravel Fill (gallons)
500 - 1000	250	600
1,001 - 1,500	400	1,000
1,501 - 2,000	550	1,400
2,001 - 2,500*	700	1,800

* Projects adding roof or impervious areas in excess of 2,500 sq. ft. shall add 150 gallons of dry well volume (without fill) or 400 gallons of dry well volume (with gravel fill) per every 500 sq. ft. of additional area.

Small Scale Residential LID BMP Measures

Dry Well Fact Sheet

Design Criteria and Considerations

When installing a dry well, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ Location is at least 25 feet from home foundation and 10 feet from private property lines.
- ☐ Dry well has been properly located and installed to intercept and collect runoff via a downspout from a roof or adjacent impervious area.
- ☐ Utilities have been located before digging by calling Dig Alert at (800) 227-2600 or www.digalert.org at least two days before digging.
- ☐ Dry well is appropriately sized in accordance with the sizing table above.
- ☐ For dry wells with gravel fill, gravel used is 2" or greater diameter stone.
- ☐ The soil under the dry well has been over-excavated to at least one foot in depth. The soil has been re placed uniformly without compaction, or amended with 15-30% of coarse sand and replaced without compaction.
- ☐ A fine mesh screen has been installed on the inlet to prevent sediment and debris from entering the dry well.
- ☐ An observation well has been incorporated into the dry well design. The observation well consists of a slotted or perforated pipe (typically PVC), 4 – 6 inches in diameter, capped with an above-ground, sealable lid.
- ☐ An overflow has been incorporated in the dry well such that excess water will flow into the storm drain system or another pervious area and away from any nearby foundations or neighboring properties.
- ☐ Detention and infiltration do not (knowingly) cause geotechnical hazards related to slope stability or triggering expansive (clayey) soil movement.

Operations and Maintenance

Once a dry well is installed, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ Water level, drawdown time, and evidence of clogging will be monitored monthly during the rainy season.
- ☐ Standing water will not remain in an exposed dry well for more than 3 days. Extended periods of flooding may result in the breeding of mosquitoes or other vectors. If vector breeding occurs at a site asa result of contained stormwater or inadequately maintained BMPs, I understand that the City of Long Beach Department of Health and Human Services, Bureau of Environmental Health, has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).
- ☐ Rain gutters and downspouts will be inspected and cleaned at least twice annually.
- ☐ If the dry well ever becomes plugged and overflows on a continual basis, the dry well will be excavated and removed. The dry well will be repaired or replaced as necessary, and gravel media fill will be cleaned or replaced to enhance the infiltration capacity.

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date:_____

Small Scale Residential LID BMP Measures

Permeable Pavement Fact Sheet

Did you know there are pavement choices that let the water seep right through? These convenient and functional paving products bring the ultimate in beauty and practicality to Best Management Practices rain-water control.

Is Permeable Pavement Feasible at my Residence?

Permeable pavement is appropriate where the following site characteristics are present:

- Permeable pavements should work well on most residential sites where paved surfaces such as patios and driveways exist. Areas with slopes greater than 3 percent may not be appropriate.
- Permeable pavement applications should be installed at least 3 feet from public sidewalks and 10 feet from building foundations, or have an approved impermeable liner installed to prevent infiltration under these facilities.
- The infiltration rate of the site's soils should be approximately 0.5 inch per hour, and the depth to groundwater or bedrock should be at least 5 vertical feet.
- Promoting infiltration should be avoided under permeable pavements at sites with expansive, clay-rich soils, or soils susceptible to tunnel erosion.
- At sites with certain characteristics that do not permit infiltration, an underdrain system can be installed to route the water to a storm drain or other BMP (i.e. rain garden). This type of system provides temporary storage, slows runoff, and filters some pollutants.
- There are many types of permeable pavements, including pour-in-place concrete or asphalt, unit paver blocks, and granular materials. Modular types, such as stone or brick pavers and open cell pavers, tend to be good options for residential projects. The use of the surface (i.e. vehicles, foot traffic, recreation), site conditions, aesthetic qualities, price, and maintenance requirements should be considered during the design process.

How Much Permeable Pavement Do I Need?

Permeable pavement should be sized to capture the runoff produced from the design storm within the gravel subbase of the pavement. This will ensure the capture and infiltration of the design storm volume. The following table should be used as minimum sizing guidance for permeable pavement.

Contributing Area (sq. ft.)	Permeable Pavement Area 1ft Gravel Subbase (sq. ft.)	Permeable Pavement Area 2ft Gravel Subbase (sq. ft.)
500 - 1000	90	50
1,001 - 1,500	150	80
1,501 - 2,000	210	110
2,001 - 2,500*	280	140

LONG BEACH
DEVELOPMENT SERVICES
BUILDING A BETTER LONG BEACH
333 W. Ocean Blvd., 4th Floor - Long Beach, CA 90802 - www.lbds.info

Small Scale Residential LID BMP Measures

Permeable Pavement Fact Sheet

Design Criteria and Considerations

When installing permeable pavement, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ Installed subsurface is an open-graded base of crushed stone, which has 35 to 45 percent pore space, to allow for adequate drainage and storage.
- ☐ Site soils have adequate drainage (at least 0.5 inches per hour) and depth to groundwater (5 feet) if water will infiltrate from the open-graded base into site soils.
- ☐ Infiltration will not cause geotechnical hazards related to expansive soil movement, tunnel erosion, or slope stability.
- ☐ If infiltration hazards are a concern, an underdrain has been installed to drain water into a storm drain inlet or onsite BMP.
- ☐ Slope is not greater than 3 percent.
- ☐ Flow directed to permeable pavement is dispersed so as not to be concentrated at a small area of pavement.
- ☐ Pavers have a minimum thickness of 80 mm (3.14 inches).
- ☐ Pre-fabricated products have been installed per all appropriate manufacturer's specifications. If required, sub-grade soil has been compacted in accordance with product installation specifications.
- ☐ Project is in full compliance with all applicable sections of the current municipal code, including disabled access requirements and site drainage requirements per the Long Beach Building Code.

Operations and Maintenance

Once permeable pavement is installed, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ Pavement will be inspected after rains for pooling or other visible problems. Surface clogging or movement of modular pavers can cause problems with both drainage and pavement function. Missing sand or gravel between pavers will be replaced as necessary.
- ☐ Pavement will be inspected for vegetation. Depending on the type of pavement and growth, vegetation may need to be removed.
- ☐ Home owners have talked with the contractor or manufacturer for additional maintenance requirements for their specific installation.
- ☐ Permeable pavement can involve significant maintenance, depending on the type of pavement installed.

* Projects adding roof or impervious areas in excess of 2,500 sq. ft. shall add 60 sq. ft. of permeable pavement (with 1' of gravel subbase) or 30 sq. ft. of permeable pavement (with 2' of gravel subbase) per every 500 sq. ft. of addition.

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date: _____

Small Scale Residential LID BMP Measures

Planter Box Fact Sheet

What could be better than a Best Management Practices component that adds so much to your environment? Planter box natural filtration systems not only provide exceptional water management but bring beauty and life to your property.

Are Planter Boxes Feasible at My Residence?

Planter boxes are appropriate where the following site characteristics are present:

- Roof areas with downspouts, or roof areas without downspouts that drain runoff to impervious surfaces.
- A level, firm surface away from retaining wall structures for support of the planter(s). Planters should only be elevated with solid construction materials, such as concrete, or wood for example. For sites within, immediately adjacent to, or discharging to an environmentally sensitive area, see the LID Manual for applicable criteria.

How Large Does My Planter Box Need to Be?

The total size of planter(s) necessary to capture run-off from a given roof area is shown in the table to the right. The table assumes a minimum planter depth of 2.5 feet, with 2 feet of soil and 0.5 feet of storage space, or “freeboard”, above the soil surface.

Roof Area Tributary to Planter Boxes (sq. ft.)	Total Surface Area of Planter(s) (sq. ft.)
500 - 1000	32
1,001 - 1,500	52
1,501 - 2,000	108
2,001 - 2,500*	168

The table assumes that all runoff generated from the roof area will be directed to the planter(s). If a planter only extends across a fraction of a roof drip line for which it was designed to capture all runoff, one of the following methods shall be implemented:

- Additional planters shall be installed to extend across the entire roof drip line.
- Gutters or other devices shall be installed on the tributary roof to direct all runoff to the planter box(es).
- Additional LID BMPs shall be implemented to capture the runoff unaccounted for by the planter box(es).

LONG BEACH
DEVELOPMENT SERVICES
BUILDING A BETTER LONG BEACH
333 W. Ocean Blvd., 4th Floor - Long Beach, CA 90802 - www.lbds.info

Small Scale Residential LID BMP Measures

Planter Box Fact Sheet

Design Criteria and Considerations

When installing a planter box, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ At locations without rain gutters, planters are placed directly below roof drip lines to capture runoff as efficiently as possible.
- ☐ At least 6 inches of storage is present between the planting surface and the crest of each planter.
- ☐ At locations implementing multiple planters, planters are placed directly adjacent to one another so as to minimize the impervious space between planters.
- ☐ Planters are not located on uneven or sloped surfaces.
- ☐ Planting soil is at least 2 feet deep.
- ☐ Planting soil contains no more than 30% compost.
- ☐ Planters have not been installed on elevated platforms, decks or porches without consulting local building code officials.
- ☐ The project is in full compliance with all applicable sections of the current municipal code, including drainage requirements per the Long Beach Building and Safety Code.

