Preliminary

Water Quality Management Plan

For:

ASG Development Advisors

Vineyard Industrial

APN: 1133-201-04, 1133-221-02, -06, -07

Prepared for:

ASG Development Advisors

21602 surveyor Circle, Suite 100

Huntington Beach, CA 92646

949-250-7720

Prepared by:

Huitt-Zollars, Inc

3990 Concours, Suite 330

Ontario, CA 91764

909-941-7799

Submittal Date: 8/23/2023

Revision Date: _____

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for ASG Development Advisors by Huitt-Zollars. Inc. The WQMP is intended to comply with the requirements of the County of San Bernardino and the NPDES Area-wide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

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

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	PM 19908	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 1133-221-02, -06, -07, 1133-201-04

Owner's Signature			
Owner Name: Nasser Mustafa			
Title	President		
Company	ASG Development Advisors		
Address	21602 surveyor Circle, Suite 100, Huntington Beach, CA 92646		
Email	nmustafa@asgda.com		
Telephone #	949-250-7720		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	PM 19908	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 1133-221-02, -06, -07, 1133-201-04

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Manuel (Manny) Gonzales, PE		PE Stamp Below
Title	Project Manager	
Company	Huitt-Zollars, Inc	
Address	3990 Concours, Suite 330. Ontario, CA 91764	
Email	mgonzales@huitt-zollars.com	
Telephone #	909-941-7799 X11450	
Signature		
Date		

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Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Vineyard Industrial				
Project Owner Contact Name:	Nasser Mustafa				
Mailing Address:	21602 surveyor Circle, Suite 100, Huntington Beach, CA 92646	E-mail Address:	nmustafa@asgda.com	Telephone:	949-250-7720
Permit/Application Number(s):	TBD		Tract/Parcel Map Number(s):	PM 19908	
Additional Information/ Comments:	N/A				
Description of Project:	This project is a new development of an industrial warehouse facility located in an unincorporated region in the County of San Bernardino, on the west side of Maple Avenue north of Casmalia Street and south of Bohnert Avenue. Four parcels will be merged to create one. One of the existing parcels has a single family home, but the other three are undeveloped. The proposed building is approximately 311,400 square feet in size on approximately 16 acres. The runoff from the project site (DA1) will be collected by catch basins and conveyed to the on-site underground infiltration system at the southwest corner of the project site for treatment. The underground system will be designed to hold and infiltrate the Design Capture Volume (DCV). After the runoff reaches to DCV, the excess runoff to will discharge through an outlet pipe that connects the underground system to the existing 45-inch storm drain line in Maple Avenue (Outlet 1).				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A				

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☐ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.

2 Project Area (ft2):	691,652	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	1541

5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

The property is being developed by ASG Development Advisors. ASG Development Advisors or subsequent ownership entity will be the entity responsible for long term maintenance of WQMP Storm Water Facilities throughout the site.

Name: ASG Development Advisors
Address: 21602 surveyor Circle, Suite 100, Huntington Beach, CA 92646
Contact Person: Nasser Mustafa/President
Phone: 949-250-7720

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Pathogens are typically caused by the transport of animal or human fecal wastes from the watershed.
Nutrients - Phosphorous	E ☒	N ☐	Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Noxious Aquatic Plants	E ☒	N ☐	Noxious aquatic plants are typically from animals or vehicle transport that grow aggressively, multiply quickly without natural controls (native herbivores, soil chemistry, etc.), and adversely affect native habitats.
Sediment	E ☒	N ☐	Sediments are solid materials that are eroded from the land surface.
Metals	E ☒	N ☐	The primary source of metal pollution in stormwater is typically commercially available metals and metal products, as well as emissions from brake pad and tire tread wear associated with driving.
Oil and Grease	E ☒	N ☐	Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E ☒	N ☐	Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste from human or animals
Pesticides / Herbicides	E ☒	N ☐	Pesticides and herbicides can be washed off urban landscapes during storm events.
Organic Compounds	E ☒	N ☐	Sources of organic compounds may include waste handling areas and vehicle or landscape maintenance areas.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits (N/A)

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits

1 Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	NOT APPLICABLE		

Section 3 Site and Watershed Description

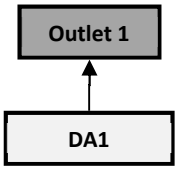
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34°08'30"N	Longitude -117°24'22"W	Thomas Bros Map page 575

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes☐ No☒ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA A to Outlet 1	On-Site water runoff will be directed to the proposed underground infiltration system at the southeast corner of the project site. When water fills up above the Design Capture Volume, the overflow will be directed to the public storm drain line in Maple Avenue (Outlet 1).

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	694,690	N/A	N/A	N/A
2 Existing site impervious area (ft^2)	0	N/A	N/A	N/A
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II	N/A	N/A	N/A
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A	N/A	N/A	N/A
5 Longest flowpath length (ft)	1,280	N/A	N/A	N/A
6 Longest flowpath slope (ft/ft)	~2.1%	N/A	N/A	N/A
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Residential/ Barren	N/A	N/A	N/A
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Poor	N/A	N/A	N/A

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)	N/A	N/A	N/A	N/A
2 Existing site impervious area (ft^2)	N/A	N/A	N/A	N/A
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	N/A	N/A	N/A	N/A
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	N/A	N/A	N/A	N/A
5 Longest flowpath length (ft)	N/A	N/A	N/A	N/A
6 Longest flowpath slope (ft/ft)	N/A	N/A	N/A	N/A
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	N/A	N/A	N/A	N/A
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	N/A	N/A	N/A	N/A

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool - http://permitrack.sbcounty.gov/wap/ See 'Drainage Facilities" link at this website*	Rialto Channel, Santa Ana Reach 3, 2 , 1, Prado Control basin, and Pacific Ocean.
Applicable TMDLs *Refer to Local Implementation Plan*	Per 2010 303(d) list, Santa Ana River Reach 3: TMDL still required. Prado Flood Control Basin: TMDL still required.
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	The project expects to generate Pathogens, Nutrients and Metals (Copper & Lead) which are listed for downstream receiving waters on the latest CWA 303(d) list.
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	None
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Santa Ana River
Hydrologic Conditions of Concern	☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owners shall review and become familiar with the site specific WQMP. Additional educational materials for day to day operations are contained in Attachment C. Additional materials can be obtained from the local water pollution prevention program. Education of property owners begin with the review/preparation of the site specific WQMP and continues through the review of additional educational material as it applies to their project.
N2	Activity Restrictions	☒	☐	Activity restriction shall be stated in the owners lease terms prior to occupancy: • Fuelling areas, air/water supply areas, maintenance bays, vehicle washing areas, outdoor material storage areas, outdoor work areas, outdoor processing areas, wash water from food preparation areas within the project site will not be allowed on the project site. • Storage of hazardous materials will not be allowed on the project site. • All pesticide applications shall be performed by a licensed contractor certified by the California Department of Pesticide Regulation. • All dumpster lids shall be kept closed at all times. • Blowing, Sweeping or hosing of debris (leaf, litter, grass clippings, trash or debris) into the streets, underground stormdrain facilities or other storm water conveyance areas shall be strictly prohibited
N3	Landscape Management BMPs	☒	☐	A landscape architect will provide design plans for the on-site landscaping and irrigation system. The design shall incorporate the use of native and drought tolerant trees and shrubs throughout the project site.
N4	BMP Maintenance	☒	☐	Property owners shall maintain the designated on-site BMP areas, see Section 5 for self inspection and maintenance form
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Industrial purposed warehouse does not apply to Title 22 CCR.
N6	Local Water Quality Ordinances	☒	☐	Local Water Quality Ordinances will be addressed by implementation of this WQMP

Form 4.1-1 Non-Structural Source Control BMPs				
N7	Spill Contingency Plan	☒	☐	Industrial Warehouse buildings and truck dock areas have potential for spills and therefore each tenant shall be required to prepare a spill contingency plan and it shall be implemented in accordance with section 6.95 of the California Health and Safety Code. The spill contingency plan shall identify responsible persons in the event of a spill, an action item list identifying how the spill should be contained, cleaned up and who should be contacted in the event of a spill. Documentation of any spill event and cleanup process shall be kept on site in perpetuity.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks are proposed for this site.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials are planned to be stored on this site.
N10	Uniform Fire Code Implementation	☒	☐	Underground fire protection service and fire sprinklers will be provided per the uniform fire code and the requirements of the County of San Bernardino Fire Department.
N11	Litter/Debris Control Program	☒	☐	Trash storage areas will be designed to have adjacent areas drain away from the trash storage areas. The entire site, with a focus on the trash storage areas shall be inspected and maintained on a monthly basis. Collection of trash from the trash storage areas shall occur on a regular basis to ensure that the trash receptacles are not overflowing. Documentation of such inspection/maintenance and trash collection shall be kept by the owner in perpetuity. See the WQMP site map in Attachment A for anticipated location of trash storage areas.
N12	Employee Training	☒	☐	The following requirements shall be stated in the owners lease terms; an Employee Training/Education program shall be provided annually to help educate employees about storm water quality management and practices that help prevent storm water pollution. Documentation of such training/education program implementation shall be kept by the owner for a minimum of ten years. Sample education materials have been provided in Attachment C. Additional educational materials can be obtained from the City of Fontana or the County of San Bernardino storm water program.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N13	Housekeeping of Loading Docks	☒	☐	The project site will have truck docks. The truck docks shall be inspected on a weekly basis to help ensure that any trash and debris are collected prior to being washed into the underground storm drain system. All storm water runoff from the loading dock areas will be discharged into infiltration basins and/or underground infiltration system prior to conveyance to the public storm drain system. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
N14	Catch Basin Inspection Program	☒	☐	The onsite catch basins shall be inspected on a quarterly basis. Inspection of the on-site catch basins shall consist of visual inspection of any sediment, trash or debris collected in the bottom of each catch basin. Any sediment, trash or debris found shall be removed from the catch basins and disposed of in a legal manner. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	The on-site parking lots, drive aisles, and loading dock areas shall be swept on a monthly basis. Documentation of such sweeping shall be kept by the owner in perpetuity. Frequency of sweeping shall be adjusted as needed to maintain a clean site.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not Applicable since this is not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	General construction permit "SWRCB Orders No. 2009-009-DWQ as amended by Order 2010-0014-DWQ"

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	The on-site storm drain catch basins shall be stenciled with the phrase "Drains to River" or other approved language. The signage shall be inspected on an annual basis. Missing or faded signage shall be replaced. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage areas are proposed for this site.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash storage areas will be designed to have adjacent areas drain away from the trash storage areas as well as have a permanent roof over them. The trash storage areas shall be inspected and maintained on a monthly basis. Collection of trash from the trash storage areas shall occur on a regular basis to ensure that the trash receptacles are not overflowing. A permanent roofing shall be provided. Documentation of such inspection/maintenance and trash collection shall be kept by the owner in perpetuity. See the WQMP site map in Attachment A for anticipated location of trash storage areas.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	The landscape architect will provide design plans for the on-site irrigation system. The irrigation system shall be inspected on a monthly basis to ensure proper operation. Any broken sprinkler heads shall be repaired immediately to ensure that the system continues to operate efficiently. Documentation of such inspection/maintenance shall be kept by the owner in perpetuity.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	The landscape architect will provide design plans for the on-site landscaping and irrigation system. The design shall incorporate a finish grade of landscaping areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement throughout the project site.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Proposed slopes shall be stabilized with drought tolerant vegetation. Most slopes will be 3:1, but may be as steep as 2:1 max.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Docks are not covered.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays are planned for this site.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas are planned for this site.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas are planned for this site.
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash areas are planned for this site.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas are planned for this site.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping are planned in this area.
S14	Wash water control for food preparation areas	☐	☒	Food preparation areas are not planned for this site.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks are planned for this site.

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Generally, Industrial Developments maximize the building and parking footprint, however 15% impervious areas will be provided. A 50-foot landscape area is proposed along the easterly property line.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The entire site drains to the infiltration/detention basin system thereby maximizing the natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: The proposed condition will mimic the existing condition southeasterly drainage pattern. The proposed runoff will drain to an on-site UG Infiltration System; overflow will discharge to the Maple Avenue storm drain. The UG Infiltration system will lengthen the time of concentration thus mimicking the existing conditions.
Disconnect impervious areas: Yes ☐ No ☒ Explanation: The designed infiltration system is sized to infiltrate the site's runoff up to the site's DCV.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The site has no existing vegetation or sensitive areas to protect. The planting of new vegetation will occur throughout the site.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: All Landscape area will be vegetated for stabilization.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The soils in the proposed infiltration system footprint will be uncompacted in-place native material and/or as directed by the Gotechnical Engineer.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: No vegetated swales are proposed. Earthen swales will be used in minor landscaping areas but not for LID purposes.
Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐ Explanation: All Landscape areas will be staked by designation of curb throughout the project site.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 1 (ft^2): 691,625	**2** Imperviousness after applying preventative site design practices (Imp%): 0.85	**3** Runoff Coefficient (Rc): 0.66 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.712 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 1.05 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): **78,405** *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☐ No ☒

Go to: *http://permitrack.sbcounty.gov/wap/*

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below

(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** N/A *Form 4.2-3 Item 12*	**2** N/A *Form 4.2-4 Item 13*	**3** N/A *Form 4.2-5 Item 10*
Post-developed	**4** N/A *Form 4.2-3 Item 13*	**5** N/A *Form 4.2-4 Item 14*	**6** N/A *Form 4.2-5 Item 14*
Difference	**7** N/A *Item 4 – Item 1*	**8** N/A *Item 2 – Item 5*	**9** N/A *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** N/A *Item 7 / Item 1*	**11** N/A *Item 8 / Item 2*	**12** N/A *Item 9 / Item 3*

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1) N/A

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type	Barren	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2a Hydrologic Soil Group (HSG)	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2b Hydrologic Soil Group (HSG)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5 Pre-Developed area-weighted CN: N/A	**7** Pre-developed soil storage capacity, S (in): N/A *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): N/A *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN: N/A	**8** Post-developed soil storage capacity, S (in): N/A *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): N/A *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in): N/A
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): N/A
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3): N/A
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft^3): N/A
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 Change in elevation (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3 Slope (ft/ft), S_o = *Item 2 / Item 1*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4 Land cover	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7 Cross-sectional area of channel (ft^2)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8 Wetted perimeter of channel (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9 Manning's roughness of channel (n)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10 Channel flow velocity (ft/sec) V_{fps} = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11 Travel time to outlet (min) T_t = *Item 6 / (Item 10 * 60)*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12 Total time of concentration (min) T_c = *Item 5 + Item 11*	N/A	N/A	N/A	N/A	11.50	N/A	N/A	N/A

13 Pre-developed time of concentration (min): N/A *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): N/A *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet HCOC requirement (min): N/A $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*		N/A	N/A	N/A	N/A	N/A	N/A
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A	N/A	N/A	N/A	N/A	N/A
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A	N/A	N/A	N/A	N/A	N/A
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*		N/A	N/A	N/A	N/A	N/A	N/A
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A	N/A	N/A	N/A	N/A	N/A
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*		N/A	N/A	N/A	N/A	N/A	N/A
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*	N/A	N/A	*n/a*	N/A	N/A
	DMA B	N/A	*n/a*	N/A	N/A	*n/a*	N/A
	DMA C	N/A	N/A	*n/a*	N/A	N/A	*n/a*

8 Pre-developed Q_p at T_c for DMA A: N/A *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: N/A *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: N/A *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*

10 Peak runoff from pre-developed condition confluence analysis (cfs): N/A *Maximum of Item 8, 9, and 10 (including additional forms as needed)*

11 Post-developed Q_p at T_c for DMA A: N/A *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: N/A *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: N/A *Same as Item 10 for post-developed values*

14 Peak runoff from post-developed condition confluence analysis (cfs): N/A *Maximum of Item 11, 12, and 13 (including additional forms as needed)*

15 Peak runoff reduction needed to meet HCOC Requirement (cfs): N/A *$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10*

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.
If no, then proceed to Item 9, below.

[9] All answers to Item 1 through Item 6 are "No":
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3):		$V_{retention}$ *=Sum of Item 4 for all BMPs*	
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3):		$V_{retention}$ *=Sum of Item 12 for all BMPs*	

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) *$V_{retention}$ = Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): *$V_{retention}$ =Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): *$V_{retention}$ = Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) *$V_{retention}$ = Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): *$V_{retention}$ =Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

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Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): **78,405** *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA 1 BMP Type ug	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	6	N/A	N/A
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	3	N/A	N/A
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	2	N/A	N/A
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	N/A	N/A
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	4	N/A	N/A
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	4	N/A	N/A
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	9,465	N/A	N/A
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
10 Amended soil porosity	N/A	N/A	N/A
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	2	N/A	N/A
12 Gravel porosity	0.4	N/A	N/A
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	N/A	N/A
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	80,330 cf @outlet Actual 50,165 CF	N/A	N/A
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	-	N/A	N/A

16 Total Retention Volume from LID Infiltration BMPs: 80,330 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1) N/A

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3):
V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16

BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility	N/A	N/A	N/A
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*	N/A	N/A	N/A
4 Landscaped area planned for use of harvested stormwater (ft^2)	N/A	N/A	N/A
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day	N/A	N/A	N/A
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*	N/A	N/A	N/A
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*	N/A	N/A	N/A
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*	N/A	N/A	N/A

9 Total Retention Volume (ft^3) from Harvest and Use BMP = 0 *Sum of Item 8 for all harvest and use BMP included in plan*

10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): **0** *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	**4** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	**5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains N/A

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A	N/A	N/A
2 Amended soil infiltration rate *Typical ~ 5.0*	N/A	N/A	N/A
3 Amended soil infiltration safety factor *Typical ~ 2.0*	N/A	N/A	N/A
4 Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*	N/A	N/A	N/A
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*	N/A	N/A	N/A
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
7 Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*	N/A	N/A	N/A
8 Amended soil surface area (ft^2)	N/A	N/A	N/A
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
10 Amended soil porosity, *n*	N/A	N/A	N/A
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
12 Gravel porosity, *n*	N/A	N/A	N/A
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	N/A	N/A	N/A
14 Biotreated Volume (ft^3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	N/A	N/A	N/A
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: 0 *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-7 Volume Based Biotreatment (DA 1) – N/A
Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A	N/A	N/A	N/A
2 Bottom width (ft)	N/A	N/A	N/A	N/A
3 Bottom length (ft)	N/A	N/A	N/A	N/A
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*	N/A	N/A	N/A	N/A
5 Side slope (ft/ft)	N/A	N/A	N/A	N/A
6 Depth of storage (ft)	N/A	N/A	N/A	N/A
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*	N/A	N/A	N/A	N/A
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*	N/A	N/A	N/A	N/A
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*	N/A		N/A	
10 Outflow rate (cfs) Q_{BMP} = *(Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)*	N/A		N/A	
11 Duration of design storm event (hrs)	N/A		N/A	
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)*	N/A		N/A	
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : 0 *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-8 Flow Based Biotreatment (DA 1) N/A

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*	N/A	N/A	N/A
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
4 Manning's roughness coefficient	N/A	N/A	N/A
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*	N/A	N/A	N/A
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*	N/A	N/A	N/A
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*	N/A	N/A	N/A
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*	N/A	N/A	N/A
11 Water surface area at water quality flow depth (ft^2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*	N/A	N/A	N/A

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): **78,405** *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): > **80,330** *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): **0** *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): **80,330** *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): 0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): 0 *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ n/a

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ n/a

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
UG Infil. System N4	Owner	- Inspect/Maintain UG-Infiltration basin Systems - Remove trash, sediments and debris by jet-vacuumed and pump and dispose of trash, sediments and debris in a legal manner. - Inspect system for standing water. If system has standing water perform re-inspection within 48-hours. If system still has standing water then the system shall be jet-vacuumed and pimped and removed debris shall be disposed of in a legal manner.	Bi-monthly and Prior to storm event and 48 hours after storm has passed
Loading Dock and Parking Lot Vacuum Sweeping N15	Owner	Vacuum Sweep loading dock and parking lot and truck courts.	Monthly / As needed.
Catch Basin Filter N17	Owner	- Inspect and maintain catch basin filters as required. - Inspect catch basin bottom for debris / remove debris and dispose as required.	Quarterly
Truck Dock N13	Owner	- Inspect loading dock for trash debris and sediments.	Weekly

		- Inspect loading dock for evidence of spills and broken containers. - Clean up spills and dispose of collected material in a legal manner.	
Planting N3	Owner	- Inspect health of planting and erosion of landscape area. - Trimming trees and bushes when needed.	Monthly
Efficient Irrigation S4	Owner	- Inspect irrigation system general operation and durations. - Repair damaged sprinkler and drip irrigation lines as needed. - Reduce durations during the winter season to prevent over irrigation.	Monthly
Trash Storage Areas and Litter Control (SD-32) N2	Owner	Inspect trash container, lids, screens and clean trash storage areas along with the entire site.	Weekly
Employee Training / Education Program N12	Owner	Building tenants to provide BMP training and hand out educational materials.	Annually or upon hire
Roof Runoff Controls (SD-11)	Owner	Inspect / repair roof drains	Quarterly
Storm drain system signage S1	Owner	Inspect Catch basin signage for faded or lost signs / repair or replace as needed.	Annually

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

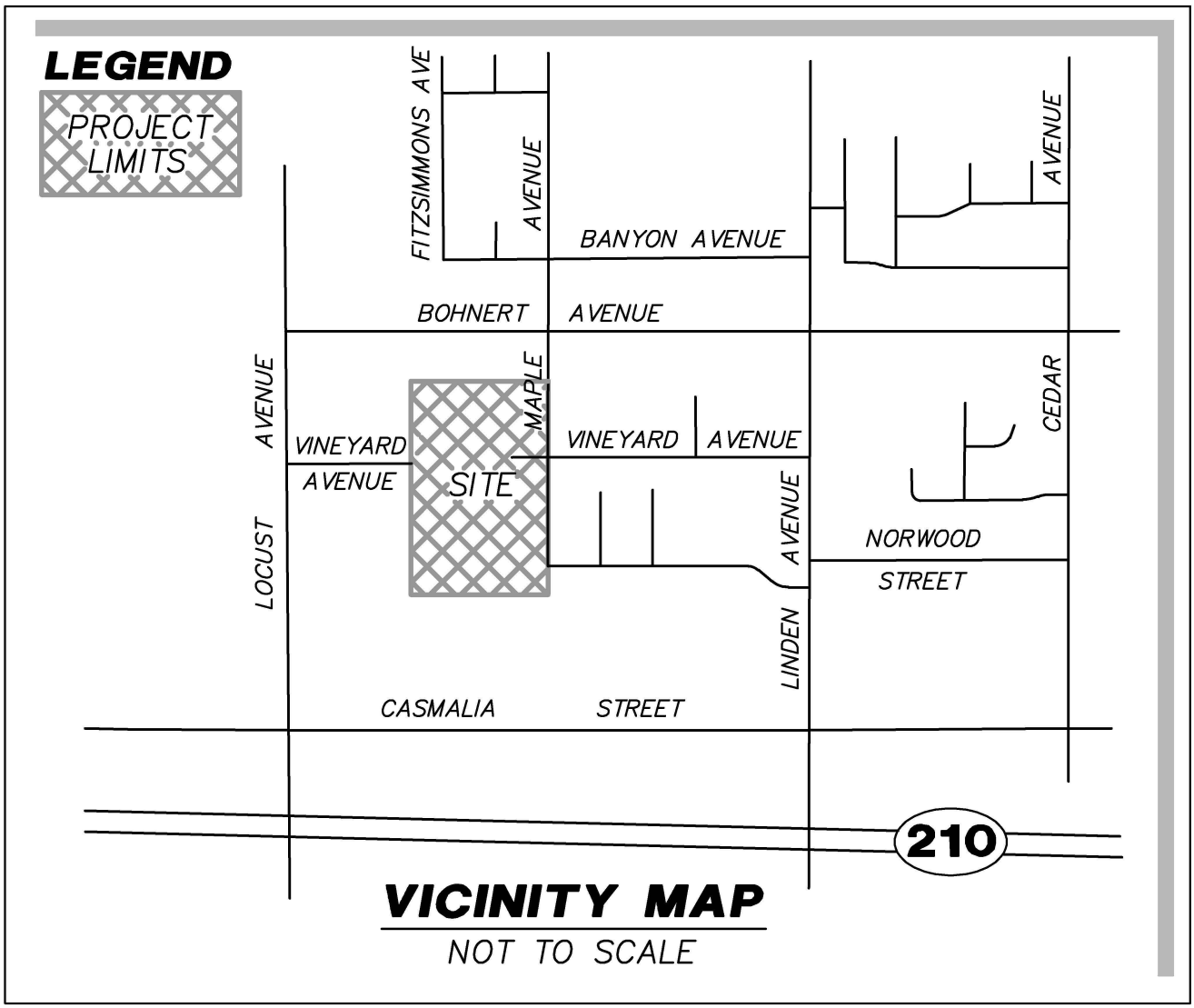
6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

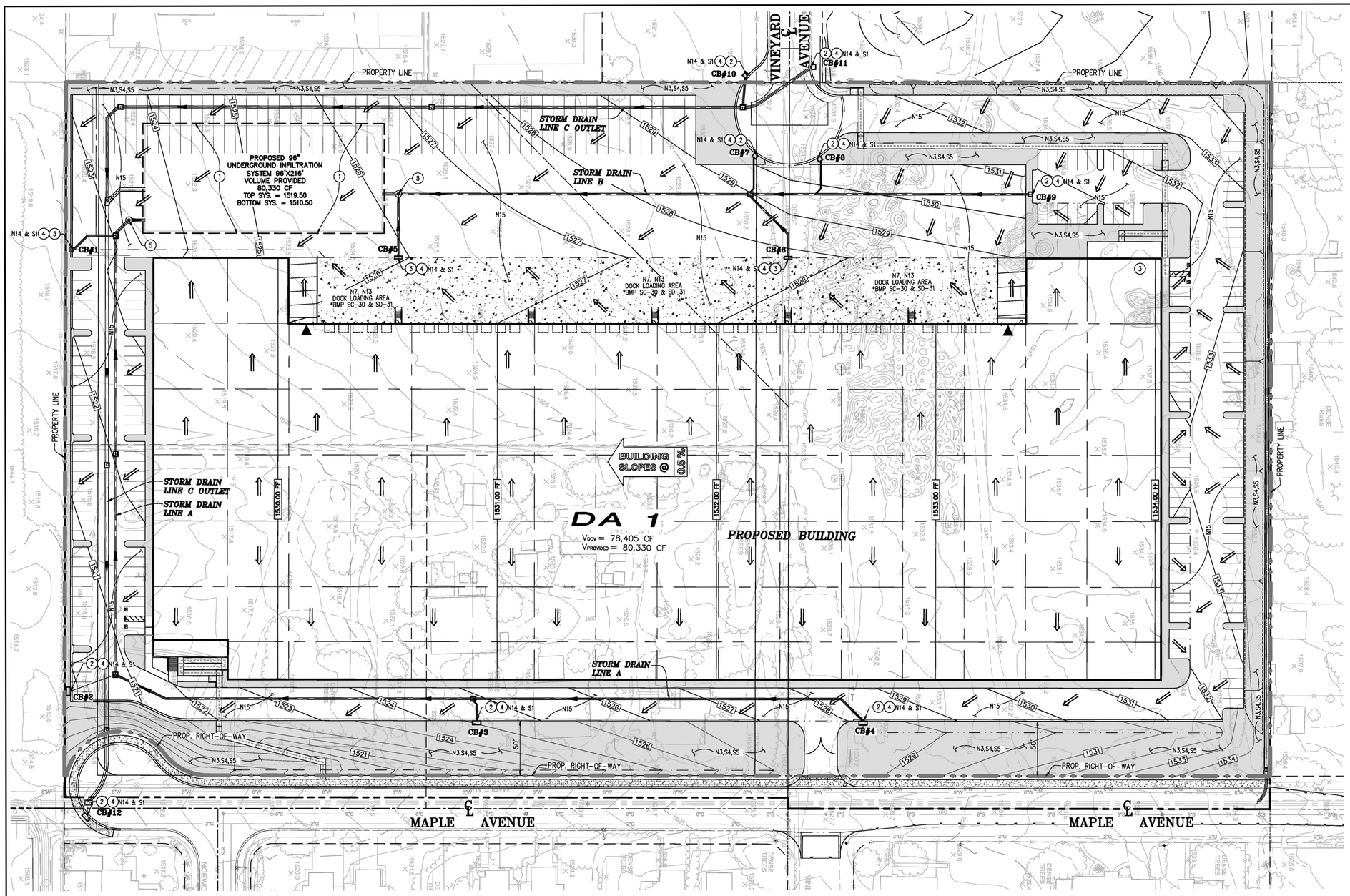
- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

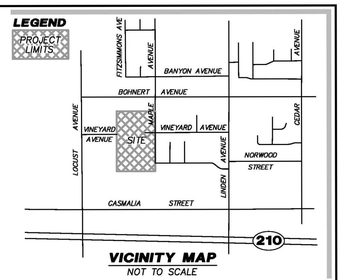
Attachment A
WQMP Site Plan



VICINITY MAP

NOT TO SCALE





VICINITY MAP
NOT TO SCALE

WQMP BMP NOTES

1. INSTALL 60" UNDERGROUND INFILTRATION SYSTEM, SEE DETAIL ON SHEET 2
2. INSTALL BIOCLEAN CURB INLET FILTER, SEE DETAIL ON SHEET 2
3. INSTALL BIOCLEAN GRATE INLET FILTER, SEE DETAIL ON SHEET 2
4. INSTALL STORM DRAIN STENCIL, SEE SAMPLE HEREON
5. INSTALL FIRST DEFENSE HYDRODYNAMIC SEPARATOR, SEE DETAIL ON SHEET 2

LEGEND

- *PROPOSED STORM DRAIN*
- *WQMP AND DRAINAGE BOUNDARY*
- *PROPOSED CURB OPENING INLET W/ FILTER INSERT*
- *PROPOSED LANDSCAPING AREA (N3, S4, AND S5)*
- *CB — CATCH BASIN*
- *FLOW DIRECTION*
- *N-- — NON-STRUCTURAL SOURCE CONTROL BMPs IDENTIFIER PER WQMP REPORT FORM 4.1-1*
- *S-- — STRUCTURAL SOURCE CONTROL BMPs IDENTIFIER PER WQMP REPORT FORM 4.1-2*
- *MH — STORM DRAIN MANHOLE*

SOURCE CONTROL BMPs INCLUDED ONSITE		
IDENTIFIER	DESCRIPTION OF BMP	RESPONSIBLE PARTY
N2	INSPECT/MAINTAIN TRASH CONTAINER	OWNER
N3	LANDSCAPE MAINTENANCE BMP'S	OWNER
N4	INSPECT/MAINTAIN DETENTION BASIN	OWNER
N7	PROVIDE SPILL PLAN	OWNER
N11	LITTER/DEBRIS CONTROL PROGRAM	OWNER
N13	HOUSEKEEPING OF LOADING DOCKS	OWNER
N14	CATCH BASIN INSPECTION PROGRAM	OWNER
N15	VACUUM SWEEPING OF PARKING LOTS	OWNER
N17	NPDES COMPLIANCE	OWNER
S1	STORM DRAIN STENCILING	OWNER
S3	REDUCED WASTE STORAGE POLLUTION	OWNER
S4	EFFICIENT IRRIGATION SYSTEM	OWNER
S5	LANDSCAPING MIN. 1-2" BELOW PAVEMENT	OWNER

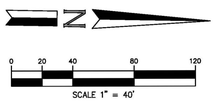
**SEE WQMP REPORT ATTACHMENT C FOR BMP FACT SHEET*

WQMP MANAGEMENT

NAME	AREA (SF)	i	C	V_{BMP} (CF)	BMP	$V_{PROVIDE}$ (CF)
DA 1	691,625	.85	.66	78,405	UNDERGRUND INFILTRATION BASIN	80,330

④ **STORM DRAIN STENCIL**
NOT TO SCALE

OWNER/DEVELOPER
ASG DEVELOPMENT ADVISORS
21602 SURVEYOR CIRCLE, SUITE 100
HUNTINGTON BEACH, CA 92646
PHONE (949) 250-7720
CONTACT PERSON: NASSER MUSTAFA



SCALE 1" = 40'

WATER QUALITY MANAGEMENT PLAN
FOR
ASG - VINEYARD INDUSTRIAL
AT THE END OF VINEYARD AVENUE AND WEST OF MAPLE AVENUE
COUNTY OF SAN BERNARDINO

HUITT ZOLLARS
3990 CONCOURS, SUITE 330, ONTARIO, CALIFORNIA 91764
Phone (909) 941-7799, www.huitt-zollars.com

DESIGNED BY	M.G.
DRAWN BY	HZ STAFF
CHECKED BY	J.M.
FIELD BOOK	
SHEET	1 OF 2 SHEETS
JOB NO.	R316522.01

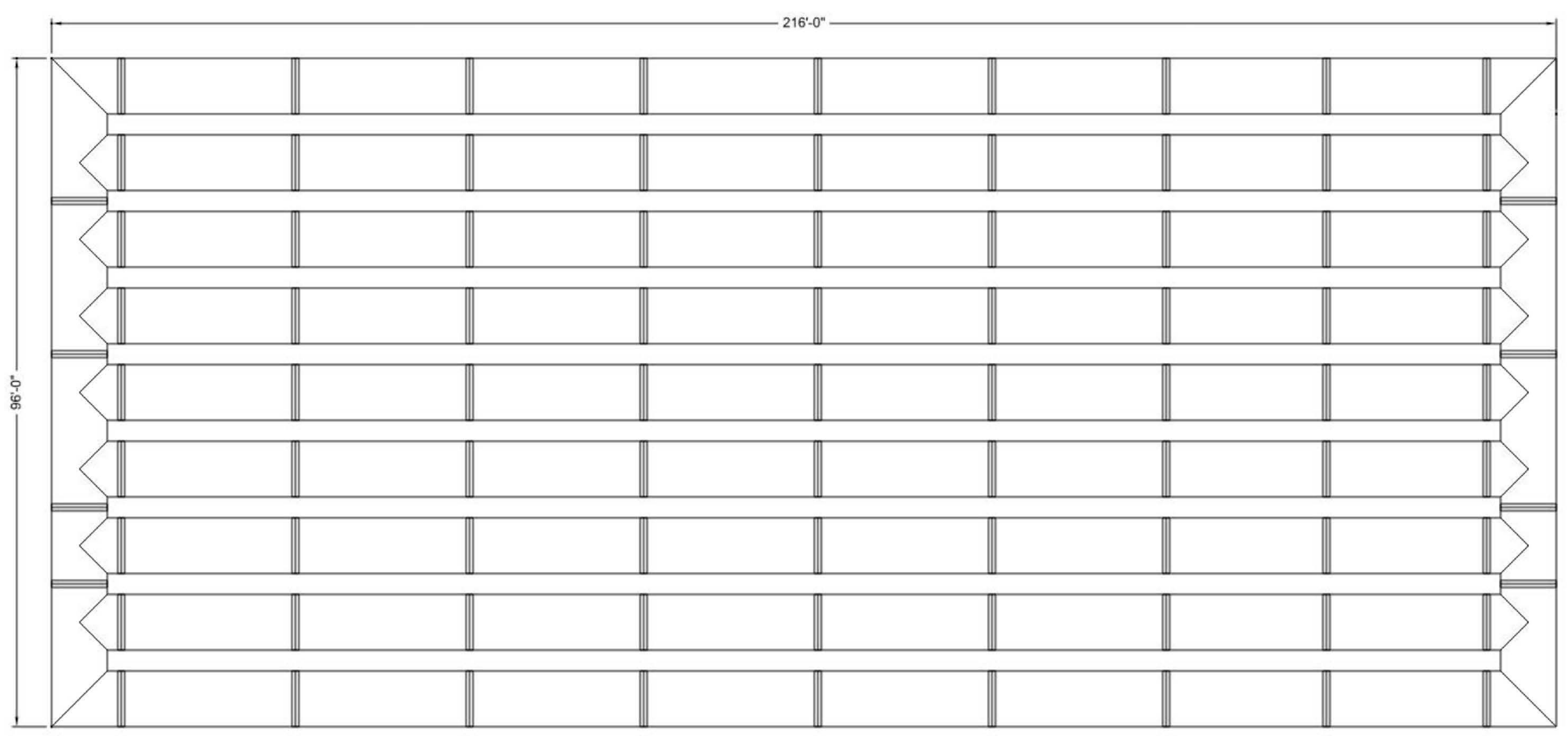
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 1,992 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 100,129 CF
- BACKFILL STORAGE VOLUME = 39,148 CF
- TOTAL STORAGE PROVIDED = 139,277 CF

