Storm Water Management Plan
For Priority Projects
(Major SWMP)

Project Name:	**Ridge Creek Tentative Map** **APN 105-310-22-00**
Permit Number (Land Development Projects):	**TM 5469** ER 05-02-043
Work Authorization Number (CIP):	**n/a**
Applicant:	**Leising Builders, Inc.**
Applicant's Address:	**1295 Via Vista** **Fallbrook, CA 92028**
Plan Prepare By (*Leave blank if same as applicant*):	**Aquaterra Engineering Inc.** **1843 Campesino Place** **Oceanside, CA 92054** **(760) 439-2802**
Original Date:	**December 14, 2005**
Revision Date (If applicable):	**March 29, 2006** **August 7, 2006** **November 16, 2006** **March 22, 2007** **August 13, 2007**

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9424) requires all applications for a permit or approval associated with a Land Disturbance Activity must be accompanied by a Storm Water Management Plan (SWMP) (section 67.804.f). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWMP need revisions?		If YES, provide Revision Date
	YES	NO	

Instructions for a Major SWMP can be downloaded at http://www.co.sandiego.ca.us/dpw/stormwater/susmp.html.

Completion of the following checklist and attachments will fulfill the requirements of a Major SWMP for the project listed above.

PROJECT DESCRIPTION

Project Location: The project is located approximately 3 miles east of downtown Fallbrook and a mile west of Interstate 15, north on East Mission at Ridge Creek Drive. The site exists as a 33-acre parcel with rolling terrain with planted fields. The site has a southern exposure and historical drainage patterns from north to south. A Vicinity Map and site plan are attached for review.

Project Description: This application is for a Tentative Map for a 14 lot subdivision. The 33 acre site will be divided in to 14 parcels. The site will ultimately be developed for single family residences with a paved private road that will run through the center of the subdivision.

PRIORITY PROJECT DETERMINATION

Please check the box that best describes the project. Does the project meet one of the following criteria?

PRIORITY PROJECT	YES	NO
Redevelopment within the County Urban Area that creates or adds at least 5,000 net square feet of additional impervious surface area		X
Residential development of more than 10 units	X	
Commercial developments with a land area for development of greater than 100,000 square feet		X
Automotive repair shops		X
Restaurants, where the land area for development is greater than 5.000 square feet		X
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface		X
Environmentally Sensitive Areas: All development and redevelopment located within or directly adjacent to or discharging directly to an environmentally sensitive area (where discharges from the development or redevelopment will enter receiving waters within the environmentally sensitive area), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition.		X
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff		X
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater	X	

Limited Exclusion: Trenching and resurfacing work associated with utility projects are not considered priority projects. Parking lots, buildings and other structures associated with utility projects are subject to SUSMP requirements if one or more of the criteria above are met.

If you answered **NO** to all the questions, then **STOP**. Please complete a Minor SWMP for your project. If you answered **YES** to any of the questions, please continue.

The following questions provide a guide to collecting information relevant to project stormwater quality issues. Please provide a description of the findings in text box below.

	QUESTIONS	COMPLETED	NA
1.	Describe the topography of the project area.	X	
2.	Describe the local land use within the project area and adjacent areas.	X	
3.	Evaluate the presence of dry weather flow.	X	
4.	Determine the receiving waters that may be affected by the project throughout the project life cycle (i.e., construction, maintenance and operation).	X	
5.	For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	X	
6.	Determine if there are any High Risk Areas (municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.	X	
7.	Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.		X
8.	Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	X	
9.	If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.	X	
10.	Determine contaminated or hazardous soils within the project area.	X	

Physical Features: The existing site terrain slopes in the north to south direction. "The site is bounded on both the west and the east by natural drainage channels", per the Preliminary Drainage Study.

Surrounding Land Use: The adjacent properties are developed rural residential and agricultural.

Proposed Project Land Use: The subject application of proposed a residential subdivision will use the current zoning of A-70 which has a maximum density of 1 du/ac. The former land use was agricultural, o land use or zoning change is required for approval of this project.

Soil: The site is comprised of one soil type in the Hydrologic group "D", according to the San Diego County Soil Survey.

There are no dry weather flows in this area. Within the project limits, there are no 303(d) impaired water bodies, High Risk areas, known contaminated soils or special Regional Board requirements.

The general climate for this area is coastal arid with an average annual rainfall for this HSA is 16.4 inches.

Complete the checklist below to determine if Treatment Best Management Practices (BMPs) are required for the project.

No.	CRITERIA	YES	NO	INFORMATION
1.	Is this an emergency project		X	If YES, go to 6. If NO, continue to 2.
2.	Have TMDLs been established for surface waters within the project limit?		X	If YES, go to 5. If NO, continue to 3.
3.	Will the project directly discharge to a 303(d) impaired receiving water body?		X	If YES, go to 5. If NO, continue to 4.
4.	Is this project within the urban and environmentally sensitive areas as defined on the maps in Appendix B of the *County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects*?	X		If YES, continue to 5. If NO, go to 6.
5.	Consider approved Treatment BMPs for the project.	X		If YES, go to 7.
6.	Project is not required to consider Treatment BMPs			Document for Project Files by referencing this checklist.
7.	End			

Now that the need for a treatment BMPs has been determined, other information is needed to complete the SWMP.

WATERSHED

Please check the watershed(s) for the project.

___San Juan ___Santa Margarita _X_San Luis Rey ___Carlsbad ___San Dieguito

___Penasquitos ____ San Diego ___Pueblo San Diego ___Sweetwater ___Otay ___Tijuana

Please provide the hydrologic sub-area and number(s)

Number	Name
903.12	Lower San Luis Rey - Bonsall

Please provide the beneficial uses for Inland Surface Waters and Ground Waters. Beneficial Uses can be obtained from the Water Quality Control Plan For The San Diego Basin, which is available at the Regional Board office or at http://www.swrcb.ca.gov/rwqcb9/programs/basinplan.html.

SURFACE WATERS	Hydrologic Unit Basin Number	MUN	AGR	IND	PROC	GWR	FRESH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Inland Surface Waters	903.12	X	X	X		X	X	X	X	X		X	X	X	X	
Ground Waters	903.12	X	X	X	X		X									

X Existing Beneficial Use 0
Potential Beneficial Use
* Excepted from Municipal

POLLUTANTS OF CONCERN

Using Table 1, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

Table 1. Anticipated and Potential Pollutants Generated by Land Use Type

	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >100,000 ft2	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets. Roads Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

The above shaded rows indicate this project's General Pollutant Categories.

Note: If other monitoring data that is relevant to the project is available. Please include as Attachment C.

CONSTRUCTION BMPs

Please check the construction BMPs that may be used. The BMPs selected are those that will be implemented during construction of the project. The applicant is responsible for the placement and maintenance of the BMPs selected.

_X_ Silt Fence

__ Fiber Rolls

_X_ Street Sweeping and Vacuuming

__ Storm Drain Inlet Protection

_X_ Stockpile Management

_X_ Solid Waste Management

_X_ Stabilized Construction Entrance/Exit

__Dewatering Operations

__ Vehicle and Equipment Maintenance

__ Desilting Basin

_X_ Gravel Bag Berm

__ Sandbag Barrier

_X_ Material Delivery and Storage

___ Spill Prevention and Control

_X_ Concrete Waste Management

___Water Conservation Practices

_X_ Paving and Grinding Operations

__Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval.

SITE DESIGN

To minimize stormwater impacts, site design measures must be addressed. The following checklist provides options for avoiding or reducing potential impacts during project planning. If YES is checked, it is assumed that the measure was used for this project. If NO is checked, please provide a brief explanation why the option was not selected in the text box below.

	OPTIONS		YES	NO	N/A
1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?				X
2.	Can the project be designed to minimize impervious footprint?		X		
3.	Conserve natural areas where feasible?		X		
4.	Where landscape is proposed, can rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?		X		
5.	For roadway projects, can structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?				X
6.	Can any of the following methods be utilized to minimize erosion from slopes:				
	6.a.	Disturbing existing slopes only when necessary?	X		
	6.b.	Minimize cut and fill areas to reduce slope lengths?	X		
	6.c.	Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	X		
	6.d.	Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?	X		
	6.e.	Rounding and shaping slopes to reduce concentrated flow?	X		
	6.f.	Collecting concentrated flows in stabilized drains and channels?	X		

Please provide a brief explanation for each option that was checked N/A or NO in the following box.

