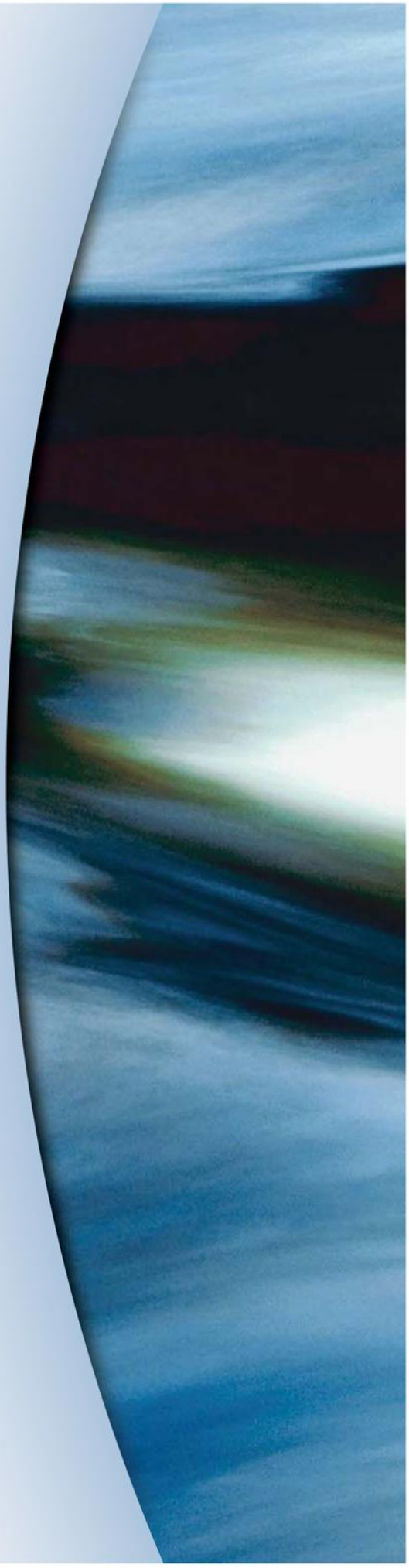


WATER QUALITY MANAGEMENT PLAN

TOPGOLF, ONTARIO

Southeast Corner of Archibald Ave.
& Fourth Street,
Ontario, California

Prepared For
TOPGOLF
8750 N. CENTRAL EXPRESSWAY,SUITE1200
Dallas, TX 75231

Prepared By

Moyenuddin Sirajee, PE
Senior Engineer
Fuscoe Engineering, Inc.
2850 Inland Empire Blvd. Building B
Ontario, California, 91764
909.581.0676
www.fuscoe.com

Project Manager:
Steven L. Ellis

Date Prepared: August 29, 2018
Revision Date: March 21, 2019

Job Number: 1774.001

full circle thinking®

Water Quality Management Plan

For:

Topgolf, Ontario

Southeast Corner of Archibald Avenue and Fourth Street

APN 0210-181-45, 0210-181-34

PARCEL 3 AND 4 OF LOT 4, SECTION 23, TOWNSHIP 1 SOUTH, RANGE 7 WEST, IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, CA

Prepared for:

TOPGOLF

8750 N. Central Expressway, Suite 1200

Dallas, TX 75231

Ph: 832.515.0150

Prepared by:

Fuscoe Engineering, Inc.

2850 Inland Empire Blvd., Suite B

Ontario, CA 91764

909.581.0676

Submittal Date: 8.29.2018
Revision Date: 11.29.18
Revision Date: 03.11.19
Revision Date: 03.21.19

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Topgolf by Fuscoe Engineering Inc. The WQMP is intended to comply with the requirements of the Santa Ana Regional Water Quality Control Board and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, the Lessee, 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):	AP20180095	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Parcel 3 and 4 of Lot 4, Section 23, Township 1 South, Range 7 West, in the County of San Bernardino	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0210-181-45, 0210-181-34

Lessee's Signature			
Lessee's Name: Jessica Sanberg			
Title	Real Estate Development Manager		
Company	Topgolf		
Address	8750 N. Central Expressway, Suite 1200, Dallas, TX 75231		
Email	Jessica.Sanberg@topgolf.com		
Telephone #	832.515.0150		
Signature		Date	3/13/2019

Preparer's Certification

Project Data			
Permit/Application Number(s):	AP20180095	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Parcel 3 and 4 of Lot 4, Section 23, Township 1 South, Range 7 West, in the County of San Bernardino	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0210-181-45, 0210-181-34

"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: Moyenuddin Sirajee	
Title	Senior Engineer
Company	Fuscoe Engineering, Inc.
Address	2850 Inland Empire Blvd., Suite B, Ontario, CA 91764
Email	msirajee@fuscoe.com
Telephone #	909.581.0676
Signature	
Date	3-12-19

PE Stamp Below

Table of Contents

Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Topgolf Ontario				
Project Owner Contact Name:	Jessica Sanberg				
Mailing Address:	8750 N. Central Expressway | Suite 1200 | Dallas, TX 75231	E-mail Address:	Jessica.Sanberg@topgolf.com	Telephone:	832.515.0150
Permit/Application Number(s):			Tract/Parcel Map Number(s):	Parcel 3 and 4 of Lot 4, Section 23, Township 1 South, Range 7 West, in the County of San Bernardino	
Additional Information/ Comments:	None				
Description of Project:	The proposed Topgolf site consists of two vacant Parcels with approximately 15.8-acre land in the City of Ontario. The project is located on the southeast corner of Archibald Avenue and 4th Street and north of Deer Creek Channel. The Deer Creek Channel is flowing along the southerly boundary of the project. The site has poor growth of vegetation throughout. Some bushes and trees were grown along its boundary. The proposed project consists of construction of a commercial Golf Driving Range with entertainment facilities, buildings and paved parking for the user. Project site will be graded to accommodate the installation of pre-fabricated driving range targets in relation to the building and Hitting Bays final elevations. The developed condition will have 6 drainage areas. Drainage area 1, DA1, is approximately 157,825 sf of which 15,272 sf will be for landscaped area and 142,553 sf will be pavement. Drainage area 2, DA2, is approximately 396,729 sf. Landscaped areas for this site will be 35,743 sf. Meanwhile, impervious areas for DA2 will be the roof (28395 sf), pavement (55142 sf), future mini-golf (72,945 sf) and the proposed range (204,504 sf). Drainage Area 3, DA3, with an area of 91,156 sf will remain undeveloped. Lastly, the perimiter landscaped areas along 4th St and Archibald Ave will be self-treating and will be designated as DA4 (18,222 sf), DA5 (9,369 sf) and DA6 (4,215 sf). DA1 and DA2 will each be mitigated thru an underground infiltration chamber with CDS unit as pretreatment. These drainage areas will eventually drain towards the public storm drain system. DA3 will remain pervious and undevelop, thus, water quality mitigation is not required. Lastly, DA4, DA5 and DA6, are landscaped areas and will be self-treating. Table of Post development imperviousness areas and percentages are shown in WQMP Exhibit.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	None				

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):	544,074	**3** Number of Dwelling Units:	None	**4** SIC Code:	7999

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:

Onsite Building and entertainment facility: Topgolf
Drive aisles parking and landscaped area: Topgolf
Golf Target and shooting bay: Topgolf
On-site BMPs: Topgolf

The Lessee, Topgolf, shall assume all on-site BMP maintenance and inspection responsibilities for the proposed project. This includes BMP maintenance, catch basin inspection, storm drain maintenance, efficient irrigation and landscape maintenance.

Topgolf
Attn: Jessica Sanberg
Real Estate Development Manager
8750 N. Central Expressway | Suite 1200 | Dallas, TX 75231
Ph: 832.515.0150
Jessica.Sanberg@topgolf.com

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 ☐	Wild Bird, Pet waste, Garbage.
Nutrients - Phosphorous	E ☒	N ☐	Fertilizers, Food waste, Garbage.
Nutrients - Nitrogen	E ☒	N ☐	Fertilizers, Food waste.
Noxious Aquatic Plants	E ☒	N ☐	Landscaped area. (No receiving water body is impacted)
Sediment	E ☒	N ☐	Driveways, Rooftops, Sidewalks, Paved areas. (No receiving water body is impacted))
Metals	E ☒	N ☐	Break Pad, Tire tread, Fuels.
Oil and Grease	E ☒	N ☐	Leaking Vehicles, Parking areas. (No receiving water body is impacted)
Trash/Debris	E ☒	N ☐	Poorly maintained trash container and parking areas. (No receiving water body is impacted)
Pesticides / Herbicides	E ☒	N ☐	Landscaped areas. (No receiving water body is impacted)
Organic Compounds	E ☒	N ☐	Vehicle, Landscape maintenance area. (No receiving water body is impacted)
Other: Oxygen Demanding Compounds	E ☒	N ☐	Fertilizers. (No receiving water body is impacted)
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

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)	N/A

Section 3 Site and Watershed Description

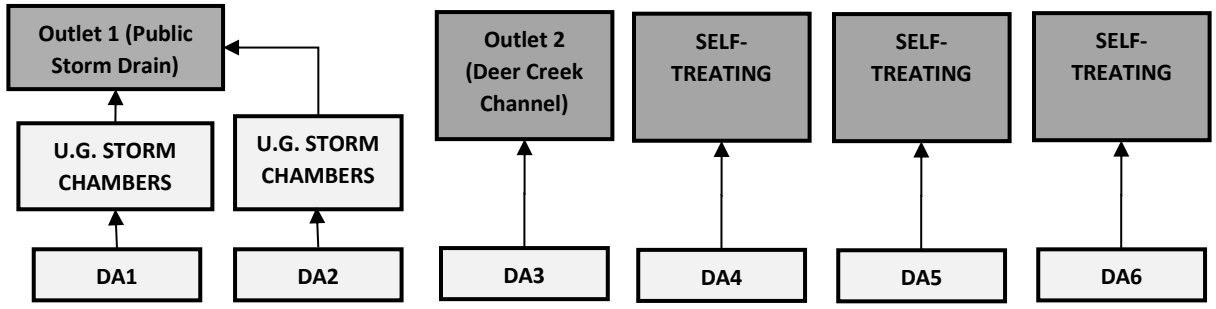
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and 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° 04' 35"	Longitude 117° 35' 29"	Thomas Bros Map page Pg: 602, Grid: 6-J

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*



Example only – modify for project specific WQMP using additional form

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 to Outlet 1	Runoff from DA1 will be collected by a series of Grate Inlets in the parking lot which then drain via storm drain system in to an underground storm chambers. The overflow will drain into an existing 96-inch storm drain on Archibald Avenue which then drain the runoff in to County maintained Deer Creek Channel.
DA2 to Outlet 1	Runoff from DA2 will be collected by a series of Grate Inlets in the Golf Field which then drain via storm drain system in to an underground storm chambers. The overflow will drain into an existing 96-inch storm drain on Archibald Avenue which then drain the runoff in to County maintained Deer Creek Channel.
DA3 to Outlet 2	The entire area of DA3 will remain pervious and undeveloped. Only the portion where the existing will match proposed elevation with a 2:1 slope will be disturbed. The current drainage pattern will remain unchanged. It is currently draining into County maintained Deer Creek Channel.
DA4, DA5 and DA6 (Self-treating)	These are perimeter landscaped areas along 4th Street and Archibald Avenue which will be self-treating.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DA 1	DA 2	DA 3	DA4, DA5 & DA6
1 DMA drainage area (ft^2)	157,825	396,729	91,156	DA4 (18,222 sf), DA5 (9,369 sf), DA6 (4,215 sf)
2 Existing site impervious area (ft^2)	0	0	0	0
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	I	I	I	I
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	A	A	A	A
5 Longest flowpath length (ft)	630	1393	1589	
6 Longest flowpath slope (ft/ft)	0.017	0.027	0.025	
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass, Annual or Perennial	Grass, Annual or Perennial	Grass, Annual or Perennial	Grass, Annual or Perennial
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	Poor	Poor	

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*	The project is located within Santa Ana River Watershed. The project site's proximate receiving water is Deer Creek located south of the property. Portion of the project directly discharges in to creek. Remaining area indirectly discharges in to the creek via the existing storm drain system on Archibald Avenue. Deer Creek then drains in to Cucamonga Creek Reach 1 which then merges with Mill Creek. Mill Creek discharges into the Prado Flood Control Basin and Santa Ana River Reach 3 in Riverside County.
Applicable TMDLs *Refer to Local Implementation Plan*	2014 and 2016 integrated Report (Clean Water Act Section 305 (b) and 303(d)), USEPA Final Approval: April 6, 2018. Pathogens- Mill Creek (Prado Area), Pathogens- Santa Ana River Reach 3
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*	Cucamonga Creek Valley Reach is 303(d) listed for Cadmium, Coliform Bacteria, Copper, Lead, and Zinc (TMDLs for Cadmium, Copper, Lead, and Zinc to be established by 2021). Mill Creek (Prado Area) is 303(d) listed for Nutrients, Pathogens, and Total Suspended Solids (TMDLs for Nutrients and Total Suspended Solids to be established by 2019). The middle reaches of the Santa Ana River, including Reach 3, is 303(d) listed for Copper, Lead and Pathogens from dairy operations (USEPA approved TMDL established for Copper and Lead by 2021).
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/*	Mill Creek, 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	☒	☐	The Owner will educate Operator, Contractor and Emplyoees. Property owners will become familiar with the educational materials provided under Section 6.4.
N2	Activity Restrictions	☒	☐	Activity restrictions will be developed by the owner that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, vehicle or equipment repair, maintenance and car/vehicle washing.
N3	Landscape Management BMPs	☒	☐	The Owner will ensure on-going maintenance and use of fertilizers and pesticides will be done so in accordance with the RWQCB guidelines.
N4	BMP Maintenance	☒	☐	The Owner will be responsible for maintenance of on-site BMPs as described in Form 5.1 of this document.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Hazardous materials will not be stored on-site. The owner shall restrict all activities that are not in complince with the hazardous waste section of Title 22. See http://www.sbcounty.gov/dph for additional information.
N6	Local Water Quality Ordinances	☒	☐	Compliance with City of Ontario Water Quality Ordinances in Title 6, Section 6 of Ontario Muncipal Code will be upheld.
N7	Spill Contingency Plan	☒	☐	The Owner will develop and implement an effective spill response and control plan. This will address spill/leak prevention measures, spill response and cleanup procedures, reporting and training.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Hazardous materials will not be stored on-site.

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	
N10	Uniform Fire Code Implementation	☐	☒	Hazardous materials will not be stored or used on-site.
N11	Litter/Debris Control Program	☒	☐	The Owner will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public or facility user and reporting such violations for investigation.
N12	Employee Training	☒	☐	City of Ontario/Owner will implement employee training program for all new employees in the proper maintenance of landscaped areas, onsite BMPs, and all current and proposed drainage structures.
N13	Housekeeping of Loading Docks	☐	☒	Loading Docks are not proposed for this project.
N14	Catch Basin Inspection Program	☒	☐	The owner will ensure that 100% of the on-site catch basins and storm drains are inspected, cleaned and maintained on an annual basis. Drainage facilities include catch basins (storm drain inlets) and underground storm drain pipes. Records shall be kept to document the annual maintenance.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	The owner will ensure that drive aisles and parking spaces are vacuum swept prior to the storm season, in late summer or early fall, prior to the start of the rainy season or equivalent as required (no later than October 1st). Vacuum sweeping shall be performed at a minimum on a bi-weekly basis or as necessary.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	Since construction will be greater than 1 acre, project will apply for coverage under the General Construction Permit, SWRCB Order No. 2009-0009-DWQ prior to start of land disturbing activities

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)	☒	☐	Storm drain stenciling is to be placed directly adjacent to all storm drain inlets. Stenciling and signage should meet the following requirements and be shown on the project plans: 1. Stenciling should include prohibitive language similar to, "NO DUMPING – DRAINS TO OCEAN" and/or include graphical icons to discourage illegal dumping. 2. Post signs and prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area. 3. Maintain legibility of stencils and signs.
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.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	The trash storage areas will be situated away from roof runoff and pavement runoff diverted. Dumpsters will be leak proof and shall be covered with permanent roofing. Litter control activities shall be performed on a weekly basis
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 Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The irrigation systems shall be in conformance with local water use efficiency guidelines.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Project will implement 1-2" depression from edge of pavement, sidewalk, etc.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	On site slopes will be vegetated
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No dock area proposed.

S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays are proposed.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash proposed.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing proposed.
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash proposed.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Project is not located in a hillside area.
S14	Wash water control for food preparation areas	☒	☐	The owner will be responsible for installing food processing area per State Health & Safety Code. It shall have either contained areas or sinks, each with sanitary sewer connections for disposal of wash waters containing kitchen and food wastes. If located outside, the contained areas or sinks shall also be structurally covered to prevent entry of stormwater. Adequate signs shall be provided and appropriately placed stating the prohibition of discharging wash water to the storm drain system.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks are proposed.

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*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Site design to incorporate landscaping and pervious areas where feasible.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Site infiltration to be maximized through proposed underground infiltration system.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: General discharge location after construction will remain as it was before construction. Underground storm drain system will increase the time of concentration.
Disconnect impervious areas: Yes ☐ No ☒ Explanation: Most of the surface of the proposed development will be impervious. The use of the site is such that "Disconnect impervious areas" not practically feasible. However all runoff goes to underground infiltration system.
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation: Portion of the property (DA3) will remain undevelop. Existing trees and vegetation will be protected.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Some disturbed area will be revegetated with native and/or drought-tolerant landscaping wherever practically feasible.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The bottom of the infiltration facilities will be placed on natural ground.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Vegetated swales area not feasible nor proposed for this project. However underground piping will discharge in to underground infiltration system to maximize infiltration.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation: This project will be mass grading operation of the entire site. Thus practically it is impossible to Stake off specific area. However staking can occur later in the development to minimize additional compaction in landscape areas.

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 (DA1)

1 Project area DMA-A (ft^2): 157,825	**2** Imperviousness after applying preventative site design practices (Imp%): 90%	**3** Runoff Coefficient (Rc): _0.735 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 17,112 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA2)

1 Project area DMA-B (ft^2): 396,729	**2** Imperviousness after applying preventative site design practices (Imp%): 91%	**3** Runoff Coefficient (Rc): _0.745 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 43,590 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA3)

1 Project area DMA-B (ft^2): 91,156	**2** Imperviousness after applying preventative site design practices (Imp%): 0%	**3** Runoff Coefficient (Rc): _0.040 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 538 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA4)

1 Project area DMA-B (ft^2): 18,222	**2** Imperviousness after applying preventative site design practices (Imp%): 0%	**3** Runoff Coefficient (Rc): _0.040 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 108 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA5)

1 Project area DMA-B (ft^2): 9,369	**2** Imperviousness after applying preventative site design practices (Imp%): 0%	**3** Runoff Coefficient (Rc): _0.040 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 55 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA6)

1 Project area DMA-B (ft^2): 4,215	**2** Imperviousness after applying preventative site design practices (Imp%): 0%	**3** Runoff Coefficient (Rc): _0.040 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.609 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.902 *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): 25 *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 (DA1 and DA2)

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								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
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								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

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

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

12 Pre-developed Volume (ft^3):
*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):
*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):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

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

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*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o = *Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t = *Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c = *Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*								

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

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)*							
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)*							
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)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
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)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
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*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA 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: *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: *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):	*Maximum of Item 8, 9, and 10 (including additional forms as needed)*	
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs):	*Maximum of Item 11, 12, and 13 (including additional forms as needed)*	
15 Peak runoff reduction needed to meet HCOC Requirement (cfs):	*$Q_{p\text{-}HCOC}$ = (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 (DA1 and DA2)

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 (DA1 & DA2)

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: 0 *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).

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA1, DA2)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 60,998 *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 A BMP Type Underground Infiltration Chamber	DA 2 DMA A BMP Type Underground Infiltration Chamber	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*	2.1	2.2	
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.0	2.0	
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	1.05	1.1	
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	4.2	4.4	
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	4.2	4.4	
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*	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	
10 Amended soil porosity	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*	N/A	N/A	
12 Gravel porosity	N/A	N/A	
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	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))]*	0	0	
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	17,420	43,772	

16 Total Retention Volume from LID Infiltration BMPs: 61,192 *(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			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			
9 Total Retention Volume (ft^3) from Harvest and Use BMP *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) N/A

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): *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) – N/A
Bioretention and Planter Boxes with Underdrains

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*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
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))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *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*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
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]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item* $8_{forebay}$ *+ Item* 8_{basin}*) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item* $8_{forebay}$ *+ Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(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*			
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*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w = *(Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} = *(Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

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 (DA1)

1 Total LID DCV for the Project DA-1 (ft^3): 17,399 *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): 17,420 *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

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA2)

1 Total LID DCV for the Project DA-1 (ft^3): 43,599 *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): 43,772 *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) N/A (No HCOC)

1 Volume reduction needed for HCOC performance criteria (ft^3): *(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): *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): *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *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 ☐

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 ☐

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) N/A

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
Education for Property Owners and service provider.	Topgolf	Educational materials will be provided to property owners and service provider prior to occupancy.	Once a year and as necessary.
Activity Restrictions	Topgolf	The Owner will prescribe activity restrictions to protect surface water quality, through education or other equally effective measure, for the property. Restrictions include, but are not limited to, prohibiting vehicle maintenance or vehicle washing.	As necessary
Landscape Management	Topgolf	Maintenance shall be consistent with City requirements for use of fertilizers and pesticides. Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting, and replacement of mulch shall be performed on an as-needed basis to prevent exposure of erodible surfaces. Trimmings, clippings, and other landscape wastes shall be properly disposed of in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and storm drain inlets.	Monthly or as necessary
BMP Maintenance	Topgolf	Maintenance of structural BMPs Underground Retention Units, CDS Unit shall be performed at the beginning and end of every rainy season. Records of inspections and	Bi-Annually or as necessary

		BMP maintenance shall be kept by the owner and shall be available for review upon request.	
Storm Drain System Stenciling and Signage	Topgolf	Storm drain placards stencils shall be installed by the Developer and inspected for damage or replacement at minimum, annually.	Annually
CDS Unit	Topgolf	CDS Units shall be inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load. The CDS units shall be cleaned by vacuum whenever the sump is >25% full of debris.	Bi-Annually
Underground Retention Storage System	Topgolf	Underground storm water Retention systems shall be inspected semiannually by October 1st and February 1st and within 48 hours after a significant rain event each year, to determine drawdowns within 48 hrs and maintained by flushing and vacuum of accumulated solids, via access manhole when necessary, to ensure optimum performance. The rate at which the system collects pollutants will depend more on site activities than the size or configuration of the system.	Bi-Annually
Trash Storage Area	Topgolf	Look for any possible licking from the Dumpsters and make sure the Dumpstars are fully coverd. Litters are dumped properly.	Weekly or as necessary
Vacuum Sweep Parking Lots	Topgolf	Parking areas within the project shall be swept at a minimum frequency of twice per month.	Bi-weekly

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
- 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

