Appendix I1
Preliminary Water Quality Management Plan

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Attachment A
WQMP Template

San Bernardino County Stormwater Program

WATER QUALITY MANAGEMENT PLAN TEMPLATE

WATER QUALITY MANAGEMENT PLAN (WQMP)

For compliance with Santa Ana Regional Water Quality Control Board

Order Number R8-2002-0012 (NPDES Permit No. CAS618036)

For

Spring Trails
Tr. 15576

Prepared for:
Montecito Equities Ltd.
3403 Martin Ranch Rd.
San Bernardino Ca, 92407

WQMP Preparation Date
May 20, 2009

WATER QUALITY MANAGEMENT PLAN (WQMP)

PROJECT SITE INFORMATION

Name of Project: Spring Trails

Project Location: North of Meyers Rd. west of of Little League Dr. East of Martin Ranch Road

Size of Significant Re-Development on an Already Developed Site (in feet^2): NA

Size of New Development (in feet^2): 15,272,197 SF / 350.6 AC

Number of Home Subdivisions: 309 DU

SIC Codes: _____

Erosive Site Conditions?: _____

Natural Slope More Than 25%?: Yes

WATER QUALITY MANAGEMENT PLAN (WQMP)

Check the appropriate project category below:

Check below	**Project Categories**
X	1. All significant re-development projects. Significant re-development is defined as the addition or creation of 5,000 or more square feet of impervious surface on an already developed site. This includes, but is not limited to, additional buildings and/or structures, extension of existing footprint of a building, construction of parking lots, etc. Where redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to SUSMPs, the design standards apply only to the addition, and not the entire development. When the redevelopment results in an increase of more than fifty percent of the impervious surfaces, then a WQMP is required for the entire development (new and existing).
X	2. Home subdivisions of 10 units or more. This includes single family residences, multi-family residence, condominiums, apartments, etc.
	3. Industrial/commercial developments of 100,000 square feet or more. Commercial developments include non-residential developments such as hospitals, educational institutions, recreational facilities, mini-malls, hotels, office buildings, warehouses, and light industrial facilities.
	4. Automotive repair shops (with SIC codes 5013, 5014, 5541, 7532- 7534, 7536-7539).
	5. Restaurants where the land area of development is 5,000 square feet or more.
X	6. Hillside developments of 10,000 square feet or more which are located on areas with known erosive soil conditions or where the natural slope is twenty-five percent or more.
	7. Developments of 2,500 square feet of impervious surface or more adjacent to (within 200 feet) or discharging directly into environmentally sensitive areas such as areas designated in the Ocean Plan as areas of special biological significance or waterbodies listed on the CWA Section 303(d) list of impaired waters.
	8. Parking lots of 5,000 square feet or more exposed to storm water. Parking lot is defined as land area or facility for the temporary storage of motor vehicles.
	The project does not fall into any of the categories described above. (If the project requires a precise plan of development [e.g. all commercial or industrial projects, residential projects of less than 10 dwelling units, and all other land development projects with potential for significant adverse water quality impacts] or subdivision of land, it is defined as a Non-Category Project.)

Section 1
Introduction And Project Description

1.1 Project Information

- Montecito Equities Ltd.
- 7 Upper Newport Plaza, Dr. Newport Beach, CA 92660
- 949-296-3078
- 3403 Martin Ranch Rd. San Bernardino CA, 92407

1.2 Permits

AGENCY	PERMIT NEEDED
State Department of Fish and Game, 1601 Streambed Alteration Agreement	No
State Water Resources Control Board, Clean Water Act (CWA) section 401 Water Quality Certification	No
US Army Corps of Engineers, CWA section 404 permit	No
US Fish and Wildlife, Endangered Species Act section 7 biological opinion	No

1.3 Project Description

The Spring Trails Site is located in the unincorporated community of Verdemont within the City of San Bernardino's sphere of influence. The location of the project site is shown in Exhibit B. Primary access is from Meyers Rd. and secondary access is from Frontage Rd. The proposed land use is Residential Development (Detached). The Spring Trails Project proposes to provide approximately 350 acres of residential, park areas, undisturbed open space and hiking trails with approximately 309 residential dwelling units.

1.4 Site Description

The Spring Trails Project is a proposed 350.6-acre residential development located in the unincorporated community of Verdemont within the city of San Bernardino's sphere of influence. The site is in the foothills of the San Bernardino Mountains and is bounded on the north, northwest and east by the San Bernardino National Forest. Rural residential properties bound the project site to the west and south.

The Spring Trials project Hydrologic area is the Upper Santa Ana River. The Spring Trails site is located approximately 11.9 miles northwest of the confluence of Warm Creek and the Santa Ana River. The project site drains into Cable Canyon and Cable Creek. Cable Creek is a partially improved facility, located in the foothills of the San Bernardino Mountains in the northerly portion of the City of San Bernardino. It initiates as an unimproved watercourse at the mouth of Cable Canyon, east of Interstate 15 and route 215 Interchange, and flows south to Cable Creek spreading grounds; thence flows south-east for approximately three miles to the Devil Creek Diversion channel. Thence flows south east for approximately 1.4 miles to Lytle Creek Wash. Flows travel in Lytle Creek Wash approximately 2.9 miles south easterly into a Flood control Basin and continues into Lytle Creek Channel for 2.8 miles until it confluences with Warm Creek and drains south westerly for one (1) mile until joining with the Santa Ana River. There are no known pollutants of concern on the existing site.

Section 2
Pollutants of concern and hydrologic conditions of concern

2.1 Pollutants of Concern

Proposed land uses at the site include residential, parks and open space. Table 2-1 of the *San Bernardino County Storm Water Program (Model Water Quality Management Plan Guidance)* dated June 05, 2005 provides anticipated and potential pollutants by land use type. The following are anticipated pollutants from one or more land uses proposed within the project: sediment/turbidity, nutrients, trash and debris, oxygen demanding substances, bacteria and viruses, oil and grease, and pesticides.

There are three (3) proposed discharge locations in the Spring Trails project. Discharge point A, B, and C. See Post Project Hydrology map in Exhibit B. The three (3) discharge locations have the same receiving waters.

According to the "Water Quality Control Plan for the Santa Ana River Basin (8)," dated January 24, 1995 (and adopted by the SARWQCB), the proposed project is located within the Bunker Hill Hydrologic Sub Area. The corresponding number designation is 801.52 (Region '8', Hydrologic Unit '01', Hydrologic Area '5', Hydrologic Sub-area '2'). The receiving water for discharge locations A, B and C are Cable Creek, Devils Creek Diversion Channel, Cajon Wash, Lytle Creek wash, Lytle Creek Channel Hydrologic unit 801.41 (Region '8', Hydrologic Unit '01', Hydrologic Area '4', Hydrologic Sub-area '1', Upper Santa Ana River Reach Hydrologic unit 801.27 (Region '8', Hydrologic Unit '01', Hydrologic Area '2', Hydrologic Sub-area '7').

Lytle creek Hydrologic unit (Region '8' Hydrologic Unit '01', Hydrologic Area '4' Hydrologic Sub -area '1'), is listed in the most recent list of Clean Water Act Section 303(d) (CWA 303 (d) list) as impaired by Pathogens. On the site, pathogens are an expected pollutant and measures will be taken to keep this pollutant form the down stream receiving waters.

Below is a list of all the expected and potential pollutants for the Spring Trails Project:

Pollutant of Concern Summary Table

Pollutant Type	Expected	Potential	Listed for Receiving Water
Bacteria/Virus	X		Lytle Creek
Heavy Metals			
Nutrients	X		
Pesticides	X		
Organic Compounds			
Sediments	X		
Trash & Debris	X		
Oxygen Demanding Substances	X		
Oil & Grease	X		
Other—specify pollutant(s):			

2.2 HYDROLOGIC CONDITIONS OF CONCERN (NOT REQUIRED FOR NON-CATEGORY PROJECTS)

All Category projects must identify any hydrologic condition of concern (HCOC) that will be caused by the project, and implement Site Design, Source Control, and/or Treatment Control BMPs to address identified impacts. Project proponents must follow the procedure for identifying HCOCs specified in Section 2.3 of the Model WQMP. Use the following Table and instructions as a guide.

1. (from Section 2.3, Part 2): Determine if the project will create a Hydrologic Condition of Concern. Check "yes" or "no" as applicable and proceed to the appropriate section as outlined below.	**Yes**	**No**
A. All downstream conveyance channels, that will receive runoff from the project, are engineered, hardened (concrete, riprap or other), and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected. Engineered, hardened, and maintained channels include channel reaches that have been fully and properly approved (including CEQA review, and permitting by USACOE, RWQCB and California Dept. of Fish & Game) by June 1, 2004 for construction and hardening to achieve design capacity, whether construction of the channels is complete. Discharge from the project will be in full compliance with Agency requirements for connections and discharges to the MS4, including both quality and quantity requirements, and the project will be permitted by the Agency for the connection or discharge to the MS4.		**NO**
B. Project runoff rates, volumes, velocities, and flow duration for the post-development condition will not exceed those of the pre-development condition for 1-year, 2-year and 5-year frequency storm events. This condition will be substantiated with hydrologic modeling methods that are acceptable to the Agency, to the U.S. Army Corps of Engineers (USACOE), and to local watershed authorities. See method described below in Parts B1- B3.	**YES**	
C. Can the conditions in part A or B above be demonstrated for the project?		**NO**
▪ If the answer for A, B, and/or C above is yes, then the project does not create a HCOC—in this case go to Section 3 (page A-12). ▪ If the answer for C above is no, the go to section 2.3. Part 3, below.		

B1. DRAINAGE CHARACTERISTICS

a. The Design Storms to be considered to determine the Hydrologic Conditions of Concern are the 5-year, 2-year, and 1-year return frequency storms, using the Unit Hydrograph Method, contained in the San Bernardino County Hydrology Manual (1986). Please see Table B-2 for data results.

For each return frequency considered, both the pre- and post-development conditions, was performed to determine the total runoff volume, the peak flow rate, and the time of duration, of runoff hydrograph flow rates that exceed the following flow rates: 90% of peak flow rate, 80% of peak flow rate, 70% of peak flow rate, 60% of peak flow rate, 50% of peak flow rate, 40% of peak flow rate, 30% of peak flow rate, 20% of peak flow rate, and 10% of peak flow rate.

b. Sediment calculations were performed to estimate the pre-and post-development conditions for the land altered by the Spring Trails project using Table 2-3, "Pre- and Post-development Hydrology Comparison Worksheet" or equivalent.

c. Based on the results of the design storms for the 5, 2 and 1-year return frequencies the Spring Trails project does not impact the downstream condition of the project.

Please see Attachment B for Hydraulics Conditions of Concern excerpt from the Hydrologic and Water Quality Report in Support of the Environmental Impact Report and Tentative Map 15576 Report Dated April, 29 2009 section 5.6.

Table B2-2: Pre- and Post-development Hydrology Comparison Worksheet

Return Period	Total Volume		Peak Flow		Flow Time Duration			Sediment Transport	
	Pre	Post	Pre	Post	% of Peak	Pre	Post	Pre	Post
1-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				
2-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				
5-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				

2. (from Section 2.3, Part 3): The WQMP for projects that create a HCOC must include an evaluation of whether the project will adversely impact downstream erosion, sedimentation or stream habitat. The Agency may require that the evaluation be conducted by a registered civil engineer in the State of California, with experience in fluvial geomorphology. Perform the required evaluation asspecified in A – F below. Check the boxes "yes" or "no" to verify a complete report and proceed to appropriate section based on results.

Does the evaluation include:	Yes	No
A. An evaluation of potential impacts to all downstream channel reaches.		
B. Consideration of the hydrology of the entire watershed. Review all applicable drainage area master plans to the extent available, to identify BMP requirements for new development that address cumulative inputs from development in the watershed.	**X**	
C. Consultation with all applicable agencies including the USACOE; local watershed authorities (e.g. San Timoteo Watershed Management Authority and SAWPA [Santa Ana Watershed Project Authority]); U.S. Geological Survey (USGS); California Dept. of Fish & Game (CDFG); and the San Bernardino County Flood Control District; to determine any areas of potential hydrologic impact.	**X**	
D. An evaluation of any available hydrologic modeling results. Modeling may have been performed by USGS, USACOE, local watershed authorities, the San Bernardino County Flood Control District, or other local jurisdiction.		**X**
E. A field reconnaissance to evaluate any natural or partially natural downstream reaches, or other sensitive habitat. The field reconnaissance must evaluate representative downstream conditions, including undercutting erosion, slope/bank stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies), and the area's susceptibility to adverse impacts resulting from an altered flow regime or change in sediment supply and/or sediment transport .	**X**	
F. A report that summarizes the findings of evaluation components A through E above, and that considers the project's location, topography, soil and vegetation conditions, proportion of impervious surfaces, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project's watershed. The report must provide a determination of whether the project will adversely impact any downstream erosion, sedimentation or stream habitat, and identify any areas where adverse impacts are expected.		

- Is the report required by 2.3, Part 3.f complete? (Attach the report) If not, perform the required evaluation and add to the report.
- Does the report determine that the project will have an adverse downstream impact? **No**
- If yes, then go to Section 2.3, Part 4, below.
- If no, then go to Section 3.

3. (from Section 2.3, Part 4)**:** If the evaluation specified in (3) above, determines that adverse impacts to downstream erosion, sedimentation or stream habitat will occur, then the project proponent must perform the requirements specified in A, B, and C, below. Check the boxes "yes" or "no" to verify all requirements have been completed.	**YES**	**NO**
A. Conduct hydrologic modeling of the project and the potentially impacted areas, according to modeling standards recommended by the Agency or local watershed authority, for the 1-year, 2-year, and 5-year frequency storm events, at a minimum. Hydrologic modeling results must include determination of peak flow rate, flow velocity, runoff volume, time of concentration, and retention volume for the project area.		
B. Ensure that the project will be consistent with any approved master plans of drainage or analogous plans or programs.		
C. Implement Site Design BMPs as specified in Section 2.5.1, and recommend any additional BMPs that will be implemented to mitigate the adverse impacts identified in (3.F) above.		

- Are the requirements for Section 2.3 Part 4 adequate? (Attach report/results**)**
- Has the project proponent recommended BMPs to mitigate any impacts based on the modeling?
- If yes, then list/describe BMPs:
- If no, then explain how mitigation will be achieved:
- Will the BMPs be effective?
- Does the Agency have any additional requirements?
- Verify with Agency before submitting the project WQMP.