All of the above Site Design criteria can be adhered to except where there the criteria does not apply.

If the project includes work in channels, then complete the following checklist. Information shall be obtained from the project drainage report.

N/A. This project does not propose work in channels.

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project increase velocity or volume of downstream flow?			X	If YES go to 5.
2.	Will the project discharge to unlined channels?	X			If YES go to 5.
3.	Will the project increase potential sediment load			X	If YES go to 5.

No.	CRITERIA	YES	NO	N/A	COMMENTS
	of downstream flow?			X	
4.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect upstream and/or downstream channel stability?			X	If YES go to 7.
5.	Review channel lining materials and design for stream bank erosion.	X			Continue to 6.
6.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.	X			Continue to 7.
7.	Include, where appropriate, energy dissipation devices at culverts.	X			Continue to 8.
8.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.			X	Continue to 9.
9.	Include, if appropriate, detention facilities to reduce peak discharges.			X	
10.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.			X	Continue to 11.
11.	Provide other design principles that are comparable and equally effective.			X	Continue to 12.
12.	End				

SOURCE CONTROL

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

BMP			YES	NO	N/A
1.	**Provide Storm Drain System Stenciling and Signage**				
	1.a.	All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language (such as: "NO DUMPING – DRAINS TO _____") and/or graphical icons to discourage illegal dumping.	X		
	1.b.	Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.	X		
2.	**Design Outdoors Material Storage Areas to Reduce Pollution Introduction**				
	2.a.	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.	X		

BMP			YES	NO	N/A
	2.b.	Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			X
	2.c.	The storage area shall be paved and sufficiently impervious to contain leaks and spills.			X
	2.d.	The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.			X
3.	**Design Trash Storage Areas to Reduce Pollution Introduction**				X
	3.a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
	3.b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	**Use Efficient Irrigation Systems & Landscape Design**		X		
	The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.		X		
	4.a.	Employing rain shutoff devices to prevent irrigation after precipitation.	X		
	4.b.	Designing irrigation systems to each landscape area's specific water requirements.	X		
	4.c.	Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.	X		
	4.d.	Employing other comparable, equally effective, methods to reduce irrigation water runoff.	X		
5.	**Private Roads**		X		
	The design of private roadway drainage shall use at least one of the following				
	5.a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.	X		
	5.b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.	X		
	5.c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.			X
	5.d.	Other methods that are comparable and equally effective within the project.	X		
6.	**Residential Driveways & Guest Parking**				X
	The design of driveways and private residential parking areas shall use one at least of the following features.				
	6.a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.	X		

	6.b.	Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the storm water conveyance system.	X		
	6.c.	Other features which are comparable and equally effective.			
7.	**Dock Areas**				X

	BMP		YES	NO	N/A
	Loading/unloading dock areas shall include the following.				
	7.a.	Cover loading dock areas, or design drainage to preclude urban run-on and runoff.			
	7.b.	Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
	7.c.	Other features which are comparable and equally effective.			
8.	**Maintenance Bays**				X
	Maintenance bays shall include the following.				
	8.a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	8.b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			
	8.c.	Other features which are comparable and equally effective.			
9.	**Vehicle Wash Areas**				X
	Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.				
	9.a.	Self-contained; or covered with a roof or overhang.			
	9.b.	Equipped with a clarifier or other pretreatment facility.			
	9.c.	Properly connected to a sanitary sewer.			
	9.d.	Other features which are comparable and equally effective.			
10.	**Outdoor Processing Areas**				X
	Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.				
	10.a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	10.b.	Grade or berm area to prevent run-on from surrounding areas.			
	10.c.	Installation of storm drains in areas of equipment repair is prohibited.			
	10.d.	Other features which are comparable or equally effective.			
11.	**Equipment Wash Areas**				X
	Outdoor equipment/accessory washing and steam cleaning activities shall be.				
	11.a.	Be self-contained; or covered with a roof or overhang.			
	11.b.	Be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate			
	11.c.	Be properly connected to a sanitary sewer.			

	11.d.	Other features which are comparable or equally effective.			
12.	**Parking Areas**				**X**
	The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.				
	12.a.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			

BMP			YES	NO	N/A
	12.b.	Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable paving.			
	12.c.	Other design concepts that are comparable and equally effective.			
13.	**Fueling Area**				**X**
	Non-retail fuel dispensing areas shall contain the following.				
	13.a.	Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system.			
	13.b.	Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			
	13.c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			
	13.d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.			

Please list other project specific Source Control BMPs in the following box. Write **N/A** if there are none and briefly explain.

N/A All applicable Source Control BMPs can be adhered to for this project.

TREATMENT CONTROL

To select a structural treatment BMP using Treatment Control BMP Selection Matrix (Table 2), each priority project shall compare the list of pollutants for which the downstream receiving waters are impaired (if any), with the pollutants anticipated to be generated by the project (as identified in Table 1). Any pollutants identified by Table 1, which are also causing a Clean Water Act section 303(d) impairment of the receiving waters of the project, shall be considered primary pollutants of concern. Priority projects that are anticipated to generate a primary pollutant of concern shall select a single or combination of stormwater BMPs from Table 2, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern.

Priority projects that are **not** anticipated to generate a pollutant for which the receiving water is Clean Water Act Section 303(d) impaired shall select a single or combination of stormwater BMPs from Table 2, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

Table 2. Treatment Control BMP Selection Matrix

Pollutant of Concern	*Treatment Control BMP Categories*						
	Biofilters	Detention Basins	Infiltration Basins(2)	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Hydrodynamic Separator Systems(3)
Sediment	M	H	H	H	L	H	M
Nutrients	L	M	M	M	L	M	L
Heavy Metals	M	M	M	H	L	H	L
Organic Compounds	U	U	U	M	L	M	L
Trash & Debris	L	H	U	H	M	H	M
Oxygen Demanding Substances	L	M	M	M	L	M	L
Bacteria	U	U	H	H	L	M	L
Oil & Grease	M	M	U	U	L	H	L
Pesticides	U	U	U	L	L	U	L

(1) Copermittees are encouraged to periodically assess the performance characteristics of many of these BMPs to update this table.
(2) Including trenches and porous pavement.
(3) Also known as hydrodynamic devices and baffle boxes.
L: Low removal efficiency: M: Medium removal efficiency: H: High removal efficiency: U: Unknown removal efficiency
Sources: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1993), *National Stormwater Best Management Practices Database* (2001), *Guide for BMP Selection in Urban Developed Areas* (2001), *and Caltrans New Technology Report (2001).*

A Treatment BMP must address runoff from developed areas. Please provide the post-construction water quality values for the project. Label outfalls on the BMP map. Q_{WQ} is dependent on the type of treatment BMP selected for the project.

Outfall	**Tributary Area (acres)**	**Q_{100} (cfs) Pre**	**Q_{100} (cfs) Post**	**Q_{WQ} (cfs)**
On & Offsite	33.0 acres + offsite	*	*	**

***Detailed calculations of the Q_{100}'s are available in Attachment "H".**

** **Q_{WQ} value tables are located in Attachment "E".**

Please check the box(s) that best describes the Treatment BMP(s) selected for this project.

Biofilters

X Grass swale
__Grass strip
__Wetland vegetation swale
___Bioretention

Detention Basins

__Extended/dry detention basin with grass lining
__Extended/dry detention basin with impervious lining

Infiltration Basins

__ **Infiltration basin**
__Infiltration trench
__Porous asphalt
__Porous concrete
__Porous modular concrete block

Wet Ponds or Wetlands

__Wet pond/basin (permanent pool)
__Constructed wetland

Drainage Inserts (See note below)

__Oil/Water separator
X **Catch basin insert**
__Storm Drain inserts
__Catch basin screens

Filtration

__Media filtration
__Sand filtration

Hydrodynamic Separator Systems

__Swirl Concentrator
__Cyclone Separator
__Baffle Separator
__Gross Solids Removal Device
__Linear Radial Device

Note: Catch basin inserts and storm drain inserts are excluded from use on County maintained right-of-way and easements.

Include Treatment Datasheet as Attachment E. The datasheet should include the following:	**COMPLETED**	**NO**
1. Description of how treatment BMP was designed. Provide a description for each type of treatment BMP.	X	
2. Engineering calculations for the BMP(s)	X	

Please describe why the selected treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a detailed explanation and justification.