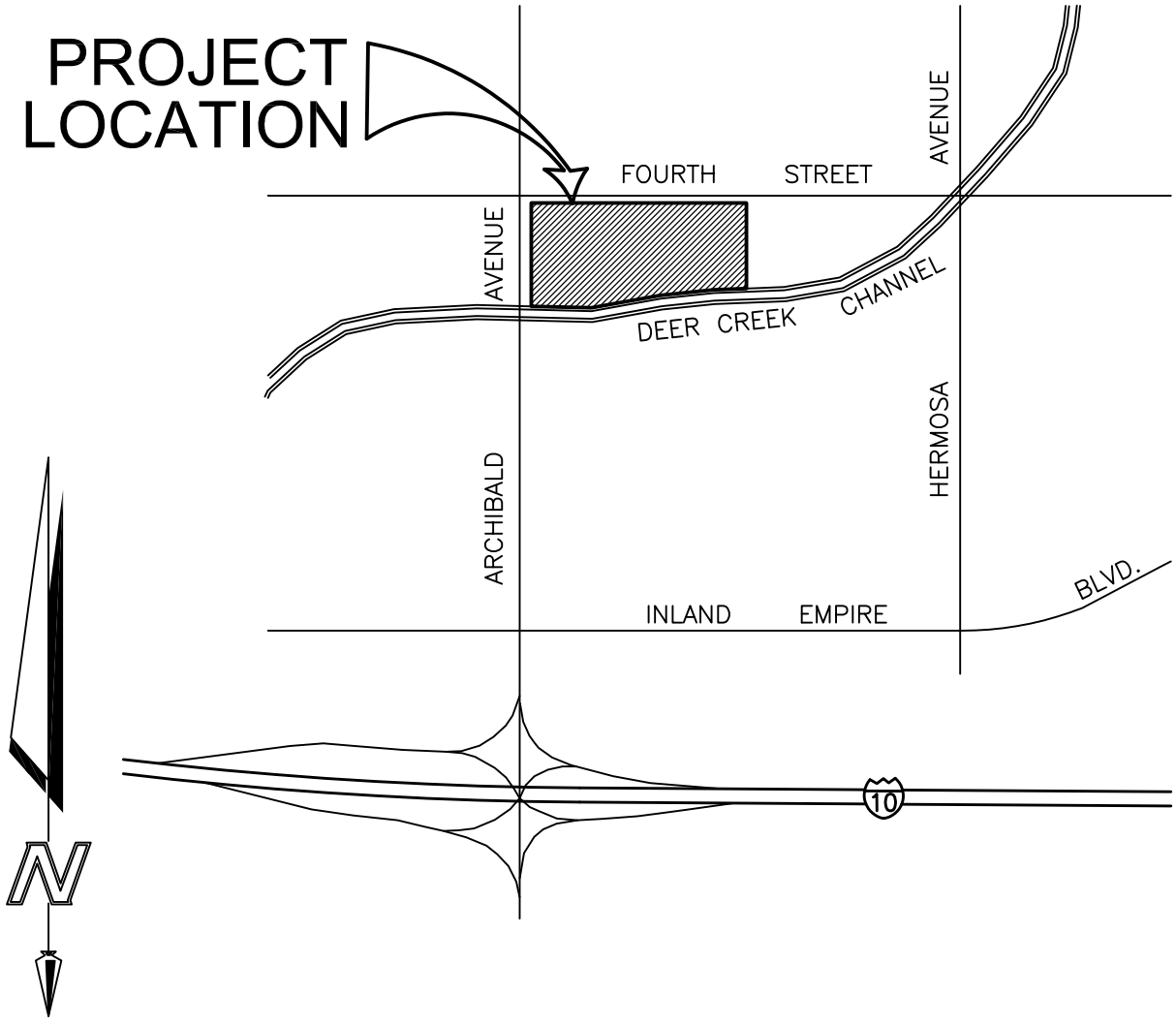
Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

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

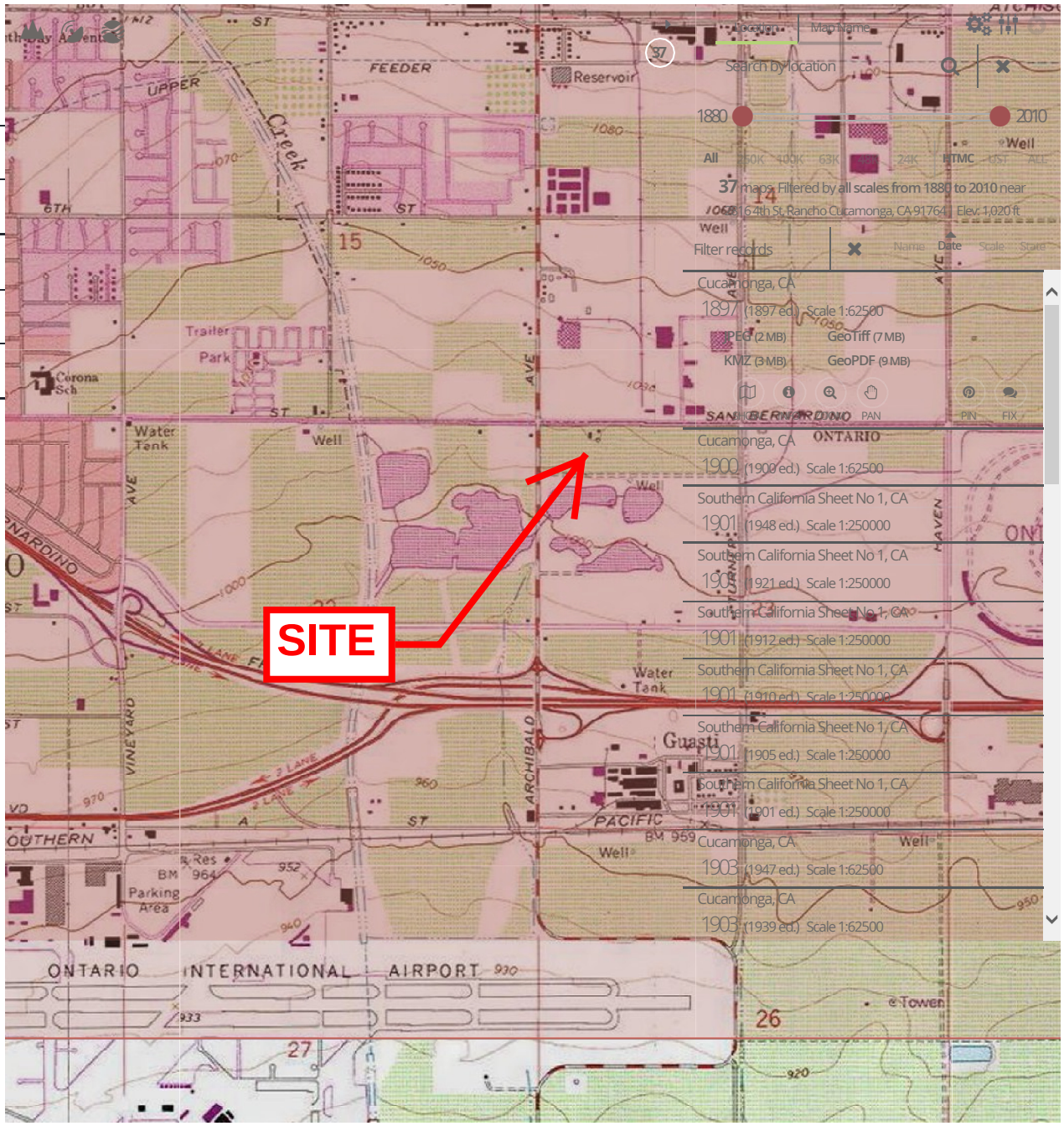
6.1 SITE PLAN AND DRAINAGE PLAN

- Vicinity Map
- Project Location Map
- Existing Drainage Flow Map
- Site Plan, Proposed Drainage Flow and LID BMP Plan
- Pre-treatment Flow Calculation and LID Detail



VICINITY MAP

NOT TO SCALE


topoView
SITE
Search by location
1880
2010
37 maps Filtered by all scales from 1880 to 2010 near
Filter records
Cucamonga, CA
1897 (1897 ed.) Scale 1:62500
JPEG (2 MB) GeoTiff (7 MB)
KMZ (3 MB) GeoPDF (9 MB)
Cucamonga, CA
1900 (1900 ed.) Scale 1:62500
Southern California Sheet No 1, CA
1901 (1948 ed.) Scale 1:250000
Southern California Sheet No 1, CA
1901 (1921 ed.) Scale 1:250000
Southern California Sheet No 1, CA
1901 (1912 ed.) Scale 1:250000
Southern California Sheet No 1, CA
1901 (1910 ed.) Scale 1:250000
Southern California Sheet No 1, CA
1901 (1905 ed.) Scale 1:250000
Southern California Sheet No 1, CA
1901 (1901 ed.) Scale 1:250000
Cucamonga, CA
1903 (1947 ed.) Scale 1:62500
Cucamonga, CA
1903 (1939 ed.) Scale 1:62500
ONTARIO INTERNATIONAL AIRPORT
Guasti
Water Tank
Trailer Park
Parking Area
Reservoir
FEEDER
UPPER
PACIFIC
SOUTHERN
VINEYARD
ARCHIBALD
Lat: 34° 4' 35" N Long: 117° 35' 29" W
DMS DD MGR UTM
Map Records: 37

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Tuesday, January 29, 2019

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

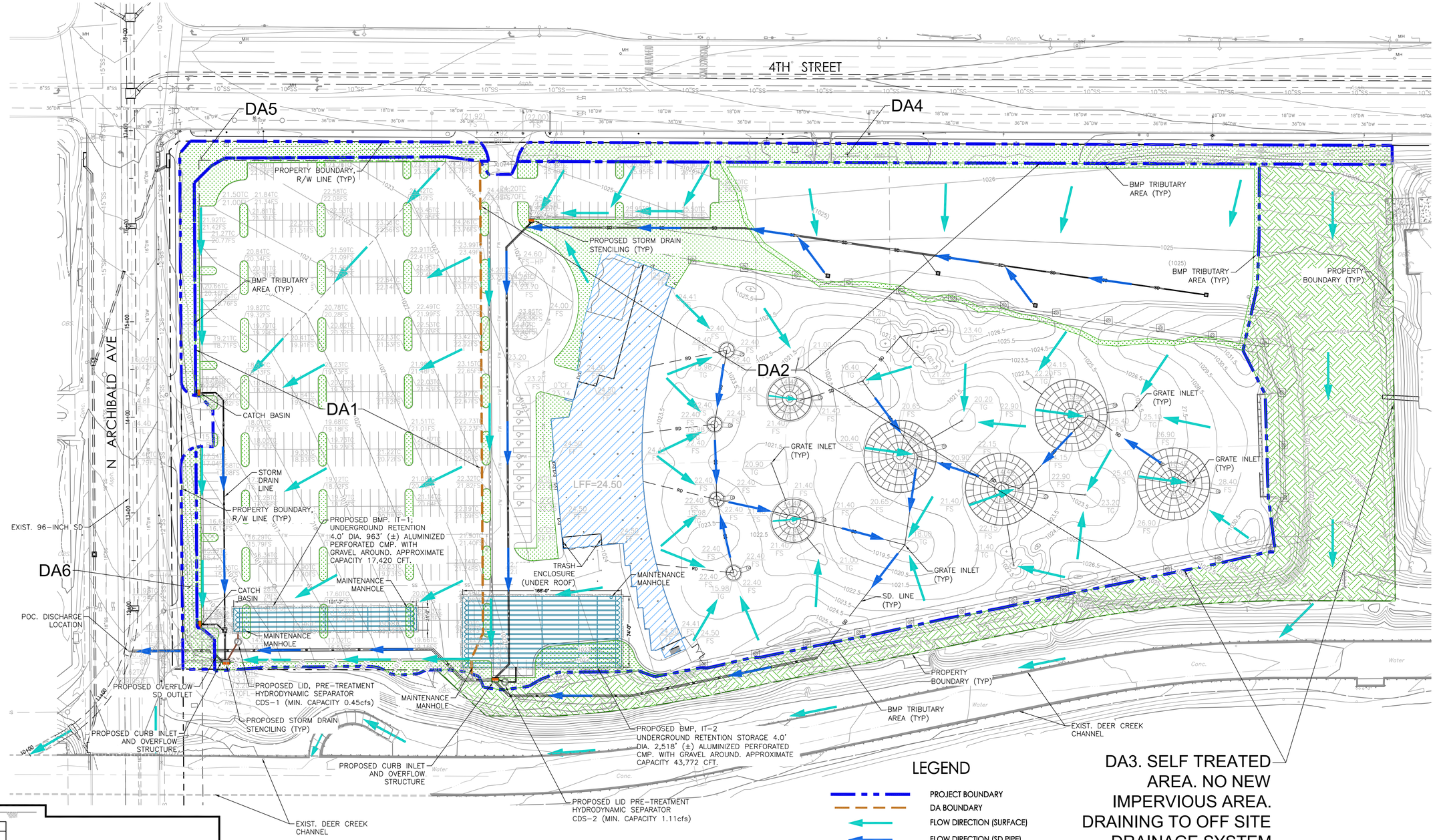
Project Site Parcel Number(s):	021018146, 021018145, 011046102, 021018144, 021018143, 021018134
Project Site Acreage:	50.376
HCOC Exempt Area:	Yes. Verify that the project is completely with the HCOC exemption area.
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - 501 **Facility Name** - Deer Creek Channel, COE **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	Yes
Is this drainage segment a 303d listed stream?	No
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	Yes
Project Site Onsite Soil Group(s):	A, B
Environmentally Sensitive Areas within 200':	None
Groundwater Depth (FT):	-383
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	City of Ontario Water Quality Report Chino Basin Recharge Master Plan Chino Basin Water Master 32nd Annual Report Sphere of Influence General Plan Amendment CSDP Project No. 1 CSDP 1 Comprehensive Storm Drain CSDP Drainage Study Calculations Review Report of the District Engineer Preliminary Report on Proposed North SBFCP SBCounty CSDP Project No.2 Volume 1 SBCounty CSDP Project No.2 Volume 2 Volume 2 Map SBCounty CSDP Project No.3 Volume I SBCounty CSDP Project No.3 Volume II

Top golf project site

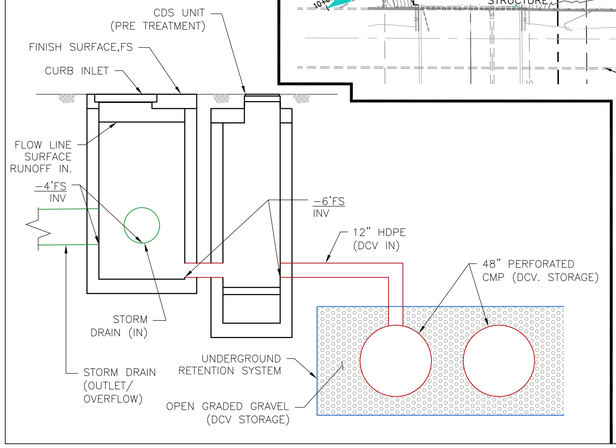
Pre-developed pervious area condition

(poor cover)

SUMMARY OF IMPERVIOUSNESS		
DA ID	**DESCRIPTION**	**AREA (SF)**
DA1		157,825
	LANDSCAPE AREA	15,272
	PAVEMENT	142,553
	% IMPERVIOUSNESS	90.0%
DA2		396,729
	LANDSCAPE AREA	35,743
	PAVEMENT	55,142
	ROOF	28,395
	GOLF RANGE (IMP)	204,504
	FUTURE MINI-GOLF (IMP)	72945
	% IMPERVIOUSNESS	91.0%
DA3	UNDISTURBED AREA	91,156
	% IMPERVIOUSNESS	100.0%
DA4	LANDSCAPE AREA	18,222
	% IMPERVIOUSNESS	100.0%
DA5	LANDSCAPE AREA	9,369
	% IMPERVIOUSNESS	100.0%
DA6	LANDSCAPE AREA	4,215
	% IMPERVIOUSNESS	100.0%



CONCEPTUAL CONNECTION DETAIL OF CURB INLET, CDS UNIT, UNDERGROUND RETENTION SYSTEM AND SD. OVERFLOW



DA AND LID SCHEDULE								
DA ID	**AREA (SF)**	**IMPERVIOUS AREA (SF)**	**PERVIOUS AREA (SF)**	**DCV (CFT)**	**TREATMENT FLOW (CFS)**	**LID ID**	**DESCRIPTION**	**PRO. VOLUME RETENTION . (CFT)**
DA1	157,825	142,553	15,272	17,112	0.44	IT-1	CDS UNIT (PRE-TREATMENT) / UNDERGROUND INFILTRATION CHAMBER	17,420
DA2	396,730	360,987	35,743	43,590	1.12	IT-2	CDS UNIT (PRE-TREATMENT) / UNDERGROUND INFILTRATION CHAMBER	43,772
DA3	91,156	0	91,156	538	0.00		UNDISTURBED: SELF-TREATING	0
DA4	18,222	0	18,222	108	0.00		SELF-TREATING	0
DA5	9,369	0	9,369	55	0.00		SELF-TREATING	0
DA6	4,215	0	4,215	25	0.00		SELF-TREATING	0
TOTAL AREA	677,517	503,540	173,977	61,428				61,192

LEGEND

- PROJECT BOUNDARY
- DA BOUNDARY
- FLOW DIRECTION (SURFACE)
- FLOW DIRECTION (SD PIPE)
- PROPOSED INLET
- SELF TREATED AREA, DRAINING TO OFF SITE DRAINAGE SYSTEM
- PERVIOUS AREAS/ LANDSCAPED AREA
- PROPOSED IMPERVIOUS AREA
- PROPOSED BUILDING/ROOFS
- PROPOSED INFILTRATION STORAGE
- STORM DRAIN SIGNAGE (ONLY RAIN DOWN THE STORM DRAIN)

DA3. SELF TREATED AREA. NO NEW IMPERVIOUS AREA. DRAINING TO OFF SITE DRAINAGE SYSTEM (DEER CREEK CHANNEL)

FUSCOE ENGINEERING
full circle thinking

N

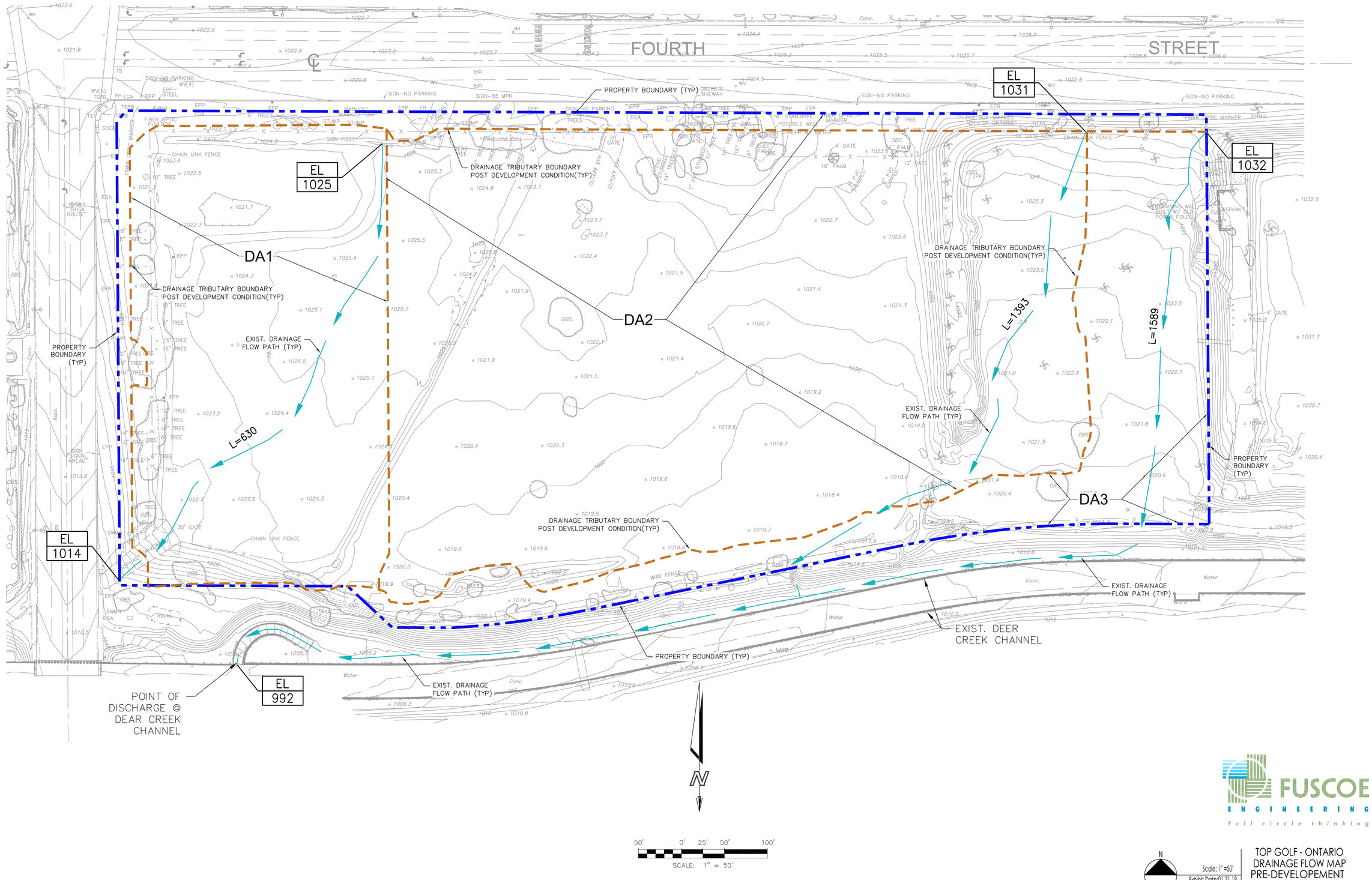
Scale: 1"=50'

Exhibit Date:01.31.19

BMP AND SITE PLAN
TOPGOLF- ONTARIO

ARCHIBALD AVE. & 4TH STREET
ONTARIO, CA

F:\PROJECTS\1774\001_SUPPORT FILES\REPORTS\WQMP\EXHIBITS\1774-001-WQMP.DWG (03-21-19 9:13:44AM) Plotted by: Roy Erlio



FUSCOE ENGINEERING
full circle thinking

N

Scale: 1" =50'
Exhibit Date:01.31.19

TOP GOLF - ONTARIO
DRAINAGE FLOW MAP
PRE-DEVELOPEMENT
ARCHIBALD AVE. & 4TH STREET
ONTARIO, CA

F:\PROJECTS\177A\00_SUPPORT FILES\REPORTS\WQMP\EXHIBIT\1774-001-FLOW PATH.DWG (01-31-19 1:11:07PM) Plotted by: Moyenuddin Sirajee