2.3 WATERSHED IMPACT OF PROJECT

The Spring Trails Project is a new development that is not significantly constrained by existing storm water conveyance infrastructure, and because it will be discharged at a controlled rate from storm water extended detention basins. Due to the steepness of the terrain on the northern portion of the site north of Cable Canyon, the BMP's such as bio-swales and infiltration BMP's are excluded as possible BMP's to treat the pollutants. Groundwater, which is a factor in the design of some BMPs, is expected to be greater than 50 feet below existing grade, based on a Preliminary Geotechnical Investigation Proposed Residential Development 353 acres, Martin Ranch, Tentative Tract 15576, Devore Area San Bernardino County, California, Project No. 56-2013-01. Dated July 28, 2000, prepared by Kleinfelder.

The following are anticipated pollutants from the land uses proposed within the Spring Trails project: sediment/turbidity, nutrients, trash and debris, oxygen demanding substances, bacteria and viruses, oil and greases and pesticides. The receiving waters Lytle Creek are listed as impaired with pathogens, per the most recent list of Clean

Water Act Section 303(d) (CWA 303(d)). With the incorporation of extended detention basins, media filtration systems as BMP's, the Spring Trails project will not have an significant impact to any of the downstream receiving waters.

In the Post-project condition all of the developed area will be routed into an extended detention basin for treatment, with the exception of the residential lots north of Cable Canyon located off of Street "A" and Street "DD", these residential lots north of Cable Canyon will be treated media filtration before discharging into Cable Canyon. The HCOC for this drainage area is accounted for in the design of the extended detention basin that drains into Cable Creek.

SECTION 3
BEST MANAGEMENT PRACTICE SELECTION PROCESS

3.1 SITE DESIGN BMPS

1. Minimize Stormwater Runoff, Minimize Project's Impervious Footprint, and Conserve Natural Areas

Maximize the permeable area. This can be achieved in various ways, including but not limited to, increasing building density (number of stories above or below ground) and developing land use regulations seeking to limit impervious surfaces.

Yes	No **X**	

The Spring Trails project proposes to have approximately 84 acres of open space, park and extended detention basin area. This makes 24% percent of the site that will remain permeable.

Runoff from developed areas may be reduced by using alternative materials or surfaces with a lower Coefficient of Runoff, or "C-Factor".

Yes	No **X**	

No alternate materials are proposed for this site, due to the street grades being grater than or equal to 10%.

Conserve natural areas. This can be achieved by concentrating or clustering development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition.

Yes **X**	No	

Offsite drainage courses entering the site will remain undisturbed as mentioned previously 24% of the site area will remain undisturbed.

Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets, and other low-traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.		
Yes **X**	No	
Hiking Trails are proposed for the site. The trails will be constructed of decomposed granite (DG).		
Construct streets, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a pedestrian friendly environment are not compromised[1]. Incorporate landscaped buffer areas between sidewalks and streets.		
Yes	No **X**	
Per the City of San Bernardino Street standards no landscape buffer is required between back of curb and right of way.		
Reduce widths of street where off-street parking is available[2].		
Yes	No **X**	
Reduced street widths are not a part of the project design.		
Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.		
Yes **X**	No	
It is recommended that drought tolerant plants be used in the landscape design. Where applicable, native trees and shrubs are to be preserved onsite.		

[1] Sidewalk widths must still comply with Americans with Disabilities Act regulations and other life safety requirements.

[2] However, street widths must still comply with life safety requirements for fire and emergency vehicle access.

Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.		
Yes **X**	No	
Decorative concrete will not be utilized in the landscape design. Landscape will be done in accordance with the City of San Bernardino landscaping design criteria.		
Use natural drainage systems.		
Yes **X**	No	
Infiltration will be used on the extended detention basins.		
Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration[3].		
Yes	No **X**	
The design of perforated pipe is not proposed in the onsite design.		
Construct onsite ponding areas, rain gardens, or retention facilities to increase opportunities for infiltration, while being cognizant of the need to prevent the development of vector breeding areas.		
Yes **X**	No	
There are three (3) extended detention basins that are proposed for the Spring Trails project. The outlet structure of the basins will be sized to match pre-project condition peak flowrates, volume, velocities and flow durations. The use of rain gardens (Bio-Retention) will be utilized in the lots North of Cable Canyon.		

[3]However, projects must still comply with hillside grading ordinances that limit or restrict infiltration of runoff. Infiltration areas may be subject to regulation as Class V injection wells and may require a report to the USEPA. Consult the Agency for more information on use of this type of facility.

2. Minimize Directly Connected Impervious Areas

Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain.

Yes **X**	No	

Roof Drains draining into a landscape area/planter will be incorporated into the site design BMPs.

Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.

Yes	No **X**	

Per the City of San Bernardino Street standards no landscape buffer is required between back of curb and right of way.

Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales.

Yes	No **X**	

Vegetated swales are not a part of the site design in the Spring Trails project due to the steep existing terrain.

Use one or more of the following:

Yes	No	Design Feature
	X	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings
	X	Urban curb/swale system; street slopes to curb; periodic swale inlets drain to vegetated swale/biofilter.
	X	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to municipal storm drain systems.
X		Rain Gardens (Residential Lots North of Cable Canyon)

For locations where the residential development cannot be routed into an extended detention basin, combination of Rain gardens and media filtration devices to treat the street run off, are proposed for the Residential Lots located North of Cable Canyon.

Use one or more of the following features for design of driveways and private residential parking areas:		
Yes	No	Design Feature
X		▪ Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the municipal storm drain system.
	X	▪ Uncovered temporary or guest parking on private residential lots may be paved with a permeable surface; or designed to drain into landscaping prior to discharging to the municipal storm drain system.
	X	▪ Other comparable design concepts that are equally effective.
Shared access is proposed for some of the residential lots north of Cable Canyon along Street "A" and Street "DD"		

3.2 SOURCE CONTROL BMPS

Use one or more of the following design concepts for the design of parking areas:		
Yes	**No**	Design Feature
	X	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.
	X	Overflow parking (parking stalls provided in excess of the Agency's minimum parking requirements) may be constructed with permeable paving.
	X	Other comparable design concepts that are equally effective.
No parking areas are proposed in the site design.		

Complete the following selection table for Source Control BMPs, by checking boxes that are applicable. All listed BMPs shall be implemented for the project. Where a required Source Control BMP is not applicable to the project due to project characteristics, justification and/or alternative practices for preventing pollutants must be provided. In addition to completing the following tables, provide detailed descriptions on the implementation of planned Source Control BMPs.

Source Control BMP Selection Matrix*

Project Category	Source Control BMPs																								
	Education of Property Owners	*Activity Restrictions*	*Spill Contingency Plan*	*Employee Training/Education Program*	*Street Sweeping Private Street and Parking Lots*	*Common Areas Catch Basin Inspection*	*Landscape Planning (SD-10)*	*Hillside Landscaping*	*Roof Runoff Controls (SD-11)*	*Efficient Irrigation (SD-12)*	*Protect Slopes and Channels*	*Storm Drain Signage (SD-13)*	*Inlet Trash Racks*	*Energy Dissipaters*	*Trash Storage Areas (SD-32) and Litter Control*	*Fueling Areas (SD-30)*	*Air/Water Supply Area Drainage*	*Maintenance Bays and Docks (SD-31)*	*Vehicle Washing Areas (SD-33)*	*Outdoor Material Storage Areas (SD-34)*	*Outdoor Work Areas (SD-35)*	*Outdoor Processing Areas (SD-36)*	*Wash Water Controls for Food Preparation Areas*	*Pervious Pavement (SD-20)*	*Alternative Building Materials (SD-21)*
Significant Re-development																									
Home subdivisions of 10 or more units	X	X			X	X	X	X	X	X	X	X	X	X	X										
Commercial/ Industrial Development >100,000 ft^2																									
Automotive Repair Shop																									
Restaurants																									
Hillside Development >10,000 ft^2																									
Development of impervious surface >2,500 ft^2																									
Parking Lots >5,000 ft^2 of exposed storm water																									

* Provide justification of each Source Control BMP that will not be incorporated in the project WQMP, or explanation of proposed equally effective alternatives in the following table.

Justification for Source Control BMPs not incorporated into the project WQMP			
Source Control BMP	Used in Project (yes/no)?	Justification/Alternative*	Implementation Description
Education of Property Owners	**Yes**		See next page*
Activity Restrictions	**Yes**		See next page**
Spill Contingency Plan	No	No Spill Contingency Plan proposed	
Employee Training/Education Program	No	Not a commercial site	
Street Sweeping Private Street and Parking Lots	**Yes**		Responsibility of the Home Owners Association (HOA) to sweep streets once a month.
Common Areas Catch Basin Inspection	**Yes**		Responsibility of the Home Owners Association (HOA)
Landscape Planning (SD-10)	**Yes**		Drought resistant plants will be used when appropriate.
Hillside Landscaping	**Yes**		Fuel modification will be implemented into project design.
Roof Runoff Controls (SD-11)	**Yes**		Roof run off will be directed to the surrounding landscape.
Efficient Irrigation (SD-12)	**Yes**		See next page***
Protect Slopes and Channels	**Yes**		Engineered slopes will be landscaped.
Storm Drain Signage (SD-13)	**Yes**		Inlets will be signed with a "No **Dumping-Drains to River"**
Inlet Trash Racks	**Yes**		Inlet trash racks will be used to prevent debris/trash from flowing downstream.
Energy Dissipaters	**Yes**		Rip-rap will be used to minimize erosion
Trash Storage Areas (SD-32) and Litter Control	**Yes**		Trash Storage areas will be provided in common areas.
Fueling Areas (SD-30)	No		
Air/Water Supply Area Drainage	No	Air/Water Supply is not in the project design.	
Maintenance Bays and Docks (SD-31)	No	There are no maintenance Bays or Docks in the project design.	
Vehicle Washing Areas (SD-33)	No	There are no vehicle washing areas in the project design	
Outdoor Material Storage Areas (SD-34)	No	No materials will be stored outdoors.	
Outdoor Work Areas (SD-35)	No	No areas have been designated for outdoor work.	
Outdoor Processing Areas (SD-36)	No	There are no outdoor processing areas in the project design.	
Wash Water Controls for Food Preparation Areas	No	No Restaurants Proposed.	
Pervious Pavement (SD-20)	No	Pervious pavement is not part of the project design.	
Alternative Building Materials (SD-21)	No	No alternative building materials are in the project design.	
*Attach additional sheets if necessary for justification.			

**Education for Property Owners, Operators, Tenants, Occupants or Employees*
Education is necessary for the proper clean and disposal of debris, nutrients, metals, pesticides, and oil and grease the can wash into the watershed. Educational materials, from San Bernardino County, are included in this WQMP Attachment E. The Spring Trails owner shall distribute additional copies of handouts and posters. Property owners must familiarize themselves with the educational materials.

***Activity Restrictions*
Activities that will significantly impact receiving waters shall not be performed. Trash bin lids shall be closed at all times. Sweeping, blowing, dumping or hosing debris into the surrounding streets or storm drains is not allowed at any time. Conditions, covenants and restrictions in regards to water quality are to be developed by the POA. Any additional activity restrictions shall require prior approval from appropriate governmental agencies regarding any activity that may affect surrounding areas or the downstream receiving waters.

****Irrigation System and Landscape Maintenance*
Water conserving irrigation measures shall be used in the landscape to avoid washing nutrients off the site. Similar plants shall be grouped together, and irrigation should be used to minimize run off form the project site due to over watering. Maintenance of landscape shall be in accordance with the City of San Bernardino design guidelines, or approved equivalent. Additionally, flows reducers or shutoff valves should be used in the irrigation to help in the case of a broken line or sprinkler.

3.3 TREATMENT CONTROL BMPS

"Treatment Control BMP" is any engineered system designed and constructed to remove pollutants from urban runoff on-site before the pollutants can enter the receiving waters. The primary pollutants of concern for the receiving waters are pathogens, which all occur on the site. The following discussion identifies treatment control BMPs for Urban Runoff that are proposed for the Spring Trails project site:

Extended Detention Basin: An extended detention basin is a water quality basin designed to detain and slowly release the design volume in at least 48 hours. The design of extended detention basin should be such that the half of the design volume drains out in not less than 24 hours and the total volume drains out in less than 72 hours to avoid vector-breeding problem. The design of such basin should incorporate certain slope towards the outlet, vegetation at the bottom and slopes to allow for infiltration while avoiding groundwater contamination. The extended detention basin can also work as flood control measure by addition of flood detention storage. Outlet of such basins should be protected against erosion and debris flow by providing proper protective measure. Extended detention basins are simple to construct and operate, and it also removes sediments and the toxics fraction associated with the particulates.

Bioretention (Rain Garden): The bioretention best management practice (BMP) function as a soil and pant-based filtration device that removes pollutants through a variety of physical biological, and chemical treatment processes. The facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days. The vegetation provides shade and wind breaks, absorbs noise and improves an area's landscape.

Water Quality Inlets: A water quality inlet is a device that works on sedimentation of coarse materials and separation of free oil from stormwater. It removes oil and grit from stormwater runoff before the water enters the storm drain system. According to Filterra the pollutant removal for their "water quality inlets/bioretention system ranges from Medium to High, following rating base on CALTRANS Treatment Technology Report (April 2008).

The maintenance and operation of the proposed BMP's will be performed by either a Landscape Maintenance District (LMD) or a Home Owners Association (HOA.)

