Appendix D Conceptual Water Quality Management Plan

Appendix

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Conceptual Water Quality Management Plan (WQMP)

Project Name:

Creekside

30700 Rancho Viejo Road, San Juan Capistrano, CA 92675

Prepared for:

SA Cosman & Damian, LLC

4030 Birch Street, Suite 100

Newport Beach, CA 92660

Prepared by:

KHR Associates

Engineer: James H. Kawamura

Registration No. 30560

17530 Von Karman Avenue, Suite 200

Irvine, CA 92614

(949) 756-6440

Prepared on:

June 25, 2019

Revised on:

September 11, 2019; October 24, 2019; February 25, 2020; April 8, 2020

Project Owner's Certification			
Permit/Application No.	AC19-010, GPA18-004	Grading Permit No.	GPM 19-012
Tract/Parcel Map No.	Parcel 1 of P.M. 83-861	Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			650-111-15

This Water Quality Management Plan (WQMP) has been prepared for SA Cosman & Damian, LLC by KHR Associates. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

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 the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the San Diego Region (South Orange County). Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title			
Company	SA Cosman & Damian, LLC		
Address	4030 Birch Street, Suite 100, Newport Beach, CA 92660		
Email			
Telephone #			
Signature		Date	

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Section 1 Discretionary Permit(s) and Water Quality Conditions

Project Infomation			
Permit/Application No.	AC19-010, GPA18-004	Site Address or Tract/Parcel Map No.	30700 Rancho Viejo Road, San Juan Capistrano, CA 92675, Parcel 1 of P.M. 83-861
Additional Information/ Comments:			
Water Quality Conditions			
Water Quality Conditions from prior approvals or applicable watershed-based plans	This is the Conceptual WQMP. Section 8-14.106 of the City of San Juan Capistrano's Municipal Code requires that the applicant for every Priority Development Project must prepare and submit to the City a WQMP. The revised South Orange County Water Quality Improvement Plan (South OC WQIP) approved on June 20, 2018 has the following Highest Priority Water Quality Conditions (HPWQCs) for San Juan Creek: Pathogen Health Risk; and Unnatural Water Balance/Flow Regime. The South OC WQIP lists a hydromodification exemption for San Juan Creek and for Trabuco Creek from the confluence of San Juan Creek to Avenida De La Vista (upstream limit).		

Section 2 Project Description

2.1 General Description

Description of Proposed Project		
Site Location	The proposed project is located at 30700 Rancho Viejo Road, San Juan Capistrano, CA 92675. The Accessor Parcel Number for the site is 650-111-15. The legal boundary of the site is as follows: REAL PROPERTY IN THE CITY OF SAN JUAN CAPISTRANO, COUNTY OF ORANGE, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS: PARCEL 1 OF PARCEL MAP NO. 83-861, IN THE CITY OF SAN JUAN CAPISTRANO, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON A MAP FILED IN BOOK 208, PAGES 1 TO 3 INCLUSIVE OF PARCEL MAPS IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.	
Development Category:	The proposed redevelopment project will create 13.40 acres of impervious area on a previously developed site, which matches the Significant Redevelopment category, as defined below, and makes the site a Priority Development project. Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. Redevelopment does not include routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair.	
Project Area (ft^2): 678,489	Number of Dwelling Units: 188	SIC Code: _____
Narrative Project Description:	The proposed overall residential development involves the construction of approximately 15.57 acres (after proposed street vacation of 11,407 square feet or 0.26 acres, and property dedication of 21 square feet) for 107 single-family units and 81 townhome units. The proposed project includes private streets, driveways, visitor parking spaces, sidewalks, landscaping, and a community recreation area, as well as the realignment of Rancho Viejo Road adjacent the project site. The project	

	creates a total of 583,618 square feet (13.40 acres) of impervious area and 94,871 square feet (2.18 acres) of pervious area. As part of the realignment of Rancho Viejo Road, 12,274 square feet or 0.28 acres of the 1.56-acre remainder parcel (owned by the proprietor of the subject residential property) located on the westerly side of Rancho Viejo Road will be dedicated to the City. The resulting 1.28 acres of the remainder parcel will not be developed.

Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	7.19	46%	8.39	54%
Post-Project Conditions	2.18	14%	13.40	86%

2.2 Post Development Drainage Characteristics

Within the project site, stormwater is collected within the private storm drain system by drop inlet and curb inlet catch basins. The proposed project is broken up into 18 drainage areas. Runoff from DMAs 1-14, containing single-family units, townhome units, private streets, driveways and common areas, is collected by a storm drain system that discharges into the storm drain main within Rancho Viejo Road. Modular Wetland Systems are used for treatment prior to being discharged off-site to the city storm drain system. DMA 15 consists of 3,049 square feet of gutter that collects run-on from the adjacent property and routes it around the site to either Malaspina Road or Rancho Viejo Road. DMA 16 is a de-minimus area that consists of 341 square feet of the private road at the intersection to Rancho Viejo Road that cannot be captured and treated on-site due to the existing grades. DMAs 17 and 18 are 33,724 square feet of self-mitigating landscaped area located adjacent the right of way.

The project site received run-on from the hillside to the east. The northerly portion of the hillside run-on is collected within a storm drain system that discharges to curb face on Malaspina Road via a parkway culvert. The southerly portion of the hillside run-on is collected within a storm drain system that discharges to curb face on Rancho Viejo Road via a parkway culvert.

2.3 Property Ownership/Management

The property owner, **SA Cosman & Damian, LLC**, shall assume all maintenance and inspection responsibilities of the stormwater facilities until a Homeowner's Association (HOA) is established for the site. In the developed condition, the HOA shall be responsible for the long-term funding, maintenance and inspection of the project's stormwater facilities. Areas within private residential lots will be the responsibility of the homeowner.

Section 3 Site & Watershed Characterization

3.1 Site Conditions

3.1.1 Existing Site Conditions

The existing site is approximately 15.57 acres (after proposed street vacation and property dedication) and consists of a one-story vacant industrial building, a separate storage building for hazardous materials, an outdoor storage area, a surface parking lot, and landscaping. The topography of the existing site ranges from relatively flat in the areas of the building and parking lot to relatively steep in areas of landscaping. Elevations range from 301 feet at the middle of the eastern boundary of the site to 225 feet at the northwest corner of the site.

The existing drainage sheet flows to on-site catch basins/inlets, Malaspina Road, and Rancho Viejo Road. The site receives run-on from the landscaped hillside to the east. The hillside contains concrete ditches that direct runoff onto the project site at two separate discharge points at the surface of the easterly parking lot, and to an inlet and headwall located on the southeasterly corner of the site.

The northern portion of the parking lot and landscaping to the north and east of the existing building drains northerly to Malaspina Road, which then drains in a westerly direction via curb and gutter to an existing catch basin located on the south side of the street at the intersection with Rancho Viejo Road. The southern portion of the parking lot and landscaping to the east of the existing building drains southeasterly to an existing storm drain inlet and headwall located on the southeasterly corner of the site. The headwall connects to a 36-inch reinforced concrete pipe (RCP) that traverses the southern portion of the site in a westerly direction, increasing to a 42-inch RCP at Rancho Viejo Road. The southern drive aisle drains southwesterly to an on-site drop inlet and to Rancho Viejo Road via the site's southern driveway. From the southern driveway, Rancho Viejo Road drains in a northerly direction via curb and gutter to an existing catch basin on the east side of street, south of the site's northern driveway, which connects to the 42-inch RCP that crosses Rancho Viejo Road.

The landscaped area on the northwest corner of the site drains in a northwesterly direction to Malaspina Road and Rancho Viejo Road. The northern portion of the parking lot and landscaping to the west of the existing building drains southwesterly to an on-site catch basin located at the site's northern driveway on Rancho Viejo Road. The southern portion of the parking lot and landscaping to the west of the existing building drains northwesterly to two additional on-site catch basins located at the site's northern driveway on Rancho Viejo Road. These three on-site catch basins connect to the 36-inch RCP that crosses the site.

The existing site has a total of 365,346 square feet (8.39 acres) of impervious area (54%) and 313,031 square feet (7.19 acres) of pervious area (46%).

Existing Land Uses				
Land Use Description	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Imperviousness (%)
Commercial/Industrial Development	15.57	8.39	7.19	54%
Total	15.57	8.39	7.19	54%

3.1.2 Infiltration-Related Characteristics

3.1.2.1 Hydrogeologic Conditions

According to the Preliminary Geotechnical Review prepared by LGC Geotechnical, Inc., dated July 30, 2019, a groundwater table was not encountered during subsurface field evaluation; however, seepage was observed during downhole logging of the bucket auger borings.

3.1.2.2 Soil and Geologic Infiltration Characteristics

According to the NRCS Hydrologic Soils Groups map from the Technical Guidance Document, the project site consists of Type D soils, which are classified as low permeability soils.

According to the Preliminary Geotechnical Review prepared by LGC Geotechnical, Inc., dated July 30, 2019, the majority of soils at the site are predominately silts and clays that are known to have a very low hydraulic conductivity and therefore have very low infiltration rates. Two field infiltration tests indicated infiltration rates of approximately 0.0 inches per hour, indicating poor infiltration conditions.

3.1.2.3 Geotechnical Conditions

According to the Preliminary Geotechnical Review prepared by LGC Geotechnical, Inc., dated July 30, 2019, the geologic materials at the site consist of alluvium, older artificial fill, and the bedrock of the Capistrano Formation. The fill soils consist of variable layers of silt, clayey silt, sandy clay with scattered gravel and few cobbles, generally moist to very moist, stiff to very stiff. The alluvium consists of silt, clay, and sandy clay with scattered gravels and cobbles, very moist, moderately stiff to stiff. The Capistrano Formation materials generally consist of very fine sandy siltstone, clayey siltstone, and few thin sandstone and very thin clay interbeds.

3.1.2.4 Summary of Infiltration Opportunities and Constraints of Existing Site

According to the Preliminary Geotechnical Review prepared by LGC Geotechnical, Inc., dated July 30, 2019, infiltration is considered infeasible for the project due to the on-site materials and the hillside nature of the site. Field infiltration tests indicated infiltration rates of 0.0 inches per hour, making the site unsuitable for infiltration.

3.2 Proposed Site Development Activities

3.2.1 Overview of Site Development Activities

The proposed overall residential development involves the construction of approximately 15.57 acres for 107 detached single-family units on lots range in size from 2,091 square feet to 3,885 square feet, and 81 attached townhome units in 9 separate buildings. The project will include new private streets, new curbs, sidewalks, asphalt concrete pavement, surface parking, retaining walls, and landscaping. Landscaped areas are located around the perimeter of the site, in common areas, and potentially within the individual residential lots (single family lot owners will determine their own landscaping). A community recreation area for the residents will include a pool and a spa, as well as restrooms and showers. Parking will be provided via 376 off-street private garage spaces, 70 off-street private driveway spaces, and 102 guest parking stalls located along the private streets.

An easement is proposed along the southerly private street to provide access rights to the adjacent property to the south, thereby replacing the existing access easement.

3.2.2 Project Attributes Influencing Stormwater Management

The proposed zoning for the project site is Planned Community, with the proposed land use consisting of single-family and multi-family residential. Buildings on the site will include detached single-family units, attached townhome units, and recreation area restrooms/showers. Vehicular surfaces exposed to the elements include private roadways, private driveways, and surface parking. Materials expected to be used/stored are maintenance materials that will be stored within buildings. Waste expected from the site is trash from the residents and landscape materials. No vehicle fueling, maintenance or cleaning areas are proposed on the site. Landscaping will consist of drought tolerant or native species grouped with similar irrigation needs.

The project creates a total of 583,618 square feet (13.40 acres) of impervious area (86%) and 94,871 square feet (2.18 acres) of pervious area (14%).

The project site receives run-on from the hillside to the east. Run-off descending toward the site from the eastern slope will be collected off-site and on-site within new concrete ditches that flow to one of four drain inlets. The northern three inlets connect to the storm drain system that directs the flows to curb face on Malaspina Road via a culvert. The southern inlet connects to a storm drain within the project site, which then connects to an existing storm drain within the property to the south that directs flows to an existing swale (within a City easement). The swale drains to a 36-inch RCP that connects to a concrete ditch prior to discharging to curb face on Rancho Viejo Road via an existing parkway culvert.

Proposed retaining walls are located at the bottom of the 3:1 slope along the east property line, and at the top of 2:1 slopes along the north and west property lines. Disturbed slope areas will be vegetated with native or drought tolerant plants.

Proposed Land Uses				
Land Use Description	Total Area (acres)	Impervious Area (acres)	Pervious Area (acres)	Imperviousness (%)
Detached Residential Development	11.90	10.11	1.79	85%
Attached Residential Development	3.67	3.29	0.38	90%
Total	15.57	13.40	2.18	86%

3.2.3 Effects on Infiltration and Harvest and Use Feasibility

Infiltration is considered infeasible for the project due to the infiltration test results provided by the geotechnical consultant indicating infiltration rates of 0.0 inches per hour. The site is also within a hillside area. The project area does not have enough demand for Harvest and Use. Biotreatment was selected as the BMP.

3.3 Receiving Waterbodies

The project site is located within the San Juan Creek Watershed and discharges to an existing MS4, which drains to Arroyo Trabuco Creek, then to San Juan Creek, and ultimately to the Pacific Ocean. The project site does not discharge directly to an environmentally sensitive area. Below is a table of the 2014/2016 Clean Water Act Section 303(d) list of downstream impaired water bodies.

Arroyo Trabuco Creek 303(d) list of impairments	**San Juan Creek 303(d) list of impairments**	**San Juan Creek (Mouth) 303(d) list of impairments**	**Pacific Ocean Shoreline, Lower San Juan HSA, at San Juan Creek 303(d) list of impairments**	**Pacific Ocean Shoreline, Lower San Juan HSA, at surfzone outfall at Doheny State Beach 303(d) list of impairments**
Benthic Community Effects	Benthic Community Effects	Cadmium	Indicator Bacteria	Indicator Bacteria
Indicator Bacteria	DDE (Dichlorodiphenyl-dichloroethylene)	Copper		
Malathion	Indicator Bacteria	Indicator Bacteria		
Nitrogen	Nitrogen	Nickel		
Phosphorus	Oxygen (Dissolved)	Nitrogen, ammonia (Total Ammonia)		
Toxicity	Phosphorus			
	Selenium			
	Toxicity			

3.4 Stormwater Pollutants or Conditions of Concern

Pollutants or Conditions of Concern				
Pollutant	Expected from Proposed Land Uses/Activities (Yes or No)	Receiving Waterbody Impaired (Yes or No)	Priority Pollutant from WQIP or other Water Quality Condition? (Yes or No)	**Pollutant of Concern (Primary, Other, or No)**
Suspended-Solids	Yes	No	Yes	Primary
Nutrients	Yes	Yes	Yes	Primary
Heavy Metals	No	Yes	No	No
Bacteria/Virus/Pathogens	Yes	Yes	Yes	Primary
Pesticides	Yes	Yes	No	Primary
Oil and Grease	Yes	No	No	Other
Toxic Organic Compounds	No	No	No	No
Trash and Debris	Yes	No	Yes	Primary
Dry Weather Runoff	Yes	No	Yes	Primary

3.5 Hydrologic Conditions of Concern

Does a hydrologic condition of concern exist for this project?

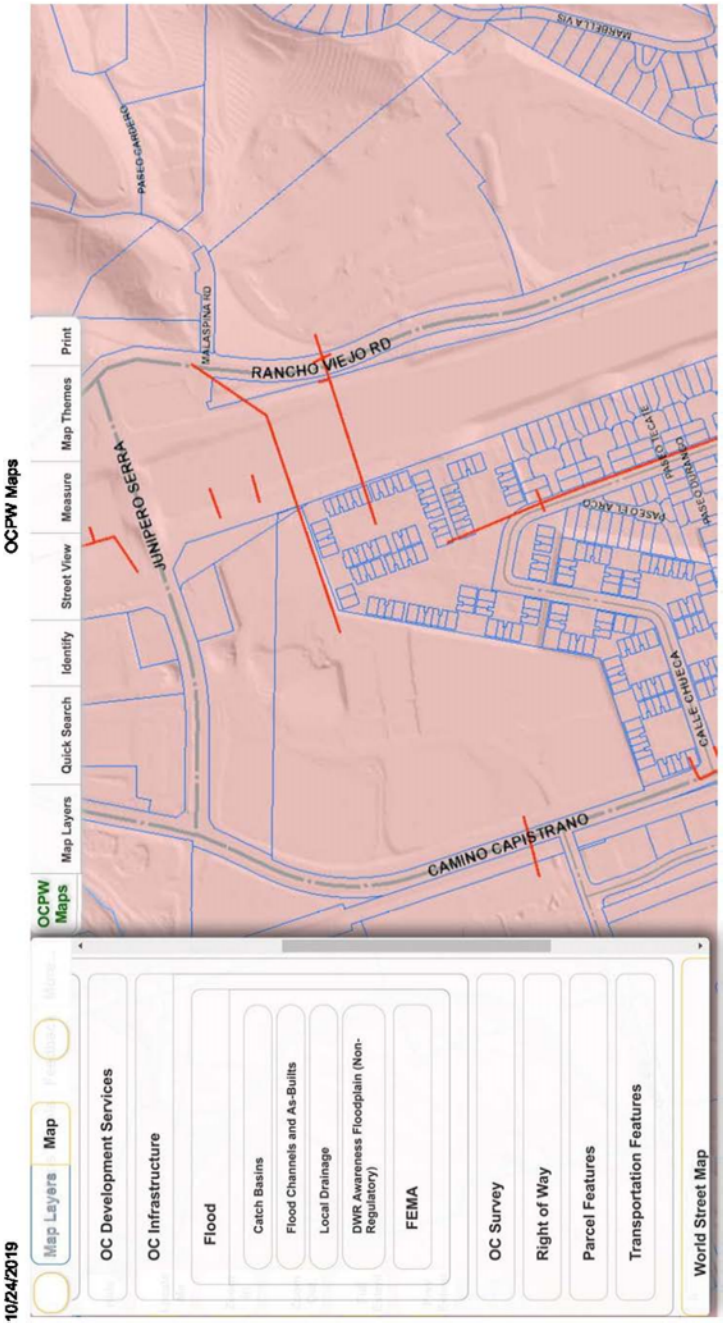
☒ No – An HCOC does not exist for this receiving water because:

- ☐ Project discharges directly to a protected conveyance (bed and bank are concrete lined the entire way from the point(s) of discharge to a receiving lake, reservoir, embayment, or the Ocean
- ☐ Project discharges directly to storm drains which discharge directly to a reservoir, lake, embayment, ocean or protected conveyance (as described above)
- ☒ The project discharges to an area identified in the WMAA as exempt from hydromodification concerns

☐ Yes – An HCOC does exist for this receiving water because none of the above are applicable.

According to the South Orange County Engineered Channel Exemption Areas, San Juan Capistrano Exemption Map, streams located downstream from the MS4 that the project site connects to in Rancho Viejo Road are engineered channels/large rivers and are exempt from hydromodification concerns. The catch basins and associated storm drain system that collects runoff at the intersection

of Malaspina Road and Rancho Viejo Road are not exempt from hydromodification. Although a portion of the hillside within the adjacent property discharges to Malaspina Road, the proposed project site's storm drain system will be directed to a storm drain system within Rancho Viejo Road that is exempt from hydromodification requirements. Potential hydrological impacts to the downstream receiving waters of Malaspina Road will be decreased by the proposed project due to a reduction in tributary area to the MS4 from 5.34 acres from the existing condition to 3.43 acres in the proposed condition. For the off-site area draining to the MS4 in Malaspina Road, the SOHM software was used to determine that hydrologic control measures would not be required. See the OCPW Map below and the following SOC Engineered Channel Exemption Areas Map, along with the SOHM Report in Attachment D.



3.6 Critical Course Sediment Yield Areas

Not applicable.

Section 4 Site Plan and Drainage Plan

4.1 Drainage Management Area Delineation

The proposed project site is divided into 18 DMAs. Due to low permeability of Type D soils and preliminary infiltration information provided by the geotechnical consultant, Modular Wetland Systems were selected for stormwater treatment. DMAs were divided based on the topography of the site and adjacent streets, and proposed grades for the site. DMA sizes were based on the design specifications for the proposed treatment device.

Within DMAs 1 through 14, stormwater sheet flows to a catch basin and is collected within the private storm drain system, which directs flows to a Modular Wetland System for treatment. From the Modular Wetland System, the stormwater is routed off-site, discharging into the 36-inch RCP in Rancho Viejo Road. In DMAs 6, 7, 8, 10, and 13, the stormwater is routed from the Modular Wetland System to a detention tank prior to discharging off-site in order for the proposed site to match the existing site's flow rate at the discharge point (see this project's Drainage Study for detention tank sizing calculations). DMA 15 consists of 3,049 square feet of gutter that collects run-on from the adjacent property and routes it around the site to either Malaspina Road or Rancho Viejo Road. DMA 16 is a de-minimus area that consists of 341 square feet of the private road at the intersection to Rancho Viejo Road that cannot be captured and treated on-site due to the existing grades. DMAs 17 and 18 are 33,742 square feet of self-mitigating landscaped area located adjacent the right of way; these DMAs will not be managed with the use of fertilizers or pesticides and are hydrologically disconnected from other DMAs.

The project site receives run-on from the hillside to the east. Run-off descending toward the site from the eastern slope will be collected off-site and on-site within new concrete ditches that flow to one of four on-site drain inlets. The northern three inlets connect to a storm drain system within the project site that directs the flows to curb face on Malaspina Road via a parkway culvert. The southern inlet connects to a storm drain system within the project site that connects to the existing storm drain within the property to the south, which discharges to curb face on Rancho Viejo Road via an existing parkway culvert.

4.2 Overall Site Design BMPs

Minimize Impervious Area – Landscaping will be provided throughout the site, within private lots and common area lots, and along the perimeter of the site.

Maximize Natural Infiltration Capacity – Project consists of Type D soils, which are not favorable for infiltration. However, landscaping will be provided throughout the site, allowing some infiltration and evapotranspiration processes.

Preserve Existing Drainage Patterns and Time of Concentration – The entire site will be developed for the proposed project, which will require some alterations to the existing drainage patterns, and will include new storm drain systems.

Disconnect Impervious Areas – Landscaping will be provided throughout the site, within private lots and common area lots, and around the perimeter of the site.

Protect Existing Vegetation and Sensitive Areas – The entire project site will be developed for the proposed project.

Revegetate Disturbed Areas – The entire project site will be developed for the proposed project and will include landscaping throughout the site. Disturbed slope areas will be vegetated with native or drought tolerant plants.

Soil Stockpiling and Site Generated Organics – There are no proposed stockpiles at this point in time.

Firescaping – Will be incorporated into landscape design.

Water Efficient Landscaping - Will be incorporated into landscape design.

Slopes and Channel Buffers – Drainage will be conveyed safely so it does not overtop slopes or channels, thereby reducing the chance for erosion. Disturbed slope areas will be vegetated with native or drought tolerant plants.

4.3 DMA Characteristics and Site Design BMPs

4.3.1 DMAs 1-18

DMAs 1 and 2 generally consist of the northerly and northwesterly portion of the site, and each contain single-family units, private streets, driveways and common areas. DMA 3 is centrally located on the northern portion of the site, and contains single-family units, townhome units, private streets, driveways and common areas, including the pool and spa. DMAs 4 and 5 are centrally located along the westerly boundary of the site, and each contain a portion of the entry/exit drive driveway, entry call box, and common areas, while DMA 5 also contains single-family units, private street, and driveways. DMAs 6-10 are located centrally and on the southerly portion of the site, and each contain single-family units, private streets, driveways and common areas. DMAs 11-13 are located along the easterly portion of the site. DMA 11 contain single-family units, private streets, driveways and common areas, while DMAs 12 and 13 each contain townhome units and the associated private street. DMA 14 generally consists of the southern boundary of the site and contains a private street and common areas. DMA 15 is a concrete gutter along the easterly property line that collects run-on and routes it around the site. DMA 16 is a small portion of the southwesterly private drive at the intersection of Rancho Viejo Road that drains untreated into the roadway. DMAs 17 and 18 are self-mitigating landscaped areas along the westerly perimeter of the property and adjacent the right of way.

Within DMAs 1 through 14, stormwater sheet flows to a catch basin and is collected within the private storm drain system, which directs flows to a Modular Wetland System for treatment. From the Modular Wetland System, the stormwater is routed off-site, discharging into the 36-inch RCP in Rancho Viejo Road. In DMAs 6, 7, 8, 10, and 13, the stormwater is routed from the Modular Wetland System to a detention tank prior to discharging off-site in order for the proposed site to match the existing site's flow rate at the discharge point (see Drainage Study for detention tank calculations).

DMA 1
Total Area: 53,404 SF (1.23 Acres)
Impervious Area: 50,559 SF (1.16 Acres)
Pervious Area: 2,845 SF (0.07 Acres)
Percent Impervious: 95%

DMA 2
Total Area: 45,745 SF (1.05 Acres)
Impervious Area: 43,339 SF (0.99 Acres)
Pervious Area: 2,406 SF (0.06 Acres)
Percent Impervious: 95%

DMA 3
Total Area: 75,406 SF (1.73 acres)
Impervious Area: 66,021 SF (1.52 Acres)
Pervious Area: 9,385 SF (0.22 Acres)
Percent Impervious: 88%

DMA 4
Total Area: 8,666 SF (0.20 Acres)
Impervious Area: 4,712 SF (0.11 Acres)
Pervious Area: 3,954 SF (0.09 Acres)
Percent Impervious: 54%

DMA 5
Total Area: 20,005 SF (0.46 Acres)
Impervious Area: 16,029 SF (0.37 Acres)
Pervious Area: 3,976 SF (0.09 Acres)
Percent Impervious: 80%

DMA 6
Total Area: 21,012 SF (0.48 Acres)
Impervious Area: 19,913 SF (0.46 Acres)
Pervious Area: 1,099 SF (0.03 Acres)
Percent Impervious: 95%

DMA 7
Total Area: 37,945 SF (0.87 Acres)
Impervious Area: 37,945 SF (0.87 Acres)
Pervious Area: 0 SF (0.00 Acres)
Percent Impervious: 100%

DMA 8
Total Area: 60,081 SF (1.38 Acres)
Impervious Area: 58,936 SF (1.35 Acres)
Pervious Area: 1,145 SF (0.03 Acres)
Percent Impervious: 98%

DMA 9
Total Area: 38,162 SF (0.88 Acres)
Impervious Area: 37,177 SF (0.85 Acres)
Pervious Area: 985 SF (0.02 Acres)
Percent Impervious: 97%

DMA 10
Total Area: 43,131 SF (0.99 Acres)
Impervious Area: 41,686 SF (0.96 Acres)
Pervious Area: 1,445 SF (0.03 Acres)
Percent Impervious: 97%

DMA 11
Total Area: 68,303 SF (1.57 Acres)
Impervious Area: 61,594 SF (1.41 Acres)
Pervious Area: 6,709 SF (0.15 Acres)
Percent Impervious: 90%

DMA 12
Total Area: 85,215 SF (1.96 Acres)
Impervious Area: 76,499 SF (1.76 Acres)
Pervious Area: 8,716 SF (0.20 Acres)
Percent Impervious: 90%

DMA 13
Total Area: 40,128 SF (0.92 Acres)
Impervious Area: 35,697 SF (0.82 Acres)
Pervious Area: 4,431 SF (0.10 Acres)
Percent Impervious: 89%

DMA 14
Total Area: 44,153 SF (1.01 Acres)
Impervious Area: 28,880 SF (0.66 Acres)
Pervious Area: 15,273 SF (0.35 Acres)
Percent Impervious: 65%

DMA 15
Total Area: 3,049 SF (0.07 Acres)
Impervious Area: 3,049 SF (0.07 Acres)
Percent Impervious: 100%

DMA 16
Total Area: 341 SF (0.01 Acres)
Impervious Area: 341 SF (0.01 Acres)
Percent Impervious: 100%

DMA 17
Total Area: 12,337 SF (0.28 Acres)
Impervious Area: 110 SF (0.00 Acres)
Pervious Area: 12,227 SF (0.28 Acres)
Percent Impervious: 1%

DMA 18
Total Area: 21,405 SF (0.49 Acres)
Impervious Area: 1,131 SF (0.03 Acres)
Pervious Area: 20,274 SF (0.46 Acres)
Percent Impervious: 5%

4.3.3 DMA Summary

Drainage Management Areas				
DMA (Number/Description)	Total Area (acres)	Imperviousness (%)	Infiltration Feasibility Category (Full, Partial, or No Infiltration)	Hydrologic Source Controls Used
1	1.23	95	No Infiltration	N/A
2	1.05	95	No Infiltration	N/A
3	1.73	88	No Infiltration	N/A
4	0.20	54	No Infiltration	N/A
5	0.46	80	No Infiltration	N/A
6	0.48	95	No Infiltration	N/A
7	0.87	100	No Infiltration	N/A
8	1.38	98	No Infiltration	N/A
9	0.88	97	No Infiltration	N/A
10	0.99	97	No Infiltration	N/A
11	1.57	90	No Infiltration	N/A
12	1.96	90	No Infiltration	N/A
13	0.92	89	No Infiltration	N/A
14	1.01	65	No Infiltration	N/A
15	0.07	100	No Infiltration	N/A
16	0.01	100	No Infiltration	N/A
17	0.28	1	No Infiltration	N/A
18	0.49	5	No Infiltration	N/A

4.4 Source Control BMPs

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**Reason Source Control is Not Applicable**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Project does not contain hazardous substances.
N6	Local Industrial Permit Compliance	☐	☒	Not an Industrial Project.
N7	Spill Contingency Plan	☐	☒	Project does not contain hazardous substances.
N8	Underground Storage Tank Compliance	☐	☒	Project site does not have any UST's.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Project does not contain hazardous substances.
N10	Uniform Fire Code Implementation	☐	☒	Project does not contain hazardous substances.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☐	☒	Proposed project is residential.
N13	Housekeeping of Loading Docks	☐	☒	Project site does not have any loading docks.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Project site does not include a retail gasoline outlet.

(N1) Education

Educational materials for good housekeeping practices, this report, as well as other applicable stormwater BMP materials will be distributed by the owner and/or HOA to all employees and contractors that will perform any task affiliated with the BMPs mentioned within this report. Materials will be presented upon hire and materials review will be done annually.

(N2) Activity Restrictions

No outdoor storage shall be permitted.

No hosing down of any paved surfaces will occur where the result would be the flow of non-stormwater into the street or storm drains.
No dumping of any waste into drop inlets or catch basins.
No blowing or sweeping of debris such as leaf litter, grass clippings, miscellaneous litter, etc. into catch basins, area drains, or streets.
These and any other restrictions shall be adhered to daily.

(N3) Common Landscape Management

Maintenance shall include trimming, mowing, weeding, removal of litter, fertilizing, water conservation, and replacement of dead, diseased, or dying plants. Any plant materials shall be installed and maintained in a neat, vigorous, and healthy condition. Irrigation will be monitored to establish proper time of watering. Landscape waste will be properly disposed of. Any fertilizer or pesticides used will be done so sparingly, according to Federal, State, and County standards, and applied in accordance with the directions on the label. Landscape Management shall be performed on a monthly basis. Irrigation Management shall be done in accordance with the landscapes watering schedule. CASQA BMP SC-41

(N4) BMP Maintenance

BMP maintenance refers to the proper inspection and maintenance at specified frequencies of all Structural BMPs, Non-Structural BMPs, and Treatment Control BMPs mentioned within this report. Record of inspections and maintenances shall be made and kept on-site. BMP Maintenance shall be adhered to as required.

(N11) Common Area Litter Control

Routine maintenance shall consist of litter control throughout entire site, closing trash can lids, cleaning area around trash can, emptying trash containers throughout the site and inspecting and implementing the Best Management Practices. Common Area Litter Control shall be adhered to on a weekly basis. CASQA BMP SC-41 & SC-43

(N14) Common Area Catch Basin Inspection

Inspection shall be performed monthly and after every rain event. Catch basins shall be cleaned when sump is 40% full but at a minimum annually before the rainy season. Repair any damage to catch basins or drop inlets. CASQA BMP SC-44

(N15) Street Sweeping Private Streets and Parking Lots

Surface inspection of the parking area shall be performed on a monthly basis at a minimum. The private streets and parking lots shall be swept and cleaned monthly to prevent potential debris and pollutants from entering into the storm drain system. Hosing off streets and parking areas is prohibited. CASQA BMP SC-43

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**Reason Source Control is Not Applicable**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	Project does not have outdoor material storage areas.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☐	☒	Project does not have trash and waste storage areas.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Project does not have dock areas.
S7	Maintenance bays	☐	☒	Project does not have maintenance bays.
S8	Vehicle wash areas	☐	☒	Project does not have vehicle wash areas.
S9	Outdoor processing areas	☐	☒	Project does not have outdoor processing areas.
S10	Equipment wash areas	☐	☒	Project does not have equipment wash areas.
S11	Fueling areas	☐	☒	Project does not have fueling areas.
S12	Hillside landscaping	☒	☐	
S13	Wash water control for food preparation areas	☐	☒	Project does not have food preparation areas.
S14	Community car wash racks	☐	☒	Project does not have community car wash racks.

S1 Catch Basin Stenciling

The on-site proposed drop inlets will use City markers that state "No Dumping – Drains to Ocean." Inspection of drop inlet markers shall be done annually. Re-stenciling shall be done as needed, with a minimum frequency of every five years, to ensure legibility. CASQA BMP SD-13

S4 Use Efficient Irrigation Systems and Landscaping Design

Landscaping will consist of drought tolerant or native plants, grouped by similar irrigation needs. Any plant materials shall be installed and maintained in a neat, vigorous, and healthy condition. Irrigation will be monitored to establish proper time of watering. Rain shutoff devices and shut off valves/flow reducers will be used to prevent erosion, over watering, and prolong plant life. The irrigation system shall minimize excess irrigation and irrigation runoff throughout the project site. Landscaping and irrigation systems will be inspected monthly and maintained as needed. CASQA BMP SD-12

S5 Protect Slopes and Channels and Provide Energy Dissipation

Run-off descending toward the site from the eastern slope will be collected off-site by existing terrace drains and on-site at a new retaining wall within a new concrete ditch that flows to one of four drains. The drains connect to the storm drain system that directs the flows off-site. Retaining walls are located at the bottom of the 3:1 slope along the east property line, and at the top of 2:1 slopes along the north and west property lines. Disturbed slope areas will be vegetated with native or drought tolerant plants.

S12 Hillside Landscaping

Vegetation planted along hillside areas will provide adequate soil cover and have limited irrigation needs. Planting material will consist of native or drought tolerant species.

Section 5 Low Impact Development BMPs

5.1 LID BMPs in DMAs 1-18

Due to the geotechnical risks, topography, and deficiency in suitable space for LID BMPs, compact biofiltration utilizing Modular Wetland Systems was determined to be used as the LID BMPs in DMAs 1-14. DMAs 15 and 16 will not have any LID BMPs and are considered de-minimus areas. DMA 15 is a ribbon gutter used to collect run-on from the hill and route the stormwater around the site. DMA 16 is a portion of the southwesterly driveway that intersects with Rancho Viejo Road. This portion of roadway is unable to be collected and treated due to the need for matching the existing roadway topography. DMAs 17 and 18 are self-mitigating landscaped areas located along the westerly property line adjacent the right of way of Rancho Viejo Road. Self-mitigating landscaped areas will not be managed with the use of fertilizers or pesticides and are hydrologically disconnected from other DMAs.

5.1.1 Hydrologic Source Controls for DMA 1-18

No HSCs are proposed for the project.

5.1.2 Structural LID BMP for DMA 1-14

The LID BMP type selected to treat the project's DMAs (DMAs 1-14) is BIO-7: Proprietary Biotreatment without supplemental retention, specifically Modular Wetlands Systems. See BIO-7: Proprietary Biotreatment fact sheet, the Modular Wetland System's brochure, and Washington State TAPE approvals in Attachment C for additional information, requirements, design criteria, and pollution removal effectiveness.

The unit sizes of the Modular Wetland Systems for each DMA were determined using the Flow-Based Compact Biofiltration without Supplemental Retention Method (see Worksheet 9 in Attachment D) and the manufacturer's flow based sizing specifications (see Attachment C). Each unit is sized to handle 1.5 times the Design Flow Rate from the tributary area.

5.2 Summary of LID BMPs

See Attachment C for BMP Exhibit and the Modular Wetland Systems information, and Attachment D for calculations.

DMA SUMMARY

DMA DESIGNATION	BIO-7 BMP ID	TRIBUTARY AREA (SF)	Q80% (CFS)	Qdesign (CFS)	MODULAR WETLANDS SYSTEM MODEL	BIO-7 TREATED FLOW (CFS)
1	(A)	53,404	0.27	0.411	MWS-L-8-16	0.462
2	(B)	45,745	0.23	0.352	MWS-L-8-16	0.462
3	(C)	75,406	0.36	0.545	MWS-L-8-20	0.577
4	(D)	8,666	0.03	0.043	MWS-L-4-4	0.052
5	(E)	20,005	0.09	0.134	MWS-L-4-13	0.144
6	(F)	21,012	0.11	0.162	MWS-L-4-15	0.175
7	(G)	37,945	0.20	0.306	MWS-L-8-12	0.364
8	(H)	60,081	0.32	0.476	MWS-L-8-20	0.577
9	(J)	38,162	0.20	0.301	MWS-L-8-12	0.346
10	(K)	43,131	0.23	0.338	MWS-L-8-12	0.346
11	(L)	68,303	0.34	0.505	MWS-L-8-20	0.577
12	(M)	85,215	0.42	0.628	MWS-L-8-24	0.693
13	(N)	40,128	0.20	0.294	MWS-L-8-12	0.346
14	(P)	44,153	0.17	0.253	MWS-L-4-21	0.268

DMA DESIGNATION	TOTAL AREA (SF)	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS SURFACE TYPE (DE-MINIMUS AREAS ARE LOCATED ADJACENT THE RIGHT OF WAY AND PROPERTY LINE.)	BMP TYPE
15	3,049	3,049	0	CONCRETE GUTTER COLLECTING RUN-ON FROM HILLSIDE	DE-MINIMUS
16	341	341	0	PORTION OF DRIVEWAY	DE-MINIMUS
17	12,337	110	12,227	WALL	SELF-MITIGATING
18	21,405	1,131	20,274	WALL	SELF-MITIGATING

Section 6 Hydromodification BMPs

6.1 Points of Compliance

N/A

6.2 Pre-Development (Natural) Conditions

N/A

6.3 Post-Development Conditions and Hydromodification BMPs

N/A

6.4 Measures for Avoidance of Critical Coarse Sediment Yield Areas

N/A

6.5 Hydrologic Modeling and Hydromodification Compliance

N/A

Section 7 Educational Materials Index

Educational Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☒	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☒	Proper Maintenance Practices for Your Business	☐
Household Tips	☒	Compliance BMPs for Mobile Businesses	☐
Proper Disposal of Household Hazardous Waste	☒	**Other Material**	**Check If Attached**
Recycle at Your Local Used Oil Collection Center (North County)	☐		
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☒		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Projects Using Paint	☒		☐

Attachment A: Educational Materials

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, if we are not careful, our daily activities can lead directly to water pollution problems. Water that drains through your watershed can pick up pollutants which are then transported to our waterways and beautiful ocean.

You can prevent water pollution by taking personal action and by working with members of your watershed community to prevent urban runoff from entering your waterway.