* Projects adding roof or impervious areas in excess of 2,500 sq.ft. shall add 20 sq. ft. of planter box surface area per every 500 sq. ft. of additional area.

Operations and Maintenance

Once a planter box is installed, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ Planters will undergo annual plant and soil maintenance typical of landscape care procedures to ensure optimum filtration, storage, and drainage capabilities.
- ☐ Following rain events, planters will be inspected to ensure that standing water is not present in the planter for more than 72 hours (3 days). Ponded water that is not completely drained after 72 hours can cause vector breeding.
- ☐ If vector breeding occurs as a result of contained stormwater or inadequately maintained BMPs, I understand that the City of Long Beach Department of Health and Human Services, Bureau of Environmental Health, has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).
- ☐ Pesticide additives will not be used in the planters.
- ☐ Vegetable gardens can effectively be used in planters.

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date:_____

Small Scale Residential LID BMP Measures

Rain Barrel Fact Sheet

Rain barrels have been a part of intelligent rainwater management for thousands of years. As a Best Management Practices component, rain barrels provide an extremely cost-effective rainwater storage and distribution solution .

Are Rain Barrels Feasible at my Residence?

Rain barrels are appropriate where the following site characteristics are present:

- Roof areas with downspouts are required.
- A level, firm surface for support of the rain barrel(s) is required. Rain barrels should only be elevated with solid construction materials and kept away from retaining walls as a full 55-gallon rain barrel will weigh over 400 pounds.
- An area where the captured water can be used is required to be present within a reasonable distance from the rain barrel(s).
- Design of an appropriate area for overflow from the barrel is necessary. For sites within, immediately adjacent to, or discharging to an environmentally sensitive area, see the LID Manual for applicable criteria.

How Many Rain Barrels Do I Need?

The number of rain barrels required to capture runoff from a given roof or impervious area is shown in the following table.

Roof or Impervious Area (sq. ft.)	Number of 55 Gallon Rain Barrels*
500 - 1000	4
1,001 - 1,500	8
1,501 - 2,000	10
2,001 - 2,500**	14

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Small Scale Residential LID BMP Measures

Rain Barrel Fact Sheet

Design Criteria and Considerations

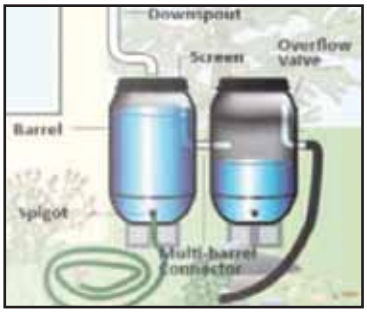
When installing a rain barrel, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ Screens are present on all rain barrel inlets to remove debris and larger particles as the water enters the barrel. Removable child-resistant covers and mosquito screening are in place.
- ☐ Barrel is child safe: access is child-proof and the barrel is properly sited and anchored on a stable surface to prevent barrel from tipping over. Remember – each rain barrel weighs approximately 400 pounds when full!
- ☐ Above-ground barrels are not located on uneven or sloped surfaces; if installed on a sloped surface, the base where the barrel is installed has been leveled using appropriate construction materials prior to installation.
- ☐ Installed rain barrels have not been placed on elevated platforms, decks or porches without consulting local building code officials.

Operations and Maintenance

Once a rain barrel is installed, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ Rain barrel components will be inspected 4 times annually and following major storm events. Screens, spigots, downspouts, and leaders will be repaired or replaced as needed.
- ☐ Rain barrels will be cleaned as necessary to prevent algae growth and the breeding of vectors. Cleaning should always take place on a permeable surface. If vectors are breeding in a rain barrel, the barrel will be drained immediately.
- ☐ During dry periods, spigot drains will be left open when barrel is not in use.
- ☐ Dispersion areas will be maintained to remove trash and debris, loose vegetation. Areas of bare soil should be rehabilitated to minimize erosion.
- ☐ Overflow outlet is provided and designed to disperse overflow onsite and through stable vegetated areas where erosion or suspension of sediment is minimized.
- ☐ Dispersion is directed so as not to knowingly cause geotechnical hazards related to slope stability or triggering expansive (clayey) soil movement. Overflow dispersion will take place at least 3 feet away from public sidewalks, at least 5 feet away from property lines and foundations, and at least 10 feet from building foundations.
- ☐ Rain barrels are opaque and dark in color to prevent UV light penetration and discourage algae growth. Barrel placement allows easy access for regular maintenance.



Rain Barrel Setup

- ☐ Where possible, effective energy dissipation and uniform flow spreading methods will be used to prevent erosion and aid dispersion.
- ☐ If adequate mosquito control is not in place and well-maintained, rain barrels will be emptied as necessary to prevent standing water from remaining in a barrel for more than 3 days, thereby preventing vectors from breeding. If vector breeding occurs as a result of contained storm water or inadequately maintained BMPs, I understand that the City of Long Beach Department of Health and Human Services, Bureau of Environmental Health, has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).
- ☐ Rain gutters will be inspected and cleaned at least twice annually.

* Or equivalent capture using larger rain barrels.

** Projects adding roof or impervious areas in excess of 2,500 sq. ft. shall add 3 rain barrels per every 500 sq. ft. of additional area.

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date:_____

Small Scale Residential LID BMP Measures

Rain Garden Fact Sheet

Imagine a garden that combines visual beauty and a thriving habitat with responsible water management. That's the perfect description of a Best Management Practices rain garden - an economical, enjoyable environmental oasis.

Are Rain Gardens Feasible at My Residence?

Rain gardens are appropriate where the following site characteristics are present:

- Rain gardens should be installed at least 10 feet from building foundations. Ground adjacent to the building should slope away at a 2% minimum. The rain garden area should receive full sunlight throughout most of the day. A downspout extention or bioswale can be used to convey rain from a roof directly into a rain garden. They are also appropriately sited downstream from a rain barrel overflow line.
- Rain gardens should be at least 3 feet from public sidewalks (or have an appropriate impermeable liner installed), 10 feet from property lines, and in an area where potential overflow will not run onto neighboring properties. Do not site rain gardens above septic systems.
- The site should have well-drained soil and be relatively flat. Soil amendments can improve infiltration in areas with poor drainage.
- A front or back yard can work well for a rain garden, especially in areas where the slope naturally takes the stormwater.

For sites within, immediately adjacent to, or discharging to an environmentally sensitive area, see the LID Manual for applicable criteria.

How Large Does My Rain Garden Need to Be?

Rain gardens should not exceed 300 square feet, and the contributing impervious area should not be more than 4,000 square feet. A general recommendation for a garden with a 6-inch ponding depth is to size the rain garden to approximately 6% of the contributing area. The infiltration rate of water into the soil will affect how the rain garden should be sized; rain gardens will need to be larger in areas with slower infiltration. The following table can be used as general guidance.

Contributing Area (sq. ft.)	Rain Garden Area (sq. ft.)
500 - 700	36
701 - 900	48
901 - 1100	60
1,101 - 1,300	72
1,301 - 1,500	84
1,501 - 2,000*	105

Small Scale Residential LID BMP Measures

Rain Garden Fact Sheet

Design Criteria and Considerations

When installing a rain garden, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ Location is at least 10 feet from home foundation, 3 feet from public sidewalks, and 10 feet from private property lines, with a slope of approximately 2% away from the home.
- ☐ Rain Garden has been located to intercept and collect runoff via a downspout or adjacent impervious area. The rain garden is not located underneath the canopy of existing trees.
- ☐ Rain garden is appropriately sized to the soil type and drainage area.
- ☐ Rain garden is not located over septic systems or shallow utilities. Utilities have been located before digging by calling Dig Alert at (800) 227-2600.
- ☐ Rain garden is not located within 50 feet of steep slopes (>25%). The rain garden has been built on a relatively flat area.
- ☐ Permits are not required for typical residential landscaping projects. If you plan on making major landscaping modifications such as moving more than 50 cubic yards of soil or altering 1 acre or more, contact the Long Beach Development Services at (562) 570-5237 for further assistance.
- ☐ An overflow has been incorporated in the rain garden such that excess water will flow into another pervious area and away from the home's foundation or neighboring property.
- ☐ Detention and infiltration do not (knowingly) cause geotechnical hazards related to slope stability or triggering expansive (clayey) soil movement.
- ☐ Drought and flood resistant native plant species are used whenever possible. Invasive or pest species have been avoided. A listing of resources where information on native plant species can be found is in the reference section. A list of invasive species may be found at the California Invasive Plant Council, Southern California Region website (www.cal-ipc.org).