Treatment Control BMP Selection Matrix

Pollutant of Concern	Treatment Control BMP Categories							
	Bioretention (2)	**Extended Detention Basins(1)**	**Infiltration Basins**	**Wet Ponds or Wetlands**	**Filtration**	**Water Quality Inlets**	**Hydrodynamic Separator Systems**	**Filterra (Bio-Filtration system) (3)**
Sediment/Turbidity	H/M	M	H/M	H/M	H/M	L	H/M (L for turbidity)	H
Yes/No? **YES**								
Nutrients	M	M	H/M	H/M	L/M	L	L	M
Yes/No? **YES**								
Organic	H	M	U	U	H/M	L	L	U
Yes/No? NO								
Trash & Debris	H	H	U	U	H/M	M	H/M	H
Yes/No? **YES**								
Oxygen Demanding Substances	H	M	H/M	H/M	H/M	L	L	M
Yes/No? **YES**								
Bacteria & Viruses	H	M	H/M	U	H/M	L	L	M/H
Yes/No? **YES**								
Oils & Grease	H	M	U	U	H/M	M	L/M	H
Yes/No? **YES**								
Pesticides (non-soil bound)	U	U	U	U	U	L	L	M/H
Yes/No? **YES**								
Metals	H	M	H	H	H	L	L	M/H
Yes/No? NO								

(1) Per the California BMP HandbookTC-22; (2) Per the California BMP Handbook TC-32 (Rain Garden); (3) Fillterra pollutant removal overview

3.4 BMP DESIGN CRITERIA

- The following Treatment Control BMP(s) (Flow Based or Volume Based) will be implemented for this project (***check "Implemented" box, if used***):

Design Basis of Treatment Control BMPs

Implemented	Treatment Control BMP	Design Basis
	Vegetated Buffer Strips	Flow Based
	Vegetated Swale	
	Multiple Systems	
	Manufactured/Proprietary	
X	Bioretention (Rain Garden)	Volume Based
	Wet Pond	
	Constructed Wetland	
X	Extended Detention Basin	
X	Water Quality Inlet	
	Retention/Irrigation	
	Infiltration Basin	
	Infiltration Trench	
X	Media Filter	
	Manufactured/Proprietary	

3.4.1 Flow Based Design Criteria

See **Attachment D** for flow based design calculations.

3.4.2 Volume-Based Design Criteria

See **Attachment D** for volume based design calculations.

Section 4
Operation and Maintenance

4.1 Operations and Maintenance

Operation and maintenance (O&M) requirements for all Source Control, Site Design, and Treatment Control BMPs shall be identified within the WQMP. The WQMP shall include the following:

4.1.1 O&M DESCRIPTION AND SCHEDULE THAT MUST:

BMP	Operation and Maintenance Activities	BMP Start Date	Frequency	Parties Responsible
Storm Drain Signage	Inspect system signage and repair/replace if needed. "NO DUMPING-DRAINS TO RIVER"	At the installation of storm drains	The signage shall be monitored yearly.	**Montecito Equities Ltd.** **7 Upper Newport Plaza Dr.** **Newport Beach, Ca 92660** **949-296-3078**
Trash Storage Areas	Wastes (debris, vegetation, etc) shall be properly disposed of in a hazardous waste facility. After a storm event, the trash areas should be monitored for vector habitats.	At the completion of project	Trash areas shall be checked before and after a major storm event. As well as on a monthly basis to reduce debris.	
Landscaping and Irrigation	Inspect landscaping and irrigation systems and repair/replace if needed.	At the completion of project	The landscaping and irrigation systems shall be monitored monthly.	
Education of Property Owners	Educational materials, from San Bernardino County, are included in this WQMP Attachment E. The POA shall distribute additional copies of handouts.	At the completion of project	The educational material provided shall be reviewed yearly as well as when there is a change in ownership.	
Activity Restrictions	Any activity that may affect surrounding areas or the downstream receiving waters (such as car washes or leaving trash bin lids open) is strictly prohibited.	At the completion of project	Trash areas shall be checked before and after a major storm event. As well as on a monthly basis to reduce debris.	

BMP	Operation and Maintenance Activities	BMP Start Date	Frequency	Parties Responsible
Street Sweeping	A street sweeper shall clean the privately maintained streets and parking areas to reduce debris.	After site is cleared and streets are paved	A street sweeper shall clean monthly and before any known storm event.	**Montecito Equities Ltd.** **7 Upper Newport Plaza Dr.** **Newport Beach, Ca 92660** **949-296-3078**
Extended Detention Basin	Maintain the basin floor, and inlets/outlets free of debris, silt, trash.	At the completion of project	At least every 6 months and before the rainy season stars.	
Media Filtration System	Inspect replace filter media, media replacement every 3 to 4 years depending on rainfall.	At the completion of project	At least every 12 months and before the rainy season stars.	

4.1.2 INSPECTION & MONITORING REQUIREMENTS THAT MUST:

BMP	Inspection and Frequency	Parties Responsible
Storm Drain Signage	*Yearly*: Monitor signs for fading or vandalism. Replace as necessary.	**Montecito Equities Ltd.** **7 Upper Newport Plaza Dr.** **Newport Beach, Ca 92660** **949-296-3078**
Trash Storage Areas	*Monthly during dry season*: Trash areas shall be checked for debris or spills. *Before and After a Major Storm Event*: Trash areas shall be checked for debris or spills.	
Landscaping and Irrigation	*Monthly*: Leaks, signs of erosion or large amounts of runoff shall be repaired. Dead vegetation shall be replaced. Vegetated swale shall be mowed to a height of 3 inches.	
Education of Property Owners	*Yearly*: Review and update of any educational materials that pertains to the site. *Within 6 months of change of ownership*: Educational materials shall be provided, along with any necessary training.	
Activity Restrictions	Trash areas shall be checked before and after a major storm event. As well as on a monthly basis to reduce debris.	
Street Sweeping	*Monthly during dry season and before a major storm event*: Clear parking lot of trash and debris.	
Media Filtration system	Units shall be inspected for sediment and oil buildup and these pollutants shall be removed and disposed of per manufacture's recommendations, recommended inspection once a year. Actual media replacement every 3 to 4 years depending on rainfall.	

4.1.3 IDENTIFICATION OF RESPONSIBLE PARTIES THAT MUST:

The owner is responsible for all Operations and Maintenance activities in the Spring Trails project. Any changes in the responsible party, must be updated in the WQMP for future reference.

Montecito Equities Ltd.
7 Upper Newport Plaza, Dr.
Newport Beach, CA 92660
949-296-3078

SECTION 5

FUNDING

5.1 Funding

The owner is responsibly for all Operations and Maintenance activities in the Spring Trails project site. Any changes in the responsible party, must be updated in the WQMP for future reference:

Montecito Equities Ltd.
7 Upper Newport Plaza, Dr.
Newport Beach, CA 92660
949-296-3078

SECTION 6
WQMP Certification

6.1 Certification

"This Water Quality Management Plan has been prepared for (Owner/Developer Name) by (Consulting /Engineering Firm Name). It is intended to comply with the requirements of the City of (name city or county) for Tract/Parcel Map No. **15576,** Condition Number(s) _____ requiring the preparation of a Water Quality Management Plan (WQMP). The undersigned is aware that Best Management Practices (BMPs) are enforceable pursuant to the City's/County's Water Quality Ordinance No. _____. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Stormwater Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity. "

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

_____ _____
Applicant's Signature Date

_____ _____
Applicant's Name Applicant's Telephone Number

Attachment A-1

Maintenance Mechanisms

A-1.1 The Agency shall not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an O&M Plan is prepared (see WQMP Section 2.6) and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs. This mechanism can be provided by the Agency or by the project proponent. As part of project review, if a project proponent is required to include interim or permanent structural and non-structural BMPs in project plans, and if the Agency does not provide a mechanism for BMP maintenance, the Agency shall require that the applicant provide verification of maintenance requirements through such means as may be appropriate, at the discretion of the Agency, including, but not limited to covenants, legal agreements, maintenance agreements, conditional use permits and/or funding arrangements (OC 2003)

A-1.2 Maintenance Mechanisms

1. **Public entity maintenance**: The Agency may approve a public or acceptable quasi-public entity (e.g., the County Flood Control District, or annex to an existing assessment district, an existing utility district, a state or federal resource agency, or a conservation conservancy) to assume responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual Agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the Permittees may seek protection from liability by appropriate releases and indemnities.

   The Agency shall have the authority to approve stormwater BMPs proposed for transfer to any other public entity within its jurisdiction before installation. The Permittee shall be involved in the negotiation of maintenance requirements with any other public entities accepting maintenance responsibilities within their respective jurisdictions; and in negotiations with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. The Agency must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

2. **Project proponent agreement to maintain stormwater BMPs:** The Agency may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the stormwater BMP as necessary into perpetuity. Security or a funding mechanism with a “no sunset” clause may be required.

3. **Assessment districts:** The Agency may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for stormwater

BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions above.

4. **Lease provisions:** In those cases where the Agency holds title to the land in question, and the land is being leased to another party for private or public use, the Agency may assure stormwater BMP maintenance, repair and replacement through conditions in the lease.

5. **Conditional use permits:** For discretionary projects only, the Agency may assure maintenance of stormwater BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required.

6. **Alternative mechanisms:** The Agency may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

Attachment A-2

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement (adapted from documents from the Ventura County Stormwater Management Program)

Recorded at the request of:

City of _____

After recording, return to:

City of _____

City Clerk _____

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

OWNER: _____

PROPERTY ADDRESS: _____

_____

APN: _____

THIS AGREEMENT is made and entered into in

_____, California, this _____ day of

_____ , by and between

_____, herein after

referred to as "Owner" and the CITY OF _____, a municipal corporation, located in the County of San Bernardino, State of California hereinafter referred to as "CITY";

WHEREAS, the Owner owns real property ("Property") in the City of

_____, County of San Bernardino, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

_____ within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City;

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement, therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner hereby provides the City of City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property.

2. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full.

4. The City may require the owner to post security in form and for a time period satisfactory to the city to guarantee the performance of the obligations state herein. Should the Owner fail to perform the obligations under the Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to City its reasonable costs incurred in accordance with paragraph 3 above.

5. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term “Owner” shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY:

_____

_____

_____

_____

IF TO OWNER:

_____

_____

_____

_____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM:

_____
City Attorney

_____
CITY OF

_____
Name

_____
Title

ATTEST:

_____
City Clerk Date

OWNER:

_____
Name

_____
Title

OWNER:

_____
Name

_____
Title

NOTARIES ON FOLLOWING PAGE

EXHIBIT A
(Legal Description)

NORTH OF RANCHO LINE

THE PORTIONS OF SECTION 26, TOWNSHIP 2 NORTH, RANGE 5 WEST, SAN BERNARDINO MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT OF THE SURVEY OF SAID LAND APPROVED JUNE 24, 1898. MORE PARTICULARLY DESCRIBED AS FOLLOWS:

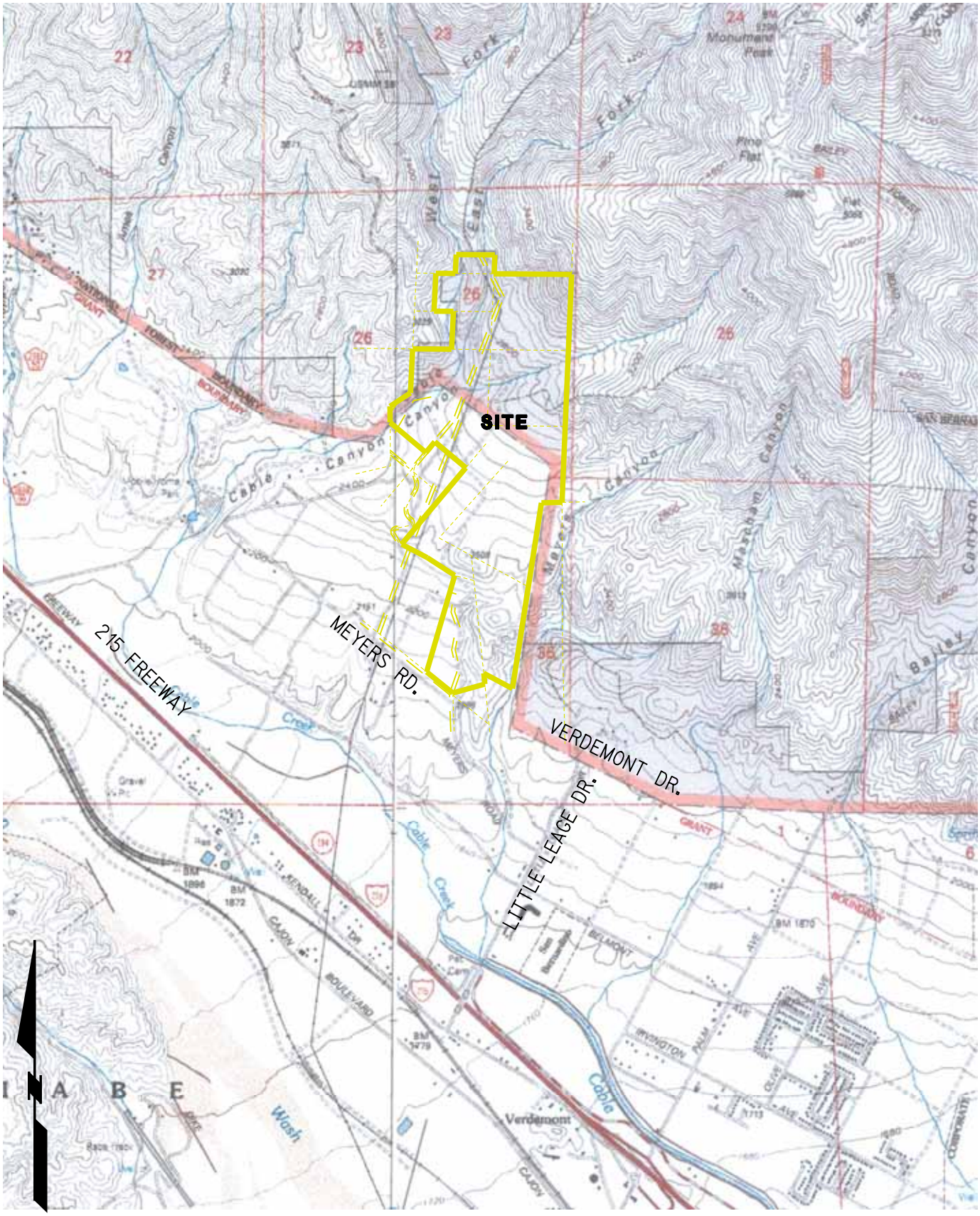
THE EAST 1/2 OF THE SOUTHWEST 1/4 OF THE NORTHEAST 1/4, THE EAST 1/2 OF THE NORTHWEST 1/4 OF THE SOUTHWEST 1/4 OF THE NORTHEAST 1/4, THE SOUTH 1/2 OF THE SOUTHEAST 1/4 OF THE NORTHWEST 1/4 OF THE NORTHEAST 1/4, THE NORTHEAST 1/4 OF THE SOUTHEAST 1/4, THE SOUTHEAST 1/4 OF THE NORTHEAST 1/4, AND GOVERNMENT LOTS 1 AND 2.