For more information, please call the **Orange County Stormwater Program** at **1.877.89.SPILL** or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1.877.89.SPILL.**

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help protect your watershed. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Tips For Protecting Your Watershed

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Protecting Your Watershed

My Watershed. Our Ocean.

Water + shed, *noun: A region of land within which water flows down into a specified water body, such as a river, lake, sea, or ocean; a drainage basin or catchment basin.*

Orange County is comprised of 11 major watersheds into which most of our water flows, connecting all of Orange County to the Pacific Ocean.

As water from rain (stormwater) or sprinklers and hoses (urban runoff) runs down your driveway and into your neighborhood streets, sidewalks and gutters, it flows into storm drains that lead to waterways within your watershed. The waterways from other cities merge as they make their way through our watersheds until all the runoff water in Orange County meets at the Pacific Ocean. The water that reaches our ocean is not pure. As it flows through the watershed, it picks up pollutants such as litter, cigarette butts, fertilizer, pesticides, pet waste, motor oil and lawn clippings. Unlike water that enters the sewer (from sinks and toilets), water that enters the storm drain is not treated before it flows, ultimately, to the ocean.

Water quality can be improved by "Adopting Your Watershed." Through this effort, we are challenging citizens and organizations to join the Orange County Stormwater Program and others who are working to protect and restore our creeks, rivers, bays and ocean.

There are many opportunities to get involved:

- Appreciate your watershed - explore the creeks, trails and ocean and make observations about its conditions. If you see anything abnormal (such as dead fish, oil spills, leaking barrels, and other pollution) contact the Orange County 24-hour water pollution problem reporting hotline at 1.877.89.SPILL to report the problem.
- Research your watershed. Learn about what watershed you live in by visiting www.ocwatersheds.com.
- Find a watershed organization in your community and volunteer to help. If there are no active groups, consider starting your own.
- Visit EPA's Adopt Your Watershed's Catalog of Watershed Groups at www.epa.gov/adopt to locate groups in your community.
- Organize or join in a creek, river, bay or ocean cleanup event such as Coastal & Inner Coastal Cleanup Day that takes place the 3rd Saturday of every September. For more information visit www.coast4u.org.

Follow these simple tips to protect the water quality of your watershed:

- **Sweep up debris and dispose of it in the trash. Do not hose down driveways or sidewalks into the street or gutter.**
- **Use dry cleanup methods such as cat litter to absorb spills and sweep up residue.**
- **Set your irrigation systems to reflect seasonal water needs or use weather-based controllers. Inspect for runoff regularly.**
- **Cover trashcans securely.**
- **Take hazardous waste to a household hazardous waste collection center. (For example, paint, batteries and petroleum products)**
- **Pick up after your pet.**
- **Follow application and disposal directions for pesticides and fertilizers.**
- **If you wash your car at home, wash it on your lawn or divert the runoff onto a landscaped area. Consider taking your car to a commercial car wash, where the water is reclaimed or recycled.**
- **Keep your car well maintained.**
- **Never pour oil or antifreeze in the street, gutter or storm drain.**

The Ocean Begins at Your Front Door

Orange County Stormwater Program

Even if you live miles from the Pacific Ocean, you may be unknowingly polluting it.

Dumping one quart of motor oil into a storm drain can contaminate 250,000 gallons of water.

Did You Know?

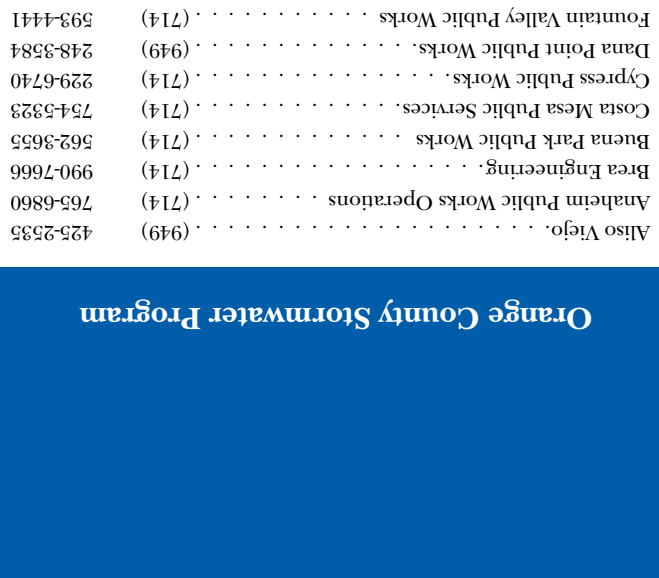
- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

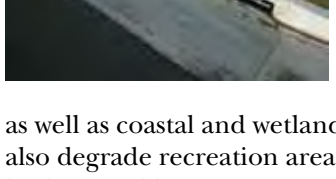
- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.



The Effect on the Ocean



Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

For More Information

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency’s Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

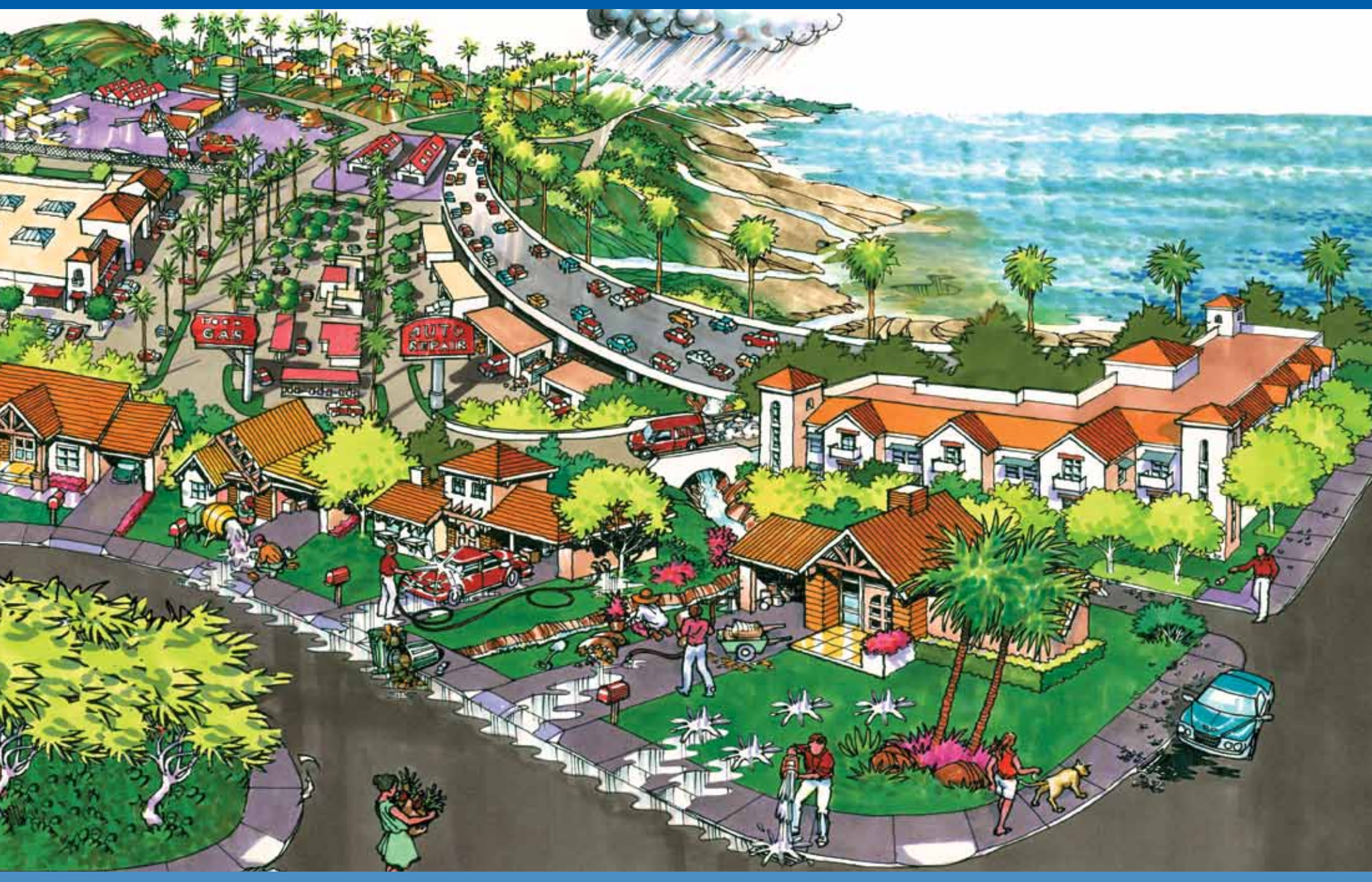
Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Printed on Recycled Paper

The Ocean Begins at Your Front Door



Never allow pollutants to enter the street, gutter or storm drain!

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance
- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden
- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile
- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, not properly disposing of used oil is illegal and can lead to fines. If you pour or drain oil onto driveways, sidewalks or streets, it can be washed into the storm drain.

Help prevent water pollution by taking your used oil and oil filters to a used oil collection center. Most major automotive maintenance centers will accept up to five gallons of used motor oil at no cost. For a list of locations, please visit www.cleanup.org.

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL (1-877-897-7455)** or visit **www.ocwatersheds.com.**

For information about the proper disposal of household hazardous waste, call the **Household Waste Hotline** at **1-877-89-SPILL (1-877-897-7455)** or visit **www.oclandfills.com.**

For additional information about the nearest oil recycling center, call the **Used Oil Program** at **1-800-CLEANUP** or visit **www.cleanup.org.**

RECYCLE USED OIL

emc/rev9/08

Help Prevent Ocean Pollution:

Tips for the Home Mechanic

PROJECT Pollution PREVENTION

The Ocean Begins at Your Front Door

Tips for the Home Mechanic

WORK SITE

- Locate the storm drains on or near your property. Do not allow used oil or any materials to flow into these drains.
- Examine your home for sources of pollution.
- Perform automotive projects under cover and in a controlled area to prevent stormwater runoff.
- Sweep or vacuum your automotive workspace regularly
- Use a damp mop to clean work areas. Never hose down surfaces into the street, gutter or storm drain.

- Pour mop water into a sink or toilet. Never dispose of water in a parking lot, street, gutter or storm drain.

PREVENT LEAKS AND SPILLS

- Keep absorbent materials such as rags and/or cat litter in the work area
- Empty drip pans into a labeled, seal container before they are full
- Wipe up any spills or repair leaks as they happen. Don't let them sit.
- Place large pans under any wrecked cars until all fluids are drained.
- Promptly dispose of collected fluids into a hazardous waste drum or deliver them to an oil recycling center. Used oil recycling locations can be found at http://www.ochealthinfo.com/regulatory/usedoil.htm

CLEANING SPILLS

- Clean up spills immediately by using absorbent material such as rags, cat litter or sand. If the material spilled is hazardous, dispose of the rag, litter or sand in the same manner as hazardous waste. If the material spill is non-hazardous, dispose of it in the trash.

- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at 1-877-89-SPILL (1-877-897-7455) or visit www.ocwatersheds.com to fill out an incident report.
- Report emergencies to 911.

VEHICLE FLUID MANAGEMENT

- Vehicle fluids are hazardous waste and must be stored and disposed of in accordance with all local, state and federal laws.
- Designate an area to drain vehicle fluids away from storm drains and sanitary drains.
- When possible, drain vehicle fluids indoors or within covered areas, and only over floors that are constructed of a non-porous material such as concrete. Asphalt and dirt floors absorb spilled or leaked fluids, making the cleanup extremely difficult.

PROJECT Pollution PREVENTION

The Pollution Solution

Several residential activities can result in water pollution. Among these activities are car washing and hosing off driveways and sidewalks. Both activities can waste water and result in excess runoff. Water conservation methods described in this pamphlet can prevent considerable amounts of runoff and conserve water. By taking your car to a commercial car wash and by sweeping driveways and sidewalks, you can further prevent the transport of pollutants to Orange County waterways. Here are some of the common pollutants for which you can be part of the solution:

1 Pesticides and Fertilizer

- **Pollution:** The same pesticides that are designed to be toxic to pests can have an equally lethal impact on our marine life. The same fertilizer that promotes plant growth in lawns and gardens can also create nuisance algae blooms, which remove oxygen from the water and clog waterways when it decomposes.
- **Solution:** Never use pesticides or fertilizer within 48 hours of an anticipated rainstorm. Use only as much as is directed on the label and keep it off driveways and sidewalks.

2 Dirt and Sediment

- **Pollution:** Dirt or sediment can impede the flow of the stormwater and negatively impact stream habitat as it travels through waterways and deposits downstream. Pollutants can attach to sediment, which can then be transported through our waterways.
- **Solution:** Protect dirt stockpiles by covering them with tarps or secure plastic sheets to prevent wind or rain from allowing dirt or sediment to enter the storm drain system.

3 Metals

- **Pollution:** Metals and other toxins present in car wash water can harm important plankton, which forms the base of the aquatic food chain.
- **Solution:** Take your car to a commercial car wash where the wash water is captured and treated at a local wastewater treatment plant.

DID YOU KNOW?

Did you know that most of the pollution found in our waterways is not from a single source, but from a "non-point" source meaning the accumulation of pollution from residents and businesses throughout the community

4 Pet Waste

- **Pollution:** Pet waste carries bacteria through our watersheds and eventually will be washed out to the ocean. This can pose a health risk to swimmers and surfers.
- **Solution:** Pick up after your pets!

5 Trash and Debris

- **Pollution:** Trash and debris can enter waterways by wind, littering and careless maintenance of trash receptacles. Street sweeping collects some of this trash; however, much of what isn't captured ends up in our storm drain system where it flows untreated out to the ocean.
- **Solution:** Don't litter and make sure trash containers are properly covered. It is far more expensive to clean up the litter and trash that ends up in our waterways than it is to prevent it in the first place. Come out to one of Orange County's many locations for Coastal and Inner-Coastal Cleanup Day, which is held in September.

6 Motor Oil / Vehicle Fluids

- **Pollution:** Oil and petroleum products from our vehicles are toxic to people, wildlife and plants.
- **Solution:** Fix any leaks from your vehicle and keep the maintenance up on your car. Use absorbent material such as cat litter on oil spills, then sweep it up and dispose of it in the trash. Recycle used motor oil at a local Household Hazardous Waste Collection Center.

A TEAM EFFORT

The Orange County Stormwater Program has teamed with the Municipal Water District of Orange County (MWDOC) and the University of California Cooperative Extension Program (UCCE) to develop this pamphlet.

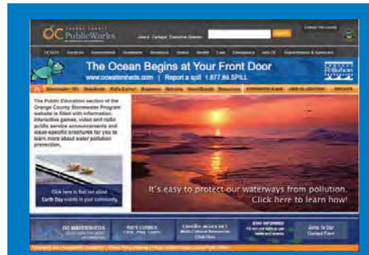
Low Impact Development (LID) and sustainable water use prevents water pollution and conserves water for drinking and reuse. Reducing your water use and the amount of water flowing from your home protects the environment and saves you money.

Thank you for making water protection a priority!

For more information, please visit
www.ocwatersheds.com/publiced/

www.mwdoc.com

www.uccemg.com



To report a spill, call the Orange County 24-Hour Water Pollution Prevention Reporting Hotline
at 1-877-89-SPILL \ (1-877-897-7455)

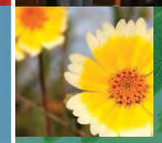
Special Thanks to
The City of Los Angeles Stormwater Program for the use of its artwork

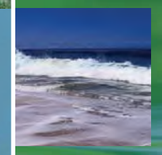
The Metropolitan Water District of Southern California for the use of the California-Friendly Plant and Native Habitat photos

Homeowners Guide for Sustainable Water Use

Low Impact Development, Water Conservation & Pollution Prevention

The Ocean Begins at Your Front Door





RUNOFF, RAINWATER AND REUSE

Where Does Water Runoff Go?

Stormwater, or water from rainfall events, and runoff from outdoor water use such as sprinklers and hoses flows from homes directly into catch basins and the storm drain system. After entering the storm drain, the water flows untreated into streams, rivers, bays and ultimately the Pacific Ocean. Runoff can come from lawns, gardens, driveways, sidewalks and roofs. As it flows over hard, impervious surfaces, it picks up pollutants. Some pollutants carried by the water runoff include trash, pet waste, pesticides, fertilizer, motor oil and more.

Water Conservation

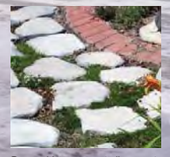
Pollution not only impairs the water quality for habitat and recreation, it can also reduce the water available for reuse. Runoff allowed to soak into the ground is cleaned as it percolates through the soil, replenishing depleted groundwater supplies. Groundwater provides at least 50% of the total water for drinking and other indoor household activities in north and central Orange County. When land is covered with roads, parking lots, homes, etc., there is less land to take in the water and more hard surfaces over which the water can flow.

In Orange County, 60-70% of water used by residents and businesses goes to irrigation and other outdoor uses. Reusing rainwater to irrigate our lawn not only reduces the impact of water pollution from runoff, but it also is a great way to conserve our precious water resources and replenish our groundwater basin.

What is Low Impact Development (LID)?

Low Impact Development (LID) is a method of development that seeks to maintain the natural hydrologic character of an area. LID provides a more sustainable and pollution-preventative approach to water management.

New water quality regulations require implementation of LID in larger new developments and encourage implementation of LID and other sustainable practices in existing residential areas. Implementing modifications to your lawn or garden can reduce pollution in our environment, conserve water and reduce your water bill.



Permeable pavement allows water runoff to infiltrate through the soil and prevents most pollutants from reaching the storm drain system.

OPTIONS FOR RAINWATER HARVESTING AND REUSE

Rainwater harvesting is a great way to save money, prevent pollution and reduce potable water use. To harvest your rainwater, simply redirect the runoff from roofs and downspouts to rain barrels. Rain gardens are another option; these reduce runoff as well as encourage infiltration.

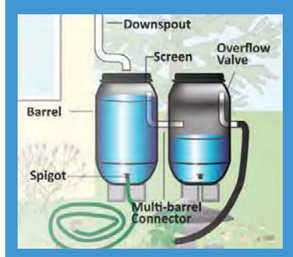
Downspout Disconnection/Redirection

Disconnecting downspouts from pipes running to the gutter prevents runoff from transporting pollutants to the storm drain. Once disconnected, downspouts can be redirected to rain gardens or other vegetated areas, or be connected to a rain barrel.

Rain Barrels

Rain barrels capture rainwater flow from roofs for reuse in landscape irrigation. Capacity of rain barrels needed for your home will depend on the amount of roof area and rainfall received. When purchasing your rain barrel, make sure it includes a screen, a spigot to siphon water for use, an overflow tube to allow for excess water to run out and a connector if you wish to connect multiple barrels to add capacity of water storage.

Mosquito growth prevention is very important when installing a rain barrel. The best way to prevent mosquito breeding is to eliminate entry points by ensuring all openings are sealed tightly. If these methods are unsuccessful, products are available to kill mosquito larvae, but that are harmless to animals and humans. Regular application of these products is essential. Please visit the Orange County Vector Control website for more information at www.ocvcd.org/mosquitoes3.php.



For information on how to disconnect a downspout or to install and maintain a rain barrel or rain garden at your home, please see the Los Angeles Rainwater Harvesting Program, A Homeowner's "How-To" Guide, November 2009 at www.larainwaterharvesting.org/

Rain Gardens

Rain gardens allow runoff to be directed from your roof downspout into a landscaped area. Vegetation and rocks in the garden will slow the flow of water to allow for infiltration into the soil. Plants and soil particles will absorb pollutants from the roof runoff. By utilizing a native plant palate, rain gardens can be maintained all year with minimal additional irrigation. These plants are adapted to the semi-arid climate of Southern California, require less water and can reduce your water bill.

Before modifying your yard to install a rain garden, please consult your local building and/or planning departments to ensure your garden plan follows pertinent building codes and ordinances. Besides codes and ordinances, some home owner associations also have guidelines for yard modifications. If your property is in hill areas or includes engineered slopes, please seek professional advice before proceeding with changes.

OTHER WATER CONSERVATION AND POLLUTION PREVENTION TECHNIQUES

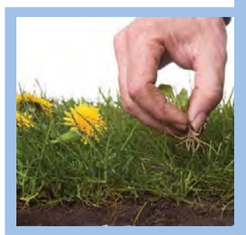
Native Vegetation and Maintenance

"California Friendly" plants or native vegetation can significantly reduce water use. These plants often require far less fertilizers and pesticides, which are two significant pollutants found in Orange County waterways. Replacing water "thirsty" plants and grass types with water efficient natives is a great way to save water and reduce the need for potentially harmful pesticides and fertilizer.

Please see the California Friendly Garden Guide produced by the Metropolitan Water District of Southern California and associated Southern California Water Agencies for a catalog of California friendly plants and other garden resources at www.bewaterwise.com/Gardensoft.

Weed Free Yards

Weeds are water thieves. They often reproduce quickly and rob your yard of both water and nutrients. Weed your yard by hand if possible. If you use herbicides to control the weeds, use only the amount recommended on the label and never use it if rain is forecast within the next 48 hours.



Soil Amendments

Soil amendments such as green waste (e.g. grass clippings, compost, etc.) can be a significant source of nutrients and can help keep the soil near the roots of plants moist. However, they can cause algal booms if they get into our waterways, which reduces the amount of oxygen in the water and impacts most aquatic organisms. It is important to apply soil amendments more than 48 hours prior to predicted rainfall.

IRRIGATE EFFICIENTLY

Smart Irrigation Controllers

Water runoff from sprinklers left on too long will carry pollutants into our waterways.

Smart Irrigation Controllers have internal clocks as well as sensors that will turn off the sprinklers in response to environmental changes. If it is raining, too windy or too cold, the smart irrigation control sprinklers will automatically shut off.

Check with your local water agency for available rebates on irrigation controllers and smart timers.

- Aim your sprinklers at your lawn, not the sidewalk – By simply adjusting the direction of your sprinklers you can save water, prevent water pollution from runoff, keep your lawn healthy and save money.
- **Set a timer for your sprinklers** – lawns absorb the water they need to stay healthy within a few minutes of turning on the sprinklers. Time your sprinklers; when water begins running off your lawn, you can turn them off. Your timer can be set to water your lawn for this duration every time.
- **Water at Sunrise** – Watering early in the morning will reduce water loss due to evaporation. Additionally, winds tend to die down in the early morning so the water will get to the lawn as intended.
- **Water by hand** – Instead of using sprinklers, consider watering your yard by hand. Hand-watering ensures that all plants get the proper amount of water and you will prevent any water runoff, which wastes water and carries pollutants into our waterways.
- **Fix leaks** - Nationwide, households waste one trillion gallons of water a year to leaks – that is enough water to serve the entire state of Texas for a year. If your garden hose is leaking, replace the nylon or rubber hose washer and ensure a tight connection. Fix broken sprinklers immediately.

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common household activities can lead to water pollution if you're not careful.

Remember the Water in Your Storm Drain is Not Treated BEFORE It Enters Our Waterways

Litter, oil, chemicals and other substances that are left on your yard or driveway can be blown or washed into storm drains that flow to the ocean. Over-watering your lawn and washing your car can also flush materials into the storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated.

You would never pour soap, fertilizers or oil into the ocean, so don't let them enter streets, gutters or storm drains. Follow the easy tips in this brochure to help prevent water pollution.

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline 1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

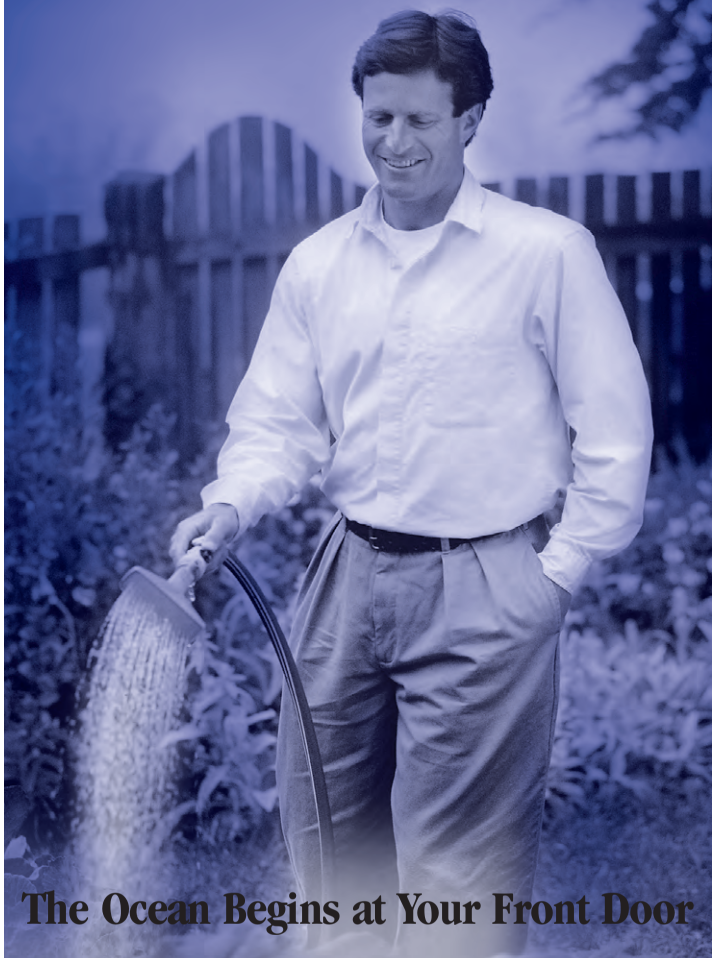
The tips contained in this brochure provide useful information to help prevent water pollution while performing everyday household activities. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

GENUINE RECYCLED PAPER
50% PRE-CONSUMER AND 15% POST-CONSUMER

RECYCLE USED OIL

Help Prevent Ocean Pollution:

Household Tips



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Pollution Prevention

Household Activities

- **Do not rinse spills with water!** Sweep outdoor spills and dispose of in the trash. For wet spills like oil, apply cat litter or another absorbent material, then sweep and bring to a household hazardous waste collection center (HHWCC).
- Securely cover trash cans.
- Take household hazardous waste to a household hazardous waste collection center.
- Store household hazardous waste in closed, labeled containers inside or under a cover.
- Do not hose down your driveway, sidewalk or patio. Sweep up debris and dispose of in trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of in the trash.
- Bathe pets indoors or have them professionally groomed.

Household Hazardous Wastes include:

- ▲ **Batteries**
- ▲ **Paint thinners, paint strippers and removers**
- ▲ **Adhesives**
- ▲ **Drain openers**
- ▲ **Oven cleaners**
- ▲ **Wood and metal cleaners and polishes**
- ▲ **Herbicides and pesticides**
- ▲ **Fungicides/wood preservatives**
- ▲ **Automotive fluids and products**
- ▲ **Grease and rust solvents**
- ▲ **Thermometers and other products containing mercury**
- ▲ **Fluorescent lamps**
- ▲ **Cathode ray tubes, e.g. TVs, computer monitors**
- ▲ **Pool and spa chemicals**

Gardening Activities

- Follow directions on pesticides and fertilizers, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Water your lawn and garden by hand to control the amount of water you use. Set irrigation systems to reflect seasonal water needs. If water flows off your yard and onto your driveway or sidewalk, your system is over-watering.
- Mulch clippings or leave them on the lawn. If necessary, dispose in a green waste container.
- Cultivate your garden often to control weeds.

Washing and Maintaining Your Car

- Take your car to a commercial car wash whenever possible.
- Choose soaps, cleaners, or detergents labeled "non-toxic," "phosphate free" or "biodegradable." Vegetable and citrus-based products are typically safest for the environment, **but even these should not be allowed into the storm drain.**
- Shake floor mats into a trash can or vacuum to clean.
- Do not use acid-based wheel cleaners and "hose off" engine degreasers at home. They can be used at a commercial facility, which can properly process the washwater.
- **Do not dump washwater onto your driveway, sidewalk, street, gutter or storm drain.** Excess washwater should be disposed of in the sanitary sewers (through a sink, or toilet) or onto an absorbent surface like your lawn.
- Use a nozzle to turn off water when not actively washing down automobile.
- Monitor vehicles for leaks and place pans under leaks. Keep your car well maintained to stop and prevent leaks.
- Use cat litter or other absorbents and sweep to remove any materials deposited by vehicles. Contain sweepings and dispose of at a HHWCC.
- Perform automobile repair and maintenance under a covered area and use drip pans or plastic sheeting to keep spills and waste material from reaching storm drains.
- **Never pour oil or antifreeze in the street, gutter or storm drains.** Recycle these substances at a service station, HHWCC, or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.ciwmb.ca.gov/UsedOil.

For locations and hours of Household Hazardous Waste Collection Centers in Anaheim, Huntington Beach, Irvine and San Juan Capistrano, call (714)834-6752 or visit www.oclandfills.com.

Do your part to prevent water pollution in our creeks, rivers, bays and ocean.

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, not properly disposing of household hazardous waste can lead to water pollution. Batteries, electronics, paint, oil, gardening chemicals, cleaners and other hazardous materials cannot be thrown in the trash. They also must never be poured or thrown into yards, sidewalks, driveways, gutters or streets. Rain or other water could wash the materials into the storm drain and eventually into our waterways and the ocean. In addition, hazardous waste must not be poured in the sanitary sewers (sinks and toilets).

NEVER DISPOSE OF HOUSEHOLD HAZARDOUS WASTE IN THE TRASH, STREET, GUTTER, STORM DRAIN OR SEWER.

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

To Report Illegal Dumping of Household Hazardous Waste call 1-800-69-TOXIC

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline 1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

RECYCLE USED OIL

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Proper Disposal of Household Hazardous Waste

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

ORANGE COUNTY

Pollution Prevention

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW." HHW can be found throughout your home, including the bathroom, kitchen, laundry room and garage.

WHEN POSSIBLE, USE NON-HAZARDOUS OR LESS-HAZARDOUS PRODUCTS.

Disposal of HHW down the drain, on the ground, into storm drains, or in the trash is illegal and unsafe.

Proper disposal of HHW is actually easy. Simply drop them off at a Household Hazardous Waste Collection Center (HHWCC) for free disposal and recycling. Many materials including anti-freeze, latex-based paint, motor oil and batteries can be recycled. Some centers have a "Stop & Swap" program that lets you take partially used home, garden, and automobile products free of charge. There are four HHWCCs in Orange County:

Anaheim:.....1071 N. Blue Gum St
Huntington Beach:.....17121 Nichols St
Irvine:.....6411 Oak Canyon
San Juan Capistrano:... 32250 La Pata Ave

Centers are open Tuesday-Saturday, 9 a.m.-3 p.m. Centers are closed on rainy days and major holidays. For more information, call **(714) 834-6752** or visit **www.oclandfills.com.**

Common household hazardous wastes

- Batteries
- Paint and paint products
- Adhesives
- Drain openers
- Household cleaning products
- Wood and metal cleaners and polishes
- Pesticides
- Fungicides/wood preservatives
- Automotive products (antifreeze, motor oil, fluids)
- Grease and rust solvents
- Fluorescent lamps
- Mercury (thermometers & thermostats)
- All forms of electronic waste including computers and microwaves
- Pool & spa chemicals
- Cleaners
- Medications
- Propane (camping & BBQ)
- Mercury-containing lamps
- Television & monitors (CRTs, flatscreens)

Tips for household hazardous waste

- Never dispose of HHW in the trash, street, gutter, storm drain or sewer.
- Keep these materials in closed, labeled containers and store materials indoors or under a cover.
- When possible, use non-hazardous products.
- Reuse products whenever possible or share with family and friends.
- Purchase only as much of a product as you'll need. Empty containers may be disposed of in the trash.
- HHW can be harmful to humans, pets and the environment. Report emergencies to 911.

Did you know that just one quart of oil can pollute 250,000 gallons of water?

A clean ocean and healthy creeks, rivers, bays and beaches are important to Orange County. However, not properly disposing of used oil can lead to water pollution. If you pour or drain oil onto driveways, sidewalks or streets, it can be washed into the storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering the ocean. Help prevent water pollution by taking your used oil to a used oil collection center.

Included in this brochure is a list of locations that will accept up to five gallons of used motor oil at no cost. Many also accept used oil filters. Please contact the facility before delivering your used oil. This listing of companies is for your reference and does not constitute a recommendation or endorsement of the company.

Please note that used oil filters may not be disposed of with regular household trash. They must be taken to a household hazardous waste collection or recycling center in Anaheim, Huntington Beach, Irvine or San Juan Capistrano. For information about these centers, visit www.oclandfills.com.

Please do not mix your oil with other substances!

For more information, please call the Orange County Stormwater Program at 1-877-89-SPILL (1-877-897-7455) or visit www.watersheds.com.

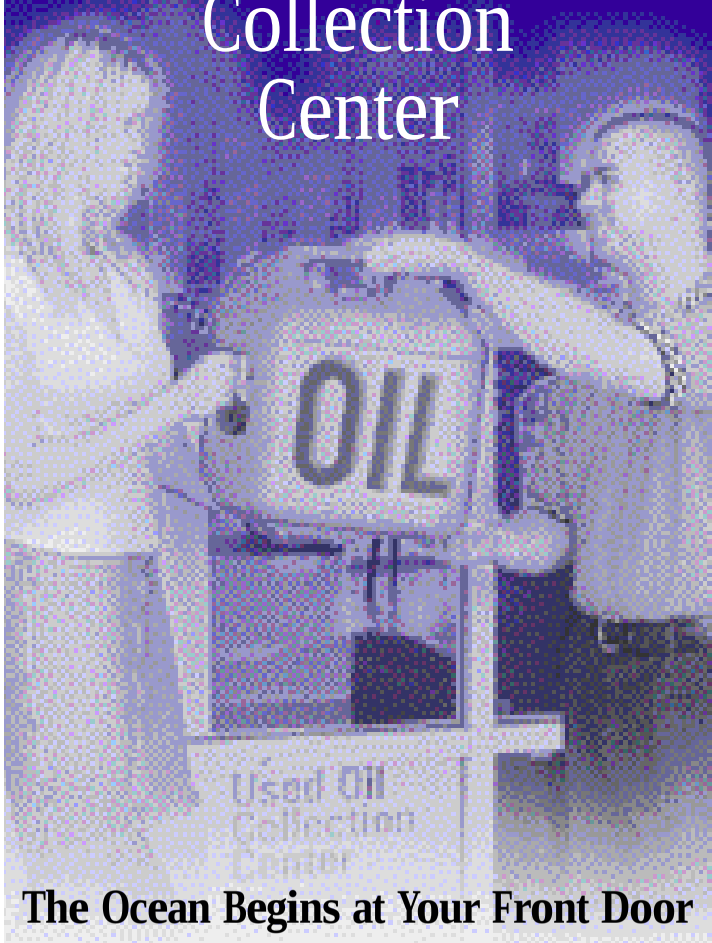
For information about the proper disposal of household hazardous waste, call the Household Waste Hotline at (714) 834-6752 or visit www.oclandfills.com.

RECYCLE USED OIL

For additional information about the nearest oil recycling center, call the Used Oil Program at 1-800-CLEANUP or visit www.cleanup.org.

Help Prevent Ocean Pollution:

Recycle at Your Local Used Oil Collection Center



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

SOUTH COUNTY

Used Oil Collection Centers

ALISO VIEJO

Big O Tires
27812 Aliso Creek Rd, Suite E-100
(949) 362-4225

Econo Lube N' Tune
22932 Glenwood Dr.
(949) 643-9667

Jiffy Lube
27832 Aliso Creek Road
(949) 362-0005

Pep Boys
26881 Aliso Creek Road
(949) 362-9254

DANA POINT

Dana Point Fuel Dock
34661 Puerto Pl. (949) 496-6113

EZ Lube Inc.
34242 Doheny Park Rd.
(949) 477-1223

FOOTHILL RANCH

USA Express Tire & Service
26492 Town Center Dr.
(714) 826-1001

LAGUNA BEACH

USA Express Tire & Service Inc.
350 Broadway (949) 494-7111

LAKE FOREST

Big O Tires
20742 Lake Forest Dr.
(949) 443-4155

EZ Lube
26731 Rancho Parkway
(949) 465-9912

Firestone Store
24421 Rockfield Blvd.
(949) 581-2660

Jiffy Lube
20781 Lake Forest Dr.
(949) 583-0470

Kragen Auto Parts
24601 Raymond Way
(949) 829-8292

Pep Boys
22671 Lake Forest Dr.
(949) 855-9593

Ryan's Foothill Ranch Transmission
20622 Pascal Way (949) 770-6888

USA Express Tire & Service
24561 Trabuco Rd (949) 454-8001

LAGUNA NIGUEL

Econo Lube N Tune
27912 Forbes Rd. (949) 364-5833

Laguna Niguel Auto Center
26042 Cape Dr. #12
(949) 582-2191

LAGUNA HILLS

David J Phillips Buick
24888 Alicia Pkwy.
(949) 831-0434

EZ Lube
24281 Moulton Pkwy.
(949) 830-9840

EZ Lube
26921 Moulton Pkwy.
(949) 751-3436

Kragen Auto Parts
26562 Moulton Ave.
(949) 831-0434

Firestone Store
24196 Laguna Hills Mall
(949) 581-4700

MISSION VIEJO

AAA Complete Auto Care & Tire
27913 Center Street
(949) 347-8200

Autobahn West
25800 Jeronimo Rd. Suite 401
(949) 770-2312

Auto Zone
22942 Los Alisos (949) 830-8181

Econo Lube & Tune
25902 El Paseo (949) 582-5483

Jiffy Lube
27240 La Paz Rd. (949) 455-0470

Kragen Auto Parts
24510 Alicia Pkwy. (949) 951-9175

Mission Viejo Chevron
27742 Crown Vly. Pkwy.
(949) 364-0137

Oilmax 10 Minute Lube
25800 Jeronimo Rd. #300
(949) 859-9271

Ramona Auto Service
27210 La Paz Rd. (949) 583-1233

RANCHO SANTA MARGARITA

Jiffy Lube
23401 Antonio Parkway
(949) 589-7447

SAN CLEMENTE

EZ Lube
525 Avenida Pico (949) 940-1850

Kragen Auto Parts
1113 S. El Camino Real
(949) 492-9850

Kragen Auto Parts
400 Camino de Estrella
(949) 240-9195

San Clemente Car Wash & Oil
1731 N. El Camino Real
(949) 847-4924

SAN JUAN CAPISTRANO

Saturn of San Juan Capistrano
33033 Camino Capistrano
(949) 248-5411

Texaco Xpress Lube
27201 Ortega Hwy.
(949) 489-8008

This information was provided by the County of Orange Integrated Waste Management Department and the California Integrated Waste Management Board (CIWMB).

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as pest control can lead to water pollution if you're not careful. Pesticide treatments must be planned and applied properly to ensure that pesticides do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pesticides into the ocean, so don't let it enter the storm drains. Pesticides can cause significant damage to our environment if used improperly. If you are thinking of using a pesticide to control a pest, there are some important things to consider.

For more information,
please call
University of California Cooperative
Extension Master Gardeners at
(714) 708-1646
or visit these Web sites:
www.uccemg.org
www.ipm.ucdavis.edu

For instructions on collecting a specimen sample visit the Orange County Agriculture Commissioner's website at:
http://www.ocagcomm.com/ser_lab.asp

To report a spill, call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
at 1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

Information From:
Cheryl Wilen, Area IPM Advisor; Darren Haver, Watershed Management Advisor; Mary Louise Flint, IPM Education and Publication Director; Pamela M. Geisel, Environmental Horticulture Advisor; Carolyn L. Unruh, University of California Cooperative Extension staff writer. Photos courtesy of the UC Statewide IPM Program and Darren Haver.

