Appendix F:
Hydrology Supporting Information

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F1: Preliminary WQMP

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OTH2021-01373

County of Orange/Santa Ana Region
City of Anaheim
Priority Project
Preliminary Water Quality Management Plan (WQMP)

Project Name:

E. BALL ROAD & S. ANAHEIM BOULEVARD

TTM 19140

ANAHEIM, CA 92805

APN: 082-461-23, -24, -25, -29, -31, -34, -38, -39

(OTH2021-01373), the WQMP is "Approvable" with the following conditions. These conditions are memorialized d as comments on the current WQMP uploaded within EPR:

Condition 1 for Final WQMP: The depth to groundwater and the infiltration rates used to design the proposed infiltration systems must be verified in the Final WQMP to ensure that the proposed systems will drawdown within 48 hours and that there is adequate separation to groundwater. Per the Orange Count Technical Guidance Document, the tests must be performed in the immediate vicinity of the proposed facilities and must correspond to the facility elevation.
Condition 2 for Final WQMP: The City of Anaheim BMP Design Guidelines must be used to upsize the onsite BMPs to account for the ROW Improvement Areas. See the Design Standard #1 table in the "On-site BMP Upsizing to Offset ROW Improvement or Other Area" section in the BMP Design Guidelines for the thresholds that must be used to upsize the onsite BMPs. If on-site BMP upsizing is infeasible, BMPs within the ROW may be required.
Condition 3 for Final WQMP: The ROW footprints and sizing provided for the improvements on E Ball Road and S Anaheim Boulevard should include the widened street area. Per the City's WQMP template, these new street areas would be considered significant redevelopment (improvements beyond maintenance including change in purpose of land use, impact to existing hydraulic capacity, or change in gutter line) as the gutter is moving and the area is changing in use from parkway/sidewalk to street, and would therefore trigger water quality requirements.

Prepared for:

Toffoli Investments, LLC

3 Hughes

Irvine, CA 92618

(949) 768-2535

Prepared by:

C&V Consulting, Inc./ Dane McDougall, P.E.

9830 Irvine Center Drive

Irvine, CA 92618

(949) 916-3800

Prepared: June 2021
Revised: June 2022

DEPARTMENT OF PUBLIC WORKS
DEVELOPMENT SERVICES
APPROVED
WITH CONDITIONS
Cesar Morales, Associate Engineer
7/19/2022, 3:14:52 PM
ANAH-OTH2021-01373
Cesar Morales

Project Owner's Certification

Planning Application No. (If applicable)		Grading Permit No.	TBD
Tract/Parcel Map and Lot(s) No.	TTM 19140	Building Permit No.	TBD
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			E. Ball Road & S. Anaheim Boulevard 082-461-23, -24, -25, -29, -31, -34, -38, -39

This Water Quality Management Plan (WQMP) has been prepared for Toffoli Investments, LLC. by C&V Consulting, Inc. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: Alan Toffoli	
Title	Principal
Company	Toffoli Investments, LLC
Address	3 Hughes, Irvine CA 92618
Email	alan.toffoli.gmail.com
Telephone #	(949) 768-2535

I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.

Owner Signature		Date	6/1/22

Preparer (Engineer): Dane McDougall, P.E.			
Title	President	PE Registration #	80705
Company	C&V Consulting, Inc.		
Address	9830 Irvine Center Drive, Irvine, CA 92618		
Email	dmcougall@cvc-inc.net		
Telephone #	(949) 916-3800		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	6/2/2022
Place Stamp Here	REGISTERED PROFESSIONAL ENGINEER DANE P. MCDOUGALL C 80705 CIVIL STATE OF CALIFORNIA		

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Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Project Infomation			
Permit/Application No. (If applicable)		Grading or Building Permit No. (If applicable)	TBD
Address of Project Site (or Tract Map and Lot Number if no address) and APN	E. Ball Road & S. Anaheim Boulevard TTM 19140 APN: 082-461-23, -24, -25, -29, -31, -34, -38, -39		
Water Quality Conditions of Approval or Issuance			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	Conditions of Approval have not been provided at this time.		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	N/A		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	Bolsa Chica Channel: Ammonia, Indicator Bacteria, and pH. Huntington Harbour: Chlordane, Copper, Indicator Bacteria, Lead, PCBs, and Toxicity.		

Section II Project Description

II.1 Project Description

Description of Proposed Project				
Development Category (From Model WQMP, Table 7.11-2; or -3):	8. All redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site.			
Project Area (ft^2): 465,220*	Number of Dwelling Units: 248		SIC Code: N/A	
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	0.03 ac	0.3%	10.10 ac	99.7%
Post-Project Conditions	1.52 ac	15%	8.61 ac	85%
Drainage Patterns/Connections	The northeasterly portion of the site generally sheet flows to E. Ball Road, traveling via onsite ribbon gutter and discharging through an existing parkway culvert. Once stormwater enters E. Ball Rd it flows in a westerly direction in E. Ball Rd. until it is intercepted by a curb inlet catch basin located on the south side of E. Ball Rd. at the intersection of Technology Cir. and Ball Rd. This catch basin is connected to an existing 51" City of Anaheim RCP. Flows are then directed through the Anaheim Barber City Channel, ultimately converging to the Bolsa Chica Channel discharging into Huntington Harbor. The remaining portions of the site all discharge into different location along S. Anaheim Blvd. The northwesterly portion of the site generally sheet flows over the existing parking lot and enters S. Anaheim Blvd. at this portion of the site's driveway entrance on S. Anaheim Blvd. There are no existing drainage facilities in the portion of the site. Once flows from this portion of the site enter S Anaheim Blvd. they are intercepted by an existing curb inlet catch basin located approximately 200' south of the intersection of E. Ball Rd. and S Anaheim Blvd. The area immediately south of the area discussed above, sheet flows over the vacant parking lot in northerly direction until it reaches an existing ribbon gutter. Once flows enter the ribbon gutter in, they are conveyed in westerly direction until they sheet flow over the existing driveway in this portion of the site. Once stormwater from this area enters S. Anaheim Blvd. it flows in a southerly direction until it is intercepted by an existing catch basin located approximately 750' south of the intersection of E. Ball Rd. and S Anaheim Blvd. The southerly section of the site sheet flows over the existing asphalt pavement in a westerly direction until it ultimately enters S Anaheim Blvd. over the			

	driveway entrance at this portion of the site. Once in S Anaheim Blvd. it flows in a southerly direction until it is intercepted by a catch basin at the intersection of E Palais Rd. and S Anaheim Blvd. south of the project site. All runoff entering S. Anaheim Boulevard right of way flows in the southerly direction and is captured by existing City of Anaheim catch basins. These catch basins are connected to an existing 36" City of Anaheim RCP that flows in a southerly direction until it converges with an existing 96" City of Anaheim RCP draining in the westerly direction along Katella Ave. Flows are then directed through the Anaheim Barber City Channel, ultimately converging to the Bolsa Chica Channel discharging into Huntington Harbor. The proposed residential development will be divided into eleven (11) Drainage Management Areas (DMA) developed based on the proposed grading design. The proposed drainage system will collect and convey stormwater runoff to the proposed biofiltration systems for pre-treatment via curb openings within the biofiltration units prior to be routed to the proposed infiltration system for water quality treatment. The proposed biofiltration systems will be equipped with internal bypass systems to allow larger storm events to bypass treatment to feed into the proposed underground infiltration systems. The proposed private underground storm drain has been designed discharge treated and overflow stormwater runoff to two (2) proposed parkway culverts. One culvert is at the site's E. Ball Rd. driveway entrance and the other is at the southerly S. Anaheim Blvd. driveway entrance. In the event where the proposed onsite storm drain system is at its full capacity or is clogged, stormwater will pond up at sump locations. Stormwater will pond in the sump locations nearest to the driveway entrances along E. Ball Rd. and S Anaheim Blvd. and overflow into their respective streets. Refer to Attachment A of this report for the WQMP Exhibit.
Narrative Project Description:	The proposed 10.13 net acre site is currently occupied by various vacant and occupied commercial buildings and parking lots serving auto repair/rental shops, an Anaheim Resort Transportation Facility, and storage containers. The existing site has approximately 99.7% (10.10 acres (ac)) impervious coverage, consisting of asphalt or concrete pavement and buildings. The site perimeter is bunded by CMU walls and chain link fencing. The site is "L" in shape and is located at the southeast corner of E. Ball Road & S. Anaheim Boulevard, in the City of Anaheim, County of Orange. The site is bound by E. Ball Road to the north, S. Anaheim Boulevard to the west, & S. Claudina Street to the east and existing vacant and occupied commercial developments to the south and east. The proposed residential development thirty-three (33) 3-story, multi-family residential buildings which will consist 212 townhome units and 36 residential flat apartment units. Units will consist of 1-, 2- and 3-bedroom layouts, ranging from 760 to 1,600 square feet. Associated parking areas will consist of 248 private garages and 58 private open stalls. In addition, the residential development will

include a private drive aisle, recreational areas, sidewalks, and landscaped open-space areas. The drive aisle will be asphalt concrete pavement and sidewalks will be Portland cement concrete (PCC). For preliminary engineer percent landscaped areas have been assumed to be 15% (1.52 ac). During final engineering pervious coverage will be re-evaluated based on the final site design.

Best Management Practice (BMP) selection for treatment of stormwater has been described in Section IV of this report. Implementation of BMPs will address the pollutants of concern associated with multi-family residential development. No car washing, outdoor storage or food processing areas will be incorporated on this project.

The project will be serviced by onsite private water system and onsite private sanitary sewer system that will be maintained by a homeowner's association and/ or appointed property management company. The proposed private water system will have two points of connection to the existing public water mains within S. Anaheim Blvd. and Claudina St. The proposed private onsite sanitary sewer system will be gravity fed from two points of connection to the existing City maintained public sewer main within E. Ball Rd. and S. Anaheim Blvd.

*A 7' wide R/W Dedication along E. Ball Road and S. Anaheim Boulevard is required to support the widening of E. Ball Road (approximately 0.09 acres) and S. Anaheim Boulevard (approximately 0.10 acres)

In addition to the R/W dedication, public improvements are required to support the development such as removal and installation of new sidewalk and driveway approach, relocation of existing public filterra units, associated parkway landscape improvements and relocation of an existing domestic water facilities are required to support the development.

Public Improvements are subject to the full trash capture requirement sized for the 1-year, 1-hour flow rate. A Connector Pipe Screen (CPS) device will be utilized within the relocated Filterra Unit and within the relocated public catch basin to meet the full trash capture requirements. Refer to Section IV.3.7, Treatment Control BMPs and Attachment A for calculations.

Due to size constraints in the right of way, onsite BMPs will be upsized to offset the right of way improvement areas.

Long-term maintenance is planned to be handled by a Homeowner's Association (HOA) and/ or Property Management Company (PMC) appointed by Troffoli Investments, LLC.

Refer to Attachment A of this report for a copy of the WQMP Exhibit.

II.2 Potential Stormwater Pollutants

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	Residential Development
Nutrients	E ☒	N ☐	Residential Development
Heavy Metals	E ☒	N ☐	Drive Aisle/ Parking Areas
Pathogens (Bacteria/Virus)	E ☒	N ☐	Residential Development
Pesticides	E ☒	N ☐	Landscaping Areas
Oil and Grease	E ☒	N ☐	Drive Aisles/ Parking Areas
Toxic Organic Compounds	E ☒	N ☐	Drive Aisles/ Parking Areas
Trash and Debris	E ☒	N ☐	Residential Development

II.3 Hydrologic Conditions of Concern

☒ No – Show map. See Calculations below.

☐ Yes – Describe applicable hydrologic conditions of concern below.

Per the TGD Figure 2, Susceptibility Analysis Huntington Harbor, the project location is not susceptible to hydrologic conditions of concern. Refer to Attachment D for the TGD Figure 1.

II.4 Post Development Drainage Characteristics

The proposed development consists of one (1) lot subdivision at approximately 10.13 net acres and will consist of 248 residential townhomes and flats and a retail space. The proposed development includes drive aisles, parking, landscaping, walkways, patios, and common open space areas. The site will be accessible via four (4) proposed driveway entrances/exits along E. Ball Road & S. Anaheim Boulevard.

The proposed site will be graded to convey stormwater as surface flow towards proposed curb-inlet catch basins, located at relative low points on-site. The site will mirror the existing drainage pattern as closely as possible, with a portion draining into E. Ball Rd. and a portion draining into S. Anaheim Blvd. The curb inlet type Modular Wetland Systems (MWS) will pre-treat flows for quality treatment and allow larger storm events to bypass the MWS and enter the detention pipe which feed to a drywell system for infiltration. Flows from the northeastern portion of the site be directed to one low point along E. Ball Road and another along S Claudina St. The curb inlet MWS along Claudina St. driveway entrance will convey flows via detention storm drain pipe to a drywell system located at the E. Ball Rd. driveway entrance. At this point flows from the E. Ball Rd. curb inlet MWS will confluence at the drywell system. When the underground system is at full capacity, flows will back up and outlet from the site via a proposed parkway culvert into E Ball Rd. Once flows from this portion enter E. Ball Rd., they will follow the historic drainage pattern.

Similarly, the western portion of site will convey flows in a westerly direction to eight (8) curb inlet MWS located at the end of drive aisles adjacent to S Anaheim Blvd. All eight of these MWS will be connected via storm drain pipe to a underground infiltration system located at the southerly driveway entrance into S Anaheim Blvd. Similar to the northeastern portion of the site, when the underground system is at capacity, flows will then be back up at the low point and be routed to a proposed parkway culvert into S. Anaheim Blvd. Once flows enter E. Ball Rd. they will follow the historic drainage pattern.

In the event the storm drain system becomes clogged or overwhelmed by extraordinary storm events, emergency overflow will be directed as sheet flow towards E. Ball Road & S. Anaheim Boulevard and overflow into the right-of-way via each proposed driveway entrance.

As part of the proposed development, proposed public street improvements will relocate the Filterra unit in E. Ball Road and the catch basin in S. Anaheim Blvd. The Filterra unit and catch basin will be equipped with a catch basin trash rack and/or filter per certified full capture system requirements and storm drain signage, and it will continue to collect flows within the adjacent street and convey flows that follow the historic drainage pattern.

II.5 Property Ownership/Management

The proposed project will be maintained by an appointed Homeowner's Association (HOA) selected by the Developer, Toffoli Investments, LLC. The HOA will be responsible for maintaining and provided regular inspections on all of the post-construction BMPs.

Toffoli Investments, LLC.
3 Hughes
Irvine, CA 92618
(949) 768-2535

Section III Site Description

III.1 Physical Setting

Name of Planned Community/Planning Area (if applicable)	n/a
Location/Address	E. Ball Road. & S. Anaheim Boulevard.
	Anaheim, CA 92805
General Plan Land Use Designation	General Commercial
Zoning	Existing Zone: C-G: General Commercial Proposed Zone: RM-1: Multiple Family Residential
Acreage of Project Site	10.68 ac (including right-of-way dedication area and extents of right-of-way improvements)
Predominant Soil Type	Per TGD, Figure XVI-2a, NRCS Soils Groups the site is located within Soil Type B

III.2 Site Characteristics

Site Characteristics	
Precipitation Zone	The site is located within 0.85 inches (85th percentile rainfall) from Figure XVI-1 (Rainfall Zones) from Orange County Technical Guidance Document.
Topography	The site is generally flat with elevations above sea level ranging between 152 feet and 154 feet. The existing site is comprised of commercial use buildings, with very minimal landscaping.
Drainage Patterns/Connections	Drainage at the site generally sheet flows via on-site ribbon gutters, entering the existing storm drain system via drain inlets, or overflowing onto street right of ways via ribbon gutter & existing driveway. See Section II.1 for a complete description of existing and proposed drainage patterns and connections.
Soil Type, Geology, and Infiltration Properties	See Attachment F for soils report, USDA web soil survey designates project site as Soil Group "B", described existing subsurface conditions as "Metzy loamy sand, moderately fine substratum." From Figure XVI-2A of the Orange County Technical Guidance document, predominant soil type for this area is designated as Soil Group "B" Refer to Attachment F within this report for a copy of the project's USDA web soil survey & Figure XVI-2A from the Orange County Technical Guidance document.
Hydrogeologic (Groundwater) Conditions	Per TGD Figure XVI, historic groundwater is encountered at approximately 50 feet below existing grades. Furthermore, the project site is located outside any Plume Protection Boundaries.
Geotechnical Conditions (relevant to infiltration)	Per Summary of Infiltration Testing done by Alta California Geotechnical Inc., dated May 4, 2022, "Two infiltration tests were recently conducted at locations shown on Plate 1, identified as P-1 and P-2. These tests were conducted in 10 and 15-feet deep borings, excavated with a hollow stem auger drill rig, utilizing percolation test methods in general conformance with the County of Orange Guidance Document for WQMP." P-1, tested infiltration rate of 2.9 in/hr P-2, tested infiltration rate of 2.9 in/hr

	"Based on our testing, use of infiltration BMP's are feasible at the subject site at the locations tested."
Off-Site Drainage	No tributary off-site run on exists.
Utility and Infrastructure Information	An existing underground storm drain system is located off-site within the E. Ball Road & S. Anaheim Boulevard street frontage. Existing domestic Water and Sewer mains are located within E. Ball Road & S. Anaheim Boulevard.

III.3 Watershed Description

Receiving Waters	Anaheim Barber City Channel, Bolsa Chica Channel, Huntington Harbour, Pacific Ocean
303(d) Listed Impairments	Anaheim Barber City Channel is not listed for any 303(d) impairments. Bolsa Chica Channel is listed for Ammonia, Indicator Bacteria, and pH. Huntington Harbor is listed for Chlordane, Copper, Indicator Bacteria, Lead, PCBs, and Toxicity.
Applicable TMDLs	Currently there are no applicable TMDL's for Huntington Harbor or Bolsa Chica Channel
Pollutants of Concern (POC) for the Project	Primary POC: Pathogens (Bacteria/Virus), Pesticides, Heavy Metals, Nutrients, Toxic Organic Compounds Other POC: Suspended Solids/Sediment, Oil & Grease, Trash & Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Per the TGD Figure 1, Susceptibility Analysis Huntington Harbor, the project location is not susceptible to hydrologic conditions of concern and does not drain to any unstable, natural channels. Therefore, downstream erosion is not a concern. Refer to Attachment D for the TGD Figure 1.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Per 7.II-2.4.3 of the Model WQMP, the LID implementation criteria are as follows: • Priority Projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). • A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume. Since infiltration are feasible onsite, the project will utilize biotreatment BMPs to pre-treat 50% of the required treatment flowrate. The entire DCV is detained and infiltrated with the infiltration BMPs. Refer to Section IV.3.2 and 3.4 for more information on proposed BMPs.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Per 7.II-2.4.2.3 of the Model WQMP, if the LID performance criteria is not feasibly met by retention and/or biotreatment, then sizing of onsite treatment control BMPs are required. Sizing of these treatment control BMPs will include, if applicable any Water Quality credits as calculated per the Technical Guidance Document. If the additional required volume cannot be met, however has a medium to high effectiveness, then a waiver application and participation in an alternative program may be not required. If the cost of providing treatment control BMPs greatly outweighs the pollution control benefits, a waiver of treatment control and LID requirements can be requested.
Calculate LID design storm capture volume for Project.	The DCV for each DMA was calculated using the TGD Worksheet B as follows: DMA 1: V_{design} = (0.79)(0.85)(0.14 acres)(43,560 sf/acre)(1 foot/12 inches) = 342 cf DMA 2: V_{design} = (0.79)(0.85)(1.51 acres)(43,560 sf/acre)(1 foot/12 inches) = 3,677 cf DMA 3: V_{design} = (0.79)(0.85)(2.62 acres)(43,560 sf/acre)(1 foot/12 inches) = 6,367 cf DMA 4: V_{design} = (0.79)(0.85)(1.23 acres)(43,560 sf/acre)(1 foot/12 inches) = 2,998 cf DMA 5: V_{design} = (0.79)(0.85)(0.24 acres)(43,560 sf/acre)(1 foot/12 inches) = 572 cf DMA 6: V_{design} = (0.79)(0.85)(0.24 acres)(43,560 sf/acre)(1 foot/12 inches) = 572 cf DMA 7: V_{design} = (0.79)(0.85)(1.51 acres)(43,560 sf/acre)(1 foot/12 inches) = 3,657 cf DMA 8: V_{design} = (0.79)(0.85)(0.24 acres)(43,560 sf/acre)(1 foot/12 inches) = 585 cf DMA 9: V_{design} = (0.79)(0.85)(0.28 acres)(43,560 sf/acre)(1 foot/12 inches) = 683 cf DMA 10: V_{design} = (0.79)(0.85)(0.23 acres)(43,560 sf/acre)(1 foot/12 inches) = 562 cf DMA 11: V_{design} = (0.79)(0.85)(1.89 acres)(43,560 sf/acre)(1 foot/12 inches) = 4,604 cf

	E Ball Road (Off-site): V_{design} = (0.79)(0.85)(0.09 acres)(43,560 sf/acre)(1 foot/12 inches)=220 cf S Anaheim Boulevard (Off-site): V_{design} = (0.79)(0.85)(0.10 acres)(43,560 sf/acre)(1 foot/12inches)=244 cf The Design Flowrate for each DMA was calculated using the TGD Worksheet D as follows: DMA 1: Q_{design} = (0.79)(0.262 in/hr)(0.14 acres) = 0.029 cfs DMA 2: Q_{design} = (0.79)(0.262 in/hr)(1.51 acres) = 0.312 cfs DMA 3: Q_{design} = (0.79)(0.262 in/hr)(2.62 acres) = 0.541 cfs DMA 4: Q_{design} = (0.79)(0.262 in/hr)(1.23 acres) = 0.255 cfs DMA 5: Q_{design} = (0.79)(0.262 in/hr)(0.24 acres) = 0.049 cfs DMA 6: Q_{design} = (0.79)(0.262 in/hr)(0.24 acres) = 0.049 cfs DMA 7: Q_{design} = (0.79)(0.262 in/hr)(1.51 acres) = 0.311 cfs DMA 8: Q_{design} = (0.79)(0.262 in/hr)(0.24 acres) = 0.050 cfs DMA 9: Q_{design} = (0.79)(0.262 in/hr)(0.28 acres) = 0.058 cfs DMA 10: Q_{design} = (0.79)(0.262 in/hr)(0.23 acres) = 0.048 cfs DMA 11: Q_{design} = (0.79)(0.262 in/hr)(1.89 acres) = 0.391 cfs E Ball Road (Off-site): Q_{design} = (0.90)(0.262 in/hr)(0.09 acres) = 0.021 cfs S Anaheim Boulevard (Off-site): Q_{design} = (0.90)(0.262 in/hr)(0.10 acres) = 0.024 cfs See Attachment D of this report for DCV and treatment flowrate calculations. Biotreatment BMPs will be utilized for water quality pre-treatment of the DCV prior to be detained and infiltrated for onsite improvement. Offsite Biotreatment BMPs will be utilized for water quality treatment of offsite improvements prior to be release downstream following historical drainage pattern.

IV.2. Site Design and Drainage

The proposed site will be graded to convey stormwater as surface flow towards proposed curb-inlet catch basins, located at relative low points on-site. The catch basins will convey flows to proposed Modular Wetland Systems for pre-treatment and the stormwater will be routed to underground storage system for infiltration through a proposed drywell/ or infiltration trench system for water quality treatment. Northerly flows will ultimately be directed to E. Ball Road, connecting an existing City of Anaheim 45" R.C.P. SD via proposed junction structure. Similarly, southerly flows will be conveyed to an existing City of Anaheim 36" R.C.P. SD and follow the historic drainage pattern.

The Modular Wetland Biofiltration Systems are designed to provide a 3 phase treatment train. Initially, when the stormwater enters the system, a trash rack, filter media and settling chamber will capture large trash/ debris and sediment in the stormwater before entering into the plant media. This system is designed to treat stormwater flow horizontally. Before the stormwater enters the planting or "wetland" chamber, the runoff flows through the 2nd phase, a pre-filter cartridge which captures fines TSS, metals, nutrients and bacteria. The pre-filter chamber eliminates additional maintenance of the planting area. The wetland chamber is the 3rd phase of the system which provides final treatment through a combination of physical, chemical and biological processes.

The MaxWell DryWell Plus Drainage System provides another round of pre-treatment of runoff prior to infiltration. Infiltration will occur below the Settling Chamber. Runoff will enter the Settling Chamber equipped with an absorbent pillow that will contain the pollutants. Runoff is then routed into the drywell portion of the subsurface soils where percolation occurs, recharging the groundwater. A proposed underground detention pipe will provide additional storage in addition to capturing the required design capture volume prior to entry into the Maxwell DryWell Plus Drainage System. The Maxwell DryWell Plus Drainage System will be sized to infiltrate the required Design Capture Volume (DCV) within a 48-hour timeframe. Refer to Section IV.3.2 of this report for sizing information for the infiltration system.

The ADS StormTech Chambers infiltration system is an underground infiltration gallery consisting of a series of open-bottom domes underlain by a bed of gravel which promotes subsurface infiltration. The system will be designed to provide enough static volume within the domes and gravel bed to retain the entire DCV. The amount of surface area provided will be designed to ensure infiltration of the entire DCV within 48 hours. Refer to Section IV.3.2 of this report for sizing information for the infiltration system.

The depths of the proposed infiltration systems will provide a minimum clearance of 10' between the bottom of the infiltration system and the groundwater elevation.

Refer to Worksheets B and D in Attachment D of this report.

Drainage Management Areas (DMA) Table:

Drainage Area No. (DMA)	Area (ac)	Design Flow Rate (cfs)	Design Capture Volume (cf)
1*	0.23	0.053	562
2	1.51	0.312	3,677
3	2.62	0.541	6,367
4	1.23	0.255	2,998
5	0.24	0.049	572
6	0.24	0.049	572
7	1.51	0.311	3,657
8	0.24	0.050	585
9	0.28	0.058	682
10	0.23	0.048	562
11*	1.99	0.415	4,848

Drainage Management Areas (DMA) Table:

Drainage Area No. (DMA)	Area (ac)	Design Capture Volume (cf)	48-hr Infiltrated Volume (cf)	Infiltration BMP
1-2*	1.74	4,239.0	4,956.2	Maxwell DryWell Plus
3-11*	8.58	20,843	32,176.2	ADS Stormtech

*Includes equivalent area and volume from the right of way dedication

IV.3 LID BMP Selection and Project Conformance Analysis

IV.3.1 Hydrologic Source Controls (HSCs)

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

No HSCs included.