SOUTH OF RANCHO LINE

TOGETHER WITH THE PORTION OF BLOCK 79 AS SHOWN BY THE MAP OF THE TOWN OF IRVINGTON AND THE LANDS OF THE IRVINGTON LAND AND WATER COMPANY RECORDED IN BOOK 3, PAGE(S) 9, WEST OF THE MUSCUPIABE RANCHO LINE AND NORTH OF THE NORTHERLY SIDE LINE OF PENNSYLVANIA AVENUE AS SHOWN ON SAID MAP; AND PARCEL NO. 4 OF PARCEL MAP NO. 3810, SHOWN BY MAP ON FILE IN BOOK 34, PAGE(S) 92; AND PARCEL NO. 4 OF PARCEL MAP NO. 3809, SHOWN BY MAP ON FILE IN BOOK 44, PAGE(S) 20; AND THAT CERTAIN 60 FOOT STRIP SHOWN AS PRIVATE ROAD (MARTIN RANCH ROAD) ON

PAGE(S) 84, AND AMENDED BY A CERTIFICATE OF CORRECTION RECORDED MAY 2, 1977 IN BOOK 9168, PAGE(S) 1056; AND LOT "A", AS SHOWN ON THE PLAT OF RESUBDIVISION OF A PORTION OF MEYER AND BARCLAY TRACT, SHOWN BY MAP ON FILE IN BOOK 12, PAGE(S) 18. EXCEPTION THEREFROM 5 ACRES IN THE SOUTHEAST CORNER OF SAID LOT, AS CONVEYED TO ROBERT B. MEYER BY DEED RECORDED IN BOOK 173, PAGE(S) 156 OF DEEDS; AND LOT "C", AS SHOWN ON THE PLAT OF A RESUBDIVISION OF A PORTION OF MEYER AND BARCLAY TRACT, SHOWN BY MAP ON FILE IN BOOK 13, PAGE(S) 32. ALL OF OFFICIAL RECORDS, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

EXHIBIT B
(POST PROJECT HYDROLOGY MAP)



SOURCE:USGS QUADRANGLES FOR DEVORE, SAN BERNARDINO NORTH

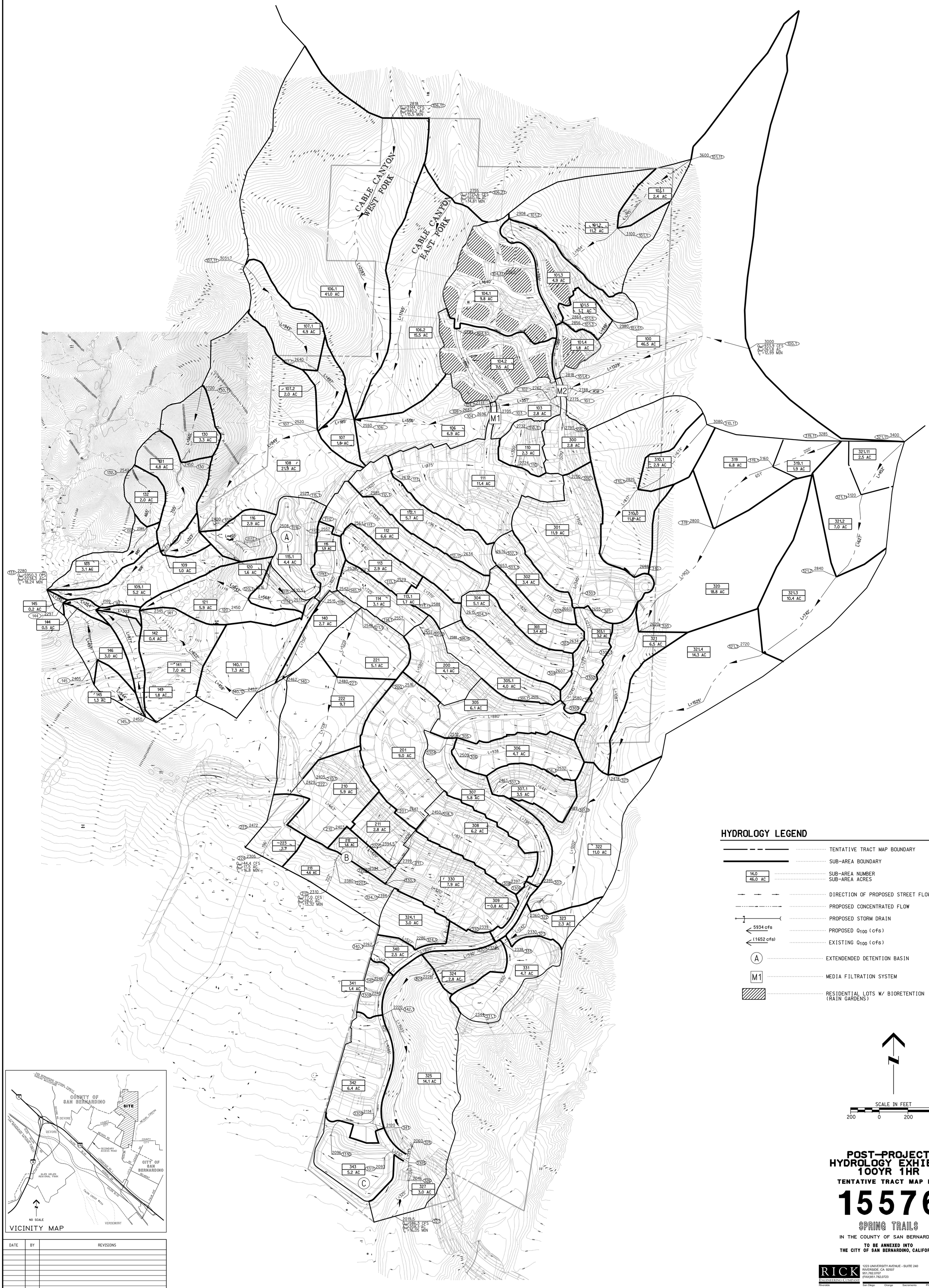
RICK ENGINEERING COMPANY
Riverside
1223 UNIVERSITY AVENUE - SUITE 240
RIVERSIDE, CA 92507
951.782.0707
(FAX)951.782.0723
rickengineering.com
San Diego Orange Sacramento Phoenix Tucson

SPRING TRAILS
EXHIBIT B

SCALE: 1"=2400'

G:\d_13565\565xbt21_WQMP_site_map.dgn

PLOT DATE: 17-DEC-2008 JN 13565C



DATE	BY	REVISIONS

POST-PROJECT HYDROLOGY EXHIBIT 100YR 1HR

TENTATIVE TRACT MAP NO.

15576

SPRING TRAILS

IN THE COUNTY OF SAN BERNARDINO

TO BE ANNEXED INTO THE CITY OF SAN BERNARDINO, CALIFORNIA

RICK ENGINEERING COMPANY
Riverside
1223 UNIVERSITY AVENUE - SUITE 240
RIVERSIDE, CA 92507
951.782.0707
(FAX)951.782.0723
rickengineering.com
San Diego Orange Sacramento Phoenix Tucson

Attachment B
Tables

Table B-1
303(d) List of Impaired Water Bodies

Waterbody	Pollutant					
	Bacteria Indicators/ Pathogens	Metals	Nutrients	Organic Enrichment	Sedimentation/Siltation	Suspended Solids
Big Bear Lake		X	X		X	
Canyon Lake (Railroad Canyon Reservoir)	X		X			
Chino Creek Reach 1	X		X			
Chino Creek Reach 2	X					
Cucamonga Creek, Valley Reach	X					
Grout Creek		X	X			
Knickerbocker Creek	X	X				
Lytle Creek	X					
Mill Creek (Prado Area)	X		X			X
Mill Creek Reach 1	X					
Mill Creek Reach 2	X					
Mountain Home Creek	X					
Mountain Home Creek, East Fork	X					
Prado Park Lake	X		X			
Rathbone (Rathbun Creek)			X		X	
Santa Ana River, Reach 3	X					
Santa Ana River, Reach 4	X					
Summit Creek			X			

NOTES:

1) Summary of the 2002 303(d) Listed Water Bodies and Associated Pollutants of Concern from RWQCB Region 8. Check for updated lists from the RWQCB.

2) Chlorides, pesticides, salinity, total dissolved solids (TDS), toxicity, and trash are listed impairments within the 303(d) table, however, they are not impairments in the above waterbodies.

Table B-2
C Values Based on Impervious/Pervious Area Ratios

% Impervious	% Pervious	C
0	100	0.15
5	95	0.19
10	90	0.23
15	85	0.26
20	80	0.30
25	75	0.34
30	70	0.38
35	65	0.41
40	60	0.45
45	55	0.49
50	50	0.53
55	45	0.56
60	40	0.60
65	35	0.64
70	30	0.68
75	25	0.71
80	20	0.75
85	15	0.79
90	10	0.83
95	5	0.86
100	0	0.90

NOTE:

Obtain individual runoff coefficient C-Factors from the local agency or from the local flood control district.

If C-Factors are not available locally, obtain factors from hydrology text books or estimate using this table.

Composite the individual C-Factors using area-weighted averages to calculate the Composite C Factor for the area draining to a treatment control BMP.

Do not use the C-Factors in this table for flood control design or related work.

5.6 Hydrologic Conditions of Concern

Detention Basin Infiltration Losses:

Infiltration rates for the project site were determined by Leighton Group, to determine the loss rates associated with infiltration within the detention basins. An infiltration rate of 1.6 cm/hour (0.63 inches/hour) was identified. Based on the footprint of the detention basin invert for each of the three proposed basins, a basin specific loss rate was calculated, and incorporated into the detention basin modeling of the post project FloodSCX models. Supporting materials for the Infiltration Loss Rate calculations are included in Attachment B of this report.

Table 7: Detention Basin Infiltration Rates

Basin ID	Basin Footprint	Infiltration Loss Rate
DB 1	1.02 acres	0.62 cfs
DB 2	0.48 acres	0.29 cfs
DB 3	1.82 acres	1.10 cfs

FloodSCX calculations were prepared for the 1-year, 2-year, and 5-year hydrologic conditions, With AMC I, and incorporating the impact of infiltration within each of the proposed detention basins for the Sprint Trails project. The following tables summarize the peak discharge results of the FloodSCX calculations at the 4 concentration points associated with the project.

Table 8: HCOC Summary

Concentration point	Existing Condition				Proposed Condition			
	RM Node	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_5 (cfs)*	*RM Node*	*Q_1 (cfs)*	*Q_2 (cfs)*	*Q_5 (cfs)*
CP 1A	138	1074.0	1335.0	1657.6	108	1023.7	1280.6	1595.8
CP 1B	144	1093.5	1358.4	1688.0	133	1037.9	1297.8	1618.7

CP 2	802	14.4	17.4	22.8	223	9.3	16.3	22.6
CP 3	210	79.7	92.2	116.0	327	57.9	75.9	106.0

The table above summarizes the impact of the proposed Spring Trails project on the peak discharges within the creeks and channels downstream of the project, for storms ranging from the 1-year to the 5-year storm. In all cases the flow rates are lower for these storm events and therefore, the project meets the criteria to address hydrologic conditions of concern. Outlet structures for the extended detention basins will be designed during final engineering for the project. The Input and output summary files are included in Attachment C.

5.7 Impacts and Mitigation Measures

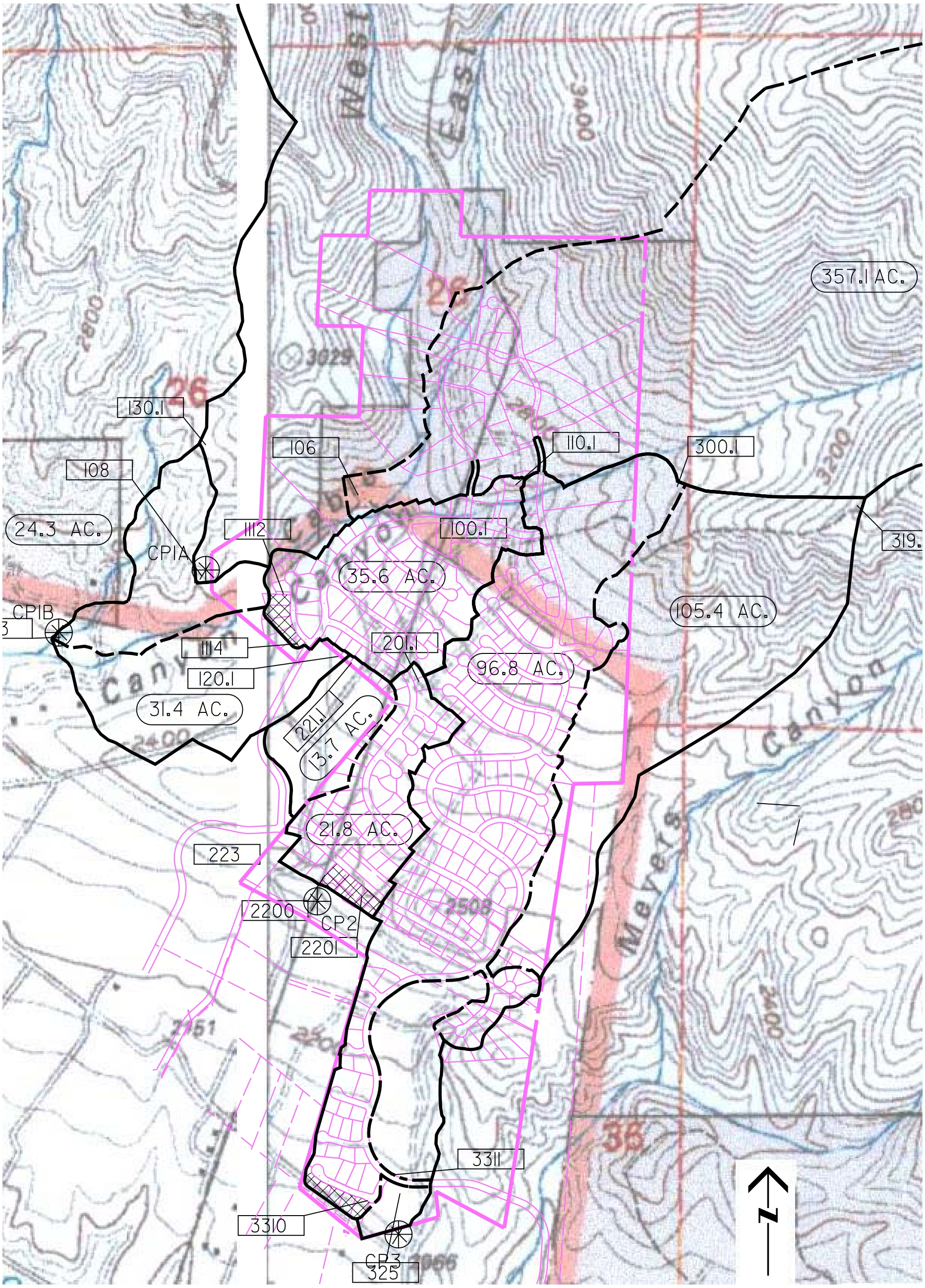
5.7.1 Potentially Significant Impacts

The project would result in significant impacts to hydrology, erosion, and siltation, if the project would:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.