PIPE DETAILS
- DIAMETER = 96"
- CORRUGATION = 5x1
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 36"

BACKFILL DETAILS
- WIDTH AT ENDS = 24"
- ABOVE PIPE = 6"
- WIDTH AT SIDES = 24"
- BELOW PIPE = 6"



ASSEMBLY
SCALE: 1" = 20'

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE 2⅔" x ½" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
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DATE	REVISION DESCRIPTION	BY

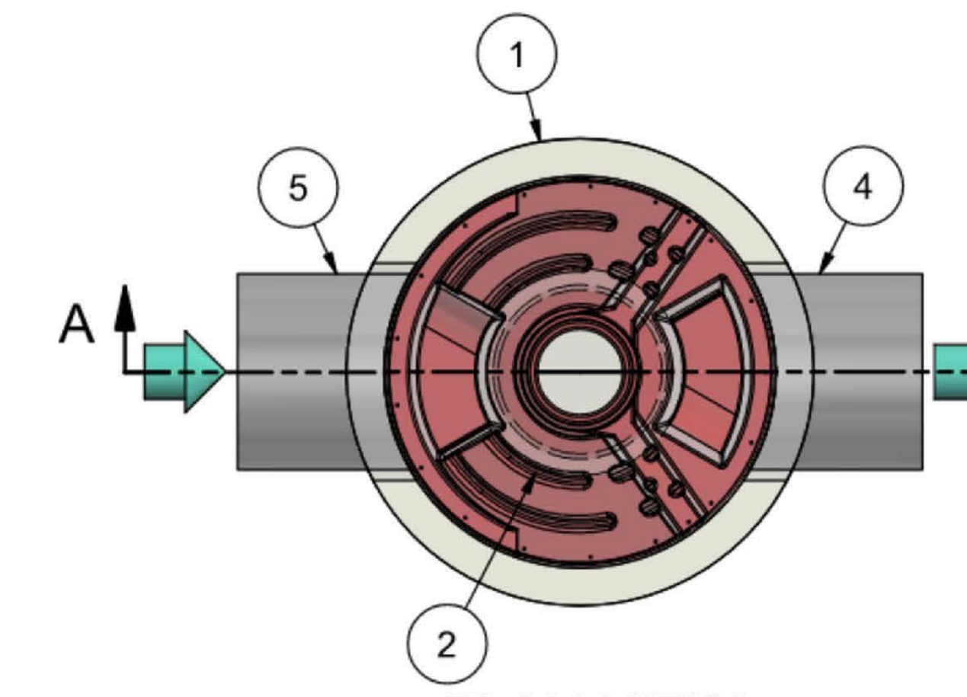
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

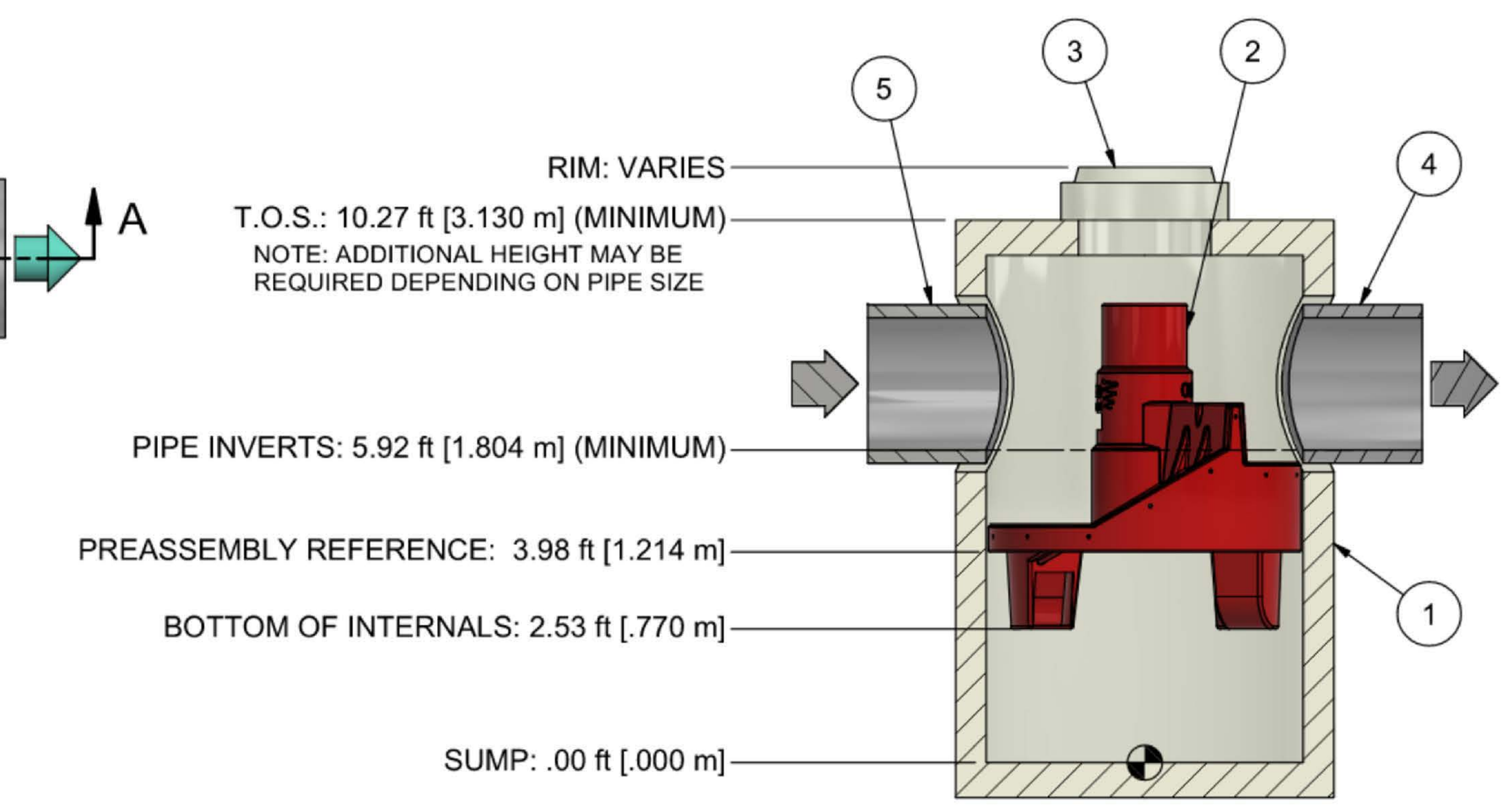
CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO34916 Vineyard Industrial
Infiltration chambers
Rialto, CA
DETENTION SYSTEM

PROJECT No.: 23708	SEQ. No.: 34916	DATE: 8/21/2023
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

(1) **UNDERGROUND INFILTRATION CHAMBERS**
NOT TO SCALE





SECTION A-A
SCALE 1:40

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

PRODUCT SPECIFICATION:

1. Peak Hydraulic Flow: 32.0 cfs (906 l/s)
2. Min Sediment Storage Capacity: 1.6 cu. yd. (1.2 cu. m.)
3. Maximum Inlet/Outlet Pipe Diameters: 30 in. (750 mm)
4. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
5. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/first-defense

GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 30".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plans).
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	72	1800	I.D. PRECAST MANHOLE
2	1			INTERNAL COMPONENTS (PRE-INSTALLED)
3	1	30	750	FRAME AND COVER (ROUND)
4	1	30 (MAX)	750 (MAX)	OUTLET PIPE (BY OTHERS)
5	1	30 (MAX)	750 (MAX)	INLET PIPE (BY OTHERS)

PROJECTION

IF IN DOUBT ASK

DATE: 11/2/2021	SCALE: 1:40	
DRAWN BY: ER	CHECKED BY: MRJ	APPROVED BY

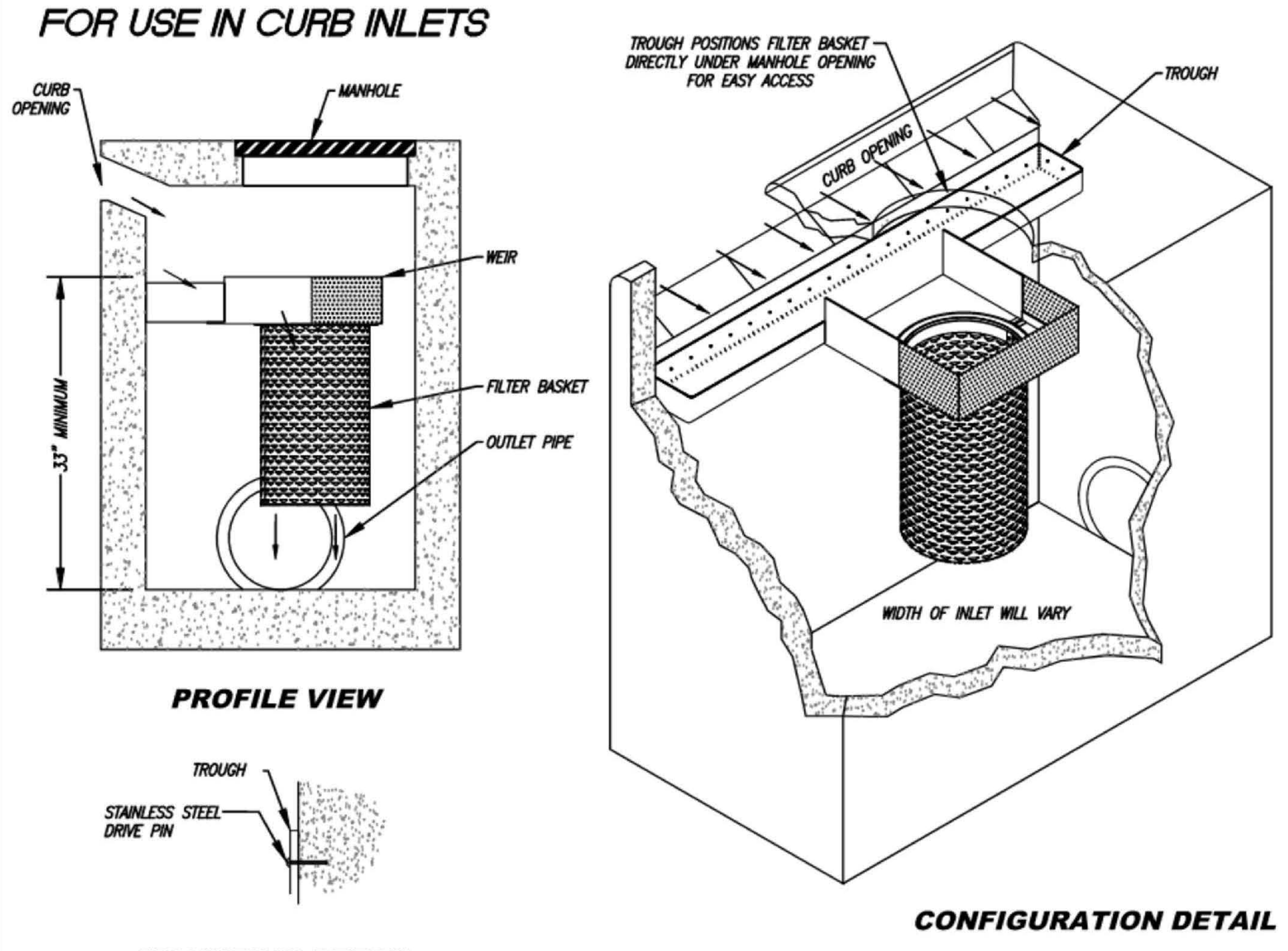
Title
6-ft DIAMETER
FIRST DEFENSE
GENERAL ARRANGEMENT

Hydro International
hydro-int.com
HYDRO INTERNATIONAL

WEIGHT:	MATERIAL:	
STOCK NUMBER: 1		
DRAWING NO.: FD GA-6		
SHEET SIZE: B	SHEET: 1 OF 1	Rev: -

(5) **FIRST DEFENSE HYDRODYNAMIC SEPARATOR**
NOT TO SCALE

BIO CLEAN KRAKEN MEMBRANE FILTER
FOR USE IN CURB INLETS



CONFIGURATION DETAIL

MOUNTING DETAIL

INSTALLATION NOTES

1. TROUGH SYSTEM PROVIDES FOR ENTIRE COVERAGE OF INLET OPENING SO TO DIVERT ALL FLOW TO FILTER.
2. TROUGH SYSTEM TO BE MANUFACTURED FROM MARINE GRADE FIBERGLASS, GEL COATED FOR UV PROTECTION.
3. ALL HARDWARE, FLANGE, FRAME, SHALL BE STAINLESS STEEL.
4. FILTER MANUFACTURED OF 100% STAINLESS STEEL
5. FILTER MADE OF NON-GLOGING SCREEN WITH 4.7 MM OPENINGS AND MEETS FULL CAPTURE REQUIREMENTS
6. FILTER IS LOCATED DIRECTLY UNDER THE MANHOLE FOR EASY REMOVAL AND MAINTENANCE.
7. LENGTH OF TROUGH CAN VARY FROM 2' TO 30'
8. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT CONTECH FOR MORE INFORMATION.
9. BYPASS IS FACILITATED VIA OVERFLOW OF THE TROUGH SYSTEM AND IS EQUAL TO THE CAPACITY OF THE CURB OPENING.
10. ADDITIONAL TREATMENT AND STORAGE CAPACITY CAN BE ACHIEVED BY UTILIZING MULTIPLE FILTER BASKETS.
11. STORAGE CAPACITY BASED ON BASKET HALF FULL.
12. CONCRETE STRUCTURES SOLD SEPARATELY.

PERFORMANCE NOTES

1. MEETS FULL CAPTURE REQUIREMENTS

MODEL #	TREATMENT FLOW RATE (CFS)	SOLIDS STORAGE CAPACITY (CF)
BIO–CURB–FULL–24	2.85	1.77
BIO–CURB–FULL–12	2.85	0.88

NOT TO SCALE

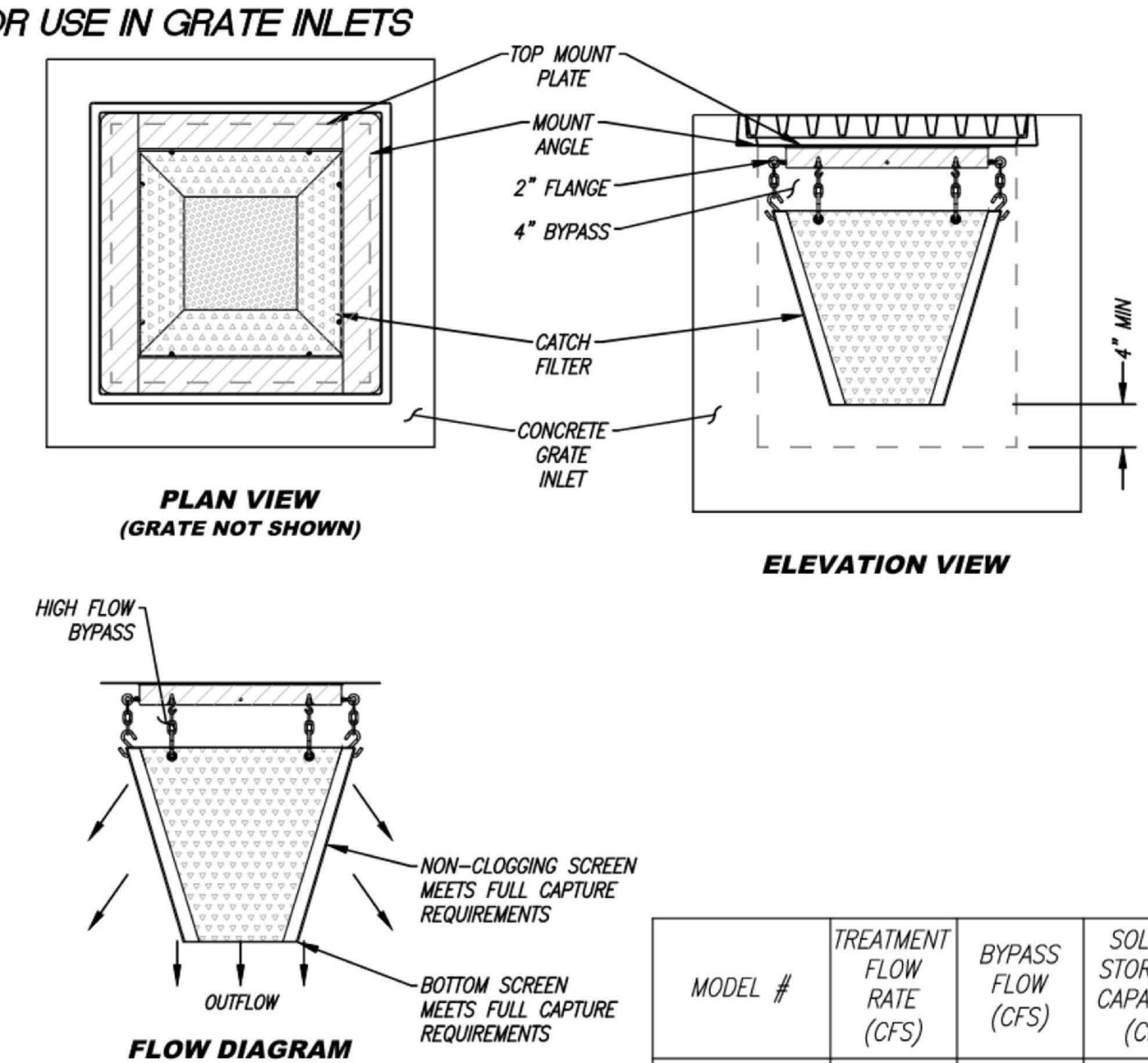
4/18/23JASON.HARLOW

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com

CURB INLET FILTER
FULL CAPTURE FILTER
STANDARD DETAIL

(2) **CURB INLET FILTER**
NOT TO SCALE

BIO CLEAN FULL CAPTURE FILTER
FOR USE IN GRATE INLETS



FLOW DIAGRAM

MODEL #	TREATMENT FLOW RATE (CFS)	BYPASS FLOW (CFS)	SOLIDS STORAGE CAPACITY (CF)
BIO–GRATE–FULL 12–12–12	1.04	1.24	0.15
BIO–GRATE–FULL 18–18–12	1.78	2.79	0.33
BIO–GRATE–FULL 24–24–12	2.70	4.96	0.59
BIO–GRATE–FULL 24–40–12	3.70	6.35	0.88
BIO–GRATE–FULL 24–24–24	7.31	4.96	1.22
BIO–GRATE–FULL 24–40–24	9.53	6.35	1.82
BIO–GRATE–FULL 36–36–24	11.93	7.74	2.73

INSTALLATION NOTES:

1. ALL HARDWARE, FLANGE, FRAME, SCREENS SHALL BE STAINLESS STEEL.
2. OPTIONAL HYDROCARBON BOOM SHALL BE 2" DIAMETER.
3. SEE PERFORMANCE REPORTS IN MANUFACTURES SPECIFICATIONS.
4. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
5. BASED ON 37% OPEN AREA.
6. CONSIDERS A SAFETY FACTOR OF 2.0.
7. CONSIDERS A LOCAL DEPRESSION PONDING DEPTH OF 6 INCHES.
8. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.
9. CONCRETE STRUCTURES SOLD SEPARATELY.

NOT TO SCALE

9/23/22GSCHIPPER

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com

GRATE INLET FILTER
FULL CAPTURE
STANDARD DETAIL

(3) **GRATE INLET FILTER**
NOT TO SCALE

WATER QUALITY MANAGEMENT PLAN
FOR
ASG - VINEYARD INDUSTRIAL
AT THE END OF VINEYARD AVENUE AND WEST OF MAPLE AVENUE
COUNTY OF SAN BERNARDINO

HZ HUITT ZOLLARS
3990 CONCOURS, SUITE 330, ONTARIO, CALIFORNIA 91764
Phone (909) 941-7799, www.huitt-zollars.com

DESIGNED BY	M.G.
DRAWN BY	HZ STAFF
CHECKED BY	J.M.
FIELD BOOK	

JOB NO. R316522.01

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Attachment B
BMP Details, Supporting Calc's, Manufacture’s Details

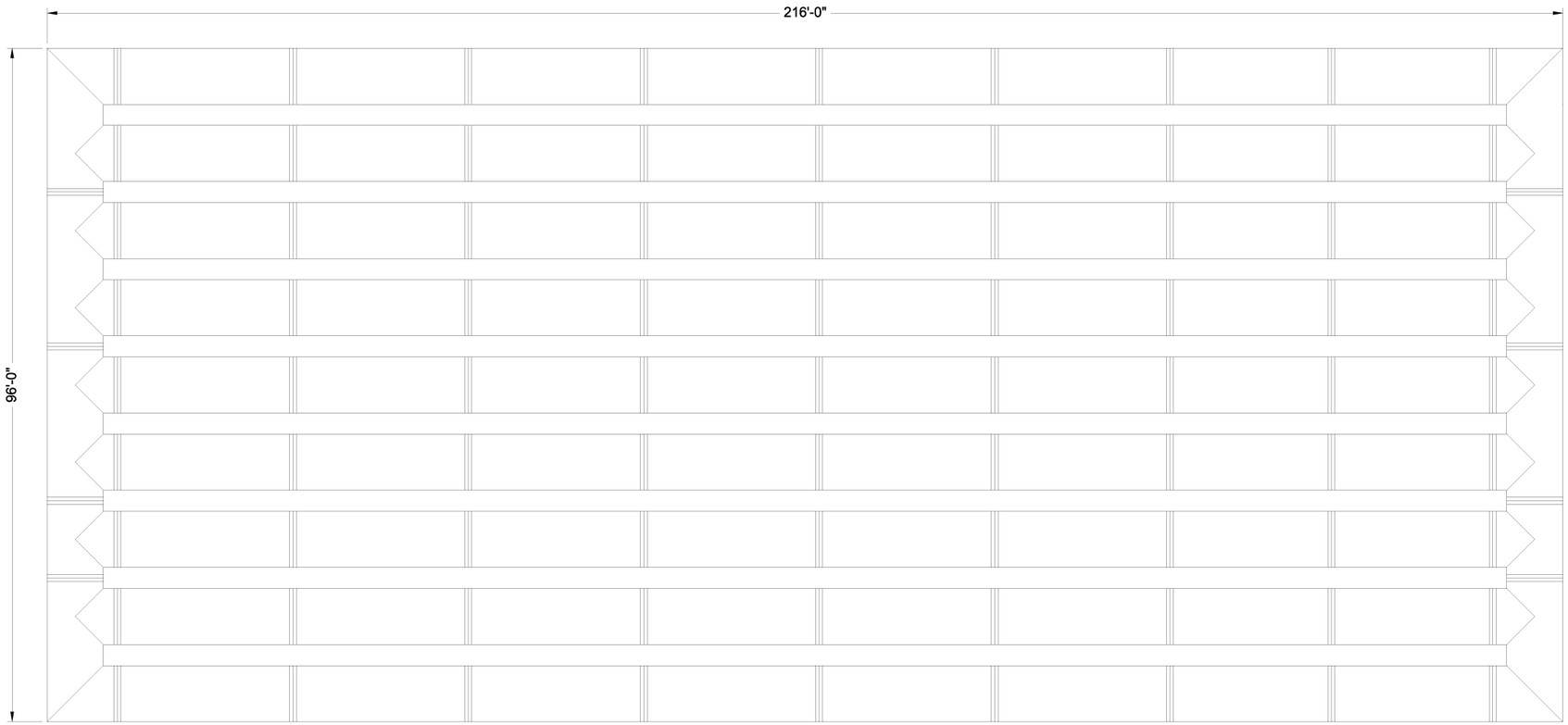
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 1,992 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 100,129 CF
- BACKFILL STORAGE VOLUME = 39,148 CF
- TOTAL STORAGE PROVIDED = 139,277 CF

PIPE DETAILS
- DIAMETER = 96"
- CORRUGATION = 5x1
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 36"

BACKFILL DETAILS
- WIDTH AT ENDS = 24"
- ABOVE PIPE = 6"
- WIDTH AT SIDES = 24"
- BELOW PIPE = 6"



NOTES

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- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
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ASSEMBLY
SCALE: 1" = 20'

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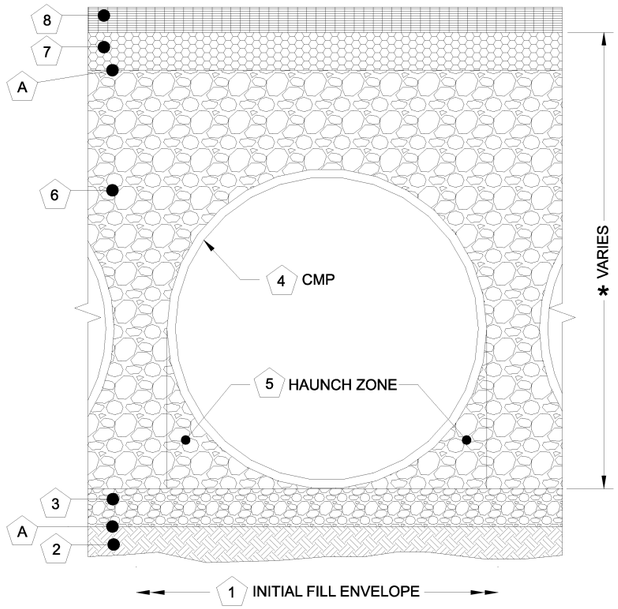
CONTECH® CMP DETENTION SYSTEMS
CONTECH **DYODS** DRAWING

DYO34916 Vineyard Industrial
Infiltration chambers
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
23708	34916	8/21/2023
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		



	Infiltration Systems - CMP Infiltration & CMP Perforated Drainage Pipe			
	Material Location	Description	Material Designation	Designation
8	Rigid or Flexible Pavement (if applicable)			
7	Road Base (if applicable			
A	Geotextile Layer	Non-Woven Geotextile	CONTECH C-40 or C-45	Engineer Decision for consideration to prevent soil migration into varying soil types. Wrap the trench only.
6	Backfill	Infiltration pipe systems have a pipe perforation sized of 3/8" diameter. An open graded, free draining stone, with a particle size of ½" – 2 ½" diameter is recommended.	AASHTO M 145-A-1 or AASHTO M 43 - 3, 4	Material shall be worked into the pipe haunches by means of shovel-slicing, rodding, air-tamper, vibratory rod, or other effective methods. Compaction of all placed fill material is necessary and shall be considered adequate when no further yielding of the material is observed under the compactor, or under foot, and the Project Engineer or his representative is satisfied with the level of compaction"
3	Bedding Stone	Well graded granular bedding material w/maximum particle size of 3"	AASHTO M43 - 3,357,4,467, 5, 56, 57	For soil aggregates larger than 3/8" a dedicated bedding layer is not required for CMP. Pipe may be placed on the trench bottom comprised of native suitable well graded & granular material. For Arch pipes it is recommended to be shaped to a relatively flat bottom or fine-grade the foundation to a slight v-shape. Soil aggregates less than 3/8" and unsuitable material should be over-excavated and re-placed with a 4"-6" layer of well graded & granular stone per the material designation.
A	Geotextile Layer	None	None	Contech does not recommend geotextiles be placed under the invert of Infilitration systems due to the propensity for geotextiles to clog over time.
*	Note: The listed AASHTO designations are for gradation only. The stone must also be angular and clean.			

1 MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT.

FOUNDATION/BEDDING PREPARATION

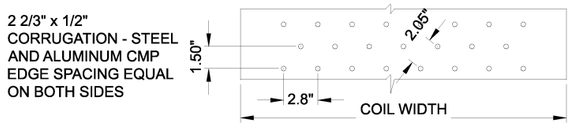
2 PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND BROUGHT BACK TO THE GRADE WITH A FILL MATERIAL AS APPROVED BY THE ENGINEER.

5 HAUNCH ZONE MATERIAL SHALL BE PLACED AND UNIFORMLY COMPACTED WITHOUT SOFT SPOTS.

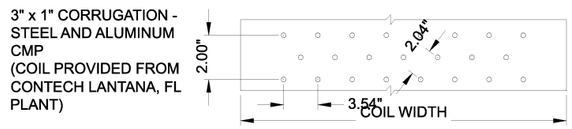
BACKFILL
MATERIAL SHALL BE PLACED IN 8"-10" MAXIMUM LIFTS. INADEQUATE COMPACTION CAN LEAD TO EXCESSIVE DEFLECTIONS WITHIN THE SYSTEM AND SETTLEMENT OF THE SOILS OVER THE SYSTEM. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO-LIFT DIFFERENTIAL BETWEEN THE SIDES OF ANY PIPE IN THE SYSTEM AT ALL TIMES DURING THE BACKFILL PROCESS. BACKFILL SHALL BE ADVANCED ALONG THE LENGTH OF THE SYSTEM AT THE SAME RATE TO AVOID DIFFERENTIAL LOADING ON ANY PIPES IN THE SYSTEM.

EQUIPMENT USED TO PLACE AND COMPACT THE BACKFILL SHALL BE OF A SIZE AND TYPE SO AS NOT TO DISTORT, DAMAGE, OR DISPLACE THE PIPE. ATTENTION MUST BE GIVEN TO PROVIDING ADEQUATE MINIMUM COVER FOR SUCH EQUIPMENT. MAINTAIN BALANCED LOADING ON ALL PIPES IN THE SYSTEM DURING ALL SUCH OPERATIONS.

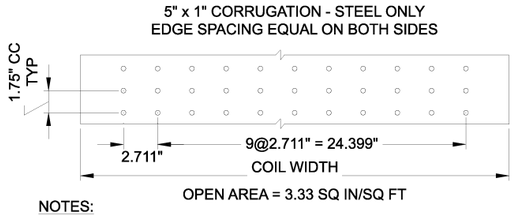
OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS. REFER TO TYPICAL BACKFILL DETAIL FOR MATERIAL REQUIRED.



OPEN AREA = 3.76 SQ IN/SQ FT



OPEN AREA = 4.16 SQ IN/SQ FT



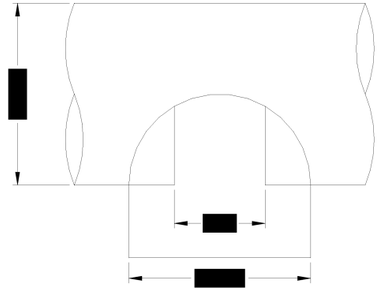
OPEN AREA = 3.33 SQ IN/SQ FT

NOTES:

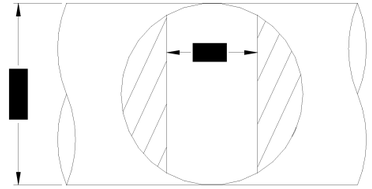
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
4. ALL HOLES ⌀3/8".

TYPICAL PERFORATION DETAIL

SCALE: N.T.S.



PLAN

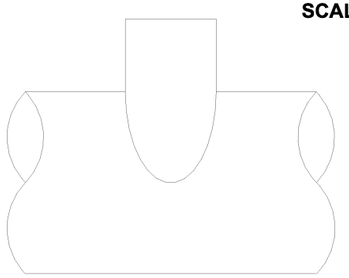


FRONT

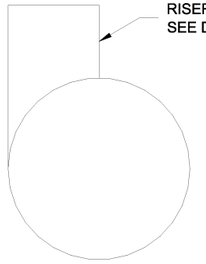
TYPICAL MANWAY DETAIL

SCALE: N.T.S.

NOTE:
MANWAY DETAIL APPLICABLE FOR CMP SYSTEMS WITH DIAMETERS 48" AND LARGER. MANWAYS MAY BE REQUIRED ON SMALLER SYSTEMS DEPENDING ON ACTUAL SITE SPECIFIC CONDITIONS.



ELEVATION

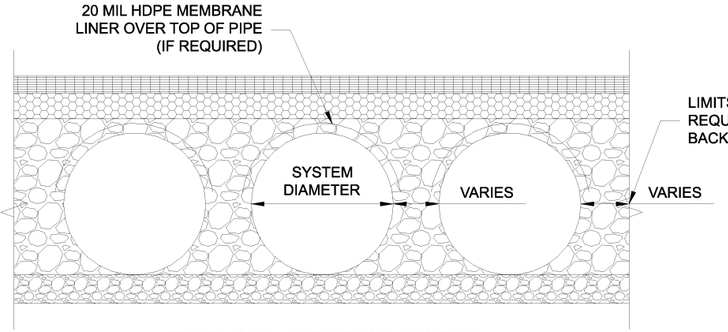


END

TYPICAL RISER DETAIL

SCALE: N.T.S.

NOTE:
LADDERS ARE OPTIONAL AND ARE NOT REQUIRED FOR ALL SYSTEMS.



TYPICAL SECTION VIEW

LINER OVER ROWS
SCALE: N.T.S.

NOTE: IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, AN HDPE MEMBRANE LINER IS RECOMMENDED WITH THE SYSTEM. THE IMPERMEABLE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

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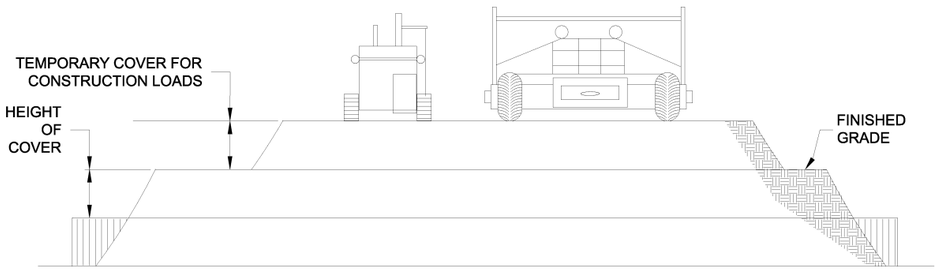


CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

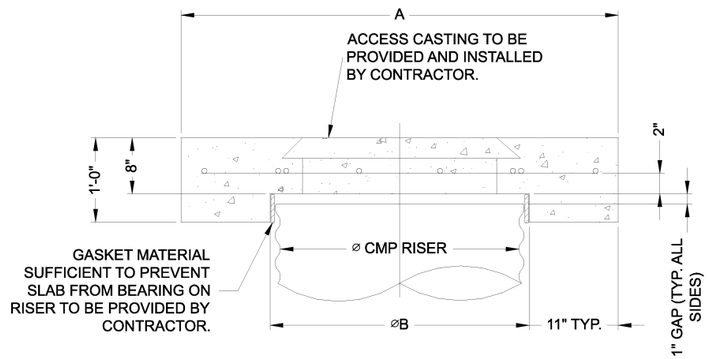
APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE
HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL APPLICABLE PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.
REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

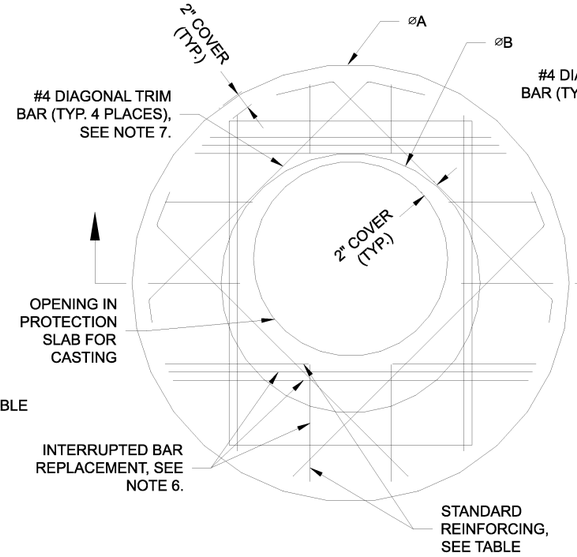
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.