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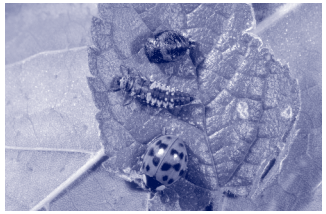
Help Prevent Ocean Pollution:

Responsible Pest Control

Tips for Pest Control

Key Steps to Follow:

Step 1: Correctly identify the pest (insect, weed, rodent, or disease) and verify that it is actually causing the problem.



Three life stages of the common lady beetle, a beneficial insect.

This is important because beneficial insects are often mistaken for pests and sprayed with pesticides needlessly.

Consult with a Certified Nursery Professional at a local nursery or garden center or send a sample of the pest to the Orange County Agricultural Commissioner's Office.

Determine if the pest is still present – even though you see damage, the pest may have left.

Step 2: Determine how many pests are present and causing damage.

Small pest populations may be controlled more safely using non-pesticide techniques. These include removing food sources, washing off leaves with a strong stream of water, blocking entry into the home using caulking and replacing problem plants with ones less susceptible to pests.

Integrated Pest Management (IPM) usually combines several least toxic pest control methods for long-term prevention and management of pest problems without harming you, your family, or the environment.

UC CE University of California Cooperative Extension

Step 3: If a pesticide must be used, choose the least toxic chemical.

Obtain information on the least toxic pesticides that are effective at controlling the target pest from the UC Statewide Integrated Pest Management (IPM) Program's Web site at www.ipm.ucdavis.edu.

Seek out the assistance of a Certified Nursery Professional at a local nursery or garden center when selecting a pesticide. Purchase the smallest amount of pesticide available.

Apply the pesticide to the pest during its most vulnerable life stage. This information can be found on the pesticide label.

Step 4: Wear appropriate protective clothing.

Follow pesticide labels regarding specific types of protective equipment you should wear. Protective clothing should always be washed separately from other clothing.

Step 5: Continuously monitor external conditions when applying pesticides such as weather, irrigation, and the presence of children and animals.

Never apply pesticides when rain is predicted within the next 48 hours. Also, do not water after applying pesticides unless the directions say it is necessary.

Apply pesticides when the air is still; breezy conditions may cause the spray or dust to drift away from your targeted area.

In case of an emergency call 911 and/or the regional poison control number at (714) 634-5988 or (800) 544-4404 (CA only).

For general questions you may also visit www.calpoison.org.

Step 6: In the event of accidental spills, sweep up or use an absorbent agent to remove any excess pesticides. Avoid the use of water.

Be prepared. Have a broom, dust pan, or dry absorbent material, such as cat litter, newspapers or paper towels, ready to assist in cleaning up spills.

Contain and clean up the spill right away. Place contaminated materials in a doubled plastic bag. All materials used to clean up the spill should be properly disposed of according to your local Household Hazardous Waste Disposal site.

Step 7: Properly store and dispose of unused pesticides.

Purchase Ready-To-Use (RTU) products to avoid storing large concentrated quantities of pesticides.

Store unused chemicals in a locked cabinet.

Unused pesticide chemicals may be disposed of at a Household Hazardous Waste Collection Center.

Empty pesticide containers should be triple rinsed prior to disposing of them in the trash.

Household Hazardous Waste Collection Center
(714) 834-6752
www.oclandfills.com

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Home improvement projects and work sites must be maintained to ensure that building materials do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump building materials into the ocean, so don't let them enter the storm drains. Follow these tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while performing home improvement projects. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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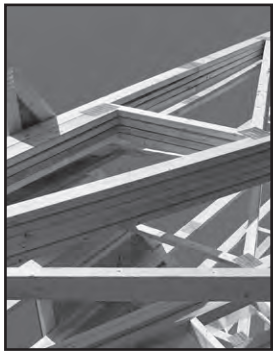
Help Prevent Ocean Pollution:

Tips for Home Improvement Projects

Tips for Home Improvement Projects

Home improvement projects can cause significant damage to the environment. Whether you hire a contractor or work on the house yourself, it is important to follow these simple tips while renovating, remodeling or improving your home:

General Construction



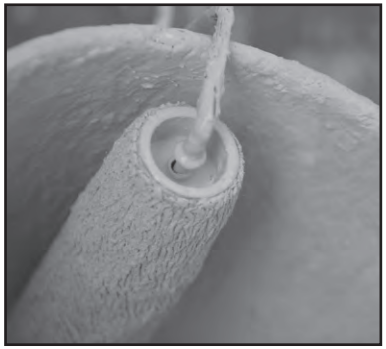
- Schedule projects for dry weather.
- Keep all construction debris away from the street, gutter and storm drain.
- Store materials under cover with temporary roofs or plastic sheets to eliminate or reduce the possibility that rainfall, runoff or wind will carry materials from the project site to the street, storm drain or adjacent properties.

Building Materials

- Never hose materials into a street, gutter or storm drain.
- Exposed piles of construction material should not be stored on the street or sidewalk.
- Minimize waste by ordering only the amount of materials needed to complete the job.
- Do not mix more fresh concrete than is needed for each project.
- Wash concrete mixers and equipment in a designated washout area where the water can flow into a containment area or onto dirt.
- Dispose of small amounts of dry excess materials in the trash. Powdery waste, such as dry concrete, must be properly contained within a box or bag prior to disposal. Call your local trash hauler for weight and size limits.

Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Place the lid on firmly and store the paint can upside-down in a dry location away from the elements.
- Tools such as brushes, buckets and rags should never be washed where excess water can drain into the street, gutter or storm drain. All tools should be rinsed in a sink connected to the sanitary sewer.
- When disposing of paint, never put wet paint in the trash.
- Dispose of water-based paint by removing the lid and letting it dry in the can. Large amounts must be taken to a Household Hazardous Waste Collection Center (HHWCC).



- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

Erosion Control

- Schedule grading and excavation projects for dry weather.
- When temporarily removing soil, pile it in a contained, covered area where it cannot spill into the street, or obtain the required temporary encroachment or street closure permit and follow the conditions instructed by the permit.
- When permanently removing large quantities of soil, a disposal location must be found prior to excavation. Numerous businesses are available to handle disposal needs. For disposal options, visit **www.ciwmb.ca.gov/SWIS**.
- Prevent erosion by planting fast-growing annual and perennial grasses. They will shield and bind the soil.

Recycle

- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry (bricks, concrete, etc.), carpet, plastic, pipes (plastic, metal and clay), drywall, rocks, dirt and green waste.

- For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**

Spills

- Clean up spills immediately by using an absorbent material such as cat litter, then sweep it up and dispose of it in the trash.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

UCCE Master Gardener Hotline:
(714) 708-1646

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Landscape & Gardening

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.

- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.

- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim:	1071 N. Blue Gum St.
Huntington Beach:	17121 Nichols St.
Irvine:	6411 Oak Canyon
San Juan Capistrano:	32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Pet waste and pet care products can be washed into the storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never put pet waste or pet care products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while caring for your pet. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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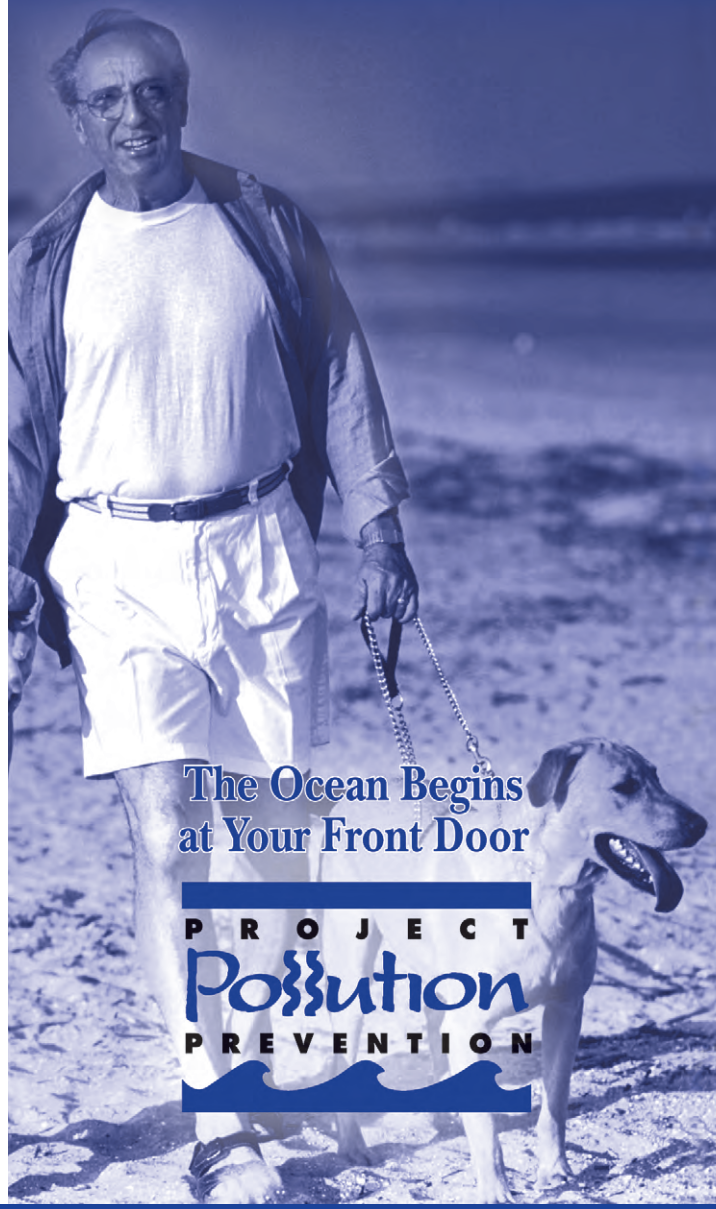
Help Prevent Ocean Pollution:

Tips for Pet Care



Tips for Pet Care

Never let any pet care products or washwater run off your yard and into the street, gutter or storm drain.

Washing Your Pets

Even biodegradable soaps and shampoos can be harmful to marine life and the environment.

- If possible, bathe your pets indoors using less-toxic shampoos or have your pet professionally groomed. Follow instructions on the products and clean up spills.

- If you bathe your pet outside, wash it on your lawn or another absorbent/ permeable surface to keep the washwater from running into the street, gutter or storm drain.

Flea Control

- Consider using oral or topical flea control products.

- If you use flea control products such as shampoos, sprays or collars, make sure to dispose of any unused products at a Household Hazardous Waste Collection Center. For location information, call **(714) 834-6752**.

Why You Should Pick Up After Your Pet

It's the law! Every city has an ordinance requiring you to pick up after your pet. Besides being a nuisance, pet waste can lead to water pollution, even if you live inland. During rainfall, pet waste left outdoors can wash into storm drains. This waste flows directly into our waterways and the ocean where it can harm human health, marine life and the environment.

As it decomposes, pet waste demands a high level of oxygen from water. This decomposition can contribute to killing marine life by reducing the amount of dissolved oxygen available to them.

Have fun with your pets, but please be a responsible pet owner by taking care of them and the environment.

- Take a bag with you on walks to pick up after your pet.

- Dispose of the waste in the trash or in a toilet.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as painting can lead to water pollution if you're not careful. Paint must be used, stored and disposed of properly to ensure that it does not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump paint into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while using, storing and disposing of paint. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Tips for Projects Using Paint

Tips for Projects Using Paint

Paint can cause significant damage to our environment. Whether you hire a contractor or do it yourself, it is important to follow these simple tips when purchasing, using, cleaning, storing and disposing of paint.

Purchasing Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Whenever possible, use water-based paint since it usually does not require hazardous solvents such as paint thinner for cleanup.

Painting

- Use only one brush or roller per color of paint to reduce the amount of water needed for cleaning.
- Place open paint containers or trays on a stable surface and in a position that is unlikely to spill.
- Always use a tarp under the area or object being painted to collect paint drips and contain spills.

Cleaning

- Never clean brushes or rinse paint containers in the street, gutter or storm drain.
- For oil-based products, use as much of the paint on the brushes as possible. Clean brushes with thinner. To reuse thinner, pour it through a fine filter (e.g. nylon, metal gauze or filter paper) to remove solids such as leftover traces of paint.
- For water-based products, use as much of the paint on the brushes as possible, then rinse in the sink.
- Collect all paint chips and dust. Chips and dust from marine paints or paints containing lead, mercury or tributyl tin are hazardous waste. Sweep up and dispose of at a Household Hazardous Waste Collection Center (HHWCC).

Storing Paint

- Store paint in a dry location away from the elements.
- Store leftover water-based paint, oil-based paint and solvents separately in original or clearly marked containers.
- Avoid storing paint cans directly on cement floors. The bottom of the can will rust much faster on cement.
- Place the lid on firmly and store the paint can upside-down to prevent air from entering. This will keep the paint usable longer. Oil-based paint is usable for up to 15 years. Water-based paint remains usable for up to 10 years.

Alternatives to Disposal

- Use excess paint to apply another coat, for touch-ups, or to paint a closet, garage, basement or attic.
- Give extra paint to friends or family. Extra paint can also be donated to a local theatre group, low-income housing program or school.
- Take extra paint to an exchange program such as the **"Stop & Swap"** that allows you to drop off or pick up partially used home care products free of charge. **"Stop & Swap"** programs are available at most HHWCCs.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.

Disposing of Paint

- Never put wet paint in the trash.

For water-based paint:

- If possible, brush the leftover paint on cardboard or newspaper. Otherwise, allow the paint to dry in the can with the lid off in a well-ventilated area protected from the elements, children and pets. Stirring the paint every few days will speed up the drying.
- Large quantities of extra paint should be taken to a HHWCC.
- Once dried, paint and painted surfaces may be disposed of in the trash. When setting a dried paint can out for trash collection, leave the lid off so the collector will see that the paint has dried.

For oil-based paint:

- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.

Aerosol paint:

- Dispose of aerosol paint cans at a HHWCC.

Spills

- Never hose down pavement or other impermeable surfaces where paint has spilled.
- Clean up spills immediately by using an absorbent material such as cat litter. Cat litter used to clean water-based paint spills can be disposed of in the trash. When cleaning oil-based paint spills with cat litter, it must be taken to a HHWCC.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

PROJECT Pollution PREVENTION

Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Swimming pools and spas are common in Orange County, but they must be maintained properly to guarantee that chemicals aren't allowed to enter the street, where they can flow into the storm drains and then into the waterways. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pool chemicals into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

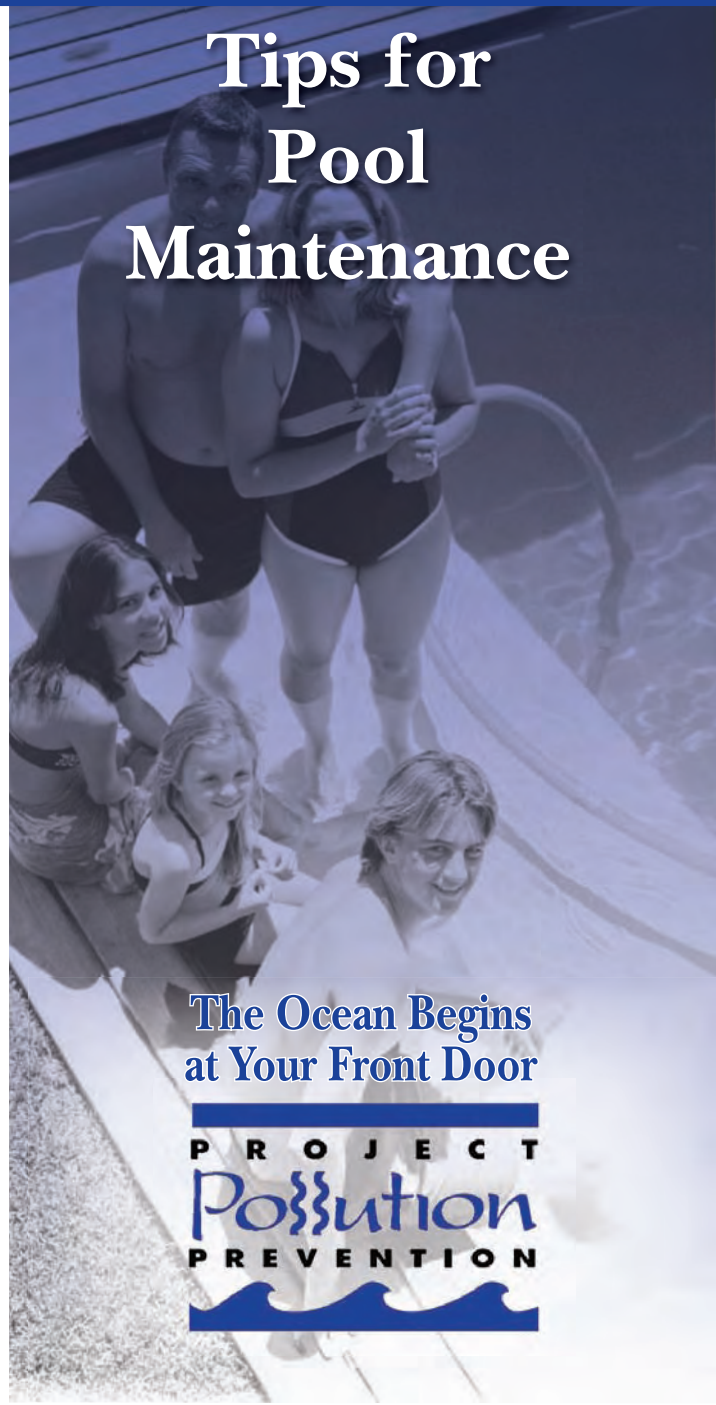
To report a spill,
call the
Orange County 24-Hour
Water Pollution Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while maintaining your pool. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Help Prevent Ocean Pollution:

Tips for Pool Maintenance



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Pool Maintenance

Many pools are plumbed to allow the pool to drain directly to the sanitary sewer. If yours is not, follow these instructions for disposing of pool and spa water.

Acceptable and Preferred Method of Disposal

When you cannot dispose of pool water in the sanitary sewer, the release of dechlorinated swimming pool water is allowed if all of these tips are followed:

- The residual chlorine does not exceed 0.1 mg/l (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration, dirt or algae.
- There is no discharge of filter media.
- There is no discharge of acid cleaning wastes.
- Some cities may have ordinances that do not allow pool water to be disposed into a storm drain. Check with your city.

How to Know if You're Following the Standards

You can find out how much chlorine is in your water by using a pool testing kit. Excess chlorine can be removed by discontinuing the use of chlorine for a few days prior to discharge or by purchasing dechlorinating chemicals from a local pool supply company. Always make sure to follow the instructions that come with any products you use.

Doing Your Part

By complying with these guidelines, you will make a significant contribution toward keeping pollutants out of Orange County's creeks, streams, rivers, bays and the ocean. This helps to protect organisms that are sensitive to pool chemicals, and helps to maintain the health of our environment.

PROJECT Pollution PREVENTION

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

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For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Residential Pool, Landscape and Hardscape Drains

The Ocean Begins at Your Front Door

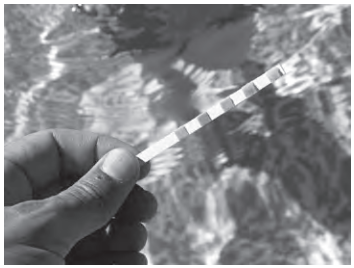
PROJECT Pollution PREVENTION

Tips for Residential Pool, Landscape and Hardscape Drains

Pool Maintenance

All pool water discharged to the curb, gutter or permitted pool drain from your property must meet the following water quality criteria:

- The residual chlorine does not exceed 0.1 mg/L (parts per million).
- The pH is between 6.5 and 8.5.
- The water is free of any unusual coloration.
- There is no discharge of filter media or acid cleaning wastes.



Some cities have ordinances that do not allow pool water to be discharged to the storm drain. Check with your city.

Landscape and Hardscape Drains

The following recommendations will help reduce or prevent pollutants from your landscape and hardscape drains from entering the street, gutter or storm drain. Unlike water that enters the sewer (from sinks and toilets), water that enters a landscape or hardscape drain is not treated before entering our creeks, rivers, bays and ocean.

Household Activities

- Do not rinse spills of materials or chemicals to any drain.
- Use dry cleanup methods such as applying cat litter or another absorbent material, then sweep it up and dispose of it in the trash. If the material is hazardous, dispose of it at a Household Hazardous Waste Collection Center (HHWCC). For locations, call **(714) 834-6752** or visit **www.oclandfills.com**.
- Do not hose down your driveways, sidewalks or patios to your landscape or hardscape drain. Sweep up debris and dispose of it in the trash.
- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash.
- Do not store items such as cleaners, batteries, automotive fluids, paint products, TVs, or computer monitors uncovered outdoors. Take them to a HHWCC for disposal.

Yard Maintenance

- Do not overwater. Water by hand or set automated irrigation systems to reflect seasonal water needs.
- Follow directions on pesticides and fertilizers (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Cultivate your garden often to control weeds and reduce the need to use chemicals.

Vehicle Maintenance

- Never pour oil or antifreeze down your landscape or hardscape drain. Recycle these substances at a service station, a waste collection center or used oil recycling center. For locations, contact the Used Oil Program at **1-800-CLEANUP** or visit **www.CLEANUP.org**.
- Whenever possible, take your vehicle to a commercial car wash.
- If you do wash your vehicle at home, do not allow the washwater to go down your landscape or hardscape drain. Instead, dispose of it in the sanitary sewer (a sink or toilet) or onto an absorbent surface such as your lawn.
- Use a spray nozzle that will shut off the water when not in use.

Efficient Irrigation SD-12

Design Objectives

- ✓ Maximize Infiltration
- ✓ Provide Retention
- ✓ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

CASQA California Stormwater Quality Association

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ✓ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING –

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DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

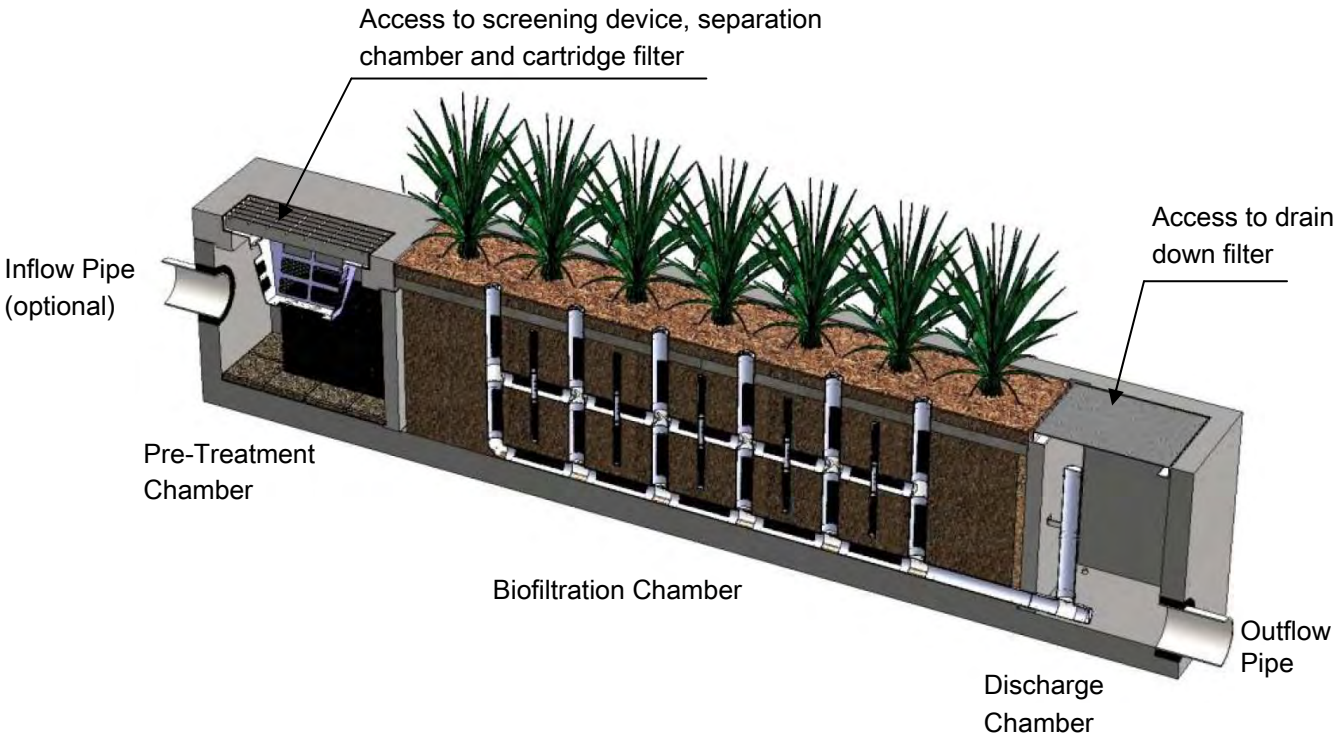
Attachment B: Operations and Maintenance Plan

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

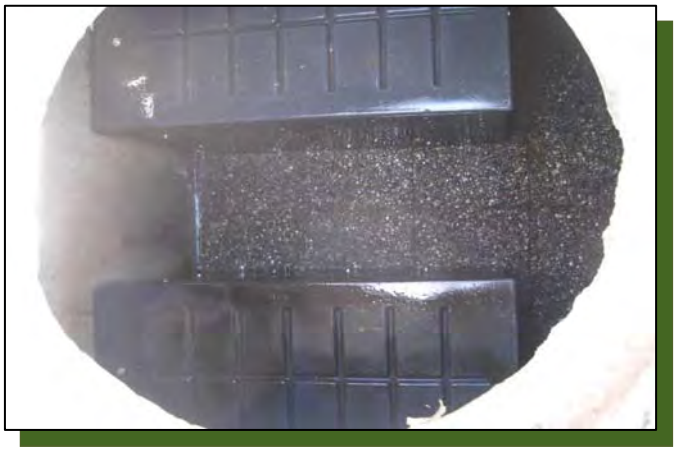
The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ___/___/___ Time _____ AM / PM

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

2972 San Luis Rey Road, Oceanside, CA 92058 P (760) 433-7640 F (760) 433-3176

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

Attachment C: Site Plans/BMP Information

SITE INFORMATION

TOTAL AREA:	678,489 S.F. (15.57 ACRES)
IMPERVIOUS AREA:	583,618 S.F. (13.40 ACRES)
PERVIOUS AREA:	94,871 S.F. (2.18 ACRES)
d:	0.825 INCHES
IMPERVIOUS %:	86%
c:	0.795
DCV:	37,058 CUBIC FEET
Q:	4.830 CUBIC FEET PER SECOND

MWS TREATED AREA

TOTAL AREA:	641,356 S.F. (14.72 ACRES)
IMPERVIOUS AREA:	578,987 S.F. (13.29 ACRES)
PERVIOUS AREA:	62,369 S.F. (1.43 ACRES)

DE-MINIMUS AREA

TOTAL AREA:	3,390 S.F. (0.08 ACRES)
PERIMETER GUTTER:	3,049 S.F. (0.07 ACRES)
DRIVEWAY:	341 S.F. (0.01 ACRES)

SELF-MITIGATING AREA

TOTAL AREA:	33,742 S.F. (0.77 ACRES)
PERIMETER LANDSCAPING:	32,502 S.F. (0.75 ACRES)
PERIMETER WALL:	1,241 S.F. (0.03 ACRES)

AREAS

EXISTING PARCEL 1 AREA:	667,103 S.F. (15.32 A.C.)
PROPOSED PARCEL 1 AREA:	678,489 S.F. (15.57 A.C.)
EXISTING REMAINDER PARCEL OF PM 83-861:	68,057 S.F. (1.56 A.C.)
PROPOSED REMAINDER PARCEL OF PM 83-861:	55,783 S.F. (1.28 A.C.)
PROPOSED NUMBERED LOTS:	109
CONDOMINIUM LOT:	160,022 S.F.
SINGLE FAMILY RESIDENTIAL LOTS:	252,172 S.F.
STREET VACATION (ADDED TO SUBDIVISION):	11,407 S.F.
CITY DEDICATIONS (PROPOSED SUBDIVISION):	21 S.F.
CITY DEDICATIONS (REMAINDER PARCEL):	12,274 S.F.

LEGEND

LANDSCAPING (TO MWS)

LANDSCAPING (SELF-MITIGATING)

HARDSCAPE (DE-MINIMUS)

DMA BOUNDARY

DMA # / DMA AREA (0.00AC)

BMP ID (MODULAR WETLANDS SYSTEM) (#)

GENERAL NOTES

EXISTING ZONE DISTRICT:	"IP" INDUSTRIAL PARK DISTRICT
EXISTING PARCELS:	PLANNED COMMUNITY
PROPOSED NUMBERED LOTS:	SINGLE & MULTI-FAMILY RESIDENTIAL
LOT 1 AND 109:	PROPOSED CONDOMINIUMS (INCLUDING 81 UNITS)
LOT 2 THROUGH 108:	SINGLE FAMILY RESIDENTIAL
ASSESSORS PARCEL NUMBER:	650-111-15

OWNERSHIP:

SA COSMAN & DAMIAN, LLC, A DELAWARE LIMITED LIABILITY COMPANY
4030 BIRCH STREET -SUITE 100
NEWPORT BEACH, CALIFORNIA 92660

CIVIL ENGINEER:

KHR ASSOCIATES
17530 VON KARMAN AVENUE -SUITE 200
IRVINE, CALIFORNIA 92614
ATTN. JAMES H. KAWAMURA, R.C.E. NO 30560
PHONE NO. (949) 756-6440

SUBDIVIDER

INTEGRAL COMMUNITIES
888 SAN CLEMENTE -SUITE 100
NEWPORT BEACH CALIFORNIA 92660
ATTN. ERIK WEEKS
PHONE NO. (949) 720-3612

DMA SUMMARY

DMA DESIGNATION	BIO-7 BMP ID	TRIBUTARY AREA (SF)	Q80% (CFS)	Qdesign (CFS)	MODULAR WETLANDS SYSTEM MODEL	BIO-7 TREATED FLOW (CFS)
1	A	53,404	0.27	0.411	MWS-L-8-16	0.462
2	B	45,745	0.23	0.352	MWS-L-8-16	0.462
3	C	75,406	0.36	0.545	MWS-L-8-20	0.577
4	D	8,666	0.03	0.043	MWS-L-4-4	0.052
5	E	20,005	0.09	0.134	MWS-L-4-13	0.144
6	F	21,012	0.11	0.162	MWS-L-4-15	0.175
7	G	37,945	0.20	0.306	MWS-L-8-12	0.364
8	H	60,081	0.32	0.476	MWS-L-8-20	0.577
9	J	38,162	0.20	0.301	MWS-L-8-12	0.346
10	K	43,131	0.23	0.338	MWS-L-8-12	0.346
11	L	68,303	0.34	0.505	MWS-L-8-20	0.577
12	M	85,215	0.42	0.628	MWS-L-8-24	0.693
13	N	40,128	0.20	0.294	MWS-L-8-12	0.346
14	P	44,153	0.17	0.253	MWS-L-4-21	0.268

DMA DESIGNATION	TOTAL AREA (SF)	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS SURFACE TYPE (DE-MINIMUS AREAS ARE LOCATED ADJACENT THE RIGHT OF WAY AND PROPERTY LINE.)	BMP TYPE
15	3,049	3,049	0	CONCRETE GUTTER COLLECTING RUN-ON FROM HILLSIDE	DE-MINIMUS
16	341	341	0	PORTION OF DRIVEWAY	DE-MINIMUS
17	12,337	110	12,227	WALL	SELF-MITIGATING
18	21,405	1,131	20,274	WALL	SELF-MITIGATING

DETAIL "A"
SCALE: 1"=50'

REGISTERED PROFESSIONAL ENGINEER JAMES H. KAWAMURA No. 30560 Expiration: 03/31/22 CIVIL STATE OF CALIFORNIA

0 25 50 100 150
SCALE: 1"=50' DATE: 4/8/20

BMP EXHIBIT

FOR SUBDIVISION & CONDOMINIUM PURPOSES

(PROPOSED SITE PLAN) CREEKSIDE

SAN JUAN CAPISTRANO, CALIFORNIA

PREPARED BY:
KHR ASSOCIATES
CONSULTING ENGINEERS/SURVEYORS/PLANNERS
17530 Von Karman Avenue - Suite 200 Irvine, California 92614
(949) 756-6440

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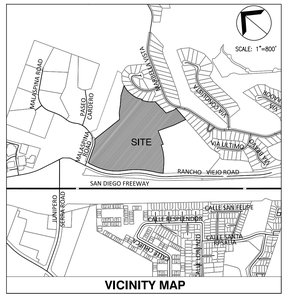
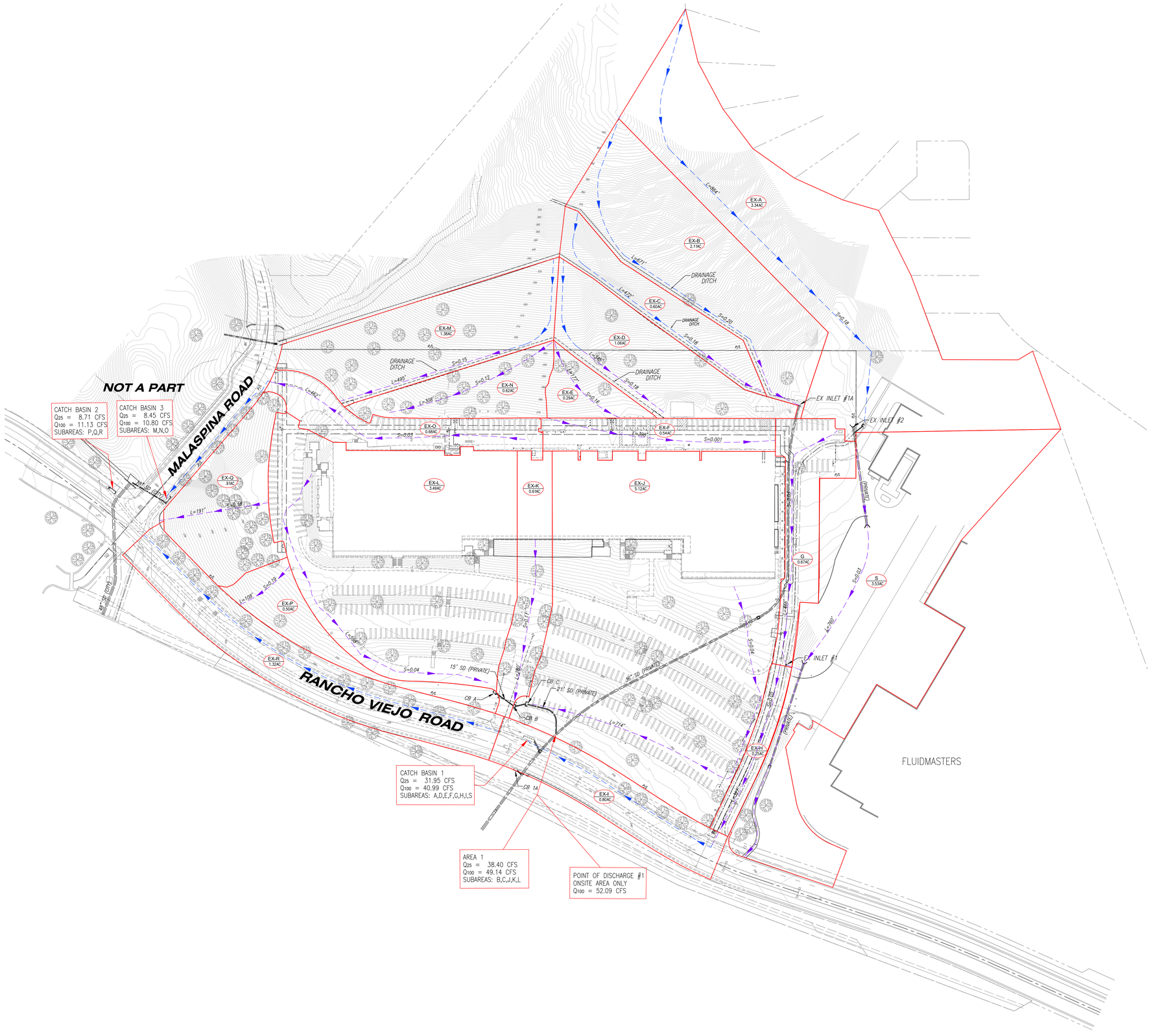


VICINITY MAP



LEGEND

- SUBAREA BOUNDARY
- SURFACE FLOW PATH ONSITE
- SURFACE FLOW PATH OFFSITE
- X / X.XXAC — SUBAREA LABEL
- Q_{25} = XX.XCFS, T_c = X.XMIN — RUNOFF, TIME OF CONCENTRATION