The conversion of existing vacant land uses into residential uses will result in new impervious surfaces, engineered slopes, and engineered conveyance systems for storm water runoff. These factors will result in an overall increase in storm water runoff in terms of peak discharge rates and volumes. In general, increases in volume and velocity

WATER QUALITY EXHIBIT



RICK ENGINEERING COMPANY
Riverside

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RIVERSIDE, CA 92507
951.782.0707
(FAX)951.782.0723

rickengineering.com
San Diego Orange Sacramento Phoenix Tucson

SCALE IN FEET

700 0 700 1400

Attachment C
Pollutants of Concern

Pollutants of Concern

- *Bacteria and Viruses* – Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically cause by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

- *Metals* – The primary source of metal pollution in stormwater is typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. At low concentrations naturally occurring in soil, metals may not be toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications (OC 2003).

- *Nutrients* – Nutrients are inorganic substances, such as nitrogen and phosphorus. Excessive discharge of nutrients to water bodies and streams causes eutrophication, where aquatic plants and algae growth can lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.

- *Pesticides* -- Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Relatively low levels of the active component of pesticides can result in conditions of aquatic toxicity. Excessive or improper application of a pesticide may result in runoff containing toxic levels of its active ingredient (OC 2003).

- *Organic Compounds* – Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life (OC 2003).

- *Sediments* – Sediments are solid materials that are eroded from the land surface. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

- *Trash and Debris* – Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash and debris may

have a significant impact on the recreational value of a water body and aquatic habitat. Trash impacts water quality by increasing biochemical oxygen demand.

- *Oxygen-Demanding Substances* – This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions. A reduction of dissolved oxygen is detrimental to aquatic life and can generate hazardous compounds such as hydrogen sulfides.

- *Oil and Grease* – Oil and grease in water bodies decreases the aesthetic value of the water body, as well as the water quality. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.

Attachment D
Flow- and Volume-Based BMP Design Calculations

INSTRUCTIONS FOR ESTIMATING VOLUME- AND FLOW-BASED BMP DESIGN RUNOFF QUANTITIES[4]

1) Identify the "BMP Drainage Area" that drains to the proposed BMP element. This includes all areas that will drain to the proposed BMP element, including pervious areas, impervious areas, and off-site areas, whether or not they are directly or indirectly connected to the BMP element. Calculate the BMP Drainage Area (A) in acres.

2) Outline the Drainage Area on the NOAA Atlas 14 Precipitation Depths (2-year 1-hour Rainfall) map (Figure D-1).

3) Determine the area-averaged 2-year 1-hour rainfall value for the Drainage Area outlined above.

A. Flow-Based BMP Design

1) Calculate the composite runoff coefficient, C_{BMP}, as defined in part A.2, above.

2) Determine which Region the BMP Drainage Area is located in (Valley, Mountain or Desert).

3) Determine BMP design rainfall intensity, I_{BMP}, by multiplying the area-averaged 2-year 1-hour value from the NOAA Atlas 14 map by the appropriate regression coefficient from Table D-1 ("I"), and then multiplying by the safety factor specified in the criteria—usually a factor of 2.

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[4] Rainfall analysis to develop regression coefficients in Table D-1 and modifications to the NOAA Atlas 14 map were conducted by:

Hromadka II, T.V., Professor Emeritus, Department of Mathematics, California State University, Fullerton, and Adjunct Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

Laton, W.R , Assistant Professor, Department of Geological Sciences, California State University, Fullerton

Picciuto J.A.., Assistant Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

With assistance from:

Rene Perez, M.S. Candidate, Department of Geological Sciences, California State University, Fullerton, and

Jim Friel, Ph.D. Professor Emeritus, Department of Mathematics, California State University, Fullerton

Reported as follows:

1. Hromadka II, T.V., Laton, W.R., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design. Final Report to the San Bernardino County Flood Control District.
2. Laton, W.R., Hromadka II, T.V., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design (submitted). Journal of the American Water Resources Association.

4) Calculate the target BMP flow rate, Q, by using the following formula (see Table D-2 below for limitations on the use of this formula):

$$\mathbf{Q = C_{BMP} \cdot I_{BMP} \cdot A}$$

where: **Q** = flow in ft^3/s

I_{BMP} = BMP design rainfall intensity, in inches/hour

A = Drainage Area in acres

C_{BMP} = composite runoff coefficient

Table D-1: Regression Coefficients for Intensity (I) and 6-hour mean storm rainfall (P_6).

Quantity	**Valley** 85% upper confidence limit	**Mountain** 85% upper confidence limit	**Desert** 85% upper confidence limit
I	**0.2787**	**0.3614**	**0.3250**
P_6	**1.4807**	**1.9090**	**1.2371**

Table D-2: Use of the flow-based formula for BMP Design (CASQA 2003).

	Composite Runoff Coefficient, "C"			
BMP Drainage Area (Acres)	**0.00 to 0.25**	**0.26 to 0.50**	**0.51 to 0.75**	**0.76 to 1.00**
0 to 25	**Caution**	**Yes**	**Yes**	**Yes**
26 to 50	**High Caution**	**Caution**	**Yes**	**Yes**
51 to 75	**Not Recommended**	**High Caution**	**Caution**	**Yes**
76 to 100	**Not Recommended**	**High Caution**	**Caution**	**Yes**

If the flow-based BMP formula use case, as determined by Table D-2, shows "Caution," "High Caution," or "Not Recommended," considering the project's characteristics, then he project proponent must calculate the BMP design flow using the unit hydrograph method, as specified in the most current version of the San Bernardino County Hydrology Manual, using the design storm pattern with rainfall return frequency such that the peak one hour rainfall depth equals the 85th-percentile 1-hour rainfall multiplied by two.

B. Volume-Based BMP Design

1) Calculate the "Watershed Imperviousness Ratio", i, which is equal to the percent of impervious area in the BMP Drainage Area divided by 100.

2) Calculate the composite runoff coefficient C_{BMP} for the Drainage Area above using the following equation:

$$\mathbf{C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04}$$

where: **C_{BMP}** = composite runoff coefficient; and,

i = watershed imperviousness ratio.

3) Determine which Region the Drainage Area is located in (Valley, Mountain or Desert).

4) Determine the area-averaged "6-hour Mean Storm Rainfall", P_6, for the Drainage Area. This is calculated by multiplying the area averaged 2-year 1-hour value by the appropriate regression coefficient from Table 1.

5) Determine the appropriate drawdown time. Use the regression constant a = 1.582 for 24 hours and a = 1.963 for 48 hours. *Note: Regression constants are provided for both 24 hour and 48 hour drawdown times; however, 48 hour drawdown times should be used in most areas of California. Drawdown times in excess of 48 hours should be used with caution as vector breeding can be a problem after water has stood in excess of 72 hours. (Use of the 24 hour drawdown time should be limited to drainage areas with coarse soils that readily settle and to watersheds where warming may be detrimental to downstream fisheries.)*

6) Calculate the "Maximized Detention Volume", P_0, using the following equation:

$$\mathbf{P_0 = a \cdot C_{BMP} \cdot P_6}$$

where: **P_0** = Maximized Detention Volume, in inches

a = 1.582 for 24 hour and a = 1.963 for 48 hour drawdown,

C_{BMP} = composite runoff coefficient; and,

P_6 = 6-hour Mean Storm Rainfall, in inches

7) Calculate the "Target Capture Volume", V_0, using the following equation:

$$\mathbf{V_0 = (P_0 \cdot A) / 12}$$

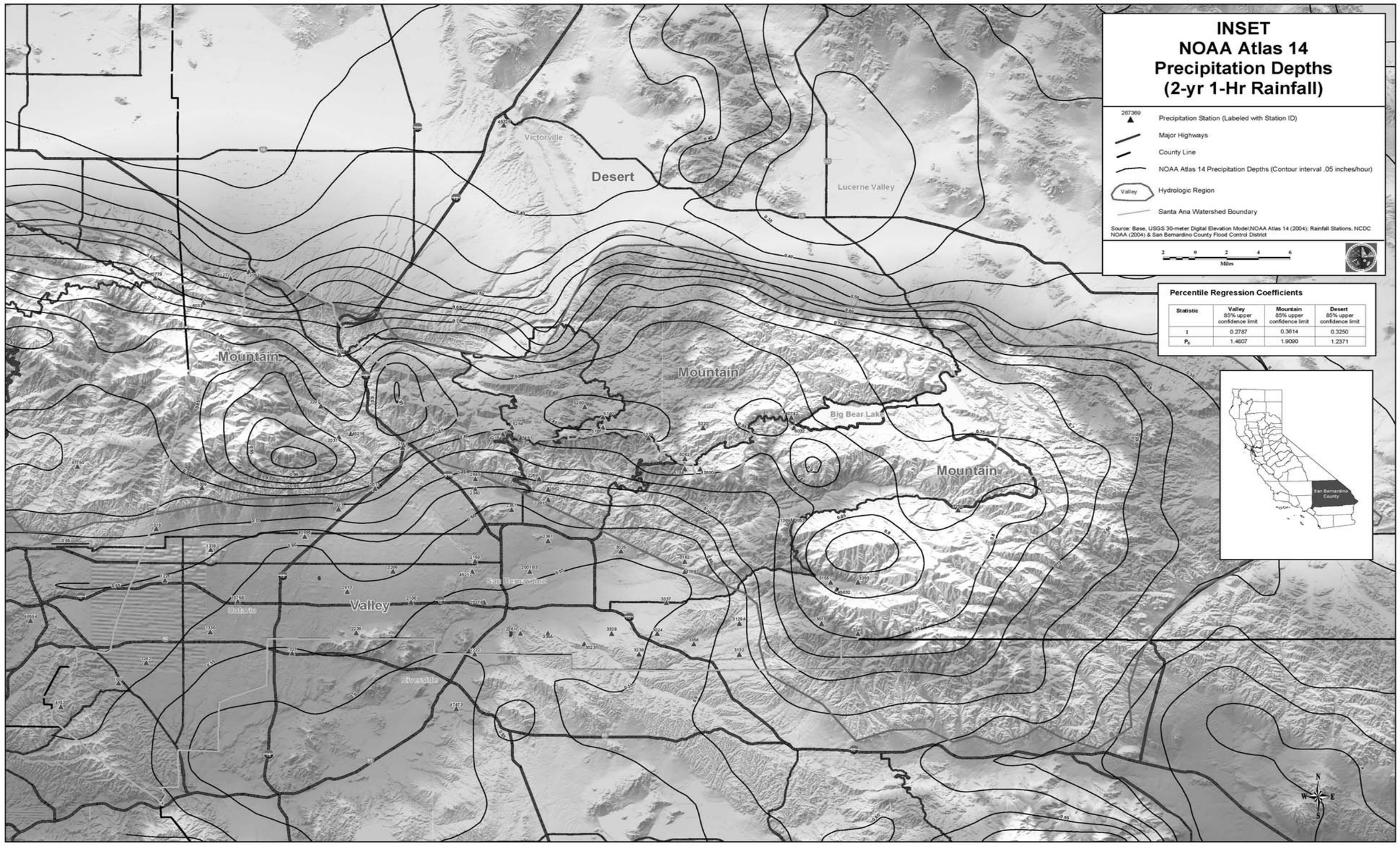
where:

V_0 = Target Capture Volume, in acre-feet

P_0 = Maximized Detention Volume, in inches; and,

A = BMP Drainage Area, in acres

Figure D-1: NOAA Atlas 14 Inset Map.



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Water Quality Treatment Calculations

Job Name: Spring Hills - TTM15576
Job Number: 13565 C
Date: 4/24/2009

Impervious Area Calculation

Treatment Location: 100 - Northern Discharge Point (to Cable Canyon)

Total Watershed Area = 40 acres

			% Impervious	
Roadway Area =	7.8 acres		100%	
Lot Area =	18.7	0.78	60%	
OpenSpace Area =	13.5 acres		5%	Area Check = OK

		40
Total Impervious Area =	19.7	19.7

Treatment Location: 100-A - Northern Area to Cable Canyon

Total Watershed Area = 23.4 acres

		% Impervious	
Roadway Area =	3 acres	100%	
Lot Area =	19.4 acres	50%	
OpenSpace Area =	1 acres	5%	Area Check = OK

Total Impervious Area = 12.8 acres

Treatment Location: 200 - Central Discharge Point

Total Watershed Area = 23.4 acres

		% Impervious	
Roadway Area =	3.9 acres	100%	
Lot Area =	11.1 acres	60%	
OpenSpace Area =	8.4 acres	5%	Area Check = OK

Total Impervious Area = 11.0 acres

Treatment Location: 300 - Southern Discharge Point (to Meyer Canyon)

Total Watershed Area = 89 acres

		% Impervious	
Roadway Area =	18.3 acres	100%	
Lot Area =	40.9 acres	60%	
OpenSpace Area =	29.8 acres	5%	Area Check = OK

Total Impervious Area = 44.3 acres

RICK ENGINEERING COMPANY

Water Quality Treatment Calculations

Job Name: Spring Hills - TTM15576
Job Number: 13565 C
Date: 4/24/2009

San Bernardino County Design Criteria

Project Site Location: North of Meyers Road

Treatment Location # : 100
Description : Northern Discharge Point (to Cable Canyon)

NOAA Atlas 14 Precipitation 0.78 inches/hour (2-year, 1-hour)
Region Mountain

Drainage Area = 40 acres
Impervious Area = 19.7 acres

i = Imperv Area/Drainage Area = 0.493

Flow Based BMP Sizing

$C_{BMP} = 0.858\ i^3 - 0.78\ i^2 + 0.774\ i + 0.04$

C_{BMP} = 0.33

I_{BMP} = 0.563784 in/hr
A (area) = 40 acres
C = 0.33

$Q_{BMP} = C_{BMP} \times i_{BMP} \times A$

Table D-1:

Quantity	Valley	Mountain	Desert
I	0.2787	0.3614	0.325
P_6	1.4807	1.909	1.2371

Regression Coefficient = 0.3614

Q_{BMP} = 7.54 cfs

Volume Based BMP Sizing

6-hour mean storm rainfall = 1.48902 inches
Desired Drawdown Time = 24 hours
a = drawdown coefficient = 1.582

P6 Coefficient = 1.909 *(from D-1)*

Drawdown Coefficient = 1.582 *(24-hours)*
1.963 *(48-hours)*

Maximized Detention Volume (Precipitation):

$P_0 = a \times C_{BMP} \times P_6$

P_0 = 0.79 inches

Target Capture Volume:

$V_0 = (P_0 \times A) / 12$

V_0 = 2.63 acre-feet

average drawdown flowrate

$Q_{DD\text{ - average}} = V_0 / Time$

$Q_{DD\text{ - ave}}$ = 1.32 cfs

RICK ENGINEERING COMPANY

Water Quality Treatment Calculations

Job Name: Spring Hills - TTM15576
Job Number: 13565 C
Date: 4/24/2009

San Bernardino County Design Criteria

Project Site Location: North of Meyers Road

Treatment Location # : 200
Description : central Discharge Point (to Cable Canyon)

NOAA Atlas 14 Precipitation 0.78 inches/hour (2-year, 1-hour)
Region Mountain

Drainage Area = 23.4 acres
Impervious Area = 11 acres

i = Imperv Area/Drainage Area = 0.470

Flow Based BMP Sizing

$C_{BMP} = 0.858\ i^3 - 0.78\ i^2 + 0.774\ i + 0.04$

C_{BMP} = **0.32**

I_{BMP} = 0.563784 in/hr
A (area) = 23.4 acres
C = 0.32

$Q_{BMP} = C_{BMP} \times i_{BMP} \times A$

Table D-1:

Quantity	Valley	Mountain	Desert
I	0.2787	0.3614	0.325
P_6	1.4807	1.909	1.2371

Regression Coefficient = 0.3614

Q_{BMP} = 4.23 cfs

Volume Based BMP Sizing

6-hour mean storm rainfall = 1.48902 inches
Desired Drawdown Time = 24 hours
a = drawdown coefficient = 1.582

P6 Coefficient = 1.909 *(from D-1)*

Drawdown Coefficient = 1.582 *(24-hours)*
1.963 *(48-hours)*

Maximized Detention Volume (Precipitation):

$P_0 = a \times C_{BMP} \times P_6$

P_0 = 0.76 inches

Target Capture Volume:

$V_0 = (P_0 \times A) / 12$

V_0 = 1.47 acre-feet

average drawdown flowrate
$Q_{DD\text{ - average}} = V_0 / \text{Time}$

$Q_{DD\text{ - ave}}$ = 0.74 cfs

RICK ENGINEERING COMPANY

Water Quality Treatment Calculations

Job Name: Spring Hills - TTM15576
Job Number: 13565 C
Date: 4/24/2009

San Bernardino County Design Criteria

Project Site Location: North of Meyers Road

Treatment Location # : 300
Description : Southern Discharge Point (to Meyer Canyon)

NOAA Atlas 14 Precipitation 0.78 inches/hour (2-year, 1-hour)
Region Mountain

Drainage Area = 89 acres
Impervious Area = 44.3 acres

i = Imperv Area/Drainage Area = 0.498

Flow Based BMP Sizing

$C_{BMP} = 0.858\ i^3 - 0.78\ i^2 + 0.774\ i + 0.04$

C_{BMP} = **0.34**

I_{BMP} = 0.563784 in/hr
A (area) = 89 acres
C = 0.34

$Q_{BMP} = C_{BMP} \times i_{BMP} \times A$

Table D-1:

Quantity	Valley	Mountain	Desert
I	0.2787	0.3614	0.325
P_6	1.4807	1.909	1.2371

Regression Coefficient = 0.3614

Q_{BMP} = 16.95 cfs

Volume Based BMP Sizing

6-hour mean storm rainfall = 1.48902 inches
Desired Drawdown Time = 24 hours
a = drawdown coefficient = 1.582

P6 Coefficient = 1.909 *(from D-1)*

Drawdown Coefficient = 1.582 *(24-hours)*
1.963 *(48-hours)*

Maximized Detention Volume (Precipitation):

$P_0 = a \times C_{BMP} \times P_6$

P_0 = 0.80 inches

Target Capture Volume:

$V_0 = (P_0 \times A) / 12$

V_0 = 5.90 acre-feet

average drawdown flowrate

$Q_{DD\ -\ average} = V_0 / Time$

$Q_{DD\ -\ ave}$ = 2.98 cfs

RICK ENGINEERING COMPANY

Water Quality Treatment Calculations

Job Name: Spring Hills - TTM15576
Job Number: 13565 C
Date: 4/24/2009

San Bernardino County Design Criteria

Project Site Location: Northern Area Draining to Cable Canyon

Treatment Location # : 100-A
Description : Low Flows will be sent to Basin 100 - Water Quality Only

NOAA Atlas 14 Precipitation 0.78 inches/hour (2-year, 1-hour)
Region Mountain

Drainage Area = 23.4 acres
Impervious Area = 12.8 acres

i = Imperv Area/Drainage Area = 0.547

Flow Based BMP Sizing

$C_{BMP} = 0.858\ i^3 - 0.78\ i^2 + 0.774\ i + 0.04$

C_{BMP} = **0.37**

I_{BMP} = 0.563784 in/hr
A (area) = 23.4 acres
C = 0.37

$Q_{BMP} = C_{BMP} \times i_{BMP} \times A$

Table D-1:

Quantity	Valley	Mountain	Desert
I	0.2787	0.3614	0.325
P_6	1.4807	1.909	1.2371

Regression Coefficient = 0.3614

Q_{BMP} = 4.89 cfs

Volume Based BMP Sizing

6-hour mean storm rainfall = 1.48902 inches
Desired Drawdown Time = 24 hours
a = drawdown coefficient = 1.582

P6 Coefficient = 1.909 *(from D-1)*

Drawdown Coefficient = 1.582 *(24-hours)*
1.963 *(48-hours)*

Maximized Detention Volume (Precipitation):

$P_0 = a \times C_{BMP} \times P_6$

P_0 = 0.87 inches

Target Capture Volume:

$V_0 = (P_0 \times A) / 12$

V_0 = 1.70 acre-feet

average drawdown flowrate

$Q_{DD\text{ - average}} = V_0 / \text{Time}$

$Q_{DD\text{ - ave}}$ = 0.86 cfs

Extended Detention Basin TC-22

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

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relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction / Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_0))^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_0= orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_0. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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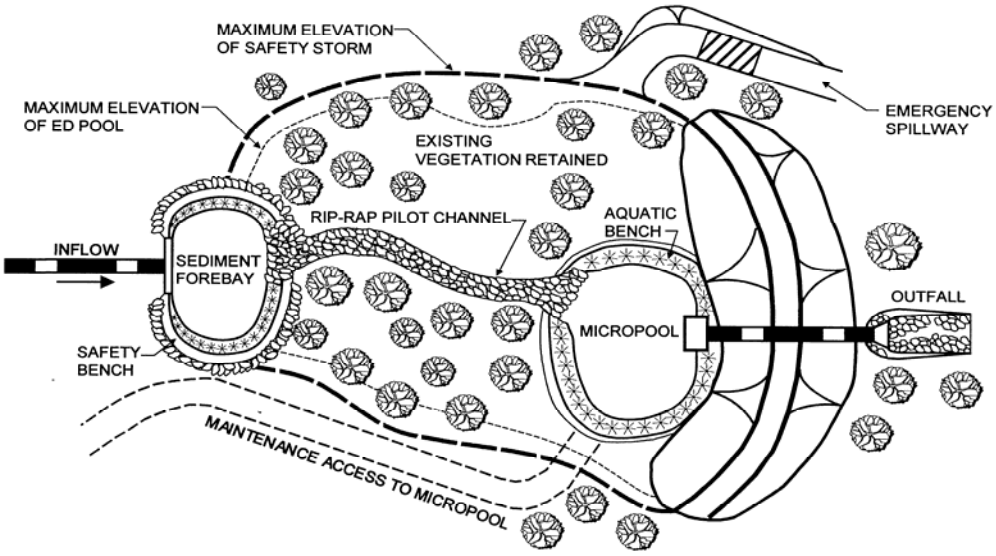
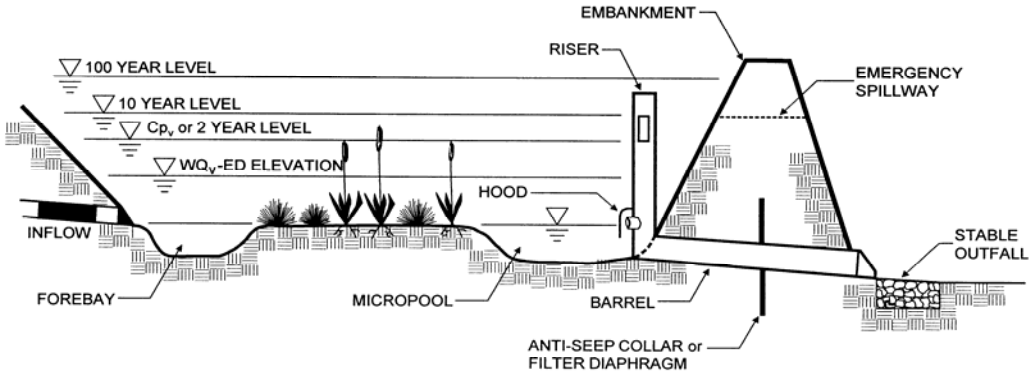


PLAN VIEW



PROFILE

Schematic of an Extended Detention Basin (MDE, 2000)

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

- ● Low
- ▲ Medium
- ■ High

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

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be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

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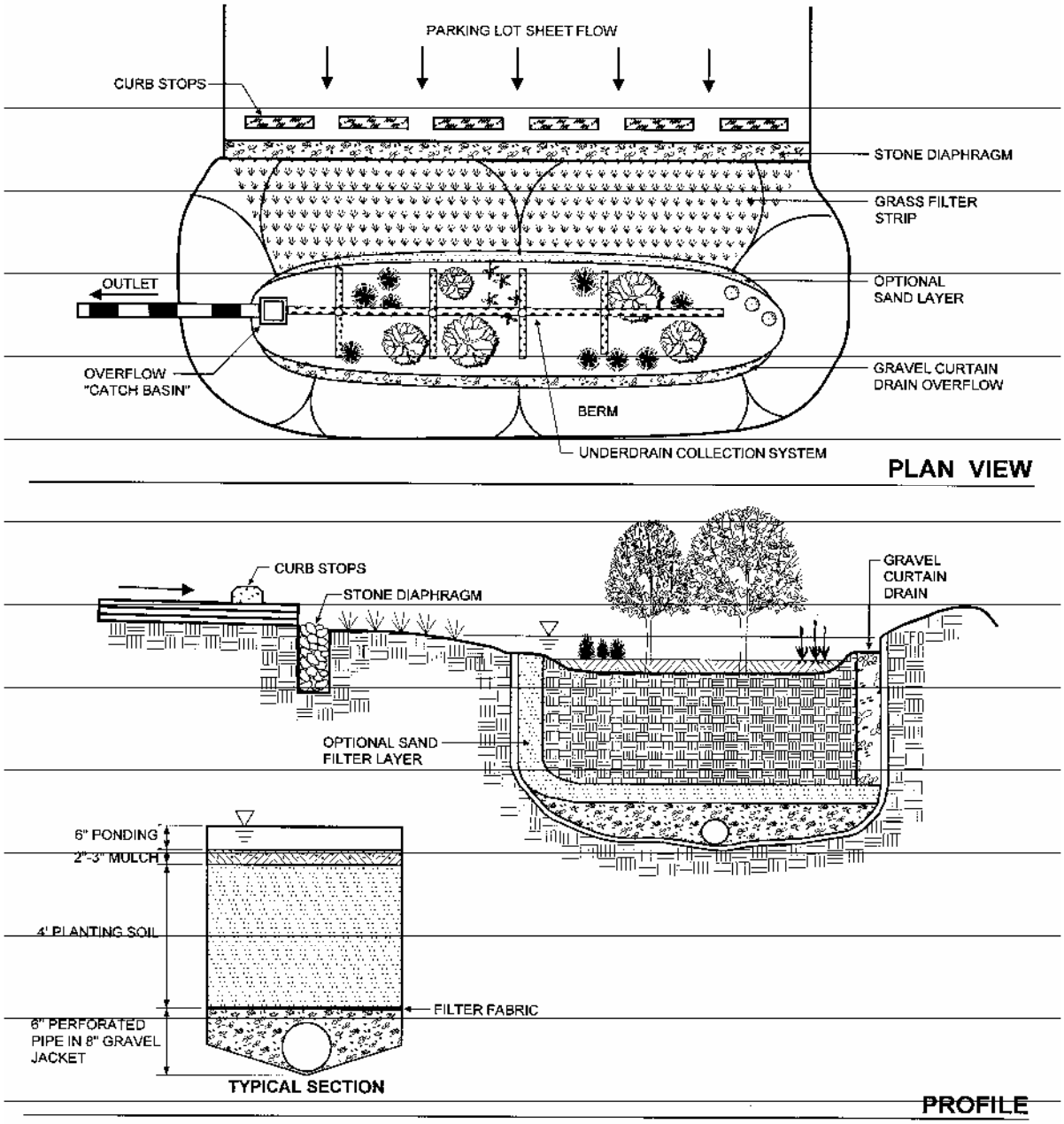

Schematic of a Bioretention Facility (MDE, 2000)

Water Quality Inlet TC-50

Description

Water quality inlets (WQIs), also commonly called trapping catch basins, oil/grit separators or oil/water separators, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Some WQIs also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalescing unit that helps promote oil/water separation. A typical WQI, as shown in the schematic, consists of a sedimentation chamber, an oil separation chamber, and a discharge chamber.

These devices are appropriate for capturing hydrocarbon spills, but provide very marginal sediment removal and are not very effective for treatment of stormwater runoff. WQIs typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs).

California Experience

Caltrans investigated the use of coalescing plate oil/water separators at maintenance stations in Southern California. Twenty-two maintenance stations were originally considered for implementation of this technology; however, only one site appeared to have concentrations that were sufficiently high to warrant installation of an oil-water separator. Concentrations of free oil in stormwater runoff observed during the course of the study even from this site were too low for effective operation of this technology, and no free oil was ever captured by the device.

Advantages

- Can provide spill control.