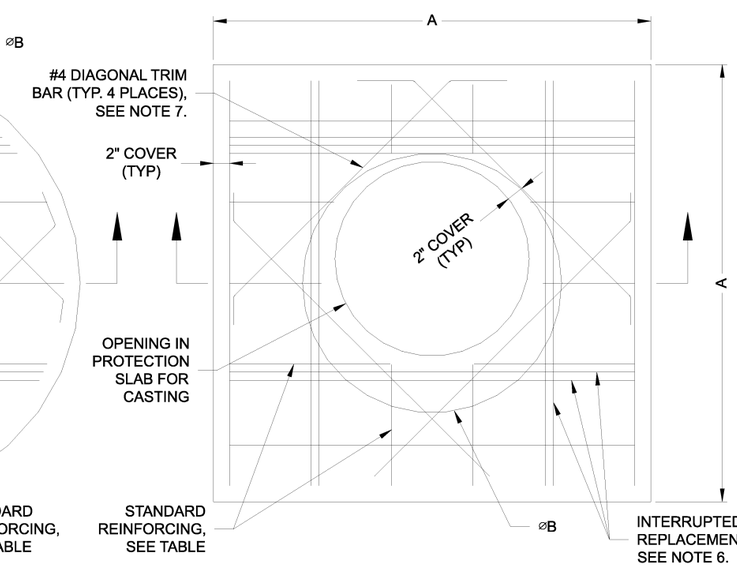
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

DATE	REVISION DESCRIPTION	BY

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH® CMP DETENTION SYSTEMS
CONTECH **DYODS** DRAWING

DYO34916 Vineyard Industrial
Infiltration chambers
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
23708	34916	8/21/2023
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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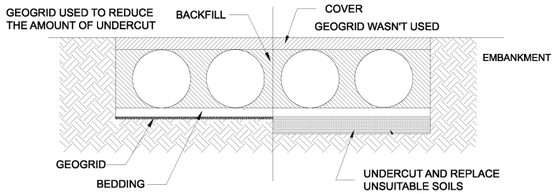
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

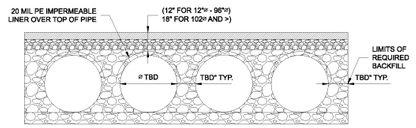


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

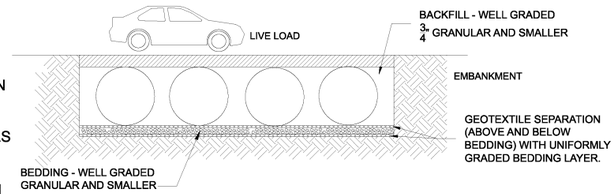
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

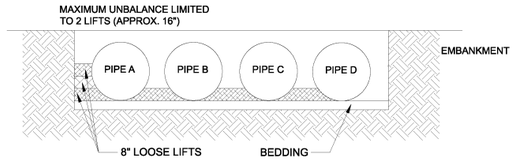
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



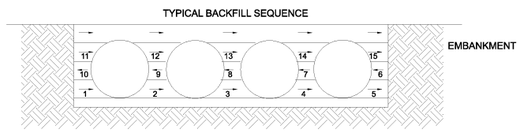
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

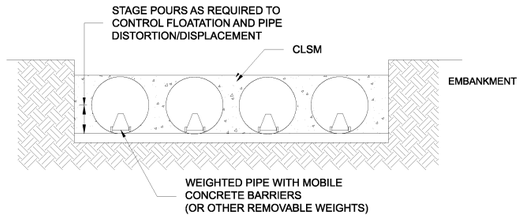


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

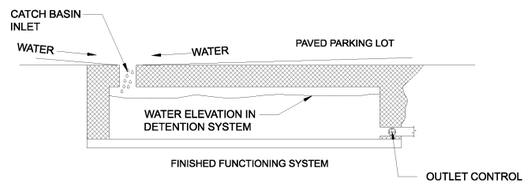


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

DATE	REVISION DESCRIPTION	BY

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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
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CONTECH® CMP DETENTION SYSTEMS
CONTECH **DYODS** DRAWING

DYO34916 Vineyard Industrial Infiltration chambers Rialto, CA DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
23708	34916	8/21/2023
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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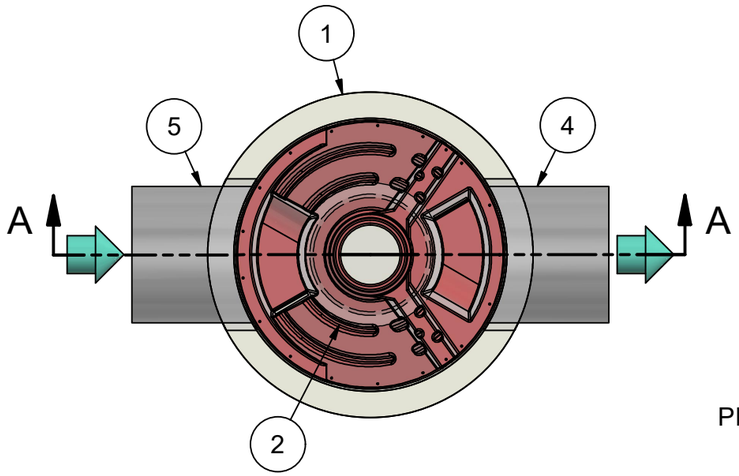
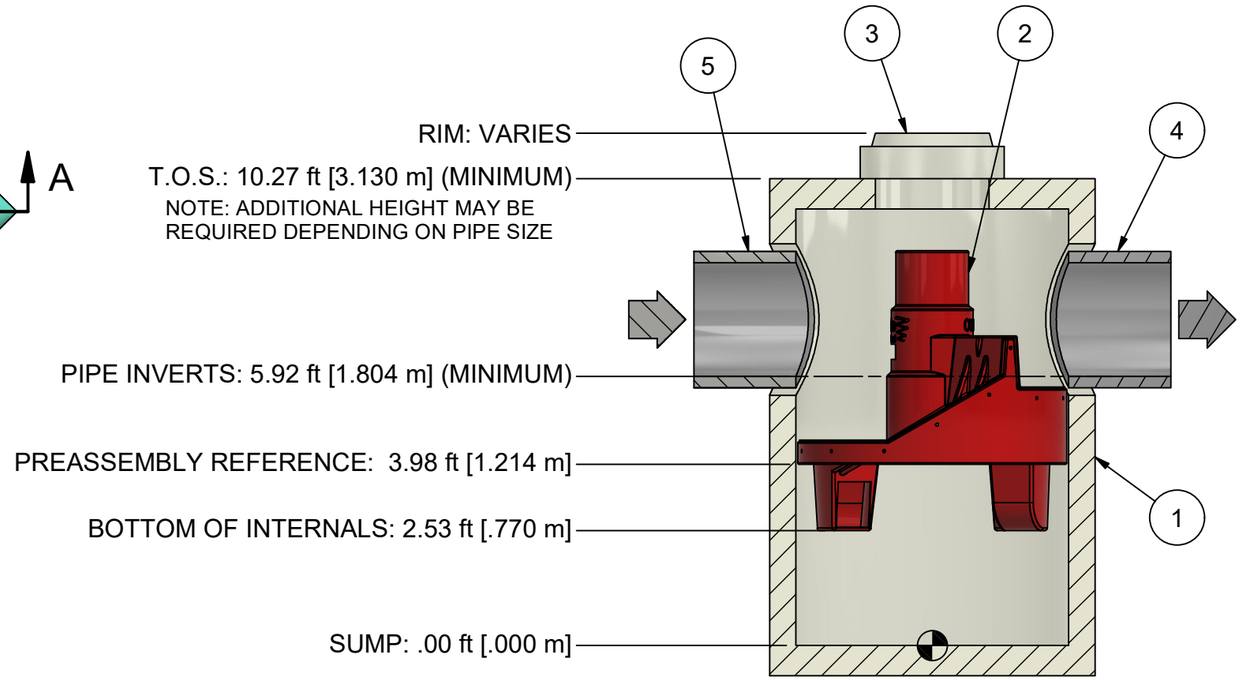


PLAN VIEW

HYDRO FRAME AND COVER (INCLUDED)

GRADE RINGS BY OTHERS AS REQUIRED



SECTION A-A
SCALE 1:40

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
11/2/2021	1:40

DRAWN BY:	CHECKED BY:	APPROVED BY
ER	MRJ	

Title
6-ft DIAMETER
FIRST DEFENSE

GENERAL ARRANGEMENT

Hydro International®
hydro-int.com
HYDRO INTERNATIONAL

WEIGHT:	MATERIAL:

STOCK NUMBER: 1

DRAWING NO.: FD GA-6

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	-

PRODUCT SPECIFICATION:

1. Peak Hydraulic Flow: 32.0 cfs (906 l/s)
2. Min Sediment Storage Capacity: 1.6 cu. yd. (1.2 cu. m.)
3. Maximum Inlet/Outlet Pipe Diameters: 30 in. (750 mm)
4. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
5. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/first-defense

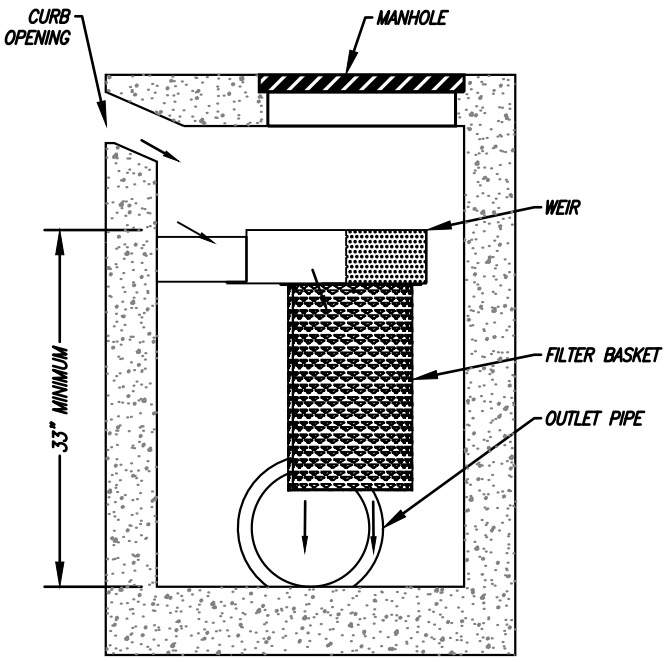
GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 30".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plans).
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

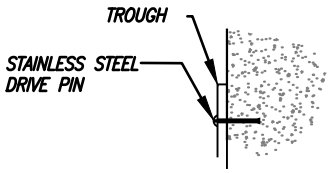
ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	72	1800	I.D. PRECAST MANHOLE
2	1			INTERNAL COMPONENTS (PRE-INSTALLED)
3	1	30	750	FRAME AND COVER (ROUND)
4	1	30 (MAX)	750 (MAX)	OUTLET PIPE (BY OTHERS)
5	1	30 (MAX)	750 (MAX)	INLET PIPE (BY OTHERS)

BIO CLEAN KRAKEN MEMBRANE FILTER

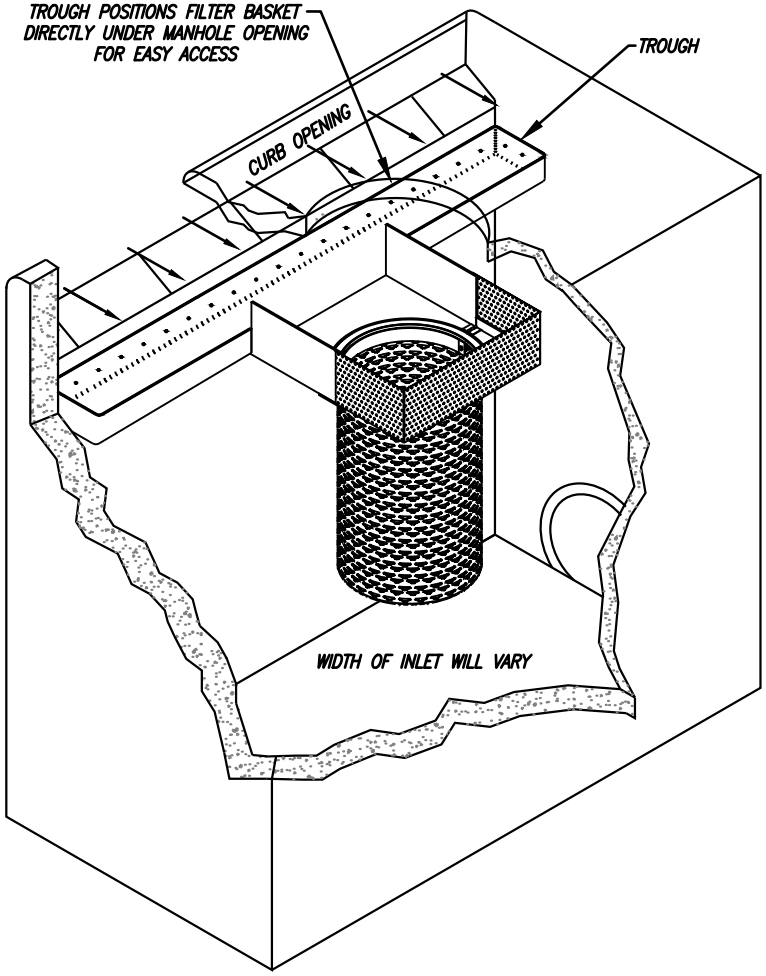
FOR USE IN CURB INLETS



PROFILE VIEW



MOUNTING DETAIL



CONFIGURATION DETAIL

INSTALLATION NOTES

1. TROUGH SYSTEM PROVIDES FOR ENTIRE COVERAGE OF INLET OPENING SO TO DIVERT ALL FLOW TO FILTER.
2. TROUGH SYSTEM TO BE MANUFACTURED FROM MARINE GRADE FIBERGLASS, GEL COATED FOR UV PROTECTION.
3. ALL HARDWARE, FLANGE, FRAME, SHALL BE STAINLESS STEEL.
4. FILTER MANUFACTURED OF 100% STAINLESS STEEL
5. FILTER MADE OF NON-GLOGING SCREEN WITH 4.7 MM OPENINGS AND MEETS FULL CAPTURE REQUIREMENTS
6. FILTER IS LOCATED DIRECTLY UNDER THE MANHOLE FOR EASY REMOVAL AND MAINTENANCE.
7. LENGTH OF TROUGH CAN VARY FROM 2' TO 30'
8. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE - CONTACT CONTECH FOR MORE INFORMATION.
9. BYPASS IS FACILITATED VIA OVERFLOW OF THE TROUGH SYSTEM AND IS EQUAL TO THE CAPACITY OF THE CURB OPENING.
10. ADDITIONAL TREATMENT AND STORAGE CAPACITY CAN BE ACHIEVED BY UTILIZING MULTIPLE FILTER BASKETS.
11. STORAGE CAPACITY BASED ON BASKET HALF FULL.
12. CONCRETE STRUCTURES SOLD SEPARATELY.

NOT TO SCALE

PERFORMANCE NOTES

1. MEETS FULL CAPTURE REQUIREMENTS

MODEL #	TREATMENT FLOW RATE (CFS)	SOLIDS STORAGE CAPACITY (CF)
BIO-CURB-FULL-24	2.85	1.77
BIO-CURB-FULL-12	2.85	0.88

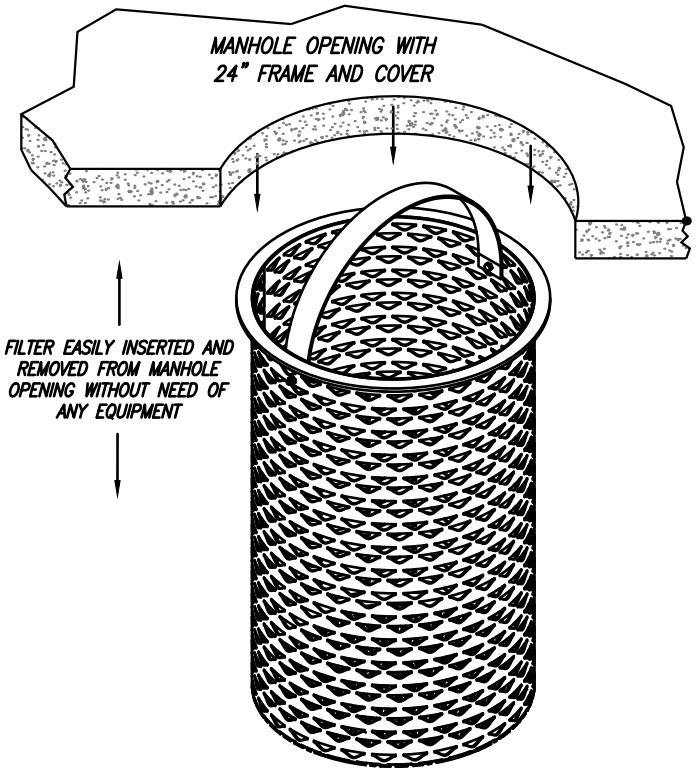
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com

CURB INLET FILTER
FULL CAPTURE FILTER
STANDARD DETAIL

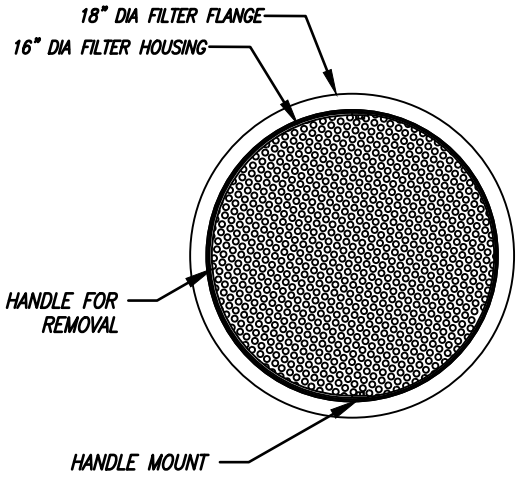
4/18/23JASON.HARLOW

BIO CLEAN FABRIC FILTER

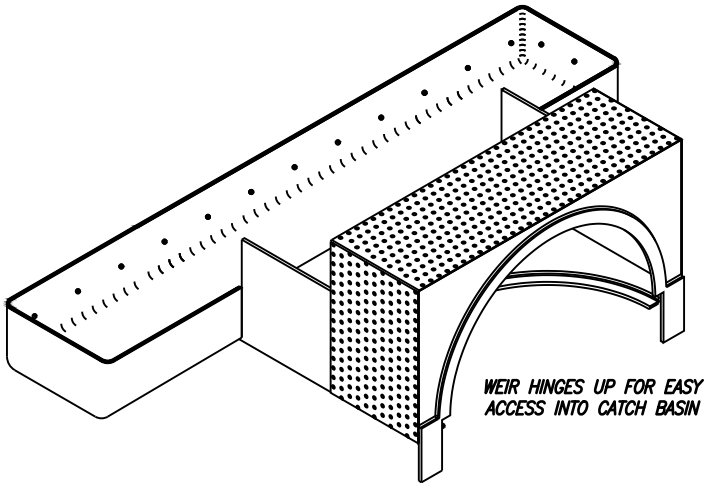
FOR USE IN CURB INLETS



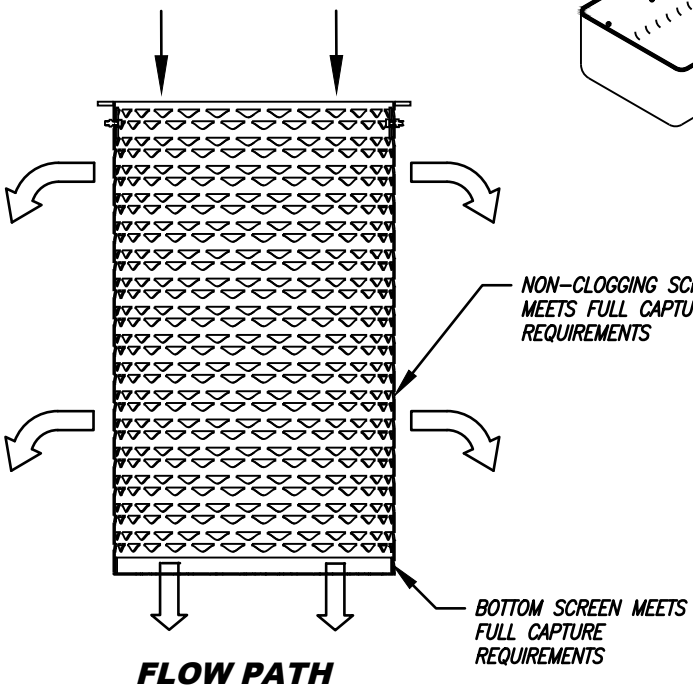
INSTALLATION DETAIL



DETAIL OF DIAMETERS



WEIR DETAIL



FLOW PATH

FLOW RATES – FULL CAPTURE FILTER	
FILTER TREATMENT FLOW RATE	2.85 CFS
SAFETY FACTOR = 2	
TREATMENT FLOW RATE IS BASED ON THE CRITICAL POINT OF RESTRICTION, WHICH IS EITHER THE WEIR OR THE SCREEN CAPACITIES	
WEIR CAPACITY = 2.85 CFS SCREEN CAPACITY = 4.82 CFS	
FLOW RATES CALCULATED USING THE FOLLOWING EQUATION $Q = SO*c_d*A\sqrt{2*g*h}$ $c_d = 0.62$	
SEE PAGE 1 FOR NOTES	

NOT TO SCALE

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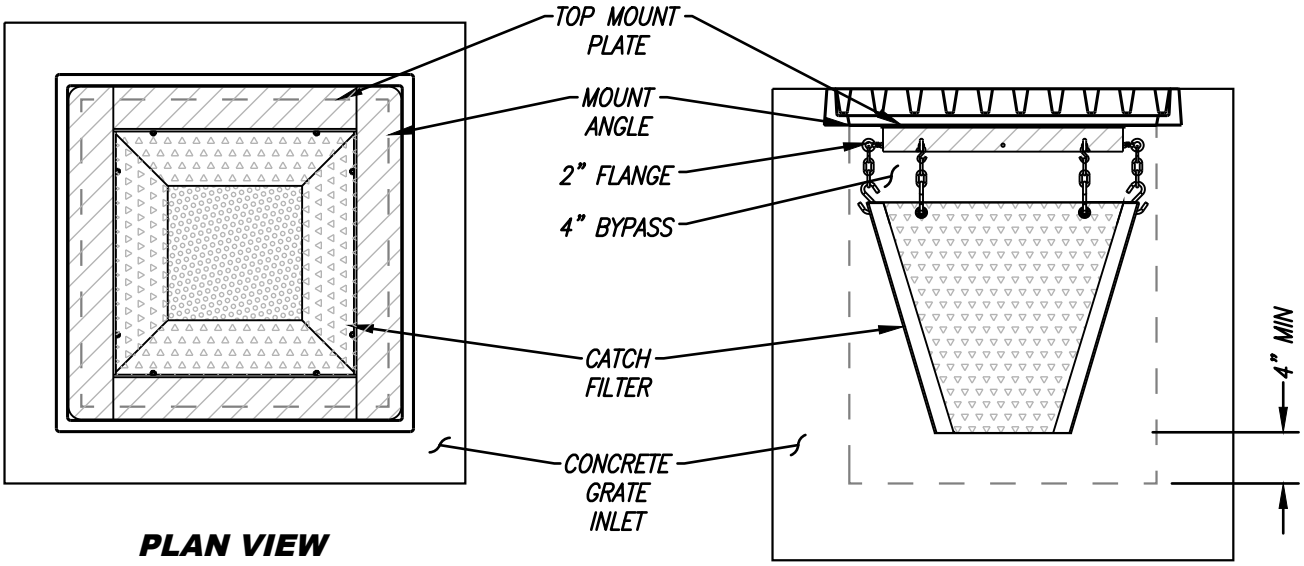
CURB INLET FILTER
FULL CAPTURE FILTER
STANDARD DETAIL

4/18/23.JASON.HARLOW

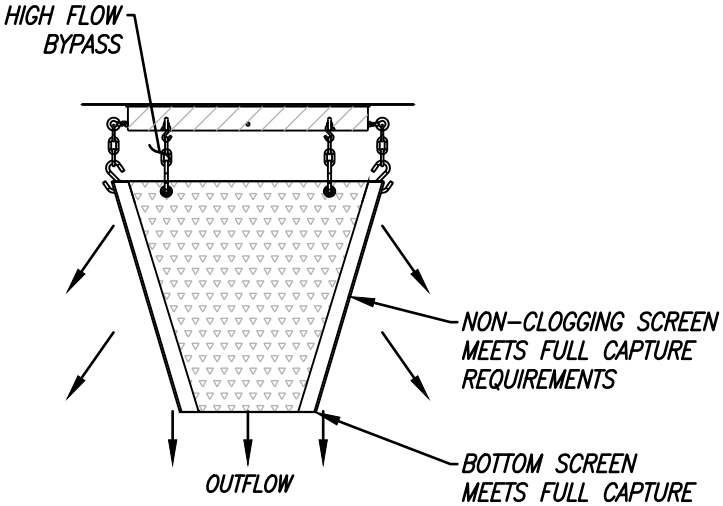
BIO CLEAN FULL CAPTURE FILTER

FOR USE IN GRATE INLETS



PLAN VIEW
(GRATE NOT SHOWN)

ELEVATION VIEW



FLOW DIAGRAM

MODEL #	TREATMENT FLOW RATE (CFS)	BYPASS FLOW (CFS)	SOLIDS STORAGE CAPACITY (CF)
BIO-GRATE-FULL 12-12-12	1.04	1.24	0.15
BIO-GRATE-FULL 18-18-12	1.78	2.79	0.33
BIO-GRATE-FULL 24-24-12	2.70	4.96	0.59
BIO-GRATE-FULL 24-40-12	3.70	6.35	0.88
BIO-GRATE-FULL 24-24-24	7.31	4.96	1.22
BIO-GRATE-FULL 24-40-24	9.53	6.35	1.82
BIO-GRATE-FULL 36-36-24	11.93	7.74	2.73

INSTALLATION NOTES:

1. ALL HARDWARE, FLANGE, FRAME, SCREENS SHALL BE STAINLESS STEEL.
2. OPTIONAL HYDROCARBON BOOM SHALL BE 2" DIAMETER.
3. SEE PERFORMANCE REPORTS IN MANUFACTURES SPECIFICATIONS.
4. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
5. BASED ON 37% OPEN AREA.
6. CONSIDERS A SAFETY FACTOR OF 2.0.
7. CONSIDERS A LOCAL DEPRESSION PONDING DEPTH OF 6 INCHES.
8. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.
9. CONCRETE STRUCTURES SOLD SEPARATELY.

NOT TO SCALE

CONTECH ENGINEERED SOLUTIONS LLC
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GRATE INLET FILTER
FULL CAPTURE
STANDARD DETAIL

9/23/22CSCHIPPER

CONTECH®
ENGINEERED SOLUTIONS

Corrugated Metal Pipe Design Guide

Table of Contents

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Durability Design Guide for Drainage Products

Proper design of culverts and storm sewers requires structural, hydraulic and durability considerations. While most designers are comfortable with structural and hydraulic design, the mechanics of evaluating abrasion, corrosion and water chemistry to perform a durability design are not commonly found in most civil engineering handbooks.

The durability and service life of a drainage pipe installation is directly related to the environmental conditions encountered at the site and the type of materials and coatings from which the culvert is fabricated. Two principle causes of early failure in drainage pipe materials are corrosion and abrasion.

Service life can be affected by the corrosive action of the backfill in contact with the outside of a drainage pipe or more commonly by the corrosive and abrasive action of the flow in the invert of the drainage pipe. The design life analysis should include a check for both the water side and soil side environments to determine which is more critical— or which governs service life.

The potential for metal loss in the invert of a drainage pipe due to abrasive flows is often overlooked by designers and its effects are often mistaken for corrosion. An estimate for potential abrasion is required at each pipe location in order to determine the appropriate material and gage.

This manual is intended to guide specifiers through the mechanics of selecting appropriate drainage products to meet service life requirements. The information contained in the following pages is a composite of several national guidelines.

Using the Design Guide

The choice of material, gage and product type can be extremely important to service life. The following steps describe the procedure for selecting the appropriate drainage product, material and gage to meet a specific service life requirement.

Design Sequence

1. Select pipe or structure based on hydraulic and clearance requirements. Use Tables 4 and 5 as reference for size limits and hydraulic properties of all drainage products.
2. Use Height of Cover tables for the chosen pipe or structure to determine the material gage required for the specific loading condition.
3. Use Table 1 to select the appropriate material for the site-specific environmental conditions. Whenever possible, existing installations of drainage structures along the same water course offer the most reliable estimate of long-term performance for specific environment conditions. In many cases, there will be more than one material that is appropriate for the project environmental conditions. Generally speaking, the metal material types increase in price as you move from top down on Table 1. Please contact your local CONTECH Sales Representative for pricing.
4. Use Table 2 to determine which abrasion level most accurately describes the typical storm event (2 year storm). The expected stream velocity and associated abrasion conditions should be based on a typical flow and not a 10 or 50-year design flood.
5. Use Table 3 to determine whether the structural gage for the selected material is sufficient for the design service life. If the structural gage is greater than or equal to the gage required for a particular abrasion condition and service life, use the structural gage. Conversely, if the structural gage is less than the gage required for a particular abrasion condition and service life, use the gage required by Table 3.

Note:

Both Contech round pipe and pipe-arch are available with either helical or annular corrugations. Contech HEL-COR® pipe (helical corrugations) is furnished with continuous lock seams and annular re-rolled ends. Contech riveted pipe is furnished with annular corrugations only. The height of cover tables in this guide are helical corrugations only. Consult your Contech representative for Height of Cover tables on riveted pipe.

Table 1 — Recommended Environments

Material Type	Soil* and Water pH 3 4 5 6 7 8 9 10 11 12	Resistivity (ohm-cm) Minimum	Maximum
Galvanized Steel*		2000	8000
Aluminized Steel Type 2		1500	N/A
Polymer Coated		250	N/A
Aluminum Alloy		500	N/A

**Appropriate pH range for Galvanized Steel is 6.0 to 10*

Table 2 — FHWA Abrasion Guidelines

Abrasion Level	Abrasion Condition	Bed Load	Flow Velocity (fps)
1	Non- Abrasive	None	Minimal
2	Low Abrasion	Minor	< 5
3	Moderate Abrasion	Moderate	5 - 15
4	Severe Abrasion	Heavy	> 15

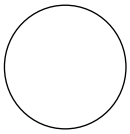
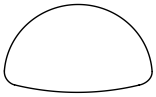
"Interim Direct Guidelines on Drainage Pipe Alternative Selection." FHWA, 2005.

Table 3 — Drainage Product Usage Guide[1]

Application	Culverts, Storm Drain, Cross Drain, Median Drain, Side Drain											
Roadway Classification	Rural	Minor	Major	Urban	Rural	Minor	Major	Urban	Rural	Minor	Major	Urban
Design Service Life	25	50	75	100	25	50	75	100	25	50	75	100
Abrasion Level	Abrasion Level 1 & 2				Abrasion Level 3				Abrasion Level 4			
CMP (1/2" & 1" deep corrugations, ULTRA FLO [3] & Smooth Cor [2,3])	Minimum gage required to meet design service life, assuming that structural design has been met.											
Galvanized (2 oz.)	*16*	*12*	*10*	*8[4]*	*14*	*10*	8	N/A	*14[5]*	*10[5]*	8[5]	N/A
Galvanized and Asphalt Coated	16	14	10	8	14	12	8	N/A	14[5]	12[5]	8[5]	N/A
Galv., Asphalt Coated and Paved Invert	16	16	14	10	16	14	12	8	14	12	10	N/A
Aluminized Type 2	16	16	16	14	14	14	14	12	14[6]	14[6]	14[6]	12[6]
Polymer Coated	16	16	16[8]	16[9]	16	16	16[8]	16[9]	14[7]	14[7]	14[7,8]	14[7,9]
Aluminum Alloy	16	16	16	16	14	14	14	14	14[5]	14[5]	14[5]	14[5]

1. *Based on Table 1 - Recommended Environments.*
2. *SmoothCor™ Steel Pipe combines a corrugated steel exterior shell with a hydraulically smooth interior liner.*
3. *Service life estimates for ULTRA FLO® and SmoothCor Pipe assume a storm sewer application. Storm sewers rarely achieve abrasion levels 3 or 4. For applications other than storm sewers or abrasion conditions above Abrasion Level 2, please contact your Contech Sales Representative for gage and coating recommendations.*
4. *Design service life for 8 gage galvanized is 97 years.*
5. *Invert protection to consist of velocity reduction structures.*
6. *Asphalt coated and paved invert or velocity reduction structures are needed.*
7. *Requires a field applied concrete paved invert with minimum thickness 1" above corrugation crests.*
8. *75 year service life for polymer coated is based on a pH range of 4-9 and resistivity greater than 750 ohm-cm.*
9. *100 year service life for polymer coated is based on a pH range of 5-9 and resistivity greater than 1500 ohm-cm.*

Table 4 - Product Dimensions

	Drainage Product	Common Uses	Size Limits* Minimum	Size Limits* Maximum	Manning's "n" Value
 Round Pipe	Corrugated Steel (1/2" deep corrugation)	Culverts, small bridges, storm water detention/ retention systems, conduits, tunnels, storm sewers.	12"	84"	0.011 - 0.021
	Corrugated Steel with Paved Invert (1/2" deep corrugation)		12"	84"	0.014 - 0.020
	Corrugated Steel (1" deep corrugation)		54"	144"	0.022 - 0.027
	Corrugated Steel with Paved Invert (1" deep corrugation)		54"	144"	0.019 - 0.023
	Corrugated Aluminum (1/2" deep corrugation)		12"	72"	0.011 - 0.021
	Corrugated Aluminum (1" deep corrugation)		30"	120"	0.023 - 0.027
	ULTRA FLO® Steel	Storm sewers, culverts, storm water detention/ retention systems.	18"	102"	0.012
	ULTRA FLO Aluminum		18"	84"	0.012
	SmoothCor™ Steel (1/2" deep corrugation)		18"	66"	0.012
	SmoothCor Steel (1" deep corrugation)		48"	126"	0.012
 Pipe-Arch	Corrugated Steel (1/2" deep corrugation)	Culverts, small bridges, storm water detention/ retention systems, conduits, tunnels, storm sewers.	17" x 13"	83" x 57"	0.011 - 0.021
	Corrugated Steel with Paved Invert (1/2" deep corrugation)		17" x 13"	83" x 57"	0.014 - 0.019
	Corrugated Steel (1" deep corrugation)		53" x 41"	142" x 91"	0.023 - 0.027
	Corrugated Steel with Paved Invert (1" deep corrugation)		53" x 41"	142" x 91"	0.019 - 0.022
	Corrugated Aluminum (1/2" deep corrugation)		17" x 13"	71" x 47"	0.011 - 0.021
	Corrugated Aluminum (1" deep corrugation)		60" x 46"	112" x 75"	0.023 - 0.027
	ULTRA FLO Steel	Storm sewers, culverts, storm water detention/ retention systems.	20" x 16"	66" x 51"	0.012
	ULTRA FLO Aluminum		20" x 16"	66" x 51"	0.012
	SmoothCor Steel (1/2" deep corrugation)		21" x 15"	77" x 52"	0.012
	SmoothCor Steel (1" deep corrugation)		53" x 41"	137" x 87"	0.012

* *For sizes outside of these limits, please contact your Contech representative.*

Table 5 — Corrugated Steel Pipe—Values of Coefficient of Roughness (n)

	All Diameters	1-1/2" x 1/4"		Helical* Corrugation Helical—2-2/3" x 1/2"						
2-2/3" x 1/2"	**Annular**	**8 in.**	**10 in.**	**12 in.**	**15 in.**	**18 in.**	**24 in.**	**36 in.**	**48 in.**	**60 in. +**
Unpaved	0.024	0.012	0.014	0.011	0.012	0.013	0.015	0.018	0.020	0.021
PAVED-INVERT	0.021						0.014	0.017	0.020	0.019
SmoothCor	N/A					0.012	0.012	0.012	0.012	0.012

		Helical*—3" x 1"							
3" x 1"	**Annular**	**36 in.**	**42 in.**	**48 in.**	**54 in.**	**60 in.**	**66 in.**	**72 in.**	**78 in. +**
Unpaved	0.027	0.022	0.022	0.023	0.023	0.024	0.025	0.026	0.027
PAVED-INVERT	0.023	0.019	0.019	0.020	0.020	0.021	0.022	0.022	0.023
SmoothCor	N/A			0.012	0.012	0.012	0.012	0.012	0.012

		Helical*—5" x 1"							
5" x 1"	**Annular**			**48 in.**	**54 in.**	**60 in.**	**66 in.**	**72 in.**	**78 in. +**
Unpaved	N/A			0.022	0.022	0.023	0.024	0.024	0.025
PAVED-INVERT	N/A			0.019	0.019	0.020	0.021	0.021	0.022
ULTRA FLO	N/A	**3/4" x 3/4" x 7-1/2"** All diameters n = 0.012							

* *Tests on helically corrugated pipe demonstrate a lower coefficient of roughness than for annularly corrugated steel pipe. Pipe-arches approximately have the same roughness characteristics as their equivalent round pipes.*

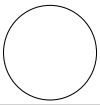
Table 6 - AASHTO Reference Specifications					
	Material Type	**Material**	**Pipe**	**Design***	**Installation***
Pipe & Pipe-Arch	**CMP (1/2" or 1" deep corrugations)**				
	Galvanized (2 oz.)	M218	M36	Section 12	Section 26
	Asphalt Coated	M190	M36	Section 12	Section 26
	Asphalt Coated and Paved Invert	M190	M36	Section 12	Section 26
	Aluminized Type 2	M274	M36	Section 12	Section 26
	Polymer Coated	M246	M36 & M245	Section 12	Section 26
	Aluminum Alloy	M197	M196	Section 12	Section 26
	ULTRA FLO (3/4" x 3/4" x 7-1/2" corrugation)				
	Galvanized (2 oz.)	M218	M36	Section 12	Section 26
	Aluminized Type 2	M274	M36	Section 12	Section 26
	Polymer Coated	M246	M36 & M245	Section 12	Section 26
	Aluminum Alloy	M197	M196	Section 12	Section 26
	SmoothCor				
	Polymer Coated	M246	M36 & M245	Section 12	Section 26

* *AASHTO LRFD Bridge Design Specification and AASHTO Standard Specification for Highway Bridges*

Corrugated Steel Pipe

Heights of Cover

2-2/3" x 1/2" Height of Cover Limits for Corrugated Steel Pipe



H 20 and H 25 Live Loads

Diameter or Span, Inches	Minimum Cover, Inches	Maximum Cover, Feet[2] Specified Thickness, Inches 0.052	0.064	0.079	0.109	0.138	0.168
6[10]	12	388	486				
8[10]		291	365				
10[10]		233	392				
12		197	248	310			
15		158	198	248			
18		131	165	206			
21		113	141	177	248		
24		98	124	155	217		
30			99	124	173		
36			83	103	145	186	
42			71	88	124	159	195
48			62	77	108	139	171
54				67	94	122	150
60					80	104	128
66					68	88	109
72						75	93
78							79
84	12						66

E 80 Live Loads

Diameter or Span, Inches	Minimum Cover, Inches	Maximum Cover, Feet[2] Specified Thickness, Inches 0.052	0.064	0.079	0.109	0.138	0.168
12	12	197	248	310			
15		158	198	248			
18		131	165	206			
21		113	141	177	248		
24		98	124	155	217		
30			99	124	173		
36			83	103	145	186	
42			71	88	124	159	195
48	12		62	77	108	139	171
54	18			67	94	122	150
60					80	104	128
66					68	88	109
72	18					75	93
78	24						79
84	24						66

H 20 and H 25 Live Loads, Pipe-Arch

Size Round Equivalent, Inches	Span x Rise, Inches	Minimum Structural Thickness, Inches	Minimum Cover, Inches	Maximum[7] Cover, Feet 2 Tons/Ft.² Corner Bearing Pressure
15	17 x 13	0.064	12	16
18	21 x 15	0.064		15
21	24 x 18	0.064		
24	28 x 20	0.064		
30	35x 24	0.064		
36	42 x 29	0.064		
42	49 x 33	0.064*		
48	57 x 38	0.064*		
54	64 x 43	0.079*		
60	71 x 47	0.109*		
66	77 x 52	0.109*		
72	83 x 57	0.138*	12	15

E 80 Live Loads, Pipe-Arch

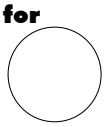
Size Round Equivalent, Inches	Span x Rise, Inches	Minimum Structural Thickness, Inches	Minimum Cover, Inches	Maximum[8] Cover, Feet 3 Tons/Ft.² Corner Bearing Pressure
15	17 x 13	0.079	24	22
18	21 x 15	0.079		
21	24 x 18	0.109		
24	28 x 20	0.109		
30	35 x 24	0.138		
36	42 x 29	0.138		
42	49 x 33	0.138*		
48	57 x 38	0.138*		
54	64 x 43	0.138*		
60	71 x 47	0.138*	24	22

* *These values are based on the AISI Flexibility Factor limit (0.0433 x 1.5) for pipe-arch.*

Heights of Cover Notes:

1. These tables are for lock-seam or welded-seam construction. They are not for riveted construction. Consult your Contech Sales Representative for Height of Cover tables on riveted pipe.
2. These values, where applicable, were calculated using a load factor of K=0.86 as adopted in the NCSPA CSP Design Manual, 2008.
3. The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.
4. E 80 minimum cover is measured from top of pipe to bottom of tie.
5. H 20 and H 25 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.
6. The H 20 and H 25 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.
7. The E 80 pipe-arch tables minimum and maximum covers are based on the corner bearing pressures shown. These values may increase or decrease with changes in allowable corner bearing pressures.
8. 0.052" is 18 gage.
   0.064" is 16 gage.
   0.079" is 14 gage.
   0.109" is 12 gage.
   0.138" is 10 gage.
   0.168" is 8 gage.
9. For construction loads, see Page 15.
10. 1-1/2" x 1/4" corrugation. H20, H25 and E80 loading.
11. SmoothCor has same Height of Cover properties as corrugated steel pipe. The exterior shell of SmoothCor is manufactured in either 2-2/3" x 1/2" or 3" x 1" corrugations; maximum exterior shell gage is 12.
12. Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.