The Treatment BMPs selected for this project are the Biofilter (Vegetated Swale TC-30), and Catch Basin Inserts. This Biofilter was selected for its efficiency (medium) at removing the main pollutants of concern, Sediments, heavy metals and Oil & Grease for the runoff water generated by this project. The biofilter is also easy to maintain and therefore will ensure the efficiency of the project long term. Other Treatment BMPs that were considered, Wet Pond and Filtration

Trench were not as cost effective, aesthetically pleasing or as easy to maintain as the Biofilter, and therefore the Biofilter was chosen.

The Catch Basin Inserts were chosen to be the Treatment BMP for the offsite street improvements. This treatment BMP was the only method available that could treat runoff water that enters a pipe. This Treatment BMP has a medium and low efficiency removal rates for the pollutants of concern. Other methods were considered but did not allow the use of piping systems, so the Catch Basin Inserts were chosen.

Onsite
Water quality treatment has been established for all basins. Vegetated Swales have been provided for onsite pad treatment on each pad.

The private road runoff will be treated via bioswales at four different locations along the road, then returned to the natural drainage pattern.

Offsite
Runoff from offsite improvements to the private road, Ridge Creek Drive, will be treated via a grate with a water quality filter within the road. The offsite improvements for this road involve an additional 4' of pavement added to the section to bring it to private road standards. The connection would involve installation of a inlet grate at the low point of the road (atop the creek) which would connect to the existing storm drain pipe. This inlet would be fitted with the appropriately sized water quality filter. This Treatment BMP would be maintained by mechanisms stated in this SWMP, as Category 2.

Many alternatives were considered to treat the runoff from the offsite improvement. A Bioswale was considered, however the existing road is too steep to provide for adequate treatment. A Bioretention area for treatment was discussed; however, the area that would be acceptable for this is within a protected area (Fish & Game restricted). Grading within this limit could hinder the natural environment and therefore would cause more disturbance than the addition of the small amount of impervious surface would cause. For these reasons, the water quality filter was determined to be the most to be the most practicable water quality treatment method available for the offsite road improvement.

MAINTENANCE

Please check the box that best describes the maintenance mechanism(s) for this project. 13

CATEGORY	SELECTED	
	YES	NO
First	X	
Second	X	
Third		X
Fourth		X

Please briefly describe the long-term fiscal resources for the selected maintenance mechanism(s).

The Biofilters (Bioswales) are Category 1 BMPs and will be maintained by each individual lot owner as part of there normal landscaping. The Catch Basin Insert is Category 2 and will be maintained via a Storm Water Maintenance Agreement (SWMA) with the Home Owners

Association (HOA) as the designated responsible party. At the final engineering phase, the SWMA will address provisions for the proposed HOA. Please see Attachment "F" for the Maintenance Program and Costs.

Land owners will be responsible for the continual maintenance of the Biofilter (Vegetated Swale) located on each lot. Each Land Owner will be responsible for maintenance of the Biofilter on their lot, into perpetuity. Approximate Annual Maintenance Schedules and Costs for each individual Biofilter are located in Attachment "F" of this SWMP.

The following is a discussion from the SUSMP manual to describe how each of the BMPs will be maintained via "Mechanisms to Assure Maintenance" and "Funding"

FIRST CATEGORY:

The County will have only minimal concern for ongoing maintenance. The proposed BMPs inherently "take care of themselves", or property owners can naturally be expected to do so as an incident of taking care of their property

Project BMPs

Biofilters (Vegetated swale) on the Individual Lots

Mechanisms to Assure Maintenance:

1. Stormwater Ordinance Requirement: The WPO requires this ongoing maintenance. In the event that the mechanisms below prove ineffective, or in addition to enforcing those mechanisms, civil action, criminal action or administrative citation could also be pursued for violations of the ordinance.
2. Public Nuisance Abatement: Under the WPO failure to maintain a BMP would constitute a public nuisance, which may be abated under the Uniform Public Nuisance Abatement Procedure. This provides an enforcement mechanism additional to the above, and would allow costs of maintenance to be billed to the owner, a lien placed on the property, and the tax collection process to be used.
3. Notice to Purchasers. Section 67.819(e) of the WPO requires developers to provide clear written notification to persons acquiring land upon which a BMP is located, or others assuming a BMP maintenance obligation, of the maintenance duty.
4. Conditions in Ongoing Land Use Permits: For those applications (listed in SO Section 67.804) upon whose approval ongoing conditions may be imposed, a condition will be added which requires the owner of the land upon which the stormwater facility is located to maintain that facility in accordance with the requirements specified in the SMP. Failure to perform maintenance may then be addressed as a violation of the permit, under the ordinance governing that permit process.
5. Subdivision Public Report: Tentative Map and Tentative Parcel Map approvals will be conditioned to require that, prior to approval of a Final or Parcel Map, the subdivider shall provide evidence to the Director of Public Works, that the subdivider has requested the California Department of Real Estate to include in the public report to be issued for the sales of lots within the subdivision, a notification regarding the maintenance requirement. (The requirement for this condition would not be applicable to subdivisions which are exempt from regulation under the Subdivided Lands Act, or for which no public report will be issued.)

Funding:
None Required.

SECOND CATEGORY:

The County needs to assure ongoing maintenance. The nature of the proposed BMPs indicates that it is appropriate for property owners to be given primary responsibility for maintenance, on a perpetual basis (unless a stormwater utility is eventually formed). However, the County (in a "backup" role) needs to be able to step in and perform the maintenance if property owner fails, and needs to have security to provide funding for such backup maintenance. Security for "backup" maintenance after the interim period (5 years) would not be provided, however primary owner maintenance responsibility would remain. If a stormwater utility or other permanent mechanism is put into place, it could assume either a primary or backup maintenance role.

Project BMPs

- **Catch basin insert & screens.**

Mechanisms to Assure Maintenance:

1. Stormwater Ordinance Requirement: The WPO requires this ongoing maintenance. In the event that the mechanisms below prove ineffective, or in addition to enforcing those mechanisms, civil action, criminal action or administrative citation could also be pursued for violations of the ordinance.
2. Public Nuisance Abatement: Under the WPO failure to maintain a BMP would constitute a public nuisance, which may be abated under the Uniform Public Nuisance Abatement Procedure. This provides an enforcement mechanism additional to the above, and would allow costs of maintenance to be billed to the owner, a lien placed on the property, and the tax collection process to be used.
3. Notice to Purchasers. Section 67.819(e) of the WPO requires developers to provide clear written notification to persons acquiring land upon which a BMP is located, or others assuming a BMP maintenance obligation, of the maintenance duty.
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5. Subdivision Public Report: Tentative Map and Tentative Parcel Map approvals will be conditioned to require that, prior to approval of a Final or Parcel Map, the subdivider shall provide evidence to the Director of Public Works, that the subdivider has requested the California Department of Real Estate to include in the public report to be issued for the sales of lots within the subdivision, a notification regarding the maintenance requirement. (The requirement for this condition would not be applicable to subdivisions which are exempt from regulation under the Subdivided Lands Act, or for which no public report will be issued.)
6. BMP Maintenance Agreement with Easement and Covenant: An agreement will be entered into with the County, which will function three ways:

(a) It will commit the land to being used only for purposes of the BMP;
(b) It will include an agreement by the landowner, to maintain the facilities in accordance with the SMP (this obligation would be passed on to future purchasers or successors of the landowner, as a covenant); and
(c) It will include an easement giving the County the right to enter onto the land (and any necessary adjacent land needed for access) to maintain the BMPs.

This would be required of all applications listed in WPO Section 67.804. In the case of subdivisions, this easement and covenant would be recorded on or prior to the Final or Parcel Map.

Funding:

Developer will provide the County with security to substantiate the maintenance agreement, which would remain in place for an interim period of 5 years. The amount of the security would equal the estimated cost of 2 years of maintenance activities. The security can be a Cash Deposit, Letter of Credit or other form acceptable to the County.