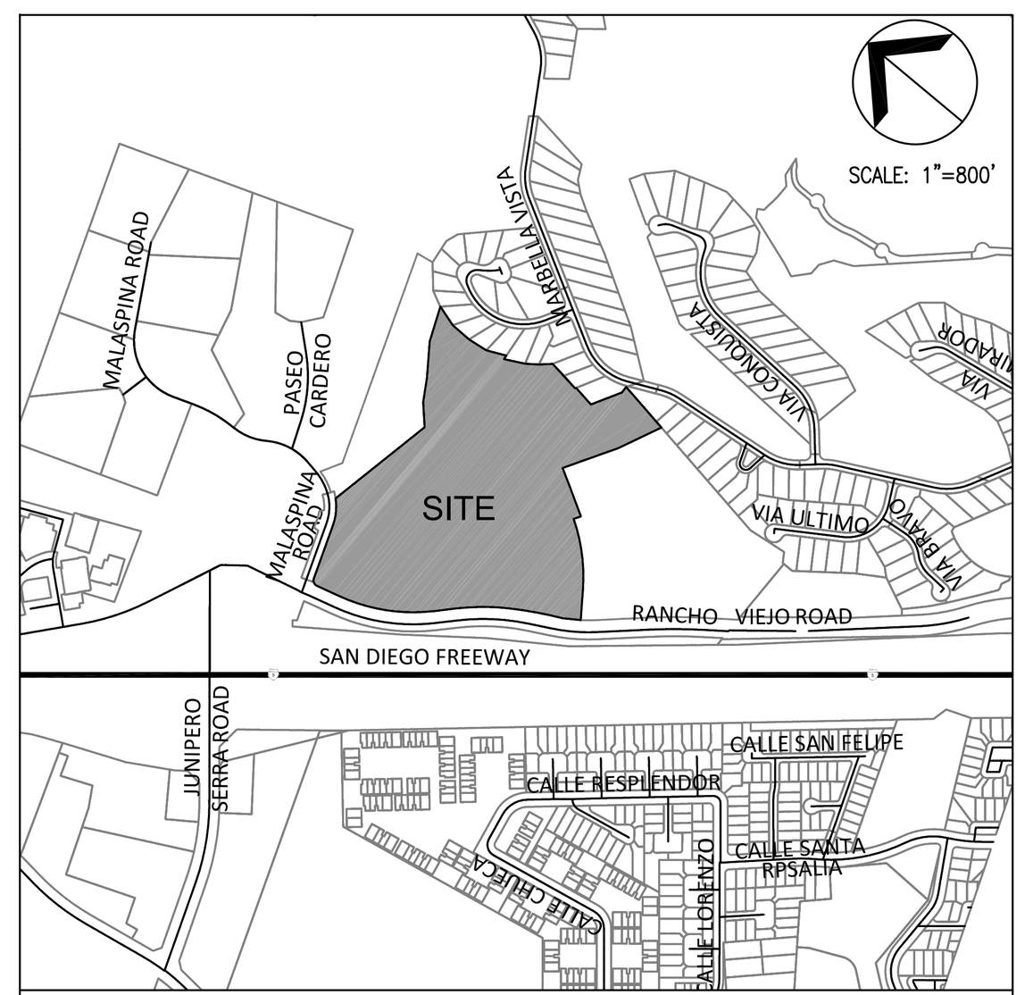
0 30 60 120 180

SCALE: 1"=60' DATE: 02/27/20

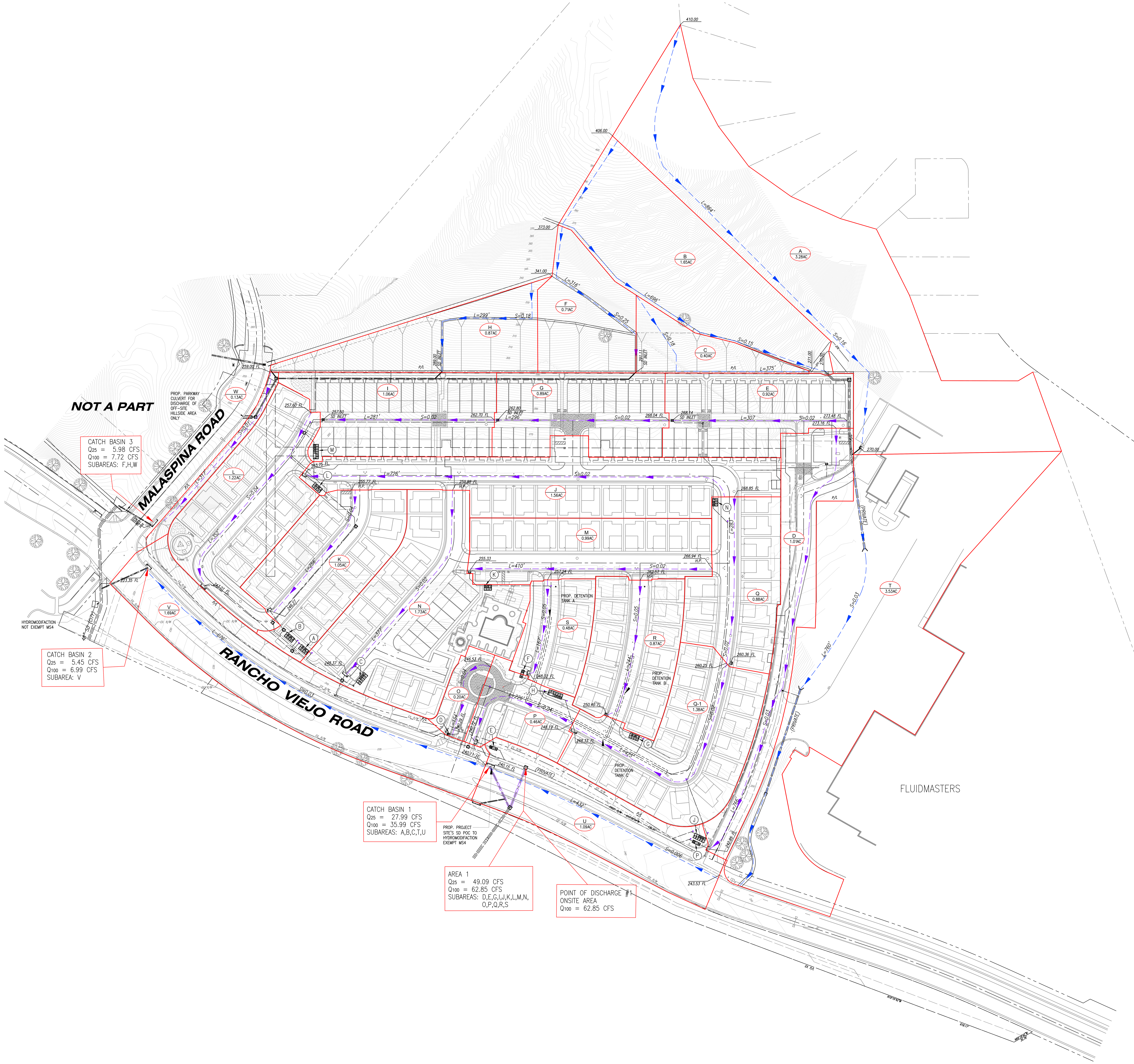
30700 RANCHO VIEJO ROAD

INTEGRAL COMMUNITIES — **EXISTING DRAINAGE PLAN** — **SAN JUAN CAPISTRANO , CALIFORNIA**

KHR ASSOCIATES
CONSULTING ENGINEERS/SURVEYORS/PLANNERS
17530 Von Karman Ave. - Suite 200 Tel (949) 756-6440
Irvine, California 92614



VICINITY MAP



MODULAR WETLAND SYSTEMS

DMA DESIGNATION	BIO-7 BMP ID	TRIBUTARY AREA (SF)	Q80% (CFS)	Qdesign (CFS)	MODULAR WETLANDS SYSTEM MODEL
1	A	53,404	0.27	0.411	MWS-L-8-16
2	B	45,745	0.23	0.352	MWS-L-8-16
3	C	75,406	0.36	0.545	MWS-L-8-20
4	D	8,666	0.03	0.043	MWS-L-4-4
5	E	20,005	0.09	0.134	MWS-L-4-13
6	F	21,012	0.11	0.162	MWS-L-4-15
7	G	37,945	0.20	0.306	MWS-L-8-12
8	H	60,081	0.32	0.476	MWS-L-8-20
9	J	38,162	0.20	0.301	MWS-L-8-12
10	K	43,131	0.23	0.338	MWS-L-8-12
11	L	68,303	0.34	0.505	MWS-L-8-20
12	M	85,215	0.42	0.628	MWS-L-8-24
13	N	40,128	0.20	0.294	MWS-L-8-12
14	P	44,153	0.17	0.253	MWS-L-4-21

LEGEND

- SUBAREA BOUNDARY
- SURFACE FLOW PATH ONSITE
- SURFACE FLOW PATH OFFSITE
- X / X.XXAC — SUBAREA LABEL
- Q_{25} = XXCFS, T_c = X.XMIN — RUNOFF, TIME OF CONCENTRATION
- (#) — BMP ID (MODULAR WETLANDS SYSTEM)

0 20 40 80 120

SCALE: 1"=60' DATE: 04/09/20

30700 RANCHO VIEJO ROAD

INTEGRAL COMMUNITIES **PROPOSED DRAINAGE PLAN** **SAN JUAN CAPISTRANO , CALIFORNIA**

KHR ASSOCIATES
CONSULTING ENGINEERS/SURVEYORS/PLANNERS
17530 Von Karman Ave. - Suite 200 Tel (949) 756-6440
Irvine, California 92614

BIO-7: PROPRIETARY BIOTREATMENT

The fact sheet for proprietary biotreatment without supplemental retention is included as part of BIO-5. This page is a placeholder to direct users to see BIO-5.

BIO-5/BIO-7: PROPRIETARY BIOTREATMENT

Category: Biotreatment with Partial Infiltration (when accompanied by supplemental retention)

Biotreatment with No Infiltration (when used without supplemental retention)

Proprietary biotreatment BMPs are proprietary devices that are manufactured to treat stormwater. **Acceptance criteria for proprietary biotreatment BMPs are defined in Appendix J**. Proprietary BMPs that do not meet these acceptance criteria are not permitted. In addition, proprietary biotreatment BMPs must meet the definition of biofiltration in order to be used as LID biotreatment BMPs. There are two configurations of proprietary biotreatment, as explained in the following subsections.

BIO-5: Proprietary Biotreatment with Enhanced Retention Configuration

As standalone systems, proprietary biotreatment BMPs typically provide negligible volume reduction. To be used as a "biotreatment BMP with partial infiltration," these BMPs must be accompanied by a retention compartment. This could consist of several options:

- Permeable pavement upstream of the proprietary BMPl
- Shallow infiltration gallery or chambers downstream of the BMP, connected to underdrains.
- Proprietary biotreatment downstream of a cistern for harvest and use.
- Use of adequate hydrologic source controls in the watershed to meet volume reduction targets (see Sizing section of this Fact Sheet).
- Other configurations that are determined to be appropriate to maximize the feasible volume reduction for the DMA.

Guidance for retention compartments is provided in other fact sheets, such as INF-5 (Permeable Pavement) and INF-6 (Underground Infiltration).

BIO-7: Standard Configuration without Supplemental Retention

For conditions that do not require partial infiltration, volume retention is not a performance goal. Acceptable proprietary biotreatment BMPs may be used as standalone systems. Guidance related to complementary retention can be disregarded.

Pollutant Removal Considerations

BMPs that meet the acceptance criteria in **Appendix J** are considered to provide adequate treatment for pollutants of concern. According to these critera, there are different levels of treatment certification needed for different pollutants of concern.

Recommended Design Criteria and Considerations

	Design Criteria	Intent/Rationale
☐	Sediment sources should be controlled prior to operation of the system.	Proprietary systems are susceptible to clogging similar to other BMPs. Systems should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.
☐	When accompanied by infiltration compartments, the ponding should not be higher than the underdrain elevation of the proprietary BMP.	This is intended to ensure that the complementary retention compartment does not reduce the hydraulic capacity of the proprietary biotreatment BMP.
☐	When accompanied by infiltration compartments, these infiltration BMPs must adhere to siting guidance found in the respective fact sheet for the BMP	Specific siting considerations apply to infiltration BMPs.
☐	Proprietary biotreatment systems typically do not require separate pretreatment	These BMPs typically include integrated mechanisms for pretreatment.
☐	Proprietary BMPs must be designed in a manner consistent with manufacturer recommendations and consistent with the design configuration that was tested as part of the BMP certification	Proprietary devices have device-specific design, installation, and maintenance details which must be followed for proper treatment results.
☐	In right of way areas, plant selection should not impair traffic sightlines or vehicle access.	Vegetation must not be prohibitive for typical vehicular movement and parking access needs.
☐	Manufacturer guidance on vegetation selection and establishment should be followed	Manufacturers have experience with plant survival in specific climates for the BMP-specific conditions.

Calculations and Sizing Method

Proprietary Biotreatment BMPs are flow-based BMPs. See **Appendix E** for acceptable sizing methods.

Supplemental retention elements (for BIO-5 configuration) should be sized for one of the following targets, where possible:

- Approximately 40 percent long term volume reduction.
- Retention storage provided for approximately one-third of the DCV.
- Infiltration footprint (collective of all infiltrating elements of the project design) meeting target defined in **Section E.4.2**.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Provide for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Sediment loading can seriously impair the capacity of the BMP.
☐ Allow plants and mulch to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify excess erosion or scour	
Identify sediment accumulation that requires maintenance	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Evaluate plant health and need for corrective action	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
• O&M of proprietary BMPs must follow established manufacturer guidelines • O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.	

Modular Wetlands System™ Linear

Biofiltration

Comprehensive Stormwater Solutions

Bio Clean
A Forterra Company

OVERVIEW

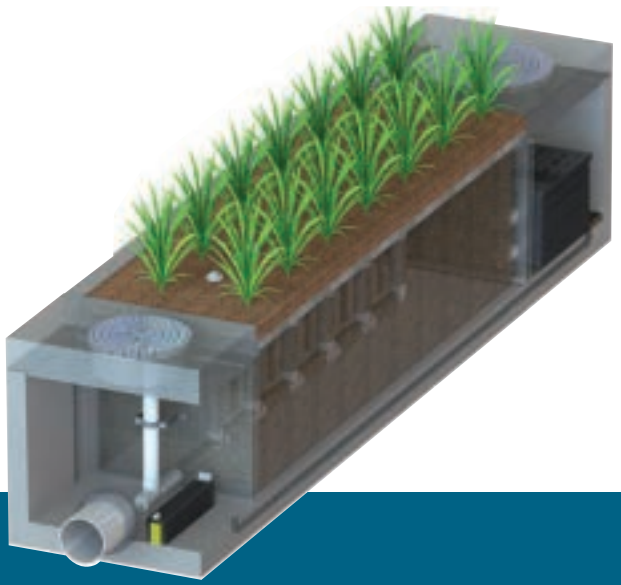
The Bio Clean Modular Wetlands System™ Linear (MWS Linear) represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pretreatment, the MWS Linear incorporates an advanced pretreatment chamber that includes separation and pre-filter cartridges. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, in turn reducing maintenance costs and improving performance.

The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.

Plant A Wetland

Without natural wetlands, our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate waterways in urban areas.



PERFORMANCE

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With its advanced pretreatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses nature's ability to process, transform, and remove even the most harmful pollutants.

66% REMOVAL OF DISSOLVED ZINC	**69%** REMOVAL OF TOTAL ZINC	**38%** REMOVAL OF DISSOLVED COPPER	**64%** REMOVAL OF TOTAL PHOSPHORUS
45% REMOVAL OF NITROGEN	**50%** REMOVAL OF TOTAL COPPER	**95%** REMOVAL OF MOTOR OIL	**67%** REMOVAL OF ORTHO PHOSPHORUS

85% REMOVAL OF TSS

APPROVALS

The MWS Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world.

WASHINGTON STATE TAPE APPROVED

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

DEQ ASSIGNMENT

The Virginia Department of Environmental Quality assigned the MWS Linear, the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) Regulation technical criteria.

MARYLAND DEPARTMENT OF THE ENVIRONMENT APPROVED

Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

MASTEP EVALUATION

The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

RHODE ISLAND DEM APPROVED

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

The MWS Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure 1 and Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

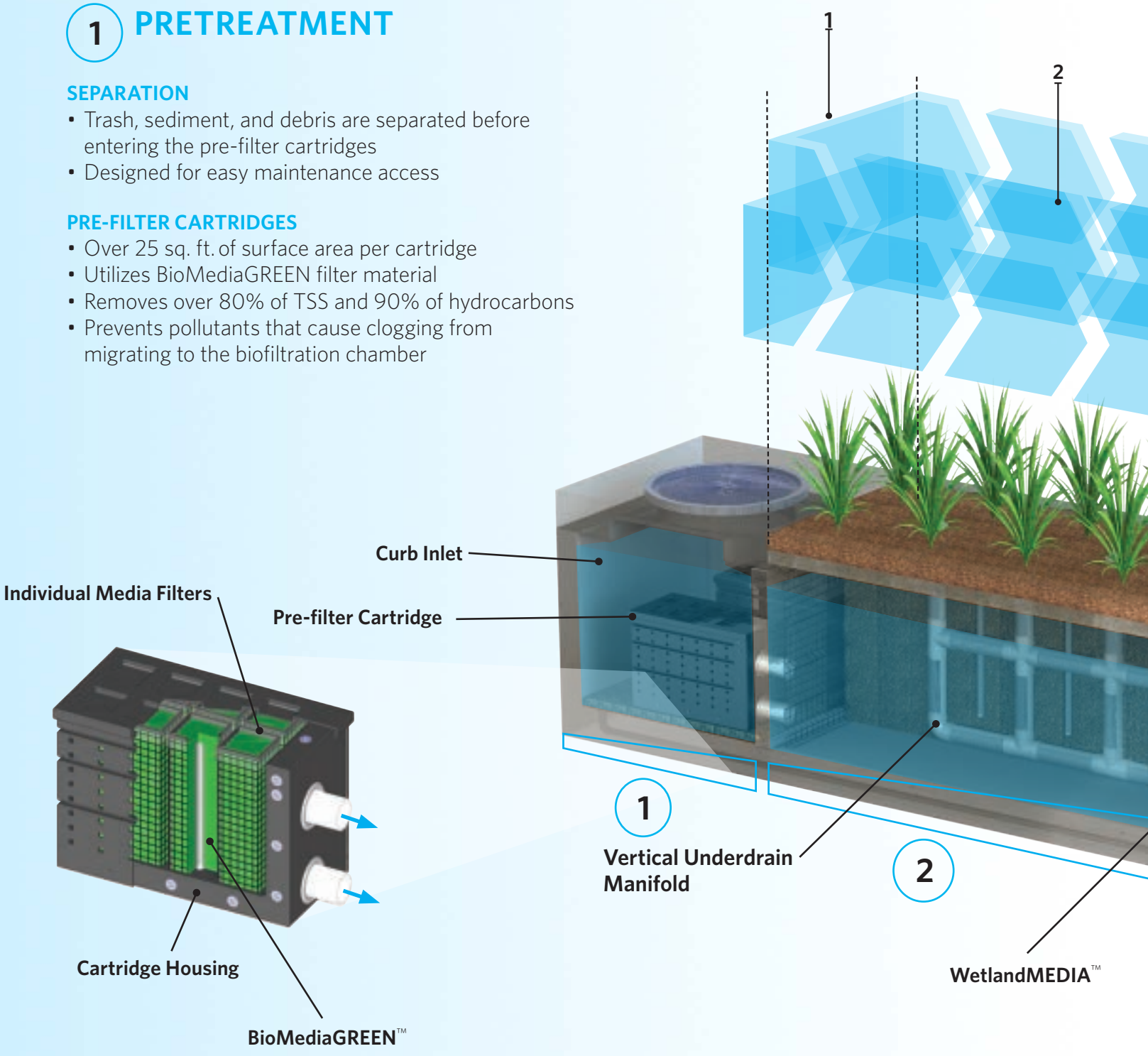
1 PRETREATMENT

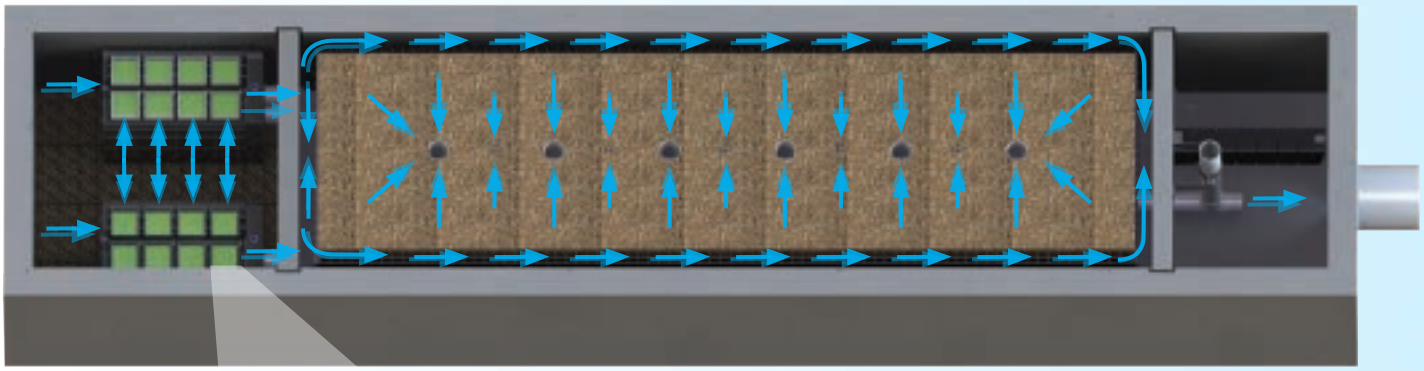
SEPARATION

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

PRE-FILTER CARTRIDGES

- Over 25 sq. ft. of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber





2x to 3x more surface area than traditional downward flow bioretention systems.

Figure 2, Top View

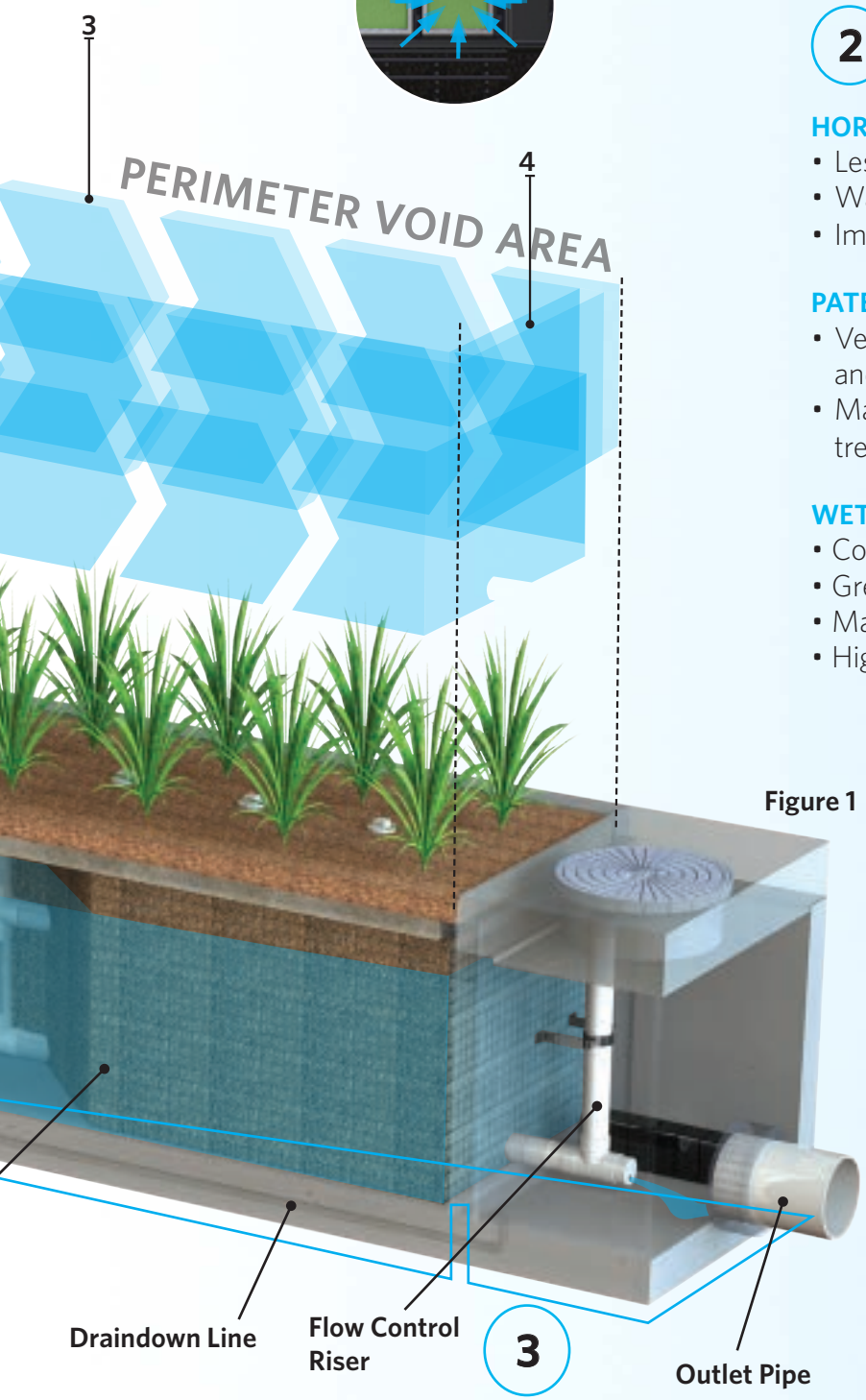


Figure 1

2 BIOFILTRATION

HORIZONTAL FLOW

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

PATENTED PERIMETER VOID AREA

- Vertically extends void area between the walls and the WetlandMEDIA on all four sides
- Maximizes surface area of the media for higher treatment capacity

WETLANDMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and lightweight

3 DISCHARGE

FLOW CONTROL

- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity
- Extends the life of the media and improves performance

DRAINDOWN FILTER

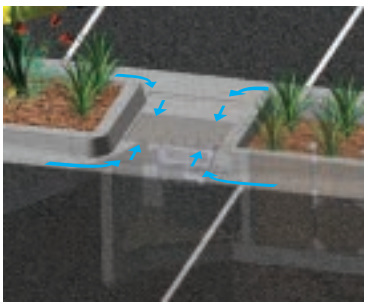
- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated

CONFIGURATIONS

The MWS Linear is the preferred biofiltration system of civil engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your storm drain design.

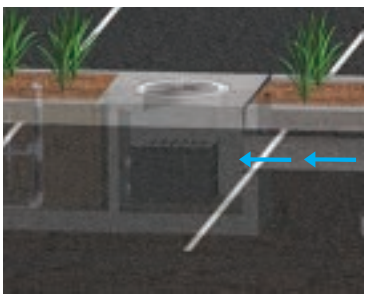
CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways and parking lots. It can be used in sump or flow-by conditions. Length of curb opening varies based on model and size.



GRATE TYPE

The Grate Type configuration offers the same features and benefits as the Curb Type but with a grated/drop inlet above the systems pretreatment chamber. It has the added benefit of allowing pedestrian access over the inlet. ADA-compliant grates are available to assure easy and safe access. The Grate Type can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



VAULT TYPE

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pretreatment chamber, meaning the MWS Linear can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/ bioretention systems. Another benefit of the "pipe-in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.

DOWNSPOUT TYPE

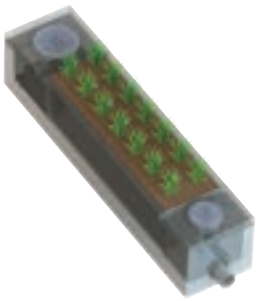
The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

ORIENTATIONS

SIDE-BY-SIDE

The Side-By-Side orientation places the pretreatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side.This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

END-TO-END



The End-To-End orientation places the pretreatment and discharge chambers on opposite ends of the biofiltration chamber, therefore minimizing the width of the system to 5 ft. (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is that bypass must be external.

BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pretreatment chamber directly to the discharge chamber.

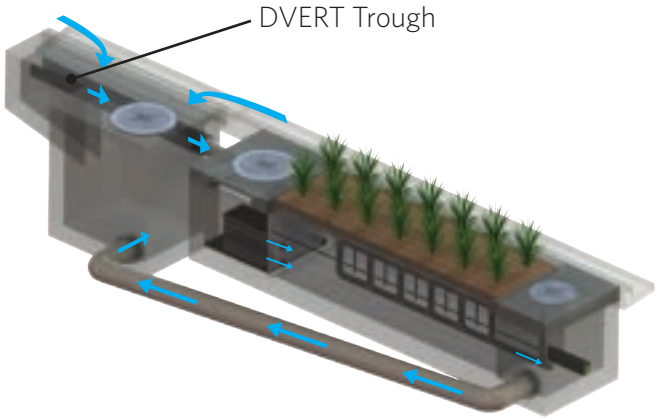
EXTERNAL DIVERSION WEIR STRUCTURE

This traditional offline diversion method can be used with the MWS Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

FLOW-BY-DESIGN

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT LOW FLOW DIVERSION



This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the MWS Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allow the MWS Linear to be installed anywhere space is available.

SPECIFICATIONS

FLOW-BASED

The MWS Linear can be used in stand-alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface, it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq.ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4′ x 4′	23	0.052
MWS-L-4-6	4′ x 6′	32	0.073
MWS-L-4-8	4′ x 8′	50	0.115
MWS-L-4-13	4′ x 13′	63	0.144
MWS-L-4-15	4′ x 15′	76	0.175
MWS-L-4-17	4′ x 17′	90	0.206
MWS-L-4-19	4′ x 19′	103	0.237
MWS-L-4-21	4′ x 21′	117	0.268
MWS-L-6-8	7′ x 9′	64	0.147
MWS-L-8-8	8′ x 8′	100	0.230
MWS-L-8-12	8′ x 12′	151	0.346
MWS-L-8-16	8′ x 16′	201	0.462
MWS-L-8-20	9′ x 21′	252	0.577
MWS-L-8-24	9′ x 25′	302	0.693

SPECIFICATIONS

VOLUME-BASED

Many states require treatment of a water quality volume and do not offer the option of flow-based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume-based design installed downstream of ponds, detention basins, and underground storage systems.

MODEL #	TREATMENT CAPACITY (cu. ft.) @ 24-HOUR DRAINDOWN	TREATMENT CAPACITY (cu. ft.) @ 48-HOUR DRAINDOWN
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-6-8	3191	6382
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145
MWS-L-8-20	12560	25120
MWS-L-8-24	15108	30216

APPLICATIONS

The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

INDUSTRIAL

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA-mandated effluent limits for dissolved metals and other pollutants.

RESIDENTIAL

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.

STREETS

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

PARKING LOTS

Parking lots are designed to maximize space and the MWS Linear's 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.

COMMERCIAL

Compared to bioretention systems, the MWS Linear can treat far more area in less space, meeting treatment and volume control requirements.

MIXED USE

The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications include:

• Agriculture • Reuse • Low Impact Development • Waste Water

PLANT SELECTION

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade, the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

INSTALLATION

The MWS Linear is simple, easy to install, and has a space-efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles precast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians are available to supervise installations and provide technical support.

MAINTENANCE

Reduce your maintenance costs, man hours, and materials with the MWS Linear. Unlike other biofiltration systems that provide no pretreatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pretreatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long-term operation, and there is absolutely no need to replace expensive biofiltration media.

Bio Clean
A Forterra Company

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072318R1

WASHINGTON STATE DEPARTMENT OF ECOLOGY

July 2017

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

    - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
    - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
    - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. The applicant tested the MWS – Linear Modular Wetland Stormwater Treatment System with an external bypass weir. This weir limited the depth of water flowing through the media, and therefore the active treatment area, to below the root zone of the plants. This GULD applies to MWS – Linear Modular Wetland Stormwater Treatment Systems whether plants are included in the final product or not.
5. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

    - Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
    - Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
    - Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific

maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

<u>Laboratory Testing</u>

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).
- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant: Zach Kent
BioClean A Forterra Company.
398 Vi9a El Centro
Oceanside, CA 92058
zach.kent@forterrabp.com

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	**Revision**
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment
December 2015	Updated GULD to document the acceptance of MWS-Linear Modular Wetland installations with or without the inclusion of plants
July 2017	Revised Manufacturer Contact Information (name, address, and email)

Attachment D: Calculations

Worksheet 1: Infiltration Feasibility Categorization

Categorization of Infiltration Feasibility Condition			*Page 1 of 5*
Part 1: Physical Limitations of Infiltration Based on the criteria for physical limitations of infiltration described in Section 4.2.2.2, what level of physical feasibility of infiltration is the maximum that the BMP location will support?			
	Physical Infiltration Feasibility Category	**Mark applicable category**	**Next step**
1	Full Infiltration of the DCV		Continue to Part 2
	Biotreatment with Partial Infiltration		Continue to Part 3
	Biotreatment with No Infiltration	X	Select and Utilize Biotreatment without Infiltration
Provide summary of basis: LGC Geotechnical, Inc. has recommended that the site not infiltrate due hazards that can't be mitigated against due to type D soils with low permeability located within a hillside area. See soils report in Attachment E. Summarize findings of studies, provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

<table>
<tr><th colspan="2">Categorization of Infiltration Feasibility Condition</th><th colspan="2">Page 2 of 5</th></tr>
<tr><td colspan="2">Part 2: Risks Limiting Full Infiltration of the DCV –Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?</td><td>Yes</td><td>No</td></tr>
<tr><td>2</td><td>Would infiltration of the DCV pose significant risk for groundwater related concerns? Use criteria described in Section 4.2.2.3 and results from Worksheet 2 (Appendix C) to describe groundwater-related infiltration feasibility criteria.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>3</td><td>Would infiltration of the full DCV pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? Use criteria described in Section 4.2.2.4.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>Would infiltration of the DCV cause an increase in groundwater flow or decrease in surface runoff over predevelopment conditions that would cause impairment to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters? Use criteria in Section 4.2.2.5</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

<table>
<tr><th colspan="2">Categorization of Infiltration Feasibility Condition</th><th colspan="2">Page 3 of 5</th></tr>
<tr><td colspan="2">Part 2 (continued): Risks Limiting Full Infiltration of the DCV –Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?</td><td>Yes</td><td>No</td></tr>
<tr><td>5</td><td>Is there substantial evidence that infiltration of the DCV would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>6</td><td>Would infiltration of the DCV violate downstream water rights?</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 2 Result</td><td>If the answer to all questions 2-6 are “No”, then the DMA is categorized as “Full Infiltration” for the purposes of LID BMP type selection. Describe finding.

At the Preliminary/Conceptual WQMP phase, describe the additional design-phase testing required to confirm this determination and identify contingencies for final design.

At the Final Project WQMP phase, identify any required construction-phase testing and identify the design contingencies that should result based on construction-phase testing.

If the answer to any of questions 2-6 is “Yes” then the site cannot be categorized as “Full Infiltration”. Continue to Part 3: Partial Infiltration Feasibility</td><td colspan="2"></td></tr>
</table>

Categorization of Infiltration Feasibility Condition		***Page 4 of 5***	
Part 3: Partial Infiltration Feasibility Criteria –*Would infiltration of any appreciable volume of stormwater result in risks of undesirable consequences that cannot reasonably be mitigated?*		***Yes***	***No***
8	**Would use of biotreatment BMPs with partial infiltration pose significant risk for groundwater related concerns?** Refer to criteria in Section 4.2.2.3 and Worksheet 1 (Appendix C) for guidance on groundwater-related infiltration feasibility criteria.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
9	**Would the use of biotreatment BMPs with partial infiltration pose elevated risks of geotechnical hazards that cannot be mitigated to an acceptable level**? Refer to Section 4.2.2.4.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
10	**Would the use of biotreatment BMPs with partial infiltration elevate risks or introduced conflicts related to groundwater balance, inflow and infiltration, or water rights?** Refer to Section 4.2.2.5. Note: this is uncommon and must be supported by site-specific analysis if it is used as a basis to reject biotreatment with partial infiltration.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Categorization of Infiltration Feasibility Condition		***Page 5 of 5***
Part 3 Result	If the answer to all questions 8-10 are “No”, then the DMA is categorized as “Biotreatment with Partial Infiltration” for the purposes of LID BMP type selection. If the answer to any of questions 8-10 is “Yes” then the site is categorized as “Biotreatment with No Infiltration” for the purposes of LID BMP type selection.	