IV.3.2 Infiltration BMPs

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☒
Subsurface infiltration galleries	☒
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Infiltration Feasibility:

For DMA 1-2, The proposed development will utilize a Maxwell DryWell Plus Drywell System and Detention Pipe System to treat and retain the required Design Capture Volume. The Drywell System is a chamber system that collects, pre-treats, stores and directs stormwater runoff underground to promote infiltration and soil percolation in order to re-charge the groundwater. The Settling Chamber will pre-treat the site runoff which will collect pollutants such as sediment/ silt to settle, oil/grease, nutrients, pathogens and phosphorus. It will also collect larger trash/debris. Clean runoff is then routed to the drywell. The settling cast-in-place concrete with perforated holes located in the lower 4 feet to maximize infiltration. An underground detention system will be connected to the drywell to provide storage. Runoff will be detained within the detention system prior to entry into the Maxwell DryWell Plus Drywell System.

In the event the drywell system is full, stormwater runoff will back up within the system into the detention pipe system. When both the detention pipe and drywell reach capacity, also known as an emergency overflow, runoff will back up through the proposed parkway culvert and flow via street flow following existing drainage pattern.

DMA 1-2
A = 1.74 ac
DCV = 4,239 cf
Maxwell DryWell Plus *Drainage System with the following properties:*
*· 20' Settling Chamber depth at 4' diameter (10' static storage depth)**
· 24' Drywell Depth at 6' diameter
· Inlet pipe at invert 10' below FS
·Total Depth (overall depth) = dsettling + ddrywell
= 20' + 24' =44'
Storage Calculations:
*VSETTLING =πr^2(dstatic settling) = π (2 ft)^2(10 ft) = 125 cf **
VPRIMARY =πr^2(dstatic primary)= π (2 ft)^2(10 ft)(14ft)=125 cf
VDRYWELL = πr^2(ddrywell)(n) = π (3 ft)^2(20 ft)(0.40) = 271 cf
where, r = radius (ft), d = depth (ft), n = Void Space (0.40) per manufacturer's specifications
∑Volume = 125 cf + 125cf+271 cf = 521 cf

** Only the portion below the inlet pipe for the Primary and Settling Chambers was included for static storage calculation of drywell system.*

Required Detention Pipe Storage = DCV - ∑V = 4,239 cf – 521 cf = 3,718 cf
Provided → 190 lf of 60" HDPE Detention Pipe (19.63 cf of storage per lf)
V = (19.63 cf/lf)(190 lf)= 3,729 cf > 3,718 cf √*

Infiltration Calculations:
V48-HR = (1 ft/ 12 in)(KDESIGN, in/hr)(SA, sf)(72 hr), where SA = Infiltrating Surface Area of Drywell
SA = $\pi r^2 + 2\pi$ (r)(ddrywell infiltration) =π (3 ft)^2 + 2(π)(3 ft)(24ft+20ft) = 857 sf
where, r = radius (ft), ddrywell infiltration = depth of drywell infiltration zone (ft)

V48-HR = (1 ft/12 in)(1.29 in/hr)(857 sf)(48 hr) = 4,425 cf > DCV = 4,239 cf√

Refer to Attachment C of this report for additional Maxwell Drywell Plus System information.

For DMA 3-11, The proposed development will utilize an ADS Stormtech System for detention and infiltration to treat and retain the required Design Capture Volume.

DMA 3-11 – MC-3500 ADS StormTech Chambers
DCV = 20,843 cf
Installed System effective depth = 3.75'
Installed System total depth (21" gravel) = 5.75'
Installed System Volume = ***20,975 cf > 20,843 cf*** ✓
Installed System Surface Area = 6,241 sf
$V_{infiltration,\ 48\ hr}$ = *(1/12)(6,241 sf)(1.29 in/hr)(48 hrs)*
= ***32,173 cf > 20,843 cf*** ✓

Drawdown time = 31.1 hrs
$V_{infiltration,\ 31.1\ hr}$ = *(1/12)(6,241 sf)(1.29 in/hr)(31.1 hrs) = 20,843 cf*

Refer to Attachment C of this report for additional ADS Stormtech information.

Conclusion:

The combination of the drywell, detention pipe system, and ADS Stormtech will be more than sufficient to capture, treat, and retain the required design capture volume to support this development. Additional Geotechnical information will be provided during final engineering to verify the feasibility and infiltration applicability of the drywell, and ADS system for sizing.

Drainage Management Areas (DMA) Table:

DMA	Area (ac)	DCV (cf)	DryWell Model	Detention Capacity (cf)	Surface Area (sf)	Infiltration Over 48 Hours (cf)
1-2*	1.74	4,239	Maxwell DryWell Plus	8,155	857	4,425

DMA	Area (ac)	DCV (cf)	ADS StormTech Model	Detention Capacity (cf)	Surface Area (sf)	Infiltration Over 48 Hours (cf)
3-11*	8.58	20,843	MC-3500	20,975	6,241	32,173

GIS Coordination of Infiltration Systems
Maxwell DryWell Plus 6058469.3284'E 2245227.5675'N
MC-3500 ADS Stormtech 6058461.5075'E 2244172.5632'N

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Evapotranspiration, Rainwater Harvesting BMPs will not be utilized for the proposed development and have been deemed infeasible due to site design constraints. Refer to Worksheet J within Attachment D of this report for more information.

IV.3.4 Biotreatment BMPs

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Biotreatment:

Since infiltration BMP will be detain and infiltrate the entire DCV, the project will utilize biotreatment BMPs as a pre-treatment size for 50% of the required treatment flowrate. Modular Wetland Systems are proposed at the low points of the site to collect runoffs for water quality pre-treatment to be routed to the proposed underground infiltration systems. The MWS Biofiltration Systems are preliminary sized on the full design flow-based calculations for conservative measures, further design calculation may be revisited during final engineering.

Refer to Attachment C for additional MWS Biofiltration System BMP information.

Refer to Worksheet D in Attachment D for additional calculations.

Drainage Area No. (DMA)	Area (ac)	Design Flow Rate (cfs)	Proposed MWS Model	MWS Flowrate Capacity (cfs)
1	0.23*	0.053	MWS-L-4-6	0.073
2	1.51	0.312	MWS-L-8-12	0.346
3	2.62	0.541	MWS-L-8-20	0.577
4	1.23	0.255	MWS-L-8-12	0.346
5	0.24	0.049	MWS-L-4-6	0.073
6	0.24	0.049	MWS-L-4-6	0.073

7	1.51	0.311	MWS-L-8-12	0.346
8	0.24	0.050	MWS-L-4-6	0.073
9	0.28	0.058	MWS-L-4-6	0.073
10	0.23	0.048	MWS-L-4-6	0.073
11	1.99*	0.415	MWS-L-8-16	0.462
∑	10.32	2.141	-	-

*Due to size constraints in the right of way, onsite BMPs will be upsized to offset the right of way improvement areas.

<u>GIS Coordination of MWS Systems</u>

	Easting	*Northing*
1	6058842.3613'	2245121.1240'
2	6058452.8493'	2245233.1085'
3	6058274.3460'	2244876.4179'
4	6058292.2550'	2244771.9125'
5	6058396.8013'	2244604.1948'
6	6058420.7948'	2244321.8875'
7	6058400.8979'	2244398.4938'
8	6058468.9988'	2244163.4541'
9	6058308.1089'	2244715.8354'
10	6058327.8614'	2244638.6558'
11	6058441.2083'	2244244.6503'

Refer to Attachment C for additional MWS Biofiltration System BMP information.

IV.3.5 Hydromodification Control BMPs

Hydromodification Control BMPs	
BMP Name	**BMP Description**
N/A	

IV.3.6 Regional/Sub-Regional LID BMPs

Regional/Sub-Regional LID BMPs
N/A

IV.3.7 Treatment Control BMPs

Treatment Control BMPs	
BMP Name	**BMP Description**
N/A	N/A

IV.3.8 Non-structural Source Control BMPs

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Title 22 CCR Compliance does not apply.
N6	Local Industrial Permit Compliance	☐	☒	Residential development.
N7	Spill Contingency Plan	☐	☒	Residential development
N8	Underground Storage Tank Compliance	☐	☒	No proposed underground storage tanks
N9	Hazardous Materials Disclosure Compliance	☐	☒	No proposed hazardous materials.
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No proposed loading docks.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Residential development.

N1: Education for Property Owners, Tenants & Occupants

Project conditions of approval will require that the Homeowner's Association (HOA) periodically provide environmental awarness education materials, made available by the municipalities, to all of its members. Among other things, these materials will be descrive the use of chemcials (including household type) that should be limited to the property, with no discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials available from the County of Orange can be downloaded here: http://www.ocwatersheds.com/PublicEd/resources/default.aspx

N2: Activity Restrictions

Conditions, covenants and restrictions (CC&Rs) must be prepared by the developer for the appointed HOA for the purpose of surface water quality protection. The CC&Rs shall incorporate the restrictions based on the Project WQMP.

N3: Common Area Landscape Management

All common landscaping and/ or open space areas shall have on-going landscape maintenance by an appointed professional landscaping maintenance company as selected by the HOA. Maintenance shall incorporate all current County Water Conservation Resolution usage and follow the Management Guidelines for Use of Fertilizers per the DAMP Section 5.5. Refer to Section 5 of this report for additional landscape maintenance requirements.

N4: BMP Maintenance

Refer to Section 5 and Attachment E of this report for additional non-structural BMP maintenance requirements, responsibility and frequency.

N10: Uniform Fire Code Implementation

HOA is responsible for compliance with Article 80 of the Uniform Fire Code enforced by the local fire protection agency.

N11: Common Area Litter Control

HOA to implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. HOA to contract with landscape maintenance company to provide this service during regularly scheduled maintenance, which will consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposals violations by homeowners, tenants or occupants and reporting the violations to the HOA for investigation.

N12: Employee Training

HOA to provide Educational Materials and Property Management manuals to all employees upon initial hiring. Any updated information shall be provided to employees within a timely manner along with information on implementation.

N14: Common Area Catch Basin Inspections

HOA to inspect, clean and repair common area catch basins within the development to verify that the private drainage system is working properly. All trash/ debris and sediment build up is removed and any repairs/ replacements are conducted. Cleaning should take place in late summer/ early fall prior to the start of the raining season. Drainage facilities include catch basins (storm drain inlets), detention basins, retention basins, sediment basins, open drainage channels, area drains, and lift stations. Records shall be kept onsite to document the annual maintenance.

N15: Street Sweeping of Private Streets & Parking Lots

HOA to schedule at a minimum street sweeping of private streets and parking areas prior to the start of the rainy seasons, in late summer or early fall. Additional sweeping may be required to remove landscaping foliage and/ or pollution.

IV.3.9 Structural Source Control BMPs

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No proposed outdoor storage areas.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No proposed slopes or channels.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not applicable.
S6	Dock areas	☐	☒	No proposed dock areas.
S7	Maintenance bays	☐	☒	No proposed maintenance bays.
S8	Vehicle wash areas	☐	☒	No proposed vehicle wash areas.
S9	Outdoor processing areas	☐	☒	No proposed outdoor processing areas.
S10	Equipment wash areas	☐	☒	No proposed equipment wash areas.
S11	Fueling areas	☐	☒	No proposed fueling areas.
S12	Hillside landscaping	☐	☒	Development not located within hillside area.
S13	Wash water control for food preparation areas	☐	☒	No proposed wash control areas for food preparation areas.
S14	Community car wash racks	☐	☒	No proposed community car wash areas.

S1 (CASQA Fact Sheet SD-13): Storm Drain Stenciling & Signage

HOA to inspect, repair and/ or replace storm drain stenciling and signage immediately. Inspection of stenciling and signage shall occur at least once per month and prior to the start of the raining season. Storm Drain stenciling and signage with a reference that indicates "Drains to Ocean" per CASQA BMP SD-13 Fact Sheet is required.

S3 (CASQA Fact Sheet SD-32): Trash Storage Areas

HOA to maintain trash enclosure areas to reduce pollutant transportation including replacement of bins if leaking, removal of any built-up trash, debris or remnants, and weekly inspections. HOA to limit the type and amount of waste removal allowed by homeowners, tenants, or occupants per the development's CC&Rs. Refer to CASQA BMP Fact Sheet SD-32 for more information.

S4 (CASQA Fact Sheet SD-12): Use Efficient Irrigation Systems & Landscape Design

HOA shall implement the timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm drain systems. HOA to implement the following methods to reduce excessive irrigation water runoff, where applicable:

- Employ rain shutoff devices to prevent irrigation after precipitation
- Utilizing landscape specific irrigation water requirements
- Utilize flow reducers or shutoff valves triggered by pressure drop to control water loss due to broken sprinkler heads
- Implement landscaping practices per the County Water Conservation Resolution or City agency equivalent
- Group plants or landscaping with similar water consumption in order to promote surface infiltration

Refer to CASQA BMP Fact Sheet SD-12 for additional information.

IV.4 Alternative Compliance Plan (If Applicable)

IV.4.1 Water Quality Credits

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td>☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="3">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="3">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td colspan="2">☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="5">The entire DCV for the project site is being treated by a LID BMP. Water quality credits will not be used.</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

n/a

Section V Inspection/Maintenance Responsibility for BMPs

The property is currently owned by Toffoli Investments, LLC. The Owner will be responsible for the long-term maintenance of the project's storm water facilities and conformance to this WQMP after construction is complete.

A Notice of Transfer of Responsibility is located in Attachment G of this report and should be executed as part of any ownership transfer after construction is complete.

The owner may appoint a Homeowner's Association (HOA) to provide long term BMP maintenance for the proposed development upon completion of construction.

Owner/Developer:
Toffoli Investments, LLC
3 Hughes
Irvine, CA 92618
Alan Toffoli, Principal
(949) 768-2535

The owner is aware of the maintenance responsibilities of the proposed BMPs. A funding mechanism is in place to maintain the BMPs at the frequency stated in the WQMP.

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Education for Property Owners, Tenants, Occupants & Employees	Homeowner's Association (HOA)	HOA to provide education material, a copy of the approved WQMP and Operation & Maintenance Plan (O&M) to new property owners, tenants, occupants & employees.	At time of hiring, leasing and/ or home purchase.
Activity Restrictions	HOA	HOA employees notified of activities that are prohibited by homeowners.	Restrictions identified in Employee Manual and reviewed yearly by employees.
Common Area Landscape Management	HOA	HOA to hire professional landscape company to conduct maintenance of landscaping to meet current water efficiency and keep plants healthy and bio areas maintained with proper soil amendments.	Regular maintenance once a week and monthly inspection to determine deficiencies.
BMP Maintenance	HOA	HOA to hire professional BMP maintenance company to conduct regular inspections, repairs and cleanings per manufacturer's specifications.	A minimum 2 inspections/ cleanings per year per manufacturer's specifications prior to October 1st (before rainy season)
Uniform Fire Code Implementation	HOA	HOA to comply with fire regulations and keep informed of the latest rules and requirements.	Comply with annual fire inspections and maintain building and access per the latest fire codes.

Common Area Litter Control	HOA	HOA to provide litter removal of site parking lot and landscape areas and to empty common area trash bins.	Once per week.
Employee Training	HOA	The distribution of these materials will be the reasonability of the HOA at the initial hiring of the employee.	At time of hiring.
Private Street & Parking Lot Sweeping	HOA	HOA to provide maintenance of Parking Lot and provide Street Sweeping services.	Weekly basis.
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	HOA	HOA to provide maintenance of landscaping to meet current water efficiency standards, and keep plants healthily.	Regular maintenance once a week and monthly inspection to determine any water deficiencies.
Common Area Catch Basin Inspections	HOA	HOA shall inspect common areas where catch basins are located within the surrounding area and remove any trash/ debris.	Inspections/ Cleaning shall occur at least twice per month.
Storm Drain System Stencilling & Signage	HOA	HOA to inspect and repair as needed all onsite storm drain stencilling & signage.	Inspection should occur at minimum twice per year.
Modular Wetlands System (MWS) Biofiltration Vaults	HOA	HOA will be required to hire a professional maintenance company to provide regular inspections, repairs and cleaning per manufacturer's specifications. Maintenance/cleaning should include removing trach from screening device, removing sediment from separation chamber, replacing cartridge	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's specifications.

		and down drain filter media, and trimming vegetation. Refer to Attachment E for manufacturer's maintenance specifications.	
ADS Stormtech	HOA	HOA will be required to hire a professional maintenance company to provide regular inspection, repairs, and cleaning per manufacturer's specifications. All trash/debris and loose sediment/silt shall be removed routinely.	Inspections should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for manufacturer's specifications.
Connector Pipe Screen (CPS) Device	City of Anaheim (offsite)	City of Anaheim to inspect and schedule maintenance to remove debris bluid-up, repair/ replace screen and mechanism, and clean as needed within catch basin and screen area.	Inspections shall occur at least two times per year and once per year for maintenance services before the start of the rainy season (October 1st).
Drywell	HOA	HOA will be required to hire a professional maintenance company to provide regular inspection, repairs, and cleaning per manufacturer's specifications. All trash/debris and loose sediment/silt shall be removed routinely.	Inspections should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for manufacturer's specifications.

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Refer to Attachment B of this report for the WQMP Exhibit.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.

Section VII Educational Materials

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

Attachment A
Educational Materials

Please visit www.ocwatersheds.com for educational materials.

Attachment B
WQMP Exhibit

WQMP EXHIBIT

E. BALL ROAD & S. ANAHEIM BLVD.

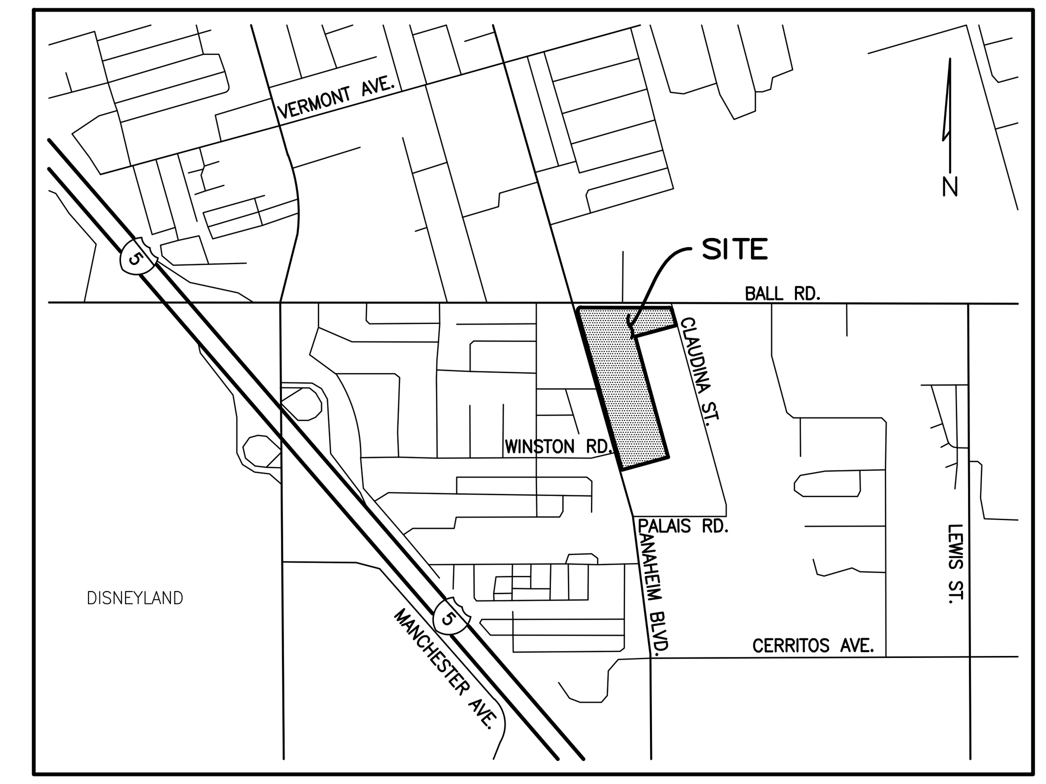
TTM 19140

LEGEND

- RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE MANAGEMENT AREA BOUNDARY
- FLOW DIRECTION
- XX — DRAINAGE AREA ID
- X.XX AC — DRAINAGE AREA IN ACRES
- AREA OF PROPOSED OFFSITE IMPROVEMENTS

BEST MANAGEMENT PRACTICES

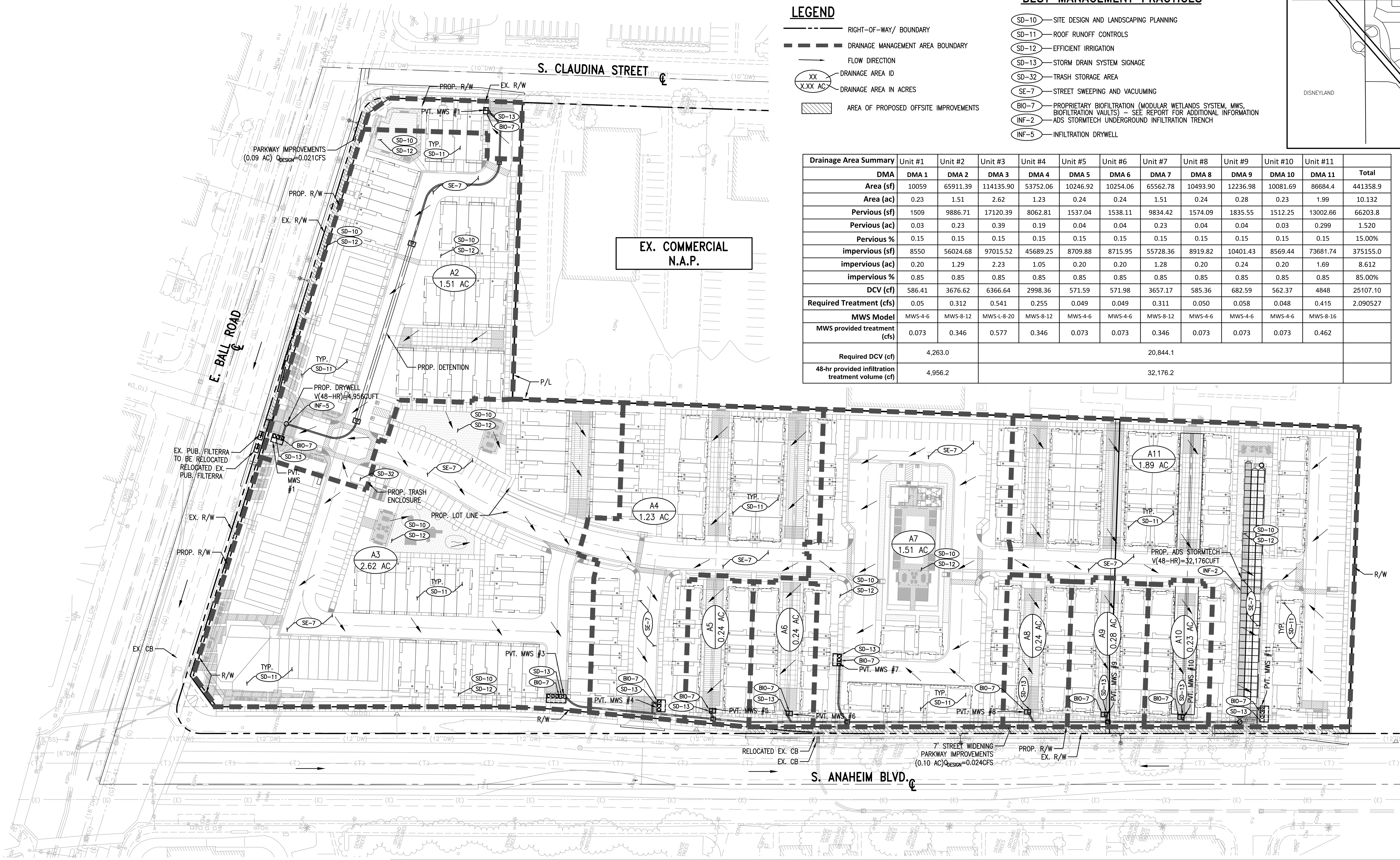
- SD-10 — SITE DESIGN AND LANDSCAPING PLANNING
- SD-11 — ROOF RUNOFF CONTROLS
- SD-12 — EFFICIENT IRRIGATION
- SD-13 — STORM DRAIN SYSTEM SIGNAGE
- SD-32 — TRASH STORAGE AREA
- SE-7 — STREET SWEEPING AND VACUUMING
- BIO-7 — PROPRIETARY BIOFILTRATION (MODULAR WETLANDS SYSTEM, MWS, BIOFILTRATION VAULTS) – SEE REPORT FOR ADDITIONAL INFORMATION
- INF-2 — ADS STORMTECH UNDERGROUND INFILTRATION TRENCH
- INF-5 — INFILTRATION DRYWELL



LOCATION MAP

NOT TO SCALE

Drainage Area Summary	Unit #1	Unit #2	Unit #3	Unit #4	Unit #5	Unit #6	Unit #7	Unit #8	Unit #9	Unit #10	Unit #11	
DMA	DMA 1	DMA 2	DMA 3	DMA 4	DMA 5	DMA 6	DMA 7	DMA 8	DMA 9	DMA 10	DMA 11	Total
Area (sf)	10059	65911.39	114135.90	53752.06	10246.92	10254.06	65562.78	10493.90	12236.98	10081.69	86684.4	441358.9
Area (ac)	0.23	1.51	2.62	1.23	0.24	0.24	1.51	0.24	0.28	0.23	1.99	10.132
Pervious (sf)	1509	9886.71	17120.39	8062.81	1537.04	1538.11	9834.42	1574.09	1835.55	1512.25	13002.66	66203.8
Pervious (ac)	0.03	0.23	0.39	0.19	0.04	0.04	0.23	0.04	0.04	0.03	0.299	1.520
Pervious %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	15.00%
impervious (sf)	8550	56024.68	97015.52	45689.25	8709.88	8715.95	55728.36	8919.82	10401.43	8569.44	73681.74	375155.0
impervious (ac)	0.20	1.29	2.23	1.05	0.20	0.20	1.28	0.20	0.24	0.20	1.69	8.612
impervious %	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	85.00%
DCV (cf)	586.41	3676.62	6366.64	2998.36	571.59	571.98	3657.17	585.36	682.59	562.37	4848	25107.10
Required Treatment (cfs)	0.05	0.312	0.541	0.255	0.049	0.049	0.311	0.050	0.058	0.048	0.415	2.090527
MWS Model	MWS-4-6	MWS-8-12	MWS-L-8-20	MWS-8-12	MWS-4-6	MWS-4-6	MWS-8-12	MWS-4-6	MWS-4-6	MWS-4-6	MWS-8-16	
MWS provided treatment (cfs)	0.073	0.346	0.577	0.346	0.073	0.073	0.346	0.073	0.073	0.073	0.462	
Required DCV (cf)	4,263.0		20,844.1									
48-hr provided infiltration treatment volume (cf)	4,956.2		32,176.2									



SCALE: 1" = 50'

0 25 50 100

DEVELOPER :	REVISIONS
NO. DATE INITIAL	DESCRIPTION APP DATE

PREPARED FOR:

TOFFOLI INVESTMENTS, LLC

3 HUGHES, IRVINE, CALIFORNIA 92618

PREPARED BY:

C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING

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IRVINE, CALIFORNIA 92618
(949) 916-3800
INFO@CVC-INC.NET
WWW.CVC-INC.NET

REGISTERED PROFESSIONAL ENGINEER
DANE P. MCDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

WQMP EXHIBIT BALL ANAHEIM AVENUE MIXED USE DEVELOPMENT		OTH-2021-01375 DATE: 6/2/2022 SHEET 1 OF 1
SCALE: AS SHOWN	DRAWN BY: EP	CHECKED BY: DM
CITY OF ANAHEIM		

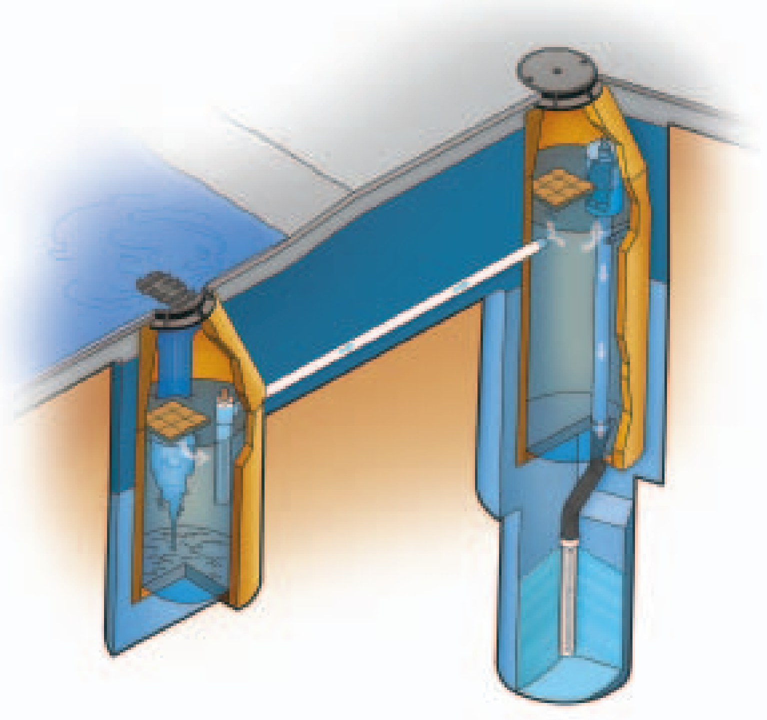
Attachment C
BMP Fact Sheets & Details

MaxWell™ Plus DRAINAGE SYSTEM

Product Information and Design Features

TORRENT RESOURCES

The ***MaxWell™ Plus,*** as manufactured and installed exclusively by Torrent Resources Incorporated, is the industry standard for draining large paved surfaces, nuisance water and other demanding applications. This patented system incorporates state-of-the-art pre-treatment technology.