5" x 1" or 3" x 1" Height of Cover Limits for Corrugated Steel Pipe



H 20 and H 25 Live Loads

Diameter or Span, Inches	Minimum Cover Inches	Maximum Cover, Feet[2] Specified Thickness, Inches 0.064	0.079	0.109	0.138	0.168
54	12	56	70	98	127	155
60		50	63	88	114	139
66		46	57	80	103	127
72		42	52	74	95	116
78		39	48	68	87	107
84		36	45	63	81	99
90		33	42	59	76	93
96	12	31	39	55	71	87
102	18	29	37	52	67	82
108			35	49	63	77
114			32	45	58	72
120			30	42	54	66
126				39	50	61
132				36	46	58
138				33	43	53
144	18				39	49

Maximum cover heights shown are for 5" x 1".

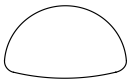
To obtain maximum cover for 3" x 1", increase these values by 12%

E 80 Live Loads

Diameter or Span, Inches	Minimum Cover Inches	Maximum Cover, Feet[2] Specified Thickness, Inches 0.064	0.079	0.109	0.138	0.168
54	18	56	70	98	127	155
60		50	63	88	114	139
66		46	57	80	103	127
72	18	42	52	74	95	116
78	24	39	48	68	87	107
84		36	45	63	81	99
90		33[1]	42	59	76	93
96	24	31[1]	39	55	71	87
102	30	29[1]	37	52	67	82
108			35	49	63	77
114			32[1]	45	58	72
120	30		30[1]	42	54	66
126	36			39	50	61
132				36	46	58
138				33[1]	43	53
144	36				39	49

Maximum cover heights shown are for 5" x 1".
To obtain maximum cover for 3" x 1", increase these values by 12%.
[1] These diameters in these gages require additional minimum cover.

5" x 1" Pipe-Arch Height of Cover Limits for Corrugated Steel Pipe



H 20 and H 25 Live Loads

Size: Equivalent Pipe Diameter	Size: Span x Rise Inches[3]	Minimum Specified Thickness, Inches*	Minimum Cover Inches	Maximum[7] Cover, Feet: 2 Tons/Ft.² Corner Bearing Pressure
72	81 x 59	0.109	18	21
78	87 x 63	0.109	18	20
84	95 x 67	0.109	18	20
90	103 x 71	0.109	18	20
96	112 x 75	0.109	21	20
102	117 x 79	0.109	21	19
108	128 x 83	0.109	24	19
114	137 x 87	0.109	24	19
120	142 x 91	0.138	24	19

Larger sizes are available in some areas of the United States. Check with your local Contech representative . Some minimum heights-of-cover for pipe-arches have been increased to take into account allowable "plus" tolerances on the manufactured rise.

E 80 Live Loads

Size: Equivalent Pipe Diameter	Size: Span x Rise Inches[3]	Minimum Specified Thickness, Inches*	Minimum Cover Inches	Maximum[8] Cover, Feet: 2 Tons/Ft.² Cover Bearing Pressure
72	81 x 59	0.109	30	21
78	87 x 63	0.109	30	18
84	95 x 67	0.109	30	18
90	103 x 71	0.109	36	18
96	112 x 75	0.109	36	18
102	117 x 79	0.109	36	17
108	128 x 83	0.109	42	17
114	137 x 87	0.109	42	17
120	142 x 91	0.138	42	17

* *Some 3" x 1" and 5" x 1" minimum gages shown for pipe-arch are due to manufacturing limitations.*

Heights of Cover Notes:

1. These tables are for lock-seam or welded-seam construction. They are not for riveted construction. Consult your Contech Sales Representative for Height of Cover tables on riveted pipe.
2. These values, where applicable, were calculated using a load factor of K=0.86 as adopted in the NCSPA CSP Design Manual, 2008.
3. The span and rise shown in these tables are nominal. Typically the actual rise that forms is greater than the specified nominal. This actual rise is within the tolerances as allowed by the AASHTO & ASTM specifications. The minimum covers shown are more conservative than required by the AASHTO and ASTM specifications to account for this anticipated increase in rise. Less cover height may be tolerated depending upon actual rise of supplied pipe arch.
4. The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.
5. E 80 minimum cover is measured from top of pipe to bottom of tie.
6. H 20 and H 25 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.
7. The H 20 and H 25 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.
8. The E 80 pipe-arch tables minimum and maximum covers are based on the corner bearing pressures shown. These values may increase or decrease with changes in allowable corner bearing pressures.
9. 0.052" is 18 gage.0.064" is 16 gage.
   0.079" is 14 gage.0.109" is 12 gage.
   0.138" is 10 gage.0.168" is 8 gage.
10. For construction loads, see Page 15.
11. SmoothCor has same Height of Cover properties as corrugated steel pipe. The exterior shell of SmoothCor is manufactured in either 2-$^{2}/_{3}$" x $^{1}/_{2}$" or 3"x1" corrugations; maximum exterior shell gage is 12.
12. Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.

3" x 1" Pipe-Arch Height of Cover Limits for Corrugated Steel Pipe-Arch

H 20 and H 25 Live Loads

Size		Minimum		Maximum[7]
Equivalent Pipe Diameter	Span x Rise Inches	Specified Thickness, Inches*	Minimum Cover Inches	Cover, Feet 2 Tons/Ft.² Corner Bearing Pressure
48	53 x 41	0.079	12	25
54	60 x 46	0.079	15	25
60	66 x 51	0.079	15	25
66	73 x 55	0.079	18	24
72	81 x 59	0.079	18	21
78	87 x 63	0.079	18	20
84	95 x 67	0.079	18	20
90	103 x 71	0.079	18	20
96	112 x 75	0.079	21	20
102	117 x 79	0.109	21	19
108	128 x 83	0.109	24	19
114	137 x 87	0.109	24	19
120	142 x 91	0.138	24	19

Larger sizes are available in some areas of the United States. Check with your local Contech Sales Representative.

Some minimum heights-of-cover for pipe-arches have been increased to take into account allowable "plus" tolerances on the manufactured rise.

E 80 Live Loads

Size		Minimum		Maximum[8]
Equivalent Pipe Diameter	Span x Rise Inches	Specified Thickness, Inches*	Minimum Cover Inches	Cover, Feet 2 Tons/Ft.² Corner Bearing Pressure
48	53 x 41	0.079	24	25
54	60 x 46	0.079	24	25
60	66 x 51	0.079	24	25
66	73 x 55	0.079	30	24
72	81 x 59	0.079	30	21
78	87 x 63	0.079	30	18
84	95 x 67	0.079	30	18
90	103 x 71	0.079	36	18
96	112 x 75	0.079	36	18
102	117 x 79	0.109	36	17
108	128 x 83	0.109	42	17
114	137 x 87	0.109	42	17
120	142 x 91	0.138	42	17

* *Some 3" x 1" and 5" x 1" minimum gages shown for pipe-arch are due to manufacturing limitations.*

Heights of Cover Notes:

1. These tables are for lock-seam or welded-seam construction. They are not for riveted construction. Consult your Contech Sales Representative for Height of Cover tables on riveted pipe.
2. These values, where applicable, were calculated using K=0.86 as adopted in the NCSPA CSP Design Manual, 2008.
3. The span and rise shown in these tables are nominal. Typically the actual rise that forms is greater than the specified nominal. This actual rise is within the tolerances as allowed by the AASHTO & ASTM specifications. The minimum covers shown are more conservative than required by the AASHTO and ASTM specifications to account for this anticipated increase in rise. Less cover height may be tolerated depending upon actual rise of supplied pipe arch.
4. The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.
5. E 80 minimum cover is measured from top of pipe to bottom of tie.
6. H 20 and H 25 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.
7. The H 20 and H 25 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.
8. The E 80 pipe-arch tables minimum and maximum covers are based on the corner bearing pressures shown. These values may increase or decrease with changes in allowable corner bearing pressures.
9. 0.052" is 18 gage.
   0.064" is 16 gage.
   0.079" is 14 gage.
   0.109" is 12 gage.
   0.138" is 10 gage.
   0.168" is 8 gage.
10. For construction loads, see Page 15.
11. SmoothCor has same Height of Cover properties as corrugated steel pipe. The exterior shell of SmoothCor is manufactured in either 2-$^{2}/_{3}$" x $^{1}/_{2}$" or 3" x 1" corrugations; maximum exterior shell gage is 15.
12. Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.

Approximate Weight (Pounds/Foot) Contech Corrugated Steel Pipe

(Estimated Average Weights—Not for Specification Use)

1-1/2″ x 1/4″ Corrugation			
Inside Diameter, in.	**Specified Thickness, in.**	**Galvanized & ALUMINIZED**	**Full Coated**
6	0.052	4	5
	0.064	5	6
8	0.052	5	6
	0.064	6	7
10	0.052	6	7
	0.064	7	8

Steel Thicknesses by Gage						
Gage	18	16	14	12	10	8
Thickness	.052	.064	.079	.109	.138	.168

2-2/3″ x 1/2″ Corrugation					
Inside Diameter, in.	Specified Thickness	Galvanized & ALUMINIZED	Full Coated	Coated & PAVED-INVERT	SmoothCor
12	0.052	8	10	13	
	0.064	10	12	15	
	0.079	12	14	17	
15	0.052	10	13	16	
	0.064	12	15	18	
	0.079	15	18	21	
18	0.052	12	16	19	
	0.064	15	19	22	25
	0.079	18	22	25	28
21	0.052	14	18	23	
	0.064	17	21	26	29
	0.079	21	25	30	33
	0.109	29	33	33	41
24	0.052	15	20	26	
	0.064	19	24	30	30
	0.079	24	29	35	38
	0.109	33	38	44	47
30	0.064	24	30	36	42
	0.079	30	36	42	48
	0.109	41	47	53	59
36	0.064	29	36	44	51
	0.079	36	43	51	58
	0.109	49	56	64	71
	0.138	62	69	77	
42	0.064	34	42	51	60
	0.079	42	50	59	68
	0.109	57	65	74	82
	0.138	72	80	89	
	0.168	88	96	105	
48	0.064	38	48	57	67
	0.079	48	58	67	77
	0.109	65	75	84	94
	0.138	82	92	101	
	0.168	100	110	119	
54	0.079	54	65	76	87
	0.109	73	84	95	106
	0.138	92	103	114	
	0.168	112	123	134	
60	0.109	81	92	106	117
	0.138	103	114	128	
	0.168	124	135	149	
66	0.109	89	101	117	129
	0.138	113	125	141	
	0.168	137	149	165	
72	0.138	123	137	154	(2)
	0.168	149	163	180	
78	0.168	161	177	194	(2)
84	0.168	173	190	208	(2)

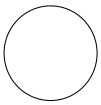
3″ x 1″ or 5″ x 1″ Corrugation					
Inside Diameter, in.	Specified Thickness	Galvanized & ALUMINIZED	Full Coated	Coated & PAVED-INVERT	SmoothCor
54	0.064	50	66	84	84
	0.079	61	77	95	95
	0.109	83	100	118	118
	0.138	106	123	140	
	0.168	129	146	163	
60	0.064	55	73	93	93
	0.079	67	86	105	105
	0.109	92	110	130	130
	0.138	118	136	156	
	0.168	143	161	181	
66	0.064	60	80	102	102
	0.079	74	94	116	116
	0.109	101	121	143	145
	0.138	129	149	171	
	0.168	157	177	199	
72	0.064	66	88	111	112
	0.079	81	102	126	127
	0.109	110	132	156	157
	0.138	140	162	186	
	0.168	171	193	217	
78	0.064	71	95	121	120
	0.079	87	111	137	136
	0.109	119	143	169	168
	0.138	152	176	202	
	0.168	185	209	235	
84	0.064	77	102	130	130
	0.079	94	119	147	147
	0.109	128	154	182	181
	0.138	164	189	217	
	0.168	199	224	253	
90	0.064	82	109	140	139
	0.079	100	127	158	157
	0.109	137	164	195	194
	0.138	175	202	233	
	0.168	213	240	271	
96	0.064	87	116	149	148
	0.079	107	136	169	168
	0.109	147	176	209	208
	0.138	188	217	250	
	0.168	228	257	290	
102	0.064	93	124	158	158
	0.079	114	145	179	179
	0.109	155	186	220	222
	0.138	198	229	263	
	0.168	241	272	306	
108	0.079	120	153	188	189
	0.109	165	198	233	235
	0.138	211	244	279	
	0.168	256	289	324	
114	0.079	127	162	199	200
	0.109	174	209	246	248
	0.138	222	257	294	
	0.168	271	306	343	
120	0.079	134	171	210	211
	0.109	183	220	259	260
	0.138	234	271	310	
	0.168	284	321	360	
126	0.109	195	233	274	276
	0.138	247	285	326	
	0.168	299	338	378	
132	0.109	204	244	287	289
	0.138	259	299	342	
	0.168	314	354	397	
138	0.109	213	255	300	300
	0.138	270	312	357	
	0.168	328	370	415	
144	0.138	282	326	373	
	0.168	344	388	435	(2)

1. *Weights for polymer coated pipe are 1% to 4% higher, varying by gage.*
2. *Please contact your Contech Sales Representative.*
3. *Weights listed in the 3″ x 1″ or 5″ x 1″ table are for 3″ x 1″ pipe. Weights for 5″ x 1″ are approximately 12% less than those used in this table, for metallic coated pipe.*

Corrugated Aluminum Pipe

Heights of Cover

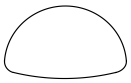
2-2/3″ X 1/2″ Height of Cover Limits for Corrugated Aluminum Pipe



HL 93 Live Load

Diameter or Span (In.)	Minimum Cover (In.)	Maximum Cover, (Ft.)[2] Equiv. Standard Gage 18	16	14	12	10	8[5]
6 [4]	12	197	247				
8 [4]		147	185				
10 [4]		119	148				
12			125	157			
15			100	125			
18			83	104			
21			71	89			
24			62	78	109		
27				69	97		
30				62	87		
36				51	73	94	
42					62	80	
48	12				54	70	85
54	15				48	62	76
60	15					52	64
66	18						52
72	18						43

2 2/3" x 1/2" Height of Cover Limits for Corrugated Aluminum Pipe-Arch



HL 93 Live Load

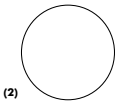
Round Pipe Dia. (Inches)	Size, (In.) Span x Rise	Minimum Gage	Minimum[3] Cover (Inches)	Maximum Cover, (Ft.) Aluminum Pipe-Arch[2] 2 Tons/Ft.² for Corner Bearing Pressures
15	17x13	16	12	13
18	21x15	16	12	12
21	24x18	16	12	12
24	28x20	14	12	12
30	35x24	14	12	12
36	42x29	12	12	12
42	49x33	12	15	12
48	57x38	10	15	12
54	64x43	10	18	12
60	71x47	8[5]	18	12

Notes:

1. *Height-of-cover is measured to top of rigid pavement or to bottom of flexible pavement.*
2. *Maximum cover meets AASHTO LRFD design criteria.*
3. *Minimum cover meets AASHTO and ASTM B 790 design criteria.*
4. *1 1/2″ x 1/4″ corrugation.*
5. *8-gage pipe has limited availability.*
6. *For construction loads, see page 15.*

Heights of Cover

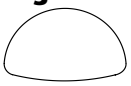
3″ x 1″ Height of Cover Limits for Corrugated Aluminum Pipe



HL 93 Live Load

Diameter or Span (In.)	Minimum[3] Cover (In.)	Maximum Cover, (Ft.) [2] Equiv. Standard Gage 16	14	12	10	8[6]
30	12	57	72	101	135	159
36		47	60	84	112	132
42		40	51	72	96	113
48	12	35	44	62	84	99
54	15	31	39	55	74	88
60	15	28	35	50	67	79
66	18	25	32	45	61	72
72	18	23	29	41	56	66
78	21		27	38	51	61
84	21			35	48	56
90	24			33	44	52
96	24			31	41	49
102	24				39	46
108	24				37	43
114	24					39
120	24					36

3″ x 1″ Height of Cover Limits for Corrugated Aluminum Pipe-Arch



HL 93 Live Load

Round Pipe Dia. (Inches)	Size, (In.) Span x Rise	Minimum Gage	Minimum[3] Cover (Inches)	Maximum Cover, (Ft.) Aluminum Pipe-Arch[2] 2 Tons/Ft.² for Corner Bearing Pressures
54	60x46	14	15	20
60	66x51	14	18	20
66	73x55	14	21	20
72	81x59	12	21	16
78[4]	87x63	12	24	16
84[4]	95x67	12	24	16
90[4]	103x71	10	24	16
96[4]	112x75	8[5]	24	16

Notes:

1. *Height-of-cover is measured to top of rigid pavement or to bottom of flexible pavement.*
2. *Maximum cover meets AASHTO LRFD design criteria.*
3. *Minimum cover meets ASTM B 790 design criteria.*
4. *Limited availability on these sizes.*
5. *8-gage pipe has limited availability.*
6. *For construction loads, see page 15.*

Approximate Weight/Foot
Contech Corrugated Aluminum Pipe

(Estimated Average Weights—Not for Specification Use)

2 2/3″ x 1/2″ Corrugation Aluminum Pipe

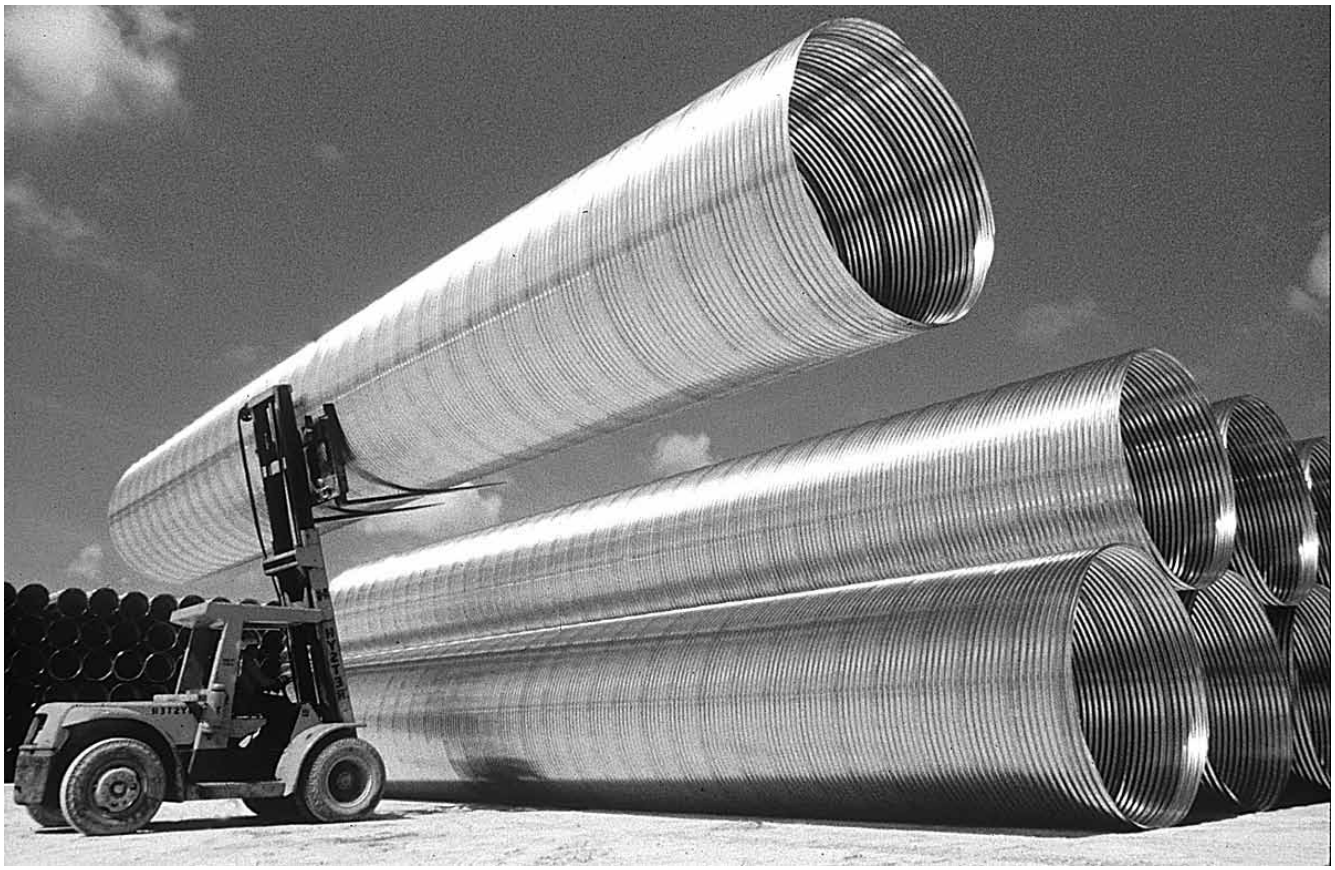
Diameter or Span (Inches)	Weight (Lb./Lineal Ft.) Equiv. Standard Gage					
	(.048) 18	(.060) 16	(.075) 14	(.105) 12	(.135) 10	(.164) 8[3]
6 [2]	1.3	1.6				
8 [2]	1.7	2.1				
10 [2]	2.1	2.6				
12		3.2	4.0			
15		4.0	4.9			
18		4.8	5.9			
21		5.6	6.9			
24		6.3	7.9	10.8		
27			8.8	12.2		
30			9.8	13.5		
36			11.8	16.3	20.7	
42				19.0	24.2	
48				21.7	27.6	33.5
54				24.4	31.1	37.7
60					34.6	41.9
66						46.0
72						50.1

3″ x 1″ Corrugation Aluminum Pipe

Diameter or Span (Inches)	Weight (Lb./Lineal Ft.) Equiv. Standard Gage				
	(.060) 16	(.075) 14	(.105) 12	(.135) 10	(.164) 8[3]
30	9.3	11.5	15.8	20.2	
36	11.1	13.7	18.9	24.1	
42	12.9	16.0	22.0	28.0	
48	14.7	18.2	25.1	32.0	38.8
54	16.5	20.5	28.2	35.9	43.6
60	18.3	22.7	31.3	40.0	48.3
66	20.2	24.9	34.3	43.7	53.0
72	22.0	27.1	37.4	47.6	57.8
78		29.3	40.4	51.5	62.5
84			43.5	55.4	67.2
90			46.6	59.3	71.9
96			49.6	63.2	76.7
102				66.6	80.8
108				71.0	86.1
114					90.9
120					95.6

Notes:

1. *Helical lockseam pipe only. Annular riveted pipe weights will be higher.*
2. *1 ½″ x ¼″ Corrugation.*
3. *8-gage pipe has limited availability.*



ULTRA FLO®

Heights of Cover

Galvanized, ALUMINIZED STEEL Type 2 or Polymer Coated Steel** ULTRA FLO H 20 and H 25 Live Load

Diameter (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.064) 16	(0.079) 14	(0.109) 12	(0.138) 10
18	1.0/108	1.0/151		
21	1.0/93	1.0/130	1.0/216	
24	1.0/81	1.0/113	1.0/189	
30	1.0/65	1.0/91	1.0/151	
36	1.0/54	1.0/75	1.0/126	
42	1.0/46	1.0/65	1.0/108	
48	1.0/40	1.0/56	1.0/94	1.0/137
54	1.25/36	1.25/50	1.0/84	1.0/122
60	1.25*/32*	1.25/45	1.0/75	1.0/109
66		1.5/41	1.25/68	1.25/99
72		1.5*/37*	1.25/63	1.25/91
78		1.75*/34*	1.5/58	1.5/84
84			1.75/54	1.75/78
90			2.0*/50*	2.0/73
96			2.0*/47*	2.0/68
102			2.5*/43*	2.5/61
108				2.5*/54*
114				2.5*/49*
120				2.5*/43*

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated** Steel** ULTRA FLO E 80 Live Load

Diameter (Inches)	(0.064) 16	(0.079) 14	(0.109) 12	(0.138) 10
18	1.0 / 93	1.0 / 130		
21	1.0 / 79	1.0 / 111	1.0 / 186	
24	1.0 / 69	1.0 / 97	1.0 / 162	
30	1.0 / 55	1.0 / 78	1.0 / 130	
36	1.5 / 46	1.25 / 65	1.0 / 108	
42	1.5 / 39	1.5 / 55	1.25 / 93	
48	2.0 / 34	1.75 / 48	1.5 / 81	1.5 / 118
54	3.0* / 28*	2.0 / 43	1.5 / 72	1.5 / 104
60		2.0 / 39	1.75 / 65	1.75 / 94
66		2.5* / 35*	2.0 / 58	2.0 / 85
72			2.0 / 49	2.0 / 78
78			2.5 / 42	2.5 / 72
84			2.75* / 35*	2.5 / 67
90				2.5 / 62
96				2.5* / 58*
102				3.0* / 52*

Notes:

1. The tables for Steel H 20 and H 25 loading are based on the NCSPA CSP Design Manual, 2008 and were calculated using a load factor of K=0.86. The tables for Steel E 80 loading are based on the AREMA Manual. The tables for Aluminum HL 93 loading are based on AAS-HTO LRFD Design Criteria.
2. The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.
3. E 80 minimum cover is measured from top of pipe to bottom of tie.
4. H 20, H 25 and HL 93 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.
5. The H 20, H 25 and HL 93 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.
6. The E 80 pipe-arch tables minimum and maximum covers are based on 3 tons per square foot corner bearing pressures shown.
7. Larger size pipe-arches may be available on special order.
8. M.L. (Heavier gage is required to prevent crimping at the haunches.)
9. For construction loads, see Page 15.
10. Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated** Steel** ULTRA FLO Pipe-Arch H 20 and H 25 Live Load

Equiv. Pipe Dia. (Inches)	Span (Inches)	Rise (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.064) 16	(0.079) 14	(0.109) 12
18	20	16	1.0/16		
21	23	19	1.0/15		
24	27	21	1.0/13		
30	33	26	1.0/13	1.0/13	
36	40	31	1.0/13	1.0/13	
42	46	36	M.L.[8]	M.L.[8]	1.0/13
48	53	41	M.L.[8]	M.L.[8]	1.25/13
54	60	46	M.L.[8]	M.L.[8]	1.25/13
60	66	51	M.L.[8]	M.L.[8]	1.25/13

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated** Steel** ULTRA FLO Pipe-Arch E 80 Live Load

Span x Rise (Inches)	Round Equivalent	Minimum Cover (Inches)	Minimum Gage	Max Cover (Feet)
20x16	18	24	16	22
23x19	21	24	16	21
27x21	24	24	16	18
33x26	30	24	16	18
40x31	36	24	16	17
46x36	42	24	12	18
53x41	48	24	12	18
60x46	54	24	12	18
66x51	60	24	12	18

ULTRA FLO can be manufactured from polymer coated steel for added durability.

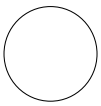
11. All heights of cover are based on trench conditions. If embankment conditions exist, there may be restriction on gages for the large diameters. Your Contech Sales Representative can provide further guidance for a project in embankment conditions.
12. All steel ULTRA FLO is installed in accordance with ASTM A798 "Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications."

* *These sizes and gage combinations are installed in accordance with ASTM A796 paragraphs 18.2.3 and ASTM A798. For aluminum ULTRA FLO refer to ASTM B790 and B788.*

** *Contact your local Contech representative for more specific information on Polymer Coated ULTRA FLO for gages 12 and 10.*

Heights of Cover

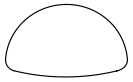
Aluminum ULTRA FLO HL 93 Live Load



Diameter (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.060) 16	(0.075) 14	(0.105) 12	(0.135) 10
18	1.0/43	1.0/61		
21	1.0/38	1.0/52	1.0/84	
24	1.0/33	1.0/45	1.0/73	
30	1.0/26	1.25/36	1.25/58	
36	1.5*/21*	1.50/30	1.5/49	1.5/69
42		1.75*/25*	1.75/41	1.75/59
48			2.0/36	2.0/51
54			2.0/32	2.0/46
60			2.0*/29*	2.0/41
66				2.0/37
72				2.5*/34*

See previous page for height of cover notes.

Aluminum ULTRA FLO Pipe-Arch HL 93 Live Load



Equiv. Pipe Dia. (Inches)	Span (Inches)	Rise (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.060) 16	(0.075) 14	(0.105) 12	(0.135) 10
18	20	16	1.0/16			
21	23	19	1.0/15			
24	27	21	1.25/13	1.25/13		
30	33	26	1.5/13	1.5/13	1.5/13	
36	40	31		1.75/13	1.75/13	
42	46	36			2.0/13	2.0/13
48	53	41			2.0/13	2.0/13
54	60	46			2.0*/13*	2.0/13
60	66	51				2.0/13

Approximate Weight/Foot Contech ULTRA FLO Pipe

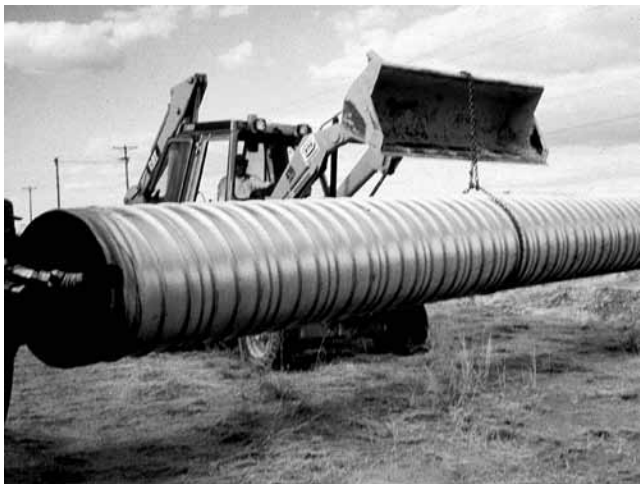
Handling Weight for **ALUMINIZED STEEL Type 2** or **Galvanized Steel** ULTRA FLO

Diameter (Inches)	Weight (Pounds/Lineal Foot) Specified Thickness and Gage (0.064) 16	(0.079) 14	(0.109) 12	(0.138) 10
18	15	18		
21	17	21	29	
24	19	24	36	
30	24	30	42	
36	29	36	50	
42	33	42	58	
48	38	48	66	80
54	45	54	75	90
60	48	60	83	99
66		66	91	109
72		72	99	119
78		78	108	129
84			116	139
90			124	149
96			132	158
102			141	168
108				175
114				196
120				206

Weights for polymer coated pipe are 1% to 4% higher, varying by gage.

Handling Weight for **ALUMINUM** ULTRA FLO

Diameter (Inches)	Weight (Pounds/Lineal Foot) Specified Thickness and Gage (0.060) 16	(0.075) 14	(0.105) 12	(0.135) 10
18	5	6		
21	6	8	11	
24	7	9	13	
30	9	11	15	
36	11	13	18	23
42	12	15	21	26
48		17	24	30
54		19	27	34
60			30	37
66			33	41
72			36	45
78				49
84				52



ULTRA FLO is available in long lengths. And, its light weight allows it to be unloaded and handled with small equipment.

Reduced excavation because of ULTRA FLO's smaller outside diameter.

Installation Corrugated Metal Pipe

Overview
Satisfactory site preparation, trench excavation, bedding and backfill operations are essential to develop the strength of any flexible conduit. In order to obtain proper strength while preventing settlement, it is necessary that the soil envelope around the pipe be of good granular material, properly placed and carefully compacted.

Bedding
Bedding preparation is critical to both pipe performance and service life. The bed should be constructed to uniform line and grade to avoid distortions that may create undesirable stresses in the pipe and/or rapid deterioration of the roadway. The bed should be free of rock formations, protruding stones, frozen lumps, roots and other foreign matter that may cause unequal settlement.

Placing the pipe
Corrugated metal pipe weighs much less than other commonly used drainage structures. This is due to the efficient strength of the metal, further improved with carefully designed and formed corrugations. Even the heaviest sections of Contech pipe can be handled with relatively light equipment compared with equipment required for much heavier reinforced concrete pipe.

Backfill
Satisfactory backfill material, proper placement and compaction are key factors in obtaining maximum strength and stability. Backfill should be a well-graded granular material and should be free of large stones, frozen lumps and other debris.