Simple Design Capture Volume

SIMPLE DCV WORKSHEET	**Drainage Management Area (DMA):**	**TOTAL SITE**

Calculate Design Storm Volume

1	Enter design capture storm depth, *d* (inches)	d=	0.825	inches
2a	Enter the combined effect of provided HSCs, d_{HSC} (inches) (based on Worksheet 4)	d_{HSC}=	0	inches
2b	Calculate the remainder of the design capture storm depth, $d_{remainder} = d - d_{HSC}$	$d_{remainder}$=	0.825	inches
3a	Enter DMA area tributary to BMP(s), A (acres) excluding any self-retaining areas	A=	15.57	acres
3b	Enter DMA Imperviousness, imp (unitless) after removal of self-retaining areas	imp=	86	%
3c	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.795	
3d	Calculate runoff volume, DCV = $(C \times d_{remainder} \times A \times 43560 \times (1/12))$ (See Section E.2.2)	DCV=	**37,058**	cu. ft.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**Site**
		BMP ID:		
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	15.58	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	86	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.795	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	3.22	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**4.830**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

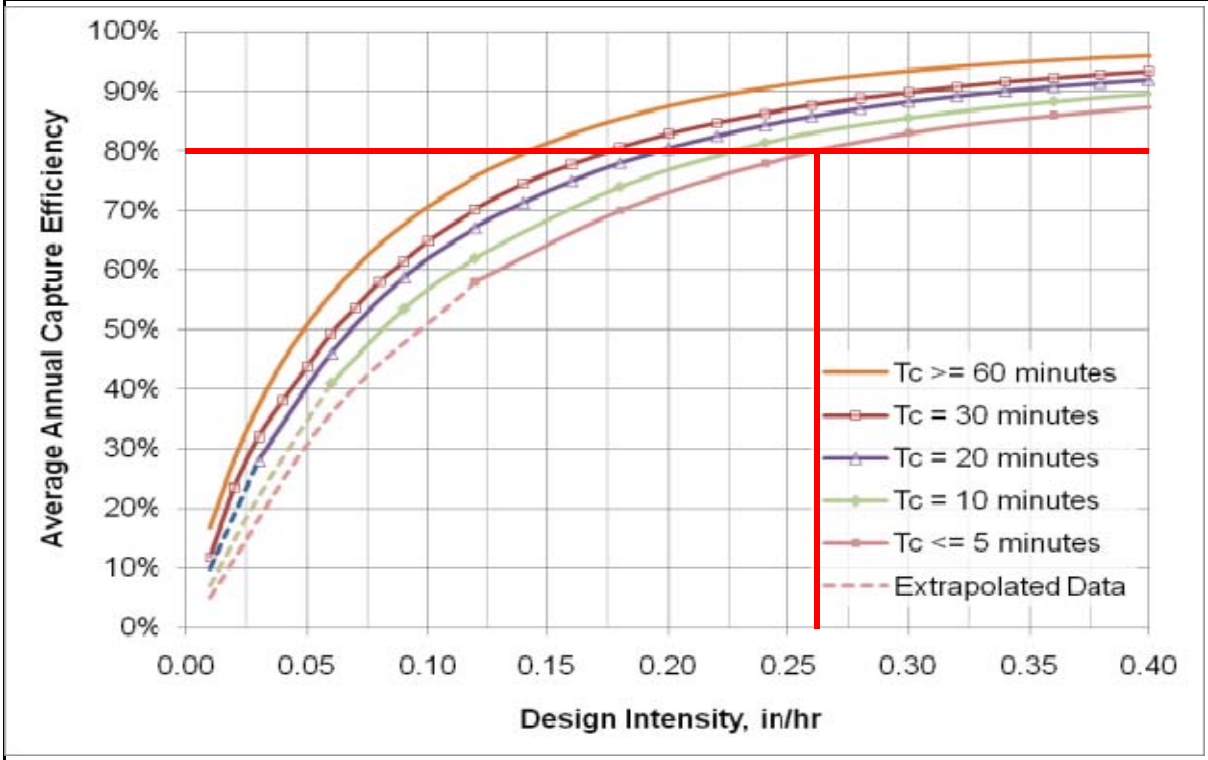
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA 1**	
		BMP ID:	**BIO-7 A**	
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.23	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	95	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.860	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.27	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.411**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

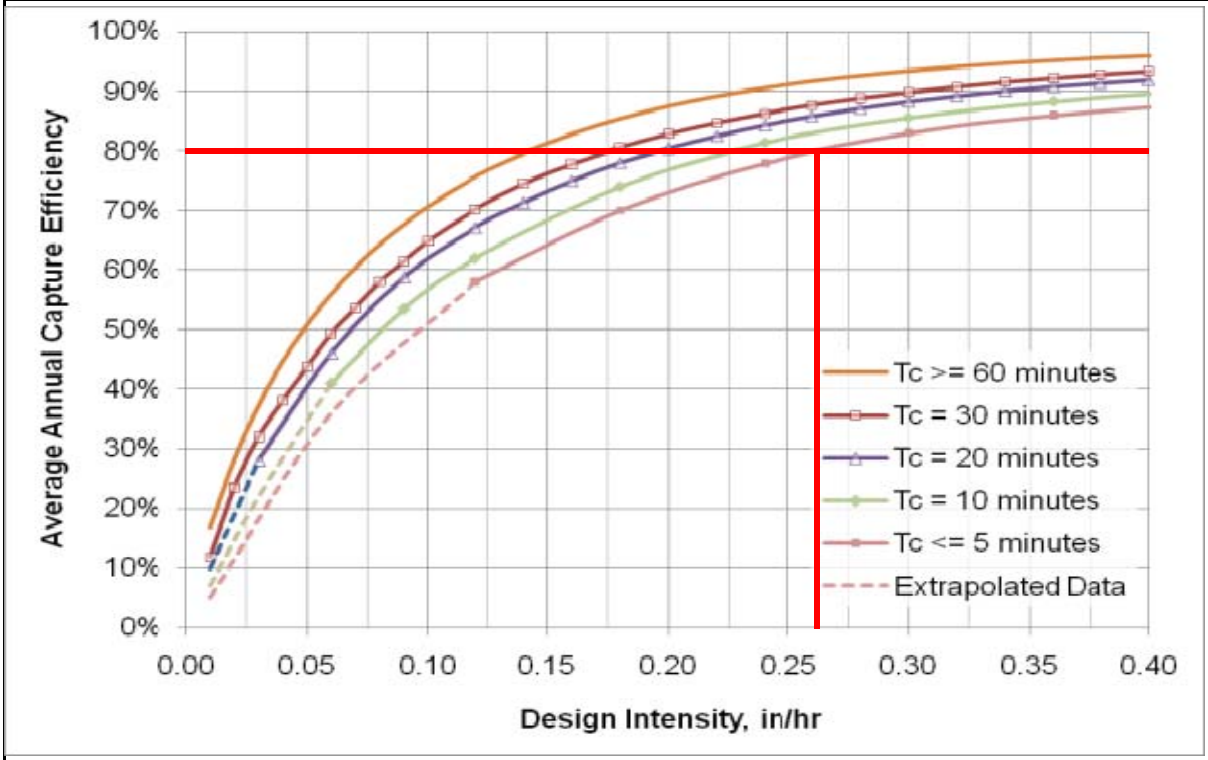
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA 2**	
		BMP ID:	**BIO-7 B**	
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.05	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	95	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.861	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.23	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.352**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

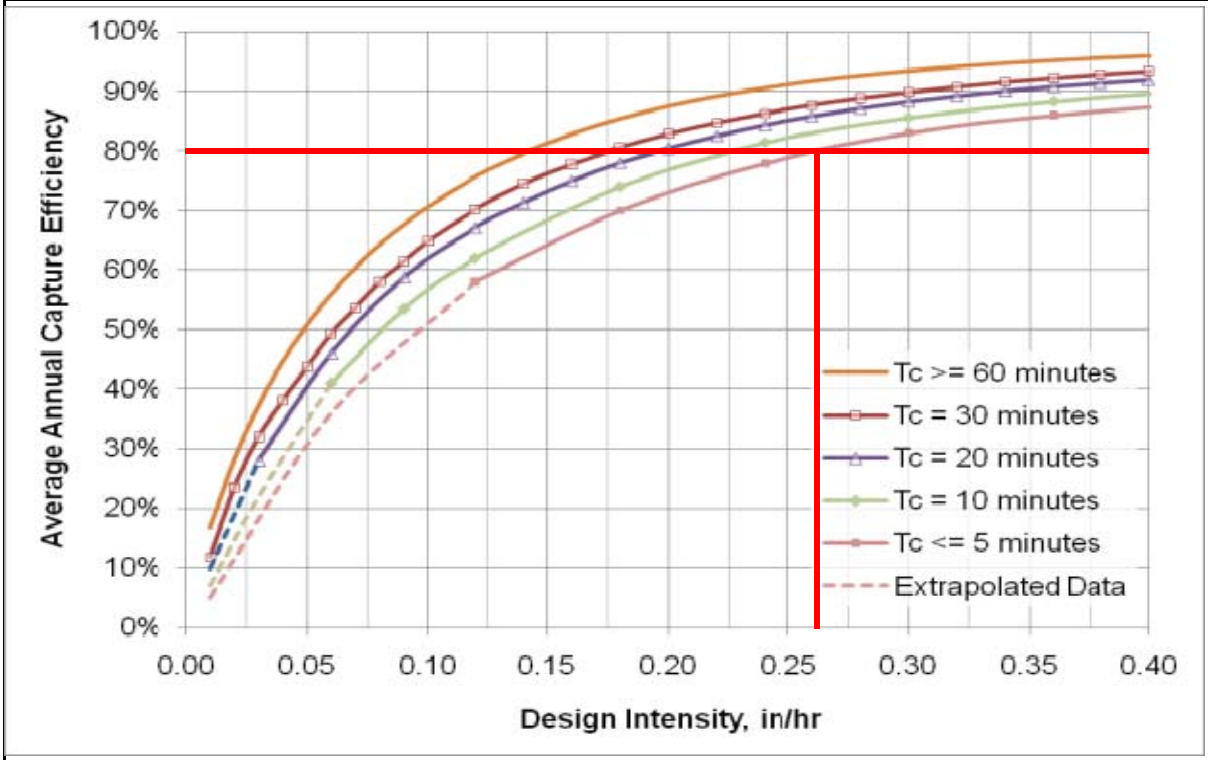
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA 3**	
		BMP ID:	**BIO-7 C**	
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.73	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	88	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.807	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.36	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.545**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

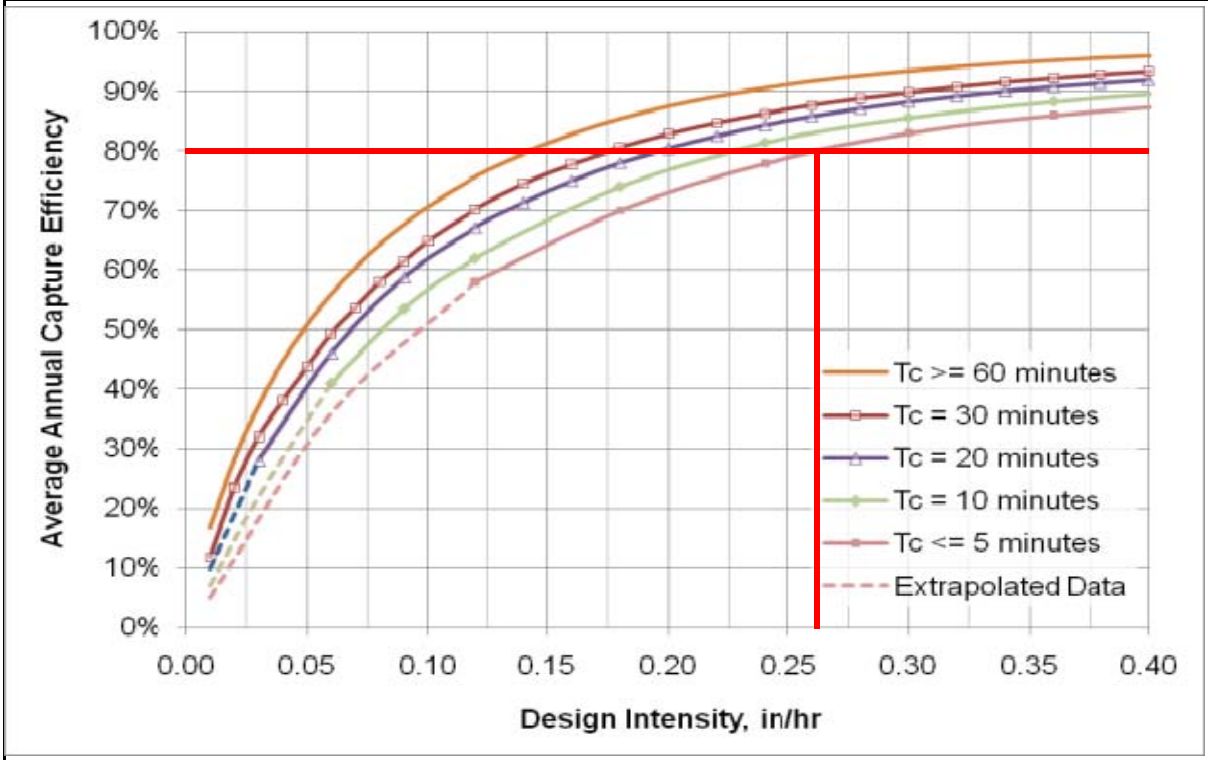
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**4**
		BMP ID:	**BIO-7**	**D**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.20	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	54	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.558	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.03	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.043**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

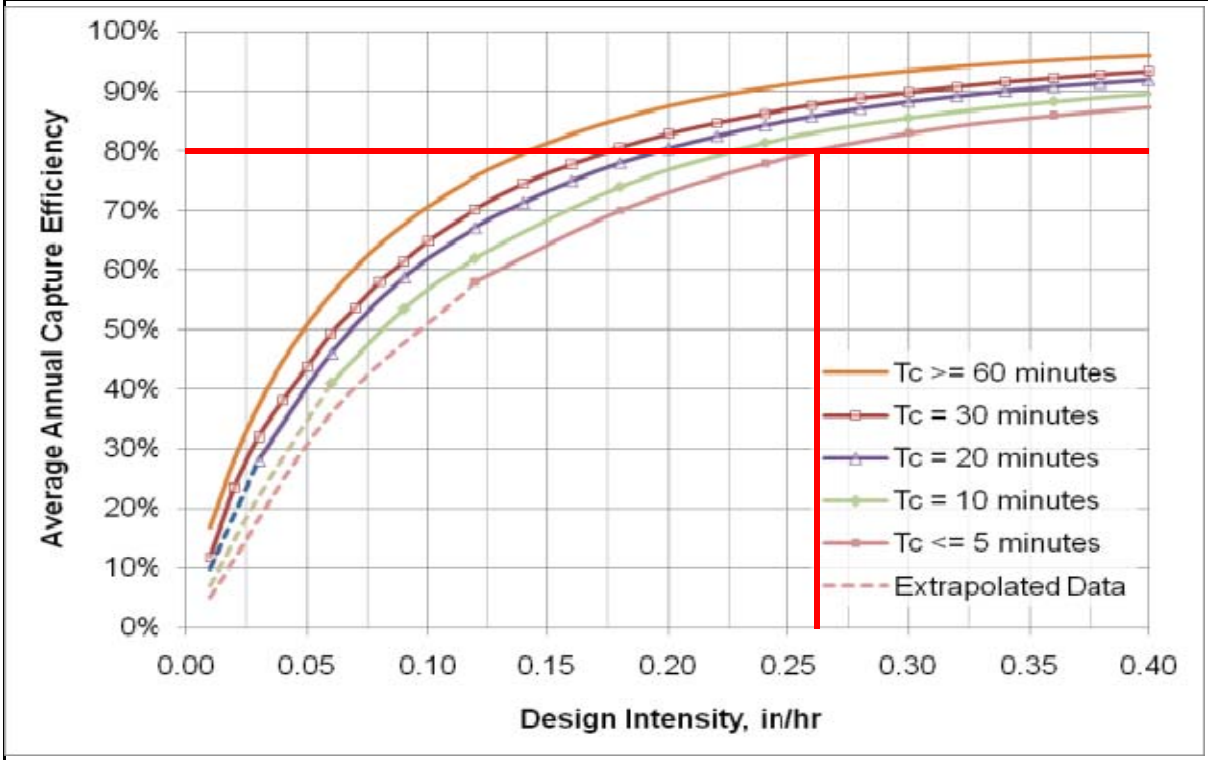
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**5**
		BMP ID:	**BIO-7**	**E**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.46	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	80	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.751	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.09	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.134**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

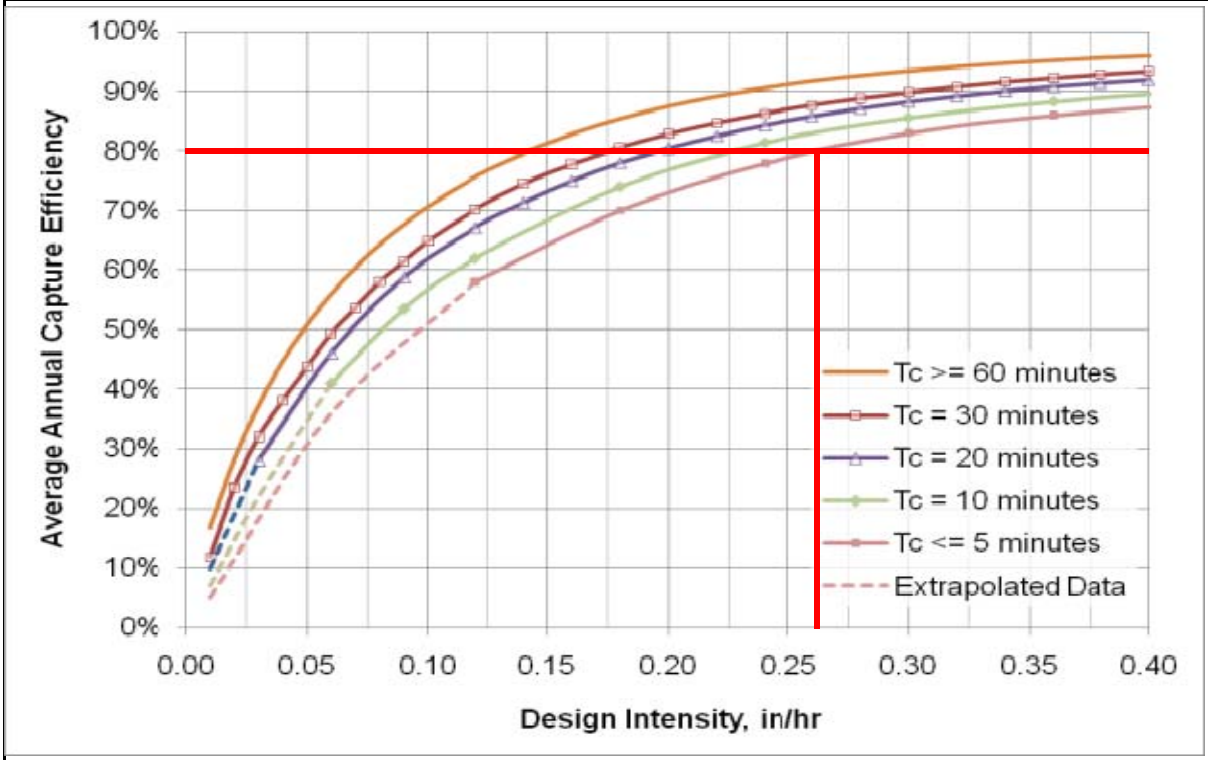
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**6**
		BMP ID:	**BIO-7**	**F**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.48	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	95	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.861	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.11	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.162**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

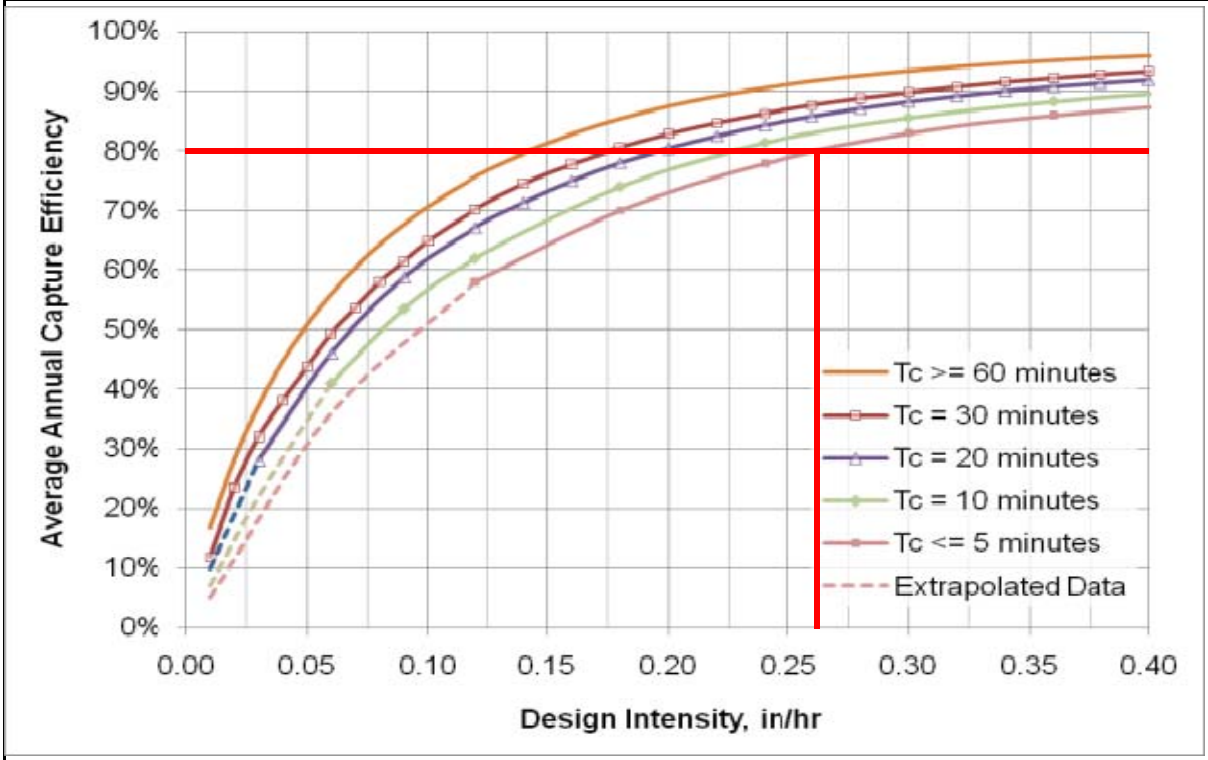
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA 7**	
		BMP ID:	**BIO-7 G**	
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.87	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	100	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.900	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.20	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.306**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

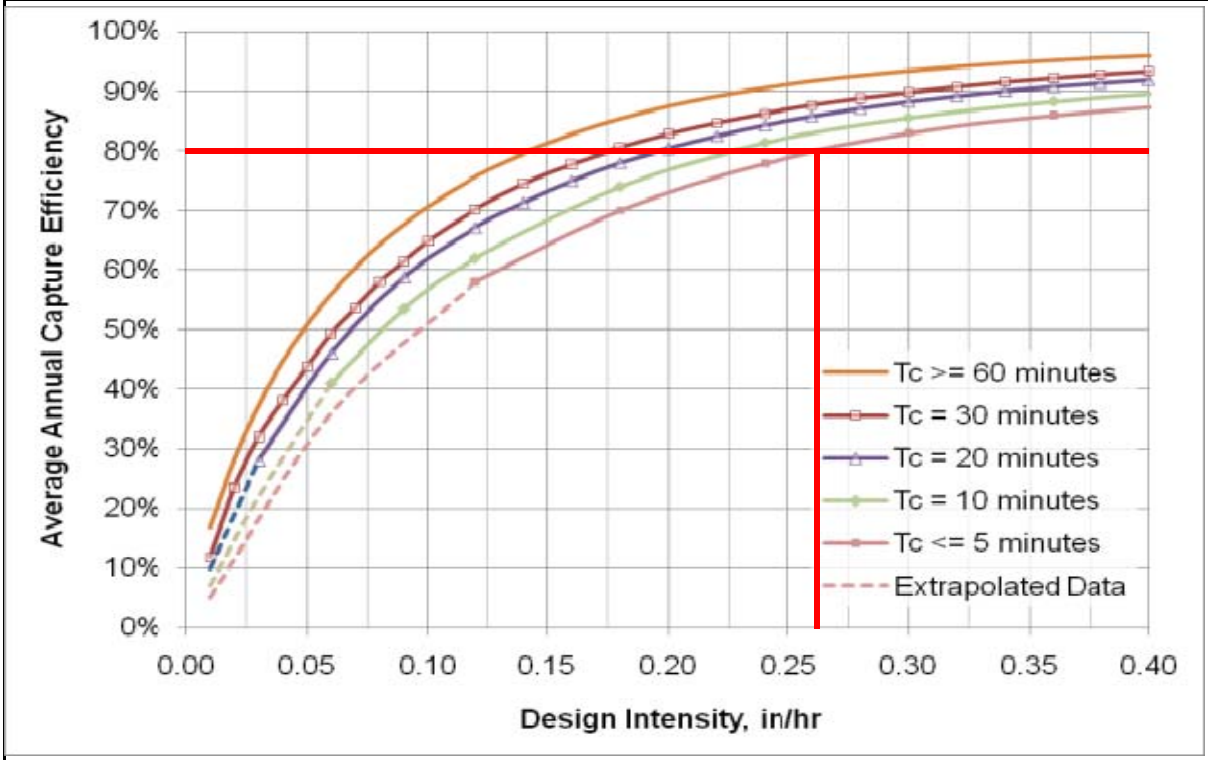
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**8**
		BMP ID:	**BIO-7**	**H**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.38	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	98	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.886	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.32	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.476**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

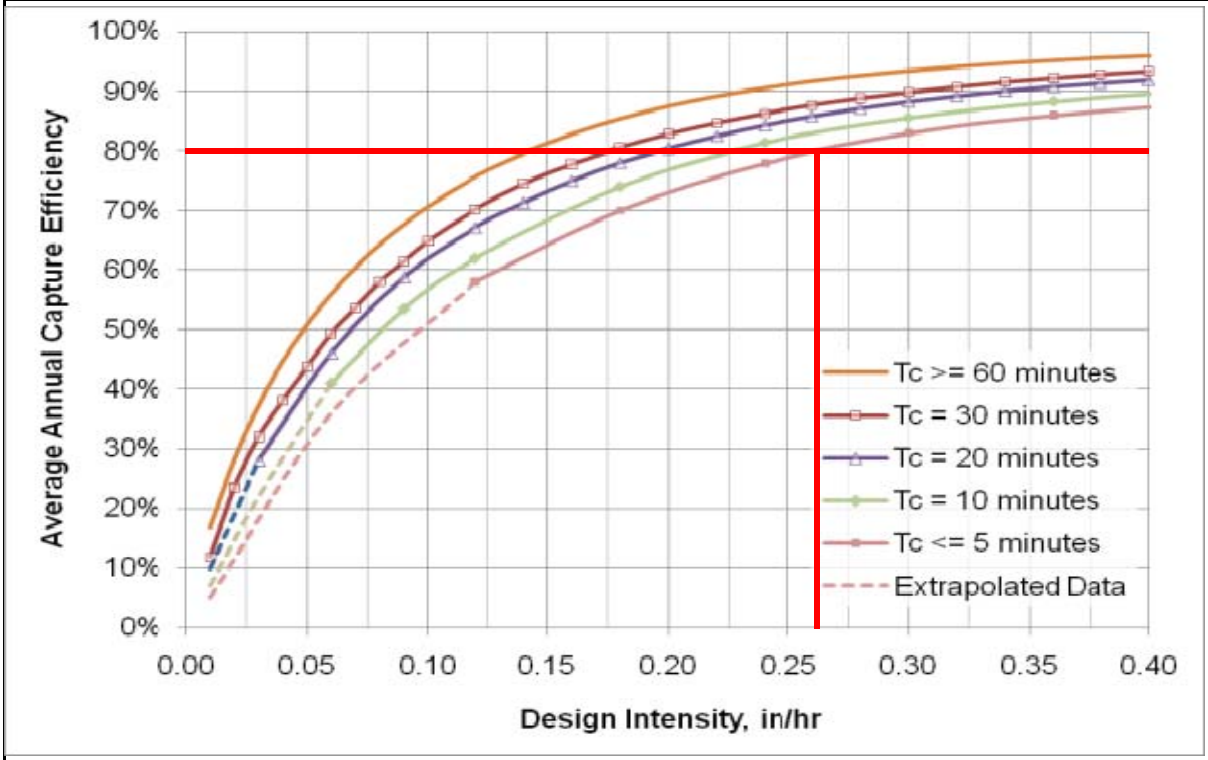
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**9**
		BMP ID:	**BIO-7**	**J**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.88	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	97	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.881	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.20	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.301**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

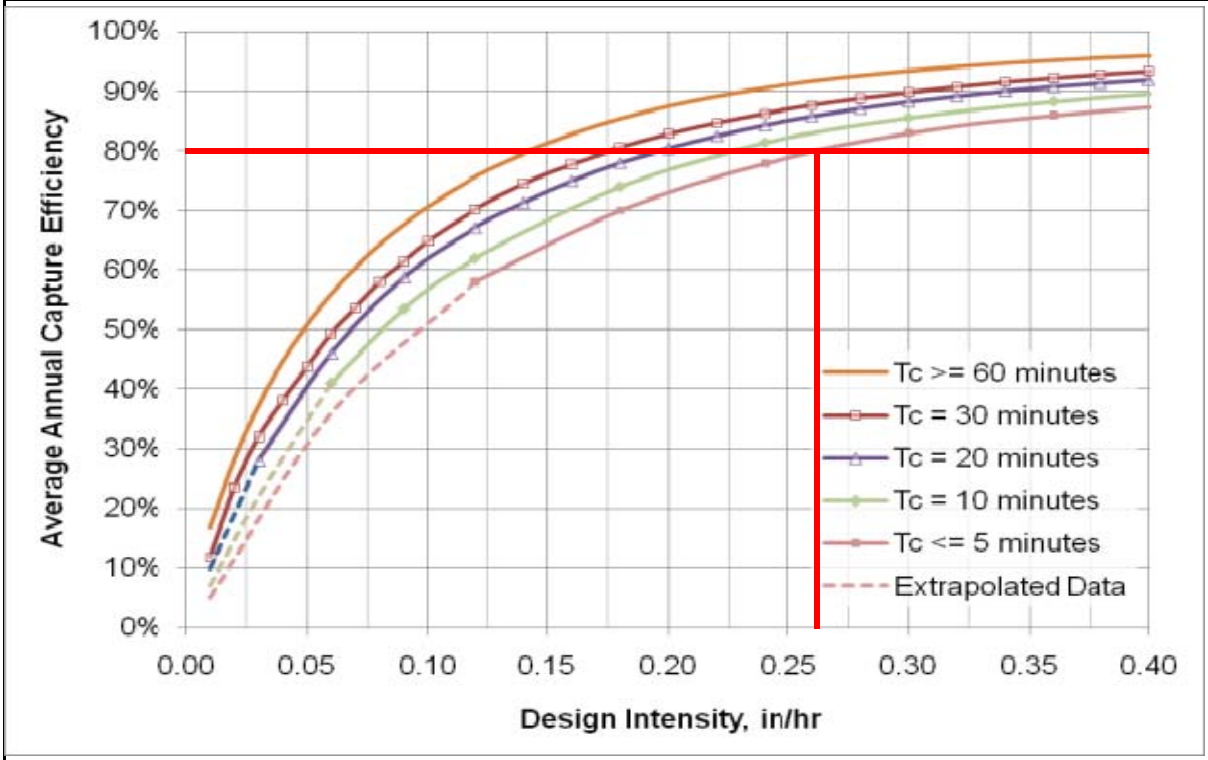
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**10**
		BMP ID:	**BIO-7**	**K**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.99	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	97	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.875	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.23	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.338**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

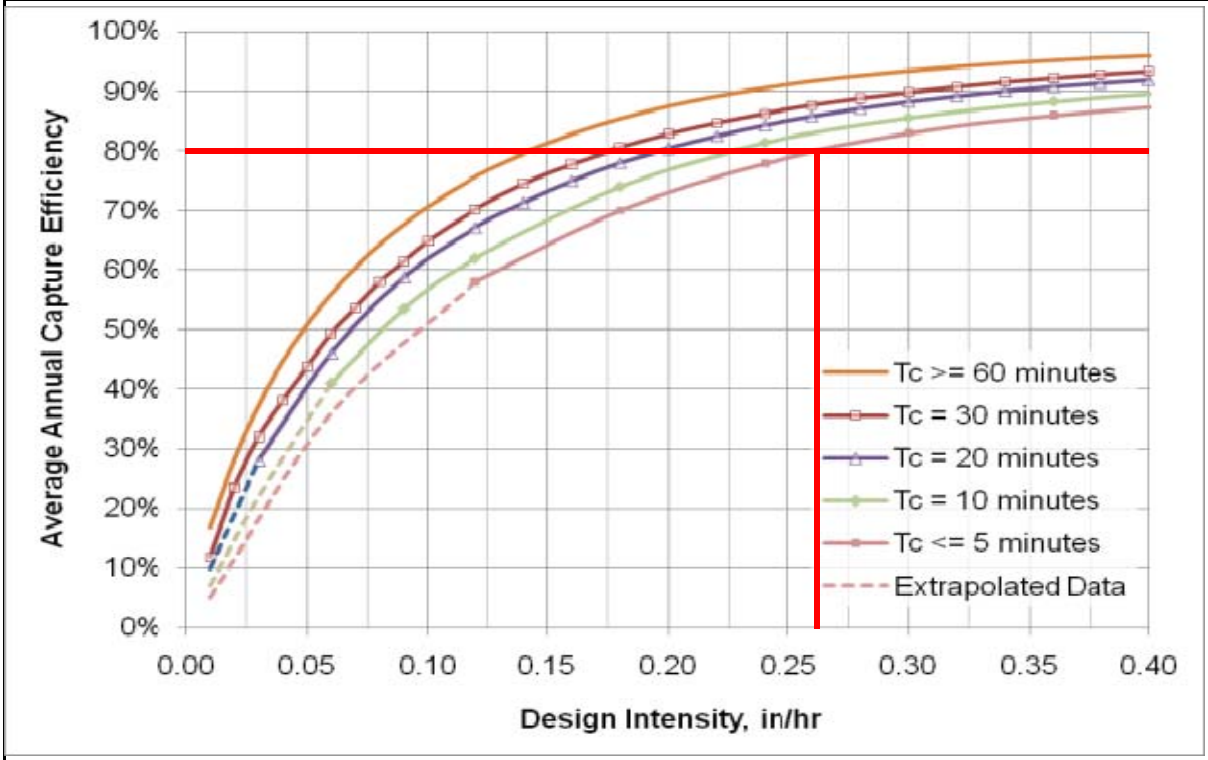
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**11**
		BMP ID:	**BIO-7**	**L**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.57	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	90	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.826	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.34	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.505**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

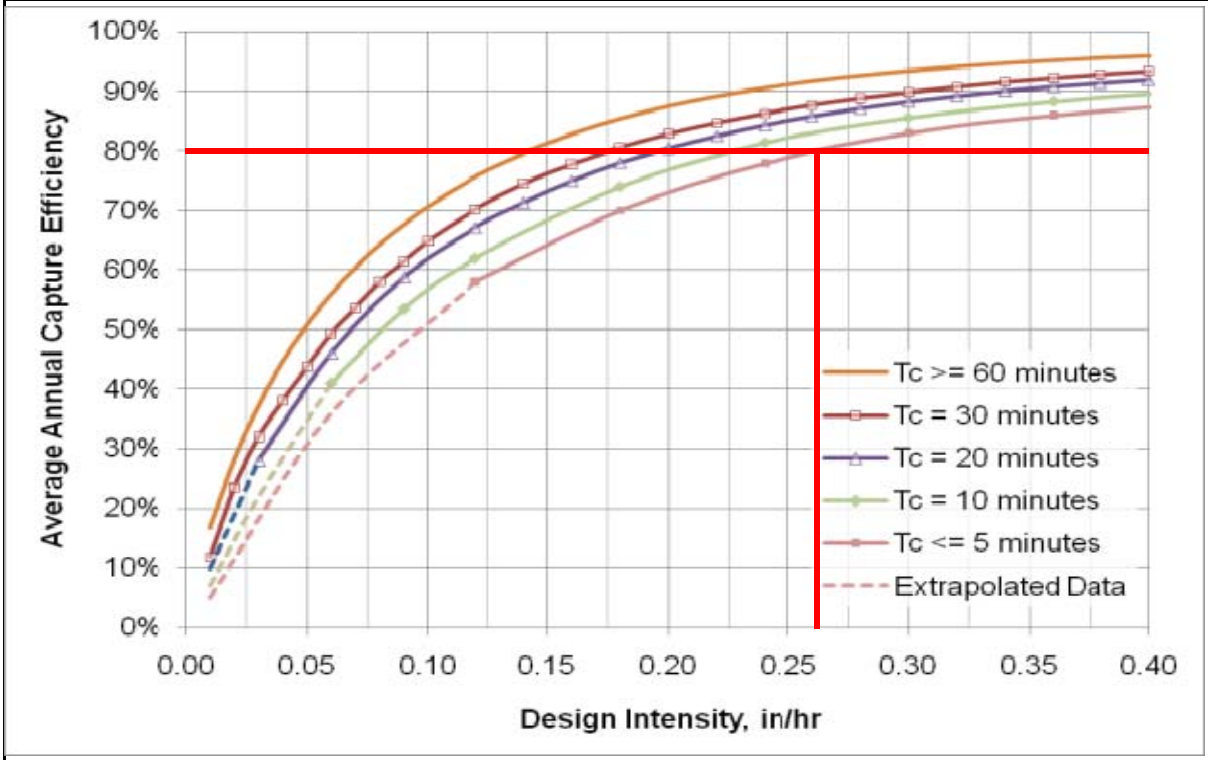
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**12**
		BMP ID:	**BIO-7**	**M**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.96	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	90	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.823	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.42	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.628**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

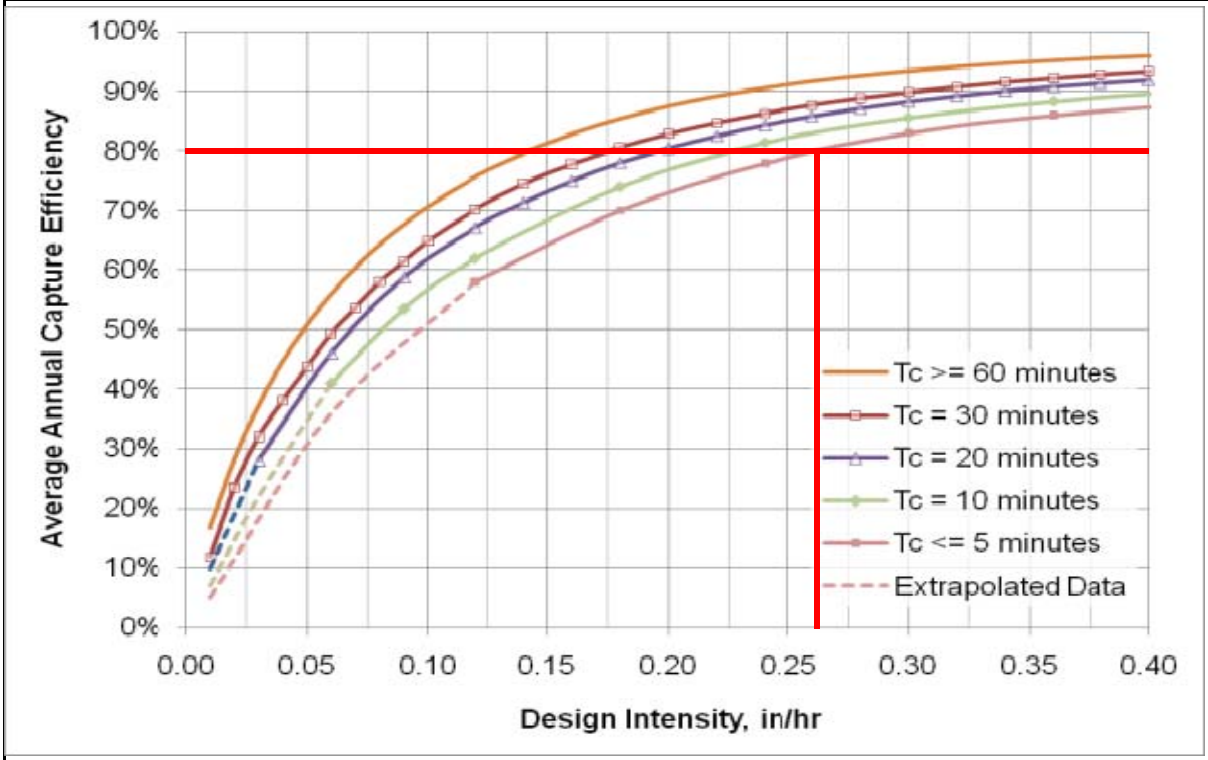
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**13**
		BMP ID:	**BIO-7**	**N**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	0.92	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	89	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.817	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.20	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.294**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

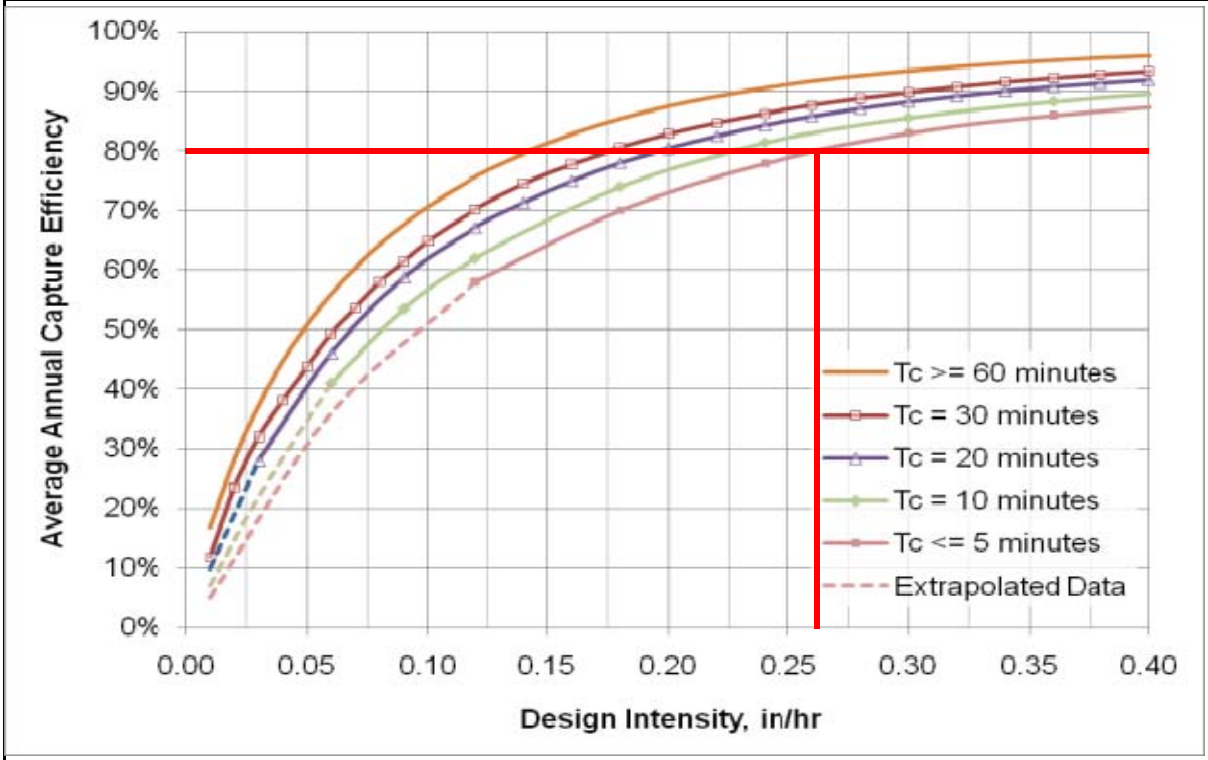
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method				
BIOFILTRATION BMPs SIZING WORKSHEET		**Drainage Management Area:**	**DMA**	**14**
		BMP ID:	**BIO-7**	**P**
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, Tc (min) (See E.2.3) (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	Tc=	5	min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (Tc) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2=	0.00	%
4	Using Figure E-7, determine the design intensity at which the time of concentration (Tc) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0.00	in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design\_80\%}$=	0.26	in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP(s), A (acres)	A=	1.01	acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=	65	%
6c	Calculate runoff coefficient, C = (0.75 x imp) + 0.15	C=	0.641	
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= (c x I_{design} x A)	$Q_{80\%}$=	0.17	cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ x 150%	Q_{design}=	**0.253**	cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

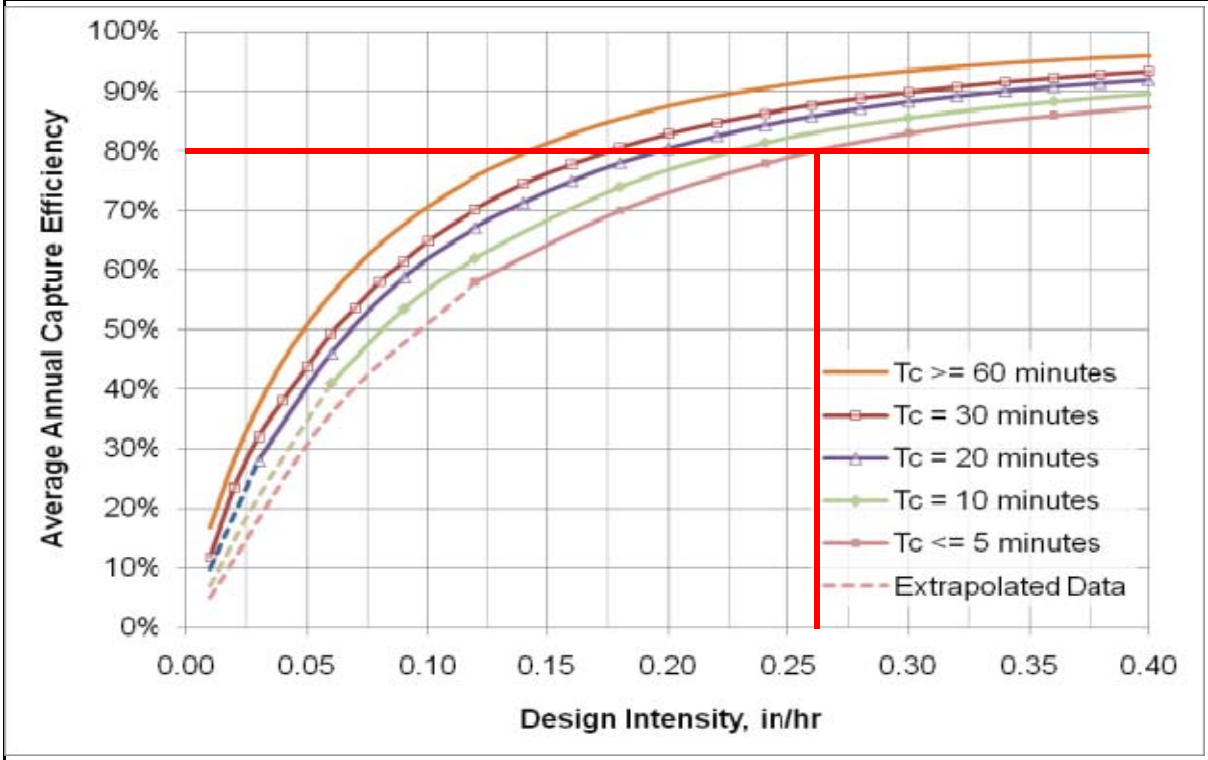
Worksheet 9: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Assumed a Tc of 5 minutes.