THE ULTIMATE IN DESIGN

Since 1974, over 40,000 MaxWell™ Systems have proven their value as a cost-effective solution in a wide variety of drainage applications. They are accepted by state and municipal agencies and are a standard detail in numerous drainage manuals. Many municipalities have recognized the inherent benefits of the MaxWell Plus and now require it for drainage of all paved surfaces.

SUPERIOR PRE-TREATMENT

Industry research, together with Torrent Resource's own experience, has shown that initial storm drainage flows have the greatest impact on system performance. This "first flush" occurs during the first few minutes of runoff and carries the majority of sediment and debris. Larger paved surfaces or connecting pipes from catch basins, underground storage, etc. can also generate high peak flows which may strain system function. In addition, nuisance water flows require controlled processing separate from normal storm runoff demands.

In the ***MaxWell Plus,*** preliminary treatment is provided through collection and separation in deep large-volume settling chambers. The standard MaxWell Plus system has over 2,500 gallons of capacity to contain sediment and debris carried by incoming water. Floating trash, paper, pavement oil, etc. is effectively stopped by the **PureFlo™ Debris Shields** in each chamber. These shielding devices are equipped with an effective screen to filter suspended material and are vented to prevent siphoning of floating surface debris as the system drains.

EFFECTIVE PROCESSING

Incoming water from the surface grated inlets or connecting pipes is received in the Primary Settling Chamber where silt and other heavy particles settle to the bottom. A PureFlo™ Debris Shield ensures containment by trapping floating debris and pavement oil. The pre-treated flow is then regulated to a design rate of up to 0.25cfs and directed to a secondary settling chamber. The settling and containment process is repeated, thereby effectively achieving controlled, uniform treatment. The system is drained as water rises under the PureFlo Debris Shield and spills into the top of the overflow pipe. The drainage assembly returns the cleaned water to the surrounding soil through the **FloFast™ Drainage Screen.**

ABSORBENT TECHNOLOGY

To provide prompt removal of pavement oils, both ***MaxWell Plus*** settling chambers are equipped with absorbent sponges. These floating pillow-like devices are 100% water repellent and literally wick petrochemical compounds from the water. Each sponge has a capacity of over 128 ounces to accommodate effective, long-term treatment. The absorbent is completely inert and will safely remove runoff constituents down to rainbow sheens which are typically no more than one molecule thick.

SECURITY FEATURES

MaxWell Plus Systems include bolted, theft-resistance, cast iron gratings and covers as standard security features. Special inset castings which are resistant to loosening from accidental impact are available for use in landscaped applications. Machined mating surfaces and "Storm Water Only" wording are standard.

THE MAXWELL FIVE-YEAR WARRANTY

Innovative engineering, quality materials and exacting construction are standard with every MaxWell system produced and installed by Torrent Resources Incorporated. The MaxWell Drainage Systems Warranty is the best in the industry and guarantees against failures due to workmanship or materials for a period of five years from date of completion.

Manufactured and Installed Exclusively by Torrent Resources Incorporated

Please see reverse side for additional information

U.S. Patent No. 4,923,330 ™Trademark 1974, 1987, 2004

11/04

MAXWELL™ PLUS DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

CALCULATING MAXWELL PLUS REQUIREMENTS:

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained storm water, use **one standard MaxWell Plus per the instructions below** for up to 5 acres of landscaped contributory area, and up to 2 acres of paved surface. To drain nuisance water flows in storm runoff systems, **add a remote inlet** to the System. For smaller drainage needs, refer to our ***Type IV MaxWell.*** For industrial drainage, our ***Envibro™ System*** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

COMPLETING THE MAXWELL PLUS DRAWING

To apply the ***MaxWell Plus*** drawing to your specific project, simply fill in the blue boxes per the following instructions. For assistance, please consult our Design Staff.

PRIMARY SETTLING CHAMBER DEPTH

The overall depth of the Primary Settling Chamber is determined by the amount of surface area being drained. Use a standard depth of **10 feet** for the initial acre of contributory drainage area, **plus 2 feet** for each additional acre, up to the design limits of the property type noted in "Calculating MaxWell Plus Requirements" noted above. Other conditions that would require increased chamber depths are property usage, maintenance scheduling, and severe or unusual service conditions. Connecting Pipe Depth may dictate deeper chambers so as to maintain the effectiveness of the settling process.

ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate total system depth required to achieve 10 continuous feet of penetration into permeable soils, based upon known soil information. Torrent's specialized **"crowd"** equipped rigs get through the difficult cemented soils to reach clean drainage soils at depths up to **180 feet** and their extensive drilling log database is available to use as a reference.

SETTLING CHAMBER DEPTH

On **MaxWell Plus Systems** of over 30 feet overall depth and up to 0.25cfs design rate, the standard Settling Chamber Depth is **18 feet.**

OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. An overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet.**

DRAINAGE PIPE

This dimension also applies to the ***PureFlo™*** Debris Shields, the ***FloFast™*** Drainage Screen, and fittings. The size is based upon system design rates, multiple primary settling chambers, soil conditions, and need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to our company's **"Design Suggestions for Retention and Drainage Systems"** for recommendations on which size best matches your application.

BOLTED RING & GRATE/COVER

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

INLET PIPE INVERT

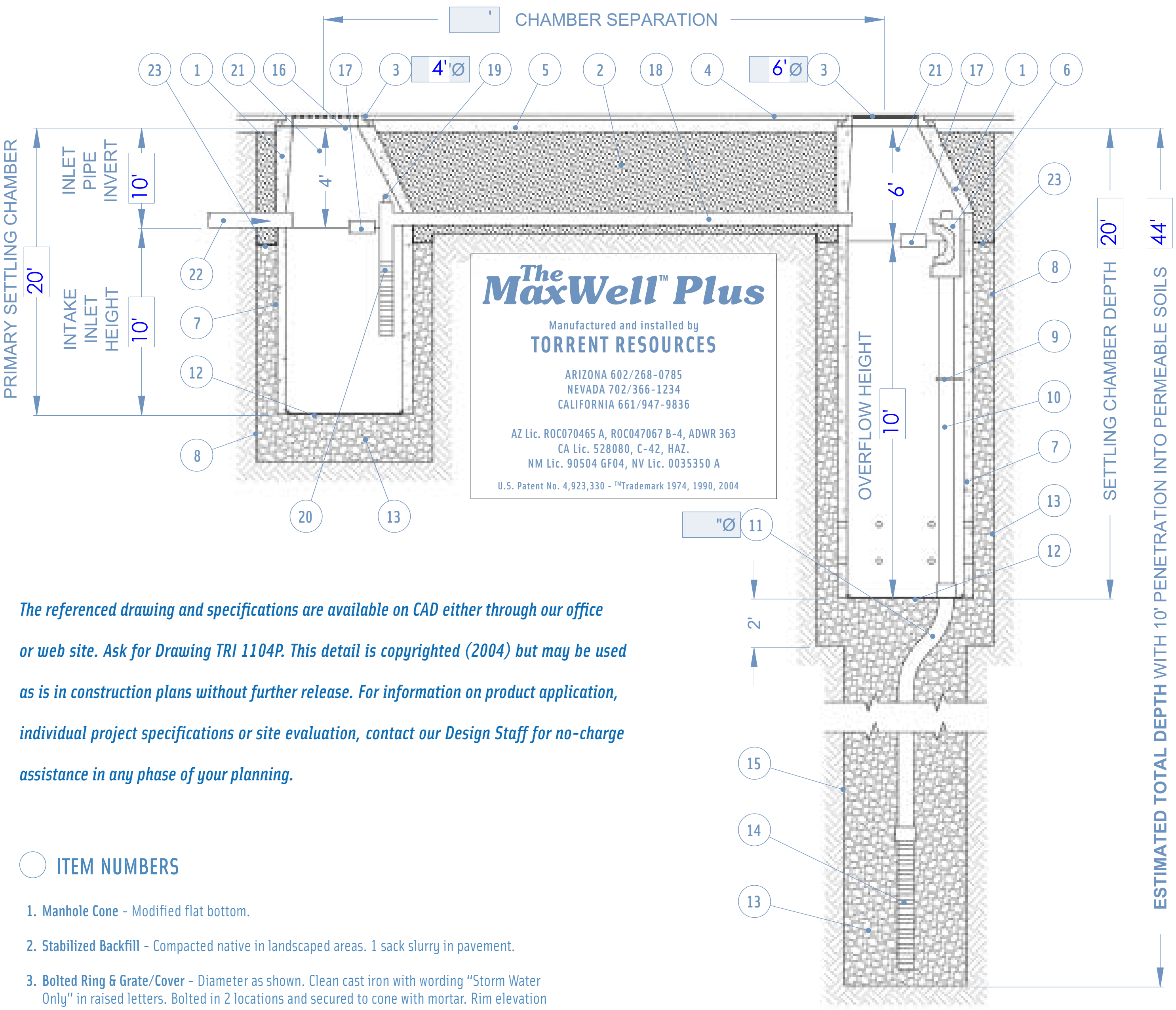
Pipes up to 24" in diameter from catch basins, underground storage, etc. may be connected into the primary settling chamber. Inverts deeper than 4 feet will require additional depth in both system settling chambers to maintain respective effective settling capacities.

INTAKE INLET HEIGHT

The Intake Inlet Height determines the effectiveness of the settling process in the Primary Settling Chamber. A minimum inlet height of **6 feet** is used with the standard primary settling chamber depth of 10 feet. Greater inlet heights would be required with increased system demands as noted in Primary Settling Chamber Depth.

CHAMBER SEPARATION

The standard separation between chambers is **15 feet** from center to center for inlet pipe inverts up to 7 feet. For deep inlet pipes or underground storage systems that result in a deeper Connector Pipe, add 5 feet of separation for each 3 feet of additional Connector Pipe depth. Maximum Connector Pipe depths and Chamber separations are 13 feet and 25 feet, respectively. A pump and lift station is recommended for systems with deeper requirements.



The referenced drawing and specifications are available on CAD either through our office or web site. Ask for Drawing TRI 1104P. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.

ITEM NUMBERS

1. **Manhole Cone** - Modified flat bottom.
2. **Stabilized Backfill** - Compacted native in landscaped areas. 1 sack slurry in pavement.
3. **Bolted Ring & Grate/Cover** - Diameter as shown. Clean cast iron with wording "Storm Water Only" in raised letters. Bolted in 2 locations and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** (by Others).
6. **PureFlo™ Debris Shield** - Rolled 16 Ga. steel X 24" length with vented anti-siphon and internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections to **maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile, poly liner or concrete slurry.
13. **Rock** - Clean and washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast™ Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft. 96" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. Resistant Geotextile - **To be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. 128 oz. capacity.
18. **Connector Pipe** – 4" Ø Sch. 40 PVC.
19. **Vented Anti-Siphon** intake with flow regulator.
20. **Intake Screen** – Sch. 40 PVC 0.120" modified slotted well screen with 32 slots per row/ft. 48" overall length with TRI-C end cap.
21. **Freeboard Depth Varies** with inlet pipe elevation. Increase primary/secondary settling chamber depths as needed to maintain all inlet pipe elevations above connector pipe overflow.
22. **Optional Inlet Pipe** (by Others).
23. **Moisture Membrane** – 6 mil. Plastic. Place securely against eccentric cone and hole sidewall. Used in lieu of slurry in landscaped areas.

The watermark for drainage solutions.

TORRENT RESOURCES

INDUSTRY SERVICES

Site Drainage Systems
- Stormwater Drywells
- French Drains
- Piping
- Drainage Appurtenances
- Pump Systems

Technical Analysis
- Design Review
- Percolation Testing
- Geologic Database
- ADEQ Drywell Registration

Recharge Systems
- Municipal/Private Recharge Wells
- Injection Wells & Galleries

Environmental Applications
- Pattern Drilling/Soil Remediation
- Drainage Rehabilitation
- Drywell Abandonments
- OSHA HAZMAT-Certified

Drainage Renovation
- Problem Assessment
- Site Redesign/Modification
- System Retrofit

Drainage Maintenance
- Preventive Maintenance
- Service Contracts
- Drywell Cleaning

TORRENT RESOURCES INCORPORATED

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www.TorrentResources.com

AZ Lic. ROC070465 A,
ROC047067 B-4; ADWR 363

CA Lic. 528080 A, C-42, HAZ

NV Lic. 0035350 A

NM Lic. 90504 GF04

An evolution of McGuckin Drilling

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteAssist™
FOR STORMTECH
INSTALLATION INSTRUCTIONS
VISIT OUR APP

GLPX-003

ANAHEIM, CA

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

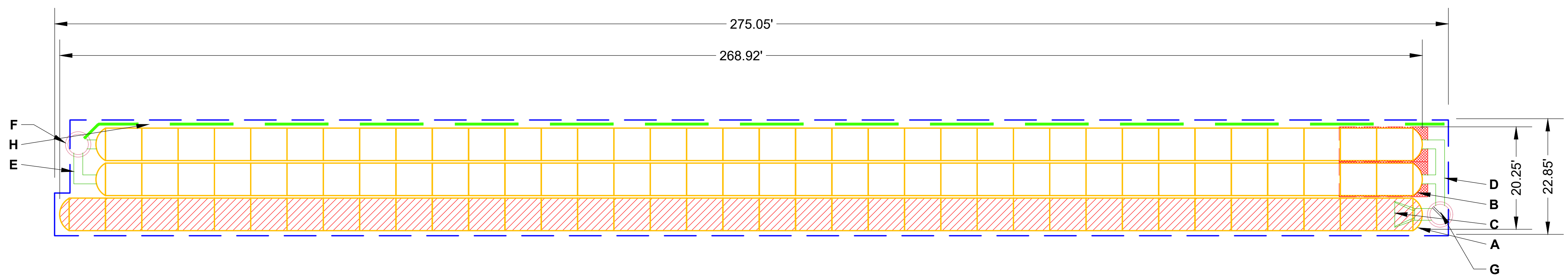
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT	
109	STORMTECH MC-3500 CHAMBERS
6	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	STONE VOID
20975	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
6241	SYSTEM AREA (SF)
595.8	SYSTEM PERIMETER (ft)

CONCEPTUAL ELEVATIONS	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	12.50
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	6.50
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	6.00
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	6.00
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	6.00
TOP OF STONE:	5.50
TOP OF MC-3500 CHAMBER:	4.50
24" ISOLATOR ROW PLUS INVERT:	0.92
18" x 18" BOTTOM MANIFOLD INVERT:	0.90
18" x 18" BOTTOM MANIFOLD INVERT:	0.90
18" BOTTOM CONNECTION INVERT:	0.90
BOTTOM OF MC-3500 CHAMBER:	0.75
UNDERDRAIN INVERT:	0.00
BOTTOM OF STONE:	0.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	24" BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.06"	
PREFABRICATED END CAP	B	18" BOTTOM CORED END CAP, PART#: MC3500IEPP18BC / TYP OF ALL 18" BOTTOM CONNECTIONS	1.77"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MC350024RAMP		
MANIFOLD	D	18" x 18" BOTTOM MANIFOLD, ADS N-12	1.77"	
MANIFOLD	E	18" x 18" BOTTOM MANIFOLD, ADS N-12	1.77"	
CONCRETE STRUCTURE	F	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		8.0 CFS OUT
CONCRETE STRUCTURE W/WEIR	G	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		11.0 CFS IN
UNDERDRAIN	H	6" ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN		



ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

GLPX-003
ANAHEIM, CA

DRAWN: KL
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

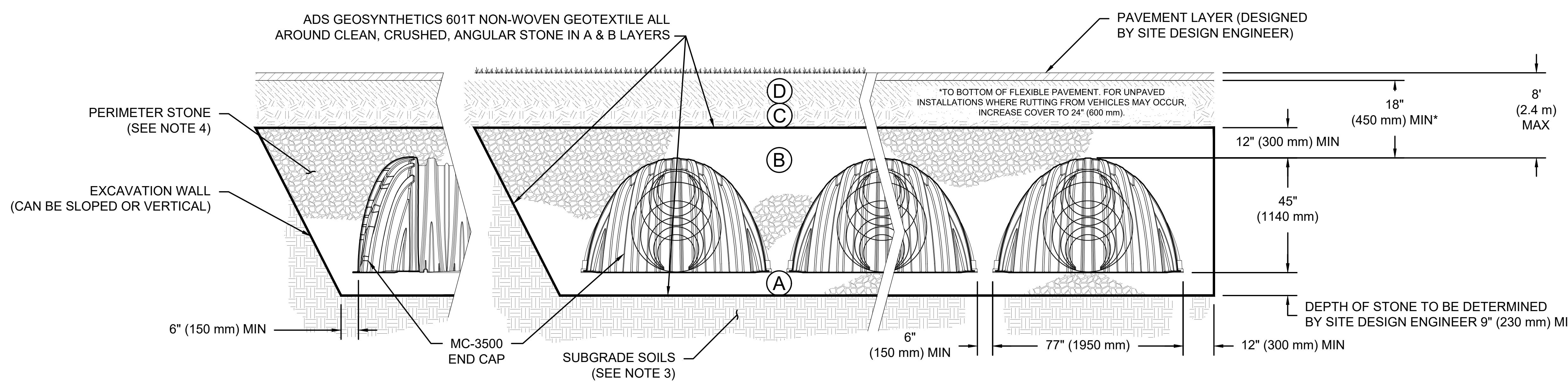
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

0 25' 50'

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

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DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

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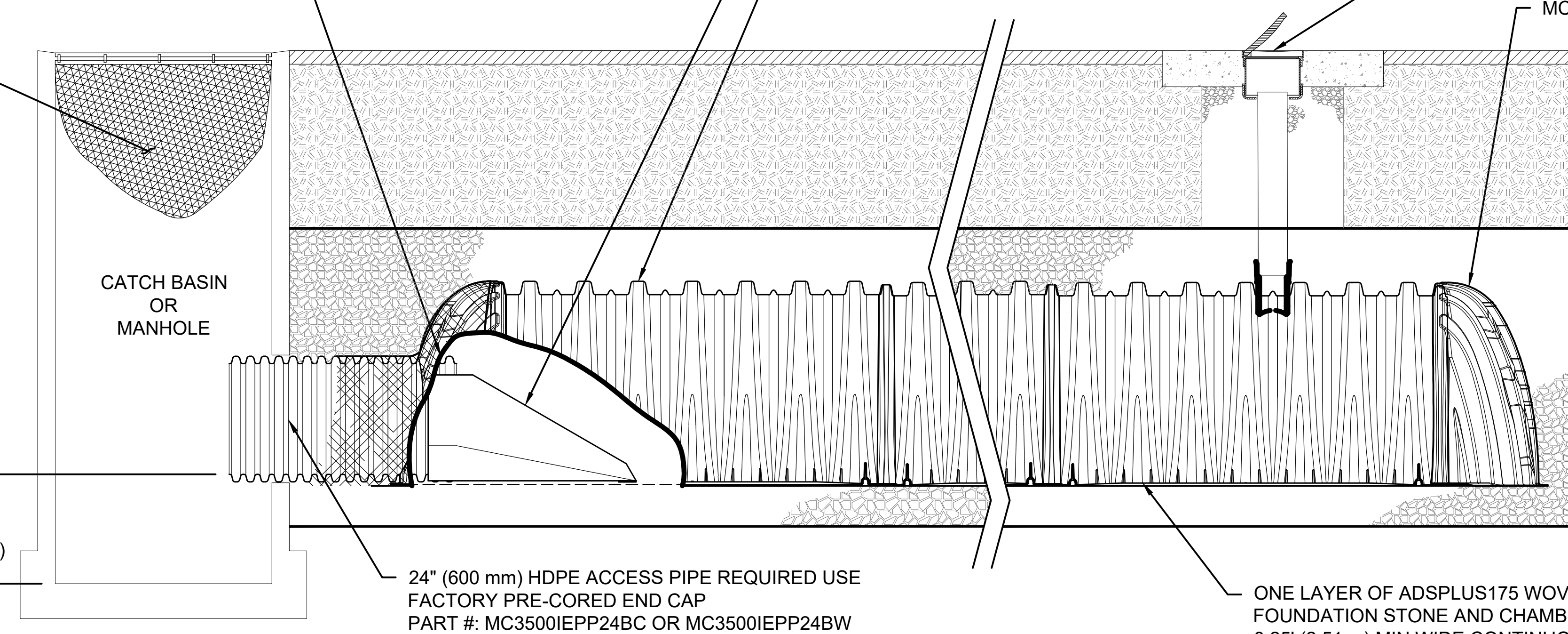

MC-3500 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

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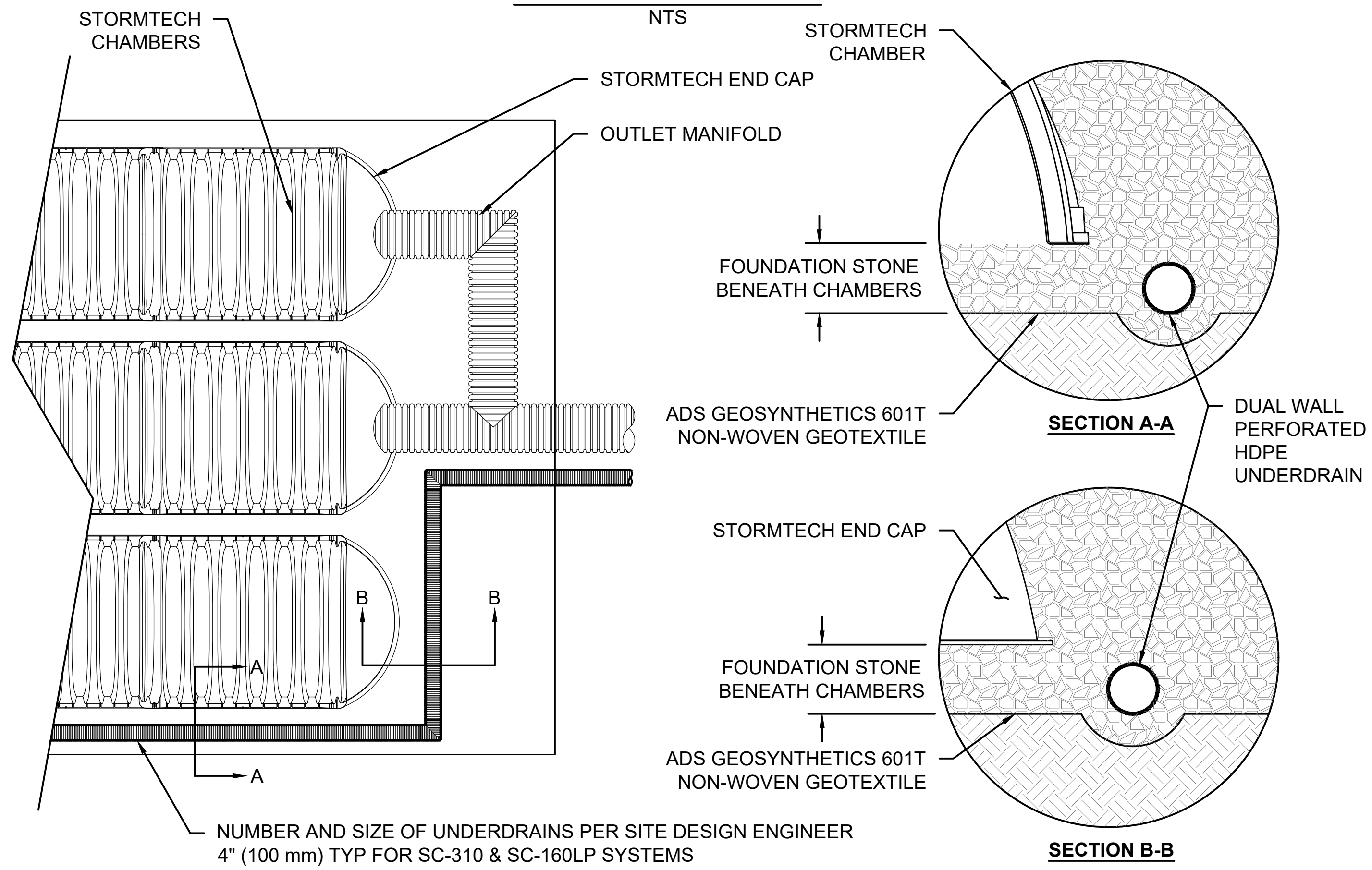
UNDERDRAIN DETAIL