ATTACHMENTS

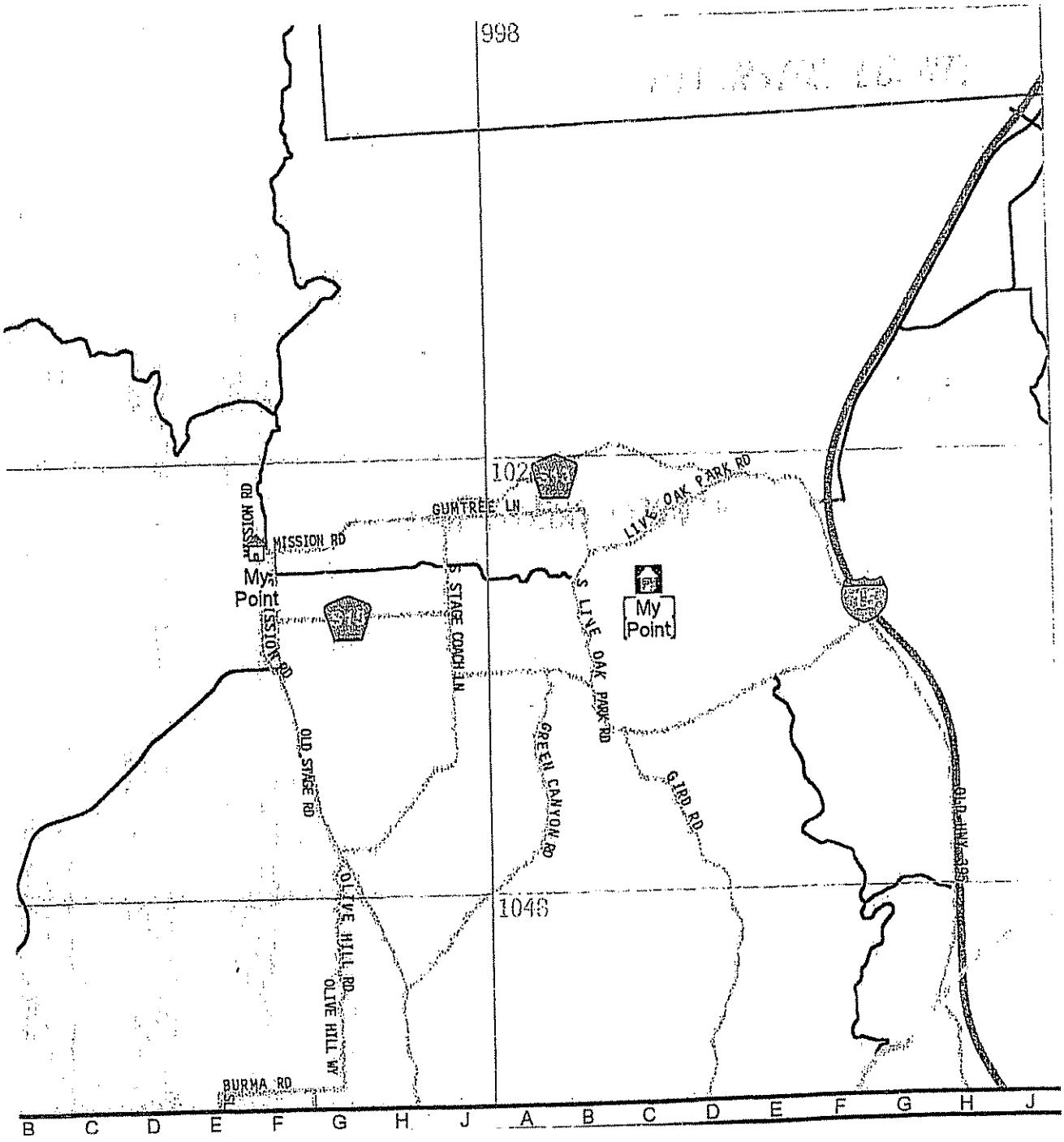
Please include the following attachments.

	ATTACHMENT	COMPLETED	N/A
A	Project Location Map	X	
B	Site Map	X	
C	Relevant Monitoring Data	X	
D	Treatment BMP Location Map	X	
E	Treatment BMP Datasheets	X	
F	Operation and Maintenance Program for Treatment BMPs	X	
G	Engineer's Certification Sheet	X	
H	Hydrologic Calculations – Q_{100s}	X	

Note: Attachments A and B are combined.

ATTACHMENT A & B

LOCATION MAP & PROJECT SITE MAP



ATTACHMENT C

RELEVANT MONITORING DATA

(NOTE: PROVIDE RELEVANT WATER QUALITY MONITORING DATA IF AVAILABLE.)

No relevant Monitoring date is available

ATTACHMENT D

TREATMENT BMP LOCATION MAP

Treatment

Control

ATTACHMENT E

TREATMENT BMP DATASHEET

*(**NOTE:** POSSIBLE SOURCE FOR DATASHEETS CAN BE FOUND AT WWW.CABMPHANDBOOKS.COM. INCLUDE ENGINEERING CALCULATIONS FOR SIZING THE TREATMENT BMP.)*

TM 5489 RPL
Drainage Basin
Q(wq)
Impervious Analysis

DRAINAGE BASIN ID DB NO.	DRAINAGE BASIN AREA BA1 Acres	DRAINAGE BASIN SF BA2 SQFT	Impervious Pavement Areas Sq Ft	Impervious Driveways Areas Sq Ft	Impervious Roof/Patios Areas Sq Ft	Impervious Area Total IP1 Sq Ft	Impervious Area Total IP2 AC	Percent Impervious Area(sf) PIA percent	Qwq CIA (1)(0.2)Ap Q CFS	NOTES
CP5W 1A	1.03	44867	0	800	4000	4800	0.110	0.107	0.022	
CP5W 1B	0.80	34848	0	0	0	0	0.000	0.000	0.000	LANDSCAPED AREA
CP5W 1C	1.09	47480	0	480	0	480	0.011	0.010	0.002	
CP5W 1D	0.33	14375	0	800	4000	4800	0.110	0.334	0.022	
	3.25								**0.046**	**Qwq at OUTFALL CP5**
CP6W_1A	0.87	37897	1678	7440	0	9118	0.209	0.241	0.042	
CP6W_1B	0.82	35719	2151	1440	0	3591	0.082	0.101	0.016	
CP6W_1C	0.61	26572	3190	3290	0	6480	0.149	0.244	0.030	
CP6W_2A	0.48	20909	4916	800	0	5716	0.131	0.273	0.026	
CP6W_2B	0.29	12632	2188	1520	0	3708	0.085	0.294	0.017	
CP6W_2C	0.45	19602	0	0	0	0	0.000	0.000	0.000	LANDSCAPED AREA
	3.52								**0.131**	**Qwq at OUTFALL CP6**
CP7W 1A	0.29	12632	0	0	2000	2000	0.046	0.158	0.009	
CP7W 1B	0.77	33541	0	1600	0	1600	0.037	0.048	0.007	
CP7W 2A	0.47	20473	0	0	0	0	0.000	0.000	0.000	LANDSCAPED AREA
CP7W 2B	1.05	45738	0	0	3000	3000	0.069	0.066	0.014	
CP7W 3A	1.14	49658	0	0	1320	1320	0.030	0.027	0.006	
CP7W 3B	0.67	29185	6500	0	1320	7820	0.180	0.268	0.036	
	4.39								**0.072**	**Qwq at OUTFALL CP7**
Total	**37.800**								**0.631**	**Qwq For Site**
Total	**37.80**	**1647052**	**54300**	**29550**	**53639**	**137489**	**3.156**	**0.135**	**0.631**	**Calculated Total Qwq CFS**
	Column Total basin area acres	Column Total basin area square feet	Column Total Area of AC Pavement square feet	Column Total Approx AC Driveway square feet	Column Total approx 4000 sf Home Per Lot	Column Total impervious square feet	Column Total impervious acres	Column Average impervious acres per basin		

Jeffrey Wilson, PE
FALLBROOK CA 92028
(760) 917-9328 (cell)