Graphical Operations



Provide supporting graphical operations in figure above.

SOHM

PROJECT REPORT

General Model Information

Project Name:	Malaspina Road
Site Name:	
Site Address:	
City:	SAN JUAN CAPISTRANO
Report Date:	1/29/2020
Gage:	Laguna Beach
Data Start:	10/01/1949
Data End:	09/30/2006
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2018/07/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data

Predeveloped Land Use

M,N,O,P,Q,R,S

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
Impervious,Mod(5-10)	5.34
Impervious Total	5.34
Basin Total	5.34

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

H,F,V,W

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A,Scrub,Steep(10-15)	1.59
Pervious Total	1.59

Impervious Land Use	acre
Impervious,Mod(5-10)	1.84
Impervious Total	1.84
Basin Total	3.43

Element Flows To:

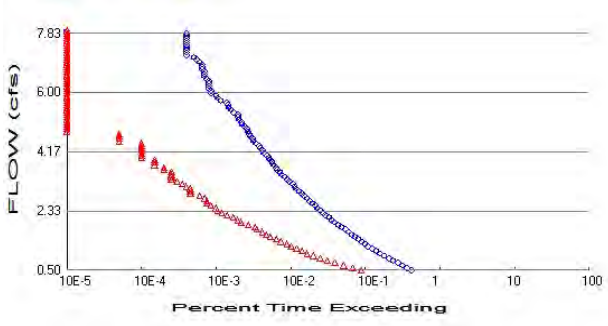
Surface	Interflow	Groundwater

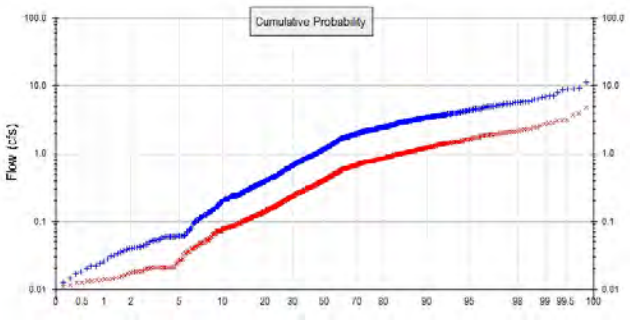
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 5.34

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.59
Total Impervious Area: 1.84

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	5.014565
5 year	6.377922
10 year	7.833882
25 year	9.08618

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.937365
5 year	2.430261
10 year	3.041172
25 year	3.751238

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.5015	8250	1766	21	Pass
0.5755	7201	1357	18	Pass
0.6496	6278	1024	16	Pass
0.7237	5462	782	14	Pass
0.7977	4703	617	13	Pass
0.8718	4113	497	12	Pass
0.9458	3560	403	11	Pass
1.0199	3150	333	10	Pass
1.0940	2776	281	10	Pass
1.1680	2460	239	9	Pass
1.2421	2177	202	9	Pass
1.3162	1976	178	9	Pass
1.3902	1785	148	8	Pass
1.4643	1605	128	7	Pass
1.5384	1455	106	7	Pass
1.6124	1301	94	7	Pass
1.6865	1190	83	6	Pass
1.7606	1075	70	6	Pass
1.8346	955	66	6	Pass
1.9087	859	54	6	Pass
1.9828	770	43	5	Pass
2.0568	700	39	5	Pass
2.1309	652	34	5	Pass
2.2049	585	28	4	Pass
2.2790	536	24	4	Pass
2.3531	494	21	4	Pass
2.4271	456	20	4	Pass
2.5012	422	17	4	Pass
2.5753	389	15	3	Pass
2.6493	358	15	4	Pass
2.7234	331	14	4	Pass
2.7975	301	12	3	Pass
2.8715	280	9	3	Pass
2.9456	257	9	3	Pass
3.0197	238	9	3	Pass
3.0937	224	8	3	Pass
3.1678	213	7	3	Pass
3.2419	194	6	3	Pass
3.3159	179	5	2	Pass
3.3900	169	5	2	Pass
3.4641	152	5	3	Pass
3.5381	143	5	3	Pass
3.6122	132	4	3	Pass
3.6862	126	4	3	Pass
3.7603	118	3	2	Pass
3.8344	113	3	2	Pass
3.9084	106	3	2	Pass
3.9825	101	2	1	Pass
4.0566	96	2	2	Pass
4.1306	86	2	2	Pass
4.2047	84	2	2	Pass
4.2788	79	2	2	Pass
4.3528	75	2	2	Pass

4.4269	68	2	2	Pass
4.5010	64	1	1	Pass
4.5750	61	1	1	Pass
4.6491	57	1	1	Pass
4.7232	56	1	1	Pass
4.7972	53	0	0	Pass
4.8713	52	0	0	Pass
4.9454	48	0	0	Pass
5.0194	44	0	0	Pass
5.0935	43	0	0	Pass
5.1675	41	0	0	Pass
5.2416	39	0	0	Pass
5.3157	39	0	0	Pass
5.3897	34	0	0	Pass
5.4638	32	0	0	Pass
5.5379	30	0	0	Pass
5.6119	29	0	0	Pass
5.6860	28	0	0	Pass
5.7601	23	0	0	Pass
5.8341	21	0	0	Pass
5.9082	20	0	0	Pass
5.9823	17	0	0	Pass
6.0563	17	0	0	Pass
6.1304	16	0	0	Pass
6.2045	16	0	0	Pass
6.2785	16	0	0	Pass
6.3526	16	0	0	Pass
6.4266	15	0	0	Pass
6.5007	14	0	0	Pass
6.5748	14	0	0	Pass
6.6488	14	0	0	Pass
6.7229	13	0	0	Pass
6.7970	13	0	0	Pass
6.8710	13	0	0	Pass
6.9451	12	0	0	Pass
7.0192	11	0	0	Pass
7.0932	10	0	0	Pass
7.1673	8	0	0	Pass
7.2414	8	0	0	Pass
7.3154	8	0	0	Pass
7.3895	8	0	0	Pass
7.4636	8	0	0	Pass
7.5376	8	0	0	Pass
7.6117	8	0	0	Pass
7.6858	8	0	0	Pass
7.7598	8	0	0	Pass
7.8339	8	0	0	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

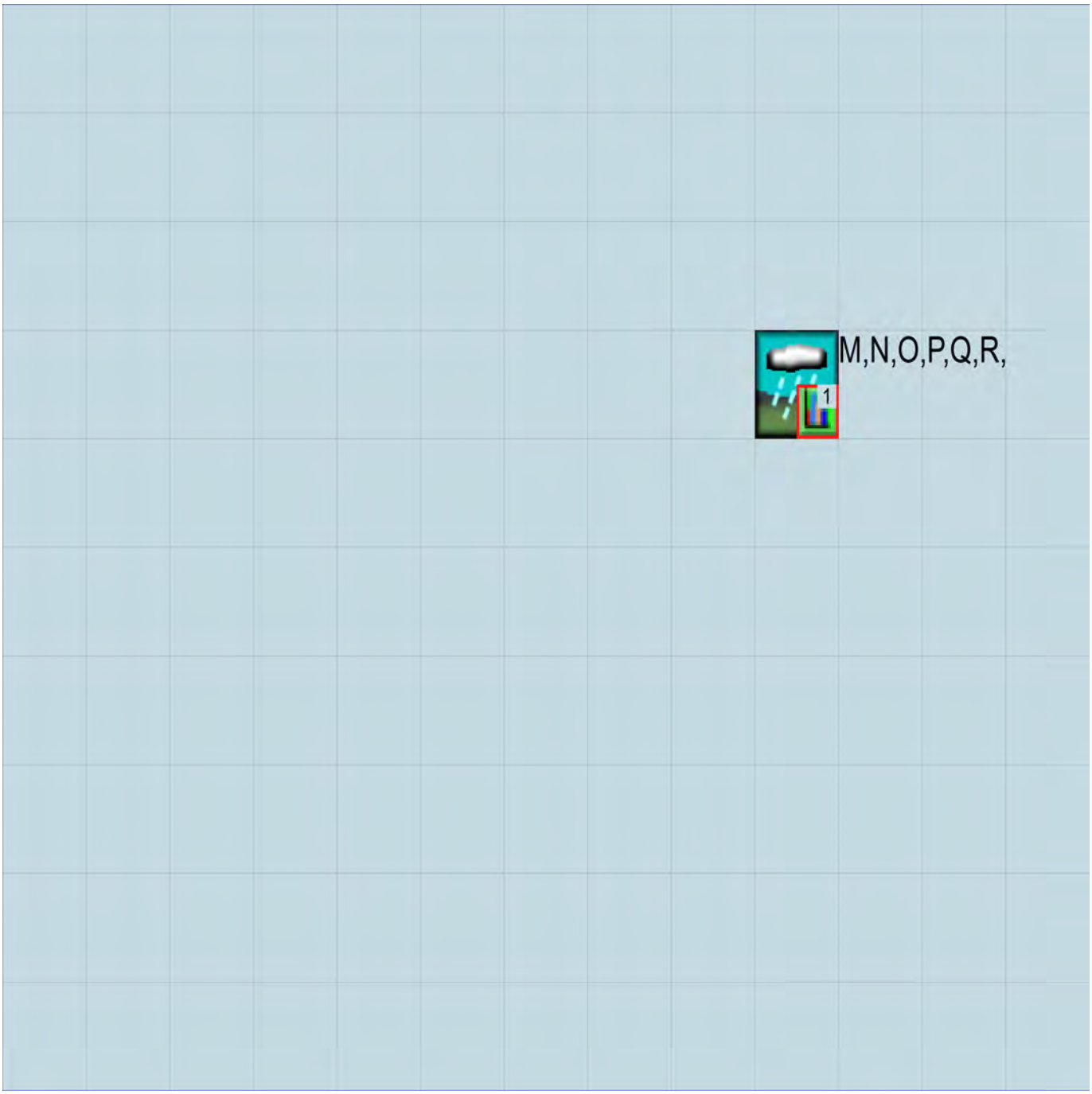
PERLND Changes

No PERLND changes have been made.

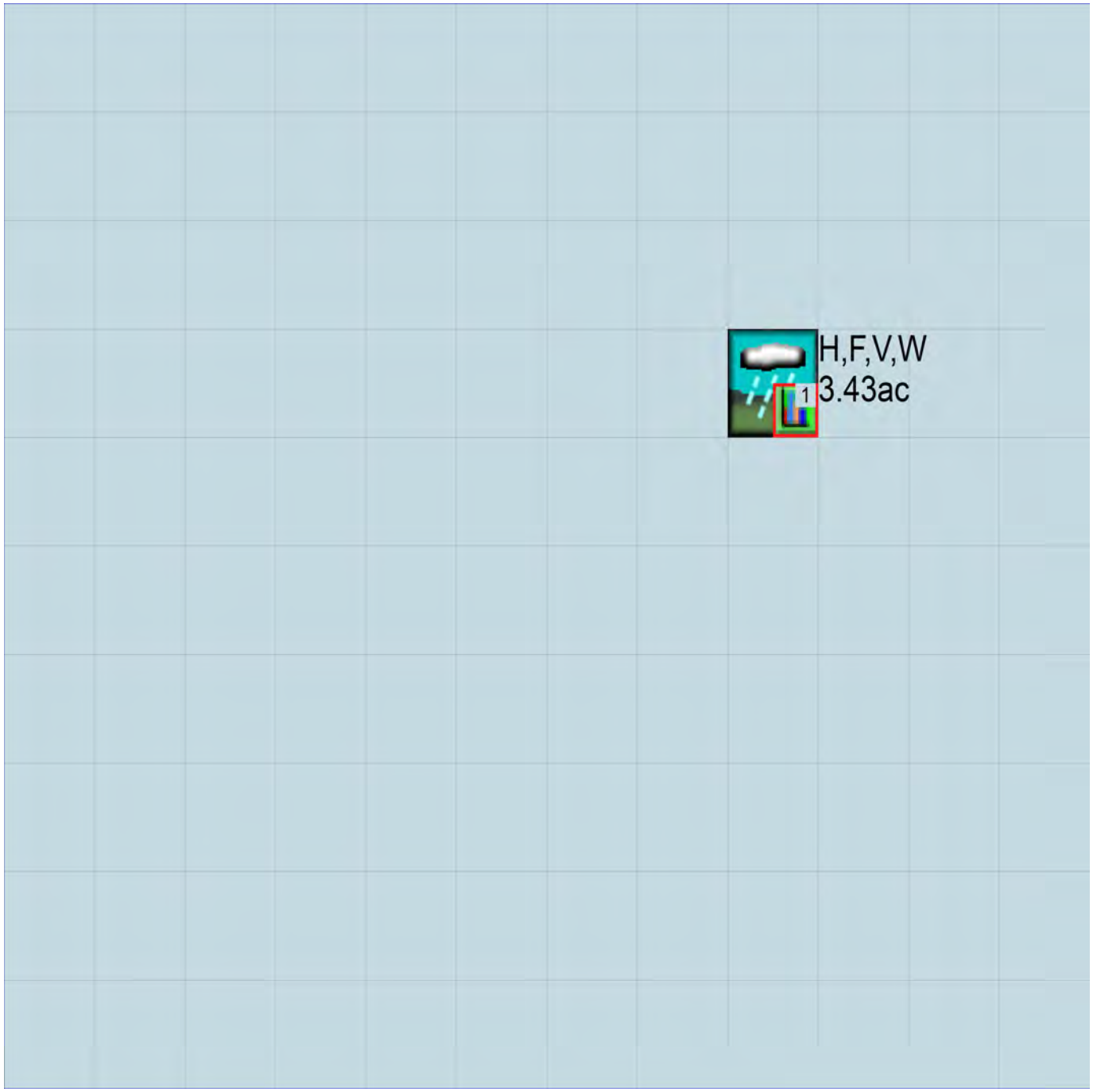
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Malaspina Road.wdm
MESSU       25   PreMalaspina Road.MES
            27   PreMalaspina Road.L61
            28   PreMalaspina Road.L62
            30   POCMalaspina Road1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        M,N,O,P,Q,R,S               MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
                                      in  out           ***
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
```

```
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2     Impervious,Mod(5-10)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2           100       0.1       0.1      0.09
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2             0         0
  END IWAT-PARM3
```

```
  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2            0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                    <--Area-->     <-Target->   MBLK   ***
<Name>   #                    <-factor->     <Name>   #   Tbl#   ***
M,N,O,P,Q,R,S***
IMPLND   2                          5.34     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES
```

```
EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1949 10 01        END    2006 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   Malaspina Road.wdm
MESSU       25   MitMalaspina Road.MES
            27   MitMalaspina Road.L61
            28   MitMalaspina Road.L62
            30   POCMalaspina Road1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       3
      IMPLND       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        H,F,V,W                    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                        in  out           ***
    3     A,Scrub,Steep(10-15)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    3         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags **************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    3         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    3         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    3             0       4.5     0.045       300      0.15       0.8     0.955
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    3            40        35         2         2         0      0.03         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    3              0       0.5       0.3       2.6       0.4         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
    3       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
    3      0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13    0
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    3             0         0      0.05         0       0.9       0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    2     Impervious,Mod(5-10)    1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    2         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2            100       0.1       0.1      0.09
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
H,F,V,W***
PERLND   3                        1.59     COPY   501     12
PERLND   3                        1.59     COPY   501     13
IMPLND   2                        1.84     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                      in  out                               ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                 ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
```

```
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                        ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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Attachment E: Soils Report

LGC Geotechnical, Inc.

July 30, 2019

Project No. 19029-01

Mr. Peter Vanek
Integral Communities
888 San Clemente Drive, Suite 100
Newport Beach, California 92660

Subject: ***Preliminary Geotechnical Review of Proposed Creekside Residential Development, Southeast of Rancho Viejo Road and Malaspina Road, Vesting Tentative Tract Map No. 19009, San Juan Capistrano, California***

In accordance with your request and authorization, LGC Geotechnical, Inc. has performed a geotechnical plan review of the proposed Creekside residential development, Vesting Tentative Tract No. 19009, located at the southeast intersection of Rancho Viejo Road and Malaspina Road (former Endevco Corporation site) within the City of San Juan Capistrano, California. This report presents a summary of our conclusions and preliminary recommendations relative to the proposed development of the site.

Should you have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Respectfully,

LGC Geotechnical, Inc.

REGISTERED PROFESSIONAL ENGINEER
DENNIS BORATYNEC
No. 2770
GEOTECHNICAL
STATE OF CALIFORNIA

Dennis Boratynec, GE 2770
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STATE OF CALIFORNIA

Katie Maes, CEG 2216
Project Geologist

KTM/DJB/BTZ/CNJ/amm

Distribution: (4) Addressee (3 wet-signed copies & electronic copy)
(2) KHR Associates (wet-signed copy & electronic copy)
Attention: Mr. Mike Thomas

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1.0 INTRODUCTION

1.1 Purpose and Scope of Services

This report presents the results of our geotechnical review of Vesting Tentative Tract No. 19009 and preliminary grading plans for proposed residential development of the approximately 15-acre site located along Rancho Viejo Road south of its intersection with Malaspina Road, in the City of San Juan Capistrano, California. (Site Location Map, Figure 1). The proposed grading plan by KHR Associates (KHR, 2019a) was utilized as a base map for our Geotechnical Map (Sheet 1).

The purpose of our study was to provide a preliminary geotechnical evaluation relative to the proposed residential development. As part of our scope of work, we have: 1) reviewed available geotechnical background information including in-house regional geologic maps and published geotechnical literature pertinent to the site (Appendix A); 2) performed a subsurface geotechnical evaluation of the site consisting of the excavation of three large diameter borings downhole-logged by a geologist, six exploratory trenches, three small-diameter borings, and six cone penetration test (CPT) soundings; 3) performed two field infiltration tests; 4) performed laboratory testing of select soil samples; and 5) prepared this preliminary geotechnical summary report presenting our findings, preliminary conclusions and recommendations for the development of the proposed project.

The findings and conclusions presented herein should be considered preliminary and will need to be updated as design documents and retaining wall plans are completed, and the overall assumptions must be confirmed during rough grading.

1.2 Project Description

The proposed residential development as presented by KHR Associates (2019a) consists of 114 detached single-family lots and 74 attached townhomes in eight separate buildings. Associated improvements include a community recreation center, private streets, sidewalks, parking areas, retaining walls, and landscaping. Site activities will include demolition of the existing former Endevco Corporation building and parking areas, and grading of pads and streets for the proposed residential use. The grading plan depicts planned cuts and fills (not including required remedial grading) up to approximately 40 and 15 feet respectively; with a net export of soils. A relatively large Mechanically Stabilized Earth (MSE) retaining wall up to 20 feet in height and more than 900 feet in length is proposed at the eastern boundary of the site.

Site water quality management plan consists of placement of multiple modular wetland areas that will capture low flow runoff and outlet it to the storm drain system to be constructed at the site.

The proposed building structures are anticipated to be relatively light-weight at-grade structures with maximum column and wall loads of approximately 30 kips and 2 kips per linear foot, respectively.

The recommendations given in this report are based upon the estimated structural loading,

grading and layout information above. We understand that the project plans are currently being developed at this time; LGC Geotechnical should be provided with updated project plans and any changes to structural loads when they become available, in order to either confirm or modify the recommendations provided herein.

1.3 Existing Conditions

The former Endevco Corporation site consists of a large building oriented approximately northwest-southeast, within an area of low to moderate relief adjacent to Rancho Viejo Road at the western portion of the site. A small slope below Rancho Viejo descends to the Interstate-5 right-of-way at the furthest western boundary of the site. Four broad terraces of asphalt parking areas and drive aisles gradually step up in elevation to the abandoned Endevco structure that is sited on the upper terrace. The parking areas are separated from surrounding streets and each other by small slopes vegetated with trees and scattered shrubs and grasses. An approximately 4:1 (horizontal to vertical) older, design cut slope ascends above the Endevco structure and parking area at the eastern boundary of the site. Including of offsite HOA portion of slope, this slope is up to approximately 130 feet tall, has v-ditches, and is moderately vegetated with grasses, few shrubs and scattered trees.

1.4 Background

Based on review of historic air photos (Historic Aerials, 2019), the western portion of the subject site was originally part of a large agricultural area through 1952, then the Interstate 5 freeway was constructed and no agricultural use was observed until 1967 when an orange grove covered the area including the current "Fluidmaster" site to the south. Several west-draining canyon/ravines crossed the larger site, and the middle small canyon was reportedly dammed with soil and utilized as a pond for watering the orange groves.

During 1970, the site was investigated for a proposed industrial development as reported in the referenced preliminary geologic and soil investigation by Converse, Davis, and Associates (Converse, 1970). The preliminary report was updated with the referenced foundation plan review report (Converse, 1970b). The original topography prior to grading of the site for the Endevco Corporation structure, consisted of moderate-size canyon requiring design cuts and fills up to approximately 40 feet and 25 feet, respectively, to create the existing graded site. Recommendations of the preliminary reports included removal of site vegetation, removal of variable density alluvial soils and uncontrolled fills prior to installation of canyon subdrains, and placement of on-site soils as compacted fill to design grades.

The site was graded and utilities installed between about April 1973 to December 1973 under the observation and testing of Converse (Converse, 1973b, c, & d). Based on review of the as-graded report, field density testing during grading was based on field density testing and laboratory compaction curves that were based on American Society for Testing and Materials (ASTM) Test Method D1557-70 (five layers). Based on the results of their testing and observation during grading, Converse concluded site soils were compacted to a minimum of 90 percent relative compaction.

1.5 *Geotechnical Evaluation by LGC Geotechnical*

LGC Geotechnical performed a subsurface geotechnical evaluation of the site consisting of the excavation of three large diameter borings ranging in depth from approximately 49 to 93 feet and downhole-logged by a geologist, excavation of six exploratory trenches for structural geologic data, excavation of four small-diameter borings ranging in depth from approximately 5 to 23 feet and pushing of six cone penetration test (CPT) soundings ranging in depth from approximately 32 to 53 feet below existing grade; 3) performed two field infiltration tests; 4) performed laboratory testing of select soil samples obtained during our subsurface evaluation

The approximate locations of bucket auger borings, hollow stem auger borings, exploratory trenches, and CPT soundings performed by LGC Geotechnical are shown on the Geotechnical Map (Sheet 1). All field logs are presented in Appendix B.

1.6 *Laboratory Testing*

Representative bulk and driven samples were retained for laboratory testing during our subsurface field evaluations. Laboratory testing included in-situ moisture content and in-situ dry density, Atterberg Limits, consolidation, direct shear and fully softened torsional ring shear.

The following is a summary of the laboratory test results.

- Dry density of the samples collected ranged from approximately 80 pounds per cubic foot (pcf) to 100 pcf, with an average of 93 pcf. Field moisture contents ranged from approximately 22 percent to 39 percent, with an average of 28 percent.
- Two Atterberg Limit (liquid limit and plastic limit) tests indicated Plasticity Index values ranging from 45 to 57.
- A fully softened torsional ring shear test was performed on a grab sample of site clay bed materials. The plot is provided in Appendix C.
- Two direct shear tests were performed on select undisturbed samples. The plots are provided in Appendix C.
- One consolidation test was performed on a select sample. The deformation versus vertical stress plot is provided in Appendix C.

A summary of the results is presented in Appendix C. The moisture and dry density results are presented on the boring logs in Appendix B.

LGC Geotechnical, Inc.

FIGURE 1
Site Location Map

PROJECT NAME	Creekside - SJC
PROJECT NO.	19029-01
ENG. / GEOL.	DJB/KTM
SCALE	NTS
DATE	July 2019

2.0 GEOTECHNICAL CONDITIONS

2.1 Regional Geology

The site is located on the southwestern border of the Peninsular Ranges. Specifically, the site lies within the sedimentary basin known as the Capistrano Embayment, a sub-horizontal deposit consisting of marine siltstone and clayey, siltstone bedrock of the Tertiary Period (late Miocene to early Pliocene Epoch; approximately 5 to 15 million years old) Capistrano Formation (Morton, 1999 & CDMG, 1974). This sedimentary unit, in excess of 3,000 feet thick near the center of the embayment, was uplifted, gently folded, and eroded to produce the low, rolling hillside topography observed today. More recently, the local geology has also been influenced by a rapid drop in sea level resulting in extensive erosion, creating numerous steep-sided drainage channels, and relatively steep slopes that are prone to landsliding.

Portions of the offsite slopes to the east are mapped within a seismic hazard zone for earthquake-induced landslide (CDMG, 2001b). However, the majority of hillsides in Southern California are within similar geologic settings are also mapped for potential for earthquake-induced landslide.

2.2 Site-Specific Geology

The geologic materials identified on the site include alluvium, older artificial fill, and the bedrock of the Capistrano Formation. The typical onsite characteristics of the materials are described in the following subsections (from youngest to oldest). The approximate lateral extent of the geologic units encountered is presented on the Geotechnical Map (Sheet 1). The topographic base utilized for our Geotechnical Map was provided by KHR Associates (KHR, 2019a).

The site is not located within a mapped State of California Earthquake Fault-Rupture Hazard Zone per compiled maps released by the CGS (2018), and no known active faults cross the site. The closest significant fault to the site is the active San Joaquin Thrust Fault, located approximately 5.5 miles north of the site.

Based on our review of the State of California Seismic Hazard Zone Report for the San Juan Capistrano 7.5 Minute Quadrangle (CDMG, 2001a), the site is not located within a potential liquefaction zone but is located partially within a zone of potential earthquake induced landslides. This report was prepared by the State to raise awareness of the potential for such hazards and to prompt appropriate investigation to evaluate these potentials on a site-by-site basis.

2.2.1 Artificial Fill – Older (Map Symbol - Afo)

Older artificial fill soils were encountered within the central area of the subject site as anticipated (Converse, 1973b). The material consists of variable layers of brown, grayish brown, and gray silt, clayey silt, sandy clay with scattered gravel and few cobbles, generally moist to very moist, stiff to very stiff.

2.2.2 *Quaternary Alluvium (Map Symbol – Qal)*

Quaternary alluvium was encountered by others during previous subsurface investigation and rough grading activities (Converse, 1970a & 1973b). The material was also encountered during the recent subsurface investigation, observed to be dark brown and dark gray silt, clay, and sandy clay with scattered gravels and cobbles. The material was very moist, moderately stiff to stiff, with few root casts and iron oxide staining.

2.2.3 *Tertiary Capistrano Formation (Map Symbol - Tc)*

Tertiary Capistrano Formation material underlies the entire site at depth. This material generally consists of very fine sandy siltstone, clayey siltstone, and few thin sandstone and very thin clay interbeds. Within the upper oxidized (weathered) portion of the formation this material is typically light gray to brown in color and is commonly has gypsum and iron-oxide along joints and fractures. The unoxidized portion of the Capistrano Formation is dark gray, very stiff to hard, fresh bedrock. In general, the Capistrano Formation material was found to be thickly bedded to massive with rare, very thin clay beds, and few concretionary nodules.

2.3 *Geologic Structure*

The Capistrano Formation bedrock as encountered in our large-diameter borings and exploratory trenches, consisted of mostly massive material with the exception of a few gently westerly dipping (approximately 5 to 7 degrees) beds. Jointing within the Capistrano Formation bedrock is commonly found to be moderately to steeply dipping, and generally randomly oriented. It should be noted, however, that low-angle joints (approximately 10 to 20 degrees) were observed in the upper several feet of the 4:1 (horizontal to vertical) slope at the eastern boundary of the site.

2.4 *Groundwater*

During our subsurface field evaluation, a groundwater table was not encountered. However, seepage was observed during downhole logging of the bucket auger borings (See Appendix B)

Seasonal fluctuations of groundwater elevations should be expected over time. In general, ground-water levels fluctuate with the seasons and local zones of perched groundwater may be present within the near-surface deposits due to local seepage or during rainy seasons. Local perched groundwater conditions or surface seepage may develop once site development is completed and landscape irrigation commences.

2.5 *Faulting and Seismic Hazards*

The subject site is not located within a State of California Earthquake Fault Zone (i.e., Alquist-Priolo Earthquake Fault Act Zone) and no "Holocene-active" faults were identified on the site

during our site evaluation (CGS, 2018). A fault is considered "Holocene-active" if evidence of surface rupture in Holocene time (the last approximately 11,700 years) is present.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. The nearby major active faults that could produce these secondary effects include the Whittier-Elsinore, Newport-Inglewood, and San Andreas Faults, among others. A discussion of these secondary effects is provided in the following sections.

2.5.1 Liquefaction and Dynamic Settlement

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction. Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry loose sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

The site is not located within a State of California Seismic Hazard Zone for liquefaction potential (CGS, 2001b). Since the site is underlain by primarily fine-grained compacted fill, competent alluvium, and very stiff to hard bedrock, the potential for liquefaction is considered to be very low.

2.5.2 Lateral Spreading

Lateral spreading is a type of liquefaction-induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures.

Due to the very low potential for liquefaction, the potential for lateral spreading is also considered to be very low.

2.6 *Seismic Design Parameters*

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2016 California Building Code (CBC). Representative site coordinates of latitude 33.5198 degrees north and longitude -117.6640 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class D are provided in Table 1 below.

TABLE 1

Seismic Design Parameters

Selected Parameters from 2016 CBC, Section 1613 - Earthquake Loads	**Seismic Design Values**
Site Class per Chapter 20 of ASCE 7	D
Risk-Targeted Spectral Acceleration for Short Periods (S_S)*	1.344g
Risk-Targeted Spectral Accelerations for 1-Second Periods (S_1)*	0.501g
Site Coefficient F_a per Table 1613.3.3(1)	1.0
Site Coefficient F_v per Table 1613.3.3(2)	1.5
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_aS_S$]	1.344g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_vS_1$]	0.751g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3)S_{MS}$]	0.896g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3)S_{M1}$]	0.501g
Mapped Risk Coefficient at 0.2 sec Spectral Response Period, C_{RS} (per ASCE 7)	0.981
Mapped Risk Coefficient at 1 sec Spectral Response Period, C_{R1} (per ASCE 7)	1.025
PGA_M (Section 11.8.3 of ASCE 7)	0.513g

* From SEAOC, 2019

A deaggregation of the PGA based on a 2,475-year average return period indicates that an earthquake magnitude of 6.7 at a distance of approximately 14.5 km from the site would contribute the most to this ground motion (USGS, 2008).

2.7 *Soil Shear Strength Parameters*

The soil shear strength parameters utilized in our slope stability analysis are based on laboratory testing of the onsite materials, our extensive experiences in Capistrano Formation bedrock, published shear strength data (CDMG, 2001a), and our professional judgement. Laboratory test results are provided in Appendix C.

TABLE 2

Soil Shear Strength Parameters for Slope Stability Analysis

Soil Type	ϕ (Degrees)	Cohesion (psf)
Capistrano Formation (massive)	28	850
Capistrano Formation Clay Bed	12	0
Compacted Fill	26	300

2.8 *Global Slope Stability Analyses*

Global slope stability analyses were performed on critical cross sections (A-A' through C-C') positioned throughout the site based on the proposed design profile. Slope stability analysis was performed using the computer program GSTABL7 with STEDwin version 2.005.3 (Gregory Geotechnical Software, 2013). Potential rotational and block surfaces were analyzed using Bishop's Modified Method and Janbu's Simplified Method, respectively. Where applicable, slope stability analysis was performed for static and seismic loading conditions. A minimum factor of safety of 1.5 is typically required for static loading conditions.

Seismic slope stability analysis was performed based on a horizontal seismic coefficient (Kh) of 0.15 with a minimum required factor of safety of 1.1. For bedding planes less than 12 degrees from the horizontal, pseudo-static (seismic) slope stability was not performed.

Once the proposed MSE Retaining Wall has been designed (including geogrid type, length, spacing, etc.), the global stability of the slopes shall be re-evaluated. There is potential that these geogrid layers may need to be extended beyond the requirements for local stability.

Slope stability analysis is provided in Appendix D.

2.9 *Infiltration Potential*

Based on our site evaluation and subsurface investigation, the majority of site soils (i.e., bedrock, fill and alluvium) are predominately fine-grained silts and clays that are known to have a very low hydraulic conductivity and therefore have very low infiltration rates.

TABLE 3

Summary of Field Infiltration Testing

Infiltration Test Location	Measured Infiltration Rate (inch/hr)*
I-1	0.0
I-2	0.0

*Includes a Factor of Safety of 2 for feasibility screening only

At the completion of grading, the proposed development will consist of compacted fill over bedrock. Engineered fill is considered unacceptable for infiltration in accordance with the Orange County Technical Guidance Document (County of Orange, 2017; "Section 4.2.2.4 Geotechnical Criteria") for the following reasons. After remedial grading, artificial fills will be greater than 5 feet thick across the majority of the site. Additionally, below the fill material will be native soils consisting of Capistrano Formation bedrock, generally more than 50 percent fine-grained, which is also unacceptable for infiltration from a geotechnical standpoint.

Based on two field infiltration tests, the measured infiltration rate of the existing fill and Capistrano Formation bedrock was essentially zero. (Refer to Appendix B for infiltration data summary)

Purposeful infiltration of water to the subsurface at the subject site is neither feasible nor acceptable from a geotechnical standpoint given the onsite materials and the hillside nature of the site.

3.0 CONCLUSIONS

Based on the results of our subsurface evaluation and geotechnical review of the Vesting Tentative Tract No. 19009 and preliminary grading plan, it is our opinion that the proposed improvements are feasible from a geotechnical standpoint, provided that the recommendations provided here and in future reports are incorporated during site grading and development. A summary of our geotechnical conclusions are as follows:

- The bedrock geologic unit mapped on the site is the Tertiary-aged Capistrano Formation. Compacted artificial fill placed in 1973 during original rough grading of the site, overlies bedrock or competent alluvium across the majority of the site. Subdrains were installed in canyon bottoms prior to fill placement.
- A groundwater table was not encountered during our subsurface field evaluation. However, some seepages were observed in the bucket auger borings (see Appendix B).
- Based on our review of the State of California Seismic Hazard Zones for the San Juan Capistrano 7.5 Minute Quadrangle, portions of the offsite slopes to the east are mapped within a zone having a potential for earthquake induced landslide. This potential will be mitigated with design cut and fill grading and remedial grading measures presented herein.
- Based on our review of the State of California Seismic Hazard Zones for the San Juan Capistrano 7.5 Minute Quadrangle, the site is not located within a zone having a potential for liquefaction. Due to the site being underlain by fine-grained cohesive compacted fill over formational material bedrock, the potential for liquefaction is considered to be very low.
- The main seismic hazard that may affect the site is from ground shaking from one of the active regional faults. The subject site will likely experience strong seismic ground shaking during its design life.
- Given that the proposed grading plan indicates that a majority of the site will be unloaded (design cut) and only shallow new fill (±15 feet) will be added, long-term fill settlement is expected to be within tolerable limits.
- Global slope stability analysis indicates global factor of safety greater than 1.5 and 1.1 for static and pseudo-static (seismic) loading conditions, respectively.
- Based on the results of laboratory testing conducted during original grading of the site and our local experiences, site soils have high expansion potential. Mitigation measures will be required for any planned foundations and site improvements, such as concrete flatwork, to minimize the impacts of expansive soils. In addition, improvements located adjacent to slopes will be impacted by slope creep.
- Based on the results of laboratory testing (sulfates and chlorides) conducted during original grading of the site and our local experience, site soils are considered corrosive per Caltrans Guidelines (Caltrans, 2012).
- Based on the results of infiltration testing and due to the hillside nature of the site, presence of fine-grained soils, it is our professional opinion that purposeful infiltration at the subject site is infeasible from a geotechnical and regulatory standpoint and therefore should not be performed.

4.0 PRELIMINARY RECOMMENDATIONS

The following recommendations are to be considered preliminary, and should be confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the owner.

It should be noted that the following geotechnical recommendations are intended to provide sufficient information to develop the site in general accordance with the 2016 CBC requirements. With regard to the possible occurrence of potentially catastrophic geotechnical hazards such as seismic shaking, earthquake-induced landslides, liquefaction, etc. the following geotechnical recommendations should provide adequate protection for the proposed development to the extent required to reduce seismic risk to an "acceptable level." The "acceptable level" of risk is defined by the California Code of Regulations as "that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project" [Section 3721(a)]. Therefore, repair and remedial work of the proposed improvements may be required after a significant seismic event. With regards to the potential for less significant geologic hazards to the proposed development such as expansive soils, fill settlement, slope creep, groundwater seepage, etc., the recommendations contained herein are intended as a reasonable protection against potential damaging effects. It should be understood, however, that our recommendations are intended to maintain the structural integrity of the proposed development and structures given the site geotechnical conditions, but cannot preclude the potential for some cosmetic distress or nuisance issues to develop as a result of the site geotechnical conditions.

The geotechnical recommendations contained herein must be confirmed to be suitable or modified based on the actual as-graded conditions.