NOAA Atlas 14, Volume 6, Version 2
Location name: Ontario, California, USA*
Latitude: 34.0765°, Longitude: -117.5919°
Elevation: 1018.16 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	**0.115** (0.096-0.139)	**0.157** (0.131-0.191)	**0.208** (0.173-0.253)	**0.247** (0.203-0.303)	**0.295** (0.235-0.375)	**0.330** (0.257-0.428)	**0.363** (0.275-0.483)	**0.394** (0.290-0.540)	**0.434** (0.306-0.621)	**0.462** (0.314-0.685)
10-min	**0.165** (0.137-0.200)	**0.225** (0.188-0.273)	**0.298** (0.248-0.363)	**0.354** (0.291-0.434)	**0.423** (0.337-0.538)	**0.473** (0.368-0.614)	**0.520** (0.394-0.692)	**0.565** (0.416-0.775)	**0.621** (0.439-0.889)	**0.662** (0.451-0.982)
15-min	**0.199** (0.166-0.241)	**0.272** (0.227-0.330)	**0.361** (0.300-0.439)	**0.428** (0.352-0.525)	**0.512** (0.407-0.650)	**0.572** (0.445-0.742)	**0.629** (0.477-0.837)	**0.683** (0.503-0.937)	**0.752** (0.530-1.08)	**0.800** (0.545-1.19)
30-min	**0.304** (0.253-0.368)	**0.415** (0.346-0.504)	**0.550** (0.457-0.669)	**0.653** (0.537-0.801)	**0.781** (0.621-0.992)	**0.872** (0.679-1.13)	**0.959** (0.727-1.28)	**1.04** (0.768-1.43)	**1.15** (0.809-1.64)	**1.22** (0.831-1.81)
60-min	**0.445** (0.371-0.539)	**0.609** (0.507-0.738)	**0.806** (0.670-0.981)	**0.956** (0.788-1.17)	**1.14** (0.910-1.45)	**1.28** (0.995-1.66)	**1.41** (1.07-1.87)	**1.53** (1.13-2.09)	**1.68** (1.19-2.40)	**1.79** (1.22-2.65)
2-hr	**0.670** (0.559-0.812)	**0.899** (0.749-1.09)	**1.17** (0.975-1.43)	**1.38** (1.14-1.70)	**1.64** (1.31-2.09)	**1.83** (1.42-2.37)	**2.00** (1.52-2.66)	**2.16** (1.59-2.97)	**2.37** (1.67-3.39)	**2.52** (1.71-3.73)
3-hr	**0.843** (0.703-1.02)	**1.12** (0.934-1.36)	**1.46** (1.21-1.77)	**1.71** (1.41-2.10)	**2.02** (1.61-2.57)	**2.25** (1.75-2.92)	**2.46** (1.86-3.27)	**2.66** (1.96-3.64)	**2.90** (2.05-4.16)	**3.08** (2.10-4.57)
6-hr	**1.20** (1.00-1.46)	**1.59** (1.32-1.93)	**2.06** (1.71-2.50)	**2.41** (1.98-2.95)	**2.84** (2.26-3.61)	**3.15** (2.45-4.09)	**3.44** (2.61-4.59)	**3.72** (2.74-5.10)	**4.07** (2.87-5.82)	**4.31** (2.94-6.40)
12-hr	**1.57** (1.31-1.90)	**2.08** (1.73-2.52)	**2.69** (2.24-3.28)	**3.16** (2.60-3.88)	**3.74** (2.98-4.76)	**4.16** (3.24-5.40)	**4.55** (3.45-6.06)	**4.92** (3.63-6.75)	**5.39** (3.80-7.72)	**5.72** (3.90-8.49)
24-hr	**2.09** (1.85-2.40)	**2.80** (2.48-3.23)	**3.67** (3.24-4.25)	**4.33** (3.79-5.05)	**5.17** (4.37-6.23)	**5.76** (4.78-7.09)	**6.33** (5.12-7.97)	**6.87** (5.42-8.90)	**7.56** (5.72-10.2)	**8.05** (5.89-11.2)
2-day	**2.50** (2.21-2.88)	**3.43** (3.03-3.95)	**4.56** (4.03-5.28)	**5.44** (4.76-6.35)	**6.56** (5.55-7.90)	**7.36** (6.11-9.05)	**8.13** (6.59-10.2)	**8.89** (7.00-11.5)	**9.84** (7.44-13.3)	**10.5** (7.70-14.7)
3-day	**2.68** (2.37-3.09)	**3.73** (3.30-4.31)	**5.04** (4.44-5.83)	**6.05** (5.29-7.05)	**7.34** (6.22-8.85)	**8.29** (6.87-10.2)	**9.20** (7.45-11.6)	**10.1** (7.95-13.1)	**11.2** (8.49-15.1)	**12.1** (8.82-16.8)
4-day	**2.89** (2.56-3.34)	**4.08** (3.61-4.71)	**5.56** (4.90-6.44)	**6.71** (5.87-7.83)	**8.20** (6.94-9.88)	**9.29** (7.71-11.4)	**10.3** (8.38-13.0)	**11.4** (8.98-14.8)	**12.7** (9.63-17.2)	**13.7** (10.0-19.1)
7-day	**3.33** (2.95-3.84)	**4.81** (4.25-5.55)	**6.67** (5.88-7.72)	**8.14** (7.12-9.50)	**10.1** (8.52-12.1)	**11.5** (9.54-14.1)	**12.9** (10.5-16.3)	**14.3** (11.3-18.5)	**16.2** (12.2-21.8)	**17.5** (12.8-24.5)
10-day	**3.57** (3.16-4.11)	**5.22** (4.62-6.02)	**7.33** (6.46-8.48)	**9.00** (7.87-10.5)	**11.2** (9.49-13.5)	**12.9** (10.7-15.8)	**14.5** (11.8-18.3)	**16.2** (12.8-21.0)	**18.4** (13.9-24.8)	**20.1** (14.7-28.0)
20-day	**4.26** (3.78-4.92)	**6.32** (5.59-7.29)	**9.00** (7.94-10.4)	**11.2** (9.78-13.0)	**14.1** (12.0-17.0)	**16.4** (13.6-20.2)	**18.7** (15.2-23.6)	**21.1** (16.6-27.3)	**24.3** (18.4-32.8)	**26.8** (19.6-37.5)
30-day	**5.03** (4.46-5.80)	**7.41** (6.55-8.55)	**10.6** (9.32-12.2)	**13.2** (11.5-15.4)	**16.8** (14.2-20.2)	**19.6** (16.2-24.1)	**22.5** (18.2-28.3)	**25.5** (20.1-33.0)	**29.7** (22.5-40.1)	**33.0** (24.1-46.1)
45-day	**6.15** (5.45-7.09)	**8.86** (7.83-10.2)	**12.5** (11.0-14.5)	**15.6** (13.7-18.2)	**20.0** (16.9-24.1)	**23.5** (19.5-28.9)	**27.1** (21.9-34.1)	**31.0** (24.4-40.1)	**36.5** (27.6-49.2)	**40.9** (29.9-57.0)
60-day	**7.27** (6.44-8.38)	**10.2** (9.02-11.8)	**14.2** (12.6-16.5)	**17.7** (15.5-20.7)	**22.7** (19.2-27.3)	**26.7** (22.2-32.9)	**31.0** (25.1-39.1)	**35.6** (28.1-46.1)	**42.3** (32.0-57.0)	**47.7** (34.9-66.6)

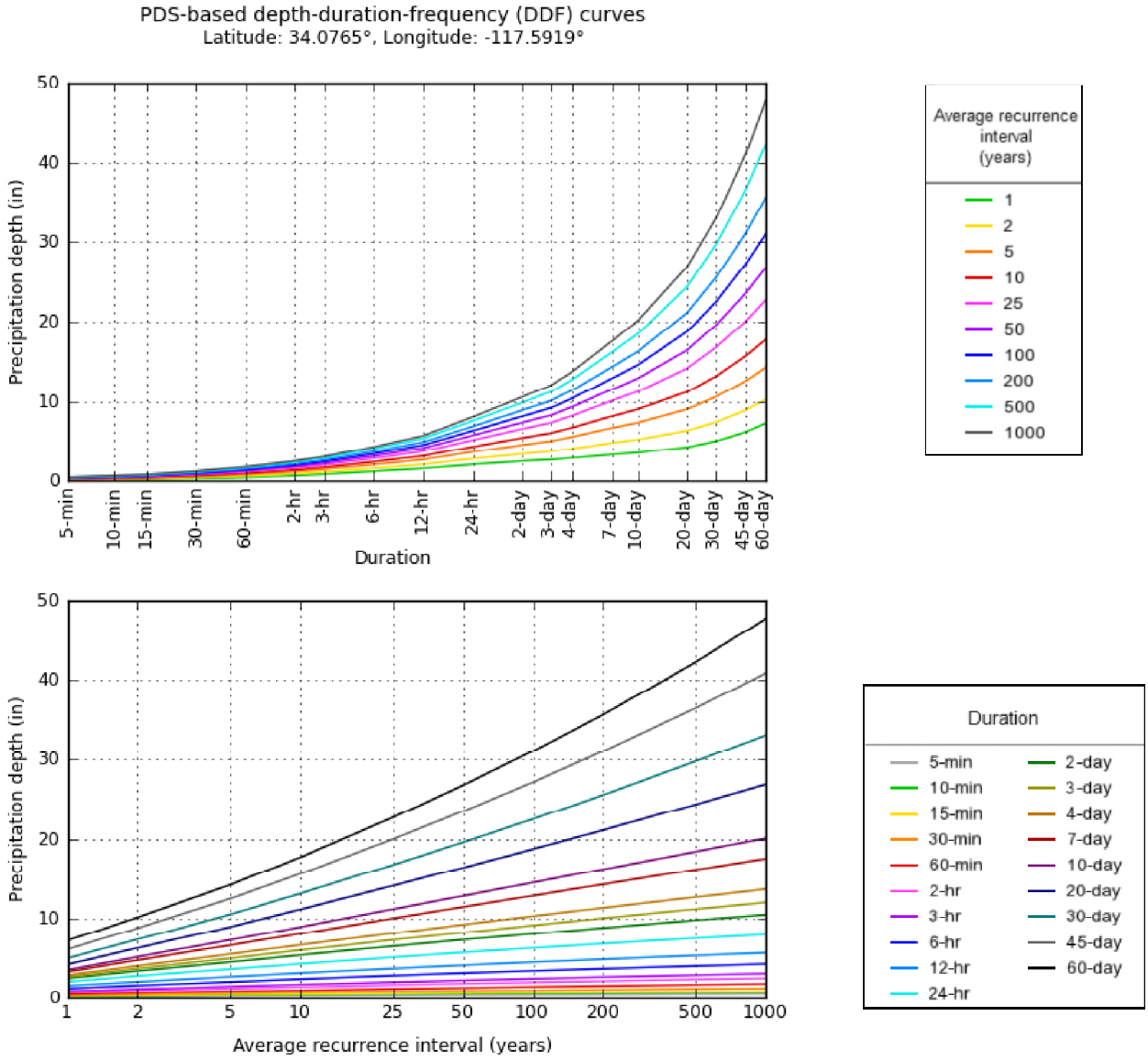
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



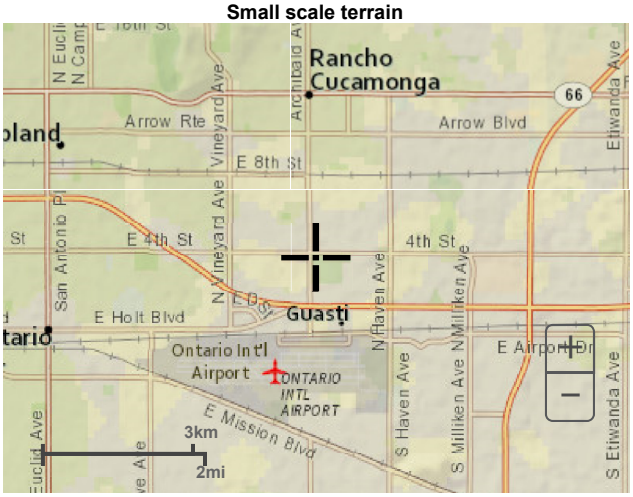
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Jan 29 20:03:37 2019

Back to Top

Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

DCV Calculation (TOP GOLF) ONTARIO SITE (DA1)

Tributary Area	157825	sf	Step 1
Pervious area	15272	sf	
Impervious area	142553	sf	
Percent Imperviousness	90%		
Runoff coefficient=	0.735		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**17,112**	cft	Step 7
Water Quality Flow rate =	0.44	cfs	Pre-treatment flow calc.

DCV Calculation (TOP GOLF) ONTARIO SITE (DA2)

Tributary Area	396729	sf	Step 1
Pervious area	35743	sf	
Impervious area	360986	sf	
Percent Imperviousness	91%		
Runoff coefficient=	0.745		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**43,590**	cft	Step 7
Water Quality Flow rate =	1.12	cfs	Pre-treatment flow calc.

DCV Calculation (TOP GOLF) ONTARIO SITE (DA3-UNDISTURBED)

Tributary Area	91156	sf	Step 1
Pervious area	91156	sf	
Impervious area	0	sf	
Percent Imperviousness	0%		
Runoff coefficient=	0.040		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**538**	cft	Step 7
Water Quality Flow rate =	0.00	cfs	Pre-treatment flow calc.

DCV Calculation (TOP GOLF) ONTARIO SITE (DA4-PERIMETER LANDSCAPE)

Tributary Area	18222	sf	Step 1
Pervious area	18222	sf	
Impervious area	0	sf	
Percent Imperviousness	0%		
Runoff coefficient=	0.040		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**108**	cft	Step 7
Water Quality Flow rate =	0.00	cfs	Pre-treatment flow calc.

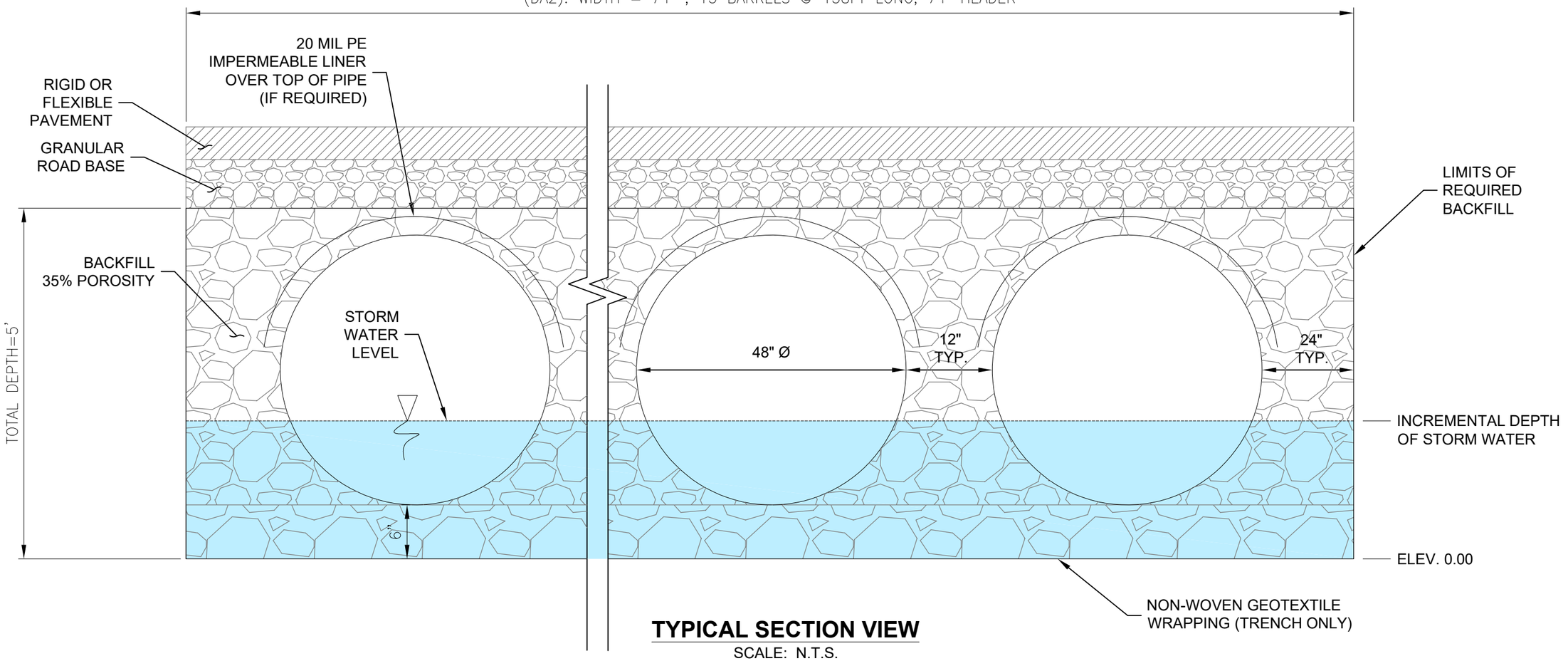
DCV Calculation (TOP GOLF) ONTARIO SITE (DA5-PERIMETER LANDSCAPE)

Tributary Area	9369	sf	Step 1
Pervious area	9369	sf	
Impervious area	0	sf	
Percent Imperviousness	0%		
Runoff coefficient=	0.040		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**55**	cft	Step 7
Water Quality Flow rate =	0.00	cfs	Pre-treatment flow calc.

DCV Calculation (TOP GOLF) ONTARIO SITE (DA6-PERIMETER LANDSCAPE)

Tributary Area	4215	sf	Step 1
Pervious area	4215	sf	
Impervious area	0	sf	
Percent Imperviousness	0%		
Runoff coefficient=	0.040		Step 3
P2yr-1hr=	0.609		Step 4 (See Attached NOAA precipitation)
C1 Valley =	1.4807		Step 5
P6 =	0.902		Step 5
Drawdown Time =	48	hour	Step 6
C2 (For 48 hour)=	1.963		Step 7
DCV =	**25**	cft	Step 7
Water Quality Flow rate =	0.00	cfs	Pre-treatment flow calc.

(DA1): WIDTH = 24' ; 5 BARRELS @ 183 FT LONG; 24' HEADER
(DA2): WIDTH = 74' ; 15 BARRELS @ 158FT LONG; 74' HEADER



TYPICAL SECTION VIEW
SCALE: N.T.S.

FUSCOE ENGINEERING

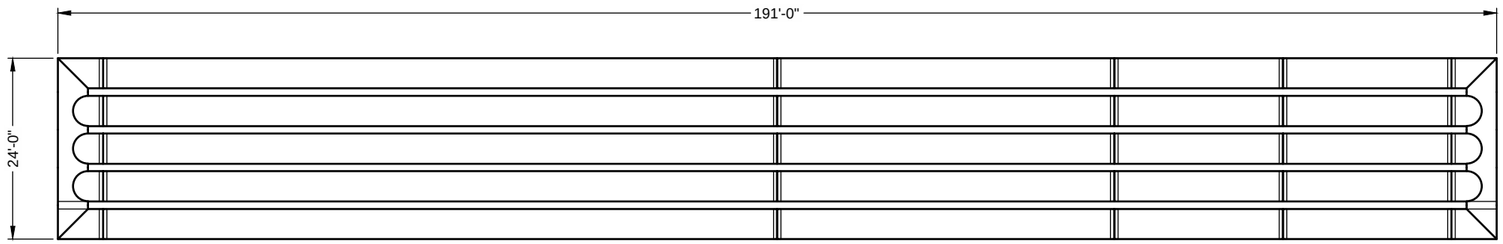
TYPICAL SECTION – STORAGE VOLUME ESTIMATION

INCREMENTAL DEPTH–STORAGE

SHEET 1 of 1

DATE:

F:\PROJECTS\1774\001\SANDBOX\RAY\INCREMENTAL STORAGE–CHAMBERS.DWG (03–21–2019 10:26:14AM) Plotted by: Ray Erillo



ASSEMBLY
SCALE: 1" = 20'

PROJECT SUMMARY

CALCULATION DETAILS
- LENGTH PER BARREL = 183 FT
- LENGTH PER HEADER = 24 FT
- LOADING = H20 & H25
- APPROX. CMP FOOTAGE = 963 FT

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED 17,399 CF
- PIPE STORAGE = 12,101 CF
- STRUCTURAL BACKFILL STORAGE = 5,319 CF
- TOTAL STORAGE PROVIDED = 17,420 CF

PIPE DETAILS
- DIAMETER = 48 IN
- CORRUGATION = 2-2/3" X 1/2"
- GAGE = 16
- COATING = ALUMINIZED STEEL TYPE 2 (ALT2)
- WALL TYPE = PERFORATED
- BARREL SPACING = 12 IN

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

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

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 2 ⅔" 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.

MARK	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

DYODS - 10482-1-0
PROJECT NAME: Top Golf
County of San Bernardino, CA
DESCRIPTION: ONSITE INFILTRATION DA-1

PROJECT No.:	SEQ. No.:	DATE:
10482-1	0	3/11/2019
DESIGNED: DYODS	DRAWN: DYODS	
CHECKED:	APPROVED:	
SHEET NO.: D1		

CONTECH ENGINEERED SOLUTIONS

Date: 3/11/19
Project Name: Top Golf

City / County: County of San Bernardino
State: CA

Designed By: Moyenuddin Sirajee
Company:
Telephone: (909) 581-6128

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

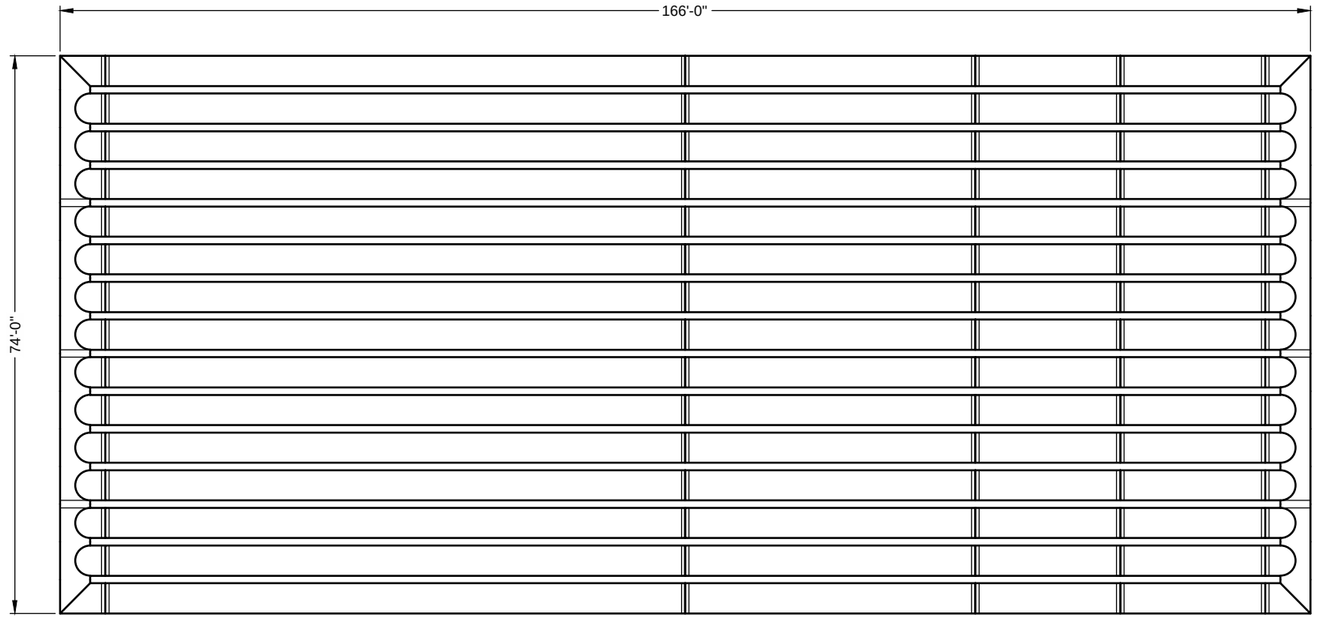
Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	191.0	Backfill Porosity (%):	35%	System Diameter (in):	48
Out-to-out width (ft):	24.0	Depth Above Pipe (in):	6.0	Pipe Spacing (in):	12
Number of Manifolds (ea):	2.0	Depth Below Pipe (in):	6.0	Incremental Analysis (in):	2
Number of Barrels (ea):	5.0	Width At Ends (ft):	2.0	System Invert (Elevation):	0
		Width At Sides (ft):	2.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	1,911.0
0.17	0.16	0.0	0.0	318.5	318.5	318.5	318.5	0.0%	1,911.0
0.33	0.33	0.0	0.0	318.5	637.0	318.5	637.0	0.0%	1,911.0
0.50	0.50	0.0	0.0	318.5	955.5	318.5	955.5	0.0%	1,911.0
0.67	0.66	172.5	172.5	258.1	1,213.6	430.6	1,386.1	12.4%	2,911.7
0.83	0.83	309.1	481.7	210.3	1,423.9	519.4	1,905.6	25.3%	3,295.0
1.00	1.00	391.4	873.1	181.5	1,605.4	572.9	2,478.5	35.2%	3,567.1
1.17	1.16	452.6	1,325.7	160.1	1,765.5	612.7	3,091.2	42.9%	3,777.2
1.33	1.33	500.8	1,826.5	143.2	1,908.7	644.0	3,735.2	48.9%	3,944.7
1.50	1.50	539.3	2,365.8	129.7	2,038.5	669.1	4,404.3	53.7%	4,079.4
1.67	1.66	570.3	2,936.2	118.9	2,157.3	689.2	5,093.5	57.6%	4,187.1
1.83	1.83	594.9	3,531.1	110.3	2,267.6	705.2	5,798.7	60.9%	4,271.6
2.00	2.00	613.9	4,145.0	103.6	2,371.3	717.5	6,516.2	63.6%	4,335.3
2.17	2.16	627.7	4,772.7	98.8	2,470.1	726.5	7,242.7	65.9%	4,379.8
2.33	2.33	636.8	5,409.5	95.6	2,565.7	732.4	7,975.1	67.8%	4,406.1
2.50	2.50	641.3	6,050.7	94.1	2,659.8	735.3	8,710.5	69.5%	4,414.8
2.67	2.66	641.3	6,692.0	94.1	2,753.8	735.3	9,445.8	70.8%	4,406.1
2.83	2.83	636.8	7,328.7	95.6	2,849.4	732.4	10,178.2	72.0%	4,379.8
3.00	3.00	627.7	7,956.5	98.8	2,948.2	726.5	10,904.7	73.0%	4,335.3
3.17	3.16	613.9	8,570.3	103.6	3,051.9	717.5	11,622.2	73.7%	4,271.6
3.33	3.33	594.9	9,165.2	110.3	3,162.2	705.2	12,327.4	74.3%	4,187.1
3.50	3.50	570.3	9,735.6	118.9	3,281.0	689.2	13,016.6	74.8%	4,079.4
3.67	3.66	539.3	10,274.9	129.7	3,410.8	669.1	13,685.7	75.1%	3,944.7
3.83	3.83	500.8	10,775.7	143.2	3,554.0	644.0	14,329.7	75.2%	3,777.2
4.00	4.00	452.6	11,228.3	160.1	3,714.1	612.7	14,942.4	75.1%	3,567.1
4.17	4.16	391.4	11,619.7	181.5	3,895.6	572.9	15,515.3	74.9%	3,295.0
4.33	4.33	309.1	11,928.9	210.3	4,105.9	519.4	16,034.8	74.4%	2,911.7
4.50	4.50	172.5	12,101.4	258.1	4,364.0	430.6	16,465.4	73.5%	1,911.0
4.67	4.66	0.0	12,101.4	318.5	4,682.5	318.5	16,783.9	72.1%	1,911.0
4.83	4.83	0.0	12,101.4	318.5	5,001.0	318.5	17,102.4	70.8%	1,911.0
5.00	5.00	0.0	12,101.4	318.5	5,319.5	318.5	17,420.9	69.5%	1,911.0



ASSEMBLY
SCALE: 1" = 20'

PROJECT SUMMARY

CALCULATION DETAILS
- LENGTH PER BARREL = 158 FT
- LENGTH PER HEADER = 74 FT
- LOADING = H20 & H25
- APPROX. CMP FOOTAGE = 2,518 FT

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED 43,599 CF
- PIPE STORAGE = 31,642 CF
- STRUCTURAL BACKFILL STORAGE = 12,130 CF
- TOTAL STORAGE PROVIDED = 43,772 CF

PIPE DETAILS
- DIAMETER = 48 IN
- CORRUGATION = 2-2/3" X 1/2"
- GAGE = 16
- COATING = ALUMINIZED STEEL TYPE 2 (ALT2)
- WALL TYPE = PERFORATED
- BARREL SPACING = 12 IN

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

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

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 2 ⅔" 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.