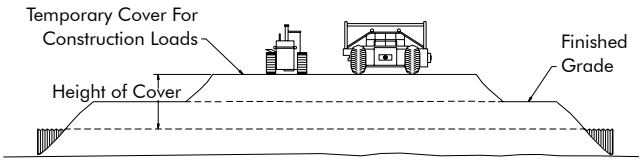
Backfill materials should be placed in layers about six inches deep, deposited alternately on opposite sides of the pipe. Each layer should be compacted carefully. Select backfill is placed and compacted until minimum cover height is reached, at which point, standard road embankment backfill procedures are used.

Installation References
For more information, see AASHTO Bridge Construction Specification Section 26, the Installation Manual of the National Corrugated Steel Pipe Association, ASTM A798 for steel and ASTM B788 for aluminum ULTRA FLO.

Additional Considerations for ULTRA FLO Installations
Bedding and Backfill
Typical ULTRA FLO installation requirements are the same as for any other corrugated metal pipe installed in a trench. Bedding and backfill materials for ULTRA FLO follow the requirements of the CMP installation specifications mentioned above, and must be free from stones, frozen lumps or other debris. When ASTM A796 (steel) or B790 (aluminum) designs are to be followed for condition III requirements, indicated by asterisk (*) in the tables on page 13 and 14, use clean, easily compacted granular backfill materials.

Embankment Conditions
ULTRA FLO is a superior CMP storm sewer product that is normally installed in a trench condition. In those unusual embankment installation conditions, pipe sizes and gages may be restricted. Your Contech Sales Representative can provide you with further guidance.

Construction Loads
For temporary construction vehicle loads, an extra amount of compacted cover may be required over the top of the pipe. The Height of Cover shall meet minimum requirements shown in the table below. The use of heavy construction equipment necessitates greater protection for the pipe than finished grade cover minimums for normal highway traffic.



Min. Height of Cover Requirements for Construction Loads On Corrugated Steel Pipe*

Diameter/ Span, (Inches)	Minimum Cover (feet) for Indicated Axle Loads (kips)			
	18-50	50-75	75-110	110-150
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

Min. Height of Cover Requirements for Construction Loads On Corrugated Aluminum Pipe*

Diameter/ Span (Inches)	Axle Load (Kips)			
	18-50	50-75	75-110	110-150
12-42	3.0′	3.5′	4.0′	4.0′
48-72	4.0′	4.0′	5.0′	5.5′
78-120	4.0′	5.0′	5.5′	5.5′

Min. Height of Cover Requirements for Construction Loads On ULTRA FLO Pipe*

Diameter/ Span (Inches)	Axle Load (Kips)			
	18-50	50-75	75-110	110-150
	Steel 3/4″ x 3/4″ x 7-1/2″			
15-42	2.0'	2.5'	3.0'	3.0'
48-72	3.0'	3.0'	3.5'	4.0'
78-108	3.0'	3.5'	4.0'	4.5'
	Aluminum 3/4″ x 3/4″ x 7-1/2″			
15-42	3.0'	3.5'	4.0'	4.0'

* Minimum cover may vary depending on local conditions. The contractor must provide the additional cover required to avoid damage to the pipe. Minimum cover is measured from the top of the pipe to the top of the maintained construction roadway surface.

SmoothCor™ Pipe

Excellent Hydraulics, Long Lengths and Easy Installation

Corrugated Steel Shell

SmoothCor pipe has a smooth interior steel liner that provides a Manning's "n" of 0.012. Its rugged, corrugated steel shell supplies the structural strength to outperform rigid pipe. SmoothCor pipe is both the economical and performance alternate to concrete.

Superior hydraulics

SmoothCor, with its smooth interior surface, is hydraulically superior to conventional corrugated steel pipe and with fewer joints and better interior surface, outperforms reinforced concrete pipe.

SmoothCor, with its long lengths, light weight and beam strength, is superior to concrete pipe in many difficult situations such as poor soils, poor subsurface drainage conditions, steep slopes and high fills. SmoothCor should be specified as an alternate under normal site conditions, and specified exclusively under very difficult situations that demand the strength of CSP with positive joints and a hydraulically efficient smooth liner.

Two Pipe Shapes

In addition to full-round pipe, SmoothCor comes in a pipe-arch shape for limited headroom conditions. The low, wide pipe-arch design distributes the flow area horizontally, enabling it to be installed with lower head room than a round pipe.

Reference specifications

Material	Polymer Coated	ASTM A 929 AASHTO M246 ASTM A 742
Pipe	Polymer	AASHTO M245 ASTM A 762 & A 760
Design	Steel Pipe	AASHTO Section 12 ASTM A 796
Installation	Steel Pipe	AASHTO Section 26 ASTM A 798

Structural Design

SmoothCor is lined with either 18 or 20 gage steel. Contech has taken a conservative approach to the Height of Cover. The maximum heights-of-cover are based on the shell thickness with no additional structural allowance for the liner as provided for in the AASHTO and ASTM design specifications. Using this approach, the Height of Cover tables for 2 2/3" x 1/2" and 3"x1" steel corrugations can be used for SmoothCor.

Diameters

SmoothCor is available in diameters ranging from 18 inches to 66 inches in 2 2/3" x 1/2" corrugation. The 3" x 1" corrugation is available in diameters of 48 inches to 126 inches.

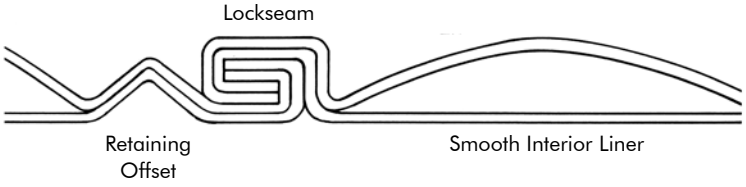
Pipe-arch sizes range from 21" x 15" through 77" x 52" for 2 2/3" x 1/2" corrugations, and 53" x 41" through 137" x 87" for 3"x1" corrugations.

Materials

SmoothCor is available with Dow's TRENCHCOAT® that allows the engineer to design for long service life. TRENCHCOAT is a tough, heavy-gage polymer film laminated to both sides of the steel coil, providing a barrier to corrosion and mild abrasion. TRENCHCOAT is particularly effective for protection in corrosive soils.

Fittings

SmoothCor can be fabricated into any type of structure including tees, elbows, laterals, catch basins, manifolds and reducers. Pre-fabricated fittings are more economical and have superior hydraulic characteristics when compared to concrete structures.



QUICK STAB® Joint

Save Time and Money With Faster Pipe Bell and Spigot Coupling

The Contech QUICK STAB Bell and Spigot joint speeds installation of corrugated metal pipe (CMP), reducing your costs. With the QUICK STAB coupling system, installation of CMP storm sewers and culverts has never been easier or faster.

The QUICK STAB joint creates a bell and spigot joining system with the bell only 1-1/2" larger than the pipe's O.D. Assembled at the factory, the QUICK STAB bell is shipped to the job site ready for installation. The only field operation is placing a special fluted gasket onto the spigot end of the pipe, applying lubricant and pushing it into the bell end of the preceding pipe. Without bands, bolts and wrenches to work and worry with, you can join pipe segments 50% to 90% faster—saving time, money and aggravation.

Soil Tight Joint

Contech's QUICK STAB joint provides the same soil tightness as conventional CMP bands. Each QUICK STAB joint uses a double sealing fluted gasket to seal the spigot against the bell. A flat gasket is installed at the plant between the pipe and the corrugated end of the bell. With the deep bell, you gain maximum soil tightness with minimal installation effort.

Wide Variety of Coatings and Materials

- Plain galvanized
- Aluminized Steel Type 2
- Aluminum
- Polymeric coated

Four Times Faster Installation Than Concrete

The QUICK STAB's bell and spigot joining system allows pipe segments to be joined quicker than reinforced concrete pipe. Next, add in Contech's corrugated metal pipe's length advantage—each segment is four times longer than standard concrete pipe lengths. That means fewer joints and faster installation—up to four times faster! Plus, with the bell only 1-1/2" larger than the pipe, trench excavation is considerably less compared with concrete—again, saving time and money.

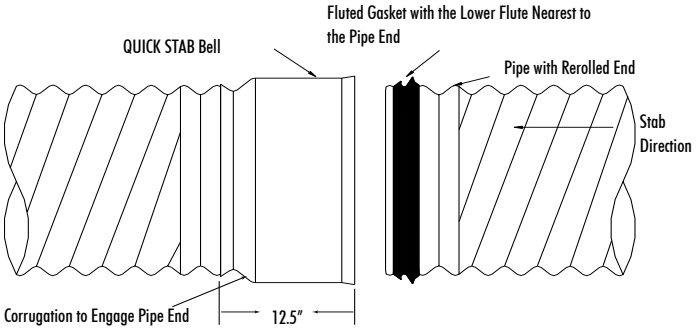
Field Installation Instructions

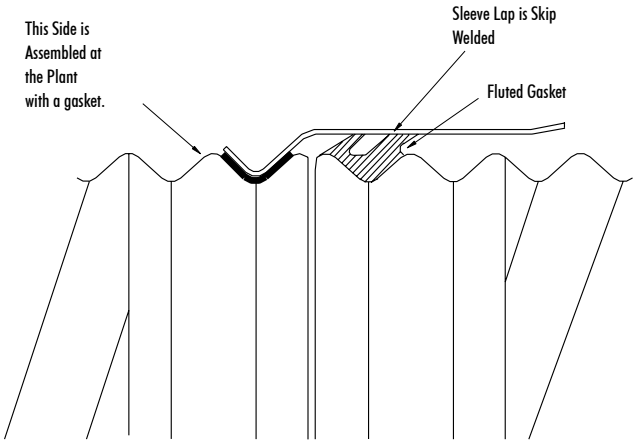
The spigot and bell ends must be cleaned of any dirt or debris prior to assembly. The fluted gasket shall be placed in the first corrugation with the lower flute nearest the end of the pipe. The bell & gasket shall be thoroughly lubed just before stabbing in the bell. Do not place hands, fingers, or any other body parts between bell and spigot during assembly. If it is necessary to pull the joint apart, the bell, spigot and gasket shall be inspected and cleaned of any dirt or debris prior to re-stabbing.

Corrugated Metal Pipe Bell and Spigot Joint Specification

The joints shall be of such design and the ends of the corrugated metal pipe sections so formed that the pipe can be laid together to make a continuous line of pipe. The joint shall be made from the same material as the pipe and shall prevent infiltration of the fill material.

Bell and Spigot Coupling System for CMP





The Bell and Spigot joint is available on ULTRA FLO and 2-2/3" x 1/2" corrugation in 15" through 60" diameter.

End Sections

Easily installed, easily maintained culvert end treatments for corrugated metal pipe, reinforced concrete pipe and HDPE Pipe

Contech End Sections provide a practical, economical and hydraulically superior method of finishing a variety of culvert materials.

The lightweight, flexible metal construction of Contech End Sections creates an attractive, durable and erosion-preventing treatment for all sizes of culvert inlets and outlets. They can be used with corrugated metal pipe having either annular or helical corrugations, and both reinforced concrete and plastic pipes. End sections can be salvaged when lengthening or relocating the culvert.

Standard End Sections are fabricated from pregalvanized steel. For added corrosion resistance, Aluminized Type II or Aluminum End Sections are available in smaller sizes. Special End Sections for multiple pipe installations may be available on a specific inquiry basis.

Better hydraulics

Flow characteristics are greatly improved by the exacting design of Contech End Sections. Scour and sedimentation conditions are improved, and headwater depth can be better controlled. Culverts aligned with the stream flow and finished with Contech End Sections generally require no additional hydraulic controls.

Improved appearance

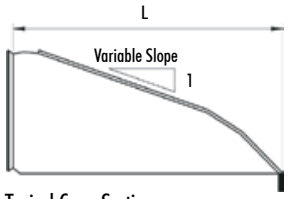
Contech End Sections blend well with the surroundings. The tapered sides of an End Section merge with slope design to improve roadside appearance. Unsightly weeds and debris collection at the culvert end are reduced.

Economical installation

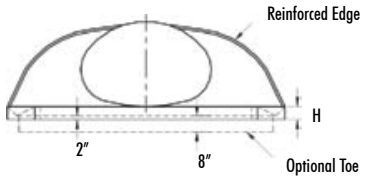
Lightweight equipment and simple crew instructions result in smooth and easy installation. Contech End Sections are easily joined to culvert barrels, forming a continuous, one-piece structure. For easiest installation, End Sections should be installed at the same time as the culvert. Installation is completed by tamping soil around the End Section.

Low maintenance

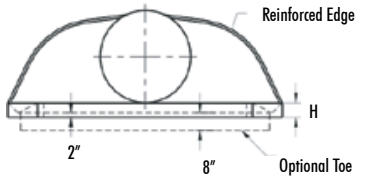
Contech End Sections reduce maintenance expense because their tapered design promotes easier mowing and snow removal. There is no obstruction to hamper weed cutting.



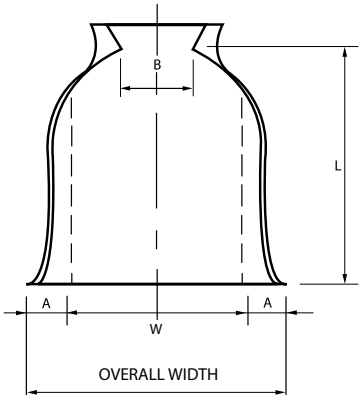
Typical Cross Section



Elevation



Elevation



Plan

Notes for all End Sections:

1. All three-piece bodies to have 12-gage sides and 10-gage center panels. Multiple panel bodies to have lap seams which are to be tightly joined by galvanized rivets or bolts.
2. For 60″ through 84″ sizes, reinforced edges are supplemented with stiffener angles. The angles are attached by galvanized nuts and bolts. For the 66″ and 72″ equivalent round pipe-arch sizes, reinforced edges are supplemented by angles. The angles are attached by galvanized nuts and bolts.
3. Angle reinforcements are placed under the center panel seams on the 66″ and 72″ equivalent round pipe-arch sizes.
4. Toe plate is available as an accessory, when specified on the order, and will be same gage as the End Section.
5. Stiffener angles, angle reinforcement, and toe plates are the same base metal as end section body.
6. **End sections with 6:1 and 4:1 slopes are available in 12″ through 24″ diameters.**
7. Actual dimensions may vary slightly.
8. During manufacturing, a slight invert slope may result along the length of the end section to be accommodated in the field.

End Sections for Round Pipe (2-2/3″ x 1/2″, 3″ x 1″ and 5″ x 1″)

		Approximate Dimensions, Inches [7]					
Pipe Diameter (Inches)	**Gage**	**A (+/- 1") (Inches)**	**B (Max) (Inches)**	**H (Min) (Inches)**	**L (+/-2") (Inches)**	**W (+/- 2") (Inches)**	**Overall Width (+/- 4") (Inches)**
12	16	6	6	6	21	24	36
15	16	7	8	6	26	30	44
18	16	8	10	6	31	36	52
21	16	9	12	6	36	42	60
24	16	10	13	6	41	48	68
30	14	12	16	8	51	60	84
36	14	14	19	9	60	72	100
42	12	16	22	11	69	84	116
48	12	18	27	12	78	90	126
54	12	18	30	12	84	102	138
60	12/10	18	33	12	87	114	150
66	12/10	18	36	12	87	120	156
72	12/10	18	39	12	87	126	162
78	12/10	18	42	12	87	132	168
84	12/10	18	45	12	87	138	174

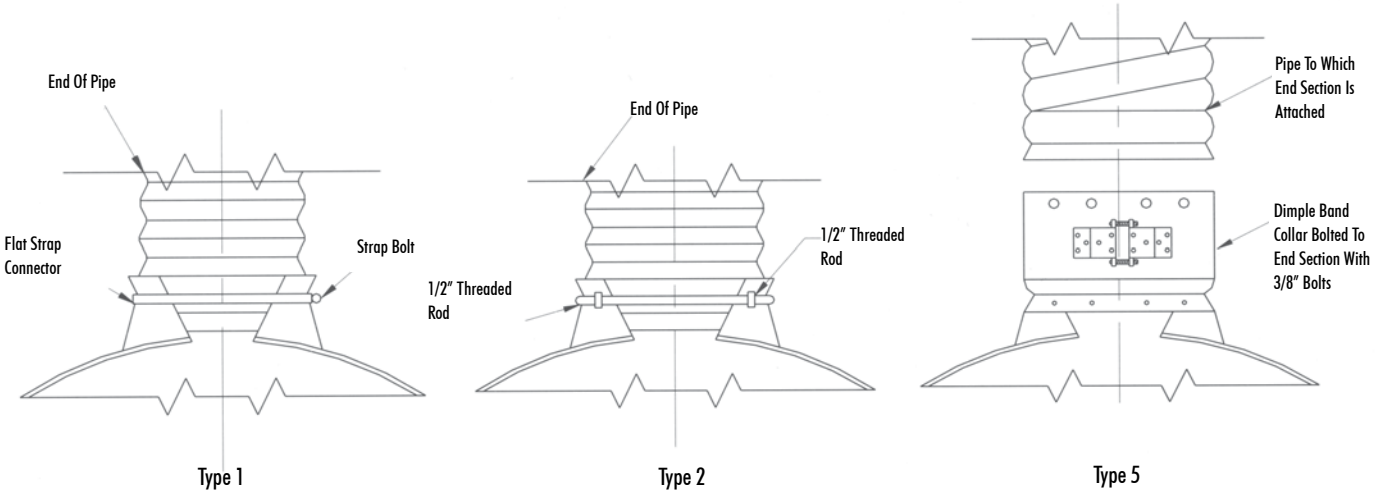
End Sections for Pipe-Arch (2-2/3″ x 1/2″)

			Approximate Dimensions, Inches [7]					
Span/Rise	**Equiv. Round (Inches)**	**Gage**	**A (+/- 1") (Inches)**	**B (Max) (Inches)**	**H (+/- 1") (Inches)**	**L (+/- 2") (Inches)**	**W (+/- 2″) (Inches)**	**Overall Width (+/- 4") (Inches)**
17″x13″	15	16	7	9	6	19	30	44
21″x15″	18	16	7	10	6	23	36	50
24″x18″	21	16	8	12	6	28	42	58
28″x20″	24	16	9	14	6	32	48	66
35″x24″	30	14	10	16	6	39	60	80
42″x29″	36	14	12	18	8	46	75	99
49″x33″	42	12	13	21	9	53	85	111
57″x38″	48	12	18	26	12	63	90	126
64″x43″	54	12	18	30	12	70	102	138
71″x47″	60	12/10	18	33	12	77	114	150
77″x52″	66	12/10	18	36	12	77	126	162
83″x57″	72	12/10	18	39	12	77	138	174

End Sections for Pipe-Arch (3″ x 1″ and 5″ x 1″)

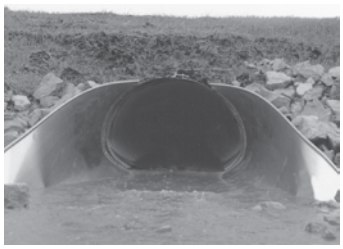
			Approximate Dimensions, Inches [7]					
Span/Rise	**Equiv. Round (Inches)**	**Gage**	**A (+/- 1") (Inches)**	**B (Max) (Inches)**	**H (+/- 1") (Inches)**	**W (+/- 2") (Inches)**	**L (+/- 2") (Inches)**	**Overall Width (+/- 4") (Inches)**
53″x41″	48	12	18	25	12	90	63	126
60″x46″	54	12	18	34	12	102	70	138
66″x51″	60	12/10	18	33	12	116	77	152
73″x55″	66	12/10	18	36	12	126	77	162
81″x59″	72	12/10	18	39	12	138	77	174
87″x63″	78	12/10	20	38	12	148	77	188
95″x67″	84	12/10	20	34	12	162	87	202
103″X71″	90	12/10	20	38	12	174	87	214
112″x75″	96	12/10	20	40	12	174	87	214

Contech End Sections attach to corrugated metal pipe, reinforced concrete and plastic pipe.



Note: *The Type 3 connection is not illustrated. This connection is a one-foot length of pipe attached to the end section.*

End Section on Round CSP



End Sections are available for CSP Pipe-Arch

Contech End Sections are often used on concrete pipe. They can be used on both the bell and spigot end.

Low-slope End Sections—Contech manufactures 4:1 and 6:1 low-slope End Sections for corrugated metal pipe. This photo shows the optional field-attached safety bars.

Contech Engineered Solutions LLC is a leading provider of site solution products and services for the civil engineering industry. Contech's product portfolio includes bridges, drainage, retaining walls, sanitary sewer, stormwater, erosion control, soil stabilization and wastewater products.

For more information, call one of Contech's Regional Offices located in the following cities:

Ohio (Corporate Office) 513-645-7000
Colorado (Denver) 720-587-2700
Florida (Orlando) 321-348-3520
Maine (Scarborough) 207-885-9830
Maryland (Baltimore) 410-740-8490
Oregon (Portland) 503-258-3180
Texas (Dallas) 972-590-2000

Visit our web site: www.ContechES.com
800-338-1122

CONTECH® ENGINEERED SOLUTIONS

BRO-CMP-DESIGN 8/14 3M PDF

Attachment C
Educational Materials

Regulatory information

The Federal Water Pollution Control Act prohibits the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 passage of the Water Quality Act established NPDES permit requirements for discharges of storm water. The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Industrial facilities and construction sites are regulated by the Regional Water Quality Control Board and State Water Resources Control Board, through general storm water permits. Most industrial, manufacturing or transportation businesses that store materials, products or equipment outdoors, or conduct vehicle washing or process operations outdoors are required to obtain coverage under the State Water Resources Control Board's General Industrial Activities Stormwater Permit. For more information about this permit, visit www.swrcb.ca.gov/stormwtr/industrial.html or contact your local storm water coordinator.

If your business conducts construction activities, including clearing, grading, stockpiling or excavation that results in soil disturbances of at least one acre, you are subject to the State Water Resources Control Board's General Construction Activities Stormwater Permit. To find out more about this storm water permit for construction, visit: www.swrcb.ca.gov/stormwtr/construction.html.

Cities and counties are regulated through permits issued by the Regional Boards. Since 1990, operators of large storm drain systems such as San Bernardino County's have been required to:

- Develop a storm water management program designed to prevent harmful pollutants from being dumped or washed by storm water runoff, into the storm water system, then discharged into local water bodies; and
- Obtain a National Pollutant Discharge Elimination System (NPDES) permit.

The NPDES permit programs in California are administered by the State Water Resources Control Board and by nine regional boards that issue NPDES permits and enforce regulations within their respective region.

San Bernardino County lies within the jurisdiction of the Santa Ana Region. This regional board issues a permit to the San Bernardino County Permittees, which includes the County of San Bernardino, San Bernardino County Flood Control District and incorporated cities of San Bernardino County. Since the program's inception, the County of San Bernardino has served as the principal permittee.

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Documents & reports:

The following documents describe the regulations and programs for water quality in San Bernardino County. You can review the latest Basin Plan, National Pollutant Discharge Elimination System (NPDES) Permit and Drainage Area Management Plan (DAMP).

- **Basin Plans:** The document for each region of the State Water Quality Board's jurisdiction, including Santa Ana, is the Water Quality Control Plan, commonly referred to as the Basin Plan. It is the foundation for the regulatory programs of each regional board. The Basin Plan documents the beneficial uses of the region's ground and surface waters, existing water quality conditions, problems, and goals, and actions by the regional board and others that are necessary to achieve and maintain water quality standards.

▸Water Control Plan for the Santa Ana River Basin

- **Municipal National Pollutant Discharge Elimination System (NPDES) Permits:** The permits of each region outline additional steps for a storm water management program and specify requirements to help protect the beneficial uses of the receiving waters. They require permittees to develop and implement Best Management Practices (BMPs) to control/reduce the discharge of pollutants to waters of the United States to the maximum extent practicable (MEP).

  ▸Santa Ana Regional Water Quality Control Board Municipal NPDES Permit Order No. R8-2002-0012

- **Report of Waste Discharge:** The Report of Waste Discharge (ROWD) describes the San Bernardino Stormwater Program, implemented by the County and cities to comply with their jointly held stormwater permit. It is the principle policy and guidance document for the NPDES Stormwater Program.

  ▸Report of Waste Discharge 2000

- **San Bernardino County Storm Water Program Annual Status Report:** The Annual Status Report is a requirement of the NPDES permit for submittal to the Regional Boards and United States Environmental Protection Agency. The report presents an analysis and assessment of permit compliance activities.

▸Annual report - will be posted soon

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

STORMWATER Pollution Prevention

Important Phone Numbers

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

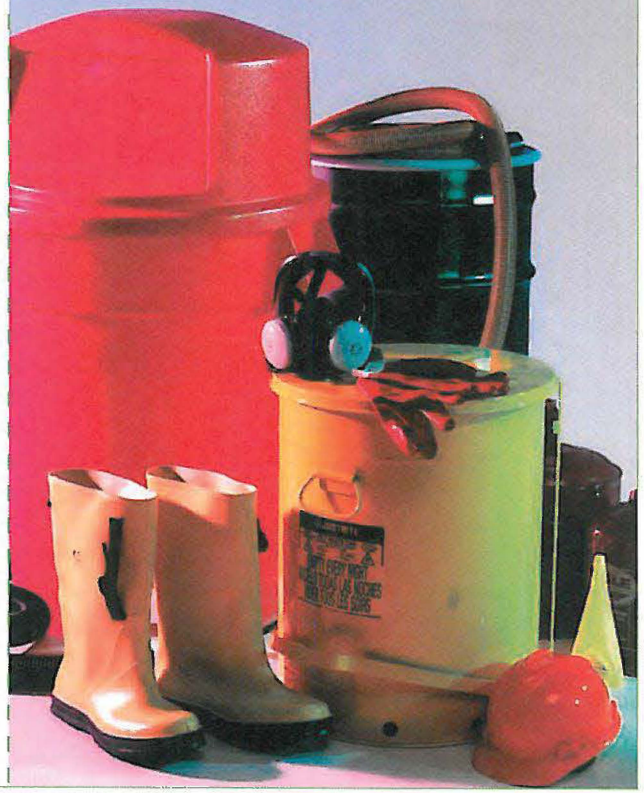
City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

San Bernardino County
Stormwater Program
825 East Third Street • Room 201
San Bernardino, CA 94215-0835

STORMWATER Pollution Prevention

INDUSTRIAL AND COMMERCIAL FACILITIES



STORMWATER Pollution Prevention

To reduce the amount of pollutants reaching our storm drain system, which leads to the Santa Ana River and Pacific Ocean, the San Bernardino County Stormwater Program has developed Best Management Practices (BMPs) for Industrial and Commercial Facilities. City and County ordinances require that businesses comply with these BMPs, where applicable, to protect local water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.

Prohibited Discharges

- Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain.

Outdoor Storage

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, except when in direct use.
- Sweep outdoor areas instead of using a hose or pressure washer.

Outdoor Processes

- Move all process operations including vehicle and equipment maintenance inside of the building or into a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to city standards, then discharged to a sanitary sewer or take them to a commercial car wash.

Spills and Clean Ups

- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials and followed by proper disposal of materials.
- Always have a spill kit available near chemical loading dock doors, vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the County Fire Department at (909) 386-8401.

Industrial and Commercial Facilities

- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator either at (800) CLEANUP or as listed at www.sbcounty.gov/stormwater.
- Report hazardous materials spills to (800) 33 TOXIC and your local Fire Department Hazmat Team at 911.

Training

Train employees in spill response procedures and prohibited discharges to the storm drain system, as prescribed in your local Stormwater Ordinance and in applicable Best Management Practices available at www.cabmphandbooks.com and www. sbcounty.gov/stormwater.

Permitting

Stormwater discharges associated with specific categories of commercial and industrial facilities are regulated by the State Water Resources Control Board (SWRCB) through an Industrial Storm Water General Permit. A copy of the General Permit and application forms are available at: www.waterboards.ca.gov/stormwtr/industrial.html

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

1 (800) CLEANUP

or visit our websites at:

www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación
AL SISTEMA DE DRENAJE

Números de Teléfono Importantes

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

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San Bernardino County
Stormwater Program
825 East Third Street • Room 201
San Bernardino, CA 94215-0835

Prevención de Contaminación
AL SISTEMA DE DRENAJE

INSTALACIONES INDUSTRIALES Y COMERCIALES

Prevención de Contaminación
AL SISTEMA DE DRENAJE

Para reducir la cantidad de contaminantes que alcanzan nuestro sistema de aguas pluviales, las cuales desembocan en el Río Santa Ana y el Océano Pacífico, el Programa del Condado de San Bernandino ha desarrollado las pautas de Mejores Prácticas de Manejo (BMPs, por sus siglas en inglés) para instalaciones industriales y comerciales. Los decretos de la ciudad y del condado establecen que todas las empresas deben de cumplir con estas BMPs, cuando corresponda, para proteger la calidad del agua local. Las ciudades locales y el condado tienen la obligación de verificar la implementación de estas BMPs al llevar a cabo inspecciones regulares en sus instalaciones.

Desagües Prohibidos

- Descontinúe todo desagüe de aguas no pluviales al sistema de drenaje de aguas pluviales. Está prohibido descargar cualquier sustancia química, residuo o agua residual a los drenajes de la cuneta, de la calle o de aguas pluviales.

Almacenamiento al Aire Libre

- Instale cubiertas y áreas de retención secundarias para todos los materiales peligrosos y residuos almacenados al aire libre, estas instalaciones deberán de cumplir con los estándares establecidos por el condado y/o la ciudad.
- Mantenga todos los recipientes temporales de residuos cubiertos, con la excepción de cuando se estén utilizando directamente.
- Barra todas las áreas al aire libre en lugar de usar una manguera o un equipo de limpieza con agua a alta presión.

Procesos al Aire Libre

- Reubique todos los procesos u operaciones, incluyendo el mantenimiento de vehículos y equipo, dentro de un edificio en una área cubierta e independiente.
- Lave el equipo y los vehículos en una fosa de lavado independiente que tenga un anillo cerrado o bien, esté conectada a un clarificador del tamaño de los estándares municipales, luego elimine los residuos en un drenaje sanitario o llévelos a un lavador de carros comercial.

Derrames y Limpieza

- Limpie los derrames inmediatamente, utilice métodos de limpieza en seco como son el uso de materiales absorbentes y elimine estos materiales de la manera adecuada.
- Siempre tenga a la mano un estuche para derrames cerca de las puertas de los muelles de carga de sustancias químicas, en las áreas de mantenimiento de vehículos y en las áreas de combustible.
- Siga su Plan de Emergencia Comercial, como lo registró con el Departamento de Bomberos del Condado marcando al (909) 386-8401.
- Reporte todos los desagües prohibidos y cualquier punto no implementado de las BMPs a su coordinador local de Aguas Pluviales llamando al (800) CLEANUP o como se indica en el enlace www.sbcounty.gov/stormwater.
- Reporte cualquier derrame peligroso al (800) 33 TOXIC y al equipo Hazmat de su departamento local de bomberos marcando al 911.

Instalaciones Industriales y Comerciales

Capacitación

Capacite a los empleados sobre los procedimientos de respuesta ante un derrame y los desagües prohibidos al sistema de aguas pluviales, como lo indica el decreto local de aguas pluviales de Mejores Prácticas de Manejo (BMPs) disponibles en el sitio www.cabmphandbooks.com y www.sbcounty.gov/stormwater.

Autoridad Competente

Los desagües de aguas pluviales relacionados con categorías específicas de instalaciones comerciales e industriales están regulados por la Junta Estatal de Control de Recursos Acuáticos (State Water Resources Control Board, SWRCB) a través de un permiso industrial general de aguas pluviales. Para obtener una copia de este permiso general y una solicitud, visite el sitio: www.waterboards.ca.gov/stormwtr/industrial.html

Para reportar el desagüe de residuos ilegales o para obtener información adicional sobre la prevención de contaminación a las aguas pluviales, llame a:

1 (800) CLEANUP

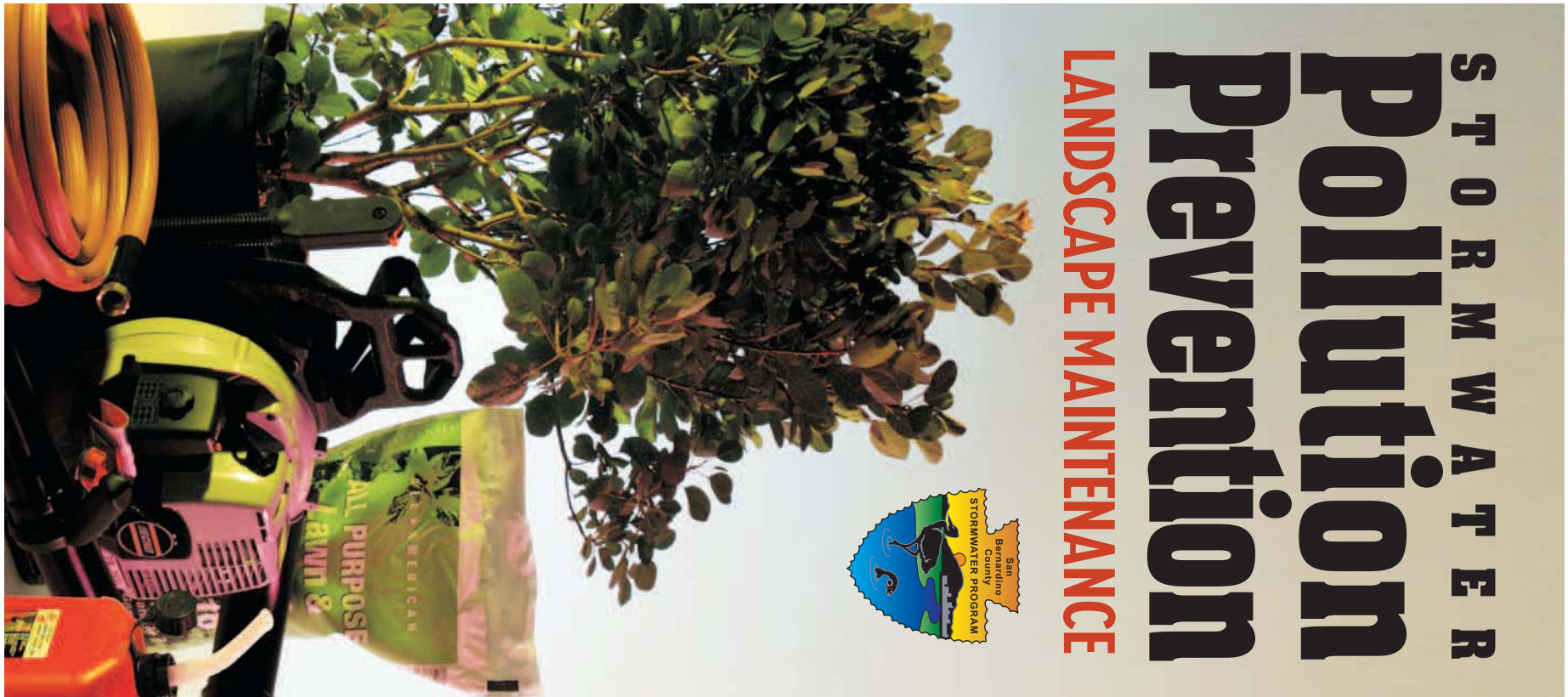
o visite nuestro sitio:

www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

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



STORMWATER Pollution Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

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

Recycle Yard Waste

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

Use Fertilizers, Herbicides and Pesticides Safely

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

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

Recycle Hazardous Waste

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

Use Water Wisely

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

Prevent Erosion

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

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

Store Materials Safely

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

To report illegal dumping call

(877) WASTE18

or visit our website:

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Commercial landscape maintenance:

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

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at www.ciwmb.ca.gov/Organics.
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.
- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.
- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.
- **Store Materials Safely:** Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials should be covered with plastic sheeting to protect from rain, wind and runoff.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

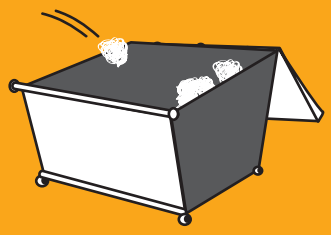
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

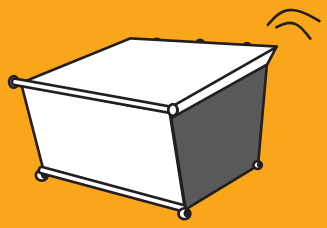
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT

- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ SWEEP FREQUENTLY

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ FIX LEAKS

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ CONSTRUCT ROOF

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

San Bernardino County STORMWATER PROGRAM

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
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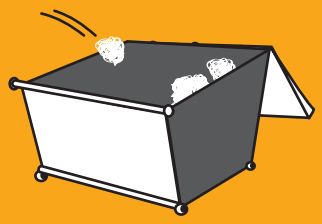
CONTENEDORES COMERCIALES PARA LA BASURA

SIGA ESTOS **PASOS** PARA MANTENER **LIMPIAS NUESTRAS VÍAS FLUVIALES**

Los contenedores de basura, tales como aquellos que se encuentran en las unidades comerciales y departamentos, generalmente contienen materiales que están destinados a los rellenos sanitarios o en algún establecimiento de reciclaje.
Estos materiales NO deben ser vertidos en nuestros lagos y ríos locales.