TM 5489 RPL
Drainage Basin
Q(wq)
Impervious Analysis

DRAINAGE BASIN ID DB NO.	DRAINAGE BASIN AREA BA1 Acres	DRAINAGE BASIN SF BA2 SQFT	Impervious Pavement Areas Sq Ft	Impervious Driveways Areas Sq Ft	Impervious Roof/Patios Areas Sq Ft	Impervious Area Total IP1 Sq Ft	Impervious Area Total IP2 AC	Percent Impervious Area(sf) PIA percent	Qwq CIA (1)(0.2)Ap Q CFS	NOTES
CP1_E1	1.43	62291	0	800	2000	2800	0.064	0.045	0.013	
CP1_E2	1.46	63598	0	0	0	0	0.000	0.000	0.000	OPEN SPACE AREA
CP1_E3	1.85	80586	0	800	4000	4800	0.110	0.060	0.022	
CP1_E4	2.16	94090	0	800	4000	4800	0.110	0.051	0.022	
CP1_E5	3.09	134600	4676	800	4000	9476	0.218	0.070	0.044	
CP1_E6	1.62	70567	16700	1600	2000	20300	0.466	0.288	0.093	
CP1_E7	2.29	99752	0	0	2000	2000	0.046	0.020	0.009	
CP1_E8	2.90	126324	5600	2080	4000	11680	0.268	0.092	0.054	
CP1_E9	2.18	94961	0	0	4000	4000	0.092	0.042	0.018	
	18.98								**0.275**	**Qwq at OUTFALL CP1**
CP2S_1A	0.21	9148	0	1050	0	1050	0.024	0.115	0.005	
CP2S_1B	0.14	6582	4701	1050	0	5751	0.132	0.874	0.026	
CP2S_1C	1.00	43560	2000	0	1333	3333	0.077	0.077	0.015	
	1.35								**0.047**	**Qwq at OUTFALL CP2**
CP3W 1A	0.52	22651	0	800	2666	3466	0.080	0.153	0.016	
CP3W 1B	1.74	75794	0	0	0	0	0.000	0.000	0.000	LANDSCAPED AREA
	2.26								**0.016**	**Qwq at OUTFALL CP3**
CP4W 1A	1.82	79279	0	1600	8000	9600	0.220	0.121	0.044	
CPW4 1B	2.23	97139	0	0	0	0	0.000	0.000	0.000	LANDSCAPED AREA
	4.05								**0.044**	**Qwq at OUTFALL CP4**

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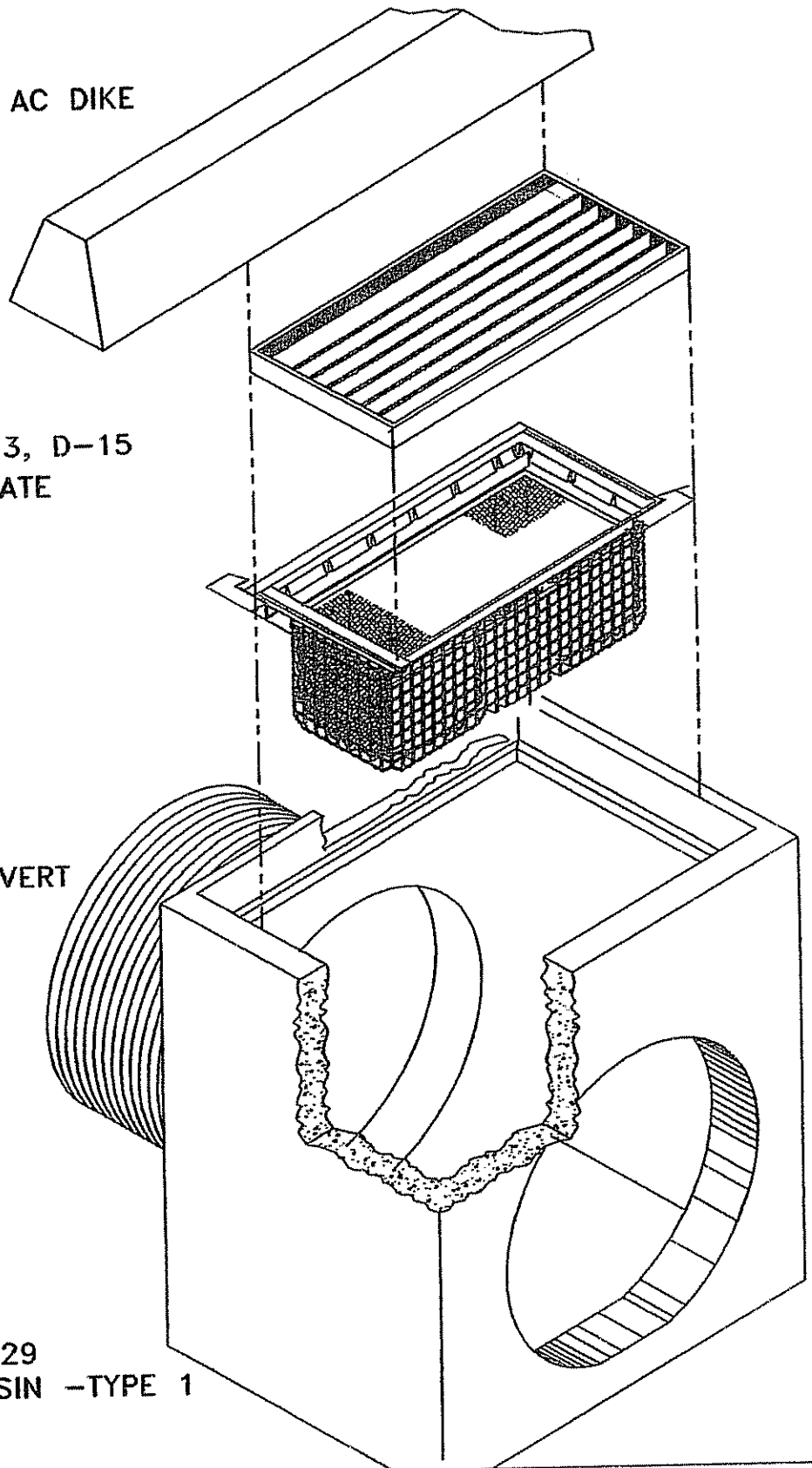
Q100_POST_OFFSITE_rev17[1]
rev'ed "C"=0.39 and
rev'ed "Ti"=11.9 min

OFFSITE TO FILTER

BASIN	Distance (D)	Elev. A	Elev. B	Slope	Ti(min)	Ti+Tc(min)	Area	Acres	C	CA	Tc(min)	I(in/hr)	Q100	Peak Q	Notes
OS RDFW R1	450	942	903	8.67	5.00	5.0	13590	0.31	0.900	0.281	5.000	9.2216	2.59	2.6	INITIAL Lm=86FT TI=10.5MIN
OS RDFW R2	550	903	846	10.36	5.00	10.0	12910	0.30	0.900	0.267	10.000	5.8971	1.57	1.6	AT CATCH BASIN NEAR CP8

$Q_{WQ} = (.2)(1)(.61\,ac.) = 0.12\,cfs$

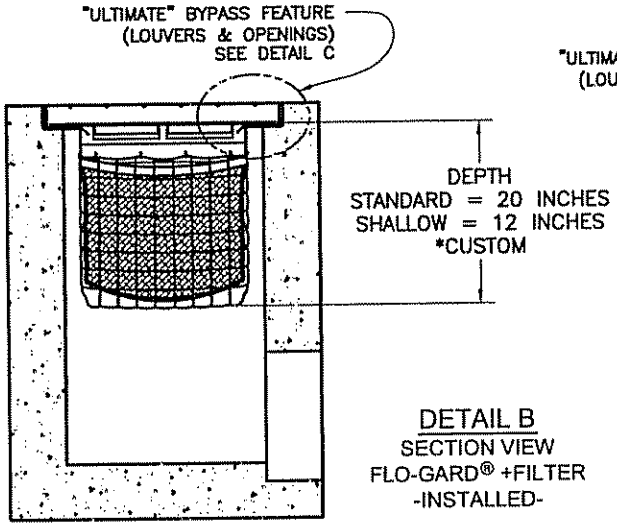


NOT TO SCALE

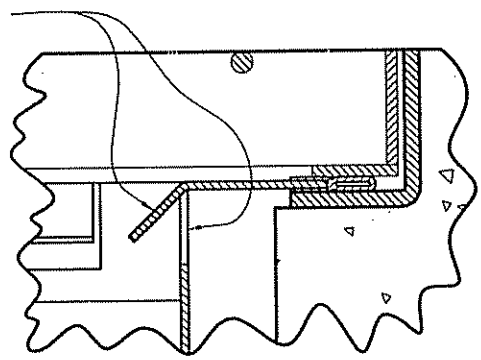
TITLE		
FloGard®+PLUS CATCH BASIN FILTER INSERT (Frame Mount) SDRSD D-29 CATCH BASIN	GRATE AND FILTER EXHIBIT AT CP8 TM 5469 DRAWING NO. E:\PROJECTS\RIDGE_CREEK\JUL2007\RC_DS_EXHIBIT_6.dwg	EXHIBIT NO. 6