C:\DYODS\DATA\CP\DYODS_10486-1.DWG 3/11/2019 5:02 PM

MARK	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

DYODS - 10486-1-0
PROJECT NAME: Top Golf
County of San Bernardino, CA
DESCRIPTION: ONSITE INFILTRATION-DA-2

PROJECT No.:	SEQ. No.:	DATE:
10486-1	0	3/11/2019
DESIGNED: DYODS	DRAWN: DYODS	
CHECKED:	APPROVED:	
SHEET NO.: D1		

CONTECH ENGINEERED SOLUTIONS

Date: 3/11/19
Project Name: Top Golf

City / County: County of San Bernardino
State: CA

Designed By: Moyenuddin Sirajee
Company:
Telephone: (909) 581-6128

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

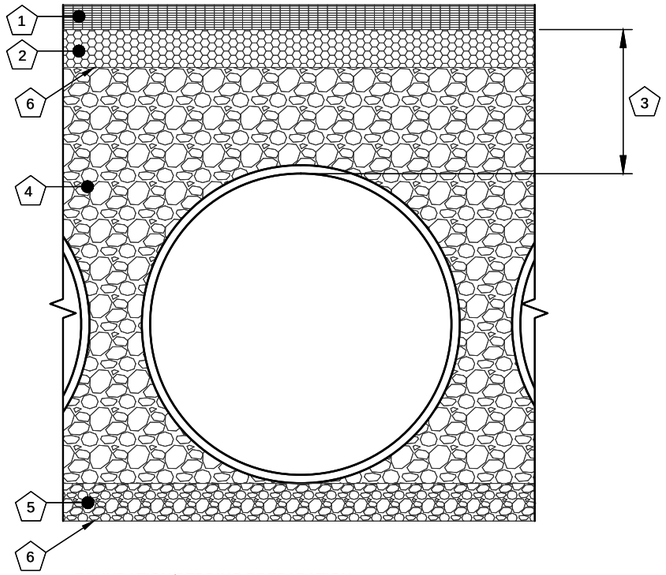
Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	166.0	Backfill Porosity (%):	35%	System Diameter (in):	48
Out-to-out width (ft):	74.0	Depth Above Pipe (in):	6.0	Pipe Spacing (in):	12
Number of Manifolds (ea):	2.0	Depth Below Pipe (in):	6.0	Incremental Analysis (in):	2
Number of Barrels (ea):	15.0	Width At Ends (ft):	2.0	System Invert (Elevation):	0
		Width At Sides (ft):	2.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	4,641.0
0.17	0.16	0.0	0.0	773.5	773.5	773.5	773.5	0.0%	4,641.0
0.33	0.33	0.0	0.0	773.5	1,547.0	773.5	1,547.0	0.0%	4,641.0
0.50	0.50	0.0	0.0	773.5	2,320.5	773.5	2,320.5	0.0%	4,641.0
0.67	0.66	451.1	451.1	615.6	2,936.1	1,066.7	3,387.2	13.3%	7,257.4
0.83	0.83	808.3	1,259.4	490.6	3,426.7	1,298.9	4,686.1	26.9%	8,259.9
1.00	1.00	1,023.4	2,282.9	415.3	3,842.0	1,438.7	6,124.9	37.3%	8,971.3
1.17	1.16	1,183.5	3,466.4	359.3	4,201.3	1,542.8	7,667.7	45.2%	9,520.7
1.33	1.33	1,309.4	4,775.8	315.2	4,516.5	1,624.6	9,292.3	51.4%	9,958.5
1.50	1.50	1,410.3	6,186.1	279.9	4,796.4	1,690.2	10,982.4	56.3%	10,310.7
1.67	1.66	1,491.3	7,677.3	251.6	5,047.9	1,742.8	12,725.3	60.3%	10,592.4
1.83	1.83	1,555.6	9,232.9	229.1	5,277.0	1,784.6	14,509.9	63.6%	10,813.4
2.00	2.00	1,605.1	10,838.0	211.7	5,488.7	1,816.8	16,326.7	66.4%	10,979.9
2.17	2.16	1,641.3	12,479.3	199.0	5,687.7	1,840.4	18,167.1	68.7%	11,096.2
2.33	2.33	1,665.0	14,144.3	190.7	5,878.5	1,855.8	20,022.8	70.6%	11,165.0
2.50	2.50	1,676.7	15,821.1	186.6	6,065.1	1,863.4	21,886.2	72.3%	11,187.8
2.67	2.66	1,676.7	17,497.8	186.6	6,251.8	1,863.4	23,749.6	73.7%	11,165.0
2.83	2.83	1,665.0	19,162.8	190.7	6,442.5	1,855.8	25,605.3	74.8%	11,096.2
3.00	3.00	1,641.3	20,804.1	199.0	6,641.6	1,840.4	27,445.7	75.8%	10,979.9
3.17	3.16	1,605.1	22,409.2	211.7	6,853.3	1,816.8	29,262.5	76.6%	10,813.4
3.33	3.33	1,555.6	23,964.8	229.1	7,082.3	1,784.6	31,047.1	77.2%	10,592.4
3.50	3.50	1,491.3	25,456.1	251.6	7,333.9	1,742.8	32,789.9	77.6%	10,310.7
3.67	3.66	1,410.3	26,866.3	279.9	7,613.8	1,690.2	34,480.1	77.9%	9,958.5
3.83	3.83	1,309.4	28,175.7	315.2	7,929.0	1,624.6	36,104.7	78.0%	9,520.7
4.00	4.00	1,183.5	29,359.2	359.3	8,288.3	1,542.8	37,647.5	78.0%	8,971.3
4.17	4.16	1,023.4	30,382.7	415.3	8,703.6	1,438.7	39,086.2	77.7%	8,259.9
4.33	4.33	808.3	31,191.0	490.6	9,194.1	1,298.9	40,385.2	77.2%	7,257.4
4.50	4.50	451.1	31,642.1	615.6	9,809.8	1,066.7	41,451.9	76.3%	4,641.0
4.67	4.66	0.0	31,642.1	773.5	10,583.3	773.5	42,225.4	74.9%	4,641.0
4.83	4.83	0.0	31,642.1	773.5	11,356.8	773.5	42,998.9	73.6%	4,641.0
5.00	5.00	0.0	31,642.1	773.5	12,130.3	773.5	43,772.4	72.3%	4,641.0



KEY

1.) RIGID OR FLEXIBLE PAVEMENT

2.) GRANULAR ROAD BASE

3.) 12" MIN. FOR DIAMETERS THROUGH 96"
18" MIN. FOR DIAMETERS FROM 102"
AND LARGER MEASURED TO TOP OF
RIGID OR BOTTOM OF FLEXIBLE
PAVEMENT.

4.) FREE DRAINING ANGULAR WASHED
STONE 3/4" - 2" MIN. PARTICLE SIZE.

5.) GRANULAR BEDDING, ROUGHLY
SHAPED TO FIT THE BOTTOM OF PIPE,
4"- 6" IN DEPTH.

6.) CONTECH C-40 OR C-45
NON-WOVEN GEOTEXTILE
REQUIRED, WRAPPING TRENCH
ONLY.

FOUNDATION/BEDDING PREPARATION

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. ONCE THE FOUNDATION PREPARATION IS COMPLETE, THE 4 INCHES OF A WELL-GRADED GRANULAR MATERIAL SHALL BE PLACED AS THE BEDDING.

BACKFILL

THE BACKFILL MATERIAL SHALL BE FREE-DRAINING ANGULAR WASHED STONE 3/4" - 2" PARTICLE SIZE. MATERIAL SHALL BE PLACED IN 8"-10" MAXIMUM LIFTS. MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR-TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS COMPACTION IS 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. 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, AND MAINTAINING BALANCED LOADING ON ALL PIPES IN THE SYSTEM, DURING ALL SUCH OPERATIONS.

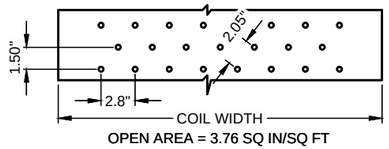
OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS. REFER TO TYPICAL BACKFILL DETAIL FOR MATERIAL REQUIRED.

BACKFILL DETAIL

SCALE: N.T.S.

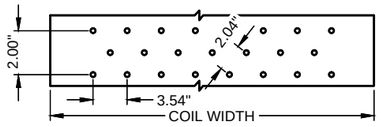
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

2 2/3" x 1/2" CORRUGATION - STEEL AND ALUMINUM CMP
EDGE SPACING EQUAL ON BOTH SIDES



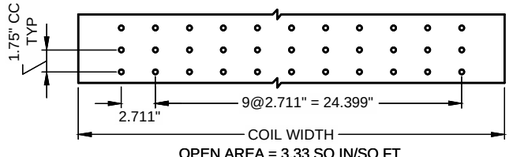
OPEN AREA = 3.76 SQ IN/SQ FT

3" x 1" CORRUGATION - STEEL AND ALUMINUM CMP
(COIL PROVIDED FROM CONTECH LANTANA, FL PLANT)



OPEN AREA = 4.16 SQ IN/SQ FT

5" x 1" CORRUGATION - STEEL ONLY
EDGE SPACING EQUAL ON BOTH SIDES



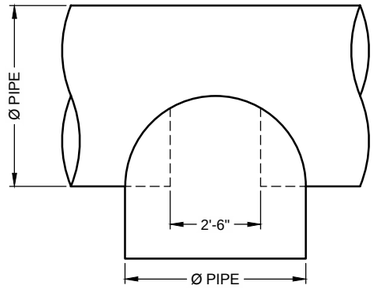
OPEN AREA = 3.33 SQ IN/SQ FT

NOTES:

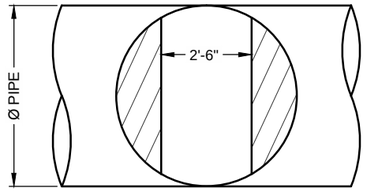
1. PERFORATIONS MEET AASHTO AND ASTM SPECIFICATIONS.
2. PERFORATION OPEN AREA PER SQUARE FOOT OF PIPE IS BASED ON THE NOMINAL DIAMETER AND LENGTH OF PIPE.
3. ALL DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
4. ALL HOLES Ø3/8".

TYPICAL PERFORATION DETAIL

SCALE: N.T.S.



PLAN

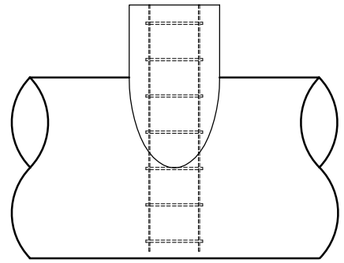


FRONT

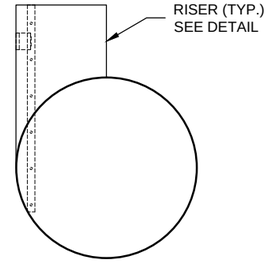
NOTE:
MANWAY DETAIL APPLICABLE FOR CMP SYSTEMS WITH DIAMETERS 48" AND LARGER. MANWAYS MAY BE REQUIRED ON SMALLER SYSTEMS DEPENDING ON ACTUAL SITE SPECIFIC CONDITIONS.

TYPICAL MANWAY DETAIL

SCALE: N.T.S.



ELEVATION

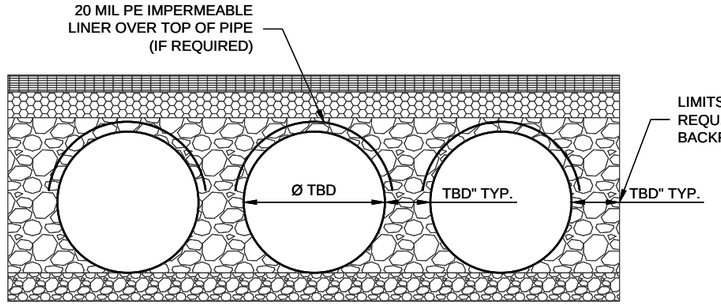


END

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

TYPICAL RISER DETAIL

SCALE: N.T.S.



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, 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 A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

MARK	DATE	REVISION DESCRIPTION	BY

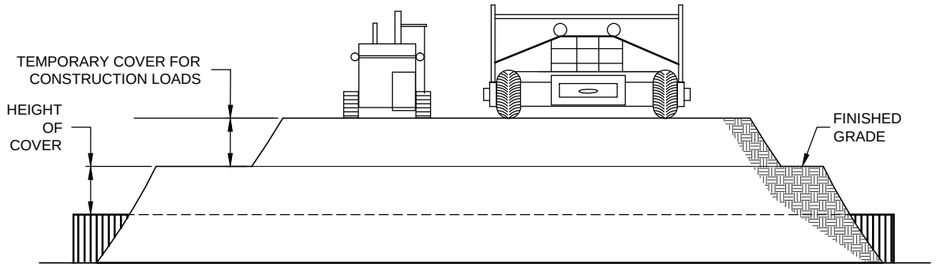
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH
DYODS
DRAWING

DYODS - 10486-1-0
PROJECT NAME: Top Golf
County of San Bernardino, CA
DESCRIPTION: ONSITE INFILTRATION-DA-2

PROJECT No.:	SEQ. No.:	DATE:
10486-1	0	3/11/2019
DESIGNED: DYODS	DRAWN: DYODS	
CHECKED:	APPROVED:	
SHEET NO.: D2		

C:\DYODS\DATA\CP\C\DYODS_10486-1.DWG 3/11/2019 5:03 PM



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 APPLICABLE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

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

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

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS 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.

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

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

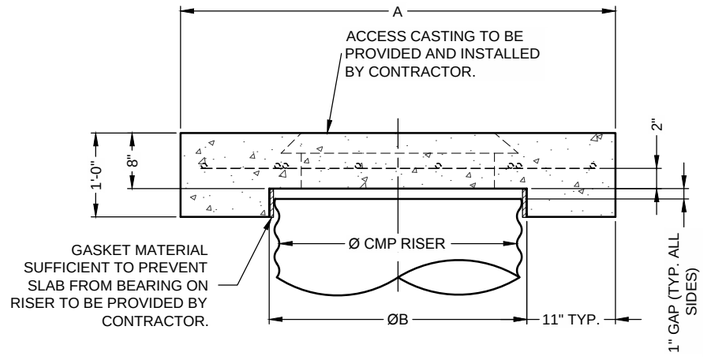
POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.

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.

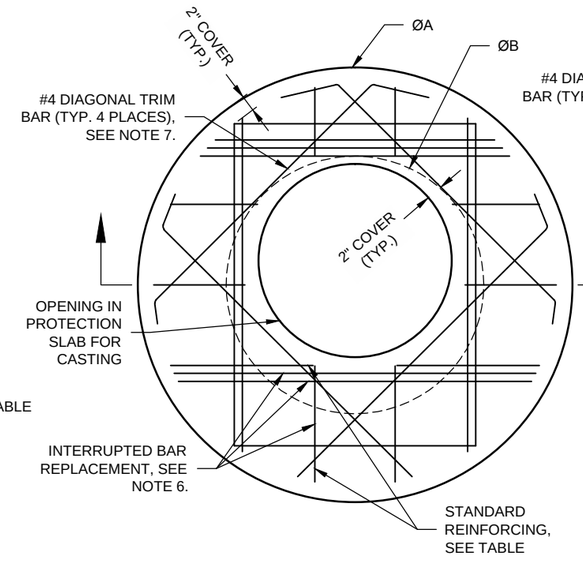
IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.



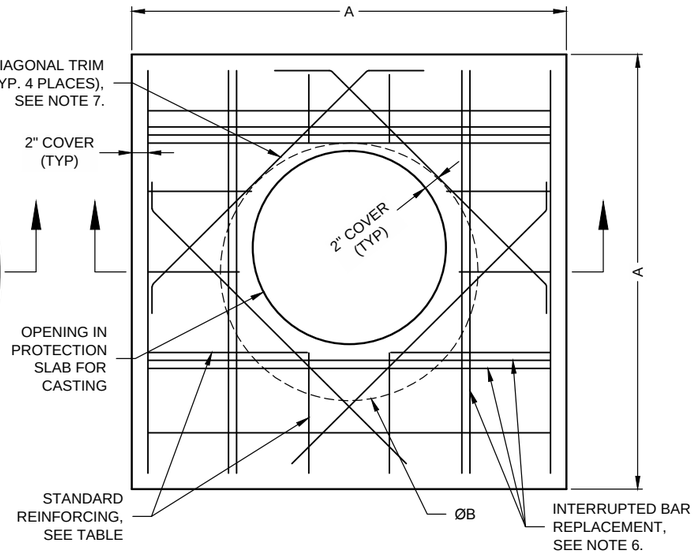
SECTION VIEW

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

MARK	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

DYODS - 10486-1-0
PROJECT NAME: Top Golf
County of San Bernardino, CA
DESCRIPTION: ONSITE INFILTRATION-DA-2

PROJECT No.:	SEQ. No.:	DATE:
10486-1	0	3/11/2019
DESIGNED: DYODS	DRAWN: DYODS	
CHECKED:	APPROVED:	
SHEET NO.: D3		

C:\DYODS\DATA\CP\CIDYODS_10486-1.DWG 3/11/2019 5:03 PM

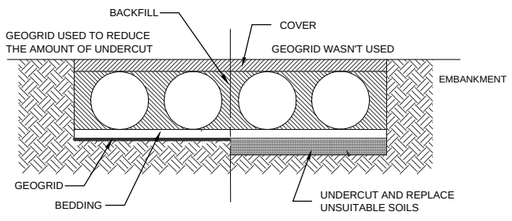
CMP DETENTION INSTALLATION GUIDE

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.



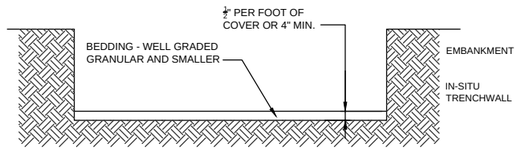
GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING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

BEDDING

A 4 TO 6-INCH THICK, WELL-GRADED, GRANULAR MATERIAL IS THE PREFERRED PIPE BEDDING. IF CONSTRUCTION EQUIPMENT WILL OPERATE FOR AN EXTENDED PERIOD OF TIME ON THE BEDDING, USE EITHER AN ENGINEERING FABRIC OR A STIFF GEOGRID TO ENSURE THE BASE MATERIAL MAINTAINS ITS INTEGRITY.

USING AN OPEN-GRADED BEDDING MATERIAL IS ACCEPTABLE; HOWEVER, AN ENGINEERING FABRIC SEPARATOR IS REQUIRED BETWEEN THE BASE AND THE SUBGRADE.

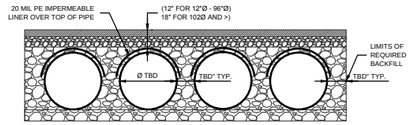
GRADE THE BASE TO A SMOOTH, UNIFORM GRADE TO ALLOW FOR THE PROPER PLACEMENT OF THE PIPE.



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.



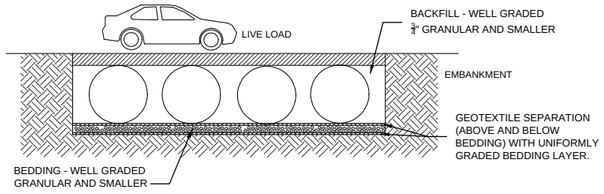
IN-SITU TRENCH WALL

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 MATERIAL

TYPICALLY, THE BEST BACKFILL MATERIAL IS AN ANGULAR, WELL-GRADED, GRANULAR FILL MEETING THE REQUIREMENTS OF AASHTO A-1, A-2 OR A-3. IN SOME CASES, IT MAY BE DESIRABLE TO USE A UNIFORMLY GRADED MATERIAL FOR THE FIRST 18- TO 24-INCHES. THIS TYPE OF MATERIAL IS EASIER TO PLACE UNDER THE HAUNCHES OF THE PIPE AND REQUIRES LITTLE COMPACTIVE EFFORT. DEPENDING ON THE BEDDING MATERIAL, A SEPARATION GEOTEXTILE MIGHT BE REQUIRED ABOVE AND BELOW THESE INITIAL LIFTS.

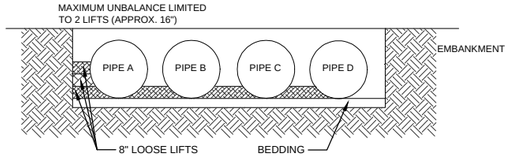


OPEN-GRADED FILL IS TYPICALLY NOT USED BEYOND THE INITIAL 18- TO 24-INCHES BECAUSE THIS TYPE OF FILL OFTEN DOES NOT PROVIDE ADEQUATE CONFINING RESTRAINT TO THE PIPES. IF A UNIFORMLY GRADED MATERIAL (PARTICLES ALL ONE SIZE) IS USED, INSTALL A GEOTEXTILE SEPARATION FABRIC TO PREVENT THE MIGRATION OF FINES INTO THE BACKFILL.

BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM OR "FLOWABLE FILL") WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. WORK CLOSELY WITH THE LOCAL CONTECH SALES ENGINEER REGARDING THE SPECIAL INSTALLATION TECHNIQUES REQUIRED WHEN USING CLSM.

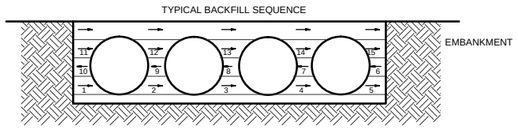
BACKFILL PLACEMENT

PLACE BACKFILL IN 8-INCH LOOSE LIFTS AND COMPACT TO 90% AASHTO T99 STANDARD PROCTOR DENSITY. MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

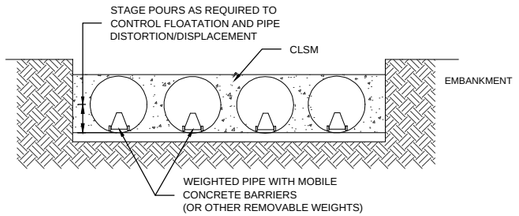


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE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

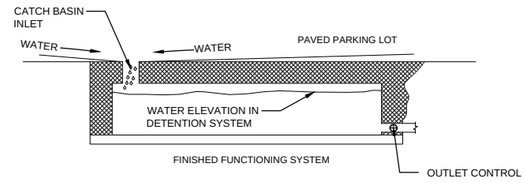


CONSTRUCTION LOADING

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, QUARTERLY 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.