Operations and Maintenance

Once a rain garden is installed, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ Rain gardens will be irrigated deeply once a week during dry months to encourage root growth and keep plants strong, especially while plants are being established. Plants will be inspected for health and weeds will be removed as often as necessary.
- ☐ Rain gardens will be monitored after storm events for signs of overflow. If overflow occurs significantly or often, the size and/or depth of the garden may need to be increased, or other actions to increase infiltration (e.g., soil amendments, underdrain installation) may be necessary.
- ☐ Signs of erosion will be repaired immediately. Further erosion can be prevented by reinforcing the surrounding area with groundcover or using energy dispersion techniques on downspouts.
- ☐ Infiltration effectiveness and excess sediment deposition will be monitored annually, preferably prior to the start of the rainy season.
- ☐ Standing water will not remain in a rain garden for more than 3 days. Extended periods of flooding will not only kill vegetation, but may result in the breeding of mosquitos or other vectors. If vector breeding occurs at a site as a result of contained stormwater or inadequately maintained BMPs, I understand that the City of Long Beach Department of Health and Human Services, Bureau of Environmental Health, has the ability to fine site owners for violating the California Health and Safety Code (Section 2060 – 2067).
- ☐ Rain gutters and downspouts will be inspected and cleaned at least twice annually.

* Projects adding roof or impervious areas in excess of 2,000 sq. ft. shall add 30 sq. ft. of rain garden surface area per every 500 sq. ft. of additional area.

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date:_____

Small Scale Residential LID BMP Measures

Tree Planting Fact Sheet

Everybody's favorite, canopy trees, are another logical Best Management Practices component that provides excellent water management. In addition to assisting in runoff control, they provide shade and beauty to every environment.

What kind of trees can I plant at my Residence?

To receive the most benefits, large canopy trees should be planted on residential properties. To maximize the tree canopy's potential for capturing precipitation and providing shade, it is best to select canopy trees with a natural growth habit that is spreading versus compact. Evergreen trees maintain their leaves year round and are good for maintaining privacy and providing the most shade for hot areas like Long Beach. Deciduous canopy trees lose most of their leaves in the fall or winter, however they still provide substantial shade in summer on your property. There are many large canopy tree species appropriate to thrive in the Long Beach coastal climate zone. In selecting your canopy trees, it is important to note that there is an array of evergreen and deciduous California native trees that would provide all the benefits of a canopy tree along with helping restore the native flora of the region.

Sources of information in how to select the appropriate trees for your area and how to care for them are available online at:

http://www.treepeople.org/choose/right/tree

http://selectree.calpoly.edu/

http://www.arborday.org/trees/righttreeandplace/

Impervious Area (sq. ft.)	Number of Large Canopy Trees Planted*
500 - 1,000	2
1,001 - 1,500	4
1,501 - 2,000	6

How Many Trees Do I Need?

The number of trees required to capture runoff from a given impervious area is shown in the following table.

For more information, contact
Long Beach Development Services at

(562) 570.5237 or www.lbds.info

Small Scale Residential LID BMP Measures

Tree Planting Fact Sheet

Design Criteria and Considerations

When installing a canopy tree, the following criteria should be adhered to unless otherwise permitted by the City of Long Beach. The owner should check all boxes that will be complied with.

- ☐ Canopy trees must be planted at least 10 feet from the house foundation and at least 5 feet from fences, patios, driveways and sidewalks. To reduce stormwater runoff most effectively, canopy trees should be planted within 10 feet of an impervious area on the residential property, such as a driveway or walkway.
- ☐ If planting a canopy tree within close proximity (20 feet) to overhead utility lines, restrictions may apply. Questions related the potential hazards of canopy tree placement near overhead utility lines can be answered by contacting Southern California Edison (800) 655-4555 or visiting their website at: http://www.sce.com/Safety/treesandpower/default.htm.
- ☐ Prior to planting, property owners must check for underground utilities before planting the canopy tree in the right-of-way. Call DigAlert (800) 227-2600 or www.digalert.org at least two days before you begin digging a hole for the tree, and they will mark where the underground utilities are in the right-of-way.

Operations and Maintenance

Once trees have been planted, the following criteria should be adhered to. The owner should check all boxes that will be complied with.

- ☐ For the first month after planting your tree, water deeply (15 gallons) twice a week. For the second and third months after planting, water deeply once a week. The next few months you should only water every two weeks and once the tree is at least six months old, you can water once a month for the rest of its first year.
- ☐ After the tree is a year old watering requirement are minimal. Expect to water every six weeks as necessary for the next few years of the tree's growth.
- ☐ Once trees are mature, maintenance will also include pulling weeds around the base of the tree and pruning (removing dead or diseased branches), which helps the tree structure and increases its longevity.

Tree Planting Guidelines

Dig a hole at least twice as wide as the root ball (all the roots inside the pot) and almost as deep as the height of the root ball. Making sure the walls of the hole you dug have loose enough soil so tree roots can penetrate. If they are slick; roughen them up with a shovel.

- ☐ Remove the tree from the container and check that its roots are not circling the trunk. If so, uncurl the circling roots gently so they go outward from the trunk and then place tree gently in the hole you dug. Make sure the tree is standing upright when placed in hole.
- ☐ Fill in hole with soil (pack down soil to help stabilize the tree), but allow the top of the root ball to be exposed above soil at least 1 inch to avoid rotting. Build a water basin around the tree to concentrate water going to the root ball. Do this by building a 6 inch high soil berm (raised barrier) around the perimeter.
- ☐ Water the tree thoroughly with 15 gallons of water immediately after planting. The best technique is "deep watering", allowing the hose to trickle 15 gallons of water around the tree over a period of 2 to 4 hours, which does not disturb the soil and ensures the roots get the amount of moisture they require.
- ☐ After watering, cover the whole planting area with a 4 inch layer of mulch, leaving a 2 inch area around the base of the tree trunk free of mulch. Mulch is plant matter that includes: shredded leaves, straw or composted wood chips. Adding mulch keeps soil temperate, reduces surface evaporation of water and slows weeds from growing around the base of the tree.

* The recommend tree planting size is 15 gallons, due to the projected health and larger growth of the tree compared to a 24 or 36 inch boxed tree in 5 years time.

Owner Certification

"As the owner of the project property, I hereby certify that the above information is true, accurate, and complete, to the best of my knowledge."

Owner Signature: _____ Date:_____

Appendix B: LB Municipal Code Chapter 18.74

CHAPTER 18.74 LOW IMPACT DEVELOPMENT STANDARDS

CHAPTER 18.74
LOW IMPACT DEVELOPMENT STANDARDS

18.74.010 – Purpose.

The purpose of this chapter is to require the use of low impact development (LID) standards in the planning and construction of development projects. LID standards promote the goal of environmental sustainability by helping improve the quality of receiving waters, protecting the Los Angeles and San Gabriel River watersheds, maintaining natural drainage paths, and protecting potable water supplies within the City. The LID objective of controlling and maintaining flow rate is addressed through land development and stormwater management techniques that imitate the natural hydrology (or movement of water) found on the site. Using site design and best management practices that allow for storage and retention, infiltration, filtering, and flowrate adjustments achieve the goals of LID, advances sustainability and reduces the overall cost of stormwater management. The use of engineered systems, structural devices, and vegetated natural designs distributes stormwater and urban runoff across a development site maximizing the effectiveness of LID.

18.74.020 – Definitions.

“Brownfield” means a piece of industrial or commercial property that is abandoned or underused and often environmentally contaminated, especially one considered as a potential site for redevelopment.

“Development” means any constructionto build any new public or private residential projects (whether single-family, multi unit or planned unit development); new industrial, commercial, retail and other non-residential projects, including public agency projects; new impervious surface area; or mass grading for future construction. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

“LID Best Management Practices Manual” means a manual of LID standards and practices for stormwater pollution mitigation, including technical feasibility and implementation parameters, alternative compliance for technical infeasibility, as well as other rules, requirements and procedures as the City deems necessary, for implementing the provisions of this section of the Long Beach Municipal Code.

“Multi-Phased Project” shall mean any Development or Redevelopment implemented over more than one phase and the Site of a Multi-Phased Project shall include any land and water area designed and being used to store, treat or manage stormwater runoff in connection with the Development or Redevelopment, including any tracts, lots, or parcels of real property, whether Developed or not, associated with, functionally connected to, or under common ownership or control with such Development or Redevelopment.

“Offsite Runoff Mitigation Fee” means fee paid to the City for the management of storm water runoff generated from the 0.75-inch water quality storm in excess of the storm water runoff that is infiltrated, evapotranspired and/or stored for use. The Offsite Runoff Mitigation Fee shall be used by the City to construct or apply towards the construction of an offsite mitigation project within the same sub-watershed that will achieve at least the same level of water quality protection as if all of the runoff was retained on site.

“Redevelopment” means land-disturbing activities that result in the replacement of more than fifty percent (50%) of an existing building, structure or impervious surface area on an already developed site. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety or grinding/overlaying and replacement of existing parking lots.

“Site” means the land or water area where any “facility or activity” is physically located or conducted,

including adjacent land use in connection with the facility or activity.

18.74.030 – LID requirements and applicability.