FGP-0001

U.S. PATENT # 6.00,023 & 6,877.029



DETAIL B
SECTION VIEW
FLO-GARD® +FILTER
-INSTALLED-



DETAIL C
"ULTIMATE"
BYPASS FEATURES

* MANY OTHER STANDARD & CUSTOM SIZES & DEPTHS AVAILABLE UPON REQUEST

SPECIFIER CHART

MODEL NO. STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data in these columes is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO. SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu ft.)	SOLIDS STORAGE CAPACITY (cu ft.)	FILTERED FLOW (cu ft / sec)		SOLIDS STORAGE CAPACITY (cu ft.)	FILTERED FLOW (cu ft / sec)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-1530F	15 X 30	15 X 35	6.9	2.3	1.6	FGP-1530F8	1.3	.9
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-1624F	16 X 24	16 X 26	5.0	1.5	1.2	FGP-1624F8	.85	.7
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1820F	16 X 19	18 X 21	5.9	2.1	1.4	FGP-1820F8	1.2	.8
FGP-1824F	16 X 22	18 X 24	5.0	1.5	1.2	FGP-1824F8	.85	.7
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-2024F	18 X 22	20 X 24	5.9	1.2	1.0	FGP-2024F8	.7	.55
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
FGP-2142F	21 X 40	24 X 40	9.1	4.3	2.4	FGP-2142F8	2.45	1.35
FGP-2148F	19 X 46	22 X 48	9.8	4.7	2.6	FGP-2148F8	2.7	1.5
FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2430F	24 X 30	26 X 30	7.0	2.8	1.8	FGP-2430F8	1.6	1.05
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	26 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-28F	28 X 28	32 X 32	6.3	2.2	1.5	FGP-28F8	1.25	.85
FGP-2440F	24 X 36	28 X 40	8.3	4.2	2.3	FGP-2440F8	2.4	1.3
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-SD24F	24 X 24	28 X 28	6.1	2.2	1.5	FGP-SD24F8	1.25	.85
FGP-1836FGO	18 X 36	20 X 40	6.9	2.3	1.6	FGP-1836F8GO	1.3	.9
FGP-2436FGO	20 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8GO	1.95	1.15
FGP-48FGO	18 X 48	20 X 54	6.3	2.2	1.5	FGP-48F8GO	1.25	.85

TITLE

FloGard®+PLUS

CATCH BASIN FILTER INSERT

(Frame Mount)

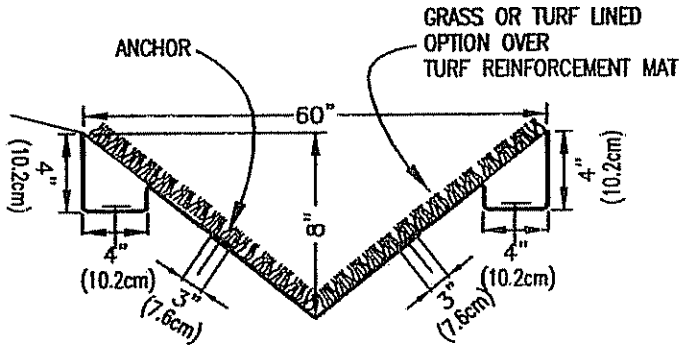
FLAT GRATED INLET

KriStar Enterprises, Inc.

P.O. Box 6419, Santa Rosa, CA 95406

Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DRAWING NO.	REV	ECO	DATE	SHEET
FGP-0001	A	0001	JPR 09/01/06	SHEET 2 OF 2



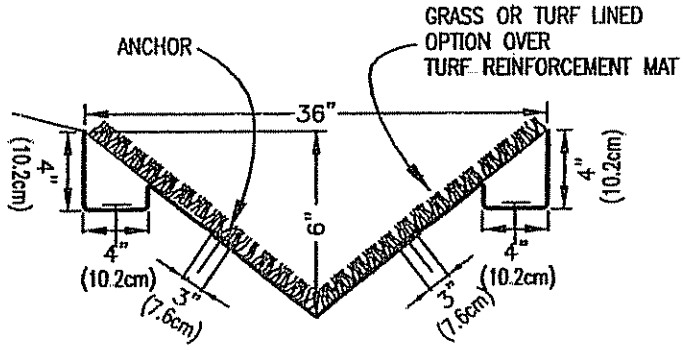
VEGETATED SWALE @ D-22

NO SCALE

NOTES:

1) PLACE 3 ANCHORS PER SQUARE YARD OF MATERIAL

2) FOR GRASS OR TURF OPTION, INSTALL TURF REINFORCEMENT MAT.



VEGETATED SWALE @ PAD

NO SCALE

NOTES:

1) PLACE 3 ANCHORS PER SQUARE YARD OF MATERIAL

2) FOR GRASS OR TURF OPTION, INSTALL TURF REINFORCEMENT MAT.

Vegetated Swale

TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

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

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd³	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd²	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil	Yd³	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Seed, and Mulch[f]	Yd²	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Sod[g]								
Subtotal	–	–	–	–	–	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	–	–	–	–	–	$6,395	$11,735	$17,076

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.85 / 1,000 ft²/ mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	$9.00 / 1,000 ft²/ year	$0.18 / linear foot	$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	--
Grass Reseeding with Mulch and Fertilizer	$0.30 / yd²	$0.01 / linear foot	$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.15 / linear foot / year, plus $25 / inspection	$0.15 / linear foot	$0.15 / linear foot	Inspect four times per year
Total	--	$0.58 / linear foot	$ 0.75 / linear foot	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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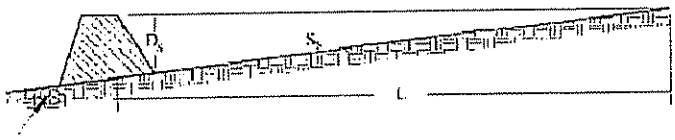
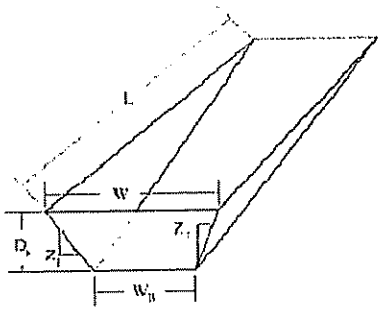


Provide for scour protection

(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area

Notation:

L = Length of swale impoundment area per check dam (ft)
D_s = Depth of check dam (ft)
S_s = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_b = Bottom width of check dam (ft)
$Z_{1&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

ATTACHMENT F

OPERATION AND MAINTENANCE PROGRAM FOR TREATMENT BMP

*(**NOTE:** INFORMATION REGARDING OPERATION AND MAINTENANCE CAN BE OBTAINED FROM THE FOLLOWING WEB SITE: HTTP://WWW.SDCOUNTY.CA.GOV/DPW/WATERSHEDS/LAND_DEV/SUSMP.HTML.)*

TREATMENT CONTROL BMP MAINTENANCE SCHEDULE AND COST ESTIMATE

BMP	Maintenance					Annual Cost
	Inspection/ Routine Actions	**Maintenance Indicator**	**Field Measurement**	**Measurement Frequency**	**Maintenance Activity**	
Biofilter (Bioswale)	Basin side slope planted for erosion protection and planted invert	Average vegetation height greater than 12-inches, emergence of trees or woody vegetation	Visual observation and random measurement through out the side slope area	Once during wet season, once during dry season	Cut vegetation to an average height of 6- inches and remove trimmings. Remove any trees, or woody vegetation	Paid for by each lot owner (County's estimate = $4328)
	Slope Stability	Evidence of Erosion	Visual observation	October each year	Reseed/revegetate barren spots prior to wet season. Contact environmental or landscape architect for appropriate seed mix. Scarify surface if needed. If after two applications (2 seasons) of reseeding/ revegetating and growth is unsuccessful both times, an erosion blanket or equivalent protection will be installed over eroding areas. No erosion blanket will be installed in the basin invert.	
	Inspect for Standing water	Standing water for more than 72 hours	Visual Observation	Annually, 72 hours after target2 storm (0.75 in) event	Drain facility. Check and unclog clogged orifice. Notify engineer if immediate solution is not evident.	

TREATMENT CONTROL BMP MAINTENANCE SCHEDULE AND COST ESTIMATE

	Inspect for Trash and Debris	Debris/Trash present	Visual Observation	During routine trashing per Districts schedule	Remove and dispose of trash and debris.	
	Inspect for sediment management and characterization of sediment for removal	Sediment depth exceeds marker on staff gage.	Measure depth at apparent maximum and minimum if sediment. Calculate average depth.	Annually	Remove and properly dispose of sediment. Regrade if necessary.	
	Inspect for burrows	Burrows, holes, mounds.	Visual Observation	Annually and after vegetation trimming.	Where burrows cause seepage, erosion and leakage, backfill firmly.	