SYSTEMS ARE TO BE RINSED, INCLUDING ABOVE THE SPRING LINE, ANNUALLY SOON AFTER THE SPRING THAW, AND AFTER ANY ADDITIONAL USE OF SALTING AGENTS, AS PART OF THE MAINTENANCE PROGRAM FOR ALL SYSTEMS WHERE SALTING AGENTS MAY ACCUMULATE INSIDE THE PIPE.

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.

MARK	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

DYODS - 10486-1-0
PROJECT NAME: Top Golf
County of San Bernardino, CA
DESCRIPTION: ONSITE INFILTRATION-DA-2

PROJECT No.:	SEQ. No.:	DATE:
10486-1	0	3/11/2019
DESIGNED: DYODS	DRAWN: DYODS	
CHECKED:	APPROVED:	
SHEET NO.: D4		

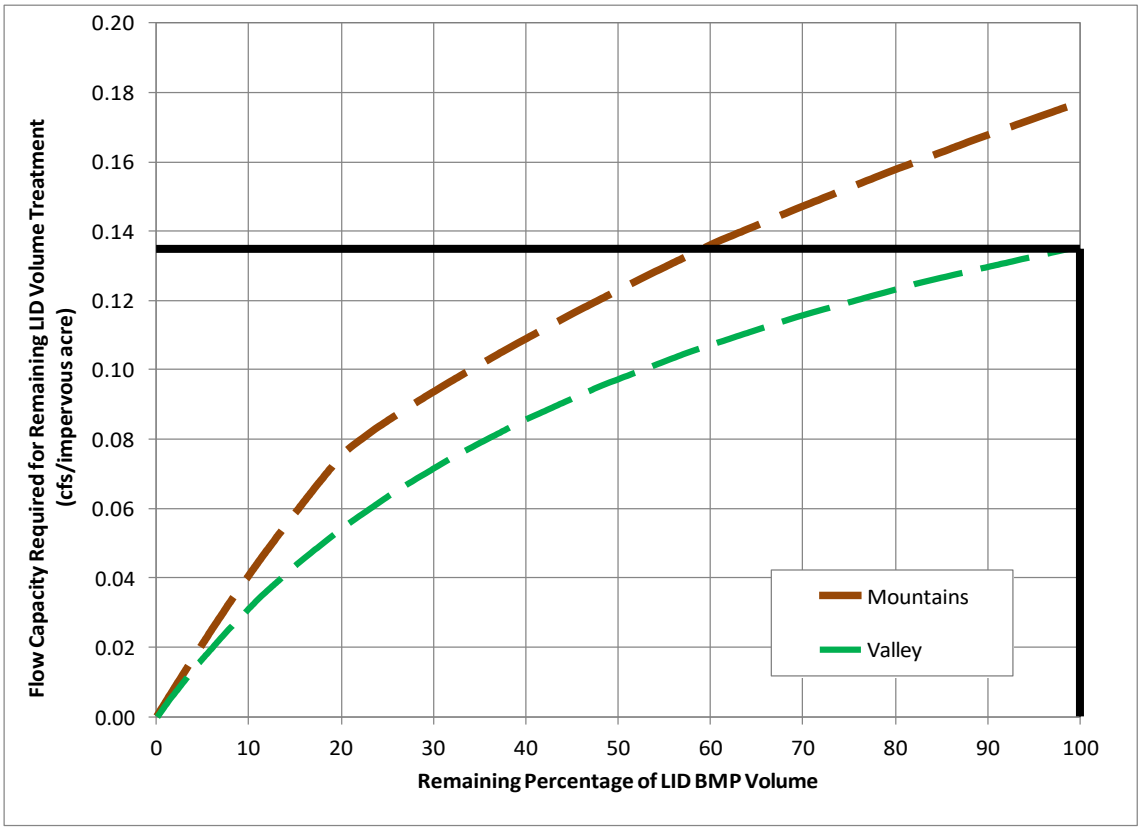


Figure 5-2. Nomograph for Determining Flow-based BMP Capacity Requirement to meet Remaining Unmet DCV

Flow rate for Valley area is 0.135 cfs/ impervious acre

Pretreatment Flow rate for DA1:

Impervious area=3.30 acre
$Q_{Pretreatment}$ = 3.30X0.135=0.45CFS
Model #CDS2015-4 can treat up to 0.5cfs > 0.45cfs

Pretreatment Flow rate for DA2:

Impervious area=8.19 acre
$Q_{Pretreatment}$ = 8.19X0.135=1.11CFS
Model #CDS3020-6 can treat up to 1.4cfs > 1.11cfs



CONTECH®
ENGINEERED SOLUTIONS

CDS®

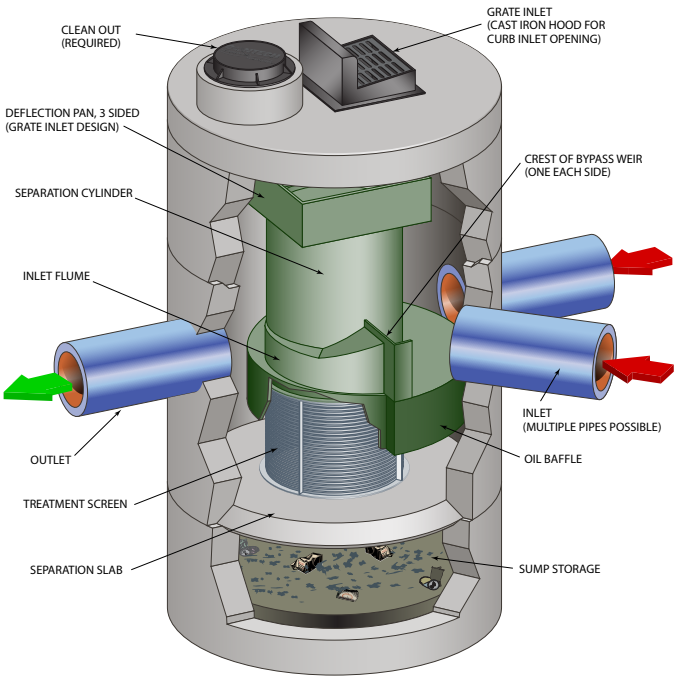
Solutions Guide

Continuous Deflective Separation - CDS®

Superior Stormwater Trash and Sediment Removal

The CDS is a swirl concentrator hybrid technology that uses continuous deflective separation – a combination of swirl concentration and indirect screening to screen, separate and trap debris, sediment, and hydrocarbons from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material debris 2.4 mm or larger, without binding. CDS retains all captured pollutants, even at high flow rates, and provides easy access for maintenance.

CDS is used to meet trash Total Maximum Daily Load (TMDL) requirements, for stormwater quality control, inlet and outlet pollution control, and as pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and a variety of green infrastructure practices.



Learn more about the CDS system at www.ContechES.com/CDS ❖ ❖ ❖

CDS® Approvals

CDS has been verified by some of the most stringent stormwater technology evaluation organizations in North America, including:

- Washington State Department of Ecology
- New Jersey Department of Environmental Protection
- Canadian Environmental Technology Verification (ETV)
- California Statewide Trash Amendments Full Capture System Certified*

Performance Claim Verified by the Canadian ETV Program

** The CDS System has been certified by the California State Water Resources Control Board as a Full Capture System provided that it is sized to treat the peak flow rate from the region specific 1-year, 1-hour design storm, or the peak flow capacity of the corresponding storm drain, whichever is less.*

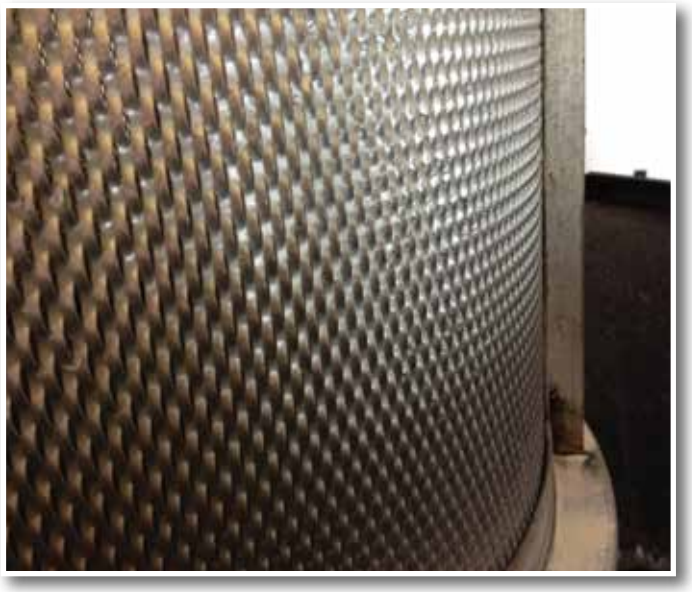
CDS® Features & Benefits

Feature	Benefit
1. Captures and retains 100% of floatables and neutrally buoyant debris 2.4 mm or larger	1. Superior pollutant removal
2. Self-cleaning screen	2. Ease of maintenance
3. Isolated storage sump eliminates scour potential	3. Excellent pollutant retention
4. Internal bypass	4. Eliminates the need for additional structures
5. Multiple pipe inlets and 90-180° angles	5. Design flexibility
6. Numerous regulatory approvals	6. Proven performance

The CDS® Screen

Traditional approaches to trash control typically involve "direct screening" that can easily become clogged, as trash is pinned to the screen as water passes through. Clogged screens can lead to flooding as water backs up.

The design of the CDS screen is fundamentally different. Flow is introduced to the screen face which is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder.

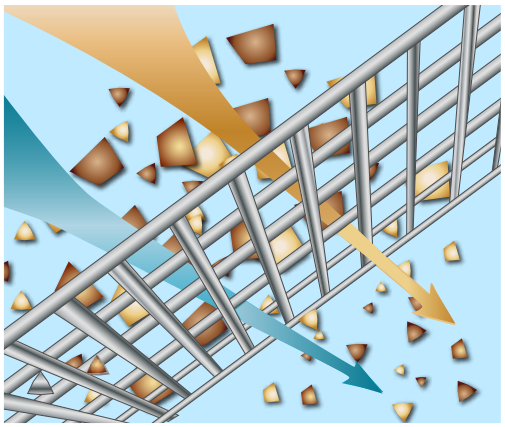


Key Features:

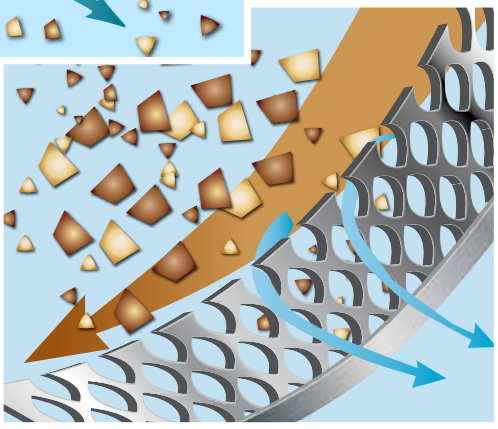
Self-Cleaning Screening Technology

- CDS Screen captures neutrally buoyant materials missed by other separator systems.
- Screen is hydraulically designed to be self-cleaning.
- Runoff entering the separation cylinder must pass through the screen prior to discharge, eliminating potential for scouring previously captured trash at high flow rates.

The CDS Screen – Self-Cleaning Screening Technology ❖ ❖ ❖



Direct Screening – particles that are larger than the aperture size of the screen can cause clogging, resulting in flooding if not maintained frequently.



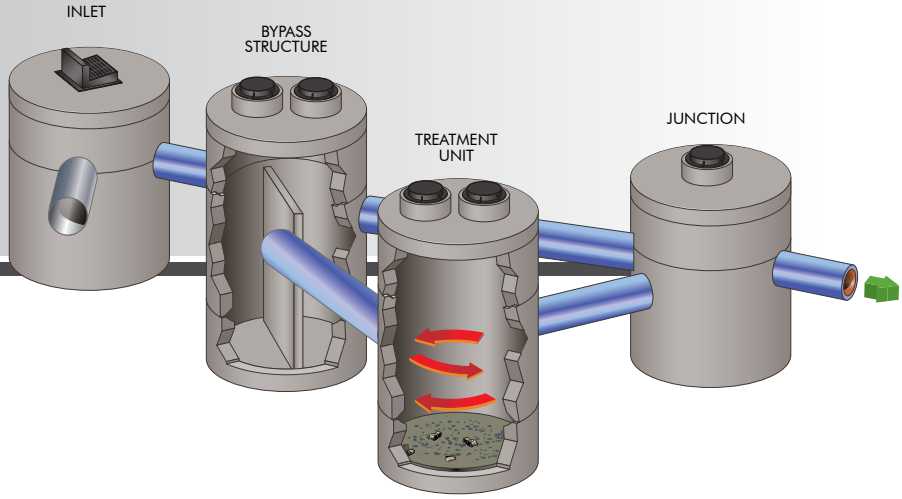
Continuous Deflective Separation Indirect Screening – water velocities within the swirl chamber continually shear debris off the screen to keep it clean.

CDS® Configuration - One System that Can Do It All!

The CDS effectively treats stormwater runoff while reducing the number of structures on your site.

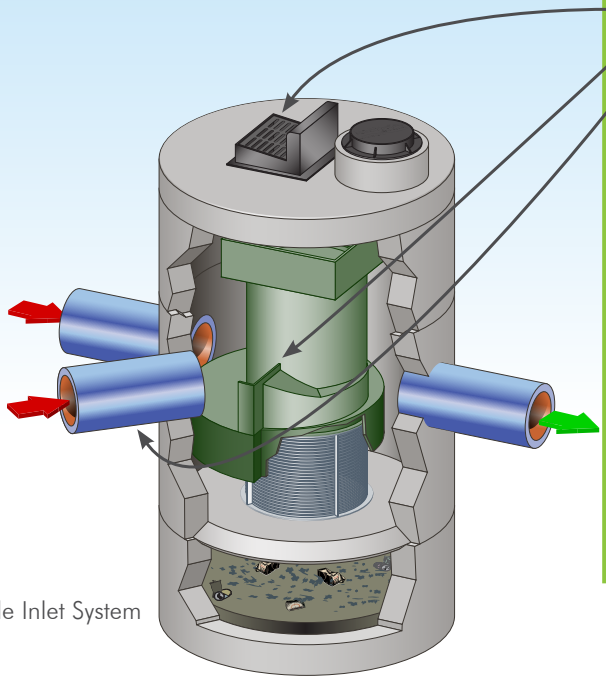
WHY GO THROUGH ALL THIS?

TRADITIONAL STORMWATER TREATMENT SITE DESIGN



ONE SYSTEM CAN DO IT ALL!

- Inline, offline, grate inlet, and drop inlet configurations available
- Internal and external peak bypass options available



CDS® Multiple Inlet System

Save Time, Space, and Money with CDS®

- Grate inlet option available
- Internal bypass weir
- Accepts multiple inlets at a variety of angles
- Advanced hydrodynamic separator
- Captures and retains 100% of floatables and neutrally buoyant debris 2.4 mm or larger
- Indirect screening capability keeps screen from clogging
- Retention of all captured pollutants, even at high flows
- Performance verified by NJCAT, WA Ecology, and ETV Canada

CDS® Applications

CDS is commonly used in the following stormwater applications:

- Stormwater quality control – trash, debris, sediment, and hydrocarbon removal
- Urban retrofit and redevelopment
- Inlet and outlet protection
- Pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and Low Impact Development designs.

CDS provides trash control.

CDS pretreats a bioswale.

CDS pretreats a rainwater harvesting cistern.

CDS standalone system removes trash and sediment.

CDS® Models and Capacities

	CDS MODEL	Treatment Flow Rates[1]			Estimated Maximum Peak Conveyance Flow[3] (cfs)/(L/s)	Minimum Sump Storage Capacity[4] (yd^3)/(m^3)	Minimum Oil Storage Capacity[4] (gal)/(L)
		75 microns (cfs)/(L/s)	125 microns[2] (cfs)/(L/s)	Trash & Debris (cfs)/(L/s)			
PRECAST	CDS2015-4	0.5 (14.2)	0.7 (19.8)	1.0 (28.3)	10 (283)	0.9 (0.7)	61 (232)
	CDS2015-5	0.5 (14.2)	0.7(19.8)	1.0 (28.3)	10 (283)	1.5 (1.1)	83 (313)
	CDS2020-5	0.7 (19.8)	1.1 (31.2)	1.5 (42.5)	14 (396)	1.5 (1.1)	99 (376)
	CDS2025-5	1.1 (31.2)	1.6 (45.3)	2.2 (62.3)	14 (396)	1.5 (1.1)	116 (439)
	CDS3020-6	1.4 (39.6)	2.0 (56.6)	2.8 (79.3)	20 (566)	2.1 (1.6)	184 (696)
	CDS3025-6	1.7 (48.1)	2.5 (70.8)	3.5 (99.2)	20 (566)	2.1 (1.6)	210 (795)
	CDS3030-6	2.0 (56.6)	3.0 (85.0)	4.2 (118.9)	20 (566)	2.1 (1.6)	236 (895)
	CDS3035-6	2.6 (73.6)	3.8 (106.2)	5.3 (150.0)	20 (566)	2.1 (1.6)	263 (994)
	CDS4030-8	3.1 (87.7)	4.5 (127.4)	6.3 (178.3)	30 (850)	5.6 (4.3)	426 (1612)
	CDS4040-8	4.1 (116.1)	6.0 (169.9)	8.4 (237.8)	30 (850)	5.6 (4.3)	520 (1970)
	CDS4045-8	5.1 (144.4)	7.5 (212.4)	10.5 (297.2)	30 (850)	5.6 (4.3)	568 (2149)
	CDS5640-10	6.1 (172.7)	9.0 (254.9)	12.6 (356.7)	50 (1416)	8.7 (6.7)	758 (2869)
	CDS5653-10	9.5 (268.9)	14.0 (396.5)	19.6 (554.8)	50 (1416)	8.7 (6.7)	965 (3652)
	CDS5668-10	12.9 (365.1)	19.0 (538.1)	26.6 (752.9)	50 (1416)	8.7 (6.7)	1172 (4435)
	CDS5678-10	17.0 (481.2)	25.0 (708.0)	35.0 (990.7)	50 (1416)	8.7 (6.7)	1309 (4956)
	CDS9280-12	27.2 (770.2)	40.0 (1132.7)	56.0 (1585.7)	Offline	16.8 (12.8)	N/A
	CDS9290-12	35.4 (1002.4)	52.0 (1472.5)	72 (2038.8)		16.8 (12.8)	
	CDS92100-12	42.8 (1212.0)	63.0 (1783.9)	88 (2491.9)		16.8 (12.8)	
CAST-IN-PLACE	CDS150134-22	100.7 (2851.5)	148.0 (4190.9)	270 (7645.6)		56.3 (43.0)	
	CDS200164-26	183.6 (5199.0)	270.0 (7645.6)	378.0 (10703.8)		78.7 (60.2)	
	CDS240160-32	204 (5776.6)	300.0 (8495.1)	420.0 (11893.0)		119.1 (91.1)	
	Additional Cast-in-Place models available upon request.						

1. Alternative PSD/D_{50} sizing is available upon request.
2. 125 micron flows are based on the CDS Washington State Department of Ecology approval for 80% removal of a particle size distribution (PSD) having a mean particle size (D_{50}) of 125 microns.
3. Estimated maximum peak conveyance flow is calculated using conservative values and may be exceeded on sites with lower inflow velocities and sufficient head over the weir.
4. Sump and oil capacities can be customized to meet site needs.

CDS® Maintenance

Systems vary in their maintenance needs, and the selection of a cost-effective and easy-to-access treatment system can mean a huge difference in maintenance expenses for years to come.

A CDS unit is designed to minimize maintenance and make it as easy and inexpensive as possible to keep our systems working properly.

Most CDS units can easily be cleaned in 30 minutes.

Inspection

Inspection is the key to effective maintenance. Pollutant deposition and transport may vary from year to year and site to site. Semi-annual inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed more frequently where site conditions may cause rapid accumulation of pollutants.

Recommendations for CDS Maintenance

The recommended cleanout of solids within the CDS unit's sump should occur at 75% of the sump capacity. Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber and sump, and another allows inspection and cleanout of sediment captured and retained behind the screen. A vacuum truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30 minutes for most installations.

DYOHDS™ Tool

Design Your Own Hydrodynamic Separator

Features

- Choose from three HDS technologies - CDS®, Vortechs® and VortSentry® HS
- Site specific questions ensure the selected unit will comply with site constraints
- Unit size based on selected mean particle size and targeted removal percentage
- Localized rainfall data allows for region specific designs
- PDF report includes detailed performance calculations, specification and standard drawing for the unit that was sized

DYO Project design made easy.

Design Your Own (DYO) Hydrodynamic Separator online at www.ContechES.com/dyohds

Next Steps

Learn more

See our CDS systems in action at **www.ContechES.com/videos**

Connect with Us

We're here to make your job easier – and that includes being able to get in touch with us when you need to. **www.ContechES.com/localresources**

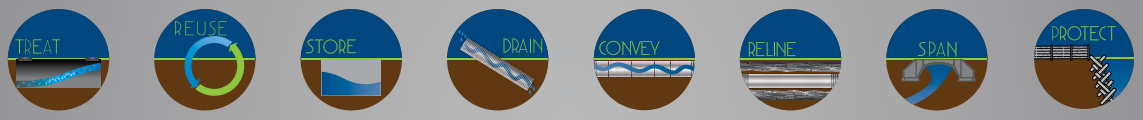
Start a Project

If you are ready to begin a project, visit us at **www.ContechES.com/startaproject**

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, retaining walls, sanitary sewer, stormwater, erosion control and soil stabilization products.

CONTECH® ENGINEERED SOLUTIONS

COMPLETE SITE SOLUTIONS



Stormwater Solutions

Helping to satisfy stormwater management requirements on land development projects

- Stormwater Treatment
- Detention/Infiltration
- Rainwater Harvesting
- Biofiltration/Bioretention

Pipe Solutions

Meeting project needs for durability, hydraulics, corrosion resistance, and stiffness

- Corrugated Metal Pipe (CMP)
- Steel Reinforced Polyethylene (SRPE)
- High Density Polyethylene (HDPE)
- Polyvinyl Chloride (PVC)

Structures Solutions

Providing innovative options and support for crossings, culverts, and bridges

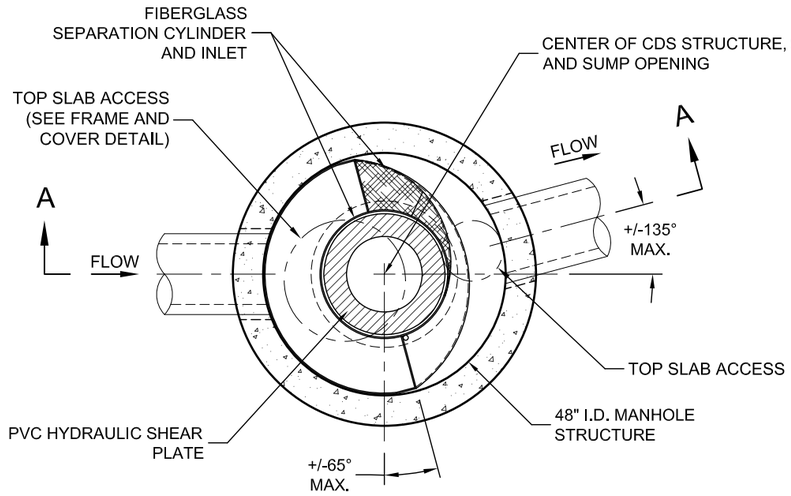
- Plate, Precast & Truss bridges
- Hard Armor
- Retaining Walls
- Tunnel Liner Plate

Get Social With Us!