Limitations

- WQIs generally provide limited hydraulic and residuals storage. Due to the limited storage, WQIs do not provide substantial stormwater improvement.
- Standing water in the devices can provide a breeding ground for mosquitoes.
- Certain designs maintain permanent sources of standing water where mosquito and other vector breeding may to occur.

Design and Sizing Guidelines

- Water quality inlets are most effective for spill control and should be sized accordingly.

Design Considerations

- Area Required

Targeted Constituents

☑	Sediment	●
☑	Nutrients	●
☑	Trash	▲
☑	Metals	●
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	●

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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- Designs that utilize covered sedimentation and filtration basins should be accessible to vector control personnel via access doors to facilitate vector surveillance and controlling the basins if needed.

Performance

WQIs are primarily utilized to remove sediment from stormwater runoff. Grit and sediment are partially removed by gravity settling within the first two chambers. A WQI with a detention time of 1 hour may expect to have 20 to 40 percent removal of sediments. Hydrocarbons associated with the accumulated sediments are also often removed from the runoff through this process. The WQI achieves slight, if any, removal of nutrients, metals and organic pollutants other than free petroleum products (Schueler, 1992).

A 1993 MWCOG study found that an average of less than 5 centimeters (2 inches) of sediments (mostly coarse-grained grit and organic matter) were trapped in the WQIs. Hydrocarbon and total organic carbon (TOC) concentrations of the sediments averaged 8,150 and 53,900 milligrams per kilogram, respectively. The mean hydrocarbon concentration in the WQI water column was 10 milligrams per liter. The study also indicated that sediment accumulation did not increase over time, suggesting that the sediments become re-suspended during storm events. The authors concluded that although the WQI effectively separates oil and grease from water, re-suspension of the settled matter appears to limit removal efficiencies. Actual removal only occurs when the residuals are removed from the WQI (Schueler 1992).

A 1990 report by API found that the efficiency of oil and water separation in a WQI is inversely proportional to the ratio of the discharge rate to the unit's surface area. Due to the small capacity of the WQI, the discharge rate is typically very high and the detention time is very short. For example, the MWCOG study found that the average detention time in a WQI is less than 0.5 hour. This can result in minimal pollutant settling (API, 1990). However, the addition of coalescing units in many current WQI units may increase oil/water separation efficiency. Most coalescing units are designed to achieve a specific outlet concentration of oil and grease (for example, 10-1 5m/L oil and grease).

Pollutant removal in stormwater inlets can be somewhat improved using inserts, which are promoted for removal of oil and grease, trash, debris, and sediment. Some inserts are designed to drop directly into existing catch basins, while others may require extensive retrofit construction.

Siting Criteria

Oil/water separation units are often utilized in specific industrial areas, such as airport aprons, equipment washdown areas, or vehicle storage areas. In these instances, runoff from the area of concern will usually be diverted directly into the unit, while all other runoff is sent to the storm drain downstream from the oil/water separator. Oil/water separation tanks are often fitted with diffusion baffles at the inlets to prevent turbulent flow from entering the unit and resuspending settled pollutants.

Additional Design Guidelines

Prior to WQI design, the site should be evaluated to determine if another BMP would be more cost-effective in removing the pollutants of concern. WQIs should be used when no other BMP is feasible. The WQI should be constructed near a storm drain network so that flow can be easily diverted to the WQI for treatment (NVPDC, 1992). Any construction activities within the

drainage area should be completed before installation of the WQI, and the drainage area should be revegetated so that the sediment loading to the WQI is minimized.

WQIs are most effective for small drainage areas. Drainage areas of 0.4 hectares (1 acre) or less are often recommended. WQIs are typically used in an off-line configuration (i.e., portions of runoff are diverted to the WQI), but they can be used as on-line units (i.e., receive all runoff). Generally, off-line units are designed to handle the first 1.3 centimeters (0.5 inches) of runoff from the drainage areas. Upstream isolation/diversion structures can be used to divert the water to the off-line structure (Schueler, 1992). On-line units receive higher flows that will likely cause increased turbulence and resuspension of settled material, thereby reducing WQI performance.

Oil/water separation tanks are often fitted with diffusion baffles at the inlets to prevent turbulent flow from entering the unit and resuspending settled pollutants. WQIs are available as pre-manufactured units or can be cast in place. Reinforced concrete should be used to construct below-grade WQIs. The WQIs should be water tight to prevent possible ground water contamination.

Maintenance

Typical maintenance of WQIs includes trash removal if a screen or other debris capturing device is used, and removal of sediment using a vactor truck. Operators need to be properly trained in WQI maintenance. Maintenance should include keeping a log of the amount of sediment collected and the date of removal. Some cities have incorporated the use of GIS systems to track sediment collection and to optimize future catch basin cleaning efforts.

One study (Pitt, 1985) concluded that WQIs can capture sediments up to approximately 60 percent of the sump volume. When sediment fills greater than 60 percent of their volume, catch basins reach steady state. Storm flows can then resuspend sediments trapped in the catch basin, and will bypass treatment. Frequent clean-out can retain the volume in the catch basin sump available for treatment of stormwater flows.

At a minimum, these inlets should be cleaned at least twice during the wet season. Two studies suggest that increasing the frequency of maintenance can improve the performance of catch basins, particularly in industrial or commercial areas. One study of 60 catch basins in Alameda County, California, found that increasing the maintenance frequency from once per year to twice per year could increase the total sediment removed by catch basins on an annual basis (Mineart and Singh, 1994). Annual sediment removed per inlet was 54 pounds for annual cleaning, 70 pounds for semi-annual and quarterly cleaning, and 160 pounds for monthly cleaning. For catch basins draining industrial uses, monthly cleaning increased total annual sediment collected to six times the amount collected by annual cleaning (180 pounds versus 30 pounds). These results suggest that, at least for industrial uses, more frequent cleaning of catch basins may improve efficiency.

BMPs designed with permanent water sumps, vaults, and/or catch basins (frequently installed below-ground) can become a nuisance due to mosquito and other vector breeding. Preventing mosquito access to standing water sources in BMPs (particularly below-ground) is the best prevention plan, but can prove challenging due to multiple entrances and the need to maintain the hydraulic integrity of the system. BMPs that maintain permanent standing water may require routine inspections and treatments by local mosquito and vector control agencies to

suppress mosquito production. Standing water in oil/water separators may contain sufficient floating hydrocarbons to prevent mosquito breeding, but this is not a reliable control alternative to vector exclusion or chemical treatment.

Cost

A typical pre-cast catch basin costs between $2,000 and $3,000; however, oil/water separators can be much more expensive. The true pollutant removal cost associated with catch basins, however, is the long-term maintenance cost. A vactor truck, the most common method of catch basin cleaning, costs between $125,000 and $150,000. This initial cost may be high for smaller Phase II communities. However, it may be possible to share a vactor truck with another community. Typical vactor trucks can store between 10 and 15 cubic yards of material, which is enough storage for three to five catch basins. Assuming semi-annual cleaning, and that the vactor truck could be filled and material disposed of twice in one day, one truck would be sufficient to clean between 750 and 1,000 catch basins. Another maintenance cost is the staff time needed to operate the truck. Depending on the regulations within a community, disposal costs of the sediment captured in catch basins may be significant.

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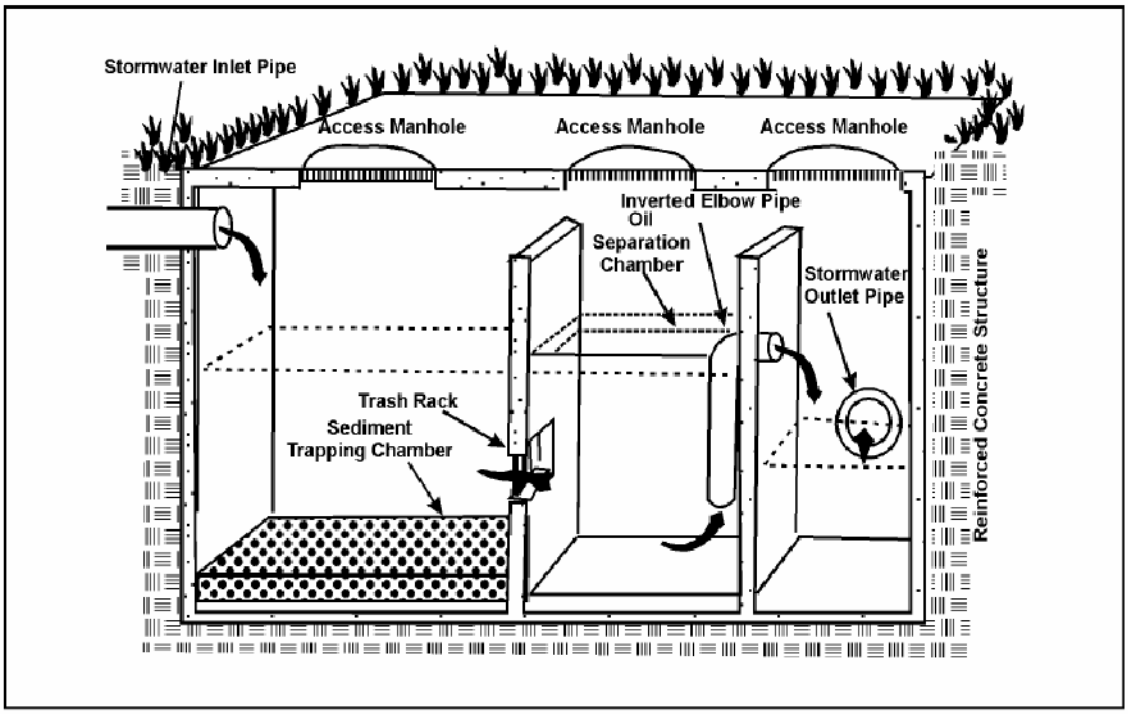
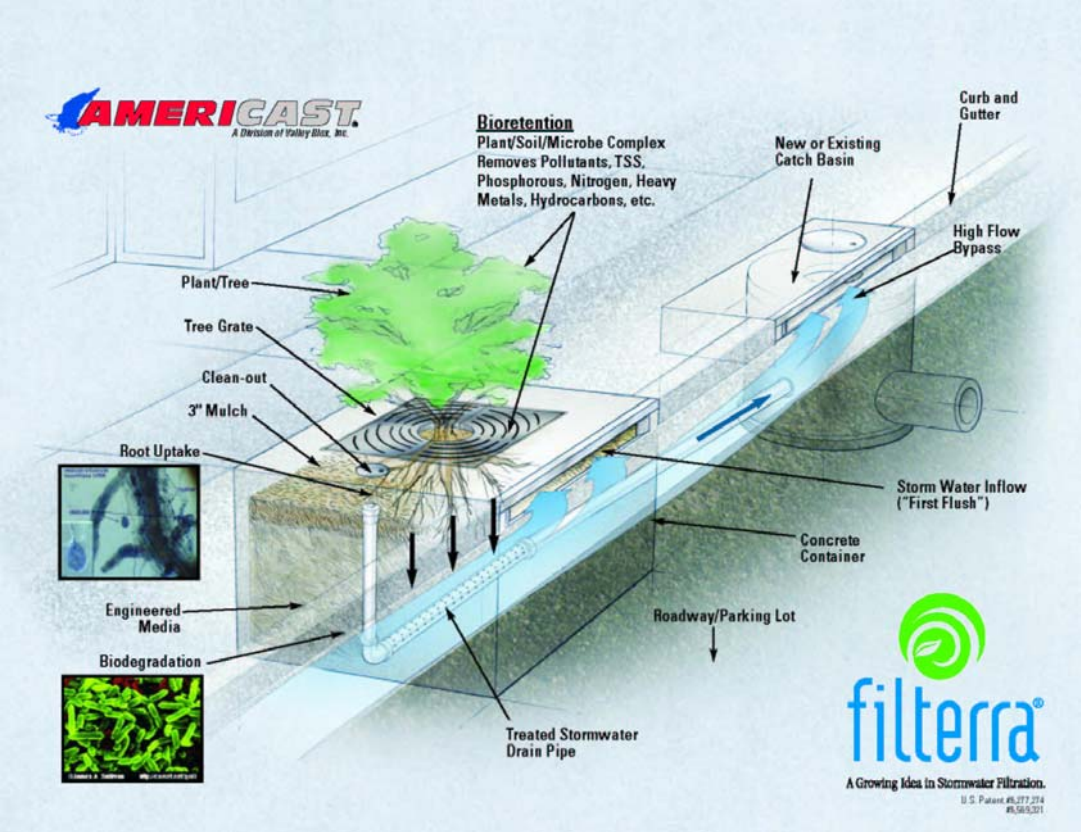

Stormwater Inlet Pipe
Access Manhole
Access Manhole
Access Manhole
Inverted Elbow Pipe
Oil
Separation
Chamber
Stormwater
Outlet Pipe
Trash Rack
Sediment
Trapping Chamber
Reinforced Concrete Structure

General Description

The following general specifications describe the installation, general operations, and maintenance requirements for the Americast stormwater bioretention filtration system, the Filterra®. The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, pre-constructed drop-in place unit designed for applications in the urban landscape to treat contaminated runoff.



Stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The mixture immobilizes pollutant, those pollutants are then decomposed, volatized and incorporated into the biomass of the Filterra® system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. Higher flows bypass the Filterra® to a downstream inlet or outfall.

Maintenance is a simple, inexpensive and safe operation that does not require confined space access, pumping or vacuum equipment or specialized tools. Properly trained landscape personnel can effectively maintain Filterra® Stormwater systems by following instructions in this manual.

Basic Operations

Filterra® is a bioretention system in a concrete box. Contaminated stormwater runoff enters the filter box through the curb inlet spreading over the 3-inch layer of mulch on the surface of the filter media. As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the soil media where the finer particles are removed and other chemical reactions take place to immobilize and capture pollutants in the soil media. The cleansed water passes into an underdrain and flows to a pipe system or other appropriate discharge point. Once the pollutants are in the soil, the bacteria immediately begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a very complex variety of biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

Design

Each project presents different scopes for the use of Filterra® systems. To ensure the safe and specified function of the stormwater BMP, Americast reviews each application before supply. Information and help may be provided to the design engineer during the planning process. Correct Filterra® box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction.

Scope

Supplier: Americast and/or authorized dealer of Americast Filterra® products.
Engineer: the site design engineer or a representative thereof.
Inspector: a representative of the governing jurisdiction or municipality for the installation site.
Contractor: company selected to carry out the works of the contract, or authorized sub-contractor thereof.