A. The provisions of this section set forth the requirements for and shall apply to all new Development and Redevelopment projects in the City of Long Beach. The following Development or Redevelopment projects are exempt from the requirements of this chapter:

1. Any Development or Redevelopment projects that creates, adds or replaces less than five hundred (500) square feet of impervious surface area;

2. Any Development or Redevelopment projects involving emergency construction activities required to immediately protect public health and safety;

3. Any Development or Redevelopment projects involving the grinding/overlaying and replacement of existing parking lots;

4. Any Development or Redevelopment projects where land disturbing activities result in the replacement of fifty percent (50%) or less of an existing building, structure or impervious surface area; or

5. Any Development or Redevelopment projects that are technically infeasible pursuant to Subsection 18.74.040.B; or

6. Any Development or Redevelopment projects that do not require a building permit.

B. LID requirements for new Development or Redevelopment projects:

1. Residential Development of 4 units or less

a. For new Development less than one (1) acre, or if Redevelopment alters more than fifty percent (50%) of existing buildings, structures or impervious surfaces of an existing developed site, comply with the standards and requirements of this chapter and implement at least two (2) adequately sized LID BMP alternatives from the LID Best Management Practices Manual.

b. For new Development that is one (1) acre and greater, the entire Site shall comply with the standards and requirements of this chapter and the LID Best Management Practices Manual.

2. Residential Developments of 5 units or more and nonresidential Developments

For new Development, or if Redevelopment alters more than fifty percent (50%) of existing buildings, structures or impervious surfaces of an existing developed site, the entire Site shall comply with the standards and requirements of this chapter and of the LID Best Management Practices Manual.

3. Nonresidential Developments in the Port of Long Beach Harbor District

For new Development or Redevelopment projects located in the Port of Long Beach Harbor District as designated in Title 21 Zoning Regulations, the site shall comply with the LID BMP alternatives set forth in the Port of Long Beach Post-Construction Design Guidance Manual and in the LID Best Management Practices Manual.

C. This chapter shall not apply to those projects for which a building permit application has been filed for and deemed complete by the Building Official prior to February 19, 2013.

18.74.040 – LID plan review.

A. Compliance with the LID standards of this chapter shall be demonstrated through a LID plan review. Permit applicant shall be required to submit a LID plan for review to the Building Official. The LID plan shall demonstrate how the project will meet the standards and requirements of this chapter and of the LID Best Management Practices Manual. A submitted LID plan shall indicate compliance with the following standards:

1. Stormwater runoff will be infiltrated, captured and reused, evapotranspired, and/or treated onsite through stormwater best management practices allowed in the LID Best Management Practices Manual.

2. The onsite stormwater management techniques must be properly sized, at a minimum, to infiltrate, evapotranspire, and/or store for use without any storm water runoff leaving the site to the maximum extent feasible, for at least the volume of water produced by a storm event that results from:

   a. The volume of runoff produced from a 0.75 inch storm event; or

   b. The eighty-fifth (85^{th}) percentile twenty-four (24) hour runoff event determined as the maximized capture stormwater volume for the area using a fourty-eight (48) to seventy-two (72) hour draw down time, from the formula recommended in Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual of Practice No. 87, (1998); or

   c. The volume of annual runoff based on unit basin storage water quality volume, to achieve eighty percent (80%) or more volume treatment by the method recommended in the California Stormwater Best Management Practices Handbook – Industrial/Commercial, (2003).

B. When the onsite LID requirements are technically infeasible, the infeasibility shall be demonstrated in the submitted LID plan and shall be reviewed in consultation with theBuilding Official. The technical infeasibility may result from conditions that may include, but are not limited to:

1. Locations where seasonal high groundwater is within ten (10) feet of surface grade;

2. Locations within one hundred (100) feet of a groundwater well used for drinking water;

3. Brownfield Development sites or other locations where pollutant mobilization is a documented concern;

4. Locations with potential geotechnical hazards; or

5. Locations with impermeable soil type as indicated in applicable soils and geotechnical reports.

C. If complete onsite compliance of any type is technically infeasible, a Development or Redevelopment project shall be required to comply with, at a minimum, all applicable Standard Urban Stormwater Mitigation Plan (SUSMP) requirements of Chapter 18.61 in order to maximize onsite compliance. For the remaining runoff that cannot feasibly be managed onsite, one or a combination of the following shall be required:

1. An Offsite Runoff Mitigation Fee pursuant to Subsection 18.74.050.B shall be paid to the City of Long Beach's Stormwater Pollution Abatement Fund for offsite mitigation, as described in the LID Best Management Practices Manual. The funding will be applied towards the construction of an offsite mitigation project(s) within the same sub-watershed that will achieve at least the same level of water quality protection as if all of the runoff was retained onsite.

2. To provide an incentive for onsite management of storm water runoff, Development and Redevelopment projects will receive the following reduction in the Offsite Runoff Mitigation Fee based on the percentages of storm water runoff that is managed on site through infiltration, evapotranspiration, and/or capture and use:

Stormwater Runoff Managed Onsite	Fee Reduction
Between 90% and 99%	75%
Between 75% and 89%	50%
Between 50% and 74%	25%

3. A Multi-Phased Project must design a system acceptable to satisfy these standards and requirements for the entire Site during the first phase and will implement these standards and requirements for each phase of Development or Redevelopment projects of the Site during the first phase or prior to commencement of construction of a later phase, to the extent necessary to treat the stormwater from such later phase.

18.74.050 – LID plan check, permit, and Offsite Runoff Mitigation fees.

A. Permit applicants who seeks to engage in new Development or Redevelopment as defined in this chapter by obtaining a building permit shall pay the required plan examination and permit fees as set forth in Chapter 18.06.

B. Permit applicants who seeks to engage in new Development or Redevelopment as defined in this chapter by obtaining a building permit and does not demonstrate complete onsite compliance as described in the LID Best Management Practices Manual are required to pay an Offsite Runoff Mitigation Fee in the manner and amount as set forth in the schedule of fees and charges established by City Council resolution.

C. Any Development or Redevelopment projects that are exempted from this chapter shall have the option to voluntarily opt in and incorporate into the project the LID requirements of this chapter. In such case, the LID plan review, permit and Offsite Runoff Mitigation fees associated with the project shall be waived.

18.74.60 LID Best Management Practices Manual.

A. The Building Official shall prepare, maintain, and update, as deemed necessary and appropriate, the LID Best Management Practices Manual to include LID standards and practices and standards for stormwater pollution mitigation. The LID Best Management Practices Manual shall also include technical feasibility and implementation parameters, alternative compliance for technical infeasibility, as well as other rules, requirements and procedures as the City deems necessary, for implementing the provisions of this chapter.

B. The Building Official shall develop, as deemed necessary and appropriate, in cooperation with other City departments and stakeholders, informational bulletins, training manuals and educational materials to assist in the implementation of the LID requirements.

18.74.070 – Hardship determination.

Whenever there are practical difficulties involved in carrying out the provisions of this chapter, the Director shall have the authority to grant modifications to the provisions of this chapter for individual cases, provided the Director shall first find that special individual reason makes the strict letter of this chapter impractical and the modification is in compliance with the intent and purpose of this chapter and that such modification does not lessen the goals of LID, sustainability or increase the overall cost of stormwater management.

Appendix C: All LID Forms

City of Long Beach
Department of Development Services
Building and Safety Bureau

Preparing Covenant and Agreement

Information Bulletin

BU-007

Eff: 04-16-2008
Rev: 11-15-2012

This Information Bulletin provides instructions for preparing covenants and agreements (i.e., affidavits) that are to be recorded with the Los Angeles County Recorder's office in conjunction with the issuance of a permit by the Building and Safety Bureau. Improper execution of covenants and agreements may result in unnecessary delays. The covenant and agreement shall be signed and approved by the staff assigned to your project prior to recording.

Please follow the steps outlined below when filing a covenant and agreement:

1. Obtain the appropriate covenant form and, if needed, consult with the staff assigned to your project for the appropriate wording.

2. Fill out the blank spaces on the covenant and agreement form.

3. Provide a plot plan, sketch or other relevant documents as required for the covenant and agreement or by the staff assigned to your project.

4. Provide a copy of proof of ownership for verification (e.g. grant deeds) including the legal description of the subject property. The owner's name on the proof of ownership, covenant, plans and permit applications **MUST** be identical.

5. Secure the proper signature(s) of the owner(s) of the subject property on the covenant and agreement. All signatures must be acknowledged before a Notary Public on the California All-Purpose Acknowledgment notary form. The following table shows the proper signature(s) required for various types of ownership.

TYPE OF OWNERSHIP	**REQUIRED SIGNATURE(S)**
Individual	The Individual (1)
Partnership	One General Partner (2)
Joint Venture	All Joint Venturers
Corporation	At least two of the following: The Chairman of the Board, President, Vice President, Secretary, Assistant Secretary, Chief Financial Officer or Assistant Treasurer (2)
Limited Liability Corporation	Managing Member (2)
Limited Liability Partnership	One General Partner (2)

(1) A husband and wife who jointly own a property need to both sign the required covenants.

(2) The person signing the covenant on behalf of the corporation or partnership must clearly state their capacity in the corporation or partnership.

6. The covenant and agreement **MUST** be signed and approved by the staff assigned to your project prior to recording. Please note that the Los Angeles County Recorder's office will not accept any documents that have been erased or altered in any manner.