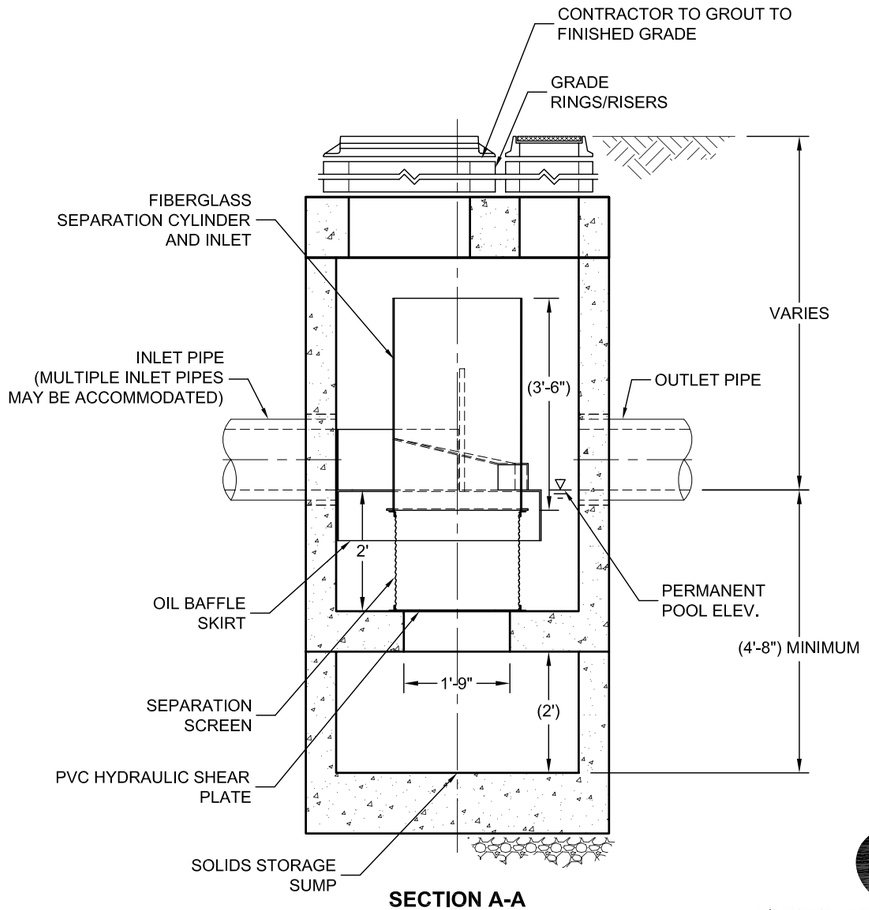
CONTECH® ENGINEERED SOLUTIONS

800-338-1122 | www.ContechES.com

CDS Brochure - 03/2018



PLAN VIEW
N.T.S.



SECTION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS2015-4 DESIGN NOTES

CDS2015-4 RATED TREATMENT CAPACITY IS 0.7 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 10.0 CFS. IF THE SITE CONDITIONS EXCEED 10.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS2015-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRATED INLET ONLY (NO INLET PIPE)
GP	GRATED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES

FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

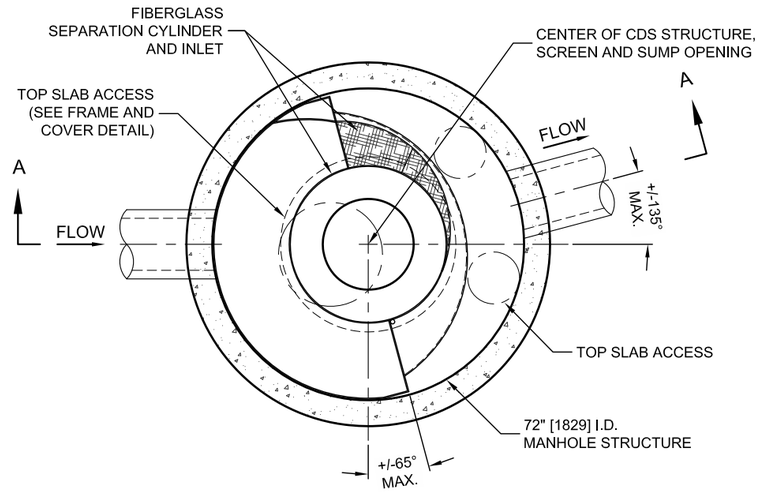
GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE AND CASTINGS SHALL MEET AASHTO HS20 LOAD RATING.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

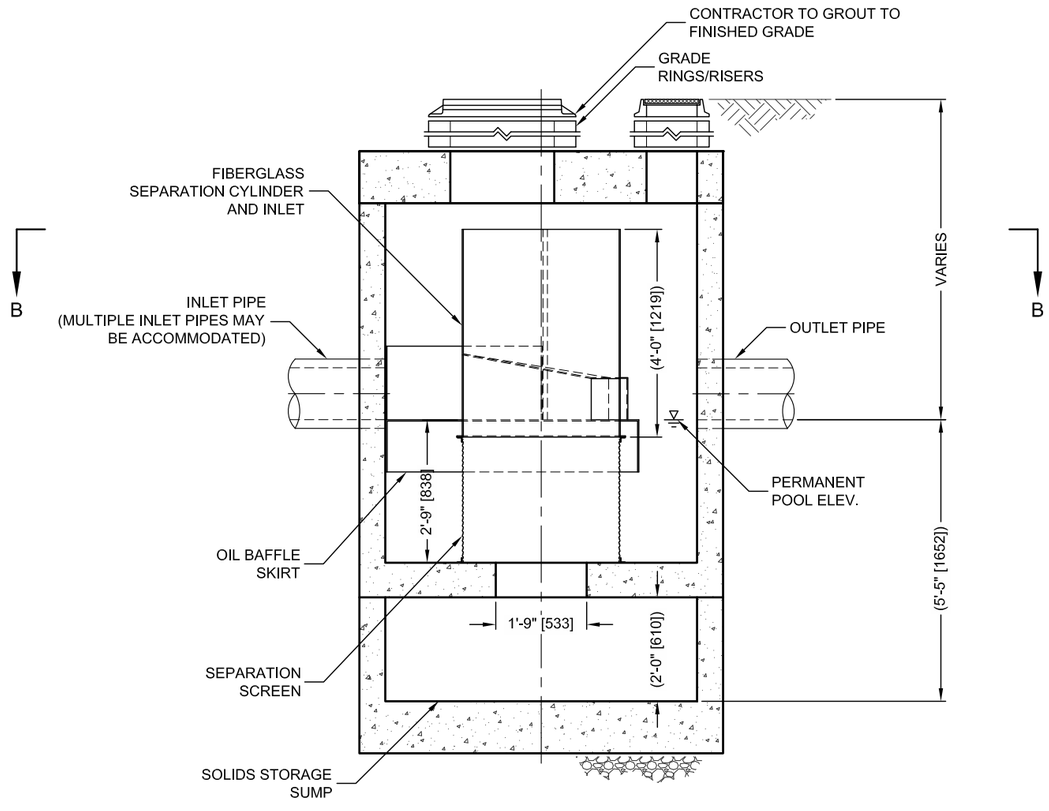
CONTECH STORMWATER SOLUTIONS
contechstormwater.com

CDS2015-4
PRECAST CONCRETE WATER QUALITY SYSTEM
STANDARD DETAIL

I:\STORMWATER\DRAFTING\TEMPLATES\CAD STANDARDS\PRODUCT SUBMITTAL DRAWINGS (CURRENT)\CDS\CDS STD DETAIL\CDS2015-4-STD.DWG 7/21/2008 11:52 AM



PLAN VIEW B-B
N.T.S.

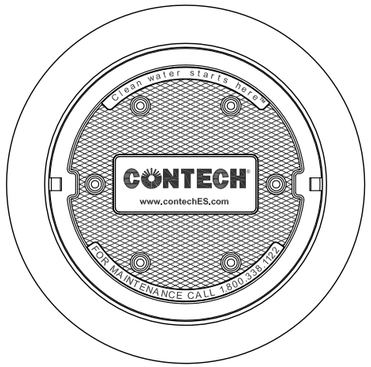


ELEVATION A-A
N.T.S.

CDS3020-6-C DESIGN NOTES

THE STANDARD CDS3020-6-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

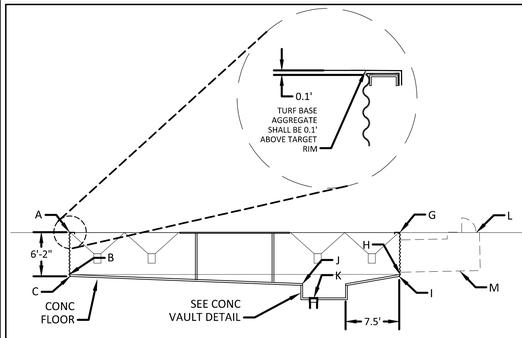
* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

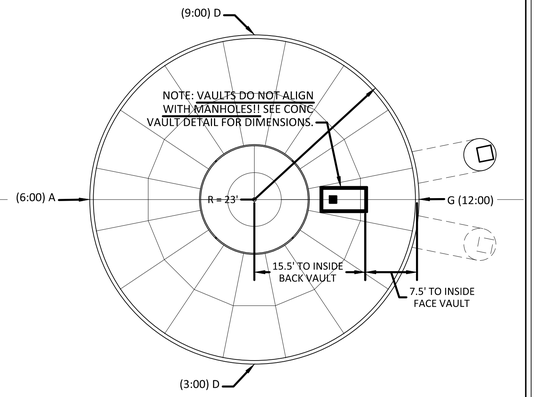
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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

CDS3020-6-C
INLINE CDS
STANDARD DETAIL



SECTION



PLAN

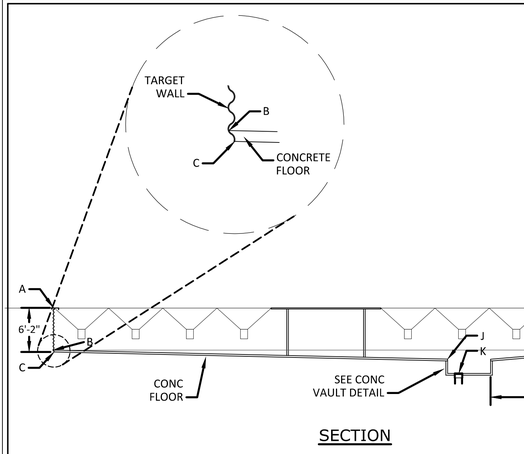
YELLOW (46' DIA.) TARGETS - (QTY 2)

SCALE: 1" = 10'

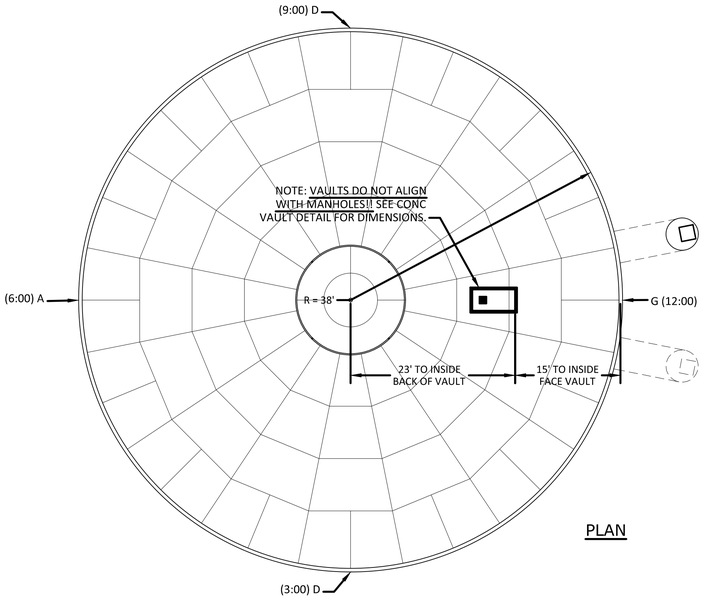
TOPGOLF Ontario - TARGET ELEVATIONS

	Yardage	Dia.	Inside Wall Ht.	Pitch	6:00 Wall Elev			3:00/9:00 Wall Elev			12:00 Wall Elev			Ball Collection Vault		Access Manhole and Tunnel			
	(YDS)	(FT)	(FT)	(FT)	Rim	Floor	Subgrade	Rim	Floor	Subgrade	Rim	Floor	Subgrade	Target Floor	Vault Floor	Plan Rim	Floor	Std. Rim	Delta
COL LN J.5	-	-	-	-	A	B	C	D	E	F	G	H	I	J	K	L	M	-	-
Red 1	25	15	5.92	0	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1014.48	NA	1021.00	1015.00	1021.00	0.00
Red 2	25	15	5.92	0	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1014.48	NA	1021.00	1015.00	1021.00	0.00
Red 3	25	15	5.92	0	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1014.48	NA	1021.00	1015.00	1021.00	0.00
Red 4	25	15	5.92	0	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1020.90	1014.98	1014.73	1014.48	NA	1021.00	1015.00	1021.00	0.00
Yellow 1	50	46	5.92	0	1019.90	1013.98	1013.73	1019.90	1013.98	1013.73	1019.90	1013.98	1013.73	1012.98	1010.98	1020.00	1014.00	1020.00	0.00
Yellow 2	50	46	5.92	0	1019.90	1013.98	1013.73	1019.90	1013.98	1013.73	1019.90	1013.98	1013.73	1012.98	1010.98	1020.00	1014.00	1020.00	0.00
Green	90	76	5.92	0.5	1018.90	1012.98	1012.73	1019.15	1013.23	1012.98	1019.40	1013.48	1013.23	1011.98	1009.98	1019.50	1013.60	1019.50	0.00
Brown	125	76	5.92	1.5	1019.90	1013.98	1013.73	1020.65	1014.73	1014.48	1021.40	1015.48	1015.23	1012.98	1010.98	1021.60	1015.70	1021.60	0.00
Blue	150	76	5.92	2.5	1021.40	1015.48	1015.23	1022.65	1016.73	1016.48	1023.90	1017.98	1017.73	1014.48	1012.48	1024.20	1018.30	1024.20	0.00
White	185	76	5.92	3	1023.90	1017.98	1017.73	1025.40	1019.48	1019.23	1026.90	1020.98	1020.73	1016.98	1014.98	1027.30	1021.30	1027.30	0.00
Black	215	LINEAR	4	-	1028.30	1024.30	1023.97	-	-	-	-	-	-	-	-	-	-	-	-

100-YR WSE	0.00	TARGET FLOOR SLAB THICKNESS:	3.0	INCHES
BLDG SLAB	1023.00	BLACK TARGET FLOOR SLAB THICKNESS:	4.0	INCHES



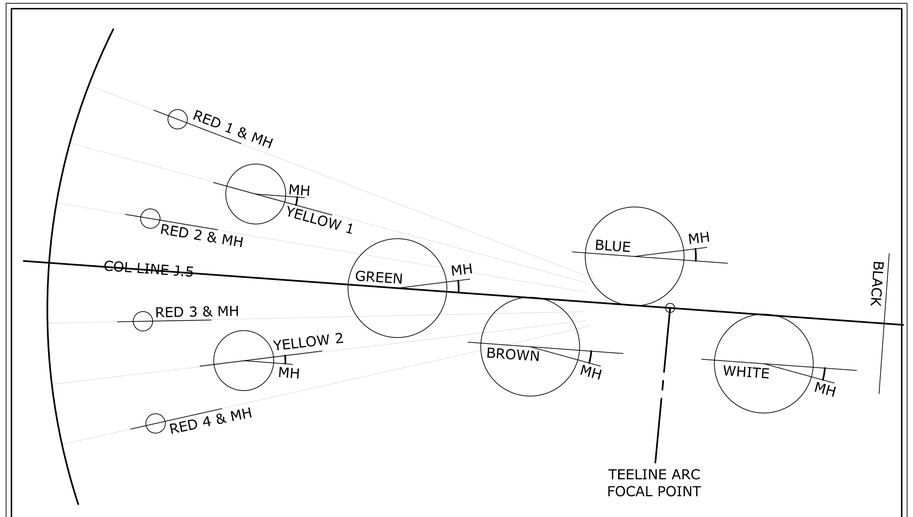
SECTION



PLAN

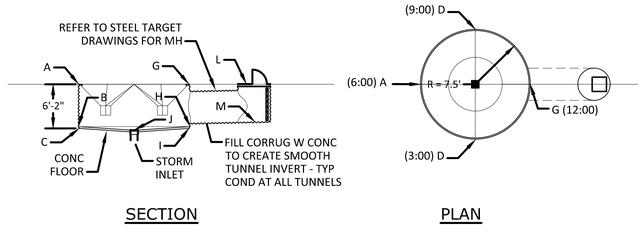
LARGE (76' DIA.) TARGETS - (QTY 4)

SCALE: 1" = 10'



TARGET ALIGNMENT SITE PLAN

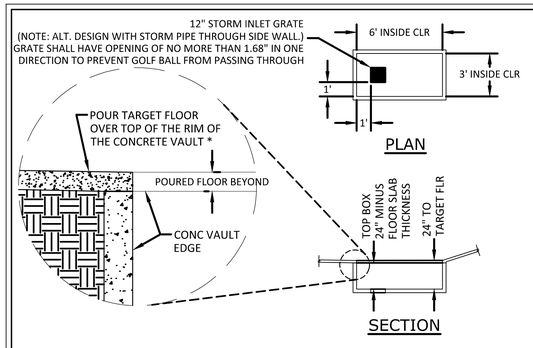
SCALE: NO SCALE



SECTION PLAN

RED (15' DIA.) TARGETS - (QTY 4)

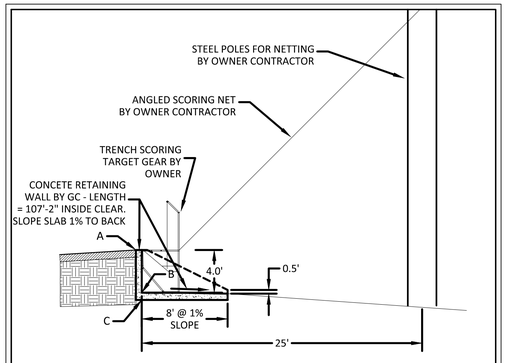
SCALE: 1" = 10'



CONC VAULT DETAILS

SCALE: 1" = 5'

* THE PRECAST VAULT DEPTH IS 24" LESS THE FLOOR SLAB THICKNESS. WHEN THE FLOOR IS POURED OVER TOP, THE TOTAL FLOOR TO FLOOR CLEAR DIM WILL BE 24" OF DEPTH.



BLACK (TRENCH) TARGET - (QTY 1)

SCALE: 1" = 5'

No.	REVISION	DATE

TARGET CIVIL DETAIL SHEET

TOPGOLF ONTARIO
ONTARIO, CA

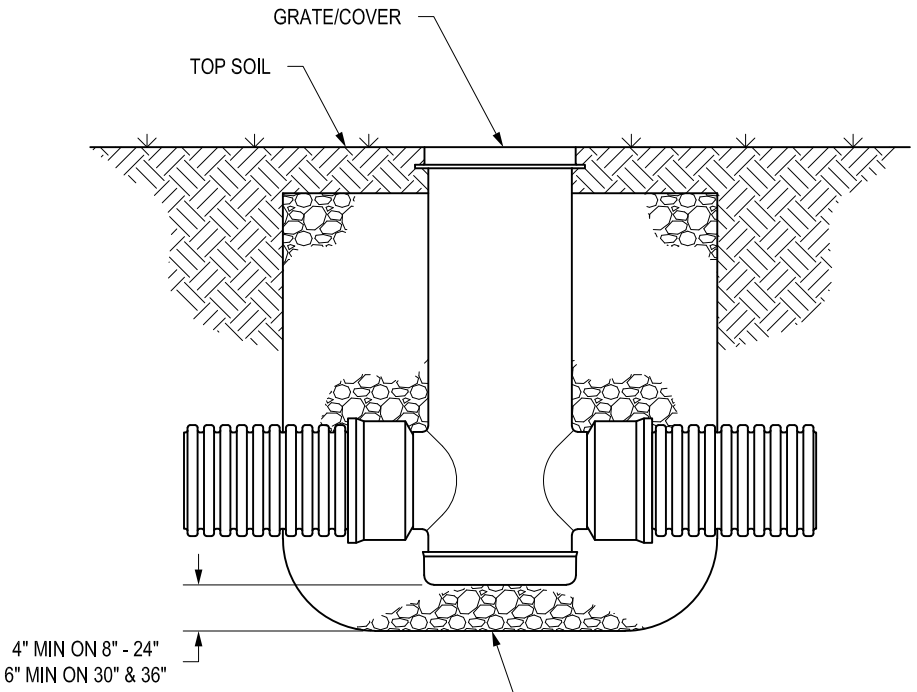
TOPGOLF

1717 McKINNEY AVE . DALLAS, TEXAS . 75202

DRAWN:	DATE:	SCALE:	SHEET:
AMS	07/11/18	VARIES	1 OF 1

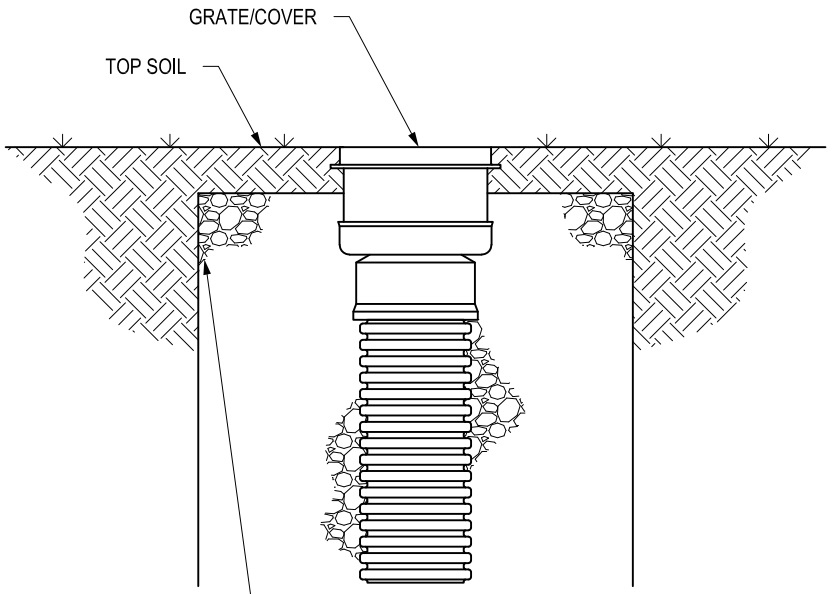
NON TRAFFIC INSTALLATION

DRAIN BASIN



THE BACKFILL MATERIAL SHALL BE CRUSHED STONE OR OTHER GRANULAR MATERIAL MEETING THE REQUIREMENTS OF CLASS I, CLASS II, OR CLASS III MATERIAL AS DEFINED IN ASTM D2321. BEDDING & BACKFILL FOR SURFACE DRAINAGE INLETS SHALL BE PLACED & COMPACTED UNIFORMLY IN ACCORDANCE WITH ASTM D2321.

INLINE DRAIN



THE BACKFILL MATERIAL SHALL BE CRUSHED STONE OR OTHER GRANULAR MATERIAL MEETING THE REQUIREMENTS OF CLASS I, CLASS II, OR CLASS III MATERIAL AS DEFINED IN ASTM D2321. BEDDING & BACKFILL FOR SURFACE DRAINAGE INLETS SHALL BE PLACED & COMPACTED UNIFORMLY IN ACCORDANCE WITH ASTM D2321.

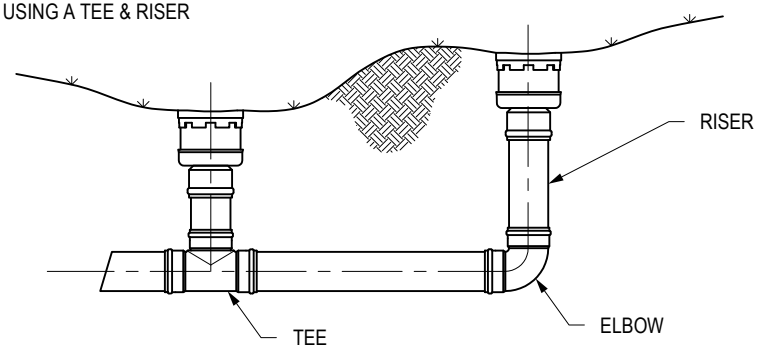
DRAWN BY CJA	MATERIAL	Nyloplast®	3130 VERONA AVE BUFORD, GA 30518 PHN (770) 932-2443 FAX (770) 932-2490 www.nyloplast-us.com
DATE 9-30-99			
REVISED BY NMH	PROJECT NO./NAME	TITLE DRAIN BASIN & INLINE DRAIN NON TRAFFIC INSTALLATION	
DATE 03-11-16			
DWG SIZE A	SCALE 1:25 SHEET 1 OF 1	DWG NO. 7001-110-111	REV F

WHEN ARE INLINE DRAINS USED?