TREATMENT CONTROL BMP MAINTENANCE SCHEDULE AND COST ESTIMATE

	General Maintenance Inspection	Inlet, structures, outlet structures, side slopes or other features damaged, significant erosion, emergence of trees or woody vegetation, graffiti or vandalism, fence damage	Visual Observation	Semi-Annual, late wet season and late dry season	Corrective action prior to wet season. Consult engineers if immediate solution is not evident.	

TREATMENT CONTROL BMP MAINTENANCE SCHEDULE AND COST ESTIMATE

BMP	Maintenance					Annual Cost
	Inspection/ Routine Actions	**Maintenance Indicator**	**Field Measurement**	**Measurement Frequency**	**Maintenance Activity**	
Catch Basin Inlet Filter	Inspect for debris/trash	Sufficient debris/trash that could interfere with proper functioning of insert	Visual observation	During the wet season, before and during and end of each target 2 storm (0.25 in.) event	Remove and properly dispose of debris/trash. Target completion period while onsite conducting inspection.	1 @ $1184 = $1184
	Oil and grease removal	Absorbent granules dark gray or darker, or unit clogged with sediment	Visual Observation	During the wet season, before and during and end of each target 2 storm (0.25 in.) event	Replace Fossil filter adsorbent within 10 day working days. Characterize and properly dispose spent media prior to wet season.	
	Inspection for structural integrity	Broken or otherwise damaged insert	Visual Observation	Twice per year in October and May	Replace insert or immediately consult vendor to develop course of action, effect repairs within 10 working days.	
	Annual renewal of medium	End of wet season, April 30	None	Annually, in May	Remove, characterize, and properly dispose of media before Oct. 1	

Total Annual Cost **$1184**
Total Two Year Cost **$2368**

ATTACHMENT G

CERTIFICATION SHEET

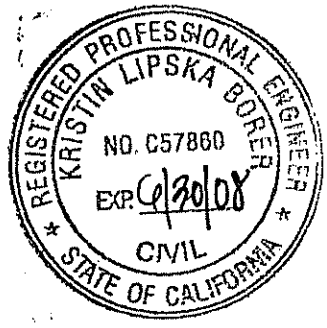
This Stormwater Management Plan has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

The combination of proposed construction and post-construction BMPs will reduce, to the maximum extent practicable, the expected pollutants and will not adversely impact the beneficial uses or water quality of the receiving waters.

8/13/07

Date

Kristin Lipska Borer, PE
C 57860 Exp. 6/30/08



ATTACHMENT H

HYDROLOGIC CALCULATIONS

Revised "C" = 0.39 and
Revised Initial Tc = Ti
Ti= 11.9 min

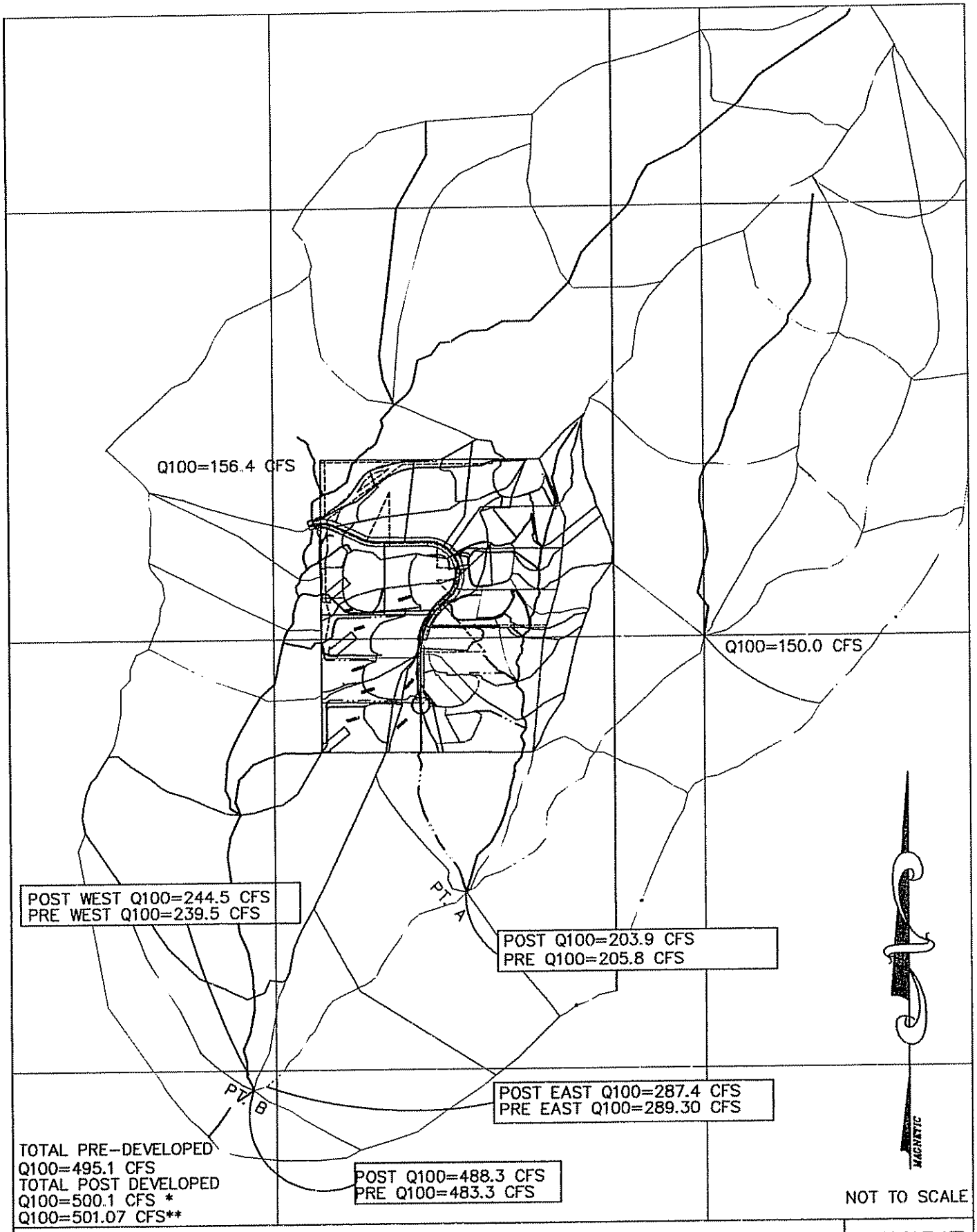
OUT FALL PT	PRE Area AC	POST Area AC	△ Area Ac	PRE Len Ft	POST Len Ft	PRE "C"	POST "C"	PRE Tc Min	POST Tc Min	PRE "I" In/Hr	* POST "I" In/Hr	PRE Q100 CFS	POST Q100 CFS	△ Runoff CFS	Notes and Locations	
1	18.58	18.98	0.40	1672.0	1285.0	0.35	0.39	19.0	34.5	3.90	2.65	28.90	26.10	-2.80	*	Eastern Watershed
2	1.35	1.35	0.00	465.0	263.0	0.35	0.54	13.0	14.3	4.99	4.69	2.40	3.30	0.90	**	Southern Watershed
3	2.45	2.26	-0.19	602.0	648.0	0.35	0.39	14.9	15.0	4.56	4.54	3.91	4.20	0.29	**	West Watershed SubBasin
4	4.91	4.05	-0.86	961.0	735.0	0.35	0.39	20.0	15.1	3.77	4.53	6.47	7.70	1.23	***	West Watershed SubBasin
5	3.12	3.25	0.13	933.0	655.0	0.35	0.39	19.4	21.1	3.83	3.65	4.20	5.70	1.50	***	West Watershed SubBasin
6	3.34	3.54	0.20	946.0	796.0	0.35	0.39	18.9	31.4	3.91	2.94	4.57	5.80	1.23	***	West Watershed SubBasin
7	4.07	4.39	0.32	1020.0	1132.0	0.35	0.39	19.4	36.3	3.71	2.57	5.48	5.70	0.22	**	West Watershed SubBasin
Total	37.82	37.82	0.00									55.93	58.50	2.57		Q100 Excess Runoff Total