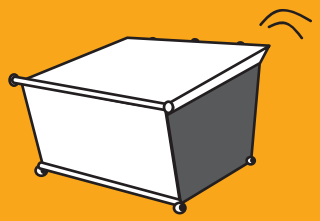
SIGA ESTOS PASOS PARA PROTEGER LA CALIDAD DEL AGUA

COLOQUE LA BASURA ADENTRO



Coloque la basura adentro del contenedor (preferentemente en bolsas selladas)

CIERRE LA TAPA



Evite que la lluvia ingrese al contenedor para evitar un escape de escorrentía contaminada

MANTENGA LOS PRODUCTOS TÓXICOS AFUERA

- Pintura
- Lubricante, grasas y aceites usados
- Baterías, componentes electrónicos y luces fluorescentes

ALGUNAS GUÍAS ADICIONALES, LAS CUALES INCLUYEN

✓ BARRER CON FRECUENCIA

Barra con frecuencia las áreas de los recintos para la basura, en lugar de lavarlas con una manguera, para evitar que el agua contaminada se vierta en las calles y los desagües de lluvia.

✓ REPARE LAS GOTERAS

Ocúpese inmediatamente de las goteras en los contenedores de basura. Use los métodos de limpieza en seco e infórmele a su recolector de basura para que reciba un reemplazo.

✓ CONSTRUYA UN TECHO

Construya un techo de cubierta sólida sobre la estructura actual del recinto para la basura a fin de evitar que el agua de lluvia entre en contacto con los desechos y la basura. Consulte con su Ciudad/Condado para conocer los Códigos de Construcción.

En el Condado de San Bernardino, los desechos de alimentos y jardines, los productos químicos y otros restos que se vierten en los desagües de aguas pluviales y que terminan en nuestras vías fluviales sin tratamiento alguno provocan la contaminación de estas aguas. Usted puede ser parte de la solución si mantiene un recinto para la basura que no contamine el agua.

¡MUCHAS GRACIAS POR AYUDAR A MANTENER EL CONDADO DE SB LIMPIO Y SIN CONTAMINACIÓN!

San Bernardino County STORMWATER PROGRAM

Para informar acerca del vertedero ilegal, llame a **(877-WASTE18)**, o para encontrar un establecimiento donde arrojar los residuos peligrosos del hogar, llame a **(800-OILY CAT)**: **sbcountystormwater.org**
Para deshacerse de los residuos peligrosos llame al Condado de San Bernardino Departamento de Bomberos - programa CUPA **(909) 386-8401**

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Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Construction & development:

Soil, cement wash, asphalt, oil and other hazardous debris from construction sites often make their way into the San Bernardino County storm drain system, and flow untreated into local waterways. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.

- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

STORMWATER Pollution Prevention

CONSTRUCTION

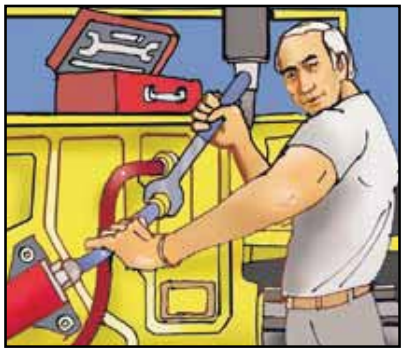
Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Store Materials Safely
Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Ordering Materials & Recycling Waste
Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.

Cleaning & Preventing Spills
Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.

Preventing Erosion
Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydromulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Channels can be lined with grass or roughened pavement to reduce runoff velocity.



Maintaining Vehicles & Equipment
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To report illegal dumping call
(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

CONSTRUCCIÓN

Cemento, sedimentos, liquidos de auto, polvos y residuos peligrosos acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

Almacenando Materiales Cuidadosamente

Manten materiales de construcción y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y herramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.

Ordenando Materiales & Reciclando Desechos

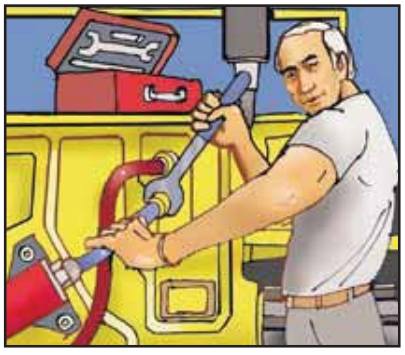
Reduce la cantidad al ordenar el material, solo ordena lo necesario. Usa materiales que se puedan reciclar cuando sea posible. Se puede reciclar el aspfalto, concreto, madera y la vegetacion. Materiales no reciclados se deven llevar a lugares de desechos peligrosos. Para mas información llama al (909) 386-8401.

Limpiando & Previniendo Derrames

Usa siempre un enbudo al vaciar liquidos. Barre los derrames en ves de lavarlos con la manguera. Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin. Para reportar derrames llama al 911.

Previniendo Erosiones

Evita las excavaciones durante lluvia. Planta vegetacion temporal en colinas donde aun no hay planes de construccion y planta vegetacion permanente al terminar las excavaciones. Construye algunos canales para el desagüe. Estos pueden ser creados con pasto y cemento para reducir la velocidad del desagüe.



Mantenimiento de Vehiculos & Herramientas

Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura y preveen goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador.

Para reportar actividades ilegales llamar al:

(877) WASTE18

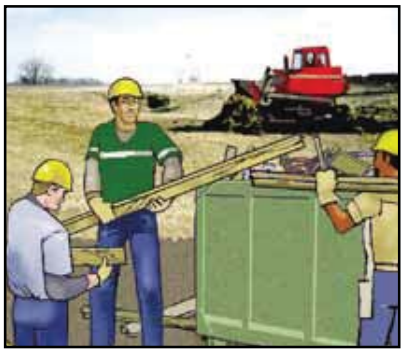
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

EXCAVATION AND GRADING

Sediment, cement wash, asphalt and vehicle fluids from soil excavation and grading often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Recycling Waste

Recycle broken asphalt, concrete, wood, and cleared vegetation whenever possible. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.

Maintaining Vehicles & Equipment

Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutters and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks. Use gravel approaches where truck traffic is heavy to reduce soil compaction and limit the tracking of sediment into the street.

Cleaning & Preventing Spills

Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids. To report serious spills, call 911.

Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Preventing Erosion

Avoid excavation or grading during wet weather. Plant temporary vegetation on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff. Channels can be lined with grass or roughened pavement to reduce runoff velocity.

To report illegal dumping call

(877) WASTE18

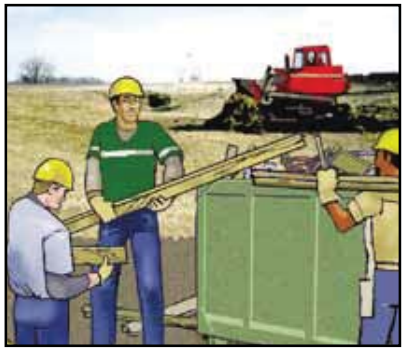
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

EXCAVACIONES

Sedimento, cemento, asfalto y liquidos de auto, tierra y residuos peligrosos de lugares de construcción acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.



Reciclando Desechos
Recicla el aspfalto, concreto, madera y la vegetacion cuando sea posible. Materiales no reciclados se deverian llevar a lugares de desechos peligrosos. Para màs informacion llama al (909) 386-8401.

Manteniendo Vehiculos & Herramientas
Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura. Usa grava donde mayormente se consentra el trafico de camiones para y reducir el sedimento en las calles.

Limpiando & Previniendo Derrames
Usa siempre un enbudo al vaciar liquidos. Barre los derrames en ves de lavarlos con la manguera. Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin. Preveen goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador. Para reportar derrames llama al 911.

Almacenando Materiales
Manten materiales de construccion y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y erramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.

Previniendo Erosiones
Evita las excavaciones durante lluvia. Planta vegetacion temporal en colinas donde aun no hay planes de construcción y planta vegetacion permanente al terminar las excavaciones. Construye algunos canales para el desagüe. Estos pueden ser creados con pasto y cemento para reducir la velocidad del desagüe.

Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County
STORMWATER PROGRAM

STORMWATER Pollution Prevention

FRESH CONCRETE & MORTAR APPLICATION

Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Secure open bags of cement and cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Ordering Materials & Recycling Waste

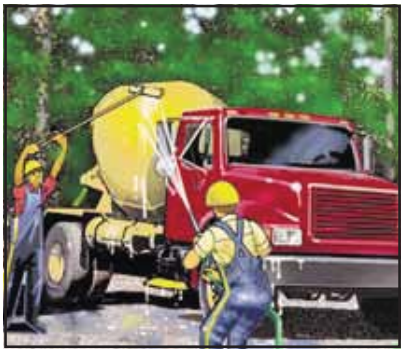
Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. When breaking up paving, recycle the pieces at a crushing company. You can also recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. Call (909) 386-8401 for recycling and disposal information.

During Construction

Schedule excavation and grading during dry weather. Prevent mortar and cement from entering the street and storm drains by placing erosion controls. Setup small mixers on tarps or drop cloths, for easy cleanup of debris. Never bury waste material. Recycle or dispose of it as hazardous waste.

Cleaning Up

Wash concrete dust onto designated dirt areas, not down driveways or into the street or storm drains. Wash out concrete mixers and equipment in specified washout areas, where water can flow into a containment pond. Cement washwater can be recycled by pumping it back into cement mixers for reuse. Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.



To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

APLICANDO CONCRETO FRESCO

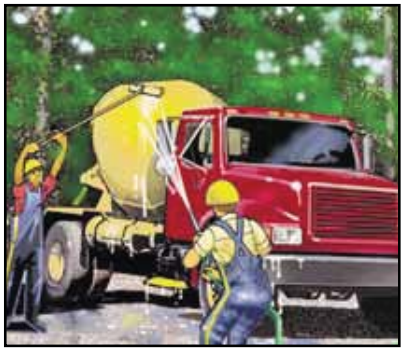
Cemento, grava, asfalto y liquidos de auto, tierra y residuos peligrosos de lugares de concreto fresco por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

Almacenando Materiales
Manten materiales de construcción y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y herramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.

Ordenando Materiales & Reciclando
Reduce la cantidad al ordenar el material, solo ordena lo necesario. Usa materiales recicables cuando sea posible. Cuando estes rompiendo el pavimento, recicla los pedasos en la compañia demolidora. Se puede reciclar el aspfalto, concreto, madera y la vegetacion. Materiales no reciclados se deverian llevar a lugares de desechos peligrosos. llama al (909) 386-8401 para más información.

Durante Construcción
Planea las excavaciones durante clima seco. No dejes que el cemento o la cal lleguen hasta las calles o drenajes, evita esto con plantas temporales para detener el desagüe. Cubre las maquinas de mesclar con alguna garra para que se facilite la limpieza de residuos. Nunca entierres los desechos. Recicla todos los desechos peligrosos.

Limpiando
Lava la cal en un area designada, no la eches hacia la cochera o en la calle. Lava las mescladoras y las herramientas en un lugar especifico, donde el agua llegue a un contenedor. El agua de cemento se puede reciclar volviendola a usar en las mescladoras. Nunca dejes el agua de cemento que corra hacia las calles, alcantarillas o drenajes.



Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

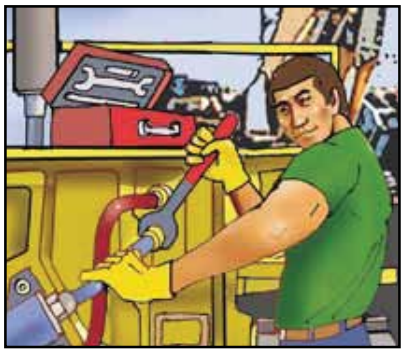
STORMWATER Pollution Prevention

ROADWORK AND PAVING

Asphalt, saw-cut slurry and excavated materials from road paving, surfacing and pavement removal often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Preventing Erosion
Schedule excavation and grading work during dry weather. Develop and implement erosion and sediment control plans for excavated embankments. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

During Construction
Cover catch basins and maintenance holes when applying seal coat, slurry seal or fog seal. Use check dams, ditches or berms around excavations, and avoid over applying water for dust control. Never wash excess materials from exposed aggregate or concrete into the street, gutter or a storm drain.



Maintaining Vehicles & Equipment
Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids.

Asphalt & Concrete Removal
Barricade storm drain openings during saw-cutting, and recycle broken up pavement at a crushing company. For recycling information, call (909) 386-8401.

Cleaning & Preventing Spills
Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Sweep up dry spills, instead of hosing. Prevent spills from paver machines by using drip pans, or by placing absorbent materials like cloths or rags under the machines when not in use. To report serious spills, call 911.

To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

TRABAJO DE CARRETERAS & PAVIMENTO

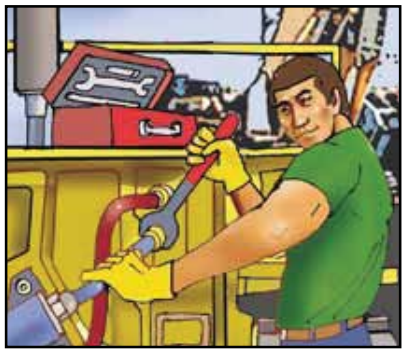
Asfalto, mezcla y materiales de excavaciones del pavimento acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

Previniendo Erosiones

Planea las excavaciones trabajo de jardineria durante el clima seco. Desarrolla e implementa planes de embancamientos de control de sedimento y excavaciones. Cubre montones de tierra, grava y otros materiales con un plastico para protejerlos de la llvia, aire y desagüe.

Durante Construcción

Cubre los lavados y da mantenimiento a los hoyos al aplicar selladura o mezcla. Revisa las areas de excavaciones, y evita pasarte de agua para preveenir polvadura. Nunca laves los materiales llenos de concreto en la calle, drenajes o en el desagüe.



Mantenimiento de Vehiculos & Herramientas

Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura y evita goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador.

Removiendo Asfalto & Concreto

Bloquea alrededor de los drenajes cuando estes usando las maquinas de sierra, tambien recicla todo el pavimento roto en la compañia demolidora. Para más información llama al (909) 386-8401.

Limpiando & Previniendo Derrames

Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin Barre los derrames en ves de lavarlos con la manguera. Previene los derrames de las maquinas usando enbudos o colocanto garras para absorver cualquier liquido. Para reportar derrames llama al 911.

Para reportar actividades ilegales llamar al:

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

After the Storm

A Citizen's Guide to Understanding Stormwater

EPA 833-B-03-002
January 2003

For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

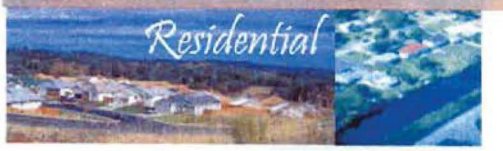
- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.

- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.

- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

Stormwater Pollution Solutions

Residential



Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

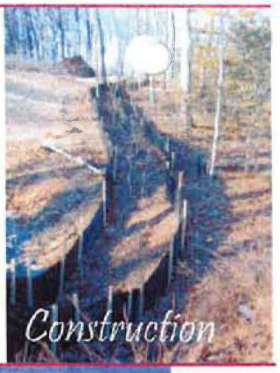
Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction



Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be washed into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

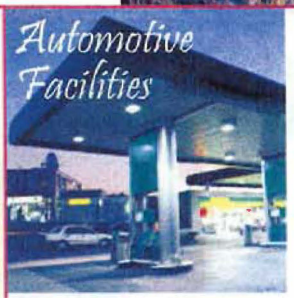
- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is *PROHIBITED* by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. ***Each of us*** can do our part to keep stormwater clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of ***small amounts*** of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.

Report illegal storm drain disposal
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.

When cleaning surfaces with a ***high-pressure washer*** or ***steam cleaner***, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks ***with loose paint***, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers

Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

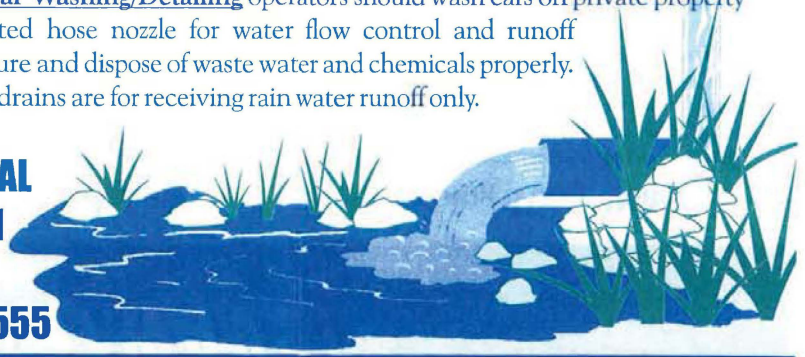
Do you know where street flows actually go?

Storm drains are NOT connected to sanitary sewer systems and treatment plants!

The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

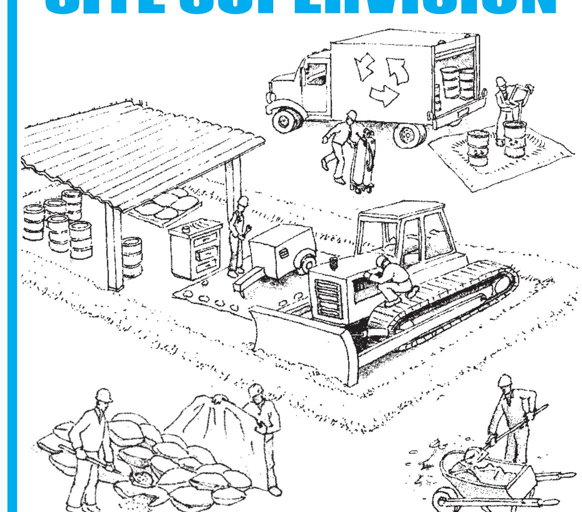
REPORT ILLEGAL STORM DRAIN DISPOSAL 1-800-506-2555



StormWater Pollution

What you should know for...

GENERAL CONSTRUCTION & SITE SUPERVISION



Best Management Practices (BMPs) for:

- Developers
- General Contractors
- Home Builders
- Construction Inspectors
- Anyone in the construction business

To report a hazardous materials spill, call:

Riverside County Hazardous Materials Emergency Response Team
(909) 358-5055 8:00 a.m. – 5:00 p.m.
(909) 358-5245 after 5:00 p.m.

In an emergency call: **911**

For recycling and hazardous waste disposal, call:

(909) 358-5055

To report an illegal dumping or a clogged storm drain, call:

1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, please call (909) 955-1200 or visit the StormWater/CleanWater Protection Program website at:
www.co.riverside.ca.us/depts/flood/waterquality npdes.asp

StormWater CleanWater PROTECTION PROGRAM

The StormWater/CleanWater Protection Program gratefully acknowledges the Santa Clara Valley Nonpoint Pollution Control Program, Alameda Countywide CleanWater Program and the City of Los Angeles Stormwater Management Division for information provided in this brochure.

Resources

State Water Resources Control Board
Division of Water Quality
1001 I Street
Sacramento CA 95814
(916) 341-5455
www.swrcb.ca.gov/stormwtr/

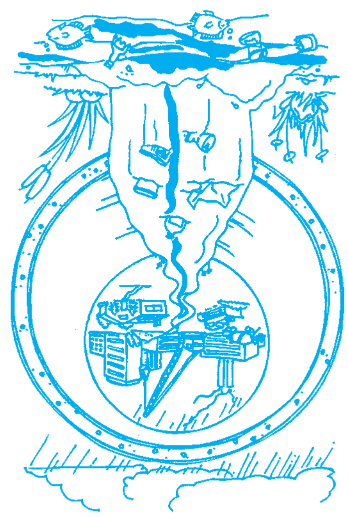
Colorado River Basin Regional Water Quality Control Board - Region 7
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
(760) 346-7491
www.swrcb.ca.gov/~rwqcb7/

Santa Ana Regional Water Quality Control Board - Region 8
3737 Main Street, Suite 500
Riverside, CA 92501-3348
(909) 782-4130
www.swrcb.ca.gov/~rwqcb8/

San Diego Regional Water Quality Control Board - Region 9
9771 Clairemont Mesa Blvd., Suite A
San Diego, CA 92124
(858) 467-2952
www.swrcb.ca.gov/~rwqcb9/

StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sewers and storm drains. The storm drain system was designed to reduce flooding by carrying excess rainwater away from streets and developed areas. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our local waterways.



Unlike sanitary sewers, storm drains are not connected to a wastewater treatment plant – they flow directly to our local streams, rivers and lakes.

Stormwater runoff is a part of the natural hydrologic process. However, land development and construction activities can significantly alter natural drainage processes and introduce pollutants into stormwater runoff. Polluted stormwater runoff from construction sites has been identified as a major source of water pollution in California. It jeopardizes the quality of our local waterways and can pose a serious threat to the health of our aquatic ecosystems.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Because preventing pollution is much easier and less costly than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses on pollution prevention activities. This pamphlet describes various Best Management Practices (BMPs) that construction site operators can use to prevent stormwater pollution.

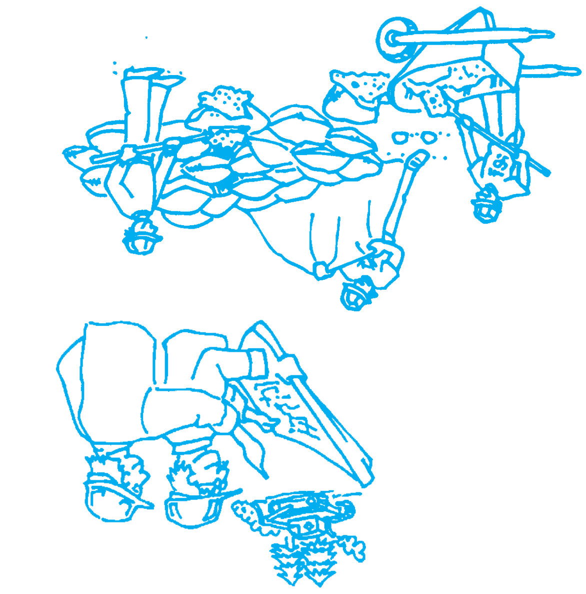
In accordance with applicable federal and state law, the Cities and County of Riverside have adopted ordinances for stormwater management and discharge control that **prohibit** the discharge of pollutants into the storm drain system or local surface water. This includes discharges from construction sites containing sediment, concrete, mortar, paint, solvents, lubricants, vehicle fluids, fuel, pesticides, and construction debris.

PLEASE NOTE: The Federal, State and local regulations strictly prohibit the discharge of sediment and pollutants into the streets, the storm drain system or waterways. As an owner, operator or supervisor of a construction site, you may be held financially responsible for any environmental damage caused by your subcontractors or employees.

Stormwater Pollution from Construction Activities

The two most common sources of stormwater pollution problems associated with construction activities are ***erosion*** and ***sedimentation***. Failure to maintain adequate erosion and sediment controls at construction sites often results in sediment discharges into the storm drain system, creating multiple problems once it enters local waterways.

Construction vehicles and heavy equipment can also track significant amounts of mud and sediment onto adjacent streets. Additionally, wind may transport construction materials and wastes into streets storm drains, or directly into our local waterways.



What Should You Do?

Advance Planning to Prevent Pollution

- ❑ Remove existing vegetation only as needed.
- ❑ Schedule excavation, grading, and paving operations for dry weather periods, if possible.
- ❑ Designate a specific area of the construction site, well away from storm drain inlets or watercourses, for material storage and equipment maintenance.
- ❑ Develop and implement an effective combination of erosion and sediment controls for the construction site.
- ❑ Practice source reduction by ordering only the amount of materials that are needed to finish the project.
- ❑ Educate your employees and subcontractors about stormwater management requirements and their pollution prevention responsibilities.
- ❑ Control the amount of surface runoff at the construction site by impeding internally generated flows and using berms or drainage ditches to direct incoming offsite flows to go around the site. ***Note:*** *Consult local drainage policies for more information.*

Best Management Practices

The following Best Management Practices (BMPs) can significantly reduce pollutant discharges from your construction site. Compliance with stormwater regulations can be as simple as minimizing stormwater contact with potential pollutants by providing covers and secondary containment for construction materials, designating areas away from storm drain systems for storing equipment and materials and implementing good housekeeping practices at the construction site.

- ❑ Protect all storm drain inlets and streams located near the construction site to prevent sediment-laden water from entering the storm drain system.
- ❑ Limit access to and from the site. Stabilize construction entrances/exits to minimize the track out of dirt and mud onto adjacent streets. Conduct frequent street sweeping.
- ❑ Protect stockpiles and construction materials from winds and rain by storing them under a roof, secured impermeable tarp or plastic sheeting.
- ❑ Avoid storing or stockpiling materials near storm drain inlets, gullies or streams.
- ❑ Phase grading operations to limit disturbed areas and duration of exposure.
- ❑ Perform major maintenance and repairs of vehicles and equipment offsite.
- ❑ Wash out concrete mixers only in designated washout areas at the construction site.
- ❑ Set-up and operate small concrete mixers on tarps or heavy plastic drop cloths.
- ❑ Keep construction sites clean by removing trash, debris, wastes, etc. on a regular basis.
- ❑ Clean-up spills immediately using dry clean-up methods (e.g., absorbent materials such as cat litter, sand or rags for liquid spills; sweeping for dry spills such as cement, mortar or fertilizer) and by removing the contaminated soil from spills on dirt areas. .
- ❑ Prevent erosion by implementing any or a combination of soil stabilization practices such as mulching, surface roughening, permanent or temporary seeding.
- ❑ Maintain all vehicles and equipment in good working condition. Inspect frequently for leaks, and repair promptly.
- ❑ Practice proper waste disposal. Many construction materials and wastes, including solvents, water-based paint, vehicle fluids, broken asphalt and concrete, wood, and cleared vegetation can be recycled. Materials that cannot be recycled must be taken to an appropriate landfill or disposed of as hazardous waste.
- ❑ Cover open dumpsters with secured tarps or plastic sheeting. Never clean out a dumpster by washing it down on the construction site.
- ❑ Arrange for an adequate debris disposal schedule to insure that dumpsters do not overflow.

General Construction Activities Stormwater Permit

(Construction Activities General Permit)

The State Water Resources Control Board (SWRCB) adopted a new Construction Activities General Permit (WQ Order No. 99-08DWQ) on August 19, 1999, superseding the now expired SWRCB statewide General Permit (WQ Order No. 92-08DWQ). This permit is administered and enforced by the SWRCB and the local Regional Water Quality Control Boards (RWQCB). The updated Construction Activities General Permit establishes a number of new stormwater management requirements for construction site operator.

NOTE: *Some construction activies stormwater permits are issued on a regional basis. Consult your local RWQCB to find out if your project requires coverage under any of these permits.*

Frequently Asked Questions:

Does my construction site require coverage under the Construction Activities General Permit?

Yes, if construction activity results in the disturbance of five or more acres of total land area or is part of a common plan of development that results in the disturbance of five or more acres.

How do I obtain coverage under the Construction Activities General Permit?

Obtain the permit package and submit the completed Notice of Intent (NOI) form to the SWRCB prior to grading or disturbing soil at the construction site. For ongoing construction activity involving a change of ownership, the new owner must submit a new NOI within 30 days of the date of change of ownership. The completed NOI along with the required fee should be mailed to the SWRCB.

What must I do to comply with the requirements of the Construction Activities General Permit?

- ● Implement BMPs for non-stormwater discharges year-round.
- ● Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) prior to commencing construction activities.
- ● Keep a copy of the SWPPP at the construction site for the entire duration of the project.
- ● Calculate the anticipated stormwater run-off.
- ● Implement an effective combination of erosion and sediment control on all soil disturbed areas.
- ● Conduct site inspections prior to anticipated storm events, every 24-hours during extended storm events, and after actual storm event.
- ● Perform repair and maintenance of BMPs as soon as possible after storm events depending upon worker safety.
- ● Update the SWPPP as needed, to manage pollutants or reflect changes in site conditions.
- ● Include description of post construction BMPs at the construction site, including parties responsible for long-term maintenance.

NOTE: *Please refer to the Construction Activities General Permit for detailed information. You may contact the SWRCB, your local RWQCB, or visit the SWRCB website at www.swrcb.ca.gov/stormwtr/ to obtain a State Construction Activities Stormwater General Permit packet.*

How long is this Construction Activities General Permit in effect?

The Permit coverage stays in effect untilyou submit a Notice of Termination (NOT) to the SWRCB. For the purpose of submitting a NOT, all soil disturbing activities have to be completed and one of the three following criteria has to be met:

1. Change of ownership;
2. A uniform vegetative cover with 70 percent coverage has been established; or,
3. Equivalent stabilization measures such as the use of reinforced channel liners, soil cement, fiber matrices, geotextiles, etc., have been employed.

Attachment D
Infiltration Report

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

November 30, 2017

Project No. 11805.001

To: Bridge Development Partners
1334 Parkview Avenue, Suite 310
Manhattan Beach, California 90266

Attention: Mr. Tom Ashcraft

Subject: Geotechnical Exploration and Infiltration Testing for the Proposed Commercial Development, North and South of Vineyard Avenue and West of Maple Avenue, Rialto Area of Unincorporated San Bernardino County, California

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) has conducted geotechnical exploration and infiltration testing for the proposed development at Vineyard Avenue on the west of side of Maple Avenue, in the Rialto area of unincorporated San Bernardino County, California. The site is bounded on the north by single-family residences, east by Maple Avenue, south by a vacant field, and west by both industrial properties and a vacant field. The purpose of our study has been to review the geotechnical conditions at the site and to identify significant geotechnical constraints to site development based on existing data. In addition to reports, maps, and aerial photographs available in our in-house library, we have reviewed the Conceptual Site Plan Scheme 8 prepared by Herdman Architecture and Design, not dated, and the Geotechnical Investigation Report by CHJ, Inc., dated April 19, 2004, provided to us by you, and comment on aspects of these references. We have also conducted infiltration testing for use in design of infiltration facilities for the proposed development at the proposed locations provided to us by you.

10532 Acacia Street, Suite B-6 ▪ Rancho Cucamonga, CA 91730-5455
909.484.2205 ▪ 909.484.2170 Fax

Our work has included the following:

- We reviewed previous geotechnical reports as well as geologic reports and maps relevant to the site and available from our in-house library. We also reviewed historic aerial photographs of the site dating back to 1938.

- Visited the site to observe existing surface conditions.

- Coordinated with Underground Service Alert (USA) prior to excavating borings so that utility companies could mark public utilities onsite.

- Conducted well permeameter tests within three borings (LB-1 through LB-3) to evaluate general infiltration rates of the subsurface soils at the depths and locations tested. The well permeameter tests were conducted based on the USBR 7300-89 method and in general accordance with San Bernardino County guidelines. The tests were conducted at depths ranging from approximately 6 to 10 feet (bgs) to estimate the infiltration rate for use of the proposed infiltration facilities. We used water from on-site faucets to provide water for the tests.

- Evaluated the collected data.

- Prepared this report to present the results of our geotechnical review and infiltration testing.

Site Conditions and Proposed Development

Based on our correspondence and the documents provided to us by you, the site of proposed development at Vineyard Avenue and west of Maple Avenue will consist of an approximately 392,500-square-foot commercial building, drainage, utility, hardscape, parking, and associated improvements in the Rialto area of unincorporated San Bernardino County, California.

Review of historic aerial photographs dating show in 1938 the southern portion of the site being used as an orchard with the northern portion being a vacant dirt lot. By 1959, the orchards had been removed and Vineyard Avenue had been constructed as what appears to be a dirt road traversing east-west across the center of the site, with the rest of the property being undeveloped. In 1980, aerial photographs show a single-family ranch-style residence in the southeast portion of the site that is still present today. Aerial photographs from 2005 show stockpiles in the central portion of the site just north of

Vineyard Avenue, which remain present today. The remainder of the site appears to have been a vacant dirt lot since at least 1959.

The rest of the parcel is bounded by Maple Avenue to the east, single-family homes to the north, a vacant field to the south, and both industrial properties and vacant fields to the west (see Site Location Map, Figure 1). The soil exposed at the surface is generally sand, gravel and cobbles. Vegetation generally consists of grasses; and shrubs and trees on the residential property. The site generally slopes to the southeast with approximately 25 feet of elevation difference.

Based on discussions and conceptual site plans from you, we understand infiltration of storm water will be required for the development and that the location of these facilities are to be located primarily in the southeast area of the site.

Previous Geotechnical Reports

CHJ Inc. (2004) conducted a geotechnical investigation of the site with the exception of the southeastern quadrant where the current residence is. The investigation included the excavation, logging, and sampling of six exploratory trenches. CHJ Inc. concluded that the site was geotechnically feasible to develop provided the recommendations presented in their report were implemented.

Earth Units

The site is mapped as being underlain with young alluvial fan deposits from the late Holocene (Morton et al., 2006). These alluvial valley deposits are described as unconsolidated to slightly consolidated coarse-grained sand to bouldery alluvial-fan deposits of the Lytle Creek fan. CHJ encountered boulders up to 24 inches in diameter within their test pits. The onsite soils are typically dense to very dense.

Based on our limited subsurface exploration, we encountered alluvial soil deposits consisting of gravelly sand and cobbles. CHJ Inc.'s report described the subsurface soils found in their test pits as dense to very dense gravelly sand with cobbles and boulders to their maximum depth explored. CHJ Inc. also encountered up to 2 feet of artificial fill in two of their test pits (Test Pit No. 5 and 6) located in the central and southwestern areas of the site.

The native subsurface soils encountered in our excavations consisted mainly of sand, gravel, and cobbles to their maximum depth explored. These excavations were located

on the southern edge of existing residential property at the locations of the proposed infiltration facilities (Figure 2, Test Location Map). These excavations were primarily for use in evaluating the subsurface soils for infiltration and cover a very limited area of the site.

Laboratory Testing

Results of lab testing done by CHJ Inc. indicated on-site soils to be mildly corrosive to ferrous metals, and PH values of the soils were found to be alkaline. We conducted corrosivity lab testing on samples from our borings and the results suggested mildly to moderately corrosive soils.

Infiltration Testing

We conducted infiltration testing in the areas of the proposed infiltration facilities for the proposed development. Our infiltration depths ranged from approximately 6 to 10 feet below the existing ground surface, and were based on the anticipated depth of the facilities, as well as on evaluation of the suitability of the soil encountered during drilling.

Three well permeameter tests (LB-1 through LB-3) were conducted to estimate the infiltration rate at specific locations of the site. The well permeameter tests were conducted inside the borings with test water levels ranging from 2.5 to 6.0 feet below ground surface for LB-1, 4.2 to 10.0 feet for LB-2, and 4.9 to 10.0 feet for LB-3.

Well permeameter tests are useful for field measurements of soil infiltration rates, and are suited for testing when the design depth of the basin or chamber is deeper than current existing grades. This is a clean-water, small-scale test, and as such, correction factors need to be applied. The test consists of excavating a boring to the depth of the test (or deeper if it is partially backfilled with soil and a bentonite plug with a thin soil covering is placed just below the design test elevation). A layer of clean sand is placed in the boring bottom to support temporary perforated well casing pipe and a float valve. In addition, coarse sand is poured around the outside of the well casing within the test zone to prevent the boring from caving/collapsing or eroding when water is added. The float valve, lowered into the boring inside the casing, adds water stored in barrels at the top of the hole to the boring as water infiltrates into the soil, while maintaining a relatively constant water head in the boring. The test was conducted based on the USBR 7300-89 test method.

Small-scale infiltration test rates were measured at the 3 well permeameter locations (LB-1 through LB-3). At location LB-1, the small-scale infiltration test rate was estimated to be 2.7 inches per hour, and was tested within sandy gravel alluvial soils. At location LB-2, the small-scale infiltration test rate was estimated to be 8.0 inches per hour, and was tested within sandy gravel alluvial soils. At location LB-3, the small-scale infiltration test rate was estimated to be 10.0 inches per hour, and was tested within sandy gravel alluvial soils. These are raw values, before applying an appropriate factor of safety or correction factor. Based on these results, the onsite soils at the depths tested resulted are anticipated to have high infiltration rates. Design rates, correction factors, and other infiltration facility recommendations are discussed below.

Groundwater

Using the California Department of Water Resources Water Data Library (2017), a well located approximately ½ mile to the east (#341412N1174003W001) showed depth to groundwater in 2011 to be on the order of 394 feet which. We found the most current depth to groundwater to be on the order of 420 feet taken from the same well in September of 2017. Shallow groundwater is not anticipated.