7. Record the covenant at any of the Los Angeles County Recorder's offices located at:

12400 E. Imperial Highway Norwalk, CA 90650 (562) 462-2716	11701 S. La Cienega Blvd. Los Angeles, CA 90045 (310) 727-6142

Please call ahead for the Los Angeles County Recorder's office hours. Various office locations may have different operating schedules. For additional information, please check the Los Angeles County Recorder's website at www.lavote.net/recorder/document_recording.cfm

8. Request a **CERTIFIED COPY** of the covenant and agreement from the Los Angeles County Recorder's office at the time of recording.

9. Return the original **CERTIFIED COPY** of the covenant and agreement to the staff assigned to your project.

City of Long Beach
Department of Development Services
Building and Safety Bureau
333 West Ocean Blvd., 4th Floor
Long Beach, CA 90802
tel: 562-570-LBDS fax: 562-570-6753
Website: http://www.lbds.info

LID OBSERVATION REPORT FORM

LID OBSERVATION means the visual observation of the Low Impact Development ("LID") and storm water related Best Management Practices (BMPs) for conformance with the approved LID Plan at significant construction stages and at completion of the project. LID observation does not include or waive the responsibility for the inspections required by Section 18.07.050 or other sections of the City of Long Beach Building Code.

LID OBSERVATION must be performed by the Registered Design Professional ("RDP") responsible for the approved LID Plan or designated staff in their employment.

LID OBSERVATION REPORT must be signed and stamped below by the RDP responsible for the approved LID Plan and submitted to the city prior to the Building Final or issuance of the certificate of occupancy.

Project Address:	Building Permit No.:
Name of RDP responsible for the approved LID Plan:	Phone Number:
Name of LID Observer:	Phone Number:

CHECK APPROPRIATE BOX

☐ Installation is approved and without deficiencies.
☐ Final lid observation for the project is 100% complete without any deficiencies.
☐ Observed deficiencies and comments:

I declare that the following statements are true to the best of my knowledge:

1. I am the Registered Design Professional retained by the Owner to be in responsible charge for the approved LID plan, and
2. I, or a designated staff under my responsible charge, has performed the required site visits at each significant construction stage and at completion to verify that the best management practices as shown on the approved LID plan have been constructed and installed in accordance with the approved LID plan.

_____ _____

SIGNATURE OF LID OBSERVER OF RECORD DATE

STAMP OF LID OBSERVER OF RECORD

Recorded at the request of and mail to:	
(Name)	
(Address)	
(Date of Recording)	

SPACE ABOVE THIS LINE FOR COUNTY RECORDER'S USE

COVENANT AND AGREEMENT
REGARDING ON-SITE LID BMP MAINTENANCE

The undersigned hereby certify that (I am) (we are) the owner(s) of real property located in the City of Long Beach, State of California that is hereinafter legally described (as follows) (on the attached exhibit(s) _____):

LEGAL DESCRIPTION:

LOT_____BLOCK_____TRACT_____

as recorded in BOOK_____PAGE_____, Records of Los Angeles County. This property is located and known as the following **ADDRESS:**

_____

And, in consideration by the City of Long Beach for allowing: _____

_____

on said property, we do hereby covenant and agree to and with said City to maintain according to the Operation & Maintenance Plan (Attachment 1), all on-site structural stormwater pollution removal devices including but not limited to: Detention/Sedimentation System, Filtration Systems, Infiltration Systems, Oil and Water Separators, Water Quality Inlets and Dry Wells. The specific structural BMPs are listed as follows:_____

_____

This covenant and agreement shall run with all of the above described land and shall be binding upon ourselves, and future owners, encumbrances, their successors, heirs or assignees and shall continue in effect until released by the authority of the Building Official of the City of Long Beach upon submittal of request, applicable fees and evidence that this covenant and agreement is no longer required by law.

Owner's Name

(Please type or print)

Signature of Owner

(Signature)

Two Officer's Signatures
Required for Corporation

(Signature)

Name of Corporation

(Please type or print)

Dated this day of , 20

FOR DEPARTMENT USE ONLY:
MUST BE APPROVED BY LBDS EMPLOYEE PRIOR TO RECORDING.

APPROVED BY _____ _____ DATE _____

(Print Name) (Signature)

Appendix D: All Other Development Volume Design Calculations

Calculating Size Requirements for Infiltration BMPs

The main challenge associated with infiltration BMPs is preventing system clogging and subsequent infiltration inhibition. In addition, infiltration BMPs must be designed to drain in a reasonable period of time so that storage capacity is available for subsequent storms and so that standing water does not result in vector risks or plant mortality. Infiltration BMPs should be designed according to the requirements listed and outlined in the text following.

Infiltration facilities must be sized to completely infiltrate the design capture volume within 48 hours. Steps for the simple sizing method are provided below.

Step 1: Calculate the Design Volume (v)

Infiltration facilities shall be sized to capture and infiltrate the design capture volume (V_{design}) based on the runoff produced from a 0.75-inch (0.0625 ft) storm event.

$$V_{design} \text{ (cu ft)} = 0.0625 \text{ (ft)} \times \textit{Catchment Area} \text{ (sq ft)}$$

Where:

Catchment Area = (Impervious Area x 0.9) + [(Pervious Area + Undeveloped Area) x 0.1]

For catchment areas given in acres, multiply the above equation by 43,560 sq. ft./acre.

Infiltration BMP Design Criteria

Design Parameter	Unit	Basins and Trenches	Galleries	Bioretention	Permeable Pavement	Dry Well	Hybrid Bioretention/ Dry Well
Design Capture Volume, $V_{capture}$	cubic feet	0.0625 (ft) x Catchment Area (sq. ft.)[a]					
Design Surface Drawdown Time	hr	48					
Setbacks and Elevations	feet	In accordance with the Infiltration Feasibility Criteria, Section 4.2					
Pretreatment	-	Appropriate Treatment Control Measure shall be provided as pretreatment for all tributary surfaces other than roofs					
Hydraulic Conductivity, $K_{sat,measured}$	in/hr	Measured hydraulic conductivity at the location of the proposed BMP at the depth of the proposed infiltrating surface (or effective infiltration rate when multi directional infiltration is occurring					
Factor of Safety, FS[b]	-	3					
Facility geometry	-	Bottom slope ≤ 3% (basins); side slope shall not exceed 3:1 (H:V)	Flat bottom slope	Bottom slope ≤ 3%; side slope shall not exceed 3:1 (H:V)	Pavement slope ≤ 5%; If ≥ 2%, area shall be terraced	Typical 18 – 36 inch diameter; flat bottom slope	Bioretention: Bottom slope ≤ 3%; side slope shall not exceed 3:1 Drywell: flat bottom
Ponding Depth	inch	18 (maximum)[c]					
Media Depth	feet	2 (min) 8 (max)	-	2 (min) 8 (max)	2 (min) 8 (max)	-	2 (min) 8 (max)
Gravel media diameter	inch	1 – 3	-	-	1 - 2	3/8 – 1	3/8 - 1
Inlet erosion control	-	Energy dissipater to reduce velocity					
Overflow	-	Required if system is on-line and does not have an upstream bypass					

Design Parameter	Unit	Basins and Trenches	Galleries	Bioretention	Permeable Pavement	Dry Well	Hybrid Bioretention/ Dry Well
device		structure.Shall be designed to handle the peak storm flow in accordance with the Building and Safety code and requirements					

a: Catchment area = (impervious area x 0.9) + [(pervious area + undeveloped area) x 0.1]

b: Listed FS values to be used only if soil infiltration / percolation test was performed and a detailed geotechnical report from a professional geotechnical engineer or engineering geologist is provided. A FS of 6 will be assigned if only a boring was done.

c: Ponding depth may vary for galleries (which have a storage depth) and may be different from one vendor to another. Ponding depth is not necessarily applicable to permeable pavement.

Step 2: Determine the Design Infiltration Rate (K_{sat})

The infiltration rate will decline between maintenance cycles as the surface becomes clogged with particulates and debris. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the sizing of facilities depending on a site's infiltration rate and expected surface loading. Where applicable, the measured infiltration rate discussed here is the infiltration rate of the underlying soils and not the infiltration rate of the filter media bed or engineered surface soils. Facility maintenance is required to maintain the infiltration rate for the life of the project. Infiltration rates used for design must be divided by the appropriate factors of safety.

$$K_{sat,design} = K_{sat,measured}/FS$$

Where:

FS = Infiltration factor of safety

Measured infiltration rates shall be determined by in-ground, site specific infiltration tests or can be based on laboratory tests conducted on soil samples collected during the exploratory work for a site-specific geotechnical report.

Step 3: Calculate the BMP Surface Area (A)

Determine the size of the required infiltrating surface by assuming the design capture volume will fill the available ponding depth plus the void spaces based on the porosity of the gravel fill (normally about 30 - 40% [1]) or amended soil (normally about 20 – 30%).