2708AG _ _ X
2710AG _ _ X
2712AG _ _ X
2715AG _ _ X
2718AG _ _ X
2724AG _ _ X
2730AG _ _ X

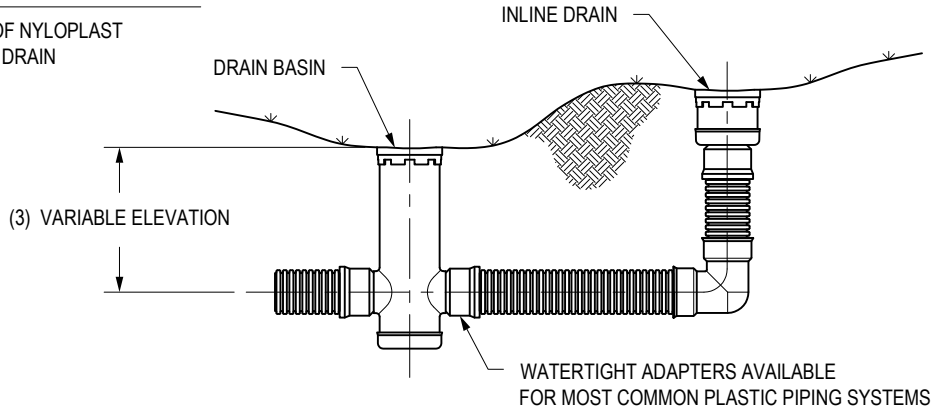
1: TO ENTER AN EXISTING LINE USING A TEE & RISER

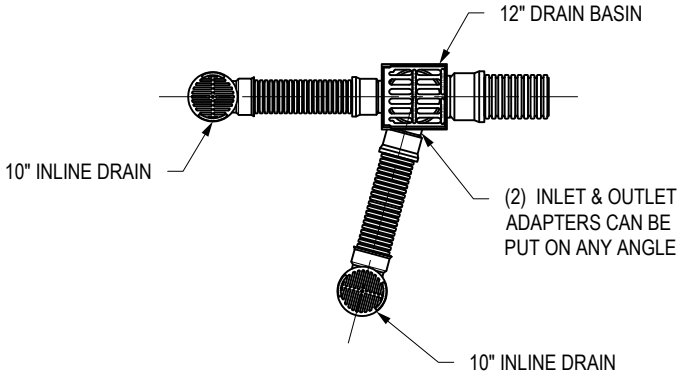
2: AT THE BEGINNING OF A DRAIN LINE USING AN ELBOW & RISER



TYPICAL INSTALLATIONS

TYPICAL INSTALLATION OF NYLOPLAST DRAIN BASIN AND INLINE DRAIN

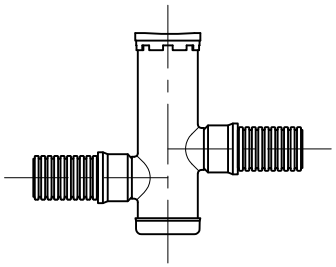




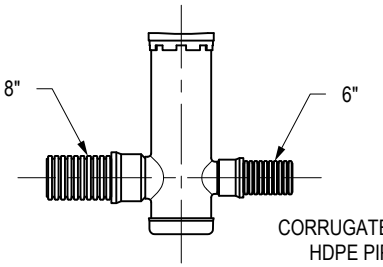
WHEN ARE DRAIN BASINS USED?

2808AG _ _ X
2810AG _ _ X
2812AG _ _ X
2815AG _ _ X
2818AG _ _ X
2824AG _ _ X
2830AG _ _ X
2836AG _ _ X

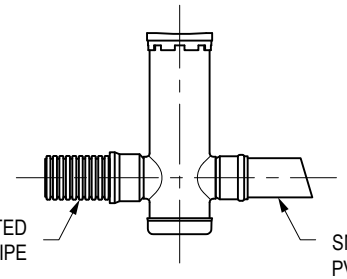
1: TO CHANGE ELEVATION



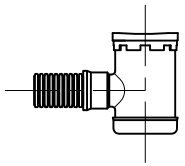
2: TO CHANGE PIPE DIAMETER



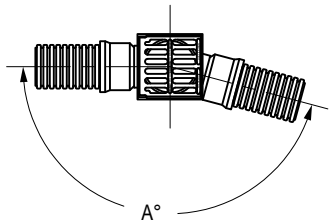
3: TO CHANGE PIPE TYPE



4: FOR SHALLOW APPLICATIONS



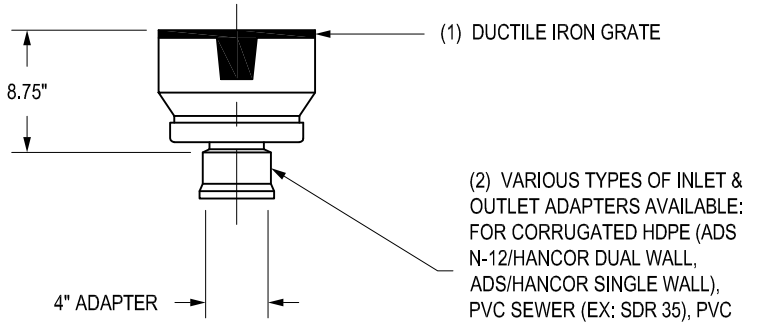
5: TO CHANGE DIRECTION

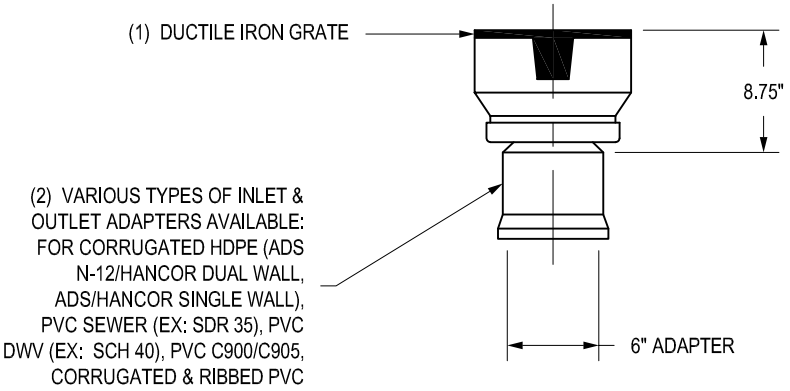


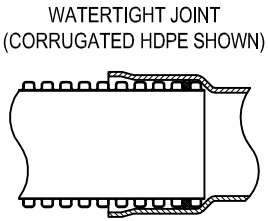
1 - STRUCTURES & ADAPTERS AVAILABLE IN SIZES 8" - 36"
2 - ADAPTERS CAN BE MOUNTED ON ANY ANGLE 0° TO 360°, TO DETERMINE MINIMUM ANGLE BETWEEN ADAPTERS SEE DRAWING NO. 7001-110-012
3 - DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS RISERS ARE NEEDED FOR BASINS OVER 84" DUE TO SHIPPING RESTRICTIONS SEE DRAWING NO. 7001-110-065
4 - REDUCING CONES DOWN TO 30" DIAMETER WILL BE REQUIRED FOR 36" DRAIN BASINS.

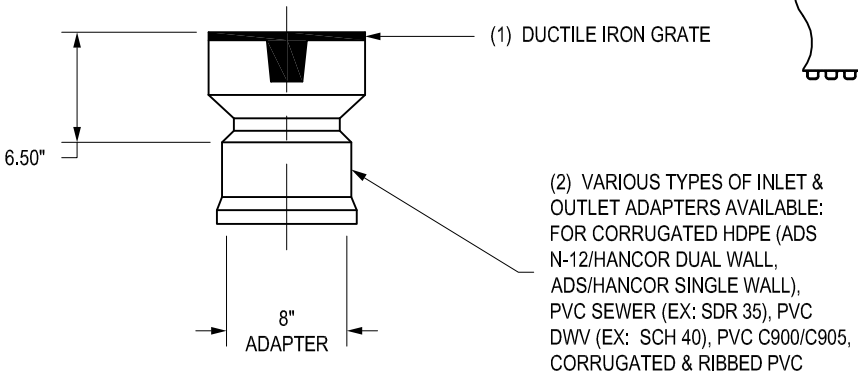
DRAWN BY AWA	MATERIAL	Nyloplast	3130 VERONA AVE BUFORD, GA 30518 PHN (770) 932-2443 FAX (770) 932-2490 www.nyloplast-us.com
DATE 8-10-00			
REVISED BY NMH	PROJECT NO./NAME	TITLE	
DATE 11-2-18		8 IN - 36 IN TYPICAL INSTALLATION OPTIONS	
DWG SIZE A	SCALE 1:40 SHEET 1 OF 1	DWG NO. 7001-110-042	REV E

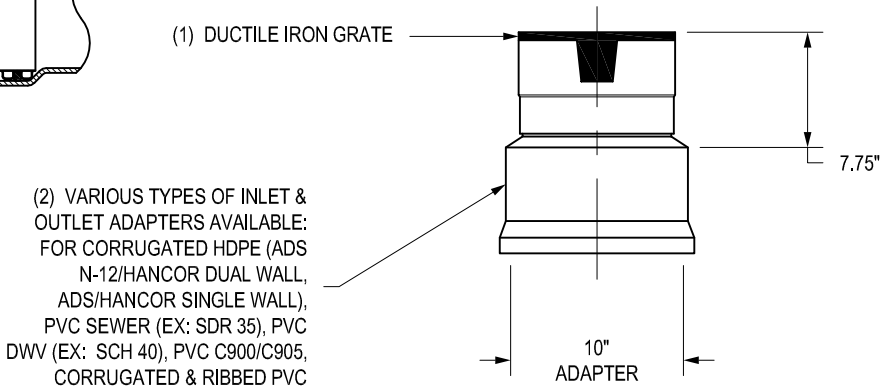
NYLOPLAST 10" INLINE DRAIN: 2710AG _ _ X









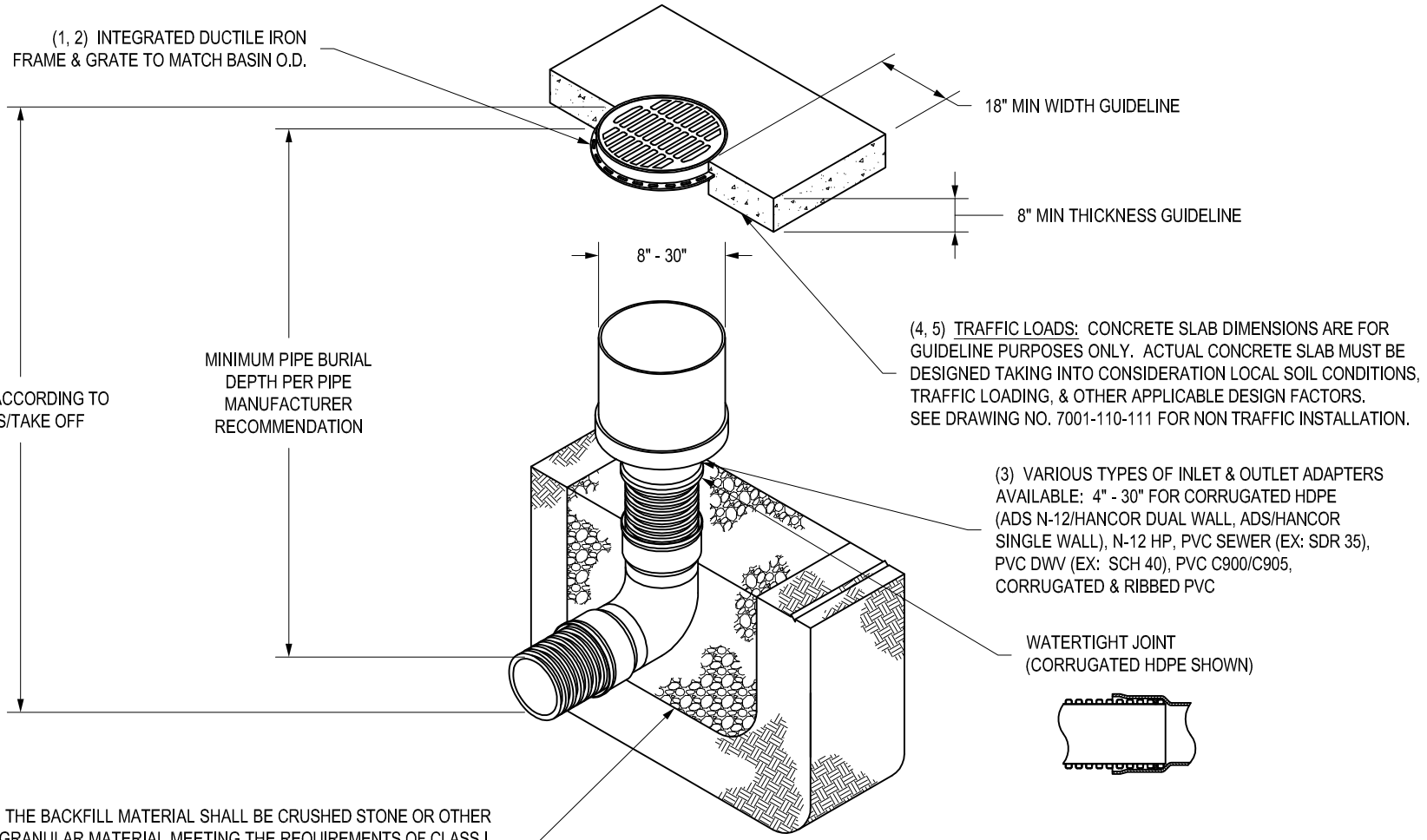


GRATE OPTIONS	LOAD RATING	PART #	DRAWING #
STANDARD	LIGHT DUTY	1099CGS	7001-110-198
SOLID COVER	LIGHT DUTY	1099CGC	7001-110-199
BRONZE	N/A	1099CGB	7001-110-200
DOME	N/A	1099CGD	7001-110-201

1 - GRATES/SOLID COVER SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05, WITH THE EXCEPTION OF THE BRONZE GRATE.
2 - DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC.
3 - DIMENSIONS ARE FOR REFERENCE ONLY.
4 - ACTUAL DIMENSIONS MAY VARY.

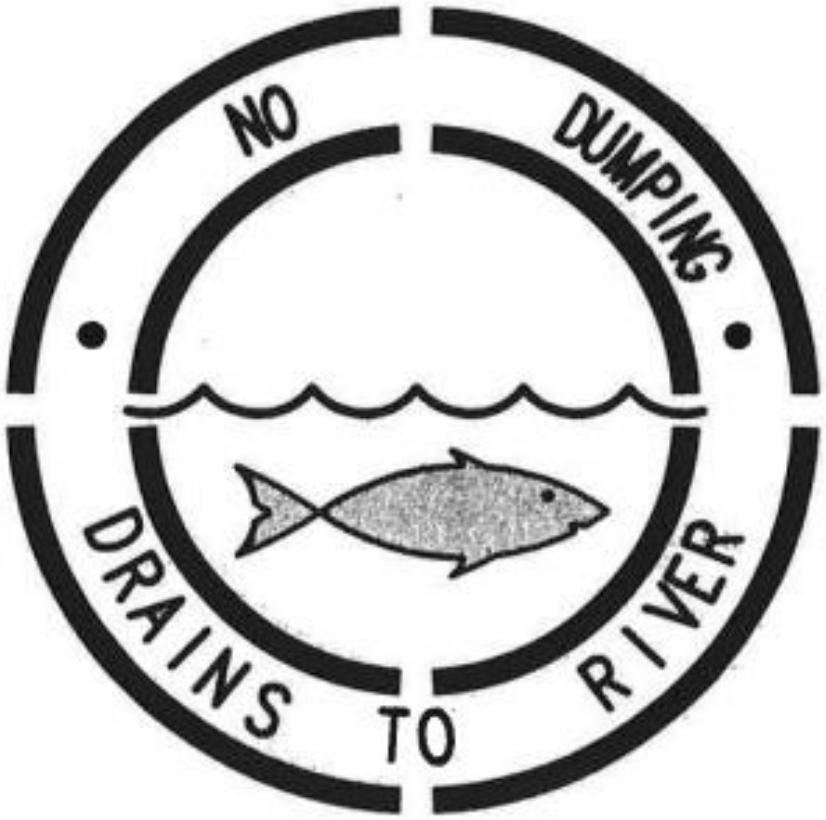
DRAWN BY CJA	MATERIAL	Nyloplast®	3130 VERONA AVE BUFORD, GA 30518 PHN (770) 932-2443 FAX (770) 932-2490 www.nyloplast-us.com
DATE 06-25-99			
REVISED BY CCA	PROJECT NO./NAME	TITLE	10 IN DESIGN DETAILS
DATE 07-19-13			
DWG SIZE A	SCALE NTS SHEET 1 OF 1	DWG NO. 7003-110-001	REV G

NYLOPLAST INLINE DRAIN WITH STANDARD GRATE



1 - 8" - 30" STANDARD GRATES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05.
2 - 12" - 30" FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05. 8" & 10" STANDARD GRATES FIT DIRECTLY ONTO INLINE DRAINS SEE DRAWING NO. 7003-110-000 & 7003-110-001.
3 - DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS N-12/HANCOR DUAL WALL), N-12 HP, & PVC SEWER (4" - 24").
4 - 12" - 30" STANDARD GRATES SHALL MEET H-20 LOAD RATING.
5 - 8" & 10" STANDARD GRATES ARE RATED FOR LIGHT DUTY APPLICATIONS ONLY; NO CONCRETE COLLAR NEEDED FOR LIGHT DUTY RATING.

DRAWN BY EBC	MATERIAL	Nyloplast®	3130 VERONA AVE BUFORD, GA 30518 PHN (770) 932-2443 FAX (770) 932-2490 www.nyloplast-us.com
DATE 1-23-06			
REVISED BY NMH	PROJECT NO./NAME	TITLE INLINE DRAIN WITH STANDARD GRATE QUICK SPEC INSTALLATION DETAIL	
DATE 03-15-16			
DWG SIZE A	SCALE 1:40 SHEET 1 OF 1	DWG NO. 7003-110-022	REV J



SAMPLE STENCIL TO BE USED NEAR
GRATE AND CURB OPENING INLETS
SYMBOL TO BE 24" IN DIAMETER

6.2 ELECTRONIC DATA

BMP AND SITE PLAN
(N/A WILL BE PROVIDED WHEN FINALIZED)

6.3 POST CONSTRUCTION

O & M PLANS AND BMP MAINTENANCE AGREEMENTS (N/A WILL BE PROVIDED WHEN FINALIZED)

6.4 SUPPORTING DOCUMENT

- BMP Educational Materials
- Infiltration Report Infiltration Testing Report by GPI Geotechnical Professional, Inc.
- Infiltration Safety factor worksheet

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

PRESORTED
STANDARD
U.S. POSTAGE
PAID
SACRAMENTO, CA
PERMIT# 000

STORMWATER Pollution Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

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

Recycle Yard Waste

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

Use Fertilizers, Herbicides and Pesticides Safely

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

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

Recycle Hazardous Waste

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

Use Water Wisely

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

Prevent Erosion

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

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

Store Materials Safely

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

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

1 (800) CLEANUP

or visit our websites:

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

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

  For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- Control the amount of water and direction of sprinklers. Sprinklers should only 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.

HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

MANTENIMIENTO DE JARDINERÍA

LAS DESCARGAS A LOS DESAGUES PLUVIALES, DE MANERA ACCIDENTAL O NO, PUEDEN INDUCIR A LA APLICACIÓN DE MULTAS Y OTRAS MEDIDAS.

Siga las mejores prácticas descritas debajo para evitar la contaminación del agua por actividades de jardinería.

RECICLAJE DE LOS DESECHOS DE JARDÍN

- Reciclar las hojas, recortes de césped y otros desechos de jardín.
- No soplar, barrer, o usar la manguera para empujar los desechos de jardín a la calle.
- **Poner a prueba el reciclaje de césped (grasscycling): la manera natural de reciclar el césped dejando los recortes sobre el césped cuando son cortados. Para más información, visite la página web: www.calrecycle.ca.gov/organics/grasscycling**

USAR FERTILIZANTES, HERBICIDAS Y PESTICIDAS DE MANERA SEGURA

- Los fertilizantes, herbicidas y pesticidas son arrastrados con frecuencia hacia el sistema de desagüe pluvial mediante el escurrimiento de los rociadores. Use alternativas naturales no tóxicas siempre que sea posible.
- Si tiene que usar fertilizantes, herbicidas o pesticidas químicos:
  Aplicar solo en el sitio necesario, en lugar de cubrir todas las áreas.
  Evitar aplicar cerca de los bordillos y las calzadas, y nunca antes de que llueva.
  Aplicar los fertilizantes cuando sea necesario: esto es, cuando las plantas mejor podrían usarlo y el posible escurrimiento sea bajo.
  Seguir las instrucciones del fabricante cuidadosamente – esto no solo le proporcionará los mejores resultados, pero le permitirá ahorrar dinero.

USAR EL AGUA DE MANERA PRUDENTE

- Controlar la cantidad de agua y la orientación de los rociadores. Los rociadores deben ser **solo lo suficientemente largos como para** permitir que el agua remoje el suelo, pero no tan largos que causen un escurrimiento.
- Inspeccione, repare los escapes y alinee los aspersores periódicamente.
- Siembre plantas nativas para reducir el uso de agua, fertilizantes, herbicidas y pesticidas.

PROPIETARIOS DE HOGARES

Tengan en cuenta estos consejos cuando contraten a paisajistas profesionales y recuérdenselos según sea necesario.

Los sobrantes de pesticidas, fertilizantes y herbicidas contaminan los vertederos y deben ser desechados a través de Plantas de Tratamiento para Residuos Peligrosos.

Para más información sobre el manejo adecuado de residuos peligrosos, llame a (909) 382-5401 o 1-800-OILY CAT.

*GRATIS únicamente para los residentes del Condado de San Bernardino. Las empresas pueden llamar para indagar sobre los costos y concertar una cita

Para denunciar el vertido ilegal de basura, llame al (877) WASTE18 o visite sbcountystormwater.org
Para denunciar derrames tóxicos, llame al 1(800) 33 TOXIC
Para desechar residuos peligrosos, llame al 1(800) OILY CAT

sbcountystormwater.org

Big Bear •Chino •Chino Hills •Colton •Fontana •Grand Terrace •Highland •Loma Linda •Montclair • Ontario •Rancho Cucamonga
Redlands •Rialto •San Bernardino •San Bernardino County •San Bernardino County Flood Control District •Upland •Yucaipa

STORMWATER Pollution Prevention

FOOD AND RESTAURANT

Food waste, grease, cleaning fluids, mop water and trash from restaurant operations 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.

Recycle Oil & Grease

Oil and grease wastes can be recycled. Look in the yellow pages for rendering companies, or call (909) 386-8401 for disposal information. Don't pour oil or grease into sinks, floor drains or onto a parking lot or street. Keep grease bins covered and contained. Keep your grease interceptor maintained to prevent sewer overflows or backups and keep records of grease waste hauling.

Dumpster Areas

Keep dumpster lids closed and the areas around them clean. Do not fill with liquid waste or hose them out. Call your trash hauler to replace any dumpsters that are damaged or leak.

Cleaning & Maintenance

Clean equipment, floor mats, filters and garbage cans in a mop sink, wash rack or floor drain connected to the sewer through a grease trap. Don't wash them or pour wash water in a parking lot, alley, sidewalk or street. Sweep outside areas and put the debris in the garbage, instead of sweeping or hosing it into the parking lot or street.

Managing Spills

Clean food spills in loading and trash areas by using absorbent materials and sweeping then mopping, and discharge mop water into the sewer through a grease interceptor. Have spill containment and cleanup kits available. To report serious toxic spills, call 911.

Handling Toxic Chemicals

Dispose of all unwanted toxics materials like cleaners, solvents and detergents through a hazardous waste hauler. These items are not trash. For information on hazardous waste pickup, call (909) 386-8401. Use non-toxic cleaning products whenever possible.