Seismic Hazards

The proposed development is not within a currently designated State established Earthquake Fault Zone for active surface faulting, and San Bernardino County (2010) has not identified any faults or fault zones through the site. No known active faults have been mapped onsite nor trending toward the site. The nearest known active faults are San Jacinto-San Bernardino Fault, located about 0.7 mile to the northeast, Cucamonga Fault, located about 3.4 miles to the northwest, and the San Andreas Fault, located about 6.7 miles to the northeast. However, as with the majority of southern California, the site is expected to be prone to strong seismic shaking.

San Bernardino County (2010) has this area mapped outside of any liquefaction or landslide hazard areas.

Seismic Design Parameters

We have provided seismic design parameters based on the UBC Seismic Map. In order to reduce the effects of ground shaking produced by regional seismic events, seismic design should be performed in accordance with the current 2016 CBC. The CBC

seismic design parameters listed in Table 1 below should be considered for the seismic analysis of the subject site.

Table 1 - 2016 CBC Seismic Design Parameters

Description (2016 CBC reference)	Design Value
Site Longitude (decimal degrees)	-117.4065
Site Latitude (decimal degrees)	34.1410
Site Class Definition (ASCE 7 Table 20.3-1)	D
Mapped Spectral Response Acceleration at 0.2s Period, $\mathbf{S_s}$ (Figure 1613.3.1(1))	1.946
Mapped Spectral Response Acceleration at 1s Period, $\mathbf{S_1}$ (Figure 1613.3.1(2))	0.867
Short Period Site Coefficient at 0.2s Period, $\mathbf{F_a}$ (Table 1613.3.3(1))	1.0
Long Period Site Coefficient at 1s Period, $\mathbf{F_v}$ (Table 1613.3.3(2)	1.5
Adjusted Spectral Response Acceleration at 0.2s Period, $\mathbf{S_{MS}}$ (Eq. 16-37)	1.946
Adjusted Spectral Response Acceleration at 1s Period, $\mathbf{S_{M1}}$ (Eq. 16-38)	1.300
Design Spectral Response Acceleration at 0.2s Period, $\mathbf{S_{DS}}$ (Eq. 16-39)	1.297
Design Spectral Response Acceleration at 1s Period, $\mathbf{S_{D1}}$ (Eq. 16-40)	0.867

Conclusions and Recommendations

Based on our review of published reports and maps, review of the conceptual site plan, and review of the data presented in CHJ Inc.'s geotechnical report, development of the site is feasible from a geotechnical viewpoint. Liquefaction and seismic settlement are not considered constraints to the project.

Specific recommendations for construction of the development of the site were provided by CHJ Inc. (2004). Those recommendations should be implemented during construction of the site. Additionally, seismic design parameters should be updated to be in accordance with the 2016 California Building Code.

Additional laboratory testing and geotechnical review of the development should be conducted as the project proceeds.

Infiltration Recommendations

Infiltration Rate:

For onsite undisturbed alluvial soils that are granular with a low fines content, we recommend an unfactored (small-scale) incremental infiltration rate of 4 inches per hour. These measured rates are applicable at the specific locations and depths tested. Infiltration rates are anticipated to vary significantly at various depths. It should be confirmed during infiltration facility excavation that the excavations penetrate into undisturbed granular soils.

The incremental infiltration rate is defined as the incremental flow rate of water infiltrated, divided by the surface area of the infiltration interface. We recommend that a correction factor/safety factor be applied to the infiltration rate in conformance with San Bernardino County guidelines, since monitoring of actual facility performance has shown that actual infiltration rates are lower than for small-scale tests. The small-scale infiltration rate should be divided by a correction factor of at least 2 for buried chambers and at least 2.5 for open basins, but the correction/safety factor may be higher based on project-specific aspects.

If dry wells are considered, we suggest that they be planned with clusters of dry wells per general location based on the presumed-conservative infiltration rate. After the first dry well is constructed in each general location, it should be tested for infiltration. If the tested infiltration rates are sufficient to reduce the number of dry wells at that location, some or all of the remaining planned dry wells may be omitted, as appropriate, based on review of the test data. Due to the very granular nature of the soil at this site, we anticipate that significant caving may be encountered during drilling of dry wells. In addition, boulders will be encountered.

The infiltration rates described herein are for a clean, unsilted infiltration surface in native, sandy alluvial soil. These values will be reduced over time if silting of the basin or chamber occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be significantly reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of the soil particles, particle shape, fines content, clay content, and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates. Infiltration is not suitable in compacted fill.

It should be noted that during periods of prolonged precipitation, the underlying soils tend to become saturated to greater and greater depths/extents. Therefore, infiltration rates tend to decrease with prolonged rainfall. It is difficult to extrapolate longer-term, full-scale infiltration rates from small-scale tests, and as such, this is a significant source of uncertainty in infiltration rates.

Additional Review and Evaluation:

Infiltration rates are anticipated to vary significantly based on the location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. Leighton should review infiltration plans, including locations and depths of proposed facilities. Further testing may be required depending on the design of infiltration facilities, particularly considering their type, depth and location.

General Design Considerations:

The periodic flow of water carrying sediments in the basin or chamber, plus the introduction of wind-blown sediments and sediments from erosion of the basin side walls, can eventually cause the bottom of the basin or chamber to accumulate a layer of silt, which has the potential of significantly reducing the overall infiltration rate of the basin or chamber. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within storm water, especially during construction of the project and prior to achieving a mature landscape on site. As it is typically very difficult to remove silt from buried infiltration facilities, we recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the buried infiltration facility.

As infiltrating water can seep within the soil strata nearly horizontally for long distances, it is important to consider the impact that infiltration facilities can have on nearby subterranean structures, such as basement walls or open excavations, whether onsite or offsite, and whether existing or planned. Any such nearby features should be identified and evaluated as to whether infiltrating water can impact these. Such features should be brought to Leighton's attention as they are identified.

Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process.

Infiltration facilities should be constructed with spillways or other appropriate means that would cause overfilling to not be a concern to the facility or nearby improvements.

For buried chambers that allow interior standing water, control/access manhole covers should not contain holes or should be screened to prevent mosquitos from entering the cambers.

Additional Design Considerations (Particularly for Open Basins):
If open basins are planned, the soils that will be exposed at the bottom of the basin are critical to the basin's success.

In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration. In open basins with compacted or silty bottoms, this could be problematic, in that, even if the basin had already infiltrated significant amounts of storm water, the lower several inches or feet of water could remain in the basin for an extended period of time, creating a prolonged open-water safety concern and potential for mosquitos. In a buried/covered infiltration chamber, these conditions would be of less concern.

Recreation areas should not be constructed within basin bottoms or below the spillway level.

For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

Estimating infiltration rates, especially based on small-scale testing, is inexact and indefinite, and often involves known and unknown soil complexities, potentially resulting in a condition where actual infiltration rates of the completed facility are significantly less than design rates. In open infiltration basins, this could create nuisance water in the basin. As such, enhancements may be needed after completion of the basin if prolonged or frequent standing water is experienced. A potential basin enhancement, if needed, might be to install infiltration trenches or dry wells in the basin bottom to capture and infiltrate low flows and to help speed infiltration during/after storms; specific recommendations, such as minimum trench/dry well depth, would be developed based on conditions observed. Such a contingency should be anticipated for open basins.

Construction Considerations:

We recommend that Leighton evaluate the infiltration facility excavations, to confirm that granular, undisturbed alluvium is exposed in the bottoms and sides. Additional excavation or evaluation may be required if silty or clayey soils are exposed.

It is critical to infiltration that the basin or chamber bottom not be allowed to be compacted during construction or maintenance; rubber-tired equipment and vehicles should not be allowed to operate on the bottom. We recommend that at least the bottom 3 feet of the basins or chambers be excavated with an excavator or similar.

If fill material is needed to be placed in the basin, such as due to removal of uncontrolled artificial fill, the fill material should be select and free-draining sand, and should be observed and evaluated by Leighton.

Maintenance Considerations:

The infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented as/when needed. Things to check for include proper upkeep, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained per manufacturers' recommendations. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed occasionally as part of maintenance.

We appreciate the opportunity to provide our services for this review. If you have any questions, please contact this office at your convenience.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

Philip A. Buchiarelli, CEG 1715
Principal Geologist

Jason D. Hertzberg, GE 2711
Principal Engineer

BER/MM/JDH/PB/rsm

Attachments: References
Figure 1 - Site Location Map
Figure 2 - Test Location Map
Boring Logs and Infiltration Test Summary
Lab Results
Seismic Parameters

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Project: 11805.001	Eng/Geol: JDH/PB
Scale: 1 " = 2,000 '	Date: November 2017

Base Map: Bing Maps 2017
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

SITE LOCATION MAP

Geotechnical Due Diligence Review
Proposed Commercial Development
Vineyard Avenue West of Maple Avenue
Unincorporated San Bernardino County, California

Figure 1

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Map Saved as P:\Drafting\11805\001\Maps\11805-001_F01_SLM_2017-10-24.mxd on 10/24/2017 4:08:18 PM

Project: 11805.001	Eng/Geol: JDH/PB
Scale: 1 " = 200 '	Date: November 2017

Base Map: Google Earth, 2017
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

TEST LOCATION MAP

Geotechnical Due Diligence Review
Proposed Commercial Development
Vineyard Avenue West of Maple Avenue
Unincorporated San Bernardino County, California

Figure 2

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GEOTECHNICAL BORING LOG LB-1

Project No.	11805.001	**Date Drilled**	9-27-17
Project	Bridge Development Rialto	**Logged By**	B. Rodriguez
Drilling Co.	2R	**Hole Diameter**	10"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1517'
Location	see Figure 2, Test Location Map	**Sampled By**	B. Rodriguez

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								@surface: sand, gravel, & cobbles **Quaternary Alluvium (Qal)** note: gravel and cobbles in spoils	
1515				R-1	32 50/6				@2.5' fractured cobble, 2.5-inch diameter, very dense note: gravel and cobbles in spoils	
	5			R-2	30 24 28				@5' NO RECOVERY, dense note: gravel and cobbles in spoils	
1510										
	10			R-3	50/4				@10' NO RECOVERY, very dense note: gravel and cobbles in spoils	
1505										
	15			R-4	50/4				@15' NO RECOVERY, very dense note: sand and gravel in spoils	
1500										
	20			R-5	50/5				@20' fractured cobble, 2.5-inch diameter, very dense	
1495										
	25			S-6	21 50/5			SW	@25' SANDY GRAVEL (GW), very dense, light brown, moist, coarse sand, angular, nonplastic	
1490									**Total depth 26.5 feet** **No groundwater encountered when drilling** **Backfilled with soil cuttings on 9/29/17**	
	30									

The Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-2

Project No.	11805.001	**Date Drilled**	9-27-17
Project	Bridge Development Rialto	**Logged By**	B. Rodriguez
Drilling Co.	2R	**Hole Diameter**	10"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1517'
Location	see Figure 2, Test Location Map	**Sampled By**	B. Rodriguez

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
1515	0								@surface: gravel, sand, and cobbles **Quaternary Alluvium (Qal)**	
1510	5			R-1	50/3	117	1	GW	@8.5' SAND (SW) with silt and gravel, very dense, light brown, dry, coarse sand, subangular, nonplastic, trace fines, 2.5-inch fractured rock in shoe	SA, M
1505	10								**Total depth 10 feet** **No groundwater encountered when drilling** **Backfilled with soil cuttings on 9/29/17**	
1500	15									
1495	20									
1490	25									
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-3

Project No.	11805.001	**Date Drilled**	9-27-17
Project	Bridge Development Rialto	**Logged By**	B. Rodriguez
Drilling Co.	2R	**Hole Diameter**	10"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1517'
Location	see Figure 2, Test Location Map	**Sampled By**	B. Rodriguez

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
1515	0			B-1					@surface: gravel, sand, and cobbles **Quaternary Alluvium (Qal)**	MD, CR
1510	5			R-1	21 42 38	122	2	GW	@8.5' SANDY GRAVEL (GW), very dense, light brown, moist, coarse sand, subrounded, nonplastic, 1.5-inch average gravel	M
1505	10								**Total depth 10 feet** **No groundwater encountered when drilling** **Backfilled with soil cuttings on 9/29/17**	
1500	15									
1495	20									
1490	25									
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: Bridge Development Rialto 11805.001

Exploration #/Location: LB-1

Depth Boring drilled to (ft): 26.5

Tested by: BER

USCS Soil Type in test zone: GW

Weather (start to finish): sunny

Liquid Used/pH: Faucet Water

Measured boring diameter: 10 in. (5 Well Radius, "r")

Approx Depth to GW below GS: 100 ft

Well Prep: Drilled to 26.5 feet, caved to 6 feet, placed perforated 4-inch pipe with 1-inch pilot tube pipe

Initial estimated Depth to Water Surface (in.): 32.712

Average depth of water in well, "h" (in.): 39.288

approx. h/r: 7.9

Tu (Fig. 8): 97.3 ft

Tu>3h?: yes, OK

	ft	in.	Total (in.)	
Depth to Bot of well (or top of soil over Bentonite)	6. ft		72	
Pilot Tube stickup (+ is above ground)		3. in.	3	
Depth to top of float assembly from top of pilot tube		13. in	13	10 Depth below GS (in.)
Float Assembly ID	C			
Float assembly Extension length (in.)		30		

Flow Meter:

Meter ID: 28

Meter Unit: Gallons

0.05 gallons/pulse

Field Data / **Calculations**

Date	Time	Data from Flow Meter		Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
		Reading (cu-ft or gal)	Interval Pulse Count											from supply	from Δh	Total					
Start Date	Start time:	Gallons		ft	in.																
9/29/2017	8:25																				
9/29/17	8:25	1240.9		4.92					0	56.0	16.0										
9/29/17	8:40	1248.6		3.59				15	15	40.1	31.9	15.96	24	1779	-501	1278	85	5111	0.9	1.07	**5.67**
9/29/17	9:03	1258.8		2.95				23	38	32.4	39.6	7.68	36	2356	-241	2115	92	5518	0.9	0.93	**4.23**
9/29/17	9:17	1263.9		2.85				14	52	31.2	40.8	1.2	40	1178	-38	1140	81	4888	0.9	0.82	**3.36**
9/29/17	9:33	1269.3		2.79				16	68	30.5	41.5	0.72	41	1247	-23	1225	77	4593	0.9	0.75	**3.09**
9/29/17	9:49	1273.8		2.8				16	84	30.6	41.4	-0.12	41	1040	4	1043	65	3912	0.9	0.64	**2.61**
9/29/17	10:06	1278.7		2.85				17	101	31.2	40.8	-0.6	41	1132	19	1151	68	4061	0.9	0.69	**2.73**
9/29/17	10:40	1288.1		2.9				34	135	31.8	40.2	-0.6	41	2171	19	2190	64	3865	0.9	0.67	**2.64**
9/29/17	11:41	1306.8		2.9				61	196	31.8	40.2	0	40	4320	0	4320	71	4249	0.9	0.73	**2.92**
9/29/17	12:54	1329.5		2.95				73	269	32.4	39.6	-0.6	40	5244	19	5263	72	4325	0.9	0.77	**2.99**

template updated: 3/7/16

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: Bridge Development Rialto 11805.001

Exploration #/Location: LB-2
Depth Boring drilled to (ft): 10
Tested by: BER
USCS Soil Type in test zone: GW
Weather (start to finish): sunny
Liquid Used/pH: Faucet Water
Measured boring diameter: 10 in. — 5 Well Radius, "r"
Approx Depth to GW below GS: 100 ft
Well Prep: drilled to 10 feet, place perforated 3" pipe (with filter fabric) within auger and pulled out

Initial estimated Depth to Water Surface (in.): 58.772
Average depth of water in well, "h" (in.): 61.228
approx. h/r: 12.2
Tu (Fig. 8): 95.1 ft
Tu>3h?: yes, OK

	ft	in.	Total (in.)	
Depth to Bot of well (or top of soil over Bentonite)	10. ft		120	
Pilot Tube stickup (+ is above ground)		4.5 in.	4.5	
Depth to top of float assembly from top of pilot tube			0	-4.5 Depth below GS (in.)
Float Assembly ID				
Float assembly Extension length (in.)				

Flow Meter:
Meter ID: 50
Meter Unit: Gallons
0.05 gallons/pulse

Field Data | **Calculations**

Date	Time	Data from Flow Meter		Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
		Reading (cu-ft or gal)	Interval Pulse Count	ft	in.									from supply	from Δh	Total					
Start Date	Start time:	Gallons																			
9/29/2017	8:44																				
9/29/17	8:44			5.1					0	56.7	63.3										
9/29/17	8:57			3.9				13	13	42.3	77.7	14.4	71	0	-452	-452	-35	-2086	0.9	-0.12	**-0.84**
9/29/17	9:08			3.69				11	24	39.8	80.2	2.52	79	0	-79	-79	-7	-431	0.9	-0.02	**-0.16**
9/29/17	9:19			3.38				11	35	36.1	83.9	3.72	82	0	-117	-117	-11	-637	0.9	-0.03	**-0.22**
9/29/17	9:37			5.92				18	53	66.5	53.5	-30.48	69	0	956	956	53	3188	0.9	0.39	**1.31**
9/29/17	9:51			6.11				14	67	68.8	51.2	-2.28	52	0	72	72	5	307	0.9	0.04	**0.16**
9/29/17	9:58			6.2				7	74	69.9	50.1	-1.08	51	0	34	34	5	290	0.9	0.04	**0.16**
9/29/17	10:03	1813.6		4.08				5	79	44.5	75.5	25.44	63	0	-798	-798	-160	-9580	0.9	-0.57	**-4.30**
9/29/17	10:08	1830.8		3.4				5	84	36.3	83.7	8.16	80	3973	-256	3717	743	44606	0.9	2.36	**15.94**
9/29/17	10:17	1848.8		4.55				9	93	50.1	69.9	-13.8	77	4158	433	4591	510	30607	0.9	2.29	**11.33**
9/29/17	10:34	1880.5		4.38			2m57s/5gal	17	110	48.1	71.9	2.04	71	7323	-64	7259	427	25619	0.9	1.75	**10.24**
9/29/17	11:04	1938.9		4.3				30	140	47.1	72.9	0.96	72	13490	-30	13460	449	26921	0.9	1.81	**10.54**
9/29/17	11:24	1959.2		6.3			6m16s/5gal	20	160	71.1	48.9	-24	61	4689	753	5442	272	16327	0.9	2.28	**7.56**
9/29/17	12:01	2012.9		4.55				37	197	50.1	69.9	21	59	12405	-659	11746	317	19047	0.9	1.29	**9.03**
9/29/17	12:20	2031.8		6.35				19	216	71.7	48.3	-21.6	59	4366	678	5044	265	15928	0.9	2.25	**7.59**
9/29/17	12:52	2073.5		5.55				32	248	62.1	57.9	9.6	53	9633	-301	9331	292	17496	0.9	1.64	**9.23**

template updated: 3/7/16

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: Bridge Development Rialto 11805.001

Exploration #/Location: LB-3

Depth Boring drilled to (ft): 10

Tested by: BER

USCS Soil Type in test zone: GW

Weather (start to finish): sunny

Liquid Used/pH: Faucet Water

Measured boring diameter: 10 in. 5 Well Radius, "r"

Approx Depth to GW below GS: 100 ft

Well Prep: drilled to 10 feet, place perforated 3" pipe (with filter fabric) within auger and pulled out

Initial estimated Depth to Water Surface (in.): 92.743

Average depth of water in well, "h" (in.): 27.257

approx. h/r: 5.5

Tu (Fig. 8): 92.3 ft

Tu>3h?: yes, OK

	ft	in.	Total (in.)	
Depth to Bot of well (or top of soil over Bentonite)	10. ft		120	
Pilot Tube stickup (+ is above ground)		7. in.	7	
Depth to top of float assembly from top of pilot tube			0	-7 Depth below GS (in.)
Float Assembly ID				
Float assembly Extension length (in.)				

Flow Meter:

Meter ID:

Meter Unit: Gallons

0.05 gallons/pulse

Field Data / **Calculations**

Date	Time	Data from Flow Meter		Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
		Reading (cu-ft or gal)	Interval Pulse Count	ft	in.									from supply	from Δh	Total					
Start Date	Start time:	Gallons																			
9/29/2017	8:42																				
9/29/17	8:42			5.2					0	55.4	64.6										
9/29/17	9:00			4.55				18	18	47.6	72.4	7.8	69	0	-245	-245	-14	-816	0.9	-0.05	**-0.34**
9/29/17	9:11			3.73				11	29	37.8	82.2	9.84	77	0	-309	-309	-28	-1684	0.9	-0.09	**-0.62**
9/29/17	9:21			3.13				10	39	30.6	89.4	7.2	86	0	-226	-226	-23	-1356	0.9	-0.06	**-0.45**
9/29/17	9:35			4				14	53	41.0	79.0	-10.44	84	0	328	328	23	1404	0.9	0.09	**0.48**
9/29/17	9:51			3.9				16	69	39.8	80.2	1.2	80	0	-38	-38	-2	-141	0.9	-0.01	**-0.05**
9/29/17	10:04			5.03				13	82	53.4	66.6	-13.56	73	0	426	426	33	1964	0.9	0.16	**0.76**
9/29/17	10:18			5.05				14	96	53.6	66.4	-0.24	67	0	8	8	1	32	0.9	0.00	**0.01**
9/29/17	10:28			5.5			2m43s/5gal	10	106	59.0	61.0	-5.4	64	0	169	169	17	1017	0.9	0.09	**0.45**
9/29/17	10:22			5.5				-6	100	59.0	61.0	0	61	0	0	0	0	0	0.9	0.00	**0.00**
9/29/17	11:35			5.5			2m37s/5gal	73	173	59.0	61.0	0	61	0	0	0	0	0	0.9	0.00	**0.00**
9/29/17	12:22			5.5			2m32s/5gal	47	220	59.0	61.0	0	61	0	0	0	0	0	0.9	0.00	**0.00**
9/29/17	12:32			5.7			turned off	10	230	61.4	58.6	-2.4	60	0	75	75	8	452	0.9	0.04	**0.21**
9/29/17	12:35			8.75				3	233	98.0	22.0	-36.6	40	0	1149	1149	383	22970	0.9	13.23	**15.75**
9/29/17	12:36			9.33				1	234	105.0	15.0	-6.96	19	0	218	218	218	13104	0.9	10.66	**18.29**
9/29/17	12:37			9.49				1	235	106.9	13.1	-1.92	14	0	60	60	60	3615	0.9	3.24	**6.40**
9/29/17	12:38			9.6				1	236	108.2	11.8	-1.32	12	0	41	41	41	2485	0.9	2.54	**4.87**
9/29/17	12:39			9.69				1	237	109.3	10.7	-1.08	11	0	34	34	34	2033	0.9	2.34	**4.34**
9/29/17	12:42			9.87				3	240	111.4	8.6	-2.16	10	0	68	68	23	1356	0.9	2.18	**3.28**
9/29/17	12:44			9.96				2	242	112.5	7.5	-1.08	8	0	34	34	17	1017	0.9	1.86	**2.84**
9/29/17	12:46			10.01				2	244	113.1	6.9	-0.6	7	0	19	19	9	565	0.9	1.11	**1.71**
9/29/17	12:51			10.15				5	249	114.8	5.2	-1.68	6	0	53	53	11	633	0.9	1.89	**2.17**

template updated: 3/7/16

Open Pit Percolation to Infiltration Calculation Sheet

Based on San Bernardino County WQMP Appendix D, dated May 19, 2011

Project Name: Bridge Rialto Due Dilligence
Project No.: 11805.001
Prepared by: B. Rodriguez
Date Prepared: 11/3/2017

Test Hole ID: LB-3
Test Hole Width: 9 inches
Test Hole Length: 9 inches
Test Hole Depth: 120 inches
Equivalent Radius 5.0777 inches

Start Time	Stop Time	Δt-Time Interval (min.)	D_0-Initial Depth (in.)	Initial Measure from fixed point (in.)	Final Measure from fixed	Initial Relative Depth Increase	Final Relative Depth	D_f-Initial Depth (in.)	ΔD-Change in Water Level (in.)	H_0 (in.)	H_f (in.)	ΔH (in.)	H_{avg} (in.)	I_t (in./hr)	Total Surface Area (ft^2)	Water Volume Change (ft^3)	Water Volume Change (gallons)	Percolation Rate ($gal/ft^2/day$)	Water Volume Change (in^3)	Total Surface Area (in^2)	I_t (in./hr)
12:32	12:35	3	108.4	68.4	105.0	0.0	36.6	145.0	36.6	11.6	-25.0	36.6	-6.7	13.5	30.6	1.72	12.83	201.6	2964.6	4401.0	13.47
12:35	12:36	1	145.0	105.0	112.0	36.6	43.6	151.9	7.0	-25.0	-31.9	7.0	-28.5	7.7	30.6	0.33	2.44	115.0	563.76	4401.0	7.69
12:36	12:37	1	151.9	112.0	113.9	43.6	45.5	153.8	1.9	-31.9	-33.8	1.9	-32.9	2.1	30.6	0.09	0.66	31.1	152.28	4401.0	2.08
12:37	12:38	1	153.8	113.9	115.2	45.5	46.8	155.1	1.3	-33.8	-35.1	1.3	-34.5	1.4	30.6	0.06	0.46	21.5	105.3	4401.0	1.44
12:38	12:39	1	155.1	115.2	116.3	46.8	47.9	156.2	1.1	-35.1	-36.2	1.1	-35.7	1.2	30.6	0.05	0.38	17.8	87.48	4401.0	1.19
12:39	12:42	3	156.2	116.3	118.4	47.9	50.0	158.3	2.1	-36.2	-38.3	2.1	-37.3	0.8	30.6	0.10	0.75	11.8	173.34	4401.0	0.79
12:42	12:44	2	158.3	118.4	119.5	50.0	51.1	159.5	1.1	-38.3	-39.5	1.1	-38.9	0.6	30.6	0.05	0.39	9.3	90.72	4401.0	0.62
12:44	12:46	2	159.5	119.5	120.1	51.1	51.7	160.1	0.6	-39.5	-40.1	0.6	-39.8	0.3	30.6	0.03	0.22	5.1	50.22	4401.0	0.34
12:46	12:51	5	160.1	120.1	121.8	51.7	53.4	161.8	1.7	-40.1	-41.8	1.7	-40.9	0.4	30.6	0.08	0.60	5.6	137.7	4401.0	0.38
						-68.4	-68.4	0.0	0.0	120.0	120.0	0.0	120.0	#####	30.6	0.00	0.00	#DIV/0!	0	4401.0	#DIV/0!
						-68.4	-68.4	0.0	0.0	120.0	120.0	0.0	120.0	#####	30.6	0.00	0.00	#DIV/0!	0	4401.0	#DIV/0!

Leighton

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D 6913

Project Name:	Bridge Development/Rialto	Tested By:	R. Manning	Date:	10/16/17
Project No.:	11805.001	Checked By:	J. Ward	Date:	10/20/17
Boring No.:	LB-2	Depth (feet):	8.5		
Sample No.:	R-1				
Soil Identification:	Light yellowish brown silty sand with gravel (SM)g				

		Moisture Content of Total Air - Dry Soil	
Container No.:	50	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	369.6	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	62.5	Wt. of Container No._____ (g)	1.0
Dry Wt. of Soil (g)	307.1	Moisture Content (%)	0.0

After Wet Sieve	Container No.	50
	Wt. of Dry Soil + Container (g)	330.3
	Wt. of Container (g)	62.5
	Dry Wt. of Soil Retained on # 200 Sieve (g)	267.8

U. S. Sieve Size (in.)	(mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
1 1/2"	37.5		
1"	25.0		
3/4"	19.0	0.0	100.0
1/2"	12.5	39.6	87.1
3/8"	9.5	64.5	79.0
#4	4.75	97.8	68.2
#8	2.36	125.5	59.1
#16	1.18	151.4	50.7
#30	0.600	178.4	41.9
#50	0.300	209.8	31.7
#100	0.150	241.6	21.3
#200	0.075	266.9	13.1
PAN			

GRAVEL: **32 %**

SAND: **55 %**

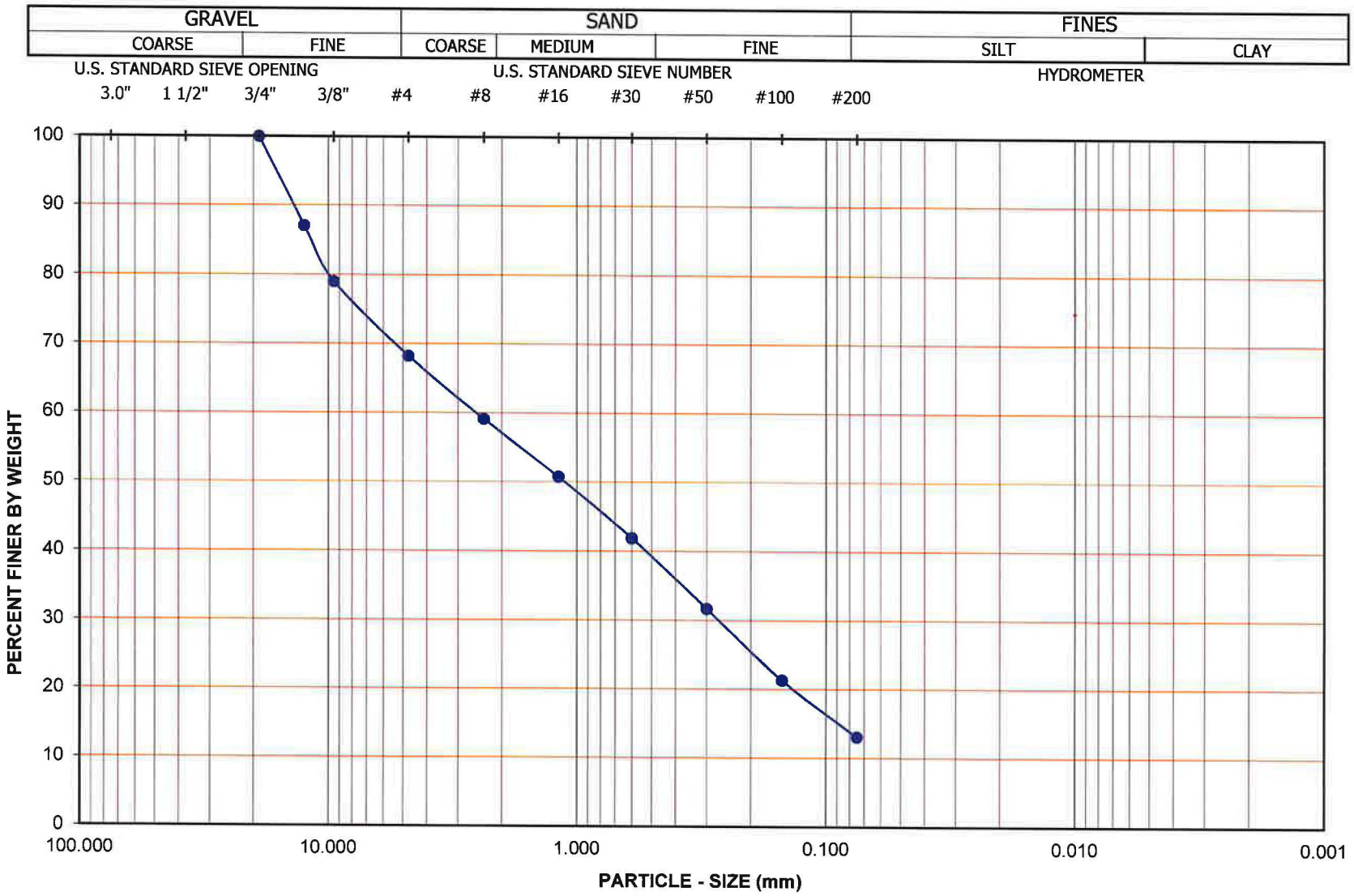
FINES: **13 %**

GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = _____

Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: _____



Project Name: Bridge Development/Rialto

Project No.: 11805.001

Boring No.: LB-2 Sample No.: R-1

Depth (feet): 8.5 Soil Type : (SM)g

Soil Identification: Light yellowish brown silty sand with gravel (SM)g

GR:SA:FI : (%) 32 : 55 : 13

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PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Oct-17

SA LB-2, R-1 @ 8.5

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Bridge Development/Rialto	Tested By:	R. Manning	Date:	10/09/17
Project No.:	11805.001	Input By:	J. Ward	Date:	10/20/17
Boring No.:	LB-3	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Dark olive gray poorly-graded sand with silt and gravel (SP-SM)g				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize material

Preparation Method:	X	Moist	
		Dry	
Compaction Method	X	Mechanical Ram	
		Manual Ram	

Scalp Fraction (%)	
#3/4	19.7
#3/8	
#4	

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft^3) 0.07450

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	7348	7587	7620			
Weight of Mold (g)	2660	2660	2660			
Net Weight of Soil (g)	4688	4927	4960			
Wet Weight of Soil + Cont. (g)	989.3	1045.6	1174.2			
Dry Weight of Soil + Cont. (g)	960.2	991.1	1087.0			
Weight of Container (g)	77.6	76.2	78.2			
Moisture Content (%)	3.30	5.96	8.64			
Wet Density (pcf)	138.7	145.8	146.8			
Dry Density (pcf)	134.3	137.6	135.1			

Maximum Dry Density (pcf) 137.5

Corrected Dry Density (pcf) 142.5

Optimum Moisture Content (%) 6.0

Corrected Moisture Content (%) 5.0

☐ **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

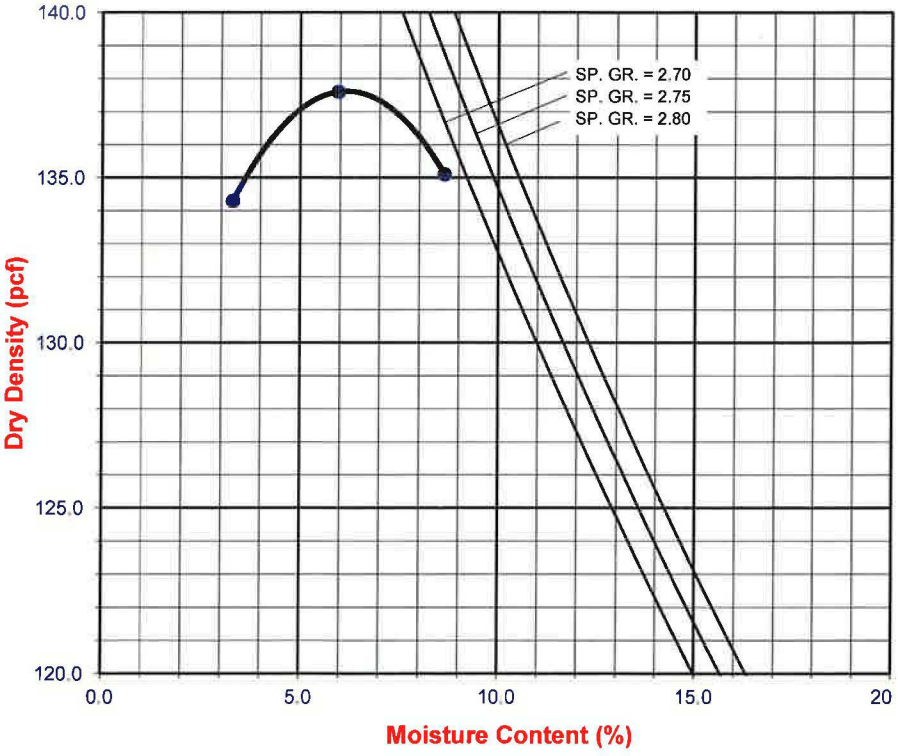
☒ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Bridge Development/Rialto Tested By : GB/ACS Date: 10/10/17

Project No. : 11805.001 Data Input By: J. Ward Date: 10/20/17

Boring No.	LB-3			
Sample No.	B-1			
Sample Depth (ft)	0-5			
Soil Identification:	Dark olive gray (SP-SM)g			
Wet Weight of Soil + Container (g)	132.98			
Dry Weight of Soil + Container (g)	132.77			
Weight of Container (g)	59.16			
Moisture Content (%)	0.29			
Weight of Soaked Soil (g)	100.22			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	92			
Crucible No.	16			
Furnace Temperature (°C)	860			
Time In / Time Out	11:20/12:05			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	25.0932			
Wt. of Crucible (g)	25.0915			
Wt. of Residue (g) (A)	0.0017			
PPM of Sulfate (A) x 41150	69.95			
PPM of Sulfate, Dry Weight Basis	**70**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	1.8			
PPM of Chloride (C -0.2) * 100 * 30 / B	320			
PPM of Chloride, Dry Wt. Basis	**321**			

pH TEST, DOT California Test 643

pH Value	**7.16**			
Temperature °C	20.6			

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SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name: Bridge Development/Rialto
Project No. : 11805.001
Boring No.: LB-3
Sample No. : B-1
Soil Identification:* Dark olive gray (SP-SM)g