Determine the minimum infiltrating surface area necessary to infiltrate the design volume:

$$A_{min} = (V_{design} \times 12 \text{ in/ft}) / (T \times K_{sat,\ design})$$

Where:

A_{min} = Minimum infiltrating surface area (ft^2)

T = Drawdown time (hours), 48 hours

The calculated minimum BMP surface area only considers the surface area of the BMP where infiltration can occur. For dry wells, the calculated surface area is the total surface area of the well lying in soils with $K_{sat,measured}$ values > 0.3 in/hr. In other words, the portion of the dry well that extends through impermeable layers should not be considered part of the infiltrating area. For the hybrid bioretention/dry well BMP design, the calculated BMP surface area applies to the combined surface area of the bioretention facility and the infiltrating portion of the underlying dry well(s).

---

1 Terzaghi and Peck stated that in the densest possible arrangement of cohesionless spheres, the porosity is equivalent to 26%; in the loosest possible arrangement, the porosity is equal to 47% (Terzaghi K. and Peck R. Soil Mechanics in Engineering Practice. 2nd ed. New York: John Wiley and Sons; 1967).

For infiltration basins, the surface area should be calculated as the surface area at mid-ponding depth. For infiltration trenches, the surface area should be calculated at the bottom of the trench.

Note that A_{min} represents the minimum calculated surface area. It is up to the discretion of the developer if A_{min} will be exceeded to allow for less media storage.

*Step 4: Calculate the Total Storage Volume**

Determine the storage volume of the infiltration unit to be filled with media for capturing the design capture volume.

$$V_{storage} = V_{design} / n$$

Where:

$V_{storage}$ = Minimum media storage of the infiltration facility (ft^3)

n = void ratio (use 0.40 for gap graded gravel)

* Note: Dry wells with gravel fill may not store the entire design volume; additional storage unit(s) to capture the remaining design volume may be required upstream of the dry well.

Step 5: Calculate the Media Storage Depth

Determine the depth of the infiltration unit to be filled with media for capturing the design capture volume. The depth shall not exceed 8 feet – except for dry well(s).

$$D_{media} = V_{storage} / A_{min}$$

Where:

D_{media} = Minimum media storage depth of the infiltration facility (ft)

If D_{media} is calculated as greater than 8 feet, the design infiltration area (A_{design}) shall be increased and the depth of media shall be recalculated until it is less than 8 feet.

Many project developers may elect to increase the design infiltration area such that $A_{design} > A_{min}$. This is especially feasible where infiltration rates are relatively high (leading to a low A_{min} value). The depth of media (D_{media}) should be calculated using the actual design area in Step 5 above. For projects with designed infiltration areas significantly higher than A_{min}, it may be feasible to have no media storage (i.e. D_{media} = 0 ft). For this to apply, the following condition must be met:

$$A_{design} \geq (V_{design} \times 12in/ft) / (K_{sat,design} \times T)$$

Infiltration Sizing Example

Given: 30,000 ft^2 apartment complex (including parking) with 10,000 ft^2 of landscaped area. An infiltration test has resulted in a $K_{sat,measured}$ value of 1.0 in/hr; Factor of Safety = 3. Design an infiltration trench meeting the sizing requirements. Assume the trench is full of gap-graded gravel with a porosity of 0.4.

1) Determine V_{design}

   Catchment Area = (30,000ft^2 x 0.9) + [(10,000 ft^2) x 0.1] = 28,000 ft^2

   $\boldsymbol{V_{design}}$ = 0.0625 ft * 28,000 ft^2 = **1,750 ft^3**

2) Determine $K_{sat,design}$

   $\boldsymbol{K_{sat,design}}$ = $k_{sat,\ measured}$ / FS = (1 in/hr) / 3 = **0.333 in/hr**

3) Determine A_{min}

   $\boldsymbol{A_{min}}$ *= (V_{design} x 12 /(T x $k_{sat,\ design}$)*

   = (1,750 ft^3 x 12 in/ft)/(48hrs x 0.333 in/hr) = ***1,214 ft^2***

4) Determine $V_{storage}$

   $\boldsymbol{V_{storage}}$ = V_{design} / n = 1,750 / 0.4 = **4,375 ft^3**

5) Determine D_{media}

   $\boldsymbol{D_{media}}$*= $V_{storage}$ / A_{min} = 4,375 ft^3 /1,314 ft^2 =* ***3.33 ft***

The trench should therefore be designed with a minimum of 1,214 ft^2 of infiltrating surface area. At this minimum surface area, the gravel media depth should be at least 3.33 ft.

Biofiltration BMP Design Criteria

Design Parameter	Unit	Bioretention with Underdrain	Planter Box	Bioinfiltration	High Flow Biotreatment[a]	Vegetated Swale	Filter Strip
Design Capture Volume, $V_{capture}$	cubic feet	1.5 x 0.0625 ft * Catchment Area (sq. ft.)[b]					-
Design Drawdown Time	hr	48 (surface); 96 (total)				-	-
Factor of Safety[c]	-	2				-	
Soil Media Infiltration Rate	in/hr	5 (max)			Per manufacturer's standards	-	
Design Contact Time	min	-				≥ 7	
Slope in Flow Direction	%	-				1% (min) 6% (max)	2% (min) 33% (max)
Design Flow Velocity	ft/sec	-				≤ 1	
Max Ponding/Flow Depth	inch	18	12	18	-	5	1
Soil Depth	ft	2 (3 preferred) Topped with 3" of mulch			-	2	-
Underdrain	-	Slotted PVC pipe embeded in 12" gavel section and located 1" from bottom of facility		Slotted PVC pipe at least 2' above bottom of facility	Per manufacturer's standards	N/A	Not required
Inlet erosion control	-	Energy dissipater to reduce velocity					
Overflow device	-	Required if system is on-line and does not have an upstream bypass structure. Shall be designed to handle the peak storm flow in					Not Required

Design Parameter	Unit	Bioretention with Underdrain	Planter Box	Bioinfiltration	High Flow Biotreatment[a]	Vegetated Swale	Filter Strip
		accordance with the Building and Safety code and requirements					

a: High flow biotreatment BMP design criteria displayed in Table 4.5 are general guidelines. Specific designs will vary depending on the vendor, design type, size, etc. High flow biotreatment BMPs must be sized to treat the design capture volume specified. They must be shown (by third party field testing) to have a pollutant removal efficiency equal to or greater than their non-proprietary counterparts.

b: Catchment area = (impervious area x 0.9) + [(pervious area + undeveloped area) x 0.1]

c: Listed FS values to be used only if soil infiltration / percolation test was performed and a detailed geotechnical report from a professional geotechnical engineer or engineering geologist is provided A FS of 6 will be assigned if only a boring was done.

Bioretention, Planter Box, Bioinfiltration, and High-Flow Biotreatment Sizing

With the exception of swales and filter strips, biofiltration facilities can be sized using one of two methods: a simple sizing method or a hydrologic routing modeling method. With either method the design capture volume must be completely infiltrated within the drawdown time. Steps for the simple sizing method are provided below.

Step 1: Calculate the Design Volume

Biofiltration facilities shall be sized to capture and treat 150% of the design capture volume (V_{design}) based on the runoff produced from a 0.75-inch (0.0625 ft) storm event.

$$V_{design} \text{ (cu ft)} = 1.5 * 0.0625 \text{ ft} * \textit{Catchment Area} \text{ (sq. ft.)}$$

Where

Catchment area = (Impervious Area x 0.9) + [(Pervious Area + Undeveloped Area) x 0.1]

Step 2: Determine the Design Infiltration Rate

The infiltration rate will decline between maintenance cycles as the surface and underlying soil matrix becomes clogged with particulates and debris. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the sizing of facilities depending on a site's infiltration rate and expected surface loading. Unlike infiltration BMPs, the measured infiltration rate discussed here is the infiltration rate of the filter media bed or engineered surface soils in the biofilter. A target long-term $K_{sat,media}$ of 5 in/hr is recommended for non-proprietary amended soil media. Facility maintenance is required to maintain the infiltration rate for the life of the project. Infiltration rates used for design must be divided by the appropriate factors of safety.

$$K_{sat,design} = K_{sat,media}/FS$$

Step 3: Calculate the BMP Ponding Depth

Select a ponding depth (d_p) that satisfies geometric criteria and is congruent with the constraints of the site. The ponding depth must satisfy the maximum ponding depth constraint as well as the following:

$$d_p \text{ (ft)} = (K_{sat,design} \text{ x T}) / 12$$

Where:

d_p = Ponding depth (ft)

$K_{sat,design}$= Design infiltration rate of filter media (in/hr)

T = Required surface drain time (hrs), from Table 4.5

Step 4: Calculate the BMP Surface Area

Calculate infiltrating surface area (filter bottom area) required:

$$A_{min} = \frac{V_{design}}{[(T_{fill} K_{sat,design}/12) + d_p]}$$

Where:

A_{min} = Design infiltrating area (ft^2)

T_{fill}= Time to fill to max ponding depth with water (hrs) [unless a hydrologic routing model is used, assume a maximum of 3 hours]

The calculated BMP surface area only considers the surface area of the BMP where infiltration through amended media can occur. The total footprint of the BMP should include a buffer for side slopes and freeboard.