NOTES

* NO EXCESS RUN OFF

** AMOUNT OF EXCESS RUN OFF LESS THAN 1 CFS IS NEGLIABLE

*** AMOUNT OF EXCESS RUN OFF >1 CFS BUT < 2 CFS INSIGNIFICANT



CONFLUENCE EXHIBIT
TM 5469

* CONFLUENCE EQUATIONS NOT USED ** CONFLUENCE EQUATIONS USED

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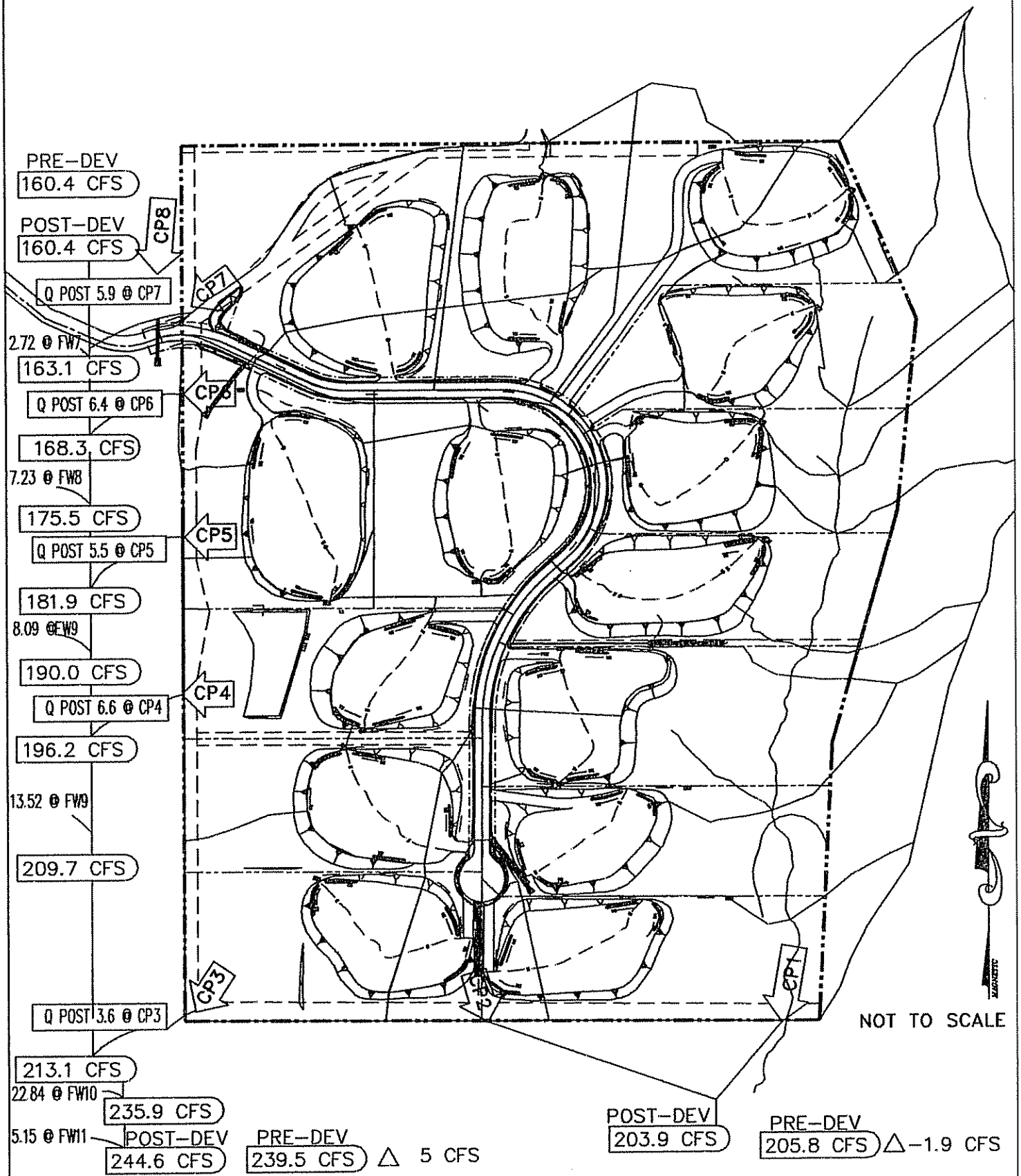
EXHIBIT NO. 1



POST-DEVELOPEMENT EXCESS RUN OFF (Q100)

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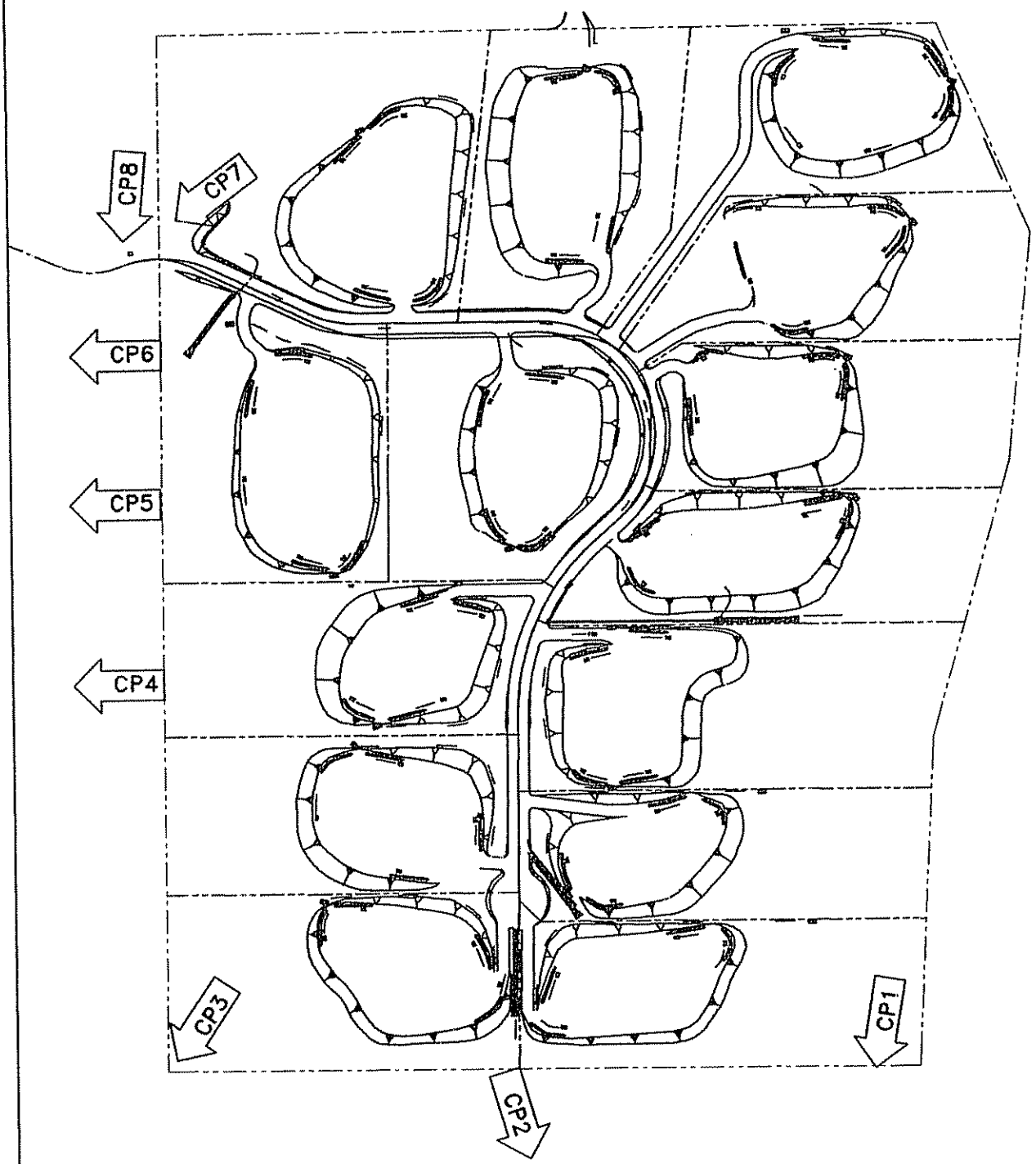
EXHIBIT NO. 2



NOT TO SCALE

PRE DEVELOPED OUTFALL LOCATIONS & POST DEVELOPED OUTFALL LOCATIONS

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EXHIBIT NO. 3