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

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

RESTAURANTES

Desechos de comida, grasa, liquidos de limpieza, agua del trapiador y basura de un restaurant acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el rio de Santa Ana. Para prevenir esta contaminación y protejer la salud publica, siga estas practicas.

Reciclando Aceite & Grasa

El aceite y la grasa se pueden reciclar. Busca en las paginas amarillas compañias de reciclaje o llama al (909) 386-8401 para información. No los tires en los lavaderos, las coladeras, el estacionamiento o en la calle. Manten los recipientes de grasa cuviertos y guardados.

Areas de Basura

Manten el bote de basura cerrada y el área del basurero limpia. No lo llenes con desechos líquidos ni utilices la manguera para lavarlo. Llama al transportador de basura para reemplasar los botes de basura que esten dañados.

Limpiando & Mantenimiento

Limpia los tapetes de piso, los filtros y los botes de basura en el contenedor para trapeadores, lavavo, o en la coladera apropiado que llegue al drenaje. No los laves en el estacionamiento, los callejones, en la banqueta o en la calle. Barre el area de afuera y pon todo en la basura, en ves de dejarlo en la banqueta o en la calle.

Controlando Derrames

Usa métodos secos para limpiar los derrames, barriendo y usando tierra para desechos de gato, no uses la manguera para limpiar los derrames. Manten un kit de limpieza de derramamientos en tu negocio. Para reportar derrames llama al 911.

Manejando Quimicos Toxicos

Deposita los desechos toxicos como limpiadores, solventes, detergentes a un bote para toxicos. Estos no son basura. Para mas información sobre desechos peligrosos, llama al (909) 386-8401. Usa productos de limpieza que no sean toxicos.

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

1 (800) CLEANUP

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

GEOTECHNICAL PROFESSIONALS INC

March 5, 2019

Topgolf
8750 North Central Expressway, Suite 1200
Dallas, California 75231

Attention: Ms. Jessica Sanberg

Subject: Results of Percolation/Infiltration Testing
Proposed Golf and Entertainment Facility
SEC 4th Street and North Archibald Avenue
Ontario, California
GPI Project No. 2872.2I

Dear Ms. Sanberg:

This report presents the results of percolation testing performed by Geotechnical Professionals Inc. (GPI) for the design of stormwater disposal systems for the subject site.

Based on the results of the percolation testing, the subsurface soils are suitable for stormwater infiltration based on the measured percolation rates. The results of our testing are presented below.

GENERAL

The percolation testing was performed to provide an estimate of infiltration of water for disposal of storm water runoff. The location of the site is shown on the attached Site Location Map, Figure 1.

Based on information provided by you and Steve Ellis of Fuscoe Engineering, the project civil engineer, we understand that the proposed storm water disposal system will include infiltration at depths of approximately 27 and 30 feet below existing site grades. The locations of the infiltration structures are shown on the on the Site Plan, Figure 2. The types of disposal systems are shown as well and include a perforated underground infiltration basin (CMP).

SCOPE OF SERVICES

We drilled two exploratory borings in the vicinity of the proposed infiltration facilities to assess the subsurface conditions. The explorations were extended to depths of 37 and 40 feet below existing grades. Laboratory testing, including percent fines, was also performed. The results of the laboratory testing are presented below. The Logs Borings are attached as Figures 3 and 4. The locations of the explorations are shown on the Site Plan, Figure 2.

5736 Corporate Avenue • Cypress, CA 90630 • (714) 220-2211 • FAX (714) 220-2122

The scope of services for this phase included installation of 2 test wells, field percolation testing, and the preparation of this report. In general, the testing was performed in accordance with the San Bernardino Method TGD-11 (see References, TGD). The percolation testing was performed using test wells founded at depths and locations corresponding to those provided by the project Civil Engineer.

Based on our experience in the area, groundwater is expected to occur at least 100 feet below existing grades.

PERCOLATION WELLS

The wells were constructed in accordance with the guidelines provided by the TGD. The wells extended approximately 27 feet and 30 feet below existing grades at the location of the infiltration basin, as indicated by the project Civil Engineer.

The test wells were installed in boreholes drilled using truck-mounted hollow-stem auger drill equipment. The wells consisted of 2-inch diameter perforated PVC casing installed in an 8-inch diameter borehole. Packing material around the slotted sections of the well casing consisted of #3 sand.

RESULTS OF LABORATORY TESTING

We performed laboratory tests to determine the percent fines (silts and clays) for the samples of the on-site soils. The results are shown in the table below.

Fines Content of Selected Samples

BORING NO.	DEPTH (ft)	SOIL DESCRIPTION	PERCENT PASSING No. 200 SIEVE
B-14	27	Sand with Silt (SP-SM)	7
B-14	29	Silty Sand (SM)	43
B-14	31	Silty Sand (SM)	34
B-14	33	Silty Sand (SM)	34
B-14	35½	Sand with Silt (SP-SM)	9
B-15	30	Sand with Silt (SP-SM)	7
B-15	32	Silty Sand (SM)	37
B-15	34	Sand with Silt (SP-SM)	7
B-15	36	Sand with Silt (SP-SM)	6
B-15	38½	Sand with Silt (SP-SM)	5

Moisture content was determined from a number of the soil samples collected below the proposed infiltration depth. The samples were weighed and then were dried in accordance with ASTM D 2216. After drying, the weight of each sample was measured, and moisture content/dry density was calculated. Moisture content values are presented on the Logs of Borings, Figures 3 and 4.

RESULTS OF PERCOLATION TESTING

Prior to performing the percolation tests, water was first introduced into the wells using hoses attached to water tanks. We pre-soaked and tested the subsurface soils in accordance with the TGD. The wells were filled with 2 feet of water and a drop in water level greater 6-inches was observed in less than 25 minutes. This was performed two consecutive times.

FINDINGS

The results of the infiltration tests performed in the test wells indicated adequate infiltration rates with respect to subsurface water infiltration as indicated by the TGD. GPI recommends using the most conservative value for the design of the disposal systems.

Subsequent to the prescribed presoaking, 6 percolation tests were performed in P-1 and P-2 over a period of 1 hour, measuring the drop in water levels for test periods of 10 minutes.

A pre-adjusted percolation rate was reduced by the reduction factor (R_f) to account for the discharge of water from both the sides and bottom of the boring in accordance with the TGD. The infiltration rates were calculated using the drop in water level over the test increment, corrected using the Porchet Method as provided in the TGD. The results of the calculated infiltration rate for each test are presented Table 1.

Based on field testing, our evaluations indicate that the site soils are suitable for infiltration of stormwater. Soils are considered potentially feasible for infiltration if the measured infiltration rate obtained from field testing is greater than 0.3 inches per hour (TGD). These measured infiltration rates were greater than 0.3 inches per hour for both wells.

It should be noted that these infiltration rates are for clean, clear water and do not include any effects of sediment, fines, dissolved solids or any other debris as the materials will significantly reduce the percolation rates of the subsurface soils. Prior to infiltration, any water should be thoroughly cleaned of any sediment or other deleterious materials to help reduce the potential for clogging and reduced percolation rates.

From a geotechnical standpoint, we recommend that any open graded materials, such as gravel, used in construction of infiltration facilities be completely encapsulated in a non-woven filter fabric such as Mirafi 140N or equivalent.

LIMITATIONS

The report, exploration logs, and other materials resulting from GPI's efforts were prepared exclusively for use by Topgolf and their consultants in designing the proposed development. The report is not intended to be suitable for reuse on extensions or modifications of the project or for use on any project other than the currently proposed development as it may not contain sufficient or appropriate information for such uses. If this report or portions of this report are provided to contractors or included in specifications, it should be understood that they are provided for information only. This report cannot be utilized by another entity without the express written permission of GPI. This report is an instrument of our services and remains the property of GPI.

Soil deposits may vary in type, strength, and many other important properties between points of exploration due to non-uniformity of the geologic formations or to man-made cut and fill operations. While we cannot evaluate the consistency of the properties of materials in areas not explored, the conclusions drawn in this report are based on the assumption that the data obtained in the field and laboratory are reasonably representative of field conditions and are conducive to interpolation and extrapolation.

Furthermore, our recommendations were developed with the assumption that a proper level of field observation and construction review will be provided during grading, excavation, and foundation construction by GPI. If field conditions during construction appear to be different than is indicated in this report, we should be notified immediately so that we may assess the impact of such conditions on our recommendations. If construction phase services are performed by others they must accept full responsibility for all geotechnical aspects of the project including this report.

Our investigation and evaluations were performed using generally accepted engineering approaches and principles available at this time and the degree of care and skill ordinarily exercised under similar circumstances by reputable Geotechnical Engineers practicing in this area. No other representation, either expressed or implied, is included or intended in our report.

Respectfully submitted,
Geotechnical Professionals Inc.

James E. Harris V
Staff Engineer

James E. Harris, P.E., G.E.
Principal

MAR 0 5 2019

REGISTERED PROFESSIONAL ENGINEER
JAMES E. HARRIS, IV
No. GE 2100
GEOTECHNICAL
STATE OF CALIFORNIA

Enclosures: References
Table 1 - Borehole Infiltration Test Results
Figure 1 - Site Location Map
Figure 2 - Site Plan
Figure 3 and 4 - Logs of Borings

Distribution: Addressee (Email only)

REFERENCES

County of San Bernardino TGD, "County of Orange, Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations", Appendix VII, Technical Guidance Document, May 9, 2011.

TABLE 1

BOREHOLE INFILTRATION TEST RESULTS (corrected with Porchet Method)

San Bernardino County Method-TGD, 2011

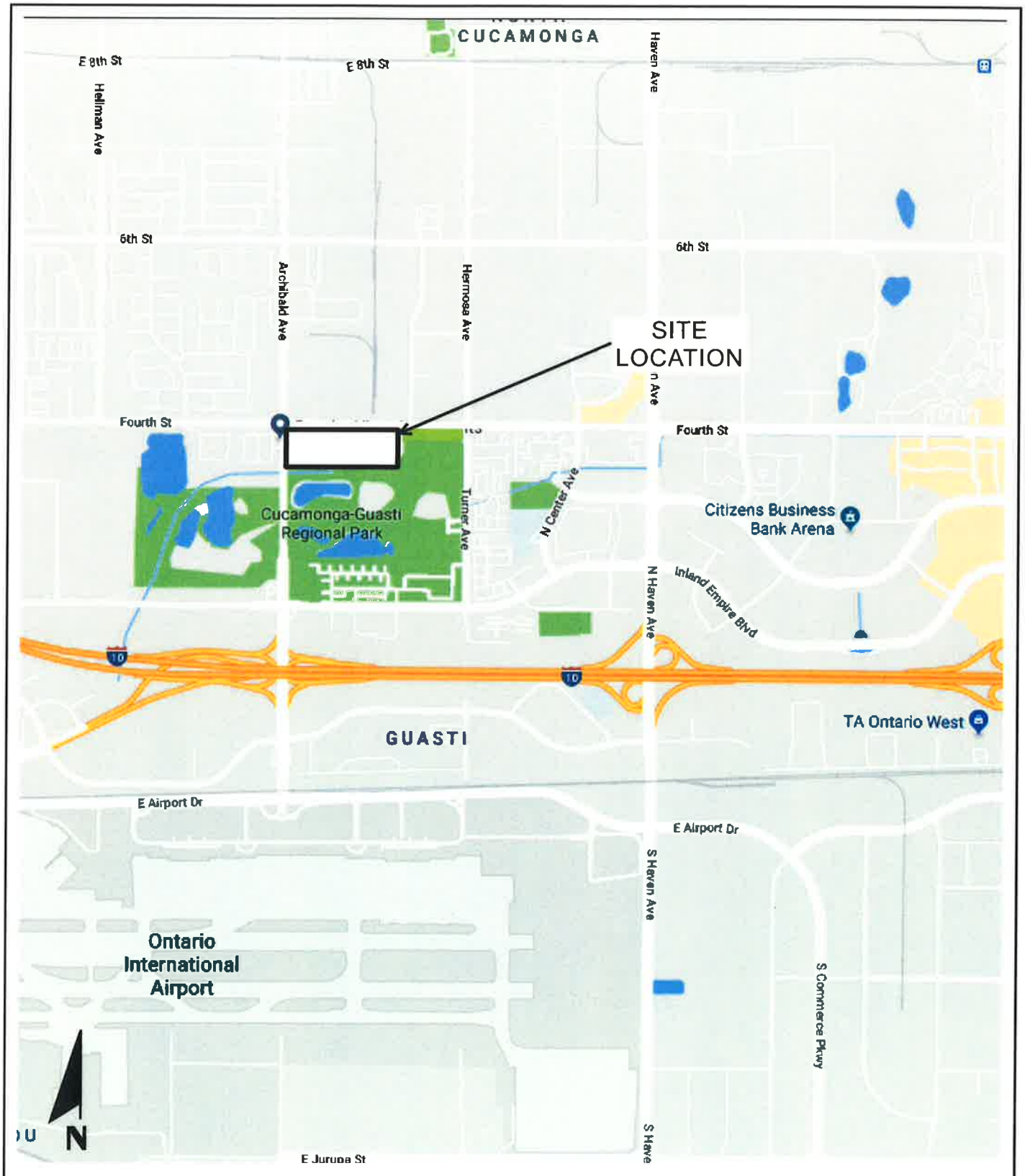
Project No. 2872.2I Project Name: Topgolf Ontario Date: 3/5/2019

Test Date 2/19/2019

Test Well	Test Duration (min) Δt	Water Depth Initial (ft) D_o	Water Depth Final (ft) D_f	Total Depth of Test Hole (ft) D_T	Hole Diameter (inches)	Initial Water Height (ft) H_o	Final Water Height (ft) H_f	Change in Height of Water (ft) $\Delta H=\Delta D$	Average Height of Water (ft) H_{avg}	Infiltration Rate (in/hr) I_t
P-1	10	25.00	25.32	27.00	8	2.00	1.68	0.32	1.84	1.9
P-1	10	25.00	25.33	27.00	8	2.00	1.68	0.325	1.84	1.9
P-1	10	25.00	25.35	27.00	8	2.00	1.66	0.345	1.83	2.1
P-1	10	25.00	25.35	27.00	8	2.00	1.66	0.345	1.83	2.1
P-1	10	25.00	25.35	27.00	8	2.00	1.66	0.345	1.83	2.1
P-1	10	25.00	25.35	27.00	8	2.00	1.65	0.35	1.83	2.1

Test Date 2/19/2019

Test Well	Test Duration (min) Δt	Water Depth Initial (ft) D_o	Water Depth Final (ft) D_f	Total Depth of Test Hole (ft) D_T	Hole Diameter (inches)	Initial Water Height (ft) H_o	Final Water Height (ft) H_f	Change in Height of Water (ft) $\Delta H=\Delta D$	Average Height of Water (ft) H_{avg}	Infiltration Rate (in/hr) I_t
P-2	10	28.00	28.37	30.00	8	2.00	1.64	0.365	1.82	2.2
P-2	10	28.00	28.36	30.00	8	2.00	1.64	0.36	1.82	2.2
P-2	10	28.00	28.37	30.00	8	2.00	1.64	0.365	1.82	2.2
P-2	10	28.00	28.35	30.00	8	2.00	1.65	0.35	1.83	2.1
P-2	10	28.00	28.37	30.00	8	2.00	1.63	0.37	1.82	2.2
P-2	10	28.00	28.37	30.00	8	2.00	1.64	0.365	1.82	2.2



BASE MAP REPRODUCED FROM GOOGLE MAPS © 2018

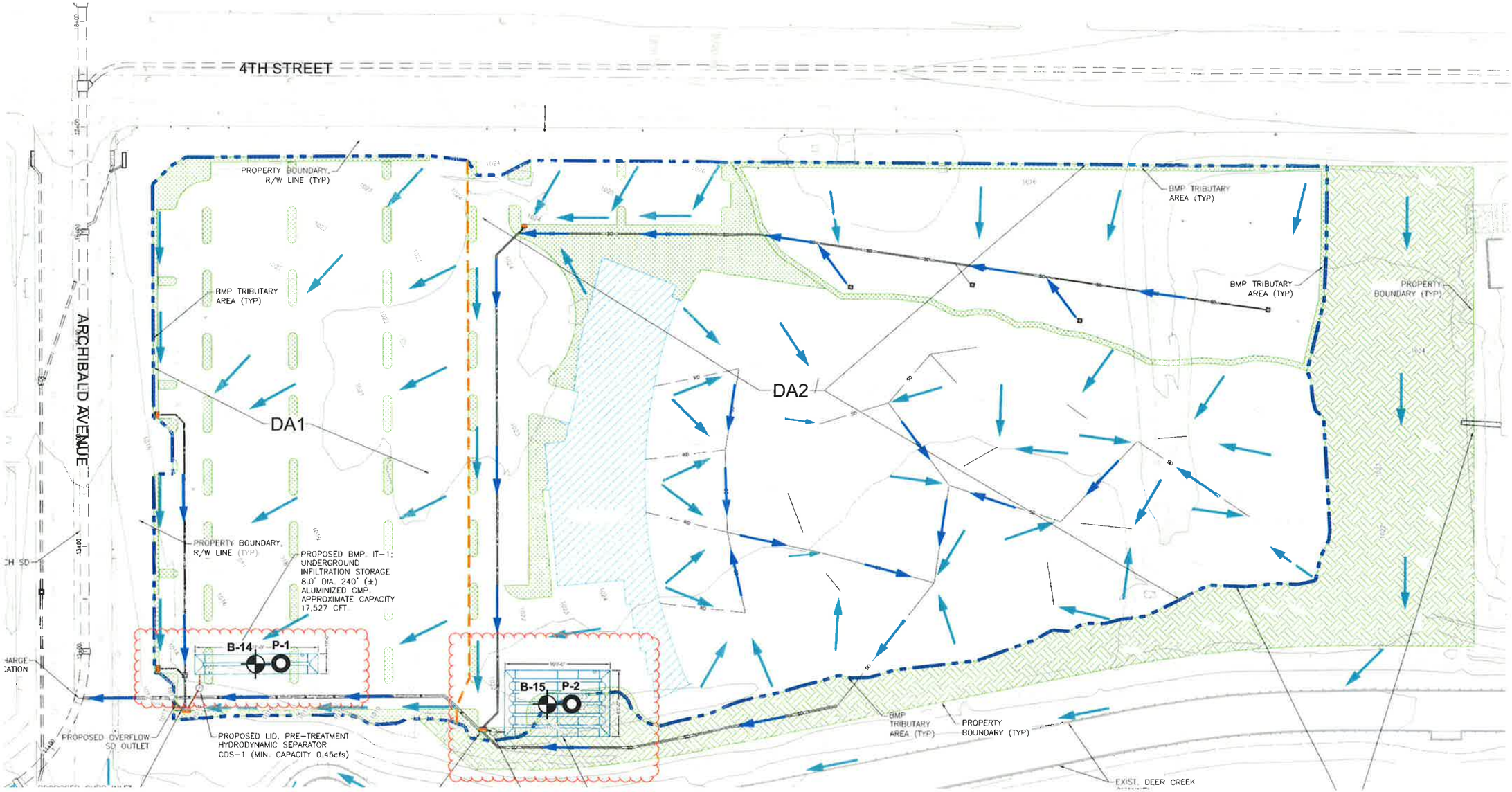
GPI GEOTECHNICAL PROFESSIONALS, INC.

TOPGOLF ONTARIO

GPI PROJECT NO. 2872.2I | SCALE: 1" = 2000'

SITE LOCATION

FIGURE 1



EXPLANATION

B-1 ⊕ APPROXIMATE LOCATION AND NUMBER OF EXPLORATORY BORING

P-2 ○ APPROXIMATE LOCATION AND NUMBER PERCOLATION TEST

0 100 200 FEET

BASE PLAN REPRODUCED FROM BMP AND SITE PLAN PROVIDED BY BY FUSCOE ENGINEERING DATED 1-30-2019

GPI GEOTECHNICAL PROFESSIONALS, INC.

TOPGOLF ONTARIO

GPI PROJECT NO.: 2872.2I | SCALE: 1" = 100'

SITE PLAN

FIGURE 2

MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
				0	This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	
					0 to 27 feet, not logged	310
				5		305
				10		300
				15		295
				20		290
				25		285
3.0		48	S		Natural: **SAND with SILT (SP-SM)** brown, dry, dense, trace gravel	
11.1		19	S	30	**SILTY SAND (SM)** brown, moist, medium dense	280
9.8		11	S			
10.8		16	S			
				35		
3.2		36	S		**SAND with SILT (SP-SM)** brown, dry, dense	275
					Total Depth 37 feet	

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED: 2-19-19

EQUIPMENT USED: 8 " Hollow Stem Auger

GROUNDWATER LEVEL (ft): Not Encountered

GPI

PROJECT NO.: 2872.2I

TOPGOLF - ONTARIO

LOG OF BORING NO. B-14

FIGURE 3

MOISTURE (%)	DRY DENSITY (PCF)	PENETRATION RESISTANCE (BLOWS/FOOT)	SAMPLE TYPE	DEPTH (FEET)	DESCRIPTION OF SUBSURFACE MATERIALS	ELEVATION (FEET)
				0	This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	
					0 to 30 feet, not logged	305
				5		
						300
				10		
						295
				15		
						290
				20		
						285
				25		
						280
3.6		19	S	30	**SAND with SILT (SP-SM)** brown, dry, medium dense	
13.9		11	S		**SILTY SAND (SM)** brown, very moist, medium dense	
3.2		38	S		**SAND with SILT (SP-SM)** brown, dry, dense	275
3.0		33	S	35		
2.7		29	S		@ 38.5 feet, medium dense Total Depth 40 feet	270

SAMPLE TYPES
- C Rock Core
- S Standard Split Spoon
- D Drive Sample
- B Bulk Sample
- T Tube Sample

DATE DRILLED: 2-19-19

EQUIPMENT USED: 8 " Hollow Stem Auger

GROUNDWATER LEVEL (ft): Not Encountered

GPI

PROJECT NO.: 2872.2I

TOPGOLF - ONTARIO

LOG OF BORING NO. B-15

FIGURE 4

VII.4. Considerations for Infiltration Rate Factor of Safety

Given the known potential for infiltration BMPs to fail over time, an appropriate factor of safety applied to infiltration testing results must be mandatory. The infiltration rate will decline between maintenance cycles as the BMP surface becomes occluded and particulates accumulate in the infiltrative layer. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the selection of design infiltration rates. The design infiltration rate discussed here is the infiltration rate of the underlying soil, below the elevation to which soil amendments would not be provided.

The factor of safety that should be applied to measured infiltration rates is a function of:

- Suitability of underlying soils for infiltration
- The infiltration system design.

These factors are discussed in the following sections.

The *measured infiltration rate* calculated for the purpose of infiltration infeasibility screening (TGD Section 2.4.2.4) shall be based on a factor of safety of 2.0 applied to the rates obtained from the infiltration test results. No adjustments from this value are permitted. The factor of safety used to compute the *design infiltration rate* shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in the following sections.

It is recognized that there are competing objectives in the selection of a factor of safety. There is an initial economic incentive to select a lower factor of safety to yield smaller BMP designs. A low factor of safety also allows a broader range of systems to be considered "feasible" in marginal conditions. However, there are both economic and environmental incentives for the use of an appropriate factor of safety to prevent premature failure and substandard performance. The use of an artificially low factor of safety to demonstrate feasibility in the design process is shortsighted in that it does not consider the long term feasibility of the system.

The best way to balance these competing factors is through a commitment to thorough site investigation, use of effective pretreatment controls, good construction practices, the commitment to restore the infiltration rates of soils that are damaged by prior uses or construction practices, and the commitment to effective maintenance practices. However, these commitments do not mitigate the need to apply a factor of safety to account for uncertainty and long term deterioration that cannot be technically mitigated. Therefore, a factor of safety of no less than 2.0 shall be used to compute the design infiltration rate.

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
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
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
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom

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.

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 (DA-1)

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
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	2	0.50
		Design Safety Factor, $S_B = \Sigma p$			2
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					1 x 2 = 2
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					2.1
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$					1.05

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet (DA-2)

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
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	2	0.50
		Design Safety Factor, $S_B = \Sigma p$			2
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					1 x 2 = 2
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					2.2
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$					1.1

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.