Bioinfiltration BMPs and high-flow biotreatment devices should incorporate a raised underdrain above the gravel sump to facilitate incidental infiltration where feasible. For these instances, infiltration screening in accordance with Section 4.2 must be carried out to show that infiltration BMPs are not allowed due to low infiltration rates or high depths of fill (i.e. there are not hazards associated with infiltration). These BMPs are not suitable for project sites that do not pass infiltration feasibility screening due to associated hazards of infiltration (e.g. high groundwater table, contaminated soil or groundwater, landslide zones, etc.)

Swale Sizing

Swales shall be designed with a trapezoidal channel shape with side slopes of 3:1 (H:V). They shall incorporate at least two feet of soil beneath the vegetated surface. The following steps shall be followed for swale sizing. As is the case with other biofiltration BMPs, the sizing criteria must be met.

Step 1: Determine the Swale Base Width and Corresponding Unit Length

The base width of a swale must be between 2 and 10 feet. The designer may select the base width that is most appropriate for the site, but the swale length (per unit catchment area) must meet the minimum requirements as shown below.

Table 4.6: Swale Base Length (Per Unit Catchment Area)

Base of Swale	ft	2	3	4	5	6	7	8	9	10
Minimum Swale Length per Acre of Catchment Area	ft/acre	770	635	535	470	415	370	335	305	285

Step 2: Determine the Distance Between Check Dams

For volume storage, swales must incorporate check dams at specified intervals depending on the longitudinal slope of the swale, which must be between one and six percent. The check dams must be 12 inches in height and include a 6 inch deep notch in the middle of the check dam that is between one and two feet wide. All check dam structures shall extend across the entire base of the swale. They may be designed using a number of different materials including concrete blocks, gabions, gravel bags, rip rap, or earthen berms. The distance between successive check dams shall be determined from the longitudinal slope of the swale in the flow direction. The table below summarizes the design distances between check dams based on slope.

*Check Dam Spacing Requirements for Swales**

Slope	%	1	2	3	4	5	6
Distance Between Checkdams	ft	N/A	N/A	33	25	20	17

* Depending on location of swale, approval from LADBS grading Division may be required.

For intermediary slopes not shown above, linear interpolation may be used to calculate the distance between check dam structures.

Step 3: Determine the Total Swale Length

The total length of the swale (L_{swale}) is a function of the catchment area and unit swale length. Total swale length is calculated as follows:

$$L_{swale} \text{ (ft)} = \textit{Catchment Area } (\text{ft}^2) \times (1 \text{ acre}/43{,}560 \text{ ft}^2) \times \textit{Swale Length per Acre of Catchment Area } (\text{ft/acre})$$

Where Catchment Area = (Impervious Area x 0.9) + [(Pervious Area + Undeveloped Area) x 0.1]

If there is adequate space on the site to accommodate a larger swale, consider using a greater length to increase the hydraulic residence time and improve the swale's pollutant removal capability. If the calculated length is too long for the site, the layout may be modified by meandering the swale or increasing the base width of the swale up to 10 feet. The total swale length shall never be less than 100 feet.

Filter Strip Sizing

Because filter strips are most often used for pretreatment purposes, their design will depend on the desired flow-rate to be treated and the type of BMP downstream, among other factors. As a result, filter strip sizing is not covered in this handbook, but will be determined on a case-by-case basis by the City of Long Beach.

Bioinfiltration Sizing Example

Given: 100,000 ft^2 commercial development, 100% impervious (negligible landscaping). Design a bioinfiltration BMP to treat runoff from the entire development ($K_{sat,media}$= 5 in/hr; Factor of Safety = 2.).

1) Determine V_{design}
   Catchment Area = (100,000ft^2 x 0.9) = 90,000ft^2

   $\boldsymbol{V_{design}}$ = 1.5 x 0.0625ft x 90,000ft^2 = **8,500 ft^3**

2) Determine $K_{sat,design}$
   $\boldsymbol{K_{sat,design}}$ = (5 in/hr) /2 = **2.5 in/hr**

3) Determine d_p
   d_p = (2.5 in/hr * 48 hrs)/12 = 10.0 ft

   Adhering to the max ponding depth requirements of Table 4.5, $\boldsymbol{d_p}$ **= 1.50 ft**

4) Calculate the infiltrating surface area, A_{min}

$$\mathbf{A_{min}} = \frac{8{,}500\ cuft}{[(3hr * 2.5\ in/hr\ /12) + 1.5\ ft]} = \mathbf{4{,}000\ ft^2}$$

For a full capture system, bioinfiltration units must be designed with a combined surface area of 4,000 ft^2.

Calculating Size Requirements for Capture and Use BMPs

At a minimum, capture and use BMPs must be designed and maintained to ensure adequate capacity is available to capture the stormwater quality design volume within 3 days of a likely storm event. A likely storm event is any weather pattern that is forecast to have a 50% or greater probability of providing precipitation at the development site. Precipitation forecast information must be obtained from the National Weather Service Forecast Office (e.g. by entering the zip code of the developments location at http://www.srh.noaa.gov/forecast).

BMPs sized to capture the runoff produced from the 0.75 inch storm event, or BMPs designed to capture less than this volume, if being used in conjunction with other BMPs, must therefore drawdown their entire captured volume within 3 days of a likely storm event.

Capture and use BMPs designed for storm events larger than 0.75 inches are required to disperse enough water from the BMP within 3 days of a likely storm event to ensure that adequate capacity is available to capture the next storm event up to 0.75 inches. In instances where the quantity of runoff from the 0.75 inch storm event exceeds the volume of the collection tank, partial capture and use can also be achieved as part of a treatment train by directing the overflow to stable vegetated areas where erosion or suspension of sediment is not a factor or through a high flow biotreatment BMP to provide additional volume reduction and water quality treatment. Overflow from the tank into the storm drain system is not allowed.

Capture and use BMPs designed for these extended holding times will require additional treatment such as filtration or disinfection to protect the collection tanks from fouling, to prevent the breeding of vectors, and/or to improve the quality of water for reuse applications. These scenarios will be reviewed on a case-by-case basis.

Calculating the Minimum Capture Volume for a 72-hour Holding Time

Assuming that demands and conditions at a site indicate that the 72-hour drawdown time requirement will be met, all cisterns shall be sized to capture the runoff generated from the 0.75-inch storm event at a minimum[1]:

$$V_{design} \text{ (gallons)} = 0.4675 * \textit{Catchment Area} \text{ (sq. ft.)}$$

Where:

Catchment Area = (Impervious Area x 0.9) + [(Pervious Area + Undeveloped Area) x 0.1]

For catchment areas given in acres, multiply the above equation by 43,560 sq. ft./acre.

1 Capture and use BMPs used in combination with other BMP types to collectively meet the water quality design storm standard set forth in Section 3.1.3 may be sized to capture less than V_{design}.

Appendix E: Stormwater Infiltration Guidelines

City of Long Beach
Department of Development Services
Building and Safety Bureau

Guidelines for Storm Water Infiltration

Information Bulletin

BU-035

Eff: 11-15-2012
Rev: 11-15-2012

This information bulletin provides guidelines for the design and acceptance of facilities to infiltrate storm water into the ground. Projects subject to the requirements of the Standard Urban Storm Water Mitigation Plan ("SUSMP") or the Low Impact Development ("LID") ordinance are required to infiltrate storm water runoff when geotechnically feasible. Infiltration facilities that are adjacent to buildings/structures are therefore required to be evaluated by a soils engineer. The findings of the soils engineer shall be contained in a report to be reviewed Building and Safety and/or Public Works plan review staff. The purpose of the soils engineer's evaluation is to prevent the infiltration of storm water from aggravating any soil or bedrock condition which could result in slope instability, settlement of footings, surcharge of retaining walls, or contributing water to subsurface de-watering devices such as basement or retaining wall backdrains.

DEFINITIONS

For the purpose of this bulletin, the following terms are defined:

1. ***Homogeneous Soils*** are soils with no discernable layering, structure, fabric, texture, or changes in soil type, either vertically or horizontally, that could affect the rate or direction of water movement.

2. ***Infiltration Facilities*** are the devices used to introduce storm water into the ground. They may consist of gravel filled pits, trenches, dry wells, or various pre-manufactured products placed in the earth. Also known as infiltration BMPs (Best Management Practices), the different types are further defined in the City of Long Beach's LID BMP Handbook available from the Department of Development Services' website.

3. ***Zone of Saturation*** is the soil mass beneath an infiltration facility where the air voids in the soil have become filled with water.

I. GENERAL REQUIREMENTS

1. A soils report is required to evaluate the effects of any proposed storm water infiltration into the ground and the pertinent recommendations shall be made a part of the approved plan.

   Exception: Where the infiltration facility is a minimum of 15 feet from all buildings, retaining walls, or property lines and whenever there is a basement beneath the building, the horizontal distance between a building and the infiltration facility is greater than 15 feet plus the depth of the basement, a soils report is not required.

2. Storm water infiltration is not allowed in areas that can possibly contribute to any groundwater that may affect the stability of slopes, either on, adjacent to, or distant from the site.

3. Storm water infiltration is not allowed on any site where the water may saturate soils that are subject to liquefaction.

II. MINIMUM DESIGN REQUIREMENTS

The following design guidelines shall be considered as minimum requirements on sites where infiltration is found acceptable by the soils engineer. Subject to the findings of the soils investigation report, additional setbacks or design considerations may be required.