The Supplier, selected by the Contractor and approved by the Engineer, shall furnish Filterra® related engineering assistance required to properly size and install all components of the treatment device in accordance with the approved drawings and these specifications. The Contractor will be responsible for unloading and installation of the delivered product. The Supplier will maintain the Filterra® system for a period of 1 year after activation. Extended maintenance contracts are available.

Delivery & Unloading/Lifting

The Supplier shall deliver the Filterra® units to site in coordination with the Contractor. By prior arrangement at the time of order, orders with multiple units may be shipped with the media separate from the Filterra® boxes (subject to extra charges). This enables different lifting devices to be used on site.

A drawing of Filterra® Weights and Lifting Details is shown after this page. For non-standard Filterra® units, please contact Americast for lifting details.

The Contractor will require spreader bars and chains/cables to safely and securely lift all box pieces and most of the top lids. Americast will supply a set of suitable lifting hooks with each project at no extra charge.

Inspection

Inspection of the Filterra® unit and all parts contained in or shipped outside of the unit shall be inspected at time of delivery by the site Engineer/Inspector and the Contractor. Any nonconformance to approved drawings or damage to any part of the system shall be documented on the Supplier shipping ticket. Damage to the unit during and after unloading shall be corrected at the expense of the Contractor. Any necessary repairs to the Filterra® unit shall be made to the acceptance of the Engineer/Inspector.

Site Preparation

A. When the Filterra® unit is installed prior to final site stabilization (full landscaping, grass cover, final paving and street sweeping completed), the Contractor is responsible for providing adequate and complete site/inlet protection.

B. The Contractor shall adhere to all jurisdictional and/or OSHA safety rules in providing temporary shoring of the excavation.

C. The Contractor or Owner is responsible for appropriately barricading the Filterra® from traffic (in accordance with local codes).

filterra
Bioretention Systems
A Growing Idea in Stormwater Filtration

Filterra® Pollutant Removal Overview

Pollutant	Filterra Performance Data	Rating
Total Suspended Solids	**85%** average removal, based on lab and field data[1]	High
	85% - 96% removal, based on field data[2]	High
Phosphorus	**73%** average removal, based on field data[1]	Medium
Nitrogen	**43%** average removal, based on lab and field data[1]	Medium
Heavy Metals	**33% - 82%** removal, based on lab and field data[1]	Medium - High
	86% - 95% removal, based on field data[2]	High
Bacteria	**57% - 77%** removal, based on lab and field data	Medium
	94% - 99% removal, based on field data	High
Oil & Grease	**>85%** removal[3]	High
Trash & Debris	**100%** capture/removal - all is collected in 6" headspace	High
Oxygen Demand	**>50%** removal[4]	Medium
Turbidity	**<20** NTU[5]	High
Pesticides	Organics within media filters have shown siginifant removal of pesticides.[6*]	Medium - High

The following rating is based on CALTRANS Treatment Technology Report (April 2008)

High = ≥ 80% removal efficiency
Medium = 80% - 40% removal efficiency
Low = < 40% removal efficiency

[1] Standard media blend removal efficiencies
[2] Bacterra media blend removal efficiencies
[3] University of Mayland Bioretention Study (2002)
[4] North Carolina State University Bioretention Study (2008)
[5] North Carolina State University Bioretention Study (2005)
[6] Stormwater Treatment, Minton (2005)
[*] Same CEC removal mechanism as oil & grease

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T: (866) 349-3458 • F: (804) 798-8400
E-mail: design@filterra.com • Web: www.filterra.com

Attachment E
Education Materials

San Bernardino County Stormwater Program
825 East Third Street · Room 127
San Bernardino, CA 94215-0835

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STORMWATER Pollution Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

Yard waste, sediments, and toxic lawn/garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Following these best management practices will prevent pollution, comply with regulations and protect public health.

Recycle Yard Waste

Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Try grasscycling - the natural recycling of grass by leaving clippings on the lawn when mowing. Grass clippings will quickly decompose, returning valuable nutrients to the soil. Further information can be obtained at www.ciwmb.ca.gov/Organics.

Use Fertilizers, Herbicides and Pesticides Safely

Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use of natural, non-toxic alternatives to the traditional fertilizers, herbicides and pesticides is highly recommended. If you must use chemical fertilizers, herbicides, or pesticides:

- Spot apply pesticides and herbicides, rather than blanketing entire areas.
- Avoid applying near curbs and driveways, and never apply before a rain.
- Apply fertilizers as needed, when plants can best use it, and when the potential for it being carried away by runoff is low.

Recycle Hazardous Waste

Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility, which accepts these types of materials. For information on proper disposal call, (909) 386-8401.

Use Water Wisely

Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads. Plant native vegetation to reduce the need of water, fertilizers, herbicides, and pesticides.

Prevent Erosion

Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways.

- Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff.
- Avoid excavation or grading during wet weather.

Store Materials Safely

Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials must be covered with plastic sheeting to protect from rain, wind and runoff.

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

or visit our websites:

www.co.san-bernardino.ca.us/flood/npdes

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Fertilizer Tips to Prevent Pollution

Water that runs off your lawn and garden can carry fertilizer into the San Bernardino County storm drain system, and it does not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

- Read the product label and follow the directions carefully, using only as directed.
- Avoid applying near driveways or gutters.
- Never apply fertilizer before a rain.
- Store fertilizers and chemicals in a covered area and in sealed, waterproof containers.
- Take unwanted lawn or garden chemicals to a household hazardous waste collection facility. Call (800) 253-2687 for the location of your city's facility.
- Use non-toxic products for your garden and lawn whenever possible.

San Bernardino County STORMWATER PROGRAM

To report illegal dumping or for more information on Stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

English side

Consejos de Prevención Para la Contaminación de Fertilizantes.

El desagüe del jardín puede llevar fertilizantes que acaben por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

- Leer las etiquetas del producto y seguir las instrucciones cuidadosamente, usarlas tal como se indica.
- Evita aplicarlos cerca de la cocheras o las alcantarillas.
- Nunca aplicar el fertilizante antes de llover.
- Guarda los fertilizantes y otros quimicos en un lugar cuvierto y en contenedores contra agua.
- Desechalos en unlugar de colección de desechos peligrosos. Llama al (800) 253-2687 para información de un centro cerca a ti.
- Trata de usar productos no-toxicos para tu jardín cada vez que sea posible.

San Bernardino County STORMWATER PROGRAM

Para reportar actividadas ilegales u obtener más información de la prevención de contaminación llamar al:

1 (800) CLEANUP

www.1800cleanup.org

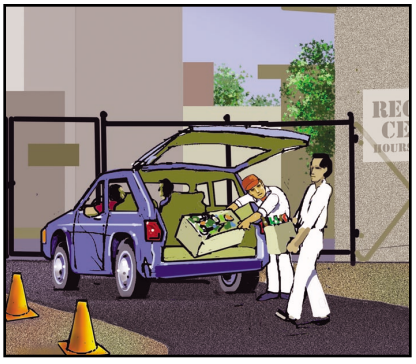
Spanish side

Item: Fertilizer bill insert **Actual size:** 3.625" x 8.5" **Advertiser:** San Bernardino County Storm Water Program
Agency: Industrial Strength Advertising **Date:** 8/29/03

STORMWATER Pollution Prevention

HOME & GARDEN

Yard waste and household toxics like paints and pesticides often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

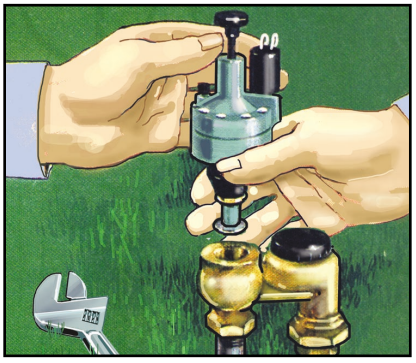


Recycle Household Hazardous Waste
Household products like paint, pesticides, solvents and cleaners are too dangerous to dump and too toxic to trash. Take them to be recycled at a convenient household hazardous waste collection facility. Call (800) CLEANUP for the facility in your area.

Disposing of Yard Waste
Recycle leaves, grass clippings and other yard waste, instead of blowing, sweeping or hosing into the street. Try grasscycling, leaving grass clippings on your lawn instead of using a grass catcher. The clippings act as a natural fertilizer, and because grass is mostly water, it also irrigates your lawn, conserving water.

Use Fertilizers & Pesticides Safely
Fertilizers and pesticides are often carried into the storm drain system by sprinkler runoff. Try using organic or non-toxic alternatives. If you use chemical fertilizers or pesticides, avoid applying near curbs and driveways and never apply before a rain.

Planting in the Yard
Produce less yard waste and save water by planting low maintenance, drought-tolerant trees and shrubs. Using drip irrigation, soaker hoses or micro-spray systems for flower beds and vegetation can also help reduce your water bill and prevent runoff.



Use Water Wisely
Cut your water costs and prevent runoff by controlling the amount of water and direction of sprinklers. The average lawn needs about an inch of water a week, including rainfall, or 10 to 20 minutes of watering. A half-inch per week is enough for fall and spring. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff.

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Pick Up After Your Pooch to Curb Pollution.

Maybe you weren't aware, but dog waste left on the ground gets into storm drains, polluting rivers, lakes and beaches. The bacteria and risk of disease threatens the health of our kids and communities. Wherever you live in San Bernardino County, this pollution is a problem. The answer? Pick up after your dog, to help prevent pollution and protect our health. It's in your hands.

San Bernardino County STORMWATER PROGRAM

To report illegal dumping or for more information on Stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

English side

Recoge los desperdicios de tu mascota para prevenir la contaminación de la calle.

Quizás usted no lo sepa, pero el excremento de perro que se deja en el suelo va a las alcantarillas, contaminando nuestros ríos, lagos y playas. Las bacterias y el riesgo de enfermedades amenazan la salud de nuestros niños y comunidades. No importa donde usted resida, esta contaminación es un problema. ¿Cuál es la respuesta? Recoja los desechos de su perro, para ayudar a prevenir la contaminación y proteger nuestra salud.

San Bernardino County STORMWATER PROGRAM

To report illegal dumping or for more information on Stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

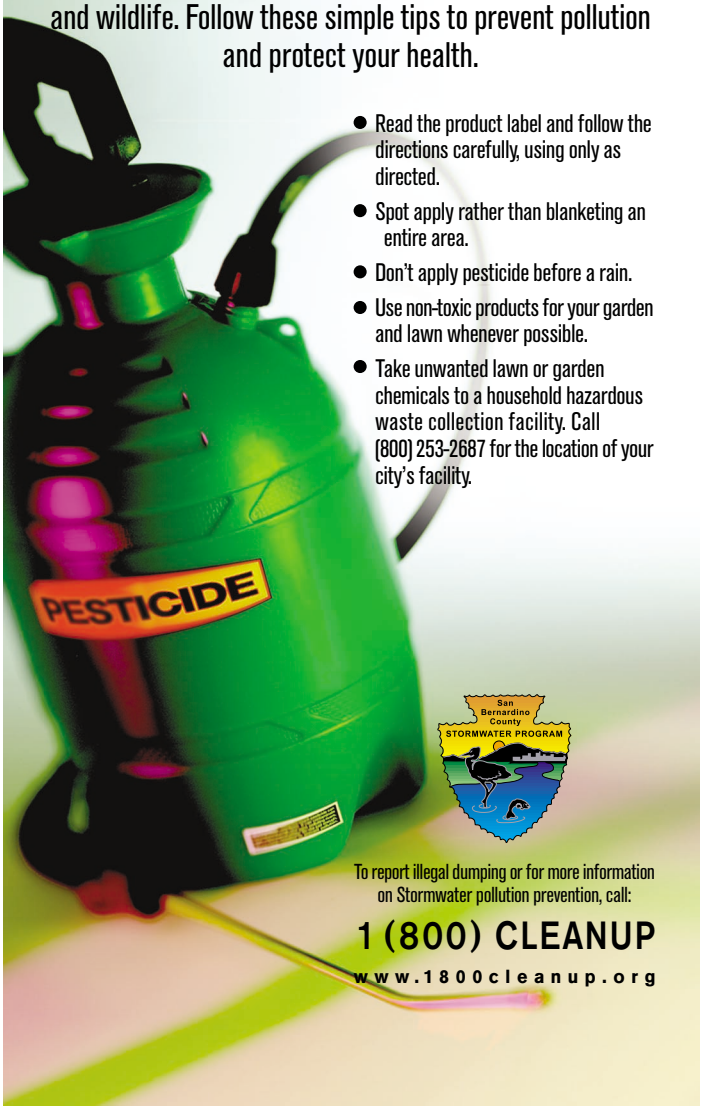
Spanish side

Item: Dog waste bill insert **Actual size:** 3.625" x 8.5" **Advertiser:** San Bernardino County Storm Water Program
Agency: Industrial Strength Advertising **Date:** 9/10/03

Pesticide Tips to Prevent Pollution

Water that runs off your lawn and garden can carry pesticide into the San Bernardino County storm drain system, and it does not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

- Read the product label and follow the directions carefully, using only as directed.
- Spot apply rather than blanketing an entire area.
- Don't apply pesticide before a rain.
- Use non-toxic products for your garden and lawn whenever possible.
- Take unwanted lawn or garden chemicals to a household hazardous waste collection facility. Call (800) 253-2687 for the location of your city's facility.



San Bernardino County STORMWATER PROGRAM

To report illegal dumping or for more information on Stormwater pollution prevention, call:

1 (800) CLEANUP

www.1800cleanup.org

English side

Consejos de Prevención Para la Contaminación de Pesticidas.

El desagüe del jardín puede llevar pesticidas que acaben por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

- Leer las etiquetas del producto y seguir las instrucciones cuidadosamente, usarlas tal como se indica.
- Apliqua solo parte por parte, no en areas grandes.
- No aplique los pesticidas antes de que llueva.
- Trata de usar productos no-toxicos para tu jardín cada vez que sea posible.
- Desechalos en unlugar de colección de desechos peligrosos. Llama al (800) 253-2687 para información de un centro cerca a ti.

San Bernardino County STORMWATER PROGRAM

Para reportar actividadas ilegales u obtener más información de la prevención de contaminación llamar al:

1 (800) CLEANUP

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Spanish side

Item: Pesticide bill insert **Actual size:** 3.625" x 8.5" **Advertiser:** San Bernardino County Storm Water Program
Agency: Industrial Strength Advertising **Date:** 8/29/03