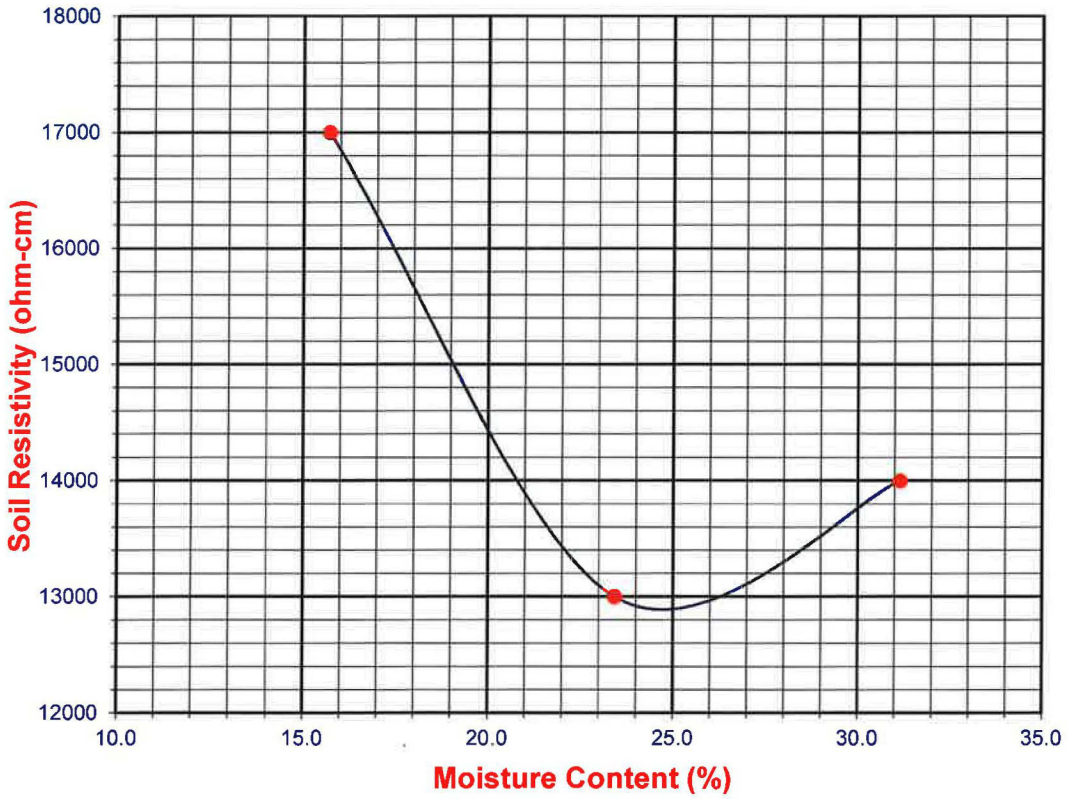
Tested By : A. Santos Date: 10/10/17
Data Input By: J. Ward Date: 10/20/17
Depth (ft.) : 0-5

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	20	15.71	17000	17000
2	30	23.43	13000	13000
3	40	31.14	14000	14000
4				
5				

Moisture Content (%) (MCi)	0.29
Wet Wt. of Soil + Cont. (g)	132.98
Dry Wt. of Soil + Cont. (g)	132.77
Wt. of Container (g)	59.16
Container No.	
Initial Soil Wt. (g) (Wt)	130.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
12900	**24.7**	**70**	**321**	**7.16**	**20.6**



USGS Design Maps Summary Report

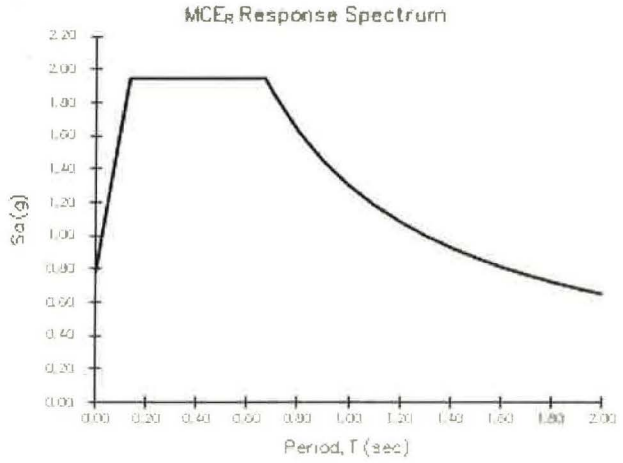
User–Specified Input

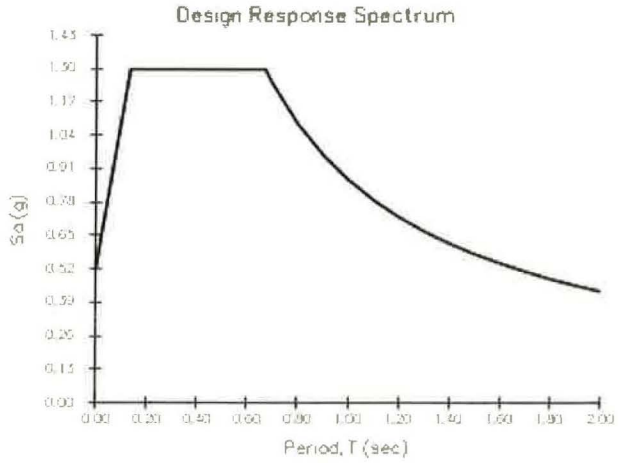
Report Title	Bridge Rialto Wed November 1, 2017 16:50:15 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	34.14102°N, 117.40649°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	1.946 g	S_{MS} =	1.946 g	S_{DS} =	1.297 g
S_1 =	0.867 g	S_{M1} =	1.300 g	S_{D1} =	0.867 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (34.14102°N, 117.40649°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 1.946 g
From Figure 22-2 [2]	S_1 = 0.867 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_S

For Site Class = D and S_s = 1.946 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.867 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 1.946 = 1.946$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.867 = 1.300$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

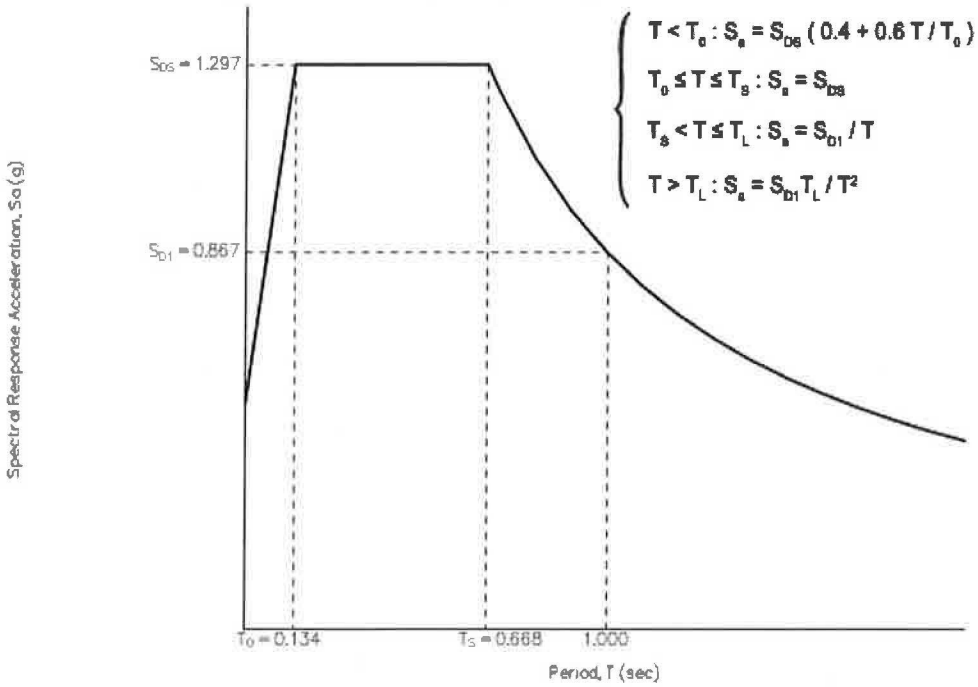
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.946 = 1.297$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 1.300 = 0.867$ g

Section 11.4.5 — Design Response Spectrum

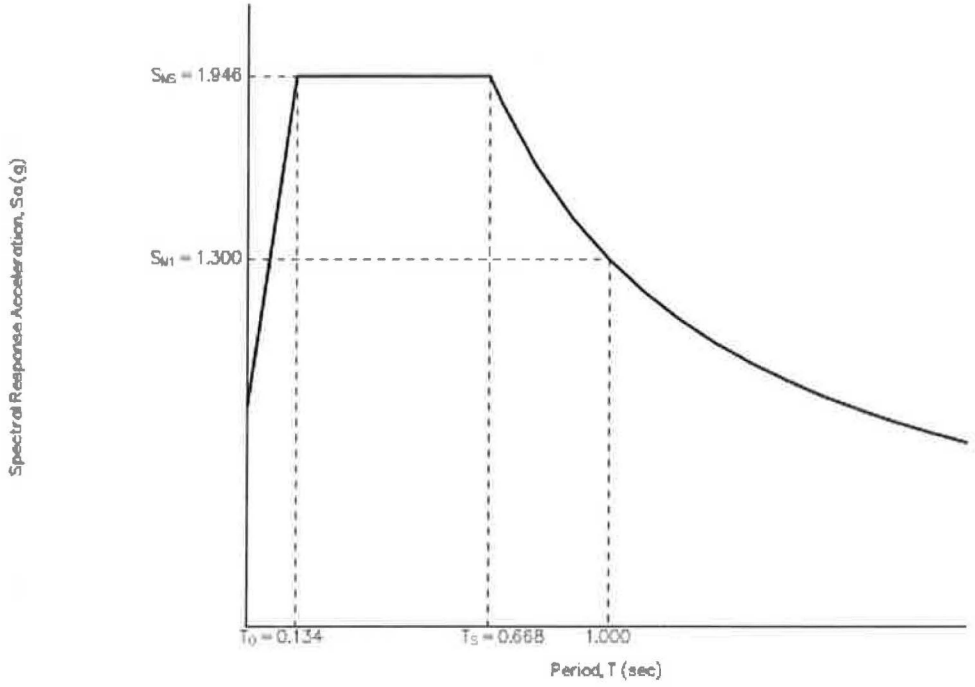
From Figure 22-12 [3] $T_L = 12$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.757

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.757 = 0.757$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.757 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.048

From Figure 22-18 [6] C_{R1} = 1.005

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.297 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.867 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = E

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

TEST.OUT

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*                    *
*    E Q F A U L T   *
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*    Version 3.00    *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 11805.001

DATE: 11-01-2017

JOB NAME: Bridge Rialto

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: CDMGFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 34.1410
SITE LONGITUDE: 117.4065

SEARCH RADIUS: 100 mi

ATTENUATION RELATION: 20) Sadigh et al. (1997) Horiz. - Soil
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: clodis
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: Campbell SHR:
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CDMGFLTE.DAT

MINIMUM DEPTH VALUE (km): 0.0

TEST.OUT

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT		
		MAXIMUM EARTHQUAKE MAG. (Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
SAN JACINTO-SAN BERNARDINO	0.7(1.1)	6.7	0.533	X
CUCAMONGA	3.4(5.4)	7.0	0.529	X
SAN ANDREAS - San Bernardino	6.7(10.8)	7.3	0.336	IX
SAN ANDREAS - Southern	6.7(10.8)	7.4	0.345	IX
CLEGHORN	10.1(16.2)	6.5	0.192	VIII
SAN JACINTO-SAN JACINTO VALLEY	12.9(20.8)	6.9	0.190	VIII
NORTH FRONTAL FAULT ZONE (West)	13.5(21.7)	7.0	0.247	IX
SAN ANDREAS - Mojave	13.7(22.0)	7.1	0.200	VIII
SAN ANDREAS - 1857 Rupture	13.7(22.0)	7.8	0.267	IX
SAN JOSE	16.3(26.3)	6.5	0.158	VIII
SIERRA MADRE	18.3(29.5)	7.0	0.188	VIII
CHINO-CENTRAL AVE. (Elsinore)	20.1(32.4)	6.7	0.144	VIII
WHITTIER	23.8(38.3)	6.8	0.100	VII
ELSINORE-GLEN IVY	23.8(38.3)	6.8	0.100	VII
CLAMSHELL-SAWPIT	26.0(41.9)	6.5	0.094	VII
ELYSIAN PARK THRUST	29.1(46.9)	6.7	0.095	VII
HELENDALE - S. LOCKHARDT	33.5(53.9)	7.1	0.083	VII
RAYMOND	34.3(55.2)	6.5	0.067	VI
ELSINORE-TEMECULA	34.5(55.6)	6.8	0.064	VI
NORTH FRONTAL FAULT ZONE (East)	35.5(57.1)	6.7	0.074	VII
SAN JACINTO-ANZA	39.4(63.4)	7.2	0.073	VII
PINTO MOUNTAIN	39.5(63.6)	7.0	0.063	VI
VERDUGO	39.6(63.7)	6.7	0.065	VI
COMPTON THRUST	40.7(65.5)	6.8	0.067	VI
LENWOOD-LOCKHART-OLD WOMAN SPRGS	45.9(73.8)	7.3	0.065	VI
NEWPORT-INGLEWOOD (L.A.Basin)	47.0(75.6)	6.9	0.047	VI
HOLLYWOOD	47.1(75.8)	6.4	0.040	V
NEWPORT-INGLEWOOD (Offshore)	47.8(77.0)	6.9	0.046	VI
JOHNSON VALLEY (Northern)	49.5(79.6)	6.7	0.037	V
SAN GABRIEL	51.4(82.8)	7.0	0.045	VI
SIERRA MADRE (San Fernando)	51.6(83.1)	6.7	0.045	VI
LANDERS	54.6(87.9)	7.3	0.052	VI
SAN ANDREAS - Coachella	55.7(89.6)	7.1	0.044	VI
PALOS VERDES	56.2(90.4)	7.1	0.043	VI
EMERSON So. - COPPER MTN.	56.5(91.0)	6.9	0.037	V
BURNT MTN.	57.3(92.2)	6.4	0.024	IV
ELSINORE-JULIAN	57.4(92.3)	7.1	0.042	VI
SANTA MONICA	57.5(92.5)	6.6	0.036	V
GRAVEL HILLS - HARPER LAKE	57.6(92.7)	6.9	0.036	V
EUREKA PEAK	57.9(93.2)	6.4	0.023	IV

DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	ESTIMATED MAX. EARTHQUAKE EVENT: PEAK SITE ACCEL. g	ESTIMATED MAX. EARTHQUAKE EVENT: EST. SITE INTENSITY MOD.MERC.
NORTHRIDGE (E. Oak Ridge)	58.1(93.5)	6.9	0.045	VI
CALICO - HIDALGO	62.2(100.1)	7.1	0.038	V
SANTA SUSANA	63.5(102.2)	6.6	0.031	V
MALIBU COAST	64.7(104.2)	6.7	0.033	V
BLACKWATER	64.9(104.5)	6.9	0.030	V
CORONADO BANK	67.2(108.2)	7.4	0.043	VI
PISGAH-BULLION MTN.-MESQUITE LK	67.9(109.3)	7.1	0.033	V
HOLSER	68.0(109.5)	6.5	0.026	V
SAN JACINTO-COYOTE CREEK	69.8(112.3)	6.8	0.025	V
ROSE CANYON	69.8(112.4)	6.9	0.027	V
SAN ANDREAS - Carrizo	73.9(118.9)	7.2	0.032	V
ANACAPA-DUME	74.4(119.8)	7.3	0.044	VI
OAK RIDGE (Onshore)	77.2(124.3)	6.9	0.030	V
SAN CAYETANO	80.2(129.0)	6.8	0.026	V
SIMI-SANTA ROSA	80.3(129.2)	6.7	0.024	V
EARTHQUAKE VALLEY	81.3(130.9)	6.5	0.015	IV
GARLOCK (West)	83.4(134.2)	7.1	0.025	V
GARLOCK (East)	86.6(139.3)	7.3	0.028	V
SANTA YNEZ (East)	90.6(145.8)	7.0	0.020	IV
SAN JACINTO - BORREGO	95.1(153.0)	6.6	0.013	III
PLEITO THRUST	96.5(155.3)	7.2	0.028	V
WHITE WOLF	98.8(159.0)	7.2	0.027	V
So. SIERRA NEVADA	100.0(160.9)	7.1	0.025	V

****

-END OF SEARCH- 63 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE SAN JACINTO-SAN BERNARDINO FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 0.7 MILES (1.1 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.5335 g

Attachment E
Rainfall Data (NOAA Atlas 14)
& Worksheet H

NOAA Atlas 14, Volume 6, Version 2
Location name: Rialto, California, USA*
Latitude: 34.1417°, Longitude: -117.406°
Elevation: 1533.48 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.135 (0.113–0.164)	0.180 (0.149–0.218)	0.237 (0.197–0.289)	0.284 (0.233–0.349)	0.348 (0.276–0.442)	0.397 (0.309–0.516)	0.447 (0.339–0.596)	0.500 (0.368–0.685)	0.571 (0.403–0.818)	0.628 (0.427–0.931)
10-min	0.194 (0.161–0.236)	0.257 (0.214–0.313)	0.340 (0.282–0.414)	0.407 (0.335–0.500)	0.499 (0.396–0.634)	0.569 (0.442–0.740)	0.641 (0.486–0.855)	0.716 (0.527–0.982)	0.819 (0.578–1.17)	0.900 (0.613–1.33)
15-min	0.235 (0.195–0.285)	0.311 (0.259–0.378)	0.411 (0.341–0.501)	0.492 (0.405–0.605)	0.603 (0.479–0.767)	0.688 (0.535–0.895)	0.776 (0.588–1.03)	0.866 (0.638–1.19)	0.990 (0.699–1.42)	1.09 (0.741–1.61)
30-min	0.353 (0.294–0.429)	0.469 (0.390–0.570)	0.619 (0.513–0.755)	0.741 (0.609–0.911)	0.908 (0.721–1.16)	1.04 (0.805–1.35)	1.17 (0.885–1.56)	1.30 (0.960–1.79)	1.49 (1.05–2.13)	1.64 (1.12–2.43)
60-min	0.537 (0.447–0.651)	0.712 (0.591–0.865)	0.940 (0.779–1.15)	1.13 (0.925–1.38)	1.38 (1.10–1.75)	1.57 (1.22–2.05)	1.77 (1.34–2.36)	1.98 (1.46–2.72)	2.26 (1.60–3.24)	2.49 (1.69–3.69)
2-hr	0.812 (0.676–0.986)	1.06 (0.882–1.29)	1.38 (1.15–1.69)	1.65 (1.35–2.02)	2.00 (1.59–2.54)	2.27 (1.76–2.95)	2.54 (1.93–3.39)	2.82 (2.08–3.87)	3.20 (2.26–4.59)	3.50 (2.38–5.20)
3-hr	1.04 (0.863–1.26)	1.35 (1.12–1.64)	1.75 (1.45–2.13)	2.07 (1.70–2.55)	2.51 (1.99–3.19)	2.84 (2.20–3.69)	3.17 (2.40–4.22)	3.51 (2.59–4.82)	3.97 (2.80–5.69)	4.33 (2.95–6.42)
6-hr	1.53 (1.28–1.86)	1.99 (1.65–2.41)	2.56 (2.12–3.12)	3.03 (2.49–3.72)	3.64 (2.89–4.63)	4.11 (3.19–5.34)	4.57 (3.46–6.09)	5.04 (3.71–6.92)	5.68 (4.01–8.13)	6.16 (4.20–9.14)
12-hr	2.10 (1.74–2.54)	2.72 (2.26–3.31)	3.51 (2.91–4.28)	4.14 (3.40–5.09)	4.96 (3.94–6.32)	5.58 (4.34–7.25)	6.19 (4.69–8.25)	6.80 (5.01–9.33)	7.61 (5.37–10.9)	8.22 (5.60–12.2)
24-hr	2.86 (2.53–3.29)	3.75 (3.32–4.33)	4.87 (4.30–5.64)	5.76 (5.04–6.71)	6.91 (5.85–8.32)	7.76 (6.44–9.55)	8.61 (6.97–10.8)	9.45 (7.44–12.2)	10.5 (7.98–14.2)	11.4 (8.31–15.9)
2-day	3.51 (3.10–4.04)	4.70 (4.15–5.42)	6.23 (5.49–7.20)	7.45 (6.52–8.69)	9.08 (7.69–10.9)	10.3 (8.56–12.7)	11.6 (9.36–14.6)	12.8 (10.1–16.6)	14.5 (11.0–19.5)	15.8 (11.5–22.0)
3-day	3.75 (3.32–4.32)	5.12 (4.53–5.90)	6.91 (6.10–8.00)	8.38 (7.34–9.78)	10.4 (8.80–12.5)	12.0 (9.92–14.7)	13.5 (11.0–17.1)	15.2 (12.0–19.7)	17.5 (13.2–23.6)	19.2 (14.1–26.8)
4-day	4.00 (3.55–4.61)	5.53 (4.89–6.37)	7.55 (6.66–8.73)	9.22 (8.07–10.8)	11.5 (9.78–13.9)	13.4 (11.1–16.4)	15.2 (12.3–19.2)	17.2 (13.6–22.3)	20.0 (15.1–26.9)	22.1 (16.2–30.9)
7-day	4.57 (4.05–5.27)	6.38 (5.65–7.37)	8.81 (7.77–10.2)	10.8 (9.47–12.6)	13.6 (11.5–16.4)	15.9 (13.2–19.5)	18.2 (14.7–22.9)	20.6 (16.2–26.7)	24.0 (18.2–32.4)	26.7 (19.5–37.3)
10-day	4.94 (4.37–5.69)	6.94 (6.14–8.00)	9.63 (8.49–11.1)	11.9 (10.4–13.9)	15.0 (12.7–18.1)	17.5 (14.5–21.6)	20.1 (16.3–25.4)	22.9 (18.0–29.7)	26.8 (20.3–36.1)	29.9 (21.8–41.7)
20-day	5.91 (5.23–6.80)	8.38 (7.41–9.67)	11.8 (10.4–13.6)	14.6 (12.8–17.0)	18.7 (15.8–22.5)	21.9 (18.2–26.9)	25.3 (20.5–31.9)	29.0 (22.8–37.5)	34.2 (25.8–46.1)	38.4 (28.1–53.6)
30-day	6.90 (6.11–7.95)	9.80 (8.67–11.3)	13.8 (12.2–16.0)	17.2 (15.1–20.1)	22.1 (18.7–26.6)	26.0 (21.6–32.0)	30.2 (24.5–38.0)	34.7 (27.3–44.9)	41.1 (31.1–55.5)	46.4 (33.9–64.7)
45-day	8.24 (7.30–9.49)	11.6 (10.3–13.4)	16.4 (14.4–18.9)	20.4 (17.9–23.8)	26.3 (22.3–31.7)	31.0 (25.8–38.2)	36.2 (29.3–45.5)	41.7 (32.9–54.0)	49.7 (37.6–67.0)	56.3 (41.2–78.5)
60-day	9.58 (8.48–11.0)	13.4 (11.9–15.5)	18.8 (16.6–21.7)	23.4 (20.5–27.3)	30.1 (25.5–36.3)	35.6 (29.6–43.8)	41.5 (33.6–52.3)	48.0 (37.8–62.2)	57.4 (43.4–77.4)	65.2 (47.6–90.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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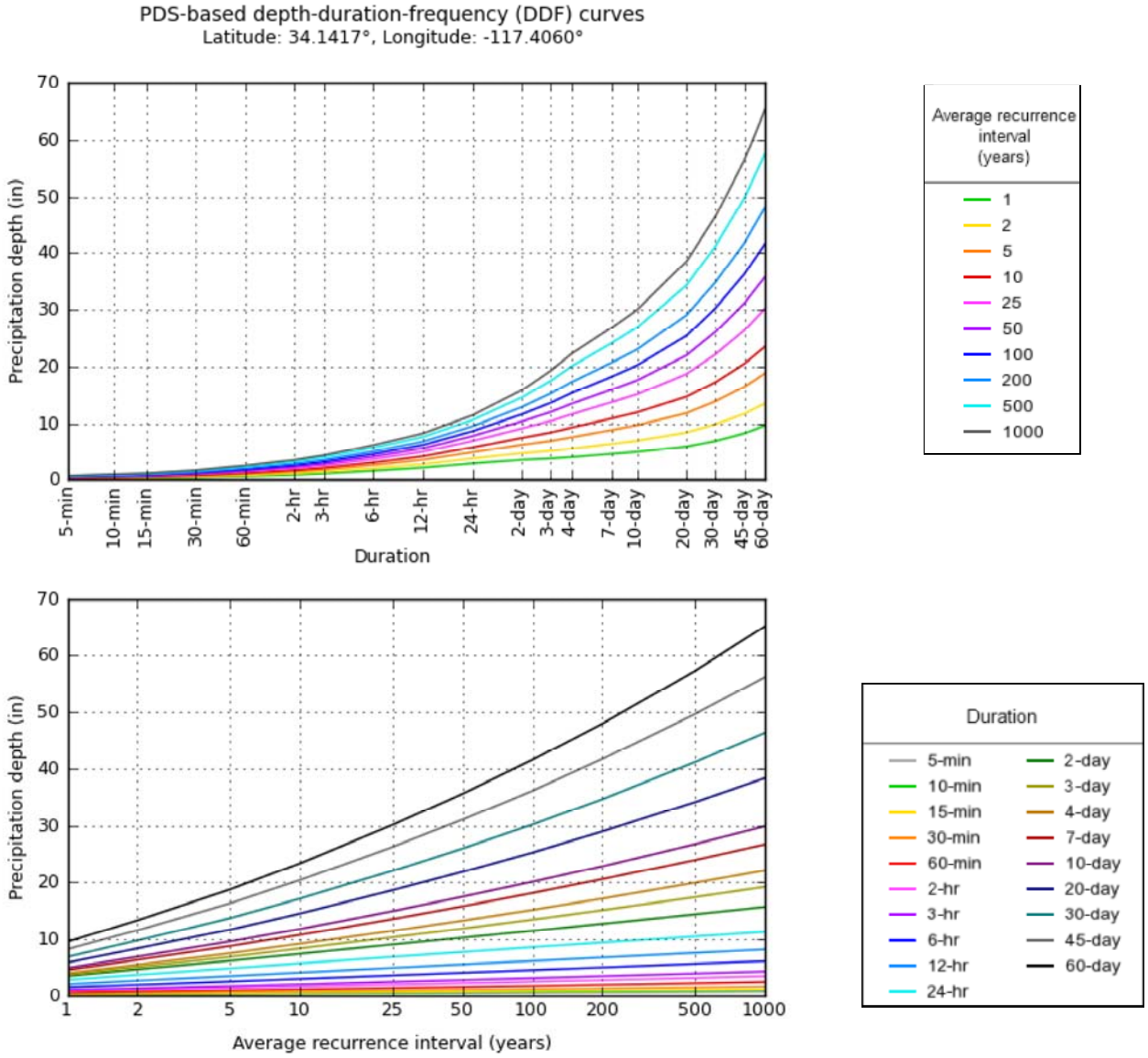
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Sep 19 00:05:27 2017

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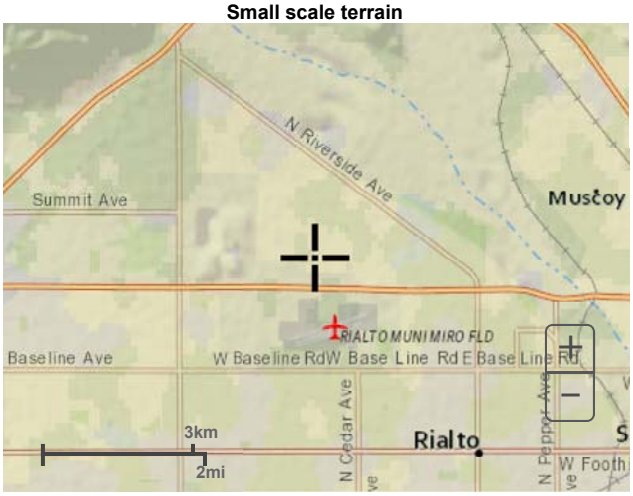
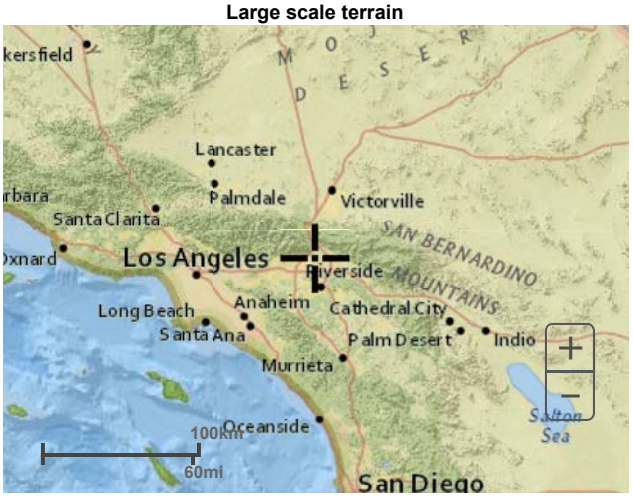
Maps & aerials

Small scale terrain

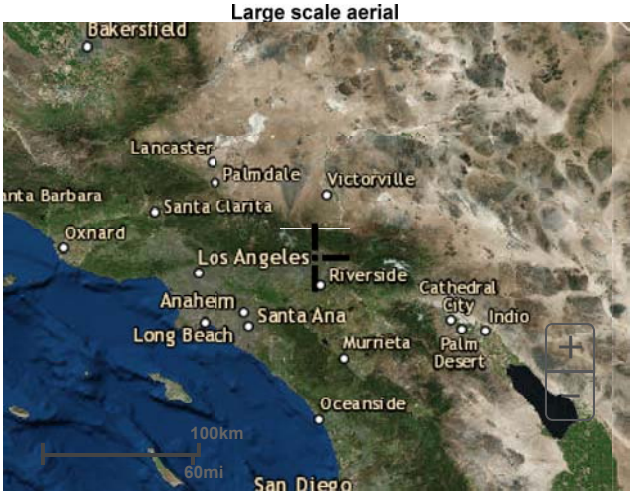


Large scale terrain



Large scale map

Large scale aerial



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National Weather Service
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Questions?: HDSC.Questions@noaa.gov

Disclaimer

VII.4.1. Site Suitability Considerations

Suitability assessment related considerations include (**Table VII.3**):

- Soil assessment methods – the site assessment extent (e.g., number of borings, test pits, etc.) and the measurement method used to estimate the short-term infiltration rate.
- Predominant soil texture/percent fines – soil texture and the percent of fines can greatly influence the potential for clogging.
- Site soil variability – site with spatially heterogeneous soils (vertically or horizontally) as determined from site investigations are more difficult to estimate average properties for resulting in a higher level of uncertainty associated with initial estimates.
- Depth to seasonal high groundwater/impervious layer – groundwater mounding may become an issue during excessively wet conditions where shallow aquifers or shallow clay lenses are present.

Table VII.3: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern	
Assessment methods (see explanation below)	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of ≥ 20 percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of ≥ 50 percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods	Per infiltration report in Attachment D
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils	Per infiltration report in Attachment D
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils	Per infiltration report in Attachment D
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom	Per infiltration report in Attachment D

Localized infiltration testing refers to methods such as the double ring infiltrometer test (ASTM D3385-88) which measure infiltration rates over an area less than 10 sq-ft, may include lateral

flow, and do not attempt to account for heterogeneity of soil. The amount of area each test represents should be estimated depending on the observed heterogeneity of the soil.

Extensive infiltration testing refers to methods that include excavating a significant portion of the proposed infiltration area, filling the excavation with water, and monitoring drawdown. The excavation should be to the depth of the proposed infiltration surface and ideally be at least 50 to 100 square feet.

In all cases, testing should be conducted in the area of the proposed BMP where, based on review of available geotechnical data, soils appear least likely to support infiltration.

VII.4.2. Design Related Considerations

Design related considerations include (**Table VII.4**):

- Size of area tributary to facility – all things being equal, risk factors related to infiltration facilities increase with an increase in the tributary area served. Therefore facilities serving larger tributary areas should use more restrictive adjustment factors.
- Level of pretreatment/expected influent sediment loads – credit should be given for good pretreatment by allowing less restrictive factors to account for the reduced probability of clogging from high sediment loading. Also, facilities designed to capture runoff from relatively clean surfaces such as rooftops are likely to see low sediment loads and therefore should be allowed to apply less restrictive safety factors.
- Redundancy – facilities that consist of multiple subsystems operating in parallel such that parts of the system remains functional when other parts fail and/or bypass should be rewarded for the built-in redundancy with less restrictive correction and safety factors. For example, if bypass flows would be at least partially treated in another BMP, the risk of discharging untreated runoff in the event of clogging the primary facility is reduced. A bioretention facility that overflows to a landscaped area is another example.
- Compaction during construction – proper construction oversight is needed during construction to ensure that the bottoms of infiltration facility are not overly compacted. Facilities that do not commit to proper construction practices and oversight should have to use more restrictive correction and safety factors.

Table VII.4: Design Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

~ 15.88 acres

Water Quality (WQ) units will be provided on all storm drain main lines as a pre-treatment control BMP prior to allowing runoff to be conveyed to the primary treatment BMP. The WQ Units will help remove large debris, trash, sediment and oil/grease from the runoff before discharging into the the on-site infiltration systems. See Attachment B for WQ Unit specification & calculations. In addition, catch basin inserts will be used to also remove debris, trash and sediment.

The soil in the proposed infiltration system footprints will be uncompacted in-place native material.

WQ unit will become a pretreatment device before entering to underground infiltration system. WQ Units is capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity. WQ units are equipped with conventional oil baffles to capture and retain oil and grease. Laboratory evaluations show that the WQ units are capable of capturing up to 70% of the free oil and grease from storm water. WQ units can also accommodate the addition of oil sorbents within their separation chambers. The addition of the oil sorbents can ensure the permanent removal of 80% to 90% of the free oil and grease from the storm water runoff.

VII.4.3. Determining Factor of Safety

A factor of safety shall be used. To assist in selecting the appropriate design infiltration rate, the measured short term infiltration rate should be adjusted using a weighted average of several safety factors using the worksheet shown in **Worksheet H** below. The design infiltration rate would be determined as follows:

1. For each consideration shown in **Table VII.3** and **Table VII.4** above, determine whether the consideration is a high, medium, or low concern.
2. For all high concerns, assign a factor value of 3, for medium concerns, assign a factor value of 2, and for low concerns assign a factor value of 1.
3. Multiply each of the factors by the corresponding weight to get a product.
4. Sum the products within each factor category to obtain a safety factor for each.
5. Multiply the two safety factors together to get the final combined safety factor. If the combined safety factor is less than 2, then 2 shall be used as the safety factor.
6. Divide the measured short term infiltration rate by the combined safety factor to obtain the adjusted design infiltration rate for use in sizing the infiltration facility.

The design infiltration rate shall be used to size BMPs and to evaluate their expected long term performance. This rate shall not be less than 2, but may be higher at the discretion of the design engineer.

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.00
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	1	0.25
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.50
Combined Safety Factor, ~~$S_{TOT} = S_A \times S_B$~~ $S_{TOT} = S_A + S_B$					2.50 use 3.0
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					4.0 in/hr
Design Infiltration Rate, in/hr, K_{DESIGN} = ~~$S_{TOT} \times K_M$~~ $K_M \div S_{TOT}$					use 1.3 in/hr

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

See Attachment D for Infiltration Report.

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

VII.5. References

ASTM D 3385-94, 2003. "Standard Test Method for Infiltration Rate of Soils Field Using Double-Ring Infiltrometer." American Society for Testing Materials, Conshohocken, PA. 10 Jun, 2003.

Caltrans, 2003. "Infiltration Basin Site Selection". Study Volume I. California Department of Transportation. Report No. CTSW-RT-03-025.

City of Portland, 2010. *Appendix F.2: Infiltration Testing.* Portland Stormwater Management Manual, Revised February 1, 2010.

United States Department of the Interior, Bureau of Reclamation (USBR), 1990a, "Procedure for Performing Field Permeability Testing by the Well Permeameter Method (USBR 7300-89)," in Earth Manual, Part 2, A Water Resources Technical Publication, 3rd ed., Bureau of Reclamation, Denver, Colo.