1. Water infiltration into the ground should occur a minimum of 10 feet above the groundwater table.

2. The distance between the infiltration facility and the adjacent private property line shall be a minimum of 10 feet. Where buildings, subterranean walls or deep basements exist on the adjacent property, a greater setback or deeper infiltration system may be required to comply with the criteria in this bulletin.

3. Foundations shall be set back a minimum of 10 feet from the infiltration facility and the bottom of the footing shall be a minimum of 10 feet from the expected zone of saturation.

   Note: The boundary of the zone of saturation in homogenous soils may be assumed to project downward from the top of the permeable portion of the infiltration facility at gradient of 1:1 or flatter, as determined by the soil engineer.

4. Infiltration facilities shall not be located on a slope with a gradient greater than 20% (5:1 horizontal to vertical).

5. Infiltration facilities shall be located so that soils supported by retaining and basement walls are not saturated.

6. Dry wells adjacent to buildings shall be cased to a depth where the potential saturation zone is at least 10 feet from any footing. The annular space around the casing shall be sealed to prevent water from raising up the outside of the casing.

7. Dry wells beneath buildings shall be cased to a depth where the potential saturation zone is a minimum of 10 feet from any footing and 10 feet beneath the bottom of any floor slab. The annular space around the casing shall be sealed to prevent water from raising up the outside of the casing.

8. No infiltration facility shall be placed to infiltrate water into fill material.

   Exception: Infiltration into soils placed as fill material may be allowed where the soil engineer can demonstrate that there will be no adverse effect on the integrity or stability of the fill. However, saturation of fill beneath a building shall not be allowed. Additionally, where adverse perched water conditions will be created along the contact of the fill and underlying soils or in layers of differing soil types within the fill, infiltration shall not be allowed.

9. Grassy swales shall be located a minimum 5 feet from any building and property line and should drain at a minimum 2% gradient with no check dams. Where check dams are constructed, the swale shall have the same setbacks from buildings and property lines as other infiltration facilities.

10. The infiltration facility shall be designed to overflow to the street in the event that the drainage capacity is exceeded or in case of future failure to adequately infiltrate.

11. Porous concrete or similar permeable hardscape materials are allowed to be used only where they will be subject to incidental rainfall and not where they would be subject to a concentrated flow of water such as from roof downspouts. Any hardscape design that impedes the flow of water over the ground surface is not acceptable.

III. SOILS REPORT CONTENT

When required by Section I Item 1, the soils engineer is to determine whether the site is suitable or unsuitable for the proposed infiltration facility. The soils report shall identify any soil/geologic conditions that could be adversely affected by water or that could influence the movement of water and make appropriate recommendations. The report shall be submitted along with the construction documents for review and approval prior to the issuance of any permit.

A. Reports For Sites Suitable For Infiltration

1. The soils report shall contain an opinion that the site is suitable for the proposed infiltration facility without increasing the potential for settlement of structures or adversely affecting retaining/basement walls located either on or adjacent to the subject site. The report shall contain the following:

    a. Map showing the locations of the proposed storm water infiltration facility and all adjacent structures, either on or adjacent to the site.

    b. A finding as to the potential for creating perched water conditions that may adversely affect structures.

    c. A finding as to the influence of the infiltration facility on the existing retaining walls. Infiltration facilities shall be located so that soil supported by retaining/basement walls is not saturated.

    d. A finding as to the presence of expansive soils and influence of the infiltration on behavior of these soils in view of soil structure interaction.

    e. A finding as to the susceptibility for hydro-consolidation, possibly resulting in distress to structures.

    f. A finding as to the susceptibility for any ground settlements due to soil saturation from infiltration, possibly resulting in distress to structures.

2. The conclusions of the report shall include:

a. An opinion as to whether the site is suitable for stormwater infiltration.

b. An opinion that the infiltration of the stormwater will not result in ground settlement that could affect structures, either on or adjacent to the site.

c. An opinion that the infiltration of the stormwater will not result in soil saturation that could affect retaining/basement structures.

B. Reports For Sites Not Suitable for Infiltration

1. The soils report shall provide the reason why infiltration is not recommended. Reasons for finding the site not suitable may include, but need not be limited to, the following:

a. Depth to groundwater is less than 10 feet from the bottom of the infiltration pit/trench/well.

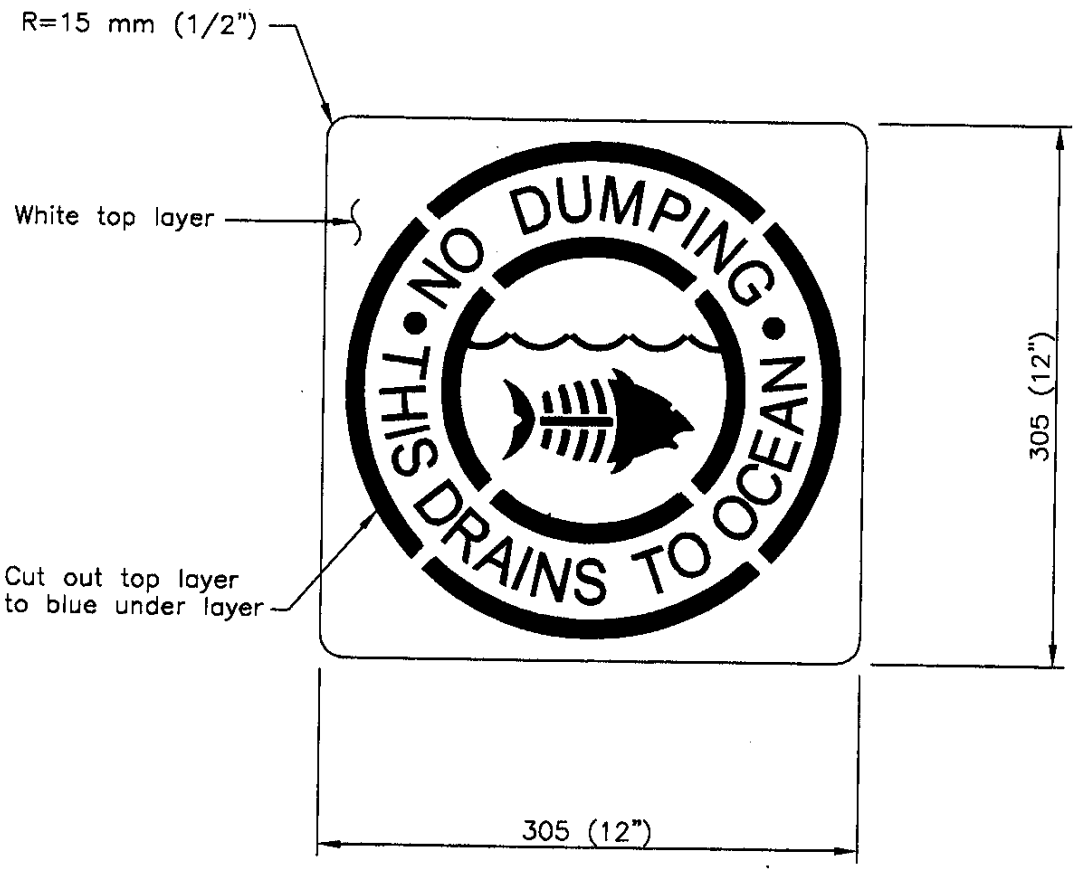
b. Impervious soils or bedrock with low infiltration rates.

c. Findings that infiltration and soil saturation may cause settlement of the existing/proposed foundations or saturation of soil supported by retaining (basement) walls.

d. Infiltration water may saturate soils subject to liquefaction.

e. Site is composed of fill material that is unacceptable for infiltration and the depth to acceptable natural soil is excessive.

Appendix F: Sample Storm Drain Message Placard



Notes:

1. Stencil material shall be two–layer resilient thermoplastic with 30% graded glass beads, 3.15 mm (125 mils) total thickness with beveled edges. Material shall be AASHTO designated M249–79(86), except that material shall be pre–formed.

2. Before application, prepare P.C.C. surfaces with a primer sealer. Apply stencils with propane torch heating, per manufacturer's recommendations.

3. Other graphic designs than that shown above are subject to approval. Submit full–size drawings and material samples to the City Engineer before application.

4. For new catch basins, stamp design into fresh concrete with tool loaned by the City of Long Beach, Public Service Bureau, Phone (562) 570–2700.

Dimensions are in millimeters, except as noted

REVISIONS		CITY OF LONG BEACH, CALIFORNIA DEPARTMENT OF PUBLIC WORKS	STANDARD PLAN NO.
NO.	DATE		
1	12/23/02	CATCH BASIN STENCIL	METRIC 636
2	02/28/03		
3		APPROVED BY: _____ DATE: 4/16/03 CITY ENGINEER R.E. No. 40599 EX. DATE 03/31/07	SHEET 1 OF 1
4			

Long Beach Development Services
333 W. Ocean Blvd., 3rd Floor
Long Beach, CA 90802
www.lbds.info

This information is available in an alternative format by request to Meg Rau at 562.570.7744.
For an electronic version of this document, visit our website at www.lbds.info

Amended November 12, 2013