4.1 Site Earthwork

We anticipate that earthwork at the site will consist of rough grading including design cuts and fills, excavation of one large buttress keyway along the easterly edge of the site, shallow remedial grading of near surface soils, installation of a subdrain system, and construction of Mechanically Stabilized Earth (MSE) walls and conventional retaining walls. In general, rough grading will be followed by the installation of utilities and foundations, and asphalt paving of interior streets. We recommend that earthwork onsite be performed in accordance with the following recommendations, the City of San Juan Capistano/2016 CBC requirements, and the General Earthwork and Grading Specifications for Rough Grading included in Appendix E. In case of conflict, the following recommendations shall supersede all previous recommendations and those included as part of Appendix E. The following recommendations should be considered preliminary and may be revised by the geotechnical consultant based on the actual conditions encountered during site grading.

4.1.1 Site Preparation

Prior to grading of areas to receive structural fill or engineered structures, the areas should be cleared of surface obstructions, vegetation, and debris. Vegetation and debris

should be removed and properly disposed of offsite. Holes resulting from the removal of buried obstructions, which extend below proposed removal bottoms, should be replaced with properly compacted fill material.

4.1.2 Buttress Keyway Excavation

The Geotechnical Map (Sheet 1) depicts the approximate location and depth of one large buttress keyway along the easterly edge of the site. The buttress keyway is shown in cross-sectional view on Geotechnical Cross Sections A-A' through C-C' (Sheet 2). Subdrains will be required for the buttress keyway at the lowest elevations available and along the buttress backcut at regular intervals. Refer to the General Earthwork & Grading Specifications (Appendix E) for details regarding keyway construction and subdrains.

4.1.3 Geologic Mapping

Removals, backcuts, and keyway excavations must be geologically mapped by the geotechnical consultant during earthwork construction to confirm the anticipated conditions. If unanticipated adverse joints, fractures, and/or bedding are exposed, additional analysis and/or remediation measures may be required. The grading contractor must trim the backcuts with a slope board to remove loose material to allow for confirmation geologic mapping. Updated and/or revised geotechnical recommendations may be required based on observed conditions.

4.1.4 Removals and Over-Excavation

Due to presence of variable near surface existing fill and bedrock, we recommend design cut pads or cut/fill transition pads be over-excavated 5 feet below finish pad grade, or a minimum of 2 feet below planned footings, whichever is greater. Lot over-excavation bottoms must be accepted and mapped by the geotechnical consultant prior to subsequent fill placement. In all design fill areas, we recommend the upper 5 feet from existing grade be removed and recompacted as fill. The actual depth and lateral extents of removals should be determined by the geotechnical consultant, based on subsurface conditions encountered during grading.

The actual depth and lateral extents of over-excavation should be determined by the geotechnical consultant, based on subsurface conditions encountered during grading.

4.1.5 Material for Fill

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are relatively free of organic materials and construction debris. This may require the use of a "root picker" during grading. Site soils are not considered suitable for placement within Mechanically Stabilized Earth (MSE) wall structural backfill zone. Refer to Section 4.1.6, Select Material for MSE Wall Backfill, for required fill materials within the Backfill Zone.

Any encountered oversized material (material larger than 8 inches in maximum dimension) must be appropriately handled as outlined in Appendix E.

Conventional (masonry) retaining wall backfill should consist of sandy soils with a maximum of 35 percent fines (passing the No. 200 sieve) per American Society for Testing and Materials (ASTM) Test Method D1140 (or ASTM D6913/D422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of organic materials, construction debris, and any material greater than 3 inches in maximum dimension. The site contains soils that are not suitable for retaining wall backfill due to their clay content and expansion potential; therefore, import will be required by the contractor for obtaining suitable backfill soil.

If any import is required for general fill (i.e., not the select fill for MSE/retaining wall backfill), it should consist of clean, relatively granular soils of Medium expansion potential (expansion index 90 or less based on ASTM D4829) and no particles larger than 3 inches in greatest dimension.

Although the site is a net export, the placement of demolition materials in compacted fill is acceptable from a geotechnical viewpoint provided the demolition material is broken up into pieces not larger than typically used for aggregate base (approximately 1 to 2-inches in maximum dimension) and well blended into fill soils with essentially no resulting voids. Demolition material placed in fills must be free of construction debris (wood, organics, etc.) and reinforcing steel. If asphalt concrete fragments will be incorporated into the demolition materials, approval from an environmental viewpoint or the City may be required and is not the purview of the geotechnical consultant. From our previous experience, we recommend that asphalt concrete fragments be limited to fill areas within planned street areas (i.e., not within building pad areas) or as MSE or conventional retaining wall backfill.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the latest requirements of Section 200-2 of the Standard Specifications for Public Works Construction ("Greenbook") for untreated base materials (except processed miscellaneous base) or Caltrans Class 2 aggregate base.

4.1.6 Select Material for MSE Wall Backfill

The proposed MSE Walls will require select backfill materials to be placed within the geogrid "reinforced" zone. The select fill shall consist of sandy materials with a maximum of 35 percent passing the No. 200 sieve and a Plasticity Index (PI) not exceeding 20. Due to the general fine-grained nature of the onsite soils, imported soil will be needed to meet this criteria.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

4.1.7 Subgrade Preparation Prior to Fill Placement

In general, removal bottom areas and areas to receive compacted fill should be scarified to a minimum depth of 6 to 8 inches, brought to a near-optimum moisture condition, and re-compacted in place. Removal bottoms and areas to receive fill should be observed and accepted by the geotechnical consultant prior to subsequent fill placement.

4.1.8 Fill Placement and Compaction

Material to be placed as fill should be brought to near optimum moisture content (generally near optimum to about 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Soils with high plasticity and high existing moisture contents are present which require significant moisture conditioning (either adding water or drying back) in order to achieve adequate compaction. The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and under the observation and testing performed by the geotechnical consultant. Any encountered oversized material as previously defined must be appropriately handled (Appendix E).

Fill placed on any slopes greater than 5:1 (horizontal to vertical) should be properly keyed and benched into firm and competent soils as it is placed in lifts. During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Fill slope faces should also be compacted to minimum project recommendations. This may require overbuilding of the slope face and trimming back to design grades. To improve surficial stability, vegetation specified by the landscape architect should be established on the slope face as soon as it is practical, refer to Section 4.3.3.

For MSE wall backfill, it is imperative that adequate compaction meeting project recommendations be obtained in the zone immediately behind the block units where compaction is typically achieved using hand equipment (e.g. whackers, etc.) in lieu of rubber-tired construction equipment.

Aggregate base material should be compacted to a minimum of 95 percent relative compaction near optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to a minimum of 90 percent relative compaction per ASTM D1557 near optimum moisture content.

4.1.9 *Conventional Retaining Wall Backfill and Compaction*

Conventional (masonry) retaining wall backfill should consist of sandy soils as outlined in Section 4.1.5. The limits of select sandy backfill should extend at minimum ½ the height of the retaining wall or the width of the heel (if applicable), whichever is greater, refer to Figure 2 (rear of text). Retaining wall backfill soils should be compacted in relatively uniform thin lifts to at least 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

4.1.10 *Shrinkage and Bulking*

Volumetric changes in earth quantities will occur when excavated onsite earth materials are replaced as properly compacted fill. The following is an ESTIMATE of shrinkage factors for the various geologic units found onsite. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction achieved during grading.

TABLE 4

Estimated Shrinkage

Soil Type	Allowance	Estimated Range
Compacted Fill	Shrinkage	0% to 5%
Capistrano Bedrock	Bulkage	5% to 10%

Subsidence due to earthwork equipment is expected to be on the order of 0.1 feet. It should be stressed that these values are only estimates and that actual shrinkage factors are extremely difficult to predict. The effective shrinkage of onsite soils will depend primarily on the type of compaction equipment and method of compaction used onsite by the contractor. The above shrinkage estimates are intended as an aid for others in determining preliminary earthwork quantities. However, these estimates should be used with some caution since they are not absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during grading. Shrinkage and bulking are also expected to vary with variations in survey accuracy during rough grading.

4.1.11 *Rippability and Oversize Material*

Based on observations during our subsurface investigation and experience at nearby sites in similar materials, we anticipate the Capistrano Formation bedrock and existing fill soils will be rippable with conventional earth-moving equipment in good condition. However, it should be noted that locally cemented beds or concretion nodules may be generated that do not break down and must be handled as "oversize" material during

fill placement. Recommendations for handling of oversize is presented in Appendix E, General Earthwork and Grading Specifications.

4.2 Slope Stability

Global slope stability for the site has been evaluated utilizing cross sections A-A' through C-C'. Buttress keyway limits and dimensions are presented on the Geotechnical Map (Sheet 1) and Cross Sections (Sheet 2). Recommendations for construction of slopes are presented below.

4.2.1 Fill Slopes

Design fill slopes at the site are anticipated to be both grossly and surficially stable as designed provided they are constructed in accordance with the Standard Earthwork and Grading Specifications (Appendix E) and proper irrigation, landscaping and maintenance is implemented (refer to Section 4.2.3). Fill slopes should be constructed with a maximum slope ratio of 2:1 (horizontal to vertical). Slope faces should also be compacted to minimum project recommendations. This may require overbuilding of the slope face and trimming back to design grades. To improve surficial stability, vegetation specified by the landscape architect should be established on the slope face as soon as it is practical, refer to Section 4.2.3.

4.2.2 Natural Slopes

The site is bordered by natural slopes to the east. These slopes will be subject to "natural" phenomena such as erosion, sloughing and surficial instabilities. It is impossible to predict where or when this may happen. Should erosion or surficial instability occur, it should be promptly repaired. Paramount in reducing the potential for either erosion or surficial instability is to properly maintain these slopes (refer to Section 4.2.3).

4.2.3 Slope Maintenance Guidelines

It is recommended that any graded slopes be planted with ground cover vegetation as soon as practical to protect against erosion by reducing runoff velocity. Deep-rooted vegetation that requires little water and is able to survive local climate conditions should also be established to protect against surficial slumping. Under no circumstances should slopes be allowed to be bare of vegetation. Landscape vegetation must not be "trimmed" to root structures leaving no protection of the slopes. Irrigation levels should be kept to the minimum level necessary to establish healthy plant growth. Slopes must not be overwatered. If automatic sprinklers are used, they must be adjusted during periods of rainfall. A landscape professional must be consulted for landscape recommendations.

A program for the elimination of burrowing animals in both native and graded slope areas must be established to protect slope stability by reducing the potential for surface water to penetrate into the slope. Continuous erosion control, rodent control, and

maintenance are essential to the long-term stability of all slopes. Trenches excavated on a slope face for utility or irrigation lines and/or for any purpose must be properly backfilled and compacted to project recommendations (refer to Section 4.1.8) to the slope face. Observation/testing and acceptance by the geotechnical consultant during trench backfill are recommended. V-ditches should be inspected and cleared of loose soil and/or debris on a routine basis, especially prior to and during the rainy season.

4.3 Provisional Foundation Recommendations

Based on the site geotechnical conditions and assuming the remedial recommendations provided herein are implemented, the site may be considered suitable for the support of the proposed residential structures using a post-tensioned slab-on-grade foundation system. Foundations must be designed to resist the impacts of expansive soils and estimated fill settlement. Soils with "High" expansion potential are anticipated. At the completion of grading, if soils with "Very High" expansion potential are encountered, supplemental geotechnical foundation recommendations will be provided.

4.3.1 Preliminary Post-Tensioned Foundation Design Parameters

The geotechnical parameters provided herein may be used for post-tensioned slab foundations. These parameters have been determined in general accordance with the Post-Tensioning Institute (PTI) Standard Requirements for Design of Shallow Post-Tensioned Concrete Foundations on Expansive Soils, referenced in Chapter 18 of the 2013 CBC. In utilizing these parameters, the foundation engineer should design the foundation system in accordance with the allowable deflection criteria of applicable codes and the requirements of the structural designer/architect. Other types of stiff slabs may be used in place of the CBC post-tensioned slab design provided that, in the opinion of the foundation structural designer, the alternative type of slab is at least as stiff and strong as that designed by the CBC/PTI method.

Our design parameters are based on our experience with similar projects, test results performed by others, and the anticipated nature of the soil (with respect to expansion potential). Please note that implementation of our recommendations will not eliminate foundation movement (and related distress) should the moisture content of the subgrade soils fluctuate. It is the intent of these recommendations to help maintain the integrity of the proposed structures and reduce (not eliminate) movement, based upon the anticipated site soil conditions. Should future homeowners not properly maintain the areas surrounding the foundation, for example by overwatering and/or incorrect landscape design, then we anticipate for highly expansive soils the maximum differential movement of the perimeter of the foundation to the center of the foundation to be on the order of a couple of inches. Soils of lower expansion potential are anticipated to show less movement.

TABLE 5

Preliminary Geotechnical Post-Tensioned Foundation Parameters for High Expansion

Parameter	PT Slab with Perimeter Footing	PT Mat with Thickened Edge
Expansion Index	High[1]	High[1]
Thornthwaite Moisture Index	-20	-20
Constant Soil Suction	PF 3.9	PF 3.9
Center Lift Edge moisture variation distance, e_m Center lift, y_m	 7.7 feet 0.75 inch	 7.7 feet 0.9 inch
Edge Lift Edge moisture variation distance, e_m Edge lift, y_m	 4.0 feet 1.65 inch	 4.0 feet 2.0 inch
Minimum Perimeter footing/thickened edge embedment below finish grade	24 inches[2]	6 inches[2]

1. Assumed for preliminary design purposes. Further evaluation is needed at the completion of grading.
2. Deepened footings may be required in certain areas due to slope setback criteria.
3. Moisture condition to 140% of optimum moisture content to a minimum depth of 24 inches prior to trenching.

4.3.2 Post-Tensioned Foundation Subgrade Preparation and Maintenance

Moisture conditioning of the subgrade soils is recommended prior to trenching the foundation. The recommendations, specific to anticipated site soil conditions, are presented in Table 5. The subgrade moisture condition of the building pad soils should be maintained at the recommended moisture content up to the time of concrete placement. This moisture content should be maintained around the immediate perimeter of the slab during construction and up to occupancy of the building structures.

The geotechnical parameters provided herein assume that if the areas adjacent to the foundation are planted and irrigated, these areas will be designed with proper drainage and adequately maintained so that ponding, which causes significant moisture changes below the foundation, does not occur. Our recommendations do not account for excessive irrigation and/or incorrect landscape design. Plants should only be provided with sufficient irrigation for life and not overwatered to saturate subgrade soils. Sunken planters placed adjacent to the foundation should either be designed with an efficient drainage system or liners to prevent moisture infiltration below the foundation. Some lifting of the perimeter foundation beam should be expected even with properly constructed planters.

In addition to the factors mentioned above, future homeowners/property management

personnel should be made aware of the potential negative influences of trees and/or other large vegetation. Roots that extend near the vicinity of foundations can cause distress to foundations. Future owners (and the owner's landscape architect) should not plant trees/large shrubs closer to the foundations than a distance equal to half the mature height of the tree or 20 feet, whichever is more conservative, unless specifically provided with root barriers to prevent root growth below the building foundation.

It is the homeowner's responsibility to perform periodic maintenance during hot and dry periods to ensure that adequate watering has been provided to keep soil from separating or pulling back from the foundation. Future homeowners and property management personnel should be informed and educated regarding the importance of maintaining a constant level of soil-moisture. The owners should be made aware of the potential negative consequences of both excessive watering as well as allowing potentially expansive soils to become too dry. Expansive soils can undergo shrinkage during drying and swelling during the rainy winter season or when irrigation is resumed. This can result in distress to building structures and hardscape improvements. The builder should provide these recommendations to future homeowners and property management personnel.

4.3.3 Slab Underlayment Guidelines

The following is for informational purposes only since slab underlayment (e.g., moisture retarder, sand or gravel layers for concrete curing and/or capillary break) is unrelated to the geotechnical performance of the foundation and thereby not the purview of the geotechnical consultant. Post-construction moisture migration should be expected below the foundation. The foundation engineer/architect should determine whether the use of a capillary break (sand or gravel layer), in conjunction with the vapor retarder, is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect.

4.4 Soil Bearing and Lateral Resistance

Provided our earthwork recommendations are implemented, an allowable soil bearing pressure of 1,500 pounds per square foot (psf) may be used for the design of footings having a minimum width of 18 inches and minimum embedment of 18 inches below lowest adjacent ground surface. This value may be increased by 300 psf for each additional foot of embedment or 150 psf for each additional foot of foundation width to a maximum value of 2,500 psf. Please note that due to expansive soils a minimum footing depth of 24-inches below lowest adjacent grade is recommended for building structures. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated above are for total dead loads and live loads. The above vertical bearing may be increased by one-third for short durations of loading which will include the effect of wind or seismic forces.

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to structural loads is anticipated

to be 1-inch or less. Differential settlement may be taken as half of the total settlement (i.e., ½-inch over a horizontal span of 40 feet).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction of 0.30 may be assumed with dead-load forces. An allowable passive lateral earth pressure of 230 psf per foot of depth (or pcf) to a maximum of 2,300 psf may be used for lateral resistance. Allowable passive pressure may be increased to 300 pcf to a maximum of 3,000 psf for short duration seismic loading. These passive pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. For a 2:1 (horizontal to vertical) downward sloping condition, a reduced passive lateral earth pressure of 85 pcf to a maximum of 850 psf may be used. This allowable passive pressure may be increased to 115 pcf to a maximum of 1,150 psf for short duration seismic loading. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. Frictional resistance and passive pressure may be used in combination without reduction. The provided allowable passive pressures are based on a factor of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively. The structural designer should incorporate appropriate factors of safety and/or load factors in their design.

4.5 Lateral Earth Pressures for Conventional Retaining Wall Design Not at Top of Slope

The following lateral earth pressures apply to conventional retaining walls that are not at the tops-of-slopes. Lateral earth pressures for typical retaining wall backfill are presented in Table 6 for approved granular soils a maximum of 35 percent fines (passing the No. 200 sieve per ASTM D1140) and an Expansion Index of 20 or less per ASTM D4829. Retaining wall backfill should also be limited to fill material not exceeding 3 inches in greatest dimension. Please note that the on-site soils are not suitable for use as retaining wall backfill. The retaining wall designer should clearly indicate on the retaining wall plans the required imported sandy soil backfill.

Lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft of depth or pcf. These values do not contain an appreciable factor of safety, so the retaining wall designer should apply the applicable factors of safety and/or load factors during design. A soil unit weight of 125 pcf may be assumed for calculating the actual weight of soil over the wall footing. The retaining wall designer should clearly indicate on the retaining wall plans the required sandy backfill.

TABLE 6

Lateral Earth Pressures – Sandy Backfill

Conditions	Equivalent Fluid Unit Weight (pcf)	
	Level Backfill	2:1 Backfill Sloping Upwards
	Sandy Backfill	Sandy Backfill
Active	35	55
At-Rest	55	80

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the earth pressure will be higher. This would include 90-degree corners of retaining walls. Such walls should be designed for "at-rest." The equivalent fluid pressure values assume free-draining conditions. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Surcharge loading effects from any adjacent structures should be evaluated by the retaining wall designer. In general, structural loads within a 1:1 (horizontal: vertical) upward projection from the bottom of the proposed retaining wall footing will surcharge the proposed retaining wall. In addition to the recommended earth pressure, retaining walls adjacent to streets should be designed to resist a uniform lateral pressure of 100 psf due to normal street vehicle traffic if applicable. The retaining wall designer should contact the geotechnical engineer for any required geotechnical input in estimating surcharge loads.

If required, the retaining wall designer may use a seismic lateral earth pressure increment of 5 pcf. This increment should be applied in addition to the provided static lateral earth pressure using a triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). Per Section 1803.5.12 of the 2010 CBC, the seismic earth pressure is applicable to "structures assigned to Seismic Design Category D, E, or F in accordance with Section 1613." This seismic lateral earth pressure is estimated using the procedure outlined by the Structural Engineers Association of California (Lew, et al, 2010).

Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. To reduce, but not eliminate, saturation of near surface (upper approximate 1-foot) soils in front of the retaining walls, the perforated subdrain pipe should be located as low as possible behind the retaining wall. The outlet pipe should be sloped to drain to a suitable outlet. In general, we do not recommend retaining wall outlet pipes be connected to area drains. If subdrains are connected to area drains, special care and information should be provided to homeowners to maintain these drains. Typical retaining wall drainage is illustrated in Figure 2. It should be noted that the recommended subdrain does not provide protection against seepage through the face of the wall and/or efflorescence. Efflorescence is generally a white crystalline powder (discoloration) that results when water containing

soluble salts migrates over a period of time through the face of a retaining wall and evaporates. If such seepage or efflorescence is undesirable, retaining walls should be waterproofed to reduce this potential.

Soil bearing and lateral resistance (friction coefficient and passive resistance) are provided in Section 4.4. Earthwork considerations (temporary backcuts, backfill, compaction, etc.) for retaining walls are provided in Section 4.1 (Site Earthwork) and the subsequent earthwork related sub-sections.

Please note that any proposed "top-of-slope retaining walls" will require separate geotechnical recommendations, not included herein.

4.6 Subsurface Water Infiltration

Recent regulatory changes in some jurisdictions have recommended that low flow runoff be infiltrated rather than discharged via conventional storm drainage systems. Typically, a combination of methods is implemented to reduce surface water runoff and increase infiltration including; permeable pavements/pavers for roadways and walkways and directing surface water runoff to grass-lined swales, retention areas, and/or drywells. It should be noted that intentionally infiltrating storm water conflicts with the geotechnical engineering objective of directing surface water away from structures and improvements. The geotechnical stability and integrity of the project site is reliant upon appropriately handling all surface water. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement. Infiltrated water may enter underground utility pipe zones and migrate along the pipe backfill, potentially impacting other improvements located far away from the point of infiltration.

Given that the measured infiltration rate was essentially zero and the hillside nature of the site, we strongly recommend against the intentional infiltration of storm water into subsurface soils.

4.7 Preliminary Asphalt Concrete Pavement Sections

Provisional minimum street sections are provided below for Traffic Indices from 5.0 to 6.0 and an R-value of 5. These recommendations must be confirmed with R-value testing of representative near-surface soils at the completion of grading and after underground utilities have been installed and backfilled. Final street sections should be confirmed by the project civil engineer based upon the projected design Traffic Index. If requested, LGC Geotechnical will provide sections for alternate TI values.

TABLE 7

Paving Section Options

Assumed Traffic Index	5.0	5.5	6.0
R-Value Subgrade	5	5	5
AC Thickness	4.0 inches	4.0 inches	5.0 inches
Aggregate Base Thickness	8.5 inches	10.5 inches	10.5 inches

The thicknesses shown are for minimum thicknesses. Increasing the thickness of any or all of the above layers will reduce the likelihood of the pavement experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of areas adjacent to the roadway will occur through the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the pavement.

Earthwork recommendations regarding aggregate base and subgrade are provided in Section 4.1 ("Site Earthwork") and the related sub-sections of this report.

4.8 *Soil Corrosivity to Concrete and Metal*

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils to buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

While LGC Geotechnical does not provide recommendations for corrosion, based on our experience typical mitigation measures include increased compressive strength for structural concrete, decreased water-to-cement ratio for structural concrete and/or encapsulation of post-tensioned cables.

Based on laboratory testing conducted during original grading of the site and our experience, the near-surface soils have a severity categorization of "Severe" and are designated to a class "S2" per ACI 318, Table 4.2.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, section 4.3 using the "S2" sulfate classification. This must be verified based on as-graded conditions.

4.9 *Control of Surface Water and Drainage Control*

From a geotechnical perspective, we recommend that compacted finished grade soils adjacent to the proposed structure be sloped away from the proposed structure and towards an approved drainage device or unobstructed swale. Drainage swales, wherever feasible, should not be constructed within 5 feet of building structures. Drainage should be designed by the project civil engineer so that a properly constructed and maintained system will prevent

ponding within 5 feet of the foundation. Code compliance of grades is not the purview of the geotechnical consultant.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Overwatering must be avoided.

4.10 Nonstructural Concrete Flatwork

Nonstructural concrete flatwork (such as walkways, patios, bicycle trails, etc.) has a high potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum guidelines outlined in Table 8. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress. Please note that these are preliminary recommendations that will need to be confirmed and/or modified based on as-graded conditions at the completion of grading.

TABLE 8

Minimal Guidelines for Nonstructural Concrete Flatwork for High Expansion Potential

	Homeowner Sidewalks	Private Drives	Patios/Entryways	City Sidewalk Curb and Gutters
Minimum Thickness (in.)	4 (nominal)	5 (full)	5 (full)	City/Agency Standard
Presoaking	Presoak to a depth of 12 inches	Presoak to a depth of 12 inches	Presoak to a depth of 12 inches	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on centers	No. 3 at 24 inches on centers	City/Agency Standard
Thickened Edge (in.)	—	8 x 8	8 x 8	City/Agency Standard
Crack Control Joints	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard
Aggregate Base Thickness (in.)	—	2	2	City/Agency Standard

To reduce the potential for driveways to separate from the garage slab, the builder may elect to install dowels to tie these two elements together. Similarly, future homeowners should consider the use of dowels to connect flatwork to the foundation.

4.11 Additional Geotechnical Plan Review

When available, any updated rough, precise grading, MSE and conventional retaining wall and foundation plans should be reviewed by LGC Geotechnical in order to verify our geotechnical recommendations are implemented. Updated recommendations and/or additional field work may be necessary. Additional analysis may be needed for excavation sequencing/temporary stability, MSE wall global stability, settlement potential in design fill areas, potential for slope creep/lot stretching, and geotechnical parameters for top-of-slope conventional retaining walls.

4.12 Geotechnical Observation and Testing During Construction

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during construction by a representative of LGC Geotechnical. Geotechnical observation and testing is required per Section 1705 of the 2016 California Building Code (CBC).

Geotechnical observation and/or testing should be performed by LGC Geotechnical at the following stages:

- During rough grading (removal/over-excavation bottoms, fill placement, buttress keyway excavation, etc.);
- Geologic mapping of temporary backcuts and buttress keyway backcut;
- During MSE and retaining wall backfill and compaction;
- During utility trench backfill and compaction;
- During drilling of any required CIDH (Cast-In-Drilled Hole) piers;
- During precise grading;
- After presoaking building pads and other concrete-flatwork subgrades, and prior to placement of aggregate base or concrete;
- Preparation of pavement subgrade and placement of aggregate base;
- After building and wall footing excavation and prior to placement of steel reinforcement and/or concrete; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

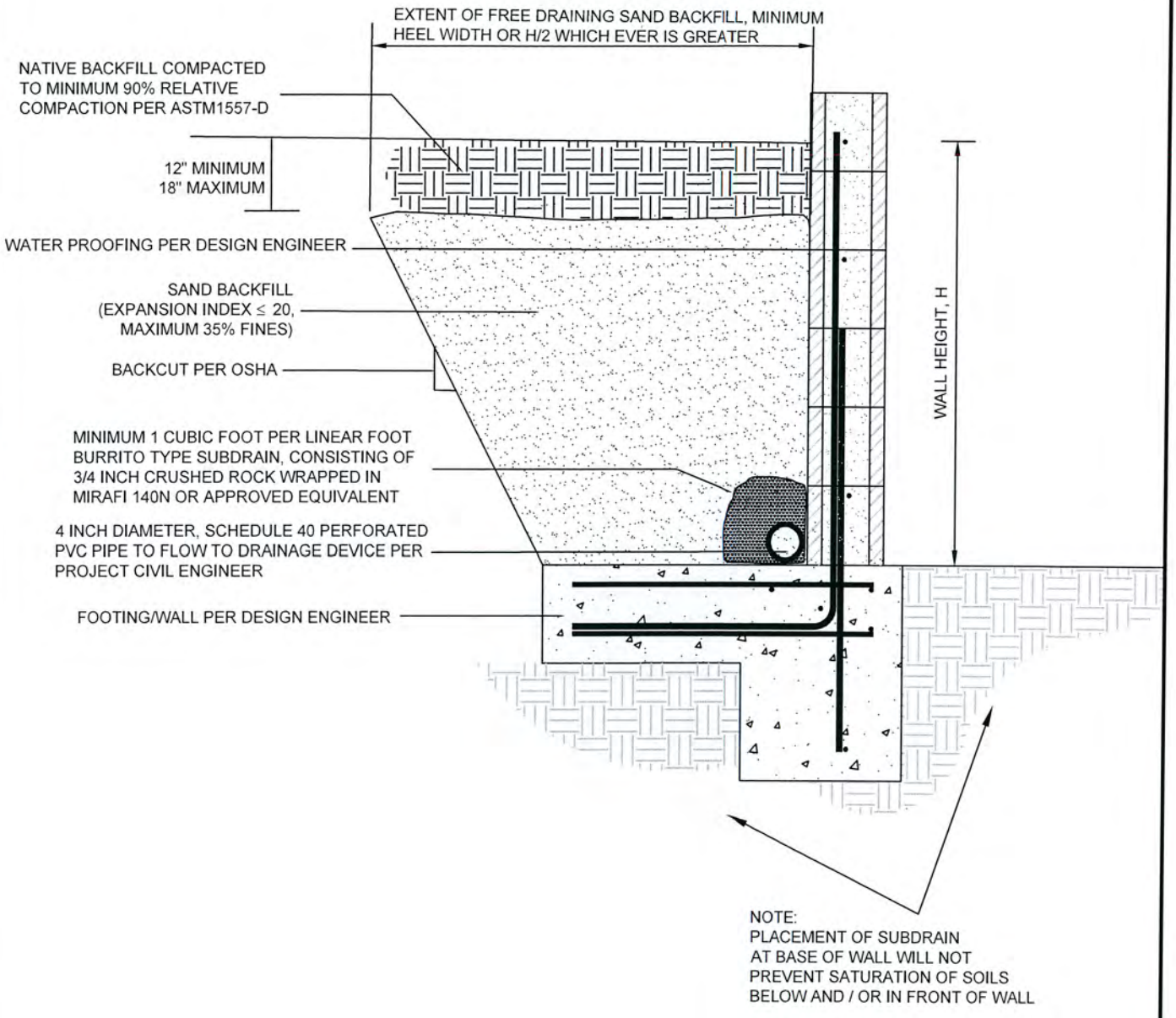
5.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is based on data obtained from limited observations of the site, which have been extrapolated to characterize the site. While the scope of services performed is considered suitable to adequately characterize the site geotechnical conditions relative to the proposed development, no practical evaluation can completely eliminate uncertainty regarding the anticipated geotechnical conditions in connection with a subject site. Variations may exist and conditions not observed or described in this report may be encountered during grading and construction.

The findings of this report are valid as of the present date. However, changes in the conditions of a site can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. The findings and conclusions presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site. This report is intended exclusively for use by the client, any use of or reliance on this report by a third party shall be at such party's sole risk.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification.



NOTE:
This Figure is not applicable to retaining walls constructed at the top of slopes

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FIGURE 2
Retaining Wall Backfill Detail

PROJECT NAME	Creekside - SJC
PROJECT NO.	19029-01
ENG. / GEOL.	DJB / KTM
SCALE	Not to Scale
DATE	July 2019

Appendix A
References

APPENDIX A

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Appendix B
Logs of Exploratory Excavations and Infiltration Test Results

Geotechnical Boring Log BA-1

Date : 5/13/2019 Page 1 of 4		**Drilling Company :** Alroy Drilling	
Project Name :		**Type of Rig :** EZ Bore	
Project Number : 19029-01		**Drop :** 12"	**Hole Diameter :** 26"
Elevation of Top of Hole : ~ 270 ' MSL		**Drive Weight :** 0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#	
Hole Location : See Geotechnical Map			

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0								**@ 0' to T.D. Tertiary Capistrano Formation (Tc)** @ 0' Silty SAND grading to SILTSTONE: brown to dark brown, zones of unoxidized material	
			J: N55E, 24S						@ 3' Joint attitude on gypsum filled joint, continuous around hole	
265	5		J: N85W, vert.						@ 5' Joint attitude on gypsum filled joint, 1/4" thick	
			J: N50E, 9S						@ 7' Joint attitude, gypsum	
260	10		B: N40-70W, 5S	R-1	2	80.7	39.3	MH	@ 10' Clayey SILTSTONE: dark brown to brownish gray, slightly moist, stiff; foraminifera @ 11' Seepage at base of locally fractured material. Possible flexural slip, lacks definitive clay. Rusty, slightly undulatory surface, unoxidized below	
255	15									
250	20			R-2	4	100.4	21.7	MH	@ 20' SILTSTONE: dark brown to gray, slightly moist, very stiff	DS
245	25									

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE

Last Edited: 5/21/2019

Geotechnical Boring Log BA-1

Date :	5/13/2019 Page 2 of 4	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :** 12"	**Hole Diameter :** 26"
Elevation of Top of Hole :	~ 270 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	30									
240	35		CB:N15W, 9W						@ 35' Clay bed attitude. CLAY: light gray, very moist to wet; 1/8 inch thick; polished surface; very active seepage. Below is SILTSTONE: dark gray; massive; unoxidized	
235	40									
230	45									
225	50			R-3	5	96.8	25.7	MH	@ 50' SILTSTONE: gray to dark gray, slightly moist, very stiff; faint petroliferous odor	
220	55									

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G	GRAB SAMPLE

TEST TYPES:

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Geotechnical Boring Log BA-1

Date :	5/13/2019 Page 3 of 4	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :**	12" **Hole Diameter :** 26"
Elevation of Top of Hole :	~ 270 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	60								Unoxidized SILTSTONE: dark gray, hard; massive; borehole walls wet from seepage from 35'	
215	65									
210	70									
205	75									
200	80			R-4	12	97.4	25.2	MH	@ 80' SILTSTONE: dark gray, slightly moist to moist, hard; odoriferous	DS
195	85									

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

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G	GRAB SAMPLE

TEST TYPES:

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Geotechnical Boring Log BA-1

Date :	5/13/2019 Page 4 of 4	**Drilling Company :**	Alroy Drilling
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Hole Location :	See Geotechnical Map		

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	90								Unoxidized SILTSTONE: dark gray, hard; massive; borehole walls wet from seepage from 35'	
190	95								**Total Depth = 93'** **Groundwater Seepage Encountered at 11' and 35'** **Backfilled with Cuttings and Tamped on 5/13/2019**	
185	100									
180	105									
175	110									
170	115									

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

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R	RING SAMPLE
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MD	MAXIMUM DENSITY
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S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE

Geotechnical Boring Log BA-2

Date :	5/14/2019 Page 1 of 2	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :** 12"	**Hole Diameter :** 26"
Elevation of Top of Hole :	~ 252 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
250	0								**@ 0' to 34' Older Artificial Fill (afo)** @ 0' Asphalt Concrete, 3" thick. Below is Clayey SILT to Silty CLAY with trace fine Sand: light orangish brown and grayish brown, moist to very moist, medium stiff to stiff; visible compaction lifts	
	5								@ 5' Increase moisture to very moist, decrease stiffness to soft to medium stiff	
245									@ 7' Decrease moisture to moist, increase stiffness to stiff; some dark fill layers	
	10			R-1	P	95.6	24.5	CL	@ 10' CLAY: light brown to olive brown, slightly moist to moist, medium stiff to stiff	
240									@ 13' Very moist, soft to medium stiff; lacks clear lifts	
	15									
235										
	20			R-2	P	88.5	32.1	CL	@ 20' CLAY to Sandy CLAY: light brown to olive brown, slightly moist to moist, soft; traces of iron oxide; few lenses of sand	
230									@ 22' Seepage	
	25								@ 24' Seepage. Decrease moisture, increase stiffness	
225									@ 27' Color change to dark gray and blue gray; odoriferous organic layer; few thin lift layers	

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE

Last Edited: 5/21/2019

Geotechnical Boring Log BA-2

Date :	5/14/2019 Page 2 of 2	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :** 12"	**Hole Diameter :** 26"
Elevation of Top of Hole :	~ 252 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by MJG/KTM

Sampled by MJG

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
220	30			R-3	P	89.4	33.5	CL	@ 30' CLAY: dark gray to olive gray, slightly moist to moist, stiff; few gravels; clasts of siltstone	CN
	35								**@ 34' to 40' Quaternary Alluvium (Qal)** @ 34' Silty CLAY with scattered Cobbles: dark gray with light gray pods, very moist to wet, medium stiff; few light gray fine sand lenses. Cobbles are subrounded, granitic, up to 6" in diameter.	
215										
	40			R-4	1	88.7	32.1	MH	**@ 40' to T.D. Tertiary Capistrano Formation (Tc)** @ 40' SILTSTONE: light olive brown, wet, very stiff to slightly hard; concretion lens up to 4" thick; becomes unoxidized with depth. Minor seepage, moisture decreases with depth	
210										
	45								@ 45' End visual log	
205										
	50								**Total Depth = 49'** **Groundwater Seepage at 23' and 41'** **Backfilled with Cuttings and Tamped on 5/14/2019**	
200										
	55									
195										

LGC Geotechnical, Inc.

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE

Geotechnical Boring Log BA-3

Date :	5/15/2019 Page 1 of 3	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :**	12" **Hole Diameter :** 26"
Elevation of Top of Hole :	~ 272 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by ARN/KTM

Sampled by ARN

Elevation (ft)	Depth (ft)	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
270	0							**@ 0' to T.D. Tertiary Capistrano Formation (Tc)** @ 0' Asphalt concrete, 5.5", over base, 2.5". Below is Clayey SILT to CLAY: brown and gray mottled, moist, very stiff; scattered gravel; concretion pieces @ 1.5' SILTSTONE: brown and gray brown, gypsum filled joints; fine sand pods and zones of bioturbation	
	5	J: N28E, 81SE						@ 4' Joint attitude on gypsum lined joint with iron oxide staining	
265		J: N50W, 36NE						@ 6' Joint attitude on gypsum lined joint; abundant jarosite laminations, faint low angle fine sandy siltstone lenses	
	10		R-1	4	96.4	25.7	MH	@ 9' Gypsum lined joints @ 10' SILTSTONE: light brown to brown, slightly moist, very stiff	
260								@ 12' Zones of unoxidized; micaceous; few foraminifera	
	15	B: N67E, 4W						@ 14' Bedding attitude on 2" thick sand lens zone; some iron oxide; increase gypsum	
		CB: N30E, 5NW	GB-1					@ 15.5' Clay bed attitude on CLAY: light greenish gray, moist, soft @ 16' Concretion continuous around boring, minor seepage out of gypsum lined joints	AL TS
255								@ 17' Minor seepage	
	20		R-2	5	92.5	28.5	MH	@ 20' SILTSTONE: gray, slightly moist, very stiff; foraminifera	
250									
	25							@ 26' Small sand burrows, light gray, fine-grained; scattered foraminifera	
245									

LGC Geotechnical, Inc.

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
TS	TORSIONAL SHEAR

Last Edited: 5/21/2019

Geotechnical Boring Log BA-3

Date :	5/15/2019 Page 2 of 3	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :**	12" **Hole Diameter :** 26"
Elevation of Top of Hole :	~ 272 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by ARN/KTM

Sampled by ARN

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
240	30								@ 30' SILTSTONE: olive gray, moist, hard; slightly fossiliferous; foraminifera	
									@ 32' Poorly cemented concretion lenses, up to 5" in diameter; soft sediment deformation; buff colored	
235	35									
230	40								@ 40' SILTSTONE: medium olive gray, moist, hard; trace foraminifera; fissile along bedding, subhorizontal	
225	45									
220	50								@ 50' Fine Sandy SILTSTONE: olive gray, moist, hard	
215	55		GB: N11W, 7SW						@ 59.5' General bedding on fabric of sand lenses. SILTSTONE: olive gray, moist, hard; scattered foraminifera	

LGC Geotechnical, Inc.