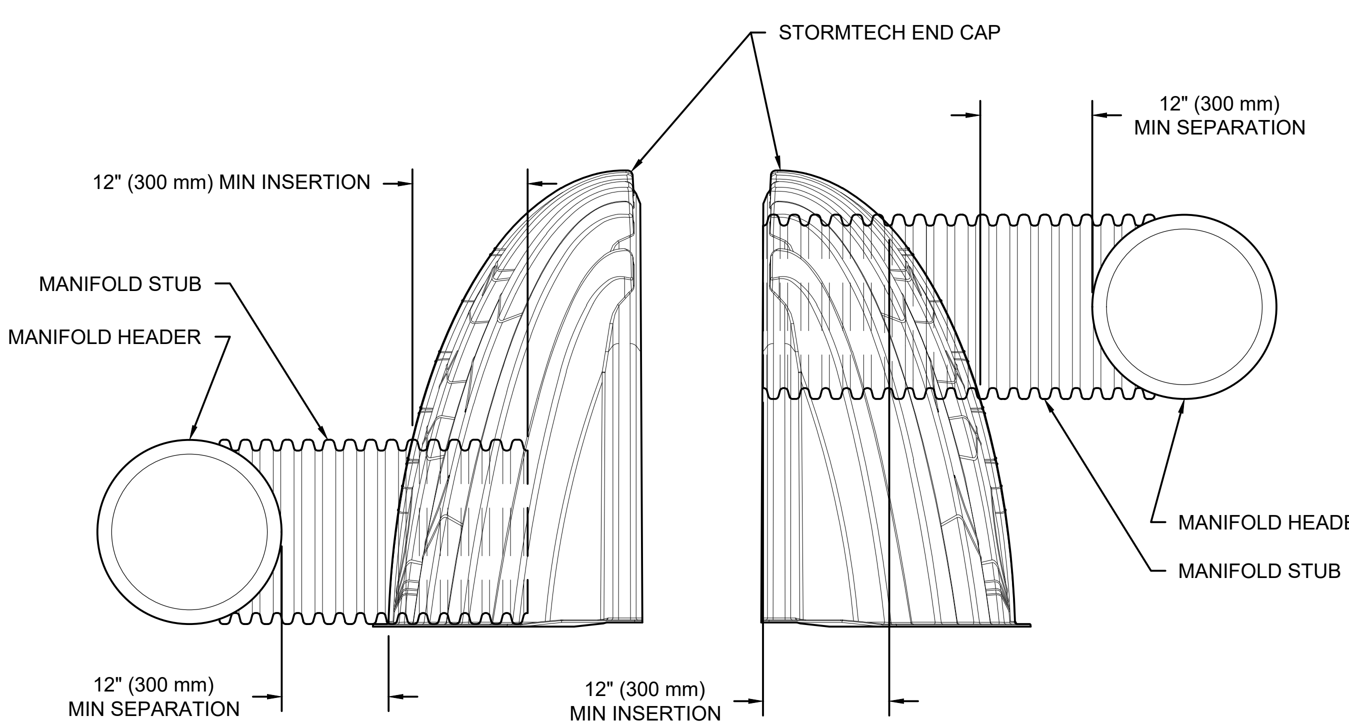
NTS



NUMBER AND SIZE OF UNDERDRAINS PER SITE DESIGN ENGINEER
4" (100 mm) TYP FOR SC-310 & SC-160LP SYSTEMS
6" (150 mm) TYP FOR SC-740, DC-780, MC-3500 & MC-4500 SYSTEMS

MC-SERIES END CAP INSERTION DETAIL

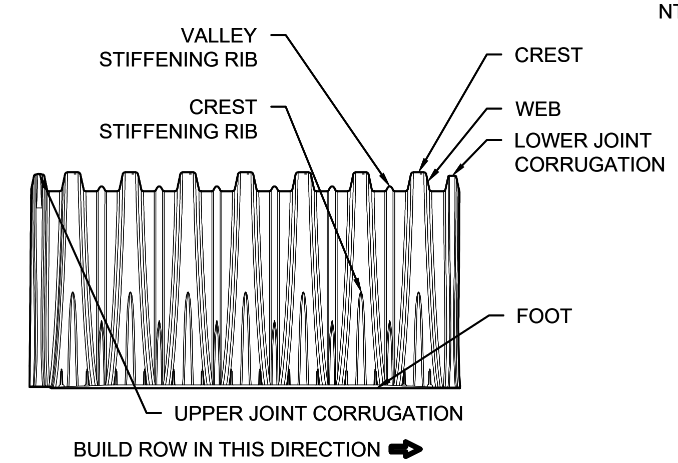
NTS

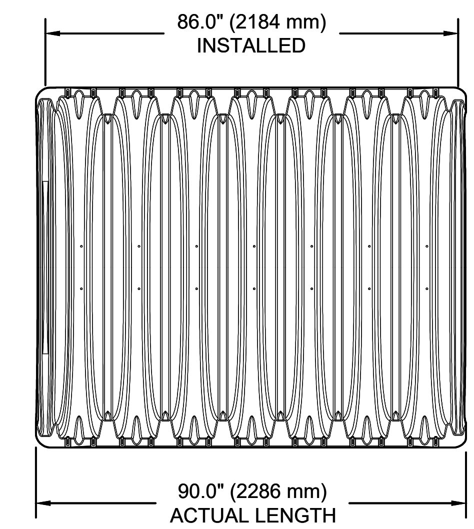


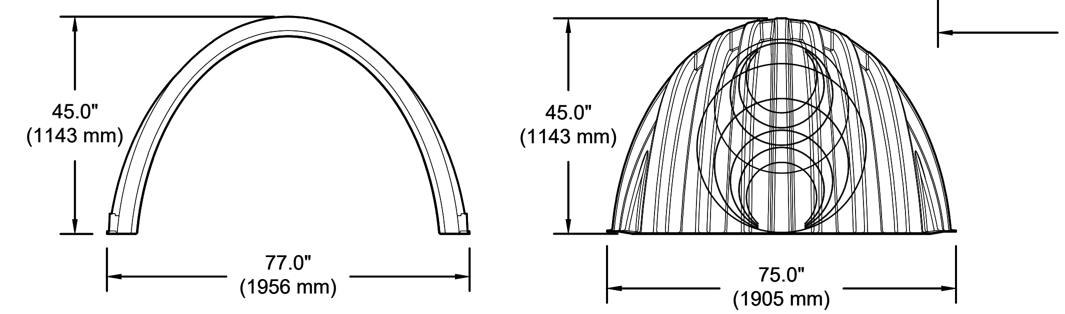
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

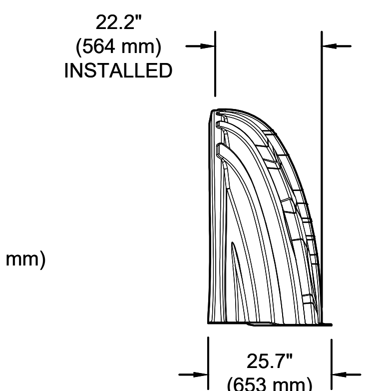
MC-3500 TECHNICAL SPECIFICATION

NTS









NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

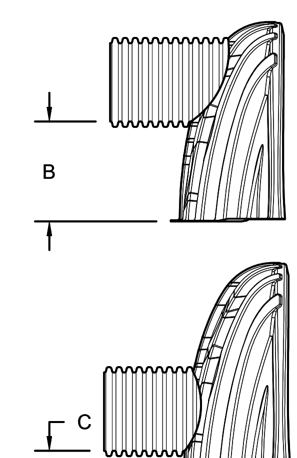
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

GLPX-003
ANAHEIM, CA
DATE:
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PROJECT #:
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DATE	DRW	CHK	DESCRIPTION

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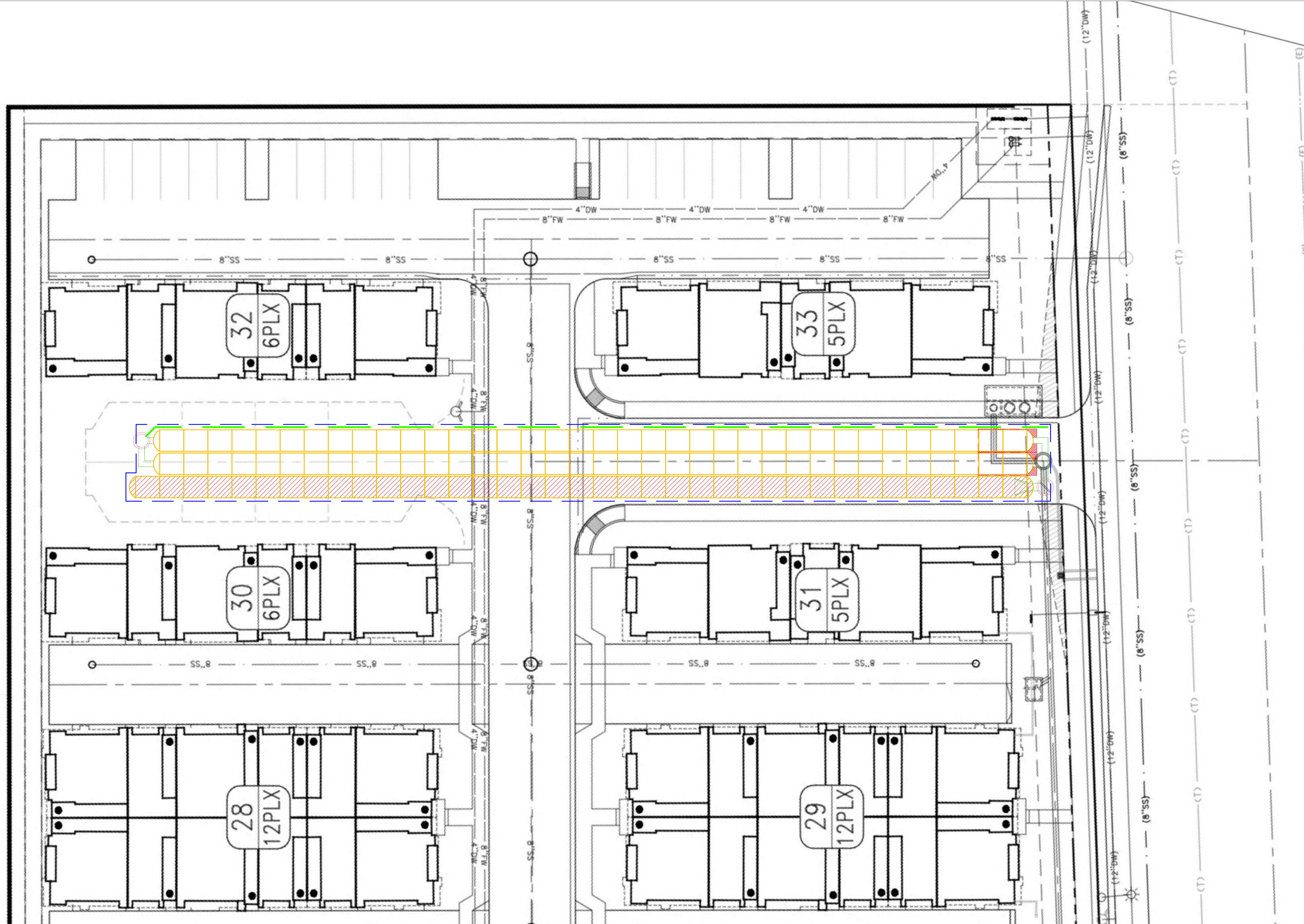
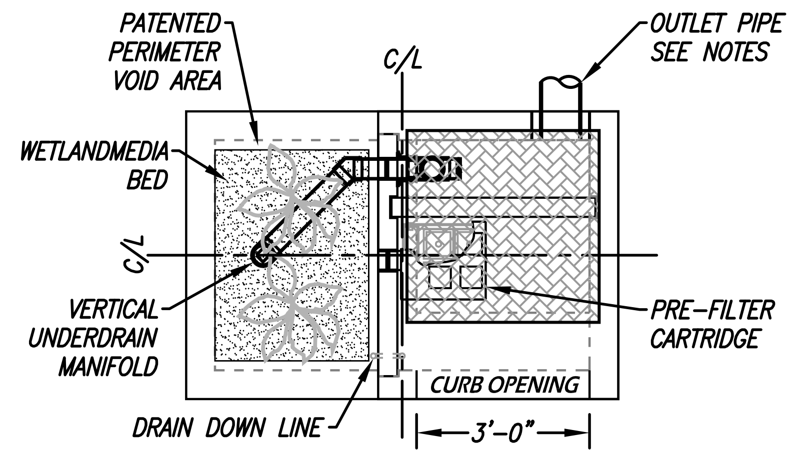
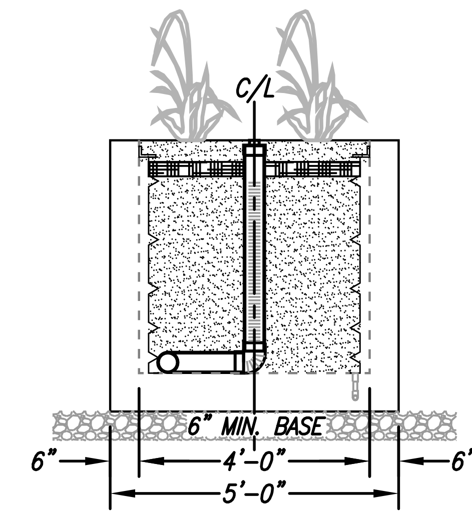


32
6PLX
33
5PLX
30
6PLX
31
5PLX
28
12PLX
29
12PLX
4"DW
8"FW
8"SS
(12"DW)
(8"SS)
(T)

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	36" x 36"	N/A	N/A
WETLANDMEDIA VOLUME (CY)			1.68
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø1.22"
MAXIMUM PICK WEIGHT (LBS)			13200
NOTES:			

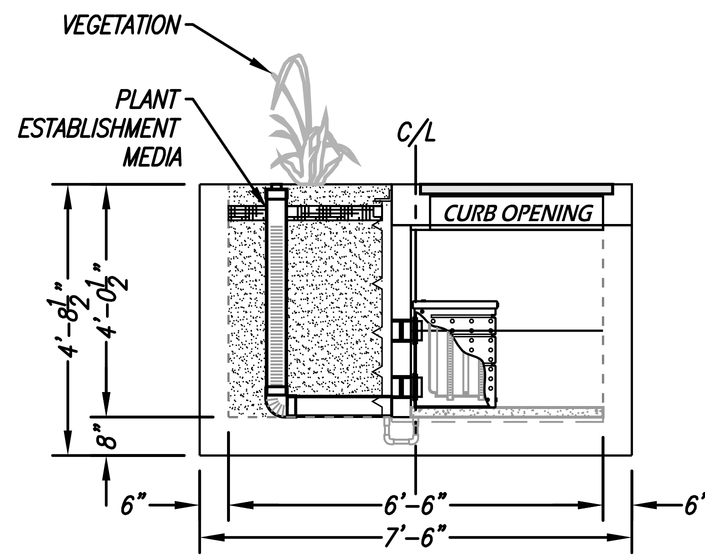


PLAN VIEW

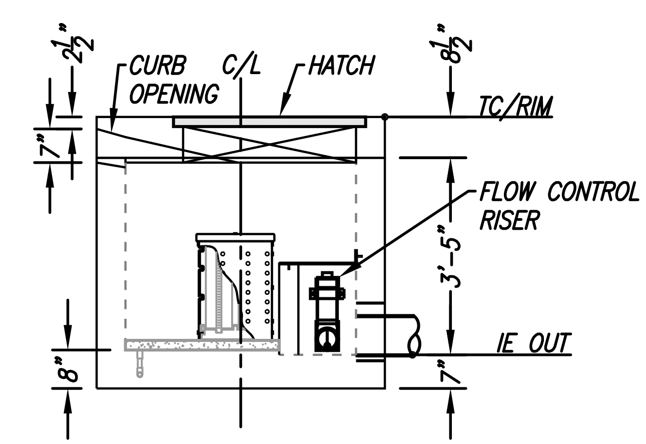


LEFT END VIEW

BIOFILTRATION



ELEVATION VIEW



RIGHT END VIEW

PRETREATMENT/DISCHARGE

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

TREATMENT FLOW (CFS)	0.073
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

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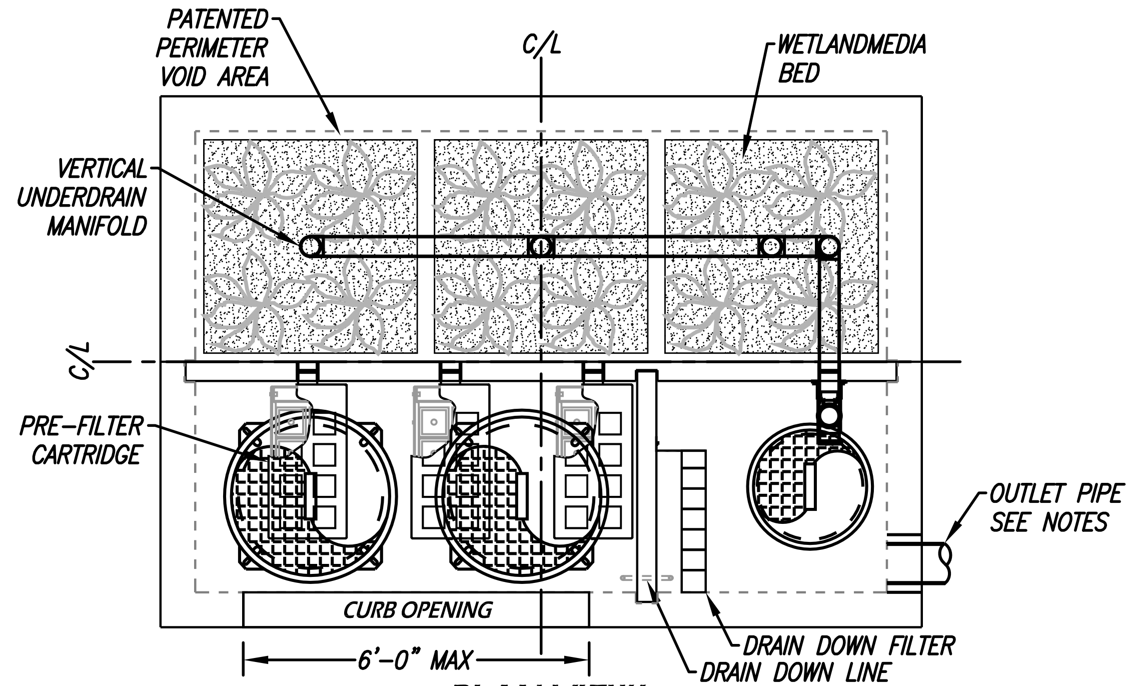
MWS-L-4-6.5-C

STORMWATER BIOFILTRATION SYSTEM

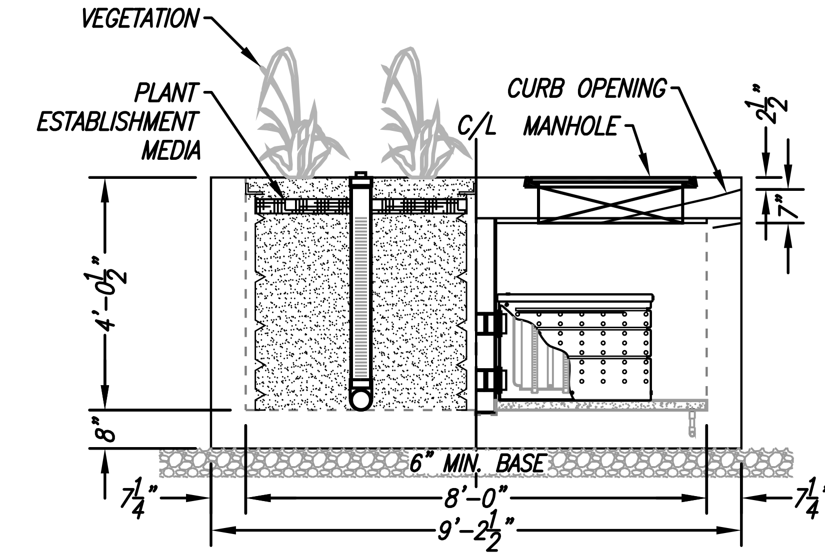
STANDARD DETAIL

5/1/15/JOHN

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			7.26
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.66"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

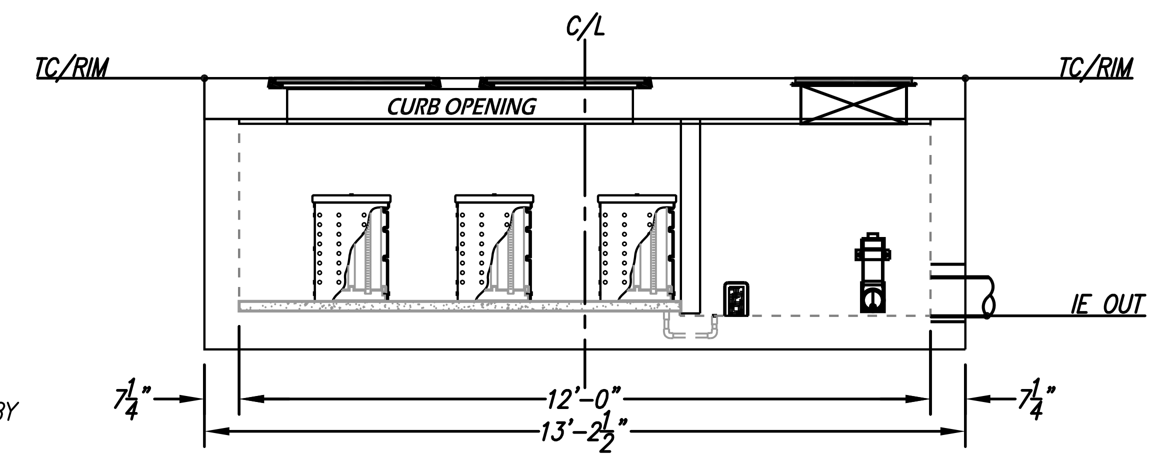


PLAN VIEW

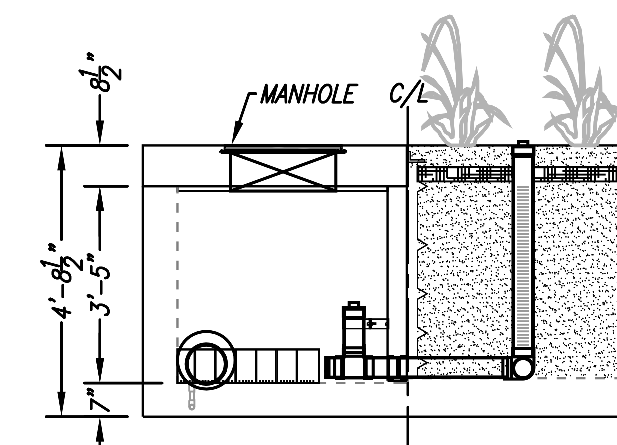


LEFT END VIEW

BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW

DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

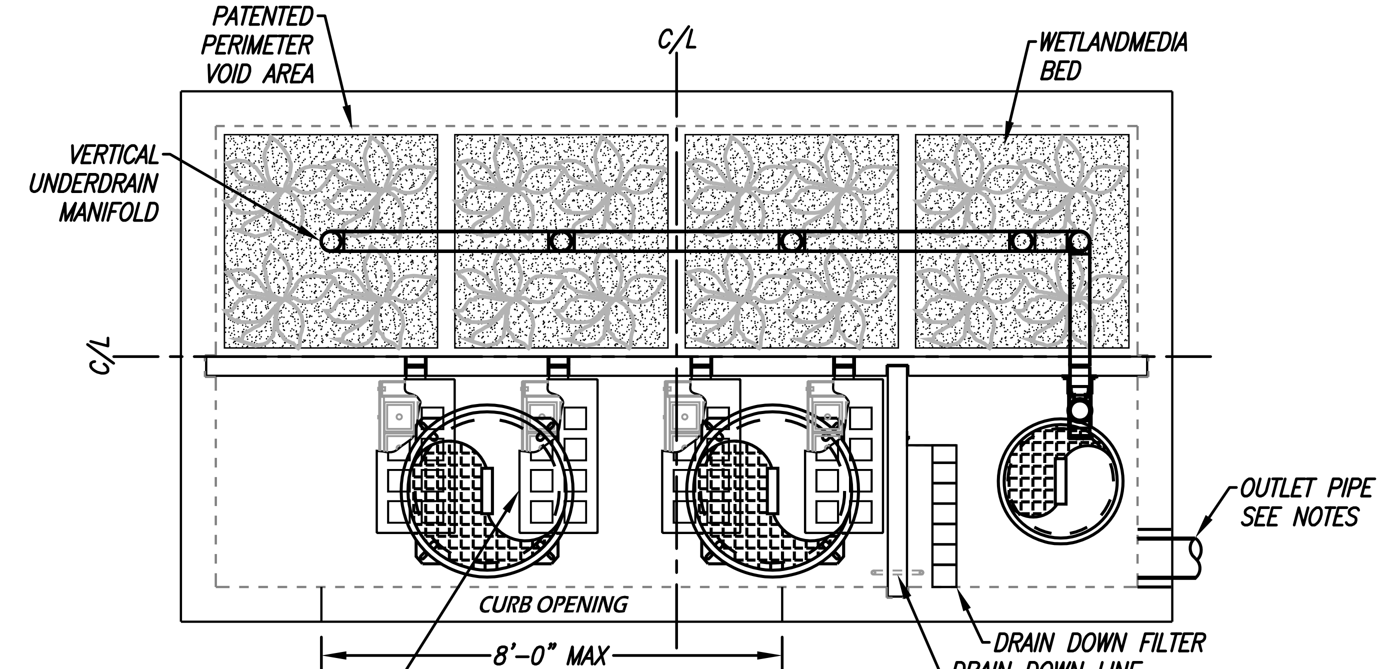
TREATMENT FLOW (CFS)	0.346
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MWS-L-8-12-C

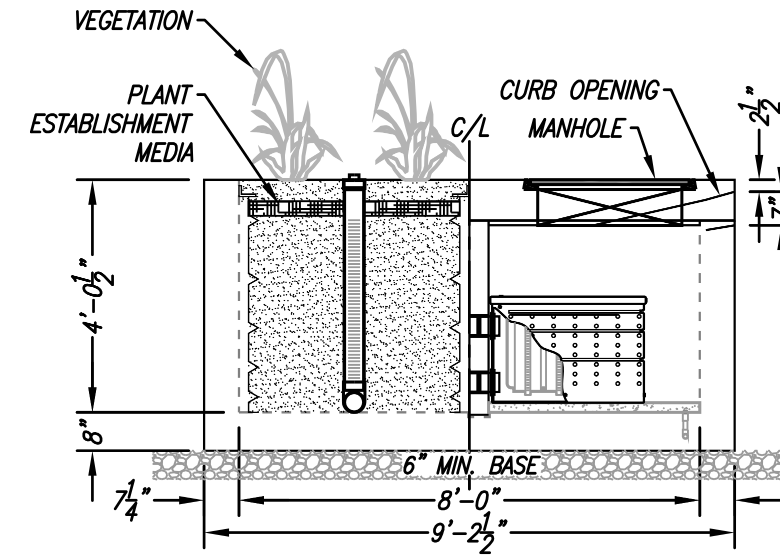
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

SITE SPECIFIC DATA

PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			9.50
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø3.07"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

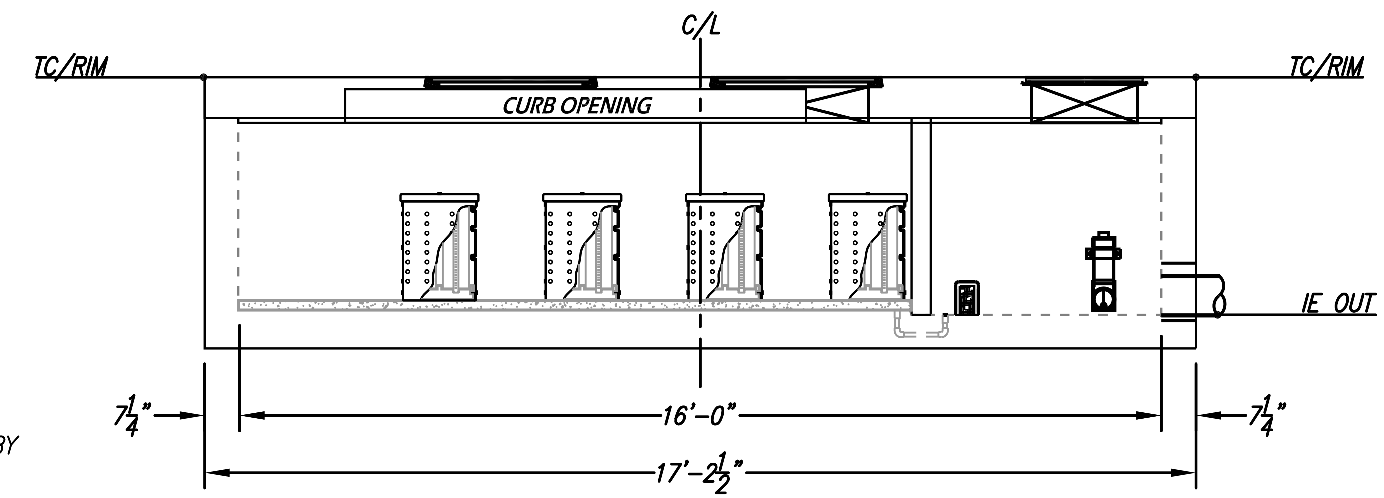


PLAN VIEW

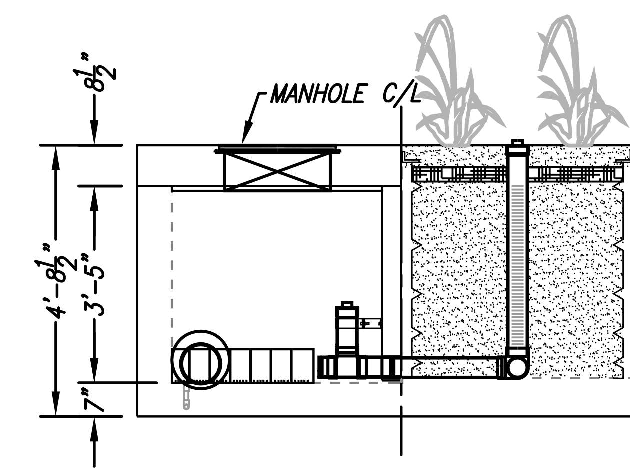


LEFT END VIEW

BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW

DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

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2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

TREATMENT FLOW (CFS)	0.462
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

MODULAR WETLANDS

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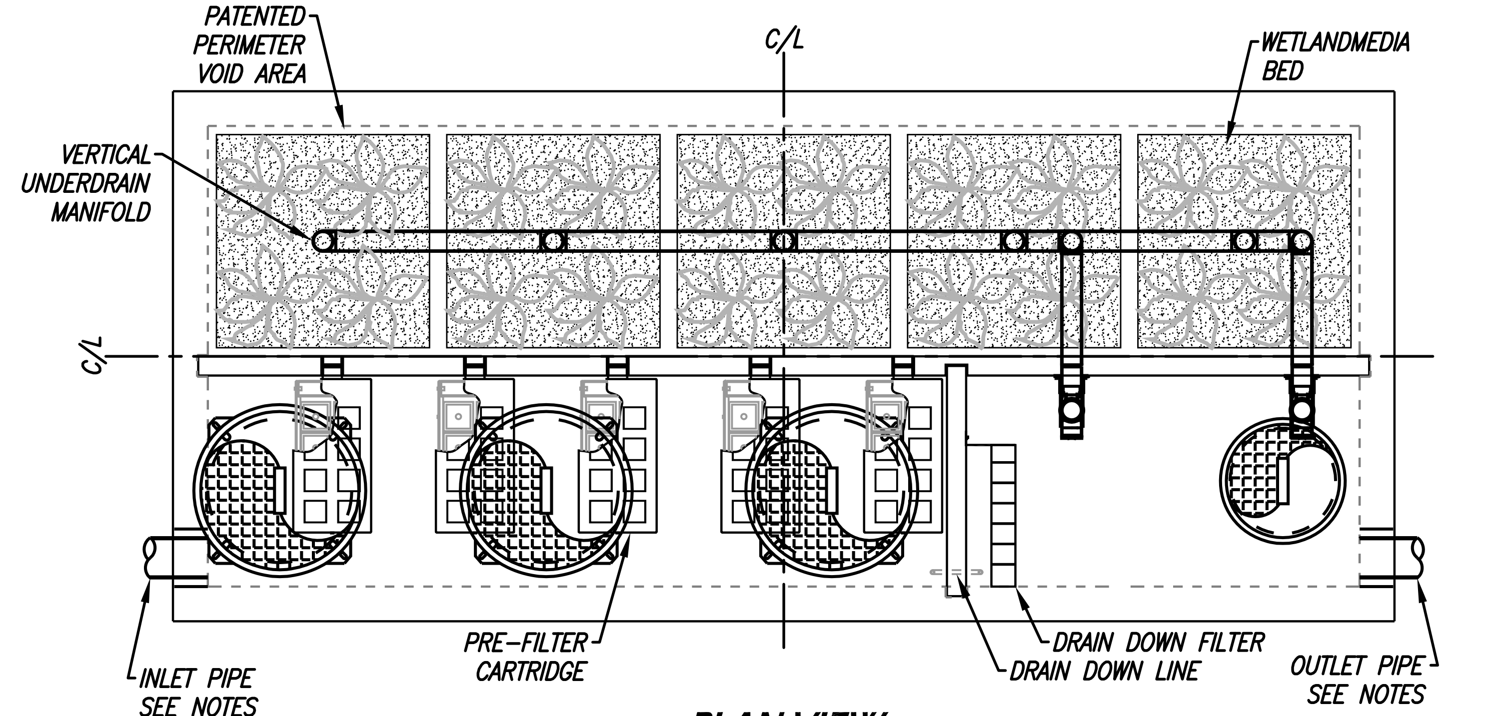
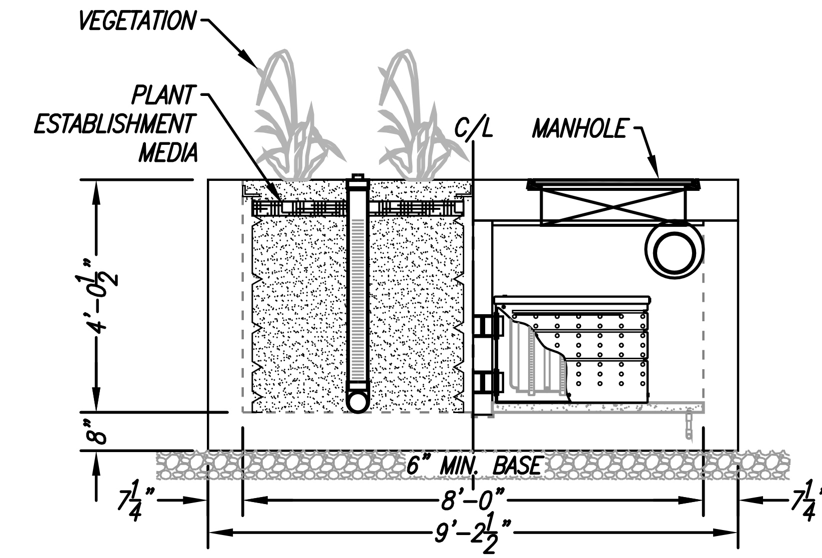
MWS-L-8-16-C
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

3/11/15/JOHN

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			11.85
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.43"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			

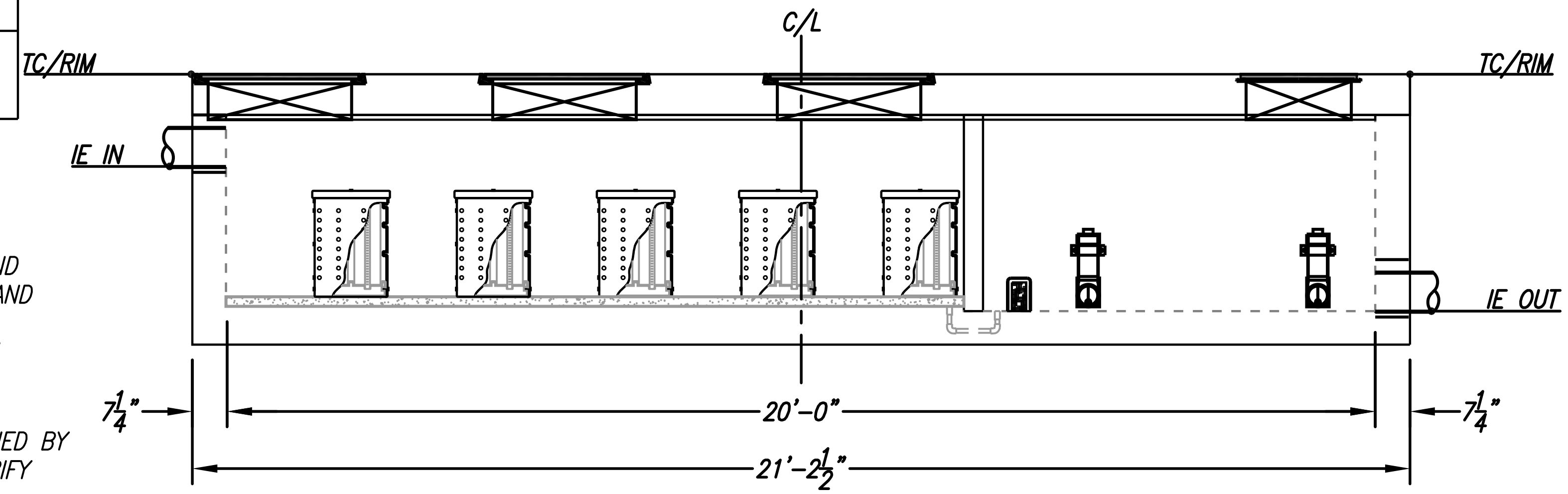


PLAN VIEW

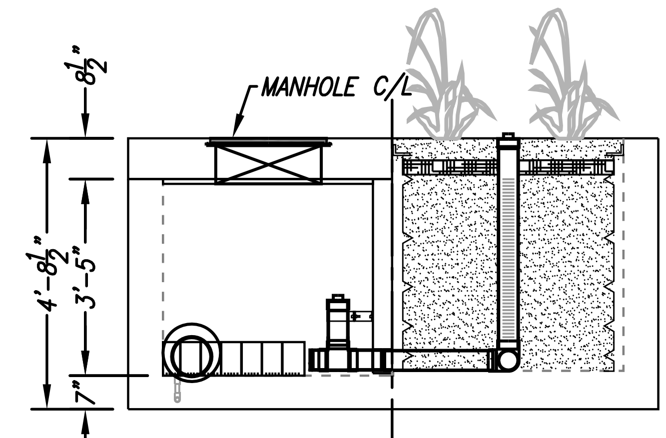


LEFT END VIEW

BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW

DISCHARGE/BIOFILTRATION

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TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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MODULAR WETLANDS

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MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

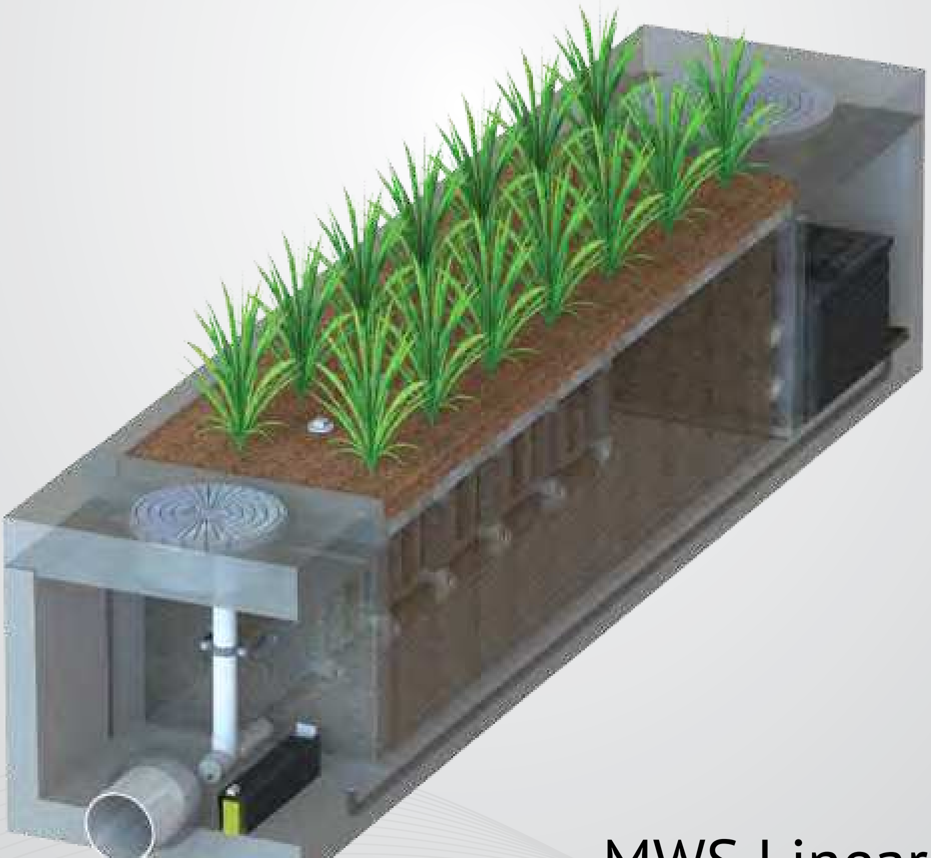
6/2/15/DHN

MWS Linear 2.0 HGL Sizing Calculations

			HGL HEIGHT																													
			SHALLOW MODELS																				STANDARD HEIGHT MODEL	HIGH CAPACITY MODELS								
MWS MODEL SIZE	WETLAND PERMITER LENGTH	LOADING RATE GPM/SF	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.65	3.70	3.75	3.80	3.85	3.90	3.95
MWS-L-4-4	6.70	1.0	0.022	0.023	0.025	0.026	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042	0.043	0.045	0.046	0.048	0.049	0.051	**0.052**	0.054	0.055	0.056	0.057	0.058	0.058	0.059	0.060	0.061
~~**MWS-L-3-6**~~	~~10.00~~	~~1.0~~	~~0.032~~	~~0.035~~	~~0.037~~	~~0.039~~	~~0.042~~	~~0.044~~	~~0.046~~	~~0.048~~	~~0.051~~	~~0.053~~	~~0.055~~	~~0.058~~	~~0.060~~	~~0.062~~	~~0.065~~	~~0.067~~	~~0.069~~	~~0.072~~	~~0.074~~	~~0.076~~	~~**0.078**~~	~~0.081~~	~~0.083~~	~~0.084~~	~~0.085~~	~~0.087~~	~~0.088~~	~~0.089~~	~~0.090~~	~~0.091~~
MWS-L-4-6	9.30	1.0	0.030	0.032	0.034	0.036	0.038	0.041	0.043	0.045	0.047	0.049	0.051	0.053	0.055	0.058	0.060	0.062	0.064	0.066	0.068	0.070	**0.073**	0.075	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084
MWS-L-4-8	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124	0.126	0.127	0.129	0.131	0.132	0.134
MWS-L-4-13	18.40	1.0	0.059	0.063	0.068	0.072	0.076	0.080	0.084	0.089	0.093	0.097	0.101	0.106	0.110	0.114	0.118	0.122	0.127	0.131	0.135	0.139	**0.144**	0.148	0.152	0.154	0.156	0.158	0.160	0.163	0.165	0.167
MWS-L-4-15	22.40	1.0	0.072	0.077	0.082	0.087	0.093	0.098	0.103	0.108	0.113	0.118	0.123	0.129	0.134	0.139	0.144	0.149	0.154	0.159	0.165	0.170	**0.175**	0.180	0.185	0.188	0.190	0.193	0.195	0.198	0.200	0.203
MWS-L-4-17	26.40	1.0	0.085	0.091	0.097	0.103	0.109	0.115	0.121	0.127	0.133	0.139	0.145	0.151	0.158	0.164	0.170	0.176	0.182	0.188	0.194	0.200	**0.206**	0.212	0.218	0.221	0.224	0.227	0.230	0.233	0.236	0.239
MWS-L-4-19	30.40	1.0	0.098	0.105	0.112	0.119	0.126	0.133	0.140	0.147	0.153	0.160	0.167	0.174	0.181	0.188	0.195	0.202	0.209	0.216	0.223	0.230	**0.237**	0.244	0.251	0.255	0.258	0.262	0.265	0.269	0.272	0.276
MWS-L-4-21	34.40	1.0	0.111	0.118	0.126	0.134	0.142	0.150	0.158	0.166	0.174	0.182	0.189	0.197	0.205	0.213	0.221	0.229	0.237	0.245	0.253	0.261	**0.268**	0.276	0.284	0.288	0.292	0.296	0.300	0.304	0.308	0.312
MWS-L-6-8	18.80	1.0	0.060	0.065	0.069	0.073	0.078	0.082	0.086	0.091	0.095	0.099	0.104	0.108	0.112	0.116	0.121	0.125	0.129	0.134	0.138	0.142	**0.147**	0.151	0.155	0.157	0.160	0.162	0.164	0.166	0.168	0.170
MWS-L-8-8	29.60	1.0	0.095	0.102	0.109	0.115	0.122	0.129	0.136	0.143	0.149	0.156	0.163	0.170	0.177	0.183	0.190	0.197	0.204	0.211	0.217	0.224	**0.231**	0.238	0.245	0.248	0.251	0.255	0.258	0.262	0.265	0.268
MWS-L-8-12	44.40	1.0	0.143	0.153	0.163	0.173	0.183	0.194	0.204	0.214	0.224	0.234	0.245	0.255	0.265	0.275	0.285	0.296	0.306	0.316	0.326	0.336	**0.346**	0.357	0.367	0.372	0.377	0.382	0.387	0.392	0.397	0.402
MWS-L-8-16	59.20	1.0	0.190	0.204	0.217	0.231	0.245	0.258	0.272	0.285	0.299	0.312	0.326	0.340	0.353	0.367	0.380	0.394	0.408	0.421	0.435	0.448	**0.462**	0.476	0.489	0.496	0.503	0.509	0.516	0.523	0.530	0.537
MWS-L-8-20	74.00	1.0	0.238	0.255	0.272	0.289	0.306	0.323	0.340	0.357	0.374	0.391	0.408	0.425	0.442	0.459	0.476	0.493	0.509	0.526	0.543	0.560	**0.577**	0.594	0.611	0.620	0.628	0.637	0.645	0.654	0.662	0.671
MWS-L-10-20 or MWS-L-8-24	88.80	1.0	0.285	0.306	0.326	0.346	0.367	0.387	0.408	0.428	0.448	0.469	0.489	0.509	0.530	0.550	0.571	0.591	0.611	0.632	0.652	0.673	**0.693**	0.713	0.734	0.744	0.754	0.764	0.774	0.785	0.795	0.805
4'x4' media cage	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	0.115	0.119	0.122	0.124						

MODULAR WETLANDS™

Advanced **Stormwater** Biofiltration



MWS Linear

Contents

The Urban Impact

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

Plant A Wetland

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

MWS Linear

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

Applications

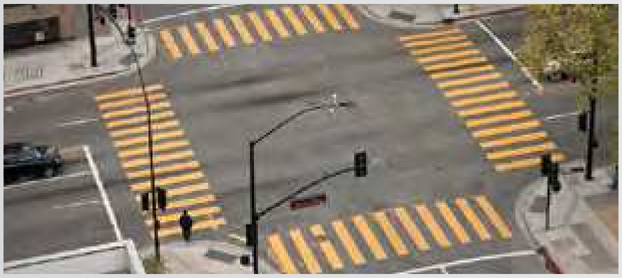
The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

Industrial

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

Residential

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



Streets

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

Parking Lots

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

Commercial

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

Mixed Use

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

More applications are available on our website: www.ModularWetlands.com/Applications

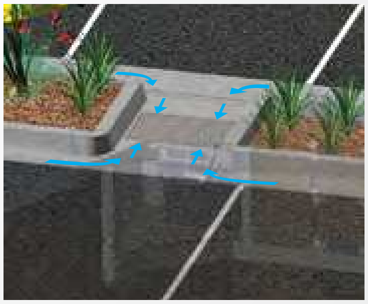
- Agriculture
- Reuse
- Low Impact Development
- Waste Water


Configurations

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

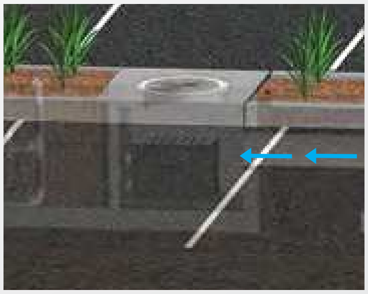
Curb Type

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



Grate Type

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



Vault Type

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

Downspout Type

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

Advantages & Operation

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

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

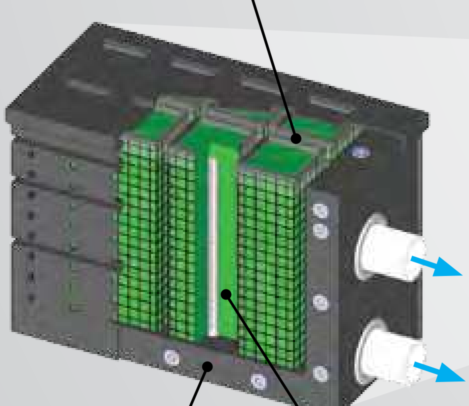
1 Pre-Treatment

Separation

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

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



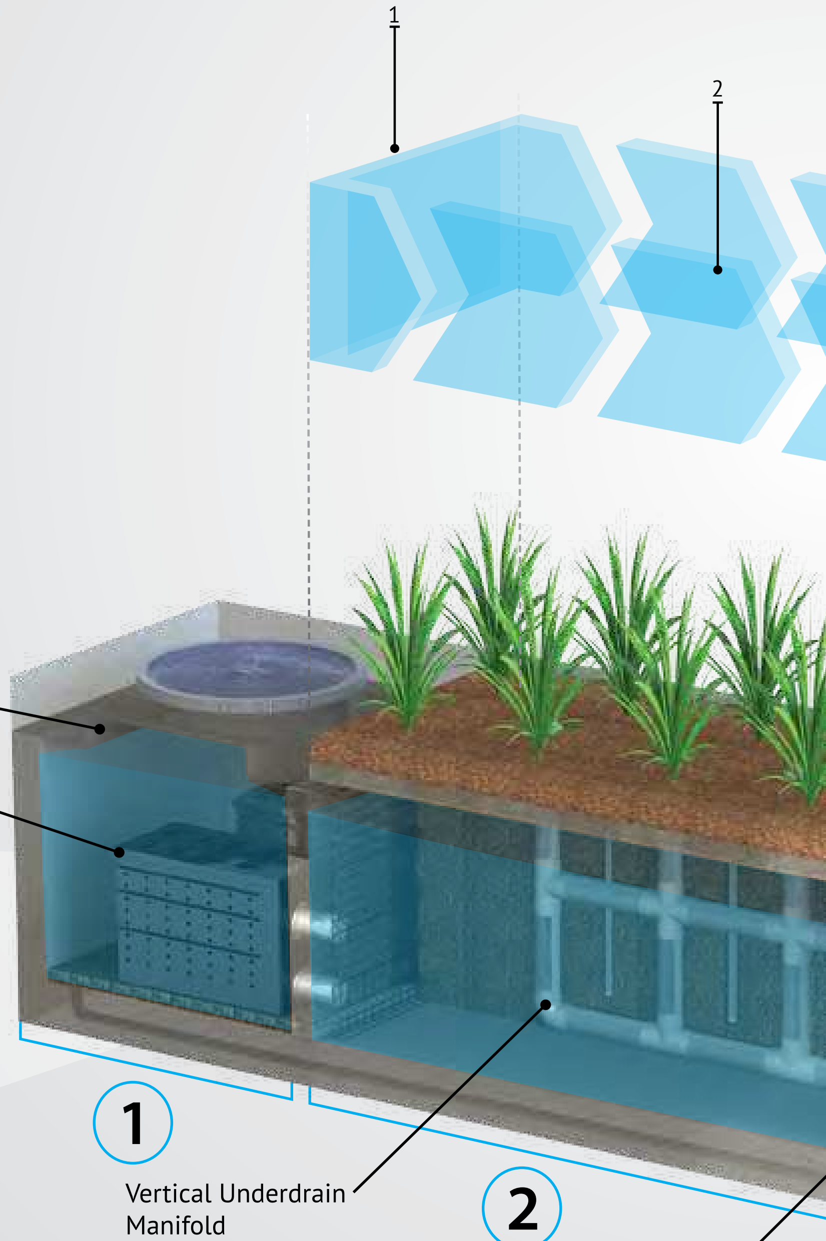


Fig. 2 - Top View

2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.

2 Biofiltration

Horizontal Flow

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

Patented Perimeter Void Area

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

WetlandMEDIA

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

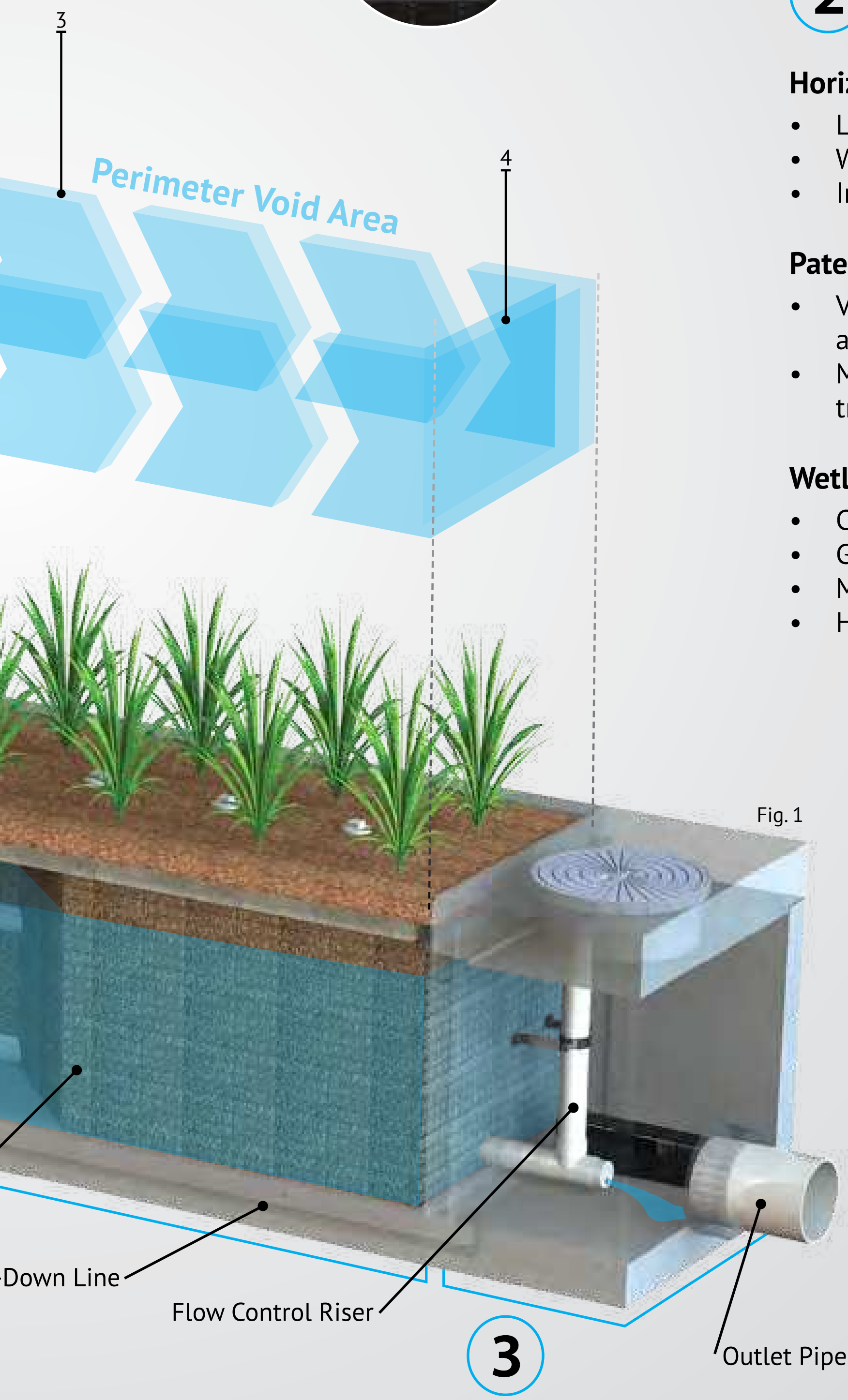


Fig. 1

3 Discharge

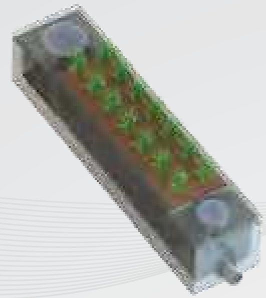
Flow Control

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

Drain-Down Filter

- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations



Side-By-Side

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

End-To-End

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

Bypass

Internal Bypass Weir (Side-by-Side Only)

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

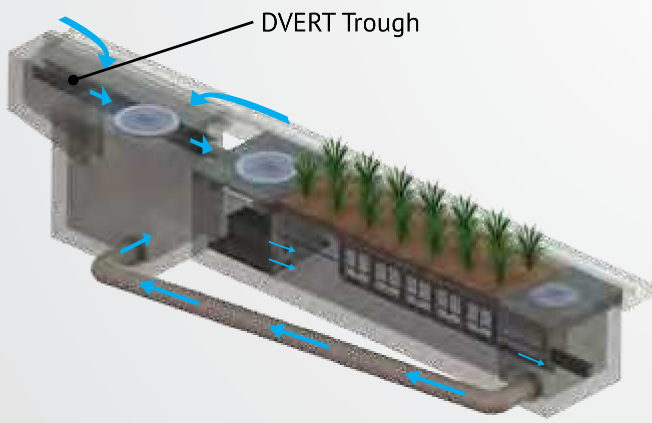
External Diversion Weir Structure

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

Flow By Design

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

DVERT Low Flow Diversion



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

Performance

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

Approvals

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

Washington State DOE Approved

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

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

DEQ Assignment

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

MASTEP Evaluation

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

Rhode Island DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus for discharges to freshwater systems, and 30% Total Nitrogen for discharges to saltwater or tidal systems.

Flow Based Sizing

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

Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4' x 4'	23 ft^2	0.052
MWS-L-4-6	4' x 6'	32 ft^2	0.073
MWS-L-4-8	4' x 8'	50 ft^2	0.115
MWS-L-4-13	4' x 13'	63 ft^2	0.144
MWS-L-4-15	4' x 15'	76 ft^2	0.175
MWS-L-4-17	4' x 17'	90 ft^2	0.206
MWS-L-4-19	4' x 19'	103 ft^2	0.237
MWS-L-4-21	4' x 21'	117 ft^2	0.268
MWS-L-8-8	8' x 8'	100 ft^2	0.230
MWS-L-8-12	8' x 12'	151 ft^2	0.346
MWS-L-8-16	8' x 16'	201 ft^2	0.462

Volume Based Sizing

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

Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

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

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

Maintenance

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

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

Plant Selection

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

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

Please visit www.ModularWetlands.com/Plants for more information and various plant lists.

SPECIFICATIONS

MWS – Linear

Hybrid Stormwater Filtration System

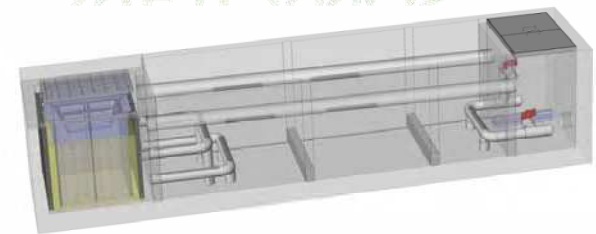
Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MWS – Linear

Hybrid Stormwater Filtration System

MODULAR WETLANDS



Save valuable space with small footprint for urban sites.

Improve BMP aesthetics with attractive native and tropical landscape plants.

Reduce lifetime costs with safer and less expensive maintenance

"The MWS – Linear hybrid stormwater treatment system is described as a self contained treatment train. This system utilizes an innovative combination of l treatment processes. Stormwater runoff flows into the system via pipe or curb/grate type catch basin opening. Polluted runoff first encounters a screening device to remove larger pollutants and then enters a hydrodynamic separation chamber which settles out the sediments and larger suspended solids. Next the runoff is treated by a revolutionary filter media, BioMediaGREEN that removes fines and associated pollutants, including bacteria. From there runoff enters of bioretention filter in the form of a subsurface flow vegetated gravel wetland. Within the wetland physical, chemical, and biological mechanisms remove the remaining particulate and dissolved pollutants. The purified runoff leaves the system via the discharge chamber. In the discharge chamber the rate of discharge is controlled by valves set to a desired rate".

Tested Pollutant Removal Efficiencies:

TSS Removal	Dissolved Lead Removal	Dissolved Copper Removal	TPH	E. coli Removal	Turbidity Removal
98%	81%	92%	99%	60.2%	92%

"Nature and Harmony Working Together in Perfect Harmony"

SPECIFICATIONS – MWS- LINEAR

Track Record: The MWS- Linear Hybrid Stormwater Treatment System is manufactured by a company whom is regularly engaged in the engineering design and production of treatment systems for stormwater.

Coverage: The MWS- Linear is designed to treat the water quality volume or water quality flow. For flow based design, high flow bypass is internal, for volume based design, high flow bypass is external and prior to pre-detention system. For offline volume based designs the MWS - Linear has the ability to treat the entire water quality volume when used with pre-storage and properly sized.

Non-Corrosive Materials: The MWS – Linear is designed with non-corrosive materials. All internal piping is SD35 PVC. Catch basin filter components, including mounting hardware, fasteners, support brackets, filtration material, and support frame are constructed of non-corrosive materials (316 stainless steel, and UV protected/marine grade fiberglass). Fasteners are stainless steel. Primary filter mesh is 316 stainless steel welded screens. Filtration basket screens for coarse, medium and fine filtration is ¾" x 1 ¾"expanded, 10 x 10 mesh, and 35 x 35 mesh, respectively. No polypropylene, monofilament netting or fabrics shall be used in this system. Media Protective Panels are constructed of UV protected/marine grade fiberglass. Mounts are constructed of stainless steel. BioMediaGREEN is an inert rock substrate and is non-corrosive. Perimeter filter structure is constructed of lightweight injection molded plastic. Mounting brackets are constructed of SD40 PVC and are mounted with 3/8" diameter stainless steel redheads. Drain down filter cover is constructed of UV protected/marine grade fiberglass and stainless steel hinge and mount.

Weight: Each complete unit weighs approximately 29,000 to 40,000 pounds and requires a boom crane to install. Details of this are provided in the installation section of the MWS-Linear Design Kit.

Transportation: The Modular Wetland System – Linear is designed to be transported on a standard flat bed truck. The unit easily fits on a flat bed truck without the need of special permitting.

Alternative Technology Configurations: The Modular Wetland System – Linear is modular is design. Each module will be up to 22 feet long and 5 feet wide. The system can be made in lengths varying from 13 to 100s of feet long. For lengths longer than 22 feet the system will shipped in modules and assembled on site. The Modular Wetland System – Linear has many alternative configurations. This allows the system to be adapted to many site conditions. Runoff can enter the system through a pipe, and/or a built in curb or grate type opening.

Energy Requirements: The Modular Wetland System – Linear is completely passive and requires no external energy sources.

Buoyancy Issues: Buoyancy is only a an issue when ground water levels rise above the bottom of the Modular Wetland System – Linear's concrete structure. With 8.5 cubic yards of wetland media there is no concern of floatation. As a precaution a footing can also be built into the systems concrete structure.

Durability: The structure of the box will be precast concrete. The concrete will be 28 day compressive strength fc = 5,000 psi. Steel reinforcing will be ASTM A – C857. Structure will support an H20 loading as indicted by AASHTO. The joint between the concrete sections will ship lap and joint sealed with ram-nek. Filter (excluding oil absorbent media) and support structures are of proven durability. The filter and mounting structures are of sufficient strength to support water, sediment, and debris loads when the filter is full, with no slippage, breaking, or tearing. All filters are warranted for a minimum of five (5) years.

Oil Absorbent Media: The MWS – Linear utilizes both physical and biological mechanisms to capture and filter oil and grease. A skimmer and boom system will be positioned on the internal perimeter of the catch basin insert. The primary filtration media, BioMediaGreen, utilized in the perimeter and drain down filters, has excellent hydrocarbon removal abilities. Within the wetland filter biological processes capture and break down oil and grease. Much of the breakdown and transformation of oil and grease is performed by natural occurring bacteria.

Overflow Protection: The grate and curb type MWS – Linear are designed with an internal bypass consisting of two SD PVC pipes which direct high flows around the perimeter and wetland filter, directly into the discharge chamber. For the volume based vault type configuration, bypass should be located prior to the pre-detention system. For peak flows that exceed internal bypass capacity, external bypass is use.

Filter Bypass: Runoff will bypass filtration (BioMediaGREEN and wetland filter) components of the MWS - Linear. The system will still provide screening and settling during higher flow rates for internally bypassed flows. External bypass will bypass of treatment processes.

Pollutant Removal Efficiency: The MWS - Linear is capable of removing over 90% of the net annual total suspended solids (TSS) load based on a 20-micron particle size. Annual TSS removal efficiency models are based on documented removal efficiency performance from full-scale laboratory tests on BioMediaGreen and quarter-scale laboratory tests on the MWS – Linear flow based system.

POLLUTANT	REMOVAL EFFICIENCY
Trash & Litter	99%
TPH (mg/L)	99%
TSS (mg/L)	98%
E. Coli (MPN/100ml)	60%
Turbidity (NTU)	92%
Dissolved Metals (mg/L)	76%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Non-Scouring: During heavy storm events the runoff bypasses perimeter and wetland filter components. The system will not re-suspend solids at design flows.

Uniqueness: The Modular Wetland System – Linear is a complete self contained treatment train that incorporates capture, screening, sedimentation, filtration, bioretention, high flow bypass, and flow control into a single modular structure. This system provides four stages of treatment making it the only 4 stage treatment train stormwater filtration system, therefore making it unique to the industry. Other systems do not incorporate all the necessary attributes to make it a complete stormwater management device as with the Modular Wetland System – Linear. Therefore, no equal exists for this system.

Pretreatment & Preconditioning: Since the Modular Wetland System – Linear is a complete capture and treatment train stormwater management system no external pretreatment of preconditioning is necessary.

SPECIFICATIONS – BioMediaGREEN

BioMediaGREEN is a proprietary engineered filter media. Made of a unique combination of the inert naturally occurring material this product is non-combustible and do not pose a fire hazard, stable and non-reactive, and is also biodegradable. It is stable with no known adverse environmental effects.

This product has been tested in long-term carcinogenicity studies [inhalation and intraperitoneal injection (i.p.)] with no significant increase in lung tumors or abdominal tumors. Short-term biopersistent (inhalation and intra-tracheal injection) studies have shown that the products disappear very rapidly from the lung.

In October 2001, IARC classified this product as Group 3, "not classifiable as to its carcinogenicity to humans". The 2001 decision was based on the latest epidemiological studies and animal inhalation studies that show no relation between inhalation exposure and the development of tumors.

The product can typically be disposed of in an ordinary landfill (local regulations may apply). If you are unsure of the regulations, contact your local Public Health Department or the local office of the Environmental Protection Agency (EPA).

Coverage: When properly installed BioMediaGREEN Filter Blocks provide sufficient contact time, at rated flows, of passing contaminate water. The BioMediaGREEN material will capture and retain most pollutants that pass through it. The BioMediaGREEN material is made of a proprietary blend of inert substances. The BioMediaGREEN Filter Blocks can be used in different treatment devices, including but not limited to flume filters, trench drain filters, downspout filters, catch basin inserts, water polishing units, and hydrodynamic separators.

Non-Corrosive Materials: The BioMediaGreen material is made of non-corrosive materials.

Durability: The BioMediaGREEN material has been chosen for its proven durability, with an expected life of 2 plus years. The BioMediaGREEN material is of sufficient strength to support water, sediment, and debris loads when the media is at maximum flow; with no slippage, breaking, or tearing. The BioMediaGREEN material has been tested through rigorous flow and loading conditions.

Oil Absorbent Media: The BioMediaGREEN material has been proven to capture and retain hydrocarbons.

Pollutant Removal Efficiency: The BioMediaGREEN Filter Blocks are designed to capture high levels of Hydrocarbons including but not limited to oils & grease, gasoline, diesel, and PAHs. BioMediaGREEN Filter Blocks have the physical ability to block and filter trash and litter, grass and foliage, sediments, TSS, particulate and dissolved metals, nutrients, and bacteria.

BioMediaGREEN technology is based on a proprietary blend of synthetic inert natural substances aimed at removal of various stormwater pollutants. BioMediaGREEN was created to have a very porous structure capable of selectively removing pollutants while allowing high flow through rates for water. As pollutants are captured by its structure, BioMediaGREEN captures most pollutants and maintains porosity and filtering capabilities.

Field and laboratory tests have confirmed the BioMediaGREEN capability to capture large percentage of TSS, hydrocarbons, nutrients, and heavy metals. Microbial reduction efficiency will vary depending on colony size, flow rates and site specific conditions.

POLLUTANT	REMOVAL EFFICIENCY
Oil & Grease (mg/L)	90%
TPH (mg/L)	99%
TSS (mg/L)	85%
Turbidity (NTU)	99%
Total Phosphorus (mg/L)	69.6%
Dissolved Metals (mg/L)	75.6%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Replacement: Removal and replacement of the blocks is simple. Remove blocks from filtration system. Replace with new block of equal size.

Bio Clean

A Forterra Company

Bio Clean CPS

A Stormwater Trash Capture Solution

OPERATION & MAINTENANCE MANUAL

5796 Armada Drive Suite 250 | Carlsbad, CA 92008 | 855.566.3938
stormwater@forterrabp.com | biocleanenvironmental.com

OPERATION & MAINTENANCE

CPS devices should be maintained by individuals who are trained in proper disposal procedures, confined space entry and traffic safety regulations. When servicing a Bio Clean CPS device be sure to follow all safety and traffic control protocols as well as wearing all proper personal protection equipment such as gloves, safety glasses, hard-hat, safety vest and work boots.

Visual Inspection

1. Begin by inspecting the inflow of the catch basin where the Bio Clean CPS device is located. Check for any obstructions to inflow of the CB unit. If any large obstructions are found, have them removed. Once the inflow inspection is completed, remove the man-hole cover for further inspection. (Note: Confined Space Entry Procedures may apply if trained personnel intend to enter the interior space of any Catch Basin. Please follow all applicable confined space entry procedures)

2. Remove the manhole cover and visually estimate the amount and types of debris found in the CB unit. Look for any visual signs of damage that may compromise the CB unit to function properly. Inspect for any standing water in the CB unit as well as for large amounts of sediment and debris surrounding the CPS device. If standing water and high sediment volume is found, remove water, sediment and debris by vacuum truck or by other debris removal methods.

Cleaning Procedures and Frequencies

1. Like all other storm water BMP's, Bio Clean CPS devices require periodic maintenance. Routine inspection and maintenance intervals for all CPS devices are typically twice per year for inspections and once per year for maintenance service. Bio Clean CPS devices may require more frequent maintenance service if the device is located in a high debris loading drainage area, such as certain downtown areas, retail/restaurant, or residential areas where a significant amount of vegetation/foliage is located. In such cases, Bio Clean CPS devices may require more frequent inspection and maintenance service, which could range from twice per year to monthly inspection and maintenance service, depending on pollutant load conditions.

2. To begin Bio Clean CPS cleaning procedures, conduct a visual inspection of the CPS device and the surrounding area to ensure a safe working environment. Setup appropriate barriers and signage as necessary to establish a work zone surrounding the catch basin. Once the work zone has been established, remove the manhole cover from the catch basin.

3. Once the manhole cover is removed from the basin the Bio Clean CPS is ready for servicing. All debris can be removed by either a vacuum truck or manually removing sediment and debris by hand.

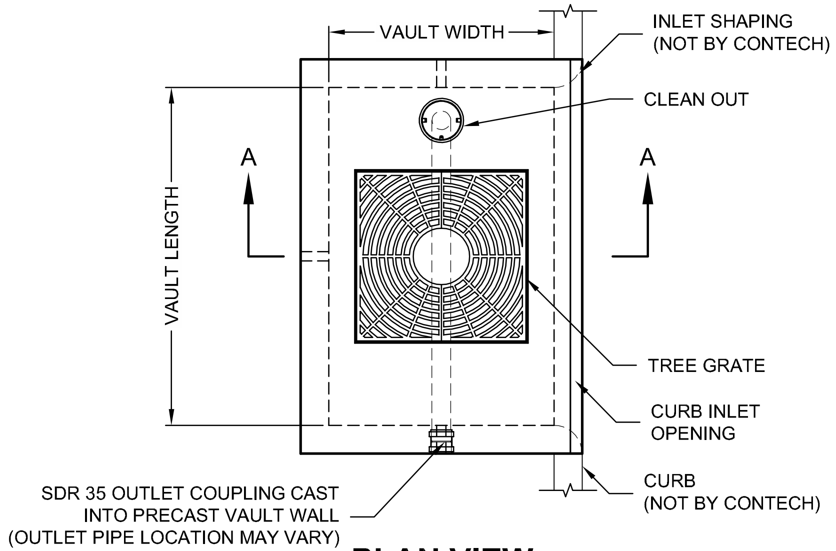
4. Bio Clean CPS devices shall be cleaned using a pressure washer as may be necessary if any materials are found to cause occlusion or clogging of the screen.

Disposal

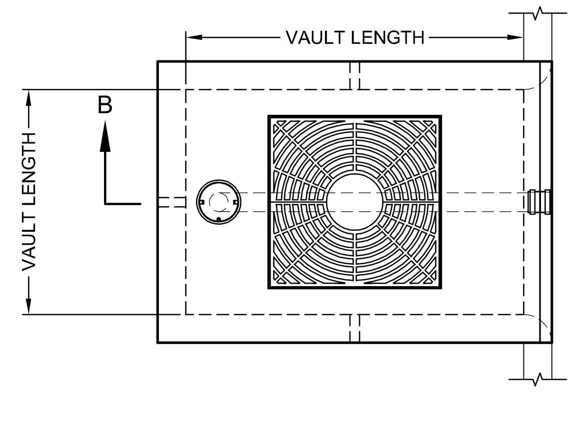
1. All trash and debris removed from the Bio Clean CPS unit shall be disposed of in accordance with local, state and federal regulation.

2. Solid waste disposal can be coordinated with local landfills. Liquids may need to be disposed of by wastewater treatment plant, municipal vacuum truck decant facility or approved facility.

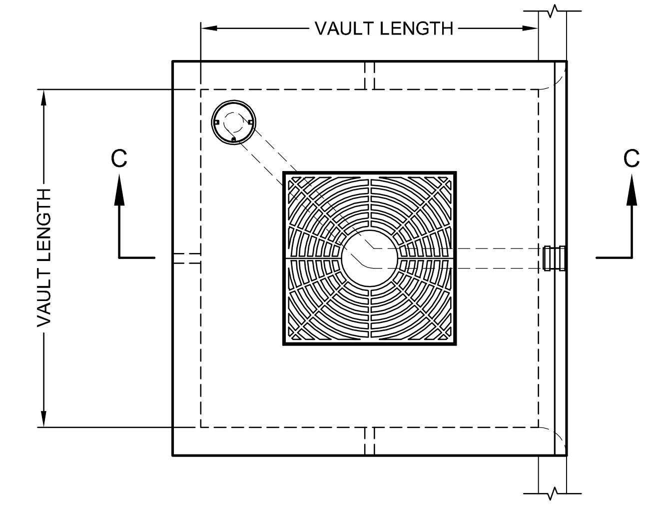
For Maintenance Services or
Information Please Contact Us At:
760-433-7640
Or Email:
info@biocleanenvironmental.com



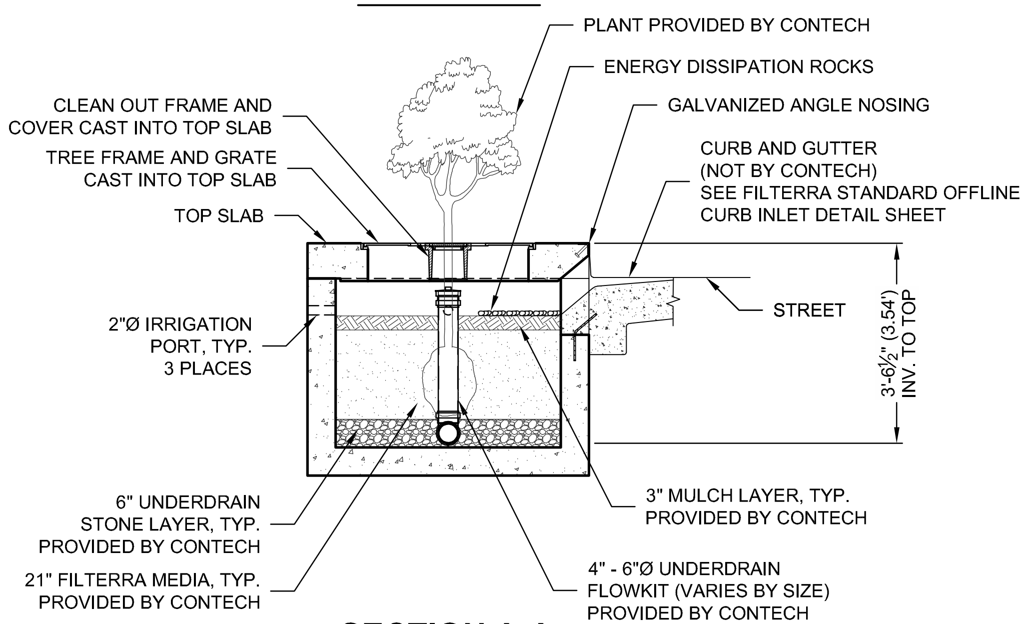
PLAN VIEW



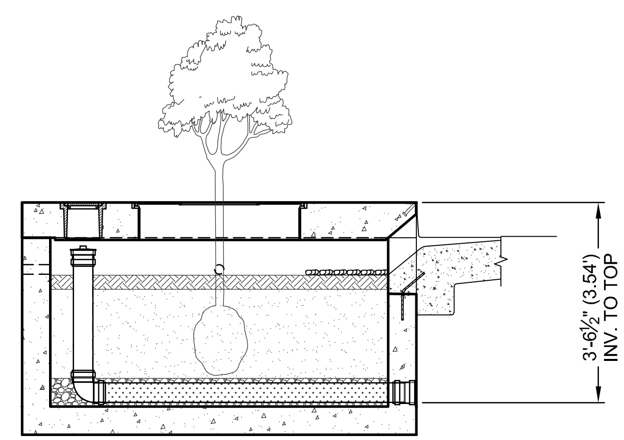
PLAN VIEW



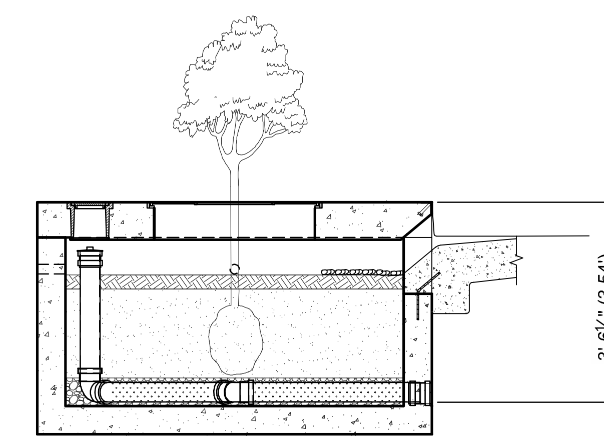
PLAN VIEW



SECTION A-A



SECTION B-B



SECTION C-C

FT LONG SIDE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0604	N/A CA	6 x 4	6 x 4	4" SDR 35	(1) 3' x 3'
FT06504	CA ONLY	6.5 x 4	6.5 x 4	4" SDR 35	(1) 3' x 3'
FT078045	MID-ATL ONLY	7.83 x 4.5	7.83 x 4.5	4" SDR 35	(1) 3' x 3'
FT0804	N/A MID-ATL	8 x 4	8 x 4	4" SDR 35	(1) 3' x 3'
FT0806	ALL	8 x 6	8 x 6	4" SDR 35	(1) 4' x 4'
FT1006	ALL	10 x 6	10 x 6	6" SDR 35	(1) 4' x 4'
FT1206	ALL	12 x 6	12 x 6	6" SDR 35	(2) 4' x 4'
FT1307	ALL	13 x 7	13 x 7	6" SDR 35	(2) 4' x 4'
FT1408	CALL CONTECH	14 x 8	14 x 8	6" SDR 35	(2) 4' x 4'
FT1608	CALL CONTECH	16 x 8	16 x 8	6" SDR 35	(2) 4' x 4'
FT1808	CALL CONTECH	18 x 8	18 x 8	6" SDR 35	(2) 4' x 4'
FT2008	CALL CONTECH	20 x 8	20 x 8	6" SDR 35	(3) 4' x 4'
FT2208	CALL CONTECH	22 x 8	22 x 8	6" SDR 35	(3) 4' x 4'

N/A = NOT AVAILABLE

FT SHORT SIDE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0406	N/A CA	4 x 6	4 x 6	4" SDR 35	(1) 3' x 3'
FT04065	CA ONLY	4 x 6.5	4 x 6.5	4" SDR 35	(1) 3' x 3'
FT0408	N/A MID-ATL	4 x 8	4 x 8	4" SDR 35	(1) 3' x 3'
FT045078	MID-ATL ONLY	4.5 x 7.83	4.5 x 7.83	4" SDR 35	(1) 3' x 3'
FT0608	ALL	6 x 8	6 x 8	4" SDR 35	(1) 4' x 4'
FT0610	ALL	6 x 10	6 x 10	6" SDR 35	(1) 4' x 4'
FT0612	ALL	6 x 12	6 x 12	6" SDR 35	(2) 4' x 4'
FT0713	ALL	7 x 13	7 x 13	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

FT SQUARE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0404	ALL	4 x 4	4 x 4	4" SDR 35	(1) 3' x 3'
FT0606	ALL	6 x 6	6 x 6	4" SDR 35	(1) 3' x 3'

N/A = NOT AVAILABLE

INTERNAL PIPE CONFIGURATION MAY VARY
DEPENDING UPON OUTLET LOCATION.

filterra®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,277,274; 6,569,321; 7,625,485; 7,425,261; 7,833,412; RELATED FOREIGN PATENTS.

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

FILTERRA OFFLINE (FT) CONFIGURATION DETAIL

CONTECH ENGINEERED SOLUTIONS

filterra Bioretention Systems

Filterra Sizing Spreadsheet
Uniform Intensity Approach
Storm Intensity = 0.20 in/hr

Filterra Infiltration Rate =	175	(in/hr)
Filterra Flow per Square Foot =	0.00405	(ft3/sec/ft2)

Filterra Flow Rate, Q = 0.00405 ft3/sec x Filterra Surface Area

Rational Method, Q = C x I x A

Site Flowrate, Q = (C x DI x DA x 43560) / (12 x3600)

OR DA = (12 x 3600 x Q) / (C x 43560 x DI)

where

Q =	Flow	(ft3/sec)
DA =	Drainage Area	(acres)
DI =	Design Intensity	(in/hr)
C =	Runoff coefficient	(dimensionless)

			DI	C	C	C
			0.2	1.00	0.85	0.50
Available Filterra Box Sizes						
L (ft)	W (ft)	Filterra Surface Area (ft2)	Filterra Flow Rate, Q (ft3/sec)	100% Imperv. DA (acres)	Commercial max DA (acres)	Residential max DA (acres)
4	4	16	0.0648	0.321	0.378	0.643
6	4	24	0.0972	0.482	0.567	0.964
6.5	4	26	0.1053	0.522	0.614	1.045
8	4	32	0.1296	0.643	0.756	1.286
12	4	48	0.1944	0.964	1.134	1.928
6	6	36	0.1458	0.723	0.851	1.446
8	6	48	0.1944	0.964	1.134	1.928
10	6	60	0.2431	1.205	1.418	2.410
12	6	72	0.2917	1.446	1.702	2.893
13	7	91	0.3686	1.828	2.151	3.656
12	8	96	0.3889	1.928	2.269	3.857
14	8	112	0.4537	2.250	2.647	4.500
16	8	128	0.5185	2.571	3.025	5.142
18	8	144	0.5833	2.893	3.403	5.785
20	8	160	0.6481	3.214	3.781	6.428
22	8	176	0.7130	3.535	4.159	7.071

INF-2: Infiltration Trench Fact Sheet

An infiltration trench is a long, narrow, rock-filled trench with no outlet other than an overflow outlet. Runoff is stored in the void space between stones and infiltrates through the bottom and sides of the trench. Infiltration trenches provide the majority of their pollutant removal benefits through volume reduction. Pretreatment is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective. *Note: if an infiltration trench is "deeper than its widest surface dimension," or includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute runoff below the surface of the ground, it would probably be considered a "Class V Injection Well" under the federal Underground Injection Control (UIC) Program, which is regulated in California by U.S. EPA Region 9. A UIC permit may be required for such a facility (for details see* **http://www.epa.gov/region9/water/groundwater/uic-classv.html***).*

Also known as:

- *French Drains*
- *Rock Trenches*
- *Exfiltration Trenches*
- *Soak-aways*
- *Soakage Trenches*

Infiltration Trench

Source: www.dot.ca.gov

Feasibility Screening Considerations

- Infiltration trenches shall pass infeasibility screening criteria to be considered for use
- Infiltration trenches, particularly deeper designs, may not provide significant attenuation of stormwater pollutants if underlying soils have high permeability; potential risk of groundwater contamination.
- The potential for groundwater mounding should be evaluated if depth to seasonally high groundwater (unmounded) is less than 15 feet.

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Drainage area area is ≤ 5 acres and has low to moderate sediment production.
- 2-3 percent of drainage area available for infiltration (generally requires less surface area than infiltration basins and bioretention areas without underdrain).
- Space available for pretreatment (biotreatment or treatment control BMP as described below).
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into shallow fill is approved by a geotechnical professional.
- Tributary area land uses include open areas adjacent to parking lots, driveways, and buildings, and roadway medians and shoulders.

OC-Specific Design Criteria and Considerations

☒ Must comply with local, state, and federal UIC regulations if applicable; a permit may be required.

☒ Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)

☒ For facilities with tributary area less than 1 acre and less than 3 foot depth, minimum separation to mounded seasonally high groundwater of 5 feet shall be observed.

☒ For facilities with tributary area greater than 1 acre or deeper than 3 feet, minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.

☒ Minimum pretreatment should be provided upstream of the infiltration trench, and water bypassing pretreatment should not be directed to the infiltration trench.

☒ Infiltration trenches should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.

☒ Ponded water should not persist within 1 foot of the surface of the facility for longer than 72 hours following the end of a storm event (observation well is needed to allow observation of drain time).

☒ Energy dissipators should be provided at inlet and outlet to prevent erosion.

☒ An overflow device must be provided if basin is on-line.

☒ A minimum freeboard of one foot should be provided above the overflow device (for an on-line basin) or the outlet (for an off-line basin).

☒ Longitudinal trench slope should not exceed 3%.

☒ Side slopes above trench fill should not be steeper than 3:1.

Simple Sizing Method for Infiltration Trenches

If the Simple Design Capture Volume Sizing Method is used to size an infiltration trench, the user calculates the DCV and then designs the geometry required to draw down the DCV in 48 hours. The sizing steps are as follows:

Step 1: Determine Infiltration Basin DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1**.

Step 2: Determine the 48-hour Effective Depth

The depth of water that can be drawn down in 48 hours can be calculated using the following equation:

$d_{48} = K_{DESIGN} \times SACF \times 48$ hours

Where:

d_{48} = trench effective 48-hour depth, ft

K_{DESIGN} = basin design infiltration rate, in/hr (See **Appendix VII**)

SACF = Surface Area Correction Factor = ranges from 1.0 (sides insignificant or not accounted) to 2.0 (sides plus bottom are 2 times the surface area of the bottom at mid depth) to account for the ratio of infiltration through the sides of the trench to the bottom footprint of the trench; should be based on anticipated trench geometry and wetted surface area at mid-depth.

This is the maximum effective depth of the trench below the overflow device to achieve drawdown in 48 hours.

Step 3: Determine the Trench Ponding Depth and Trench Depth

The depth of water stored in the ponding depth (i.e. above the trench fill) and within the trench itself should be equal or less than d_{48}. Determine the ponding depth and the trench fill depth such that:

$d_{48} \geq (n_T \times d_T + d_P)$

Where:

d_{48} = trench effective 48-hour depth, ft (from Step 2)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft (should not exceed 1 ft)

Step 4: Calculate the Required Infiltrating Area

The required footprint area can be calculated using the following equation:

$A = DCV / ((n_T \times d_T) + d_P)$

Where:

A = required trench footprint area, sq-ft

DCV = design capture volume, cu-ft (see Step 1)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

Capture Efficiency Method for Infiltration Trenches

If BMP geometry has already been defined and deviates from the 48 hour drawdown time, the designer can use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (**Appendix** III.3.2) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected trench geometry

$DD = ((n_T \times d_T) + d_P) / (K_{DESIGN} \times SACF) \times 12$

Where:

DD = time to completely drain infiltration basin ponding depth, hours

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

SACF = Surface Area Correction Factor = ranges from 1.0 (sides insignificant or not accounted) to 2.0 (sides plus bottom are 2 times the surface area of the bottom at mid depth) to account for the ratio of infiltration through the sides of the trench to the bottom footprint of the trench; should be based on anticipated trench geometry and wetted surface area at mid-depth.

K_{DESIGN} = basin design infiltration rate, in/hr (See Appendix VII)

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (**Appendix** III.3.2) to calculate the required fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the trench drawdown time calculated above.

Step 3: Determine the Trench Infiltrating Area Needed

The required footprint area can be calculated using the following equation:

$A = DCV / ((n_T \times d_T) + d_P)$

Where:

A = required trench footprint area, sq-ft

DCV = design capture volume, cu-ft (see Step 1)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

If the area required is greater than the selected trench area, adjust surface area or adjust ponding and/or trench depth and recalculate required area until the required area is achieved.

Configuration for Use in a Treatment Train

- Infiltration trenches may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required volume of the trench.
- Infiltration trenches must be preceeded by some form of pretreatment which may be biotreatment or a treatment control BMP; if an approved biotreatment BMP is used as pretreatment, the overflow from the infiltration trench may be considered "biotreated" for the purposes of meeting the LID requirments
- The overflow or bypass from an infiltration trench can be routed to a downstream biotreatment BMP and/or a treatment control BMP if additional control is required to achieve LID or treatment control requirements

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: http://www.cabmphandbooks.com/Documents/Development/TC-10.pdf
- SMC LID Manual (pp 141): http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 6: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandrainageareaintenance.pdf
- City of Portland Stormwater Management Manual (Soakage Trenches, page 2-82) http://www.portlandonline.com/bes/index.cfm?c=47954&a=202883
- San Diego County LID Handbook Appendix 4 (Factsheet 1): http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

INF-5: Drywell

Drywells are similar to infiltration trenches in their design and function, but generally have a greater depth to footprint area ratio and can be installed at relatively large depths. A drywell is a subsurface storage facility designed to temporarily store and infiltrate runoff, primarily from rooftops or other impervious areas with low pollutant loading. A drywell may be either a small excavated pit filled with aggregate or a prefabricated storage chamber or pipe segment. Drywells can be used to reduce the volume of runoff from roofs and other relatively clean surfaces. While roofs are generally not a significant source of stormwater pollutants, they can be a major contributor of runoff volumes. Therefore, drywells can indirectly enhance water quality by reducing the water quality design volume that must be treated by other, downstream stormwater management facilities. *Note: A drywell is considered a "Class V Injection Wells" under the federal Underground Injection Control (UIC) Program regulated in California by U.S. EPA Region 9. A UIC permit may be required (for details see http://www.epa.gov/region9/water/groundwater/uic-classv.html).*

Also known as:

- *Soakaway Pits*
- *Infiltration Sumps*
- *Rock Sumps*
- *Underground Injection Controls*

Drywell
Source: K&A Enterprises

Feasibility Screening Considerations

- Drywells shall pass infiltration infeasibility screening criteria (**TGD Section 2.4.2.4**) to be considered for use.
- Dry wells provide a more direct pathway for stormwater to groundwater, therefore pose a greater risk to groundwater quality than surface infiltration systems.

Opportunity Criteria

- Drywells may be used to infiltrate roof runoff, either directly or from the overflow from a cistern.
- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Space available for pretreatment (biotreatment or treatment control BMP as described below).
- The drywell must be located in native soil; over-excavated by at least one foot in depth and replaced uniformly without compaction.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.

OC-Specific Design Criteria and Considerations

☒ Must comply with local, state, and federal UIC regulations; a permit may be required.

☒ Minimum set-backs from foundations and slopes should be observed

- [X] Infiltration should not cause geotechnical concerns related to slope stability, liquefaction, or erosion.
- [X] Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- [ ] Drywells should not receive untreated stormwater runoff, except rooftop runoff. Pretreatment of runoff from other surfaces is necessary to prevent premature failure that results from clogging with fine sediment, and to prevent potential groundwater contamination due to nutrients, salts, and hydrocarbons. Maxwell Drywell Systems contain internal pretreatment systems
- [X] Design infiltration rate should be determined with an infiltration test at each drywell location.
- [ ] Drywell should be encased by 1 foot of coarse (3/4" to 2 ½"), round river rock on sides and bottom of facility. Maxwell Drywell System is encased by its manufacturer specific recommended rock as well as stabilized backfill.
- [X] Maximum facility depth is 25 feet with the approval of a geotechnical professional; preferred depth less than 10 feet does not require geotechnical approval.
- [X] If inlet is an underground pipe, a fine mesh screen should be installed to prevent coarse solids from entering drywell.
- [ ] An overflow route must be installed for flows that overtop facility. Flows will not overtop facility

Sizing Criteria for Drywells

Drywell sizing is highly site-specific. Sizing calculations shall demonstrate via the methods described in Appendix III or via project-specific methods that the system captures and fully discharges the DCV within 48 hours following the end of precipitation, or captures and infiltrates 80 percent of average annual runoff volume.

Configuration for Use in a Treatment Train

- Drywells may be preceded in a treatment train by HSCs in the drainage area, which would reduce the required volume of the drywell.
- Drywells treating any areas other than roof tops must be preceded by a robust biotreatment or conventional treatment capable of addressing all potentially generated pollutants.
- Drywells may be used in conjunction with other infiltration BMPs to increase the infiltration capacity of the entire treatment train system.

Additional References for Design Guidance

- Stormwater Management in Western Washington (Volume III: Hydrologic Analysis and Flow Control Design BMPs) http://www.ecy.wa.gov/pubs/0510031.pdf
- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- City of Portland Stormwater Management Manual (Drywell, page 2-87) http://www.portlandonline.com/bes/index.cfm?c=47954&a=202883
- San Diego County LID Handbook Appendix 4 (Factsheet 25): http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf
- City of Santa Barbara Storm Water BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:
- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

- [ ] Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.
- [ ] Consult proprietors for specific criteria concerning the design and performance.
- [ ] Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.
- [ ] Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3**).

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. Many propretary biotreatment BMPs will not be able to meet the definition of “biofiltration” that applies in South Orange County. See Section III.7 and Worksheet SOC-1.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

Street Sweeping and Vacuuming SE-7

Objectives

EC	Erosion Control	
SE	Sediment Control	☒
TR	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs
Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Site Design & Landscape Planning SD-10

Design Objectives

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

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

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

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

Rain Garden

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

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

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.

- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:

  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff

  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect

  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible

  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth

- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

- Signage on top of curbs tends to weather and fade.

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

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

Suitable Applications

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

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

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

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

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

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

Attachment D
TGD Worksheets & Figures

Table 2.7: Infiltration BMP Feasibility Worksheet

<table>
<tr><th></th><th>Infeasibility Criteria</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Would Infiltration BMPs pose significant risk for groundwater related concerns? Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>2</td><td>Would Infiltration BMPs pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert):
• The BMP can only be located less than 50 feet away from slopes steeper than 15 percent
• The BMP can only be located less than eight feet from building foundations or an alternative setback.
• A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>3</td><td>Would infiltration of the DCV from drainage area violate downstream water rights?</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:

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

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility **located on HSG D soils** or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
5	Is **measured infiltration rate below proposed facility less than 0.3 inches per hour**? This calculation shall be based on the methods described in Appendix VII.		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
6	Would **reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
7	Would **an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	No
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: Summarize findings of infeasibility screening	Feasible
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	Feasible
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	Infiltration of the full DCV is feasible. Bio-filtration will be utilized for the pre-treatment

Worksheet B: Simple Design Capture Volume Sizing Method DMA 1

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.14	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	342	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design}/ d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 2

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.51	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	3,677	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 3

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	2.62	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	6,367	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 4

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	A=	1.23	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	2,998	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design}/ d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 5

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	$d=$	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	$d_{HSC}=$	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}=$	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	$A=$	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	$imp=$	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	$C=$	0.79	
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	$V_{design}=$	572	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}=$	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	$S_{final}=$	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	$K_{design}=$	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	$T=$	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	$D_{max}=$	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design}/ d_{max}$	$A_{min}=$	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 6

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	$d=$	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	$d_{HSC}=$	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}=$	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	$A=$	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	$C=$	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	$V_{design}=$	572	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}=$	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	$S_{final}=$	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	$K_{design}=$	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	$T=$	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	$D_{max}=$	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	$A_{min}=$	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 7

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	$d=$	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	$d_{HSC}=$	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}=$	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	$A=$	1.51	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	$C=$	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	$V_{design}=$	3,657	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}=$	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	$S_{final}=$	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	$K_{design}=$	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	$T=$	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	$D_{max}=$	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	$A_{min}=$	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 8

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	585	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 9

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.28	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	683	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 10

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	A=	0.23	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	562	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method DMA 11

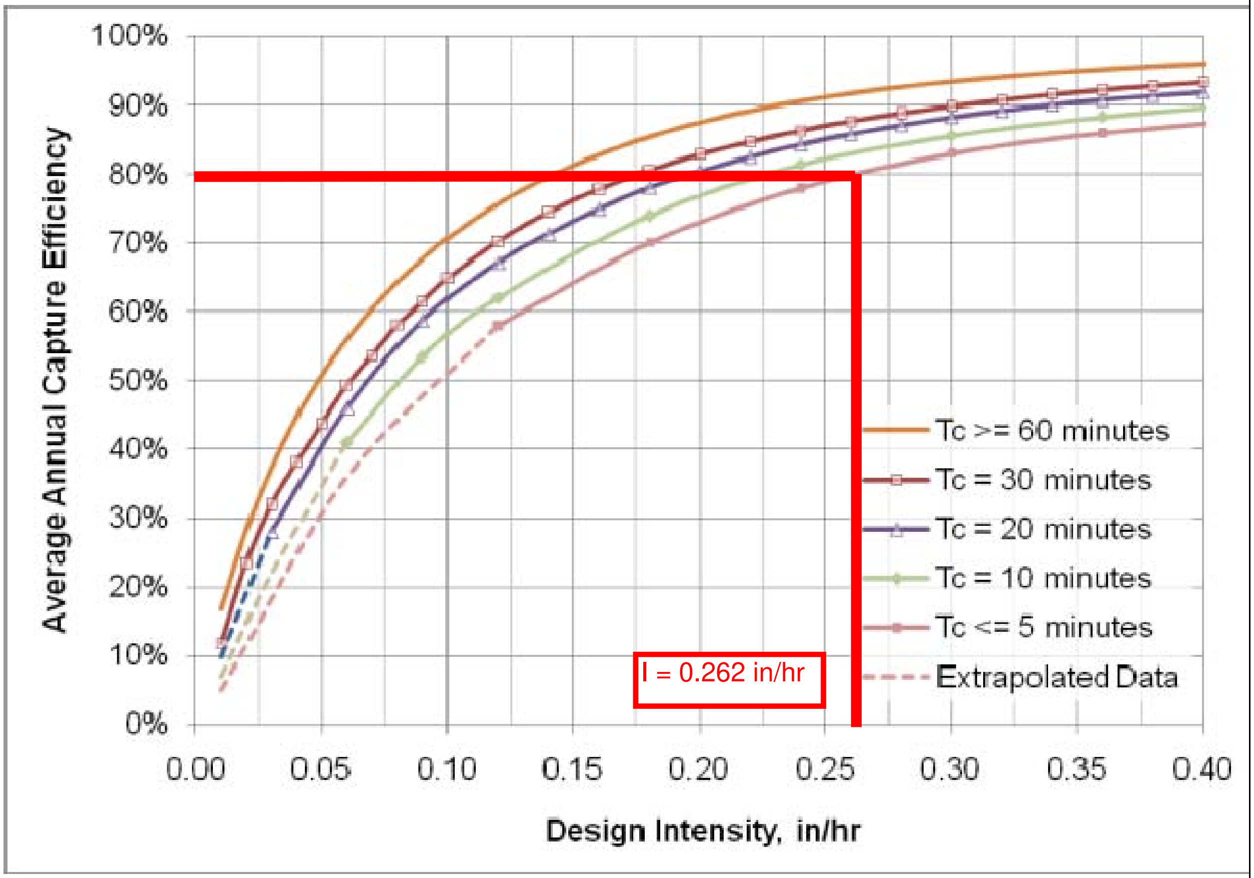
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	A=	1.89	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	4,605	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	n/a	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	n/a	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	n/a	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	T=	n/a	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=	n/a	Feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=	n/a	sq-ft

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 1

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.14	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.029	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **DMA 2**

Graphical Operations

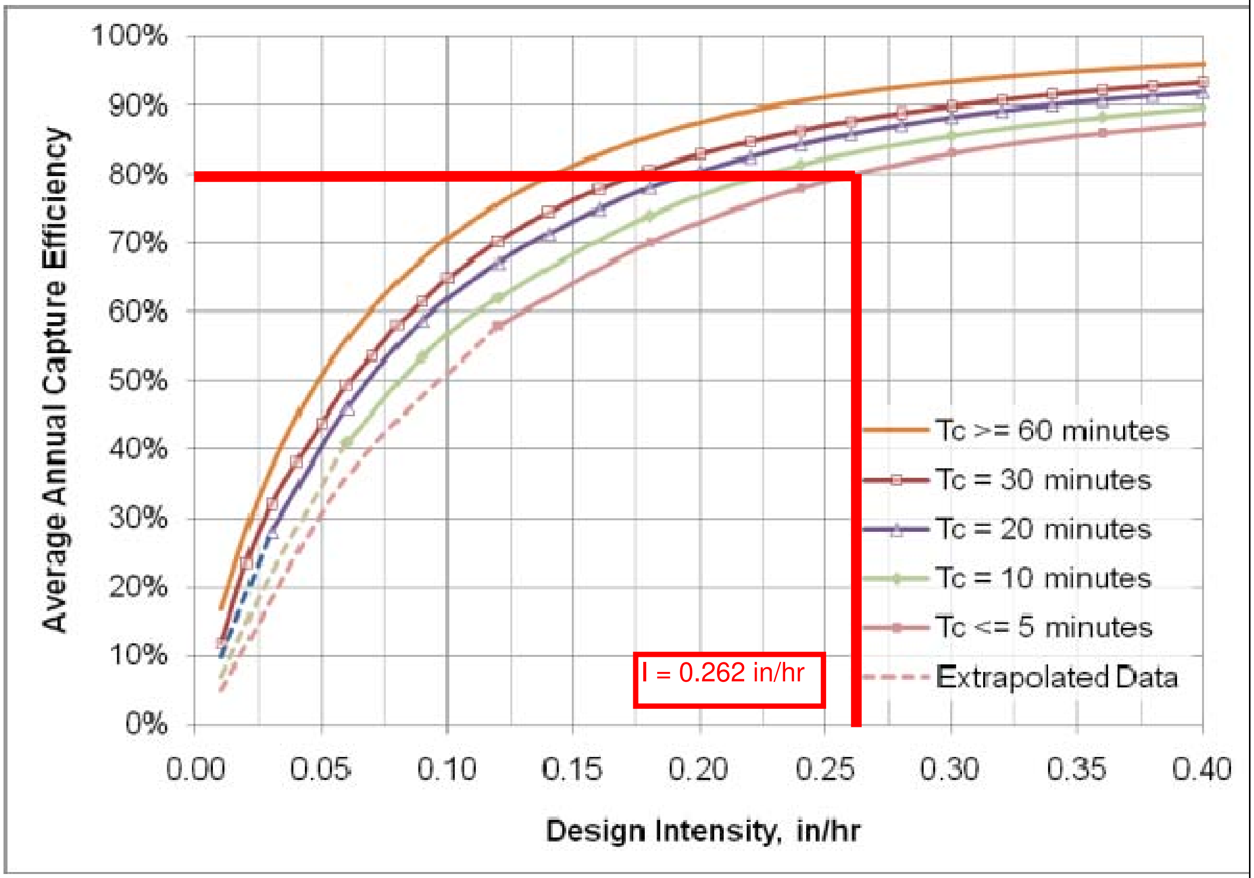


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 2

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.51	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.312	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

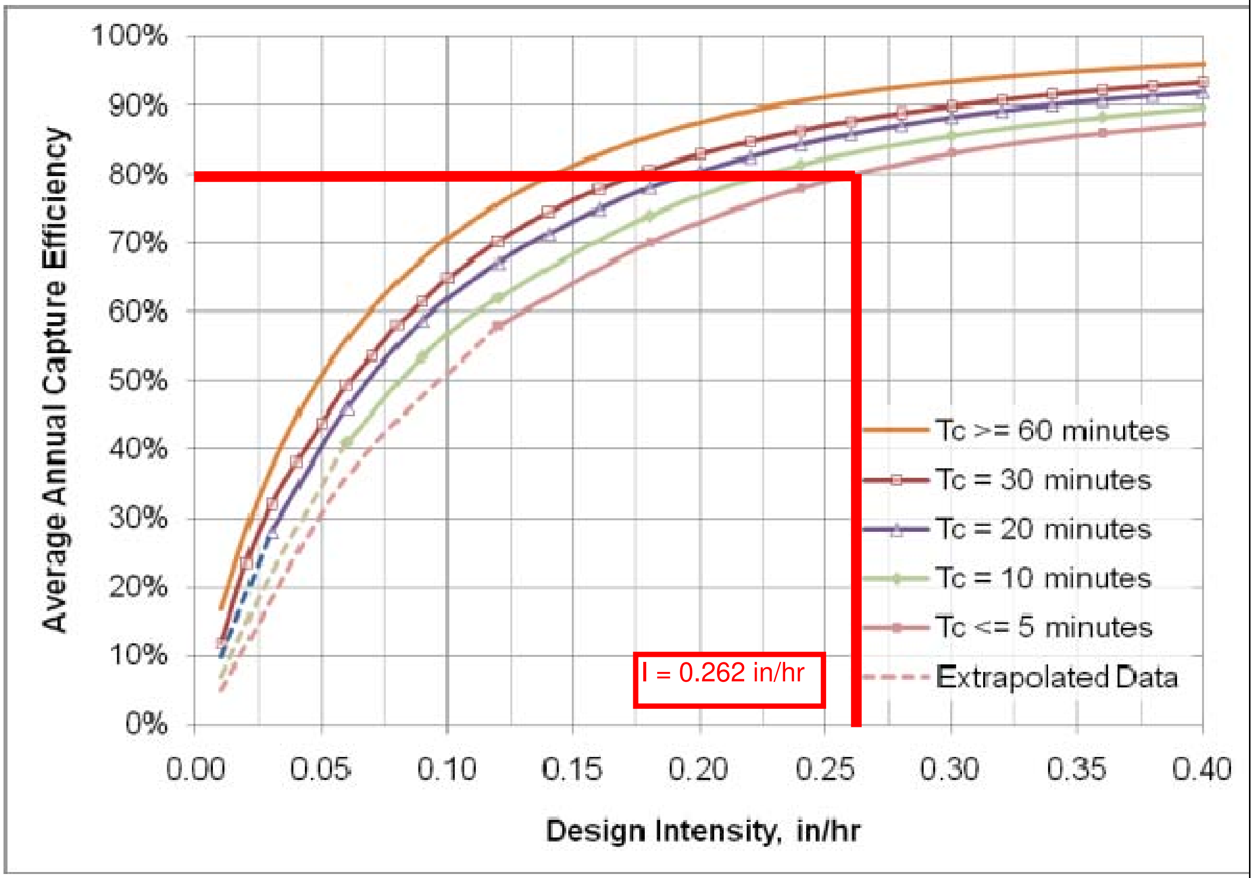


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 3

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	2.62	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.541	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

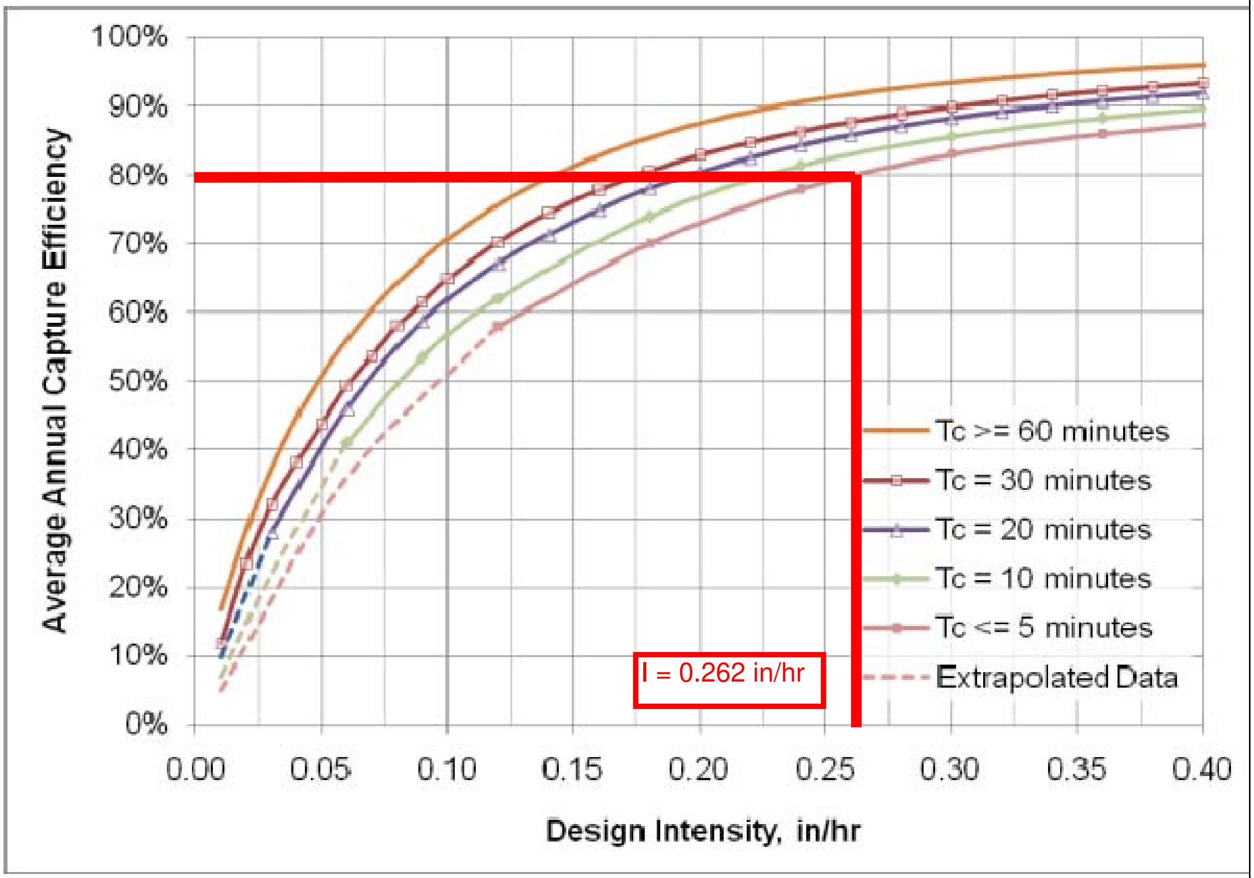


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 4

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.23	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.255	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

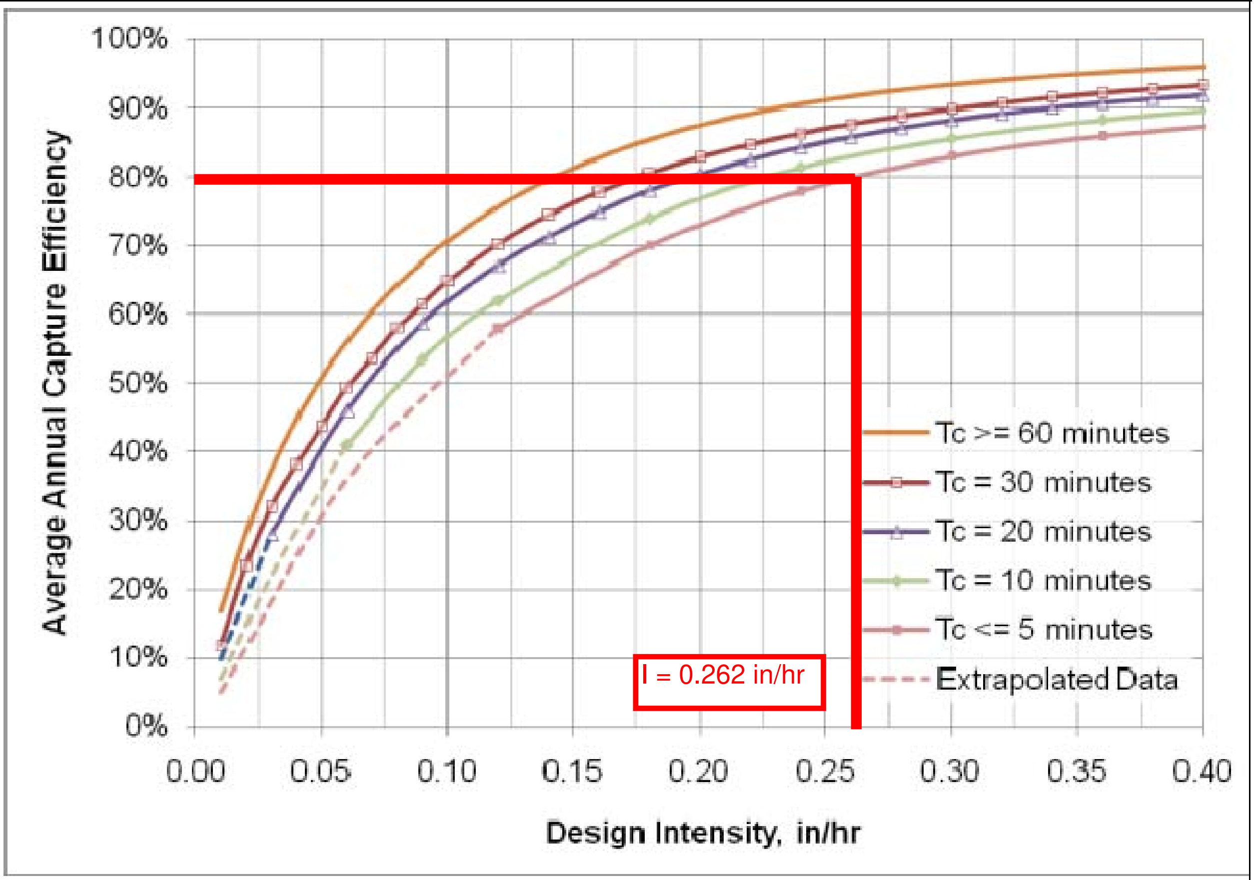


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 5

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.049	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

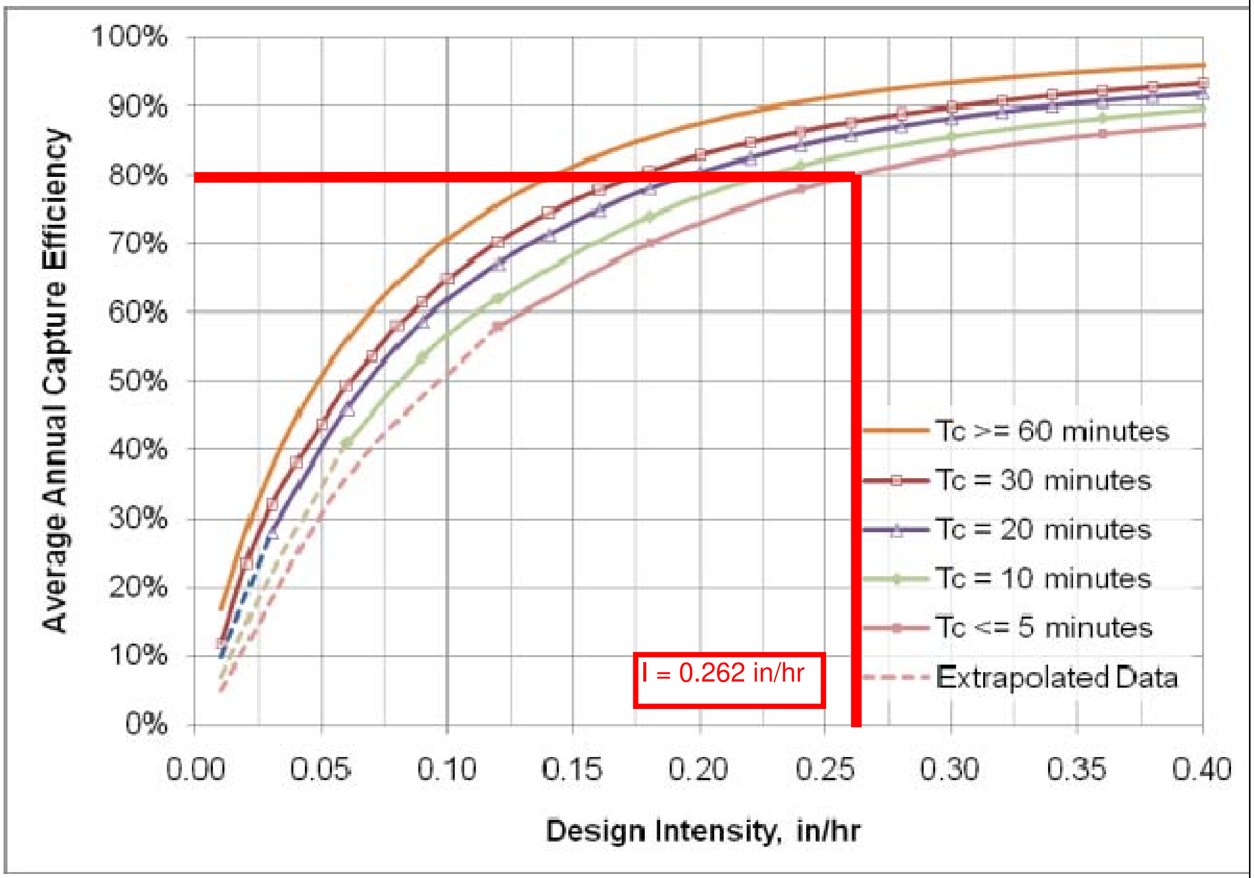


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 6

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.049	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

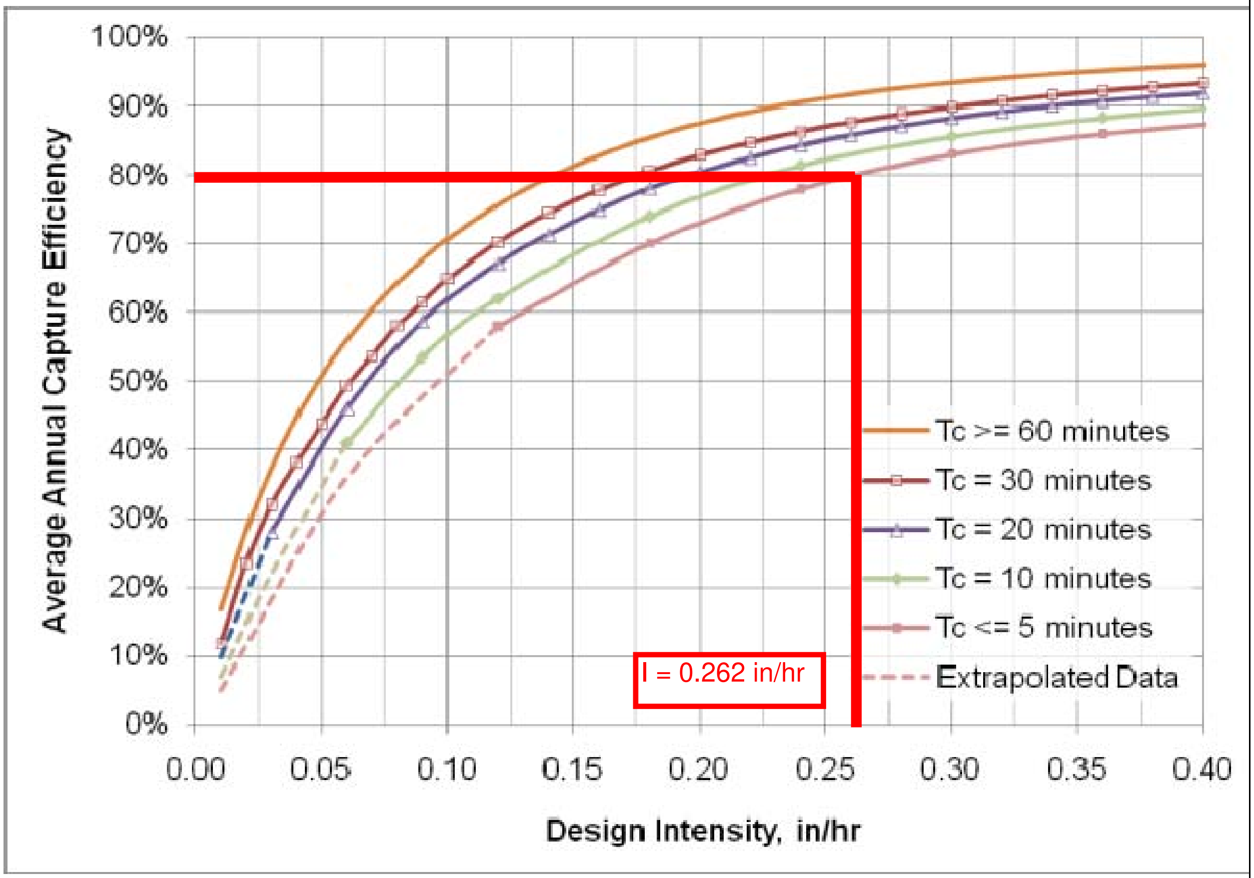


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 7

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.51	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.311	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations



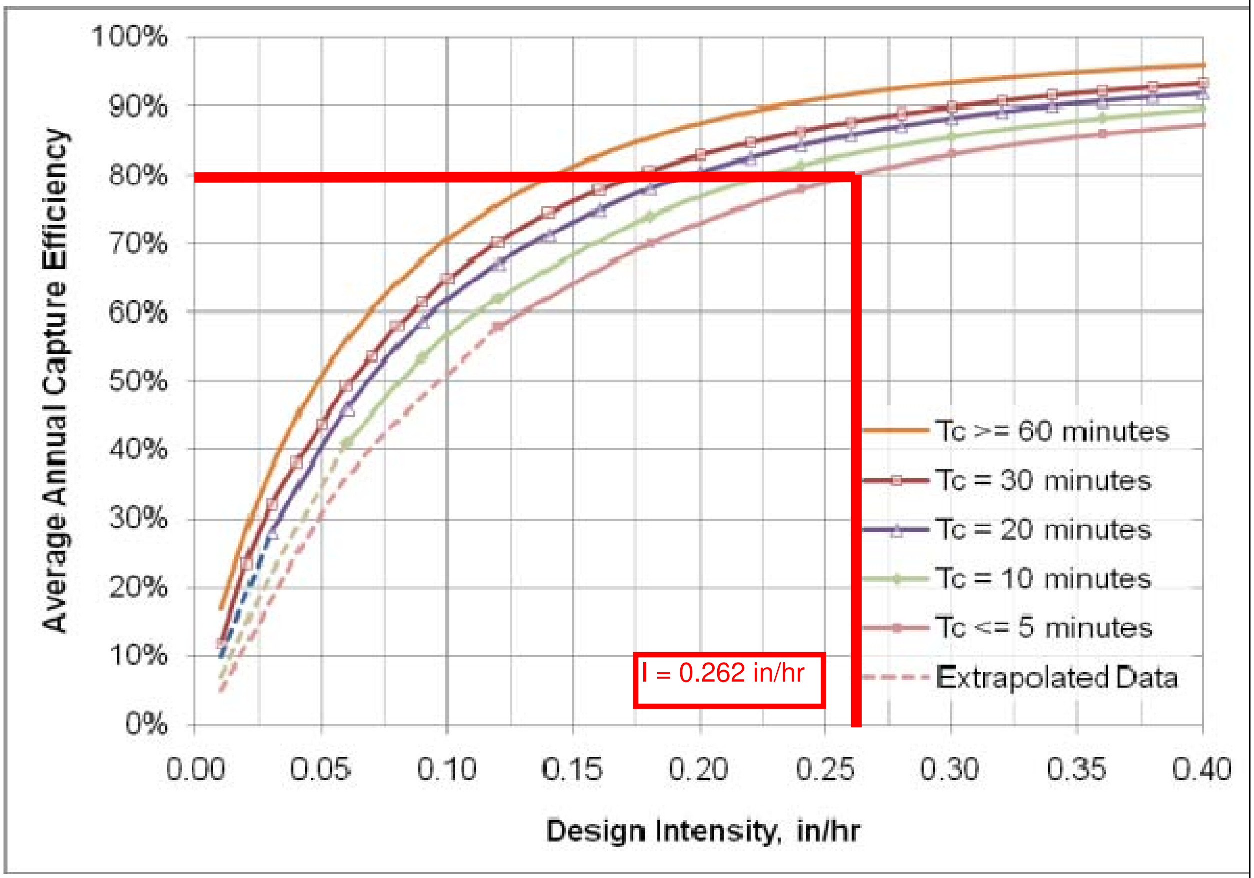
Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 8

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.24	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.050	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs — DMA 2

Graphical Operations

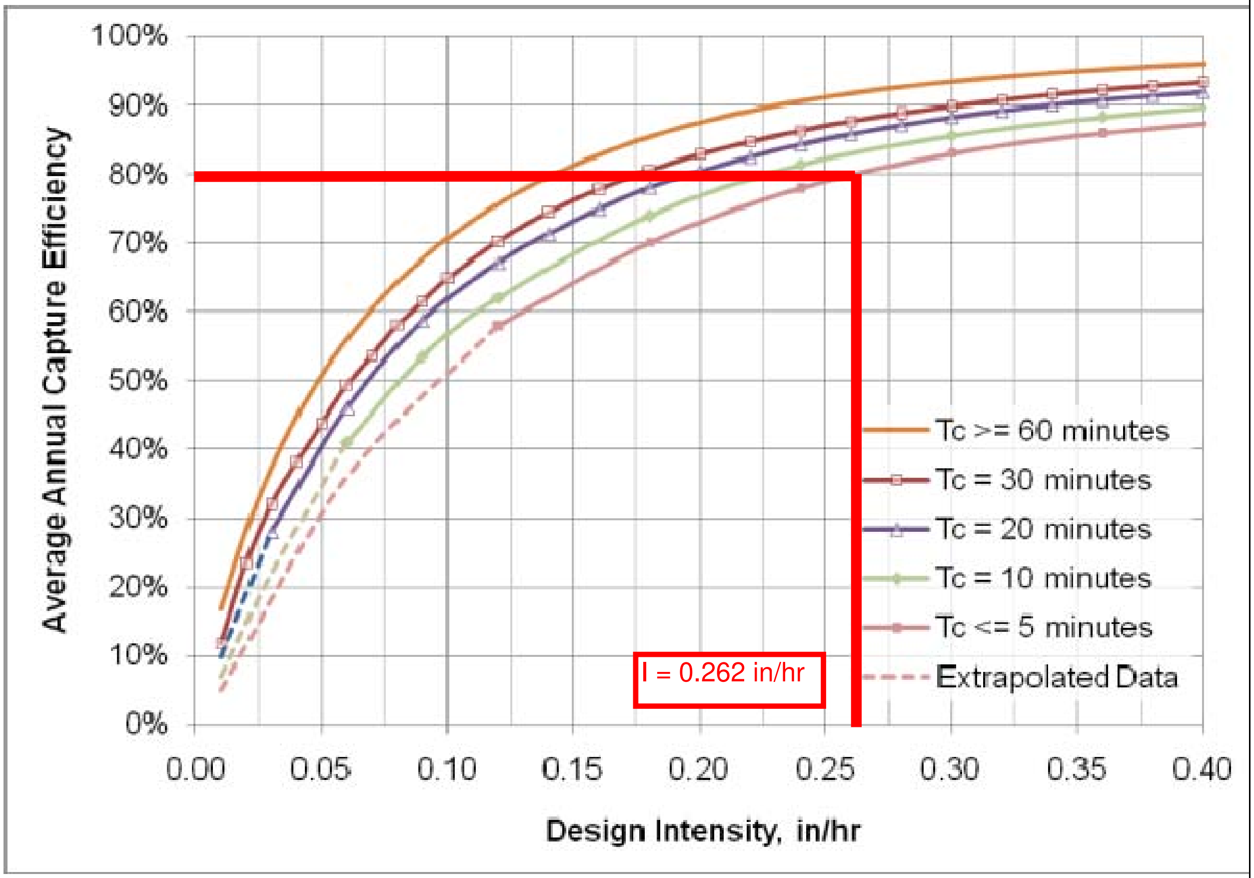


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 9

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.28	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	0.058	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Graphical Operations