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
TS	TORSIONAL SHEAR

Geotechnical Boring Log BA-3

Date :	5/15/2019 Page 3 of 3	**Drilling Company :**	Alroy Drilling
Project Name :	Creekside - SJC	**Type of Rig :**	EZ Bore
Project Number :	19029-01	**Drop :** 12"	**Hole Diameter :** 26"
Elevation of Top of Hole :	~ 272 ' MSL	**Drive Weight :**	0' to 24'=4800; 25' to 58'=3350#; 59' to 86'=2045#; 87' to 115'=1200#
Hole Location :	See Geotechnical Map		

Logged by ARN/KTM

Sampled by ARN

Elevation (ft)	Depth (ft)	Graphic Log	Attitudes	Sample Number	Blow Count	Dry Density(pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
210	60								@ 62' Concretion, up to 12" thick; end visual log	
	65								**Total Depth = 65'** **Groundwater Seepage at 17'** **Backfilled with Cuttings and Tamped on 5/15/2019**	
205										
	70									
200										
	75									
195										
	80									
190										
	85									
185										

LGC Geotechnical, Inc.

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
TS	TORSIONAL SHEAR

Geotechnical Boring Log Borehole HS-1

Date: 5/29/2019
Drilling Company: Pacific Drilling
Project Name: Creekside - SJC
Type of Rig: Mini Mole: Track Mount Hollow Stem
Project Number: 19029-01
Drop: 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~231' MSL
Drive Weight: 140 pounds
Hole Location: See Geotechnical Map

Logged By CNJ
Sampled By CNJ
Checked By KTM

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
230	0							**@0' to 8' - Older Artificial Fill (afo)** @0' - CLAY with Sand: mottled brown, slightly moist grading to moist, trace gravel	
225	5								
								@8' to T.D. - Quaternary Alluvium (Qal)	
220	10		R-1	14 21 28			CL	@10' - CLAY with some sand & gravel: dark gray to dark brown mottled, slightly moist, very stiff; few rootlets and rootcasts; iron oxide; organic odor @13' - Significant rig chatter, very hard at 13'	
215	15								
								@20' - Clay with scattered coarse sand and gravel: dark grey, moist to very moist, very stiff, sand & gravels rounded, sticky clay	
210	20		R-2	15 25 25			CL	@23' - Drill chatter. Cobbles in dark gray to black CLAY matrix, moist to very moist. Refusal at 23', caved to 19' after augers pulled	
205	25							Total Depth = 23' Groundwater Not Encountered Backfilled with Cuttings on 5/29/2019	
	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 7/22/2019

Geotechnical Boring Log Borehole I-1

Date: 5/29/2019
Drilling Company: Pacific Drilling
Project Name: Creekside - SJC
Type of Rig: Mini Mole: Track Mount Hollow Stem
Project Number: 19029-01
Drop: 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~245' MSL
Drive Weight: 140 pounds
Hole Location: See Geotechnical Map

Logged By CNJ
Sampled By CNJ
Checked By KTM

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
240	0–5		B-1					**@0' to T.D. - Older Artificial Fill (afo)** @0' - Approximately 2" of asphalt concrete over approximately 3" of base, below is CLAY: olive brown, moist to very moist, stiff; trace gravel and sand @6' - CLAY with Sand: dark gray, slightly moist	
235	5–10		R-1	17 27 28			CL	@8.5' - CLAY with fine Sand: gray brown, brown, and dark brown mottled, slightly moist to moist, very stiff	
230	10–15							Total Depth = 10' Groundwater Not Encountered Temporarily Backfilled with 3" Perforated Pipe with Filter Sock, Gravel and Pre-Soaked on 5/29/2019. Pipe Removed and Boring Backfilled with Cuttings and Capped with Asphalt Cold Patch on 5/30/2019.	
225	15–20								
220	20–25								
	25–30								

LGC Geotechnical, Inc.

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 7/22/2019

Geotechnical Boring Log Borehole I-2

Date: 5/29/2019
Drilling Company: Pacific Drilling
Project Name: Creekside - SJC
Type of Rig: Mini Mole: Track Mount Hollow Stem
Project Number: 19029-01
Drop: 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~251' MSL
Drive Weight: 140 pounds
Hole Location: See Geotechnical Map

Logged By CNJ
Sampled By CNJ
Checked By KTM

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
250	0							**@0' to T.D. - Tertiary Capistrano Formation (Tc)** @0' - Asphalt concrete over is CLAY: light brown and olive brown mottled, moist, trace gravel and sand @3.5' - Fine Sandy Siltstone: light gray brown and light brown mottled, slightly moist, very stiff, hard, weathered, jointing, iron oxide, gypsum, manganese oxide, root casts	
	5		R-1	11 19 27					
245								Total Depth = 5' Groundwater Not Encountered Temporarily Backfilled with 3" Perforated Pipe with Filter Sock, Gravel and Pre-Soaked on 5/29/2019. Pipe Removed and Boring Backfilled with Cuttings and Capped with Asphalt Cold Patch on 5/30/2019.	
	10								
240									
	15								
235									
	20								
230									
	25								
225									
	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

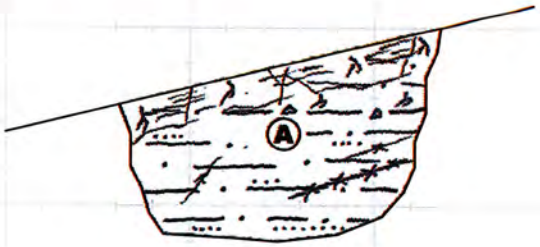
DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 7/22/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-1	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
CB: N10W, 5-7 W J: NS, 14W	A	**@0'-T.D. Tertiary Capistrano Formation** **@0' Clayey SILTSTONE with Clay and Sand lenses: light brownish gray and light brown, moist to very moist, very stiff; weathered; blocky** **@2' Clay bed attitude. CLAY: light reddish brown, very moist; lean; slightly undulatory; material below is slightly to moderately weathered; iron oxide staining; bioturbation; few rootlets; gypsum-lined joints** **@4' Joint attitude on gypsum lined joint**	Tc	ML CL			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 289 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**



Total Depth: 6'
Groundwater: None
Backfilled: 5/13/2019

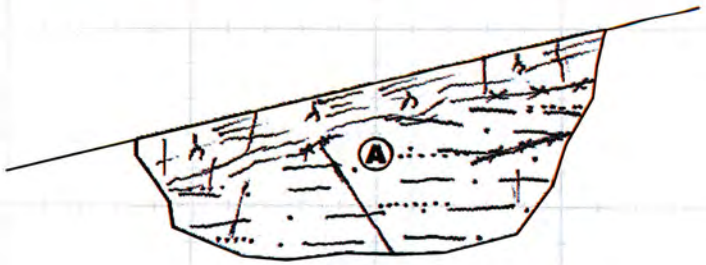
scale : 1 in = 5 ft

Last Edited: 5/21/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-2	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
B:N10W,6W J:N34W,15S B:N12W,3SW J:N63E,85N	A	@0'-T.D. Tertiary Capistrano Formation @0' Clayey SILTSTONE with trace fine Sand lenses: light brownish gray with orange staining, very moist, very stiff; very weathered upper 2' with thin topsoil; roots; low angle jointing; iron oxidized and abundant gypsum to 3/4" thick; jarosite @1' Bedding attitude on fine sand lens @1.5' Joint attitude on 1/2" thick gypsum lined joint @3' Bedding attitude, jarosite stained sand lenses @4' Joint attitude , gypsum	Tc	ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 286 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**



Total Depth: 6.5'
Groundwater: None
Backfilled: 5/13/2019

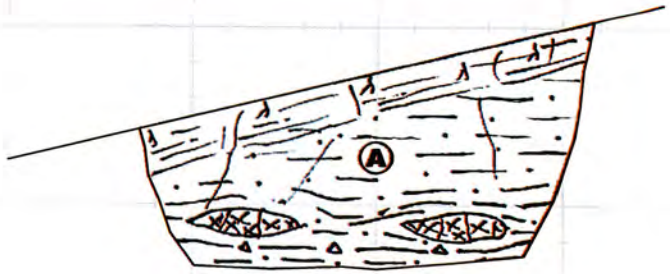
scale : 1 in = 5 ft

Last Edited: 5/21/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-3	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	@0'-T.D. Tertiary Capistrano Formation @0' Clayey SILTSTONE grading to SILTSTONE with Clay: light gray and brown, dry to moist; abundant foraminifera; fissile; extremely weathered; jarosite along jointing @3' Concretions, undulatory, "boudinage" shape, up to approximately 1' thick	Tc	ML			
CB: N70E, 7NW		@4' Clay bed attitude at base of concretions. CLAY: light gray, moist, soft; roots along bed		CL	GB-1		

GRAPHICAL REPRESENTATION BELOW: **Elevation : 292 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**



Total Depth: 6'
Groundwater: None
Backfilled: 5/13/2019

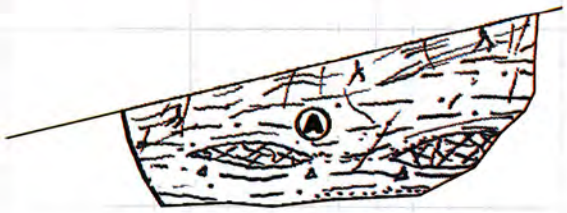
scale : 1 in = 5 ft

Last Edited: 5/21/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-4	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
B:N5W,85S	A	@0'-T.D. Tertiary Capistrano Formation @0'SILTSTONE: light gray and brownish gray, very moist, slightly stiff; foraminifera; fissile; manganese oxide; gypsum along jointing; iron oxide @3' Concretion, undulatory, "boudinage" shape, up to approximately 1' thick @4' CLAY: light gray, moist, soft; roots; very thin at base of concretion. Below is SILTSTONE: light gray, moist, stiff to very stiff @5' Bedding attitude on foraminifera and iron oxide parting	Tc	ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 285 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**



Total Depth: 5'
Groundwater: None
Backfilled: 5/13/2019

scale : 1 in = 5 ft

Last Edited: 5/21/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-5	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
J: N55W,22S J: NS, 26W B: 7SW (dip)	A	@0'-T.D. Tertiary Capistrano Formation @0' SILTSTONE with trace fine Sand: light brownish gray, moist, hard; iron oxide staining; gypsum lined low angle joints; bioturbated siltstone with sand zones @2' Joint attitude @3' Joint attitude @4' Bedding dip direction on bioturbated sandy zone, approximately 4" thick, continuous around trench	Tc				

GRAPHICAL REPRESENTATION BELOW: **Elevation : 288 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**

Total Depth: 5'
Groundwater: None
Backfilled: 5/13/2019

scale : 1 in = 5 ft

Last Edited: 5/21/2019

Project Name: Creekside - SJC	Logged By: KTM	Trench No: T-6	LGC Geotechnical, Inc.
Project Number : 19029-01	Date : 5/13/2019	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
J: N12W, 25W J: N85W, 20SE	A	@0'-T.D. Tertiary Capistrano Formation @0' SILTSTONE with trace fine Sand: light brownish gray, moist, very stiff; iron oxide; bioturbated; sand lense up to 3" thick, dips 7 degrees to the southwest; upper 2' very weathered with jarosite and rootlets @1' Joint attitude @3' Joint attitude	Tc				

GRAPHICAL REPRESENTATION BELOW: **Elevation : 283 ' MSL** **Surface Slope: 14 degrees** **Trend: N45E**

Total Depth: 5'
Groundwater: None
Backfilled: 5/13/2019

scale : 1 in = 5 ft

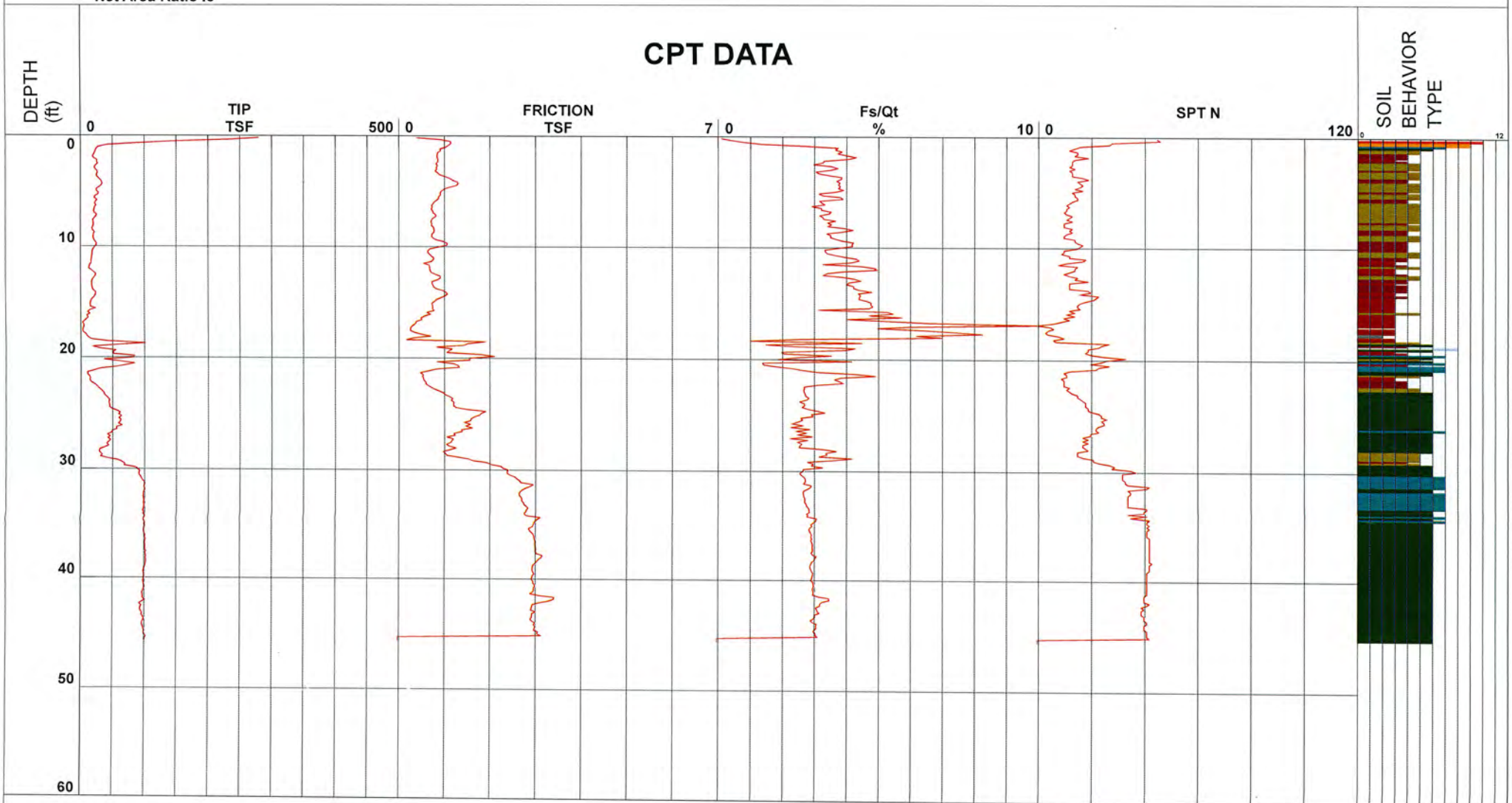
Last Edited: 5/21/2019

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(696).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-01A	Date and Time	5/29/2019 8:04:54 AM	Maximum Depth	45.60 ft
EST GW Depth During Test		>45.60 ft			

Net Area Ratio .8

CPT DATA



- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

Cone Size 15cm squared

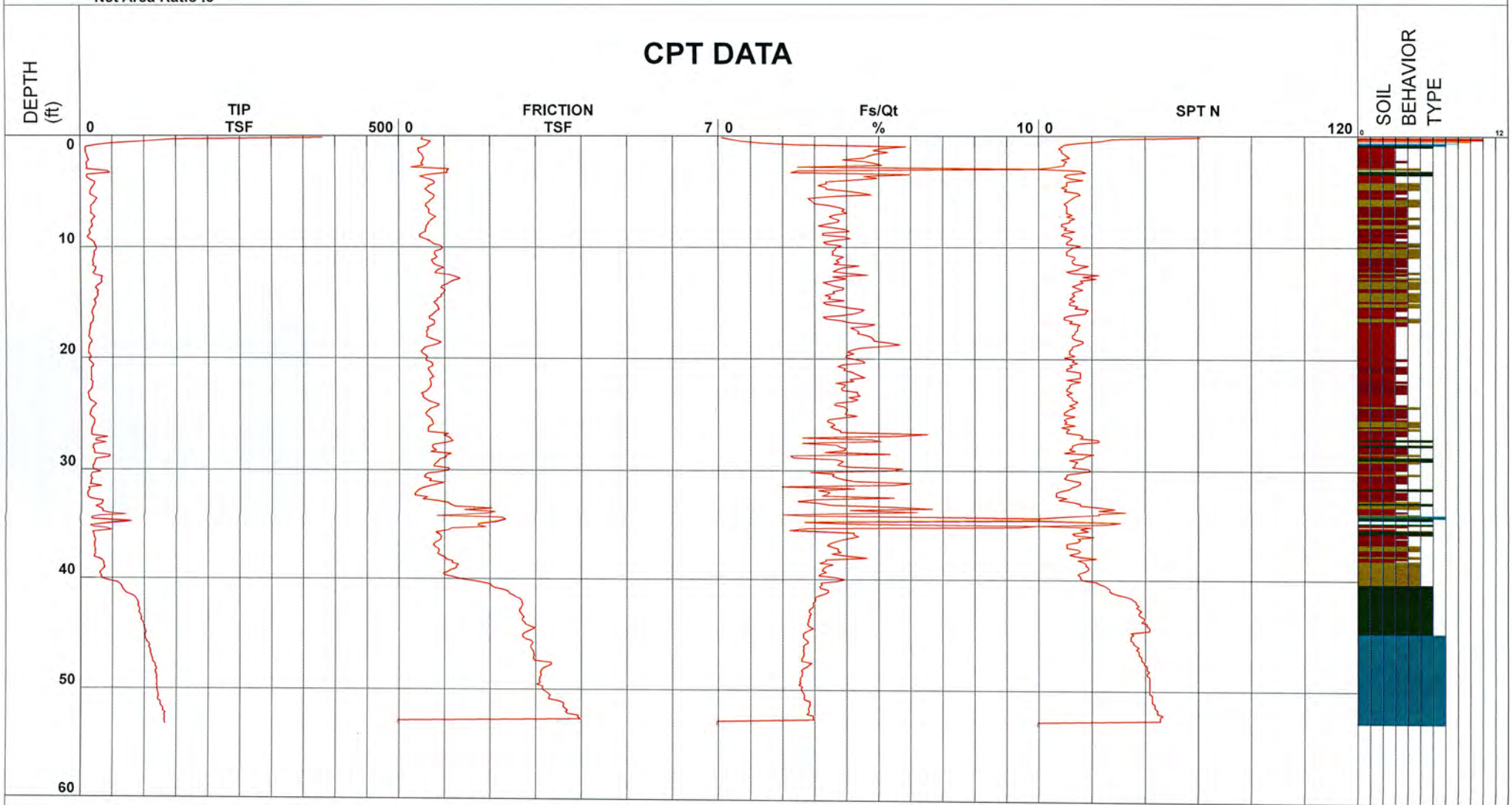
S*Soil behavior type and SPT based on data from UBC-1983

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(697).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-02	Date and Time	5/29/2019 8:53:37 AM	Maximum Depth	53.15 ft
EST GW Depth During Test		>53.15 ft			

Net Area Ratio .8

CPT DATA



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7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

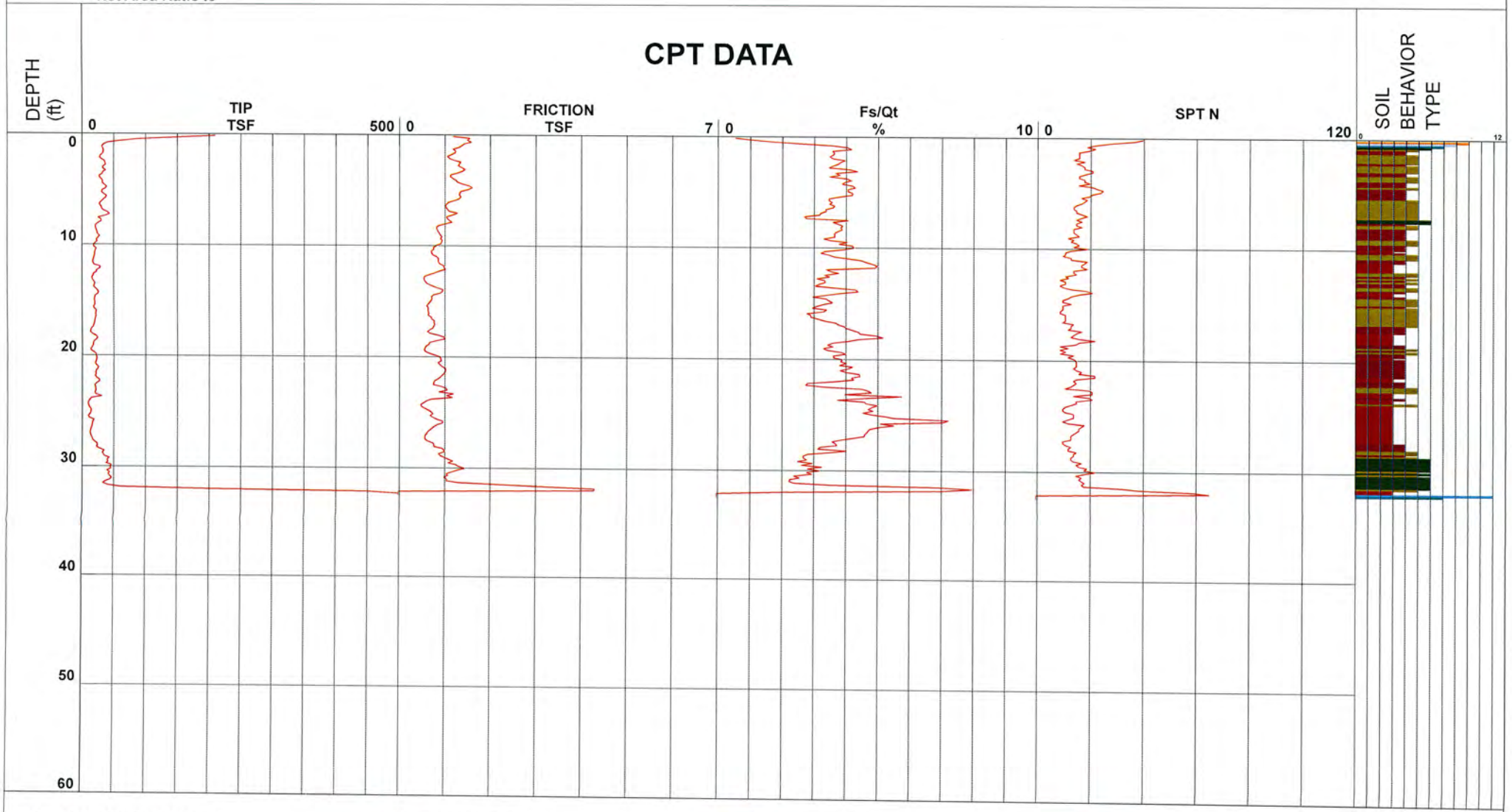
S*Soil behavior type and SPT based on data from UBC-1983

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(698).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-03	Date and Time	5/29/2019 9:40:54 AM	Maximum Depth	32.48 ft
EST GW Depth During Test		>32.48 ft			

Net Area Ratio .8

CPT DATA



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7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

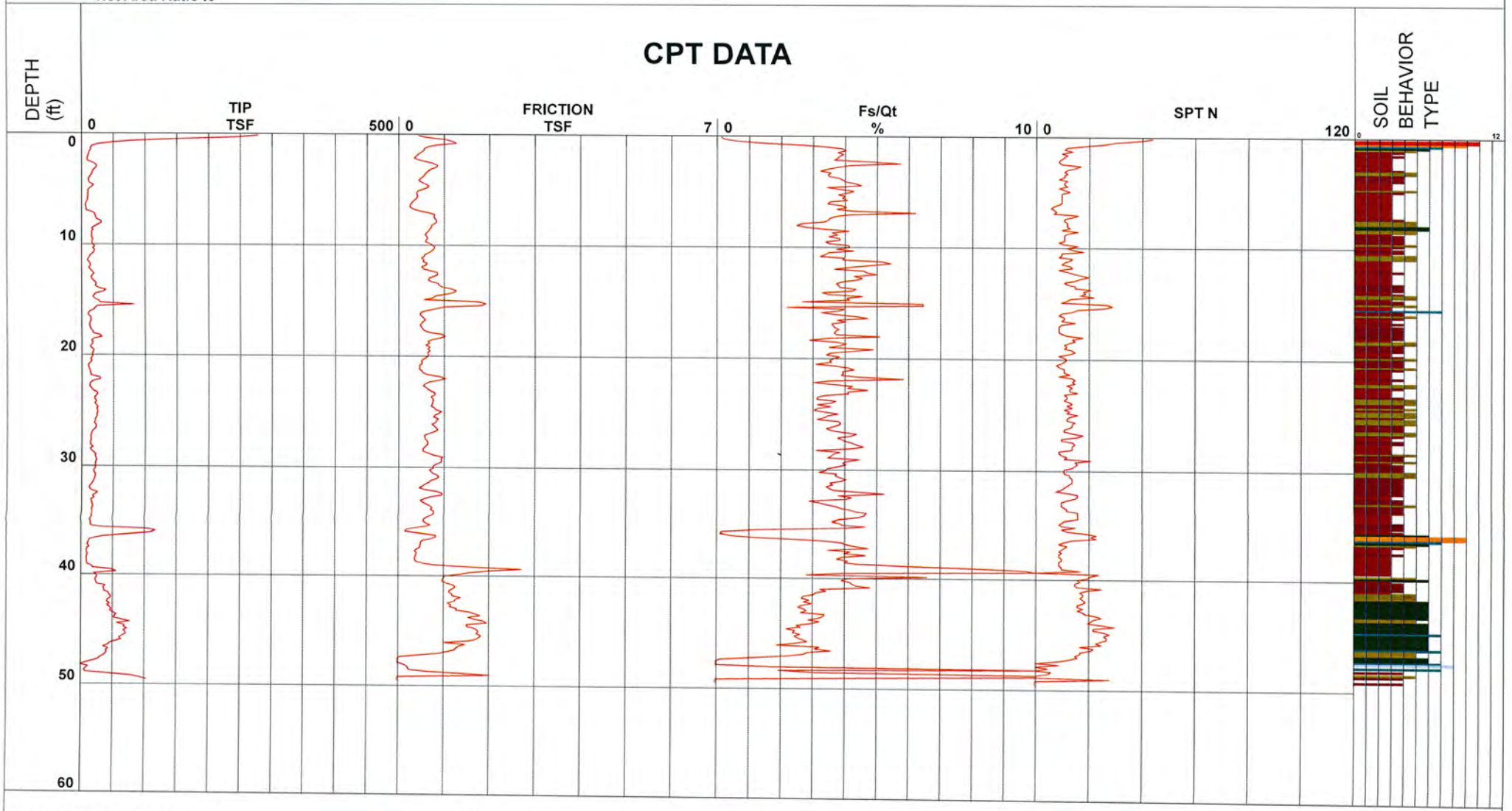
S*Soil behavior type and SPT based on data from UBC-1983

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(700).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-04	Date and Time	5/29/2019 10:13:25 AM	Maximum Depth	49.54 ft
EST GW Depth During Test		>49.54 ft			

Net Area Ratio .8

CPT DATA



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6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

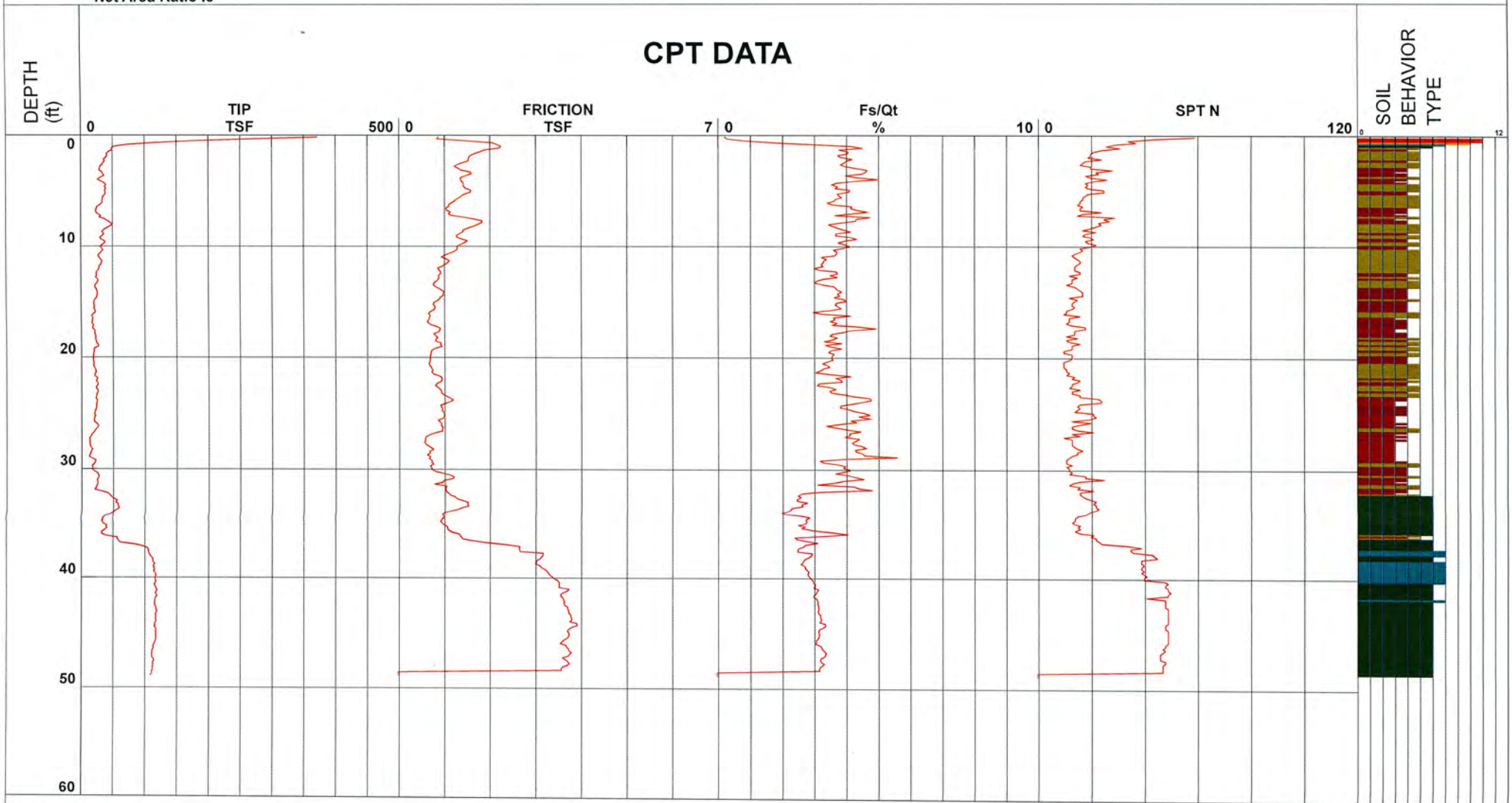
S*Soil behavior type and SPT based on data from UBC-1983

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(701).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-05	Date and Time	5/29/2019 10:58:35 AM	Maximum Depth	48.88 ft
EST GW Depth During Test		>48.88 ft			

Net Area Ratio .8

CPT DATA



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6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

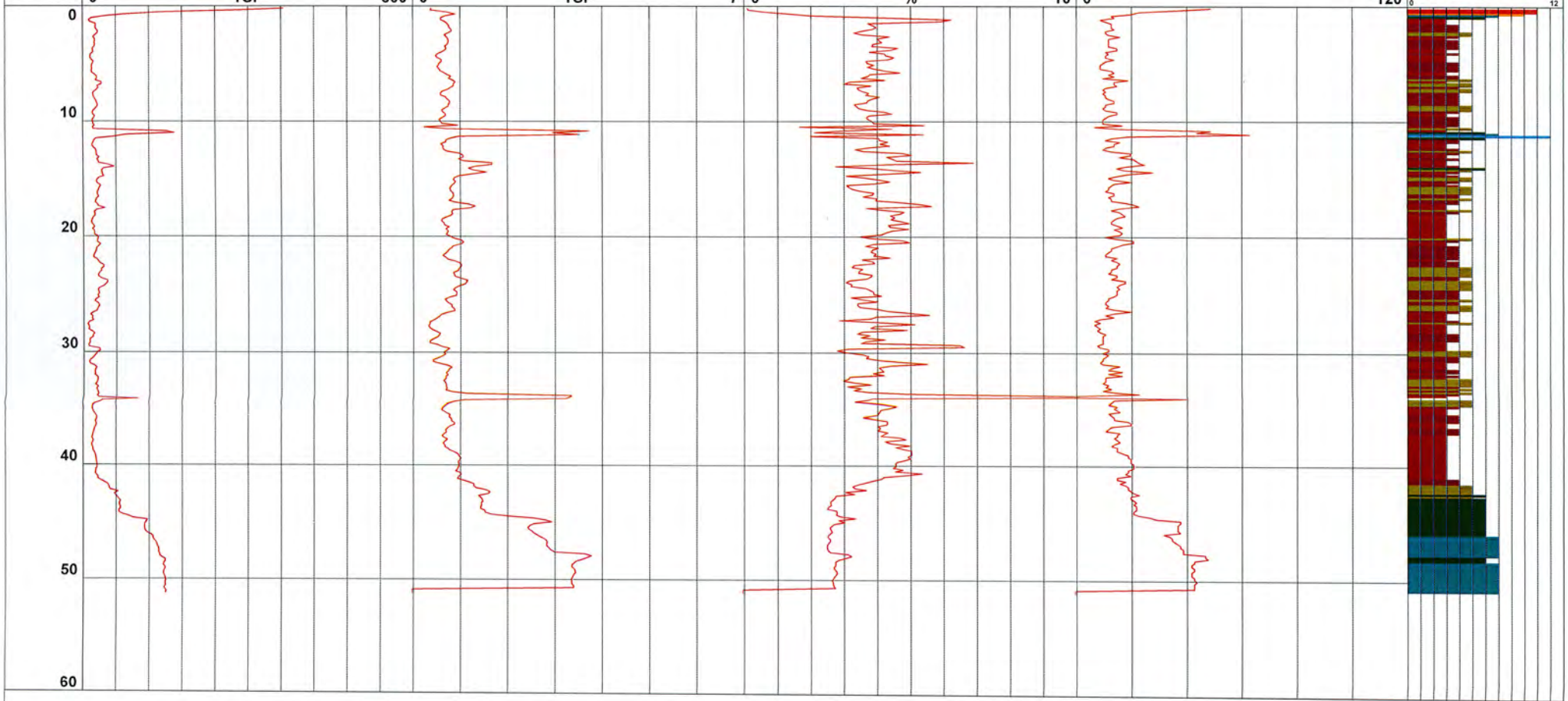
S*Soil behavior type and SPT based on data from UBC-1983

LGC Geotechnical Inc.

Project	Rancho Viejo	Operator	RC AS	Filename	SDF(702).cpt
Job Number	19029-01	Cone Number	DDG1471	GPS	
Hole Number	CPT-06	Date and Time	5/29/2019 11:47:29 AM	Maximum Depth	51.18 ft
EST GW Depth During Test		>51.18 ft			

Net Area Ratio .8

CPT DATA



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5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

Infiltration Test Data Sheet

LGC Geotechnical, Inc
131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

Project Name: Rancho Viejo
Project Number: 19029-01
Date: 5/30/2019
Boring Number: I-1

Test hole dimensions (if circular)	
Boring Depth (feet)*:	10
Boring Diameter (inches):	8
Pipe Diameter (inches):	3

*measured at time of test

Test pit dimensions (if rectangular)	
Pit Depth (feet):	
Pit Length (feet):	
Pit Breadth (feet):	

*Pre-Test (Sandy Soil Criteria)**

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Greater Than or Equal to 0.5 feet (yes/no)
1	7:40	8:05	25	4.05	3.89	0.16	No
2	8:05	8:30	25	3.89	3.81	0.08	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

Main Test Data

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval, Dt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, DD (feet)*	Calculated Infiltration Rate(in/hr)
1	8:31	9:01	30	4.07	3.89	0.18	0.1
2	9:01	9:31	30	3.89	3.82	0.07	0.0
3	9:31	10:01	30	4.23	4.11	0.12	0.1
4	10:01	10:31	30	4.11	4.09	0.02	0.0
5	10:31	11:01	30	4.09	4.07	0.02	0.0
6	11:01	11:31	30	4.07	4.06	0.01	0.0
7	11:31	12:01	30	4.06	4.05	0.01	0.0
8	12:01	12:31	30	4.05	4.05	0.00	0.0
9	12:31	13:01	30	4.05	4.04	0.01	0.0
10	13:01	13:31	30	4.04	4.05	0.01	0.0
11	13:31	14:01	30	4.05	4.04	0.01	0.0
12	14:01	14:31	30	4.04	4.05	0.01	0.0

Measured Infiltration Rate (No factor of safety)	**0.0**
Feasibility Factor of Safety	**2.0**
Measured Infiltration Rate (With Factor of Safety)	**0.0**

Sketch:

Notes:
* Beyond the 1/4" accuracy of the test

Based on Guidelines from: Orange County 12/20/2013
Spreadsheet Revised on: 10/26/2016

LGC Geotechnical, Inc.

Infiltration Test Data Sheet

LGC Geotechnical, Inc
131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

Project Name: Rancho Viejo
Project Number: 19029-01
Date: 5/30/2019
Boring Number: I-2

Test hole dimensions (if circular)	
Boring Depth (feet)*:	5
Boring Diameter (inches):	8
Pipe Diameter (inches):	3

*measured at time of test

Test pit dimensions (if rectangular)	
Pit Depth (feet):	
Pit Length (feet):	
Pit Breadth (feet):	

*Pre-Test (Sandy Soil Criteria)**

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Greater Than or Equal to 0.5 feet (yes/no)
1	7:31	7:56	25	1.90	1.92	0.02	No
2	7:56	8:21	25	1.92	1.94	0.02	No

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

Main Test Data

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval, Dt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, DD (feet)	Calculated Infiltration Rate(in/hr)
1	8:21	8:51	30	1.94	1.96	0.02	0.0
2	8:51	9:21	30	1.96	1.98	0.02	0.0
3	9:21	9:51	30	1.96	1.99	0.03	0.0
4	9:51	10:21	30	1.99	2.1	0.11	0.1
5	10:21	10:51	30	2.01	2.03	0.02	0.0
6	10:51	11:21	30	2.03	2.05	0.02	0.0
7	11:21	11:51	30	2.05	2.07	0.02	0.0
8	11:51	12:21	30	2.07	2.09	0.02	0.0
9	12:21	12:51	30	2.09	2.1	0.01	0.0
10	12:51	1:21	30	2.1	2.12	0.02	0.0
11	1:21	1:51	30	2.12	2.13	0.01	0.0
12	1:51	2:21	30	2.13	2.15	0.02	0.0

Measured Infiltration Rate (No factor of safety)	**0.0**
Feasibility Factor of Safety	**2.0**
Measured Infiltration Rate (With Factor of Safety)	**0.0**

Sketch:

Notes:

Based on Guidelines from: Orange County 12/20/2013
Spreadsheet Revised on: 10/26/2016

LGC Geotechnical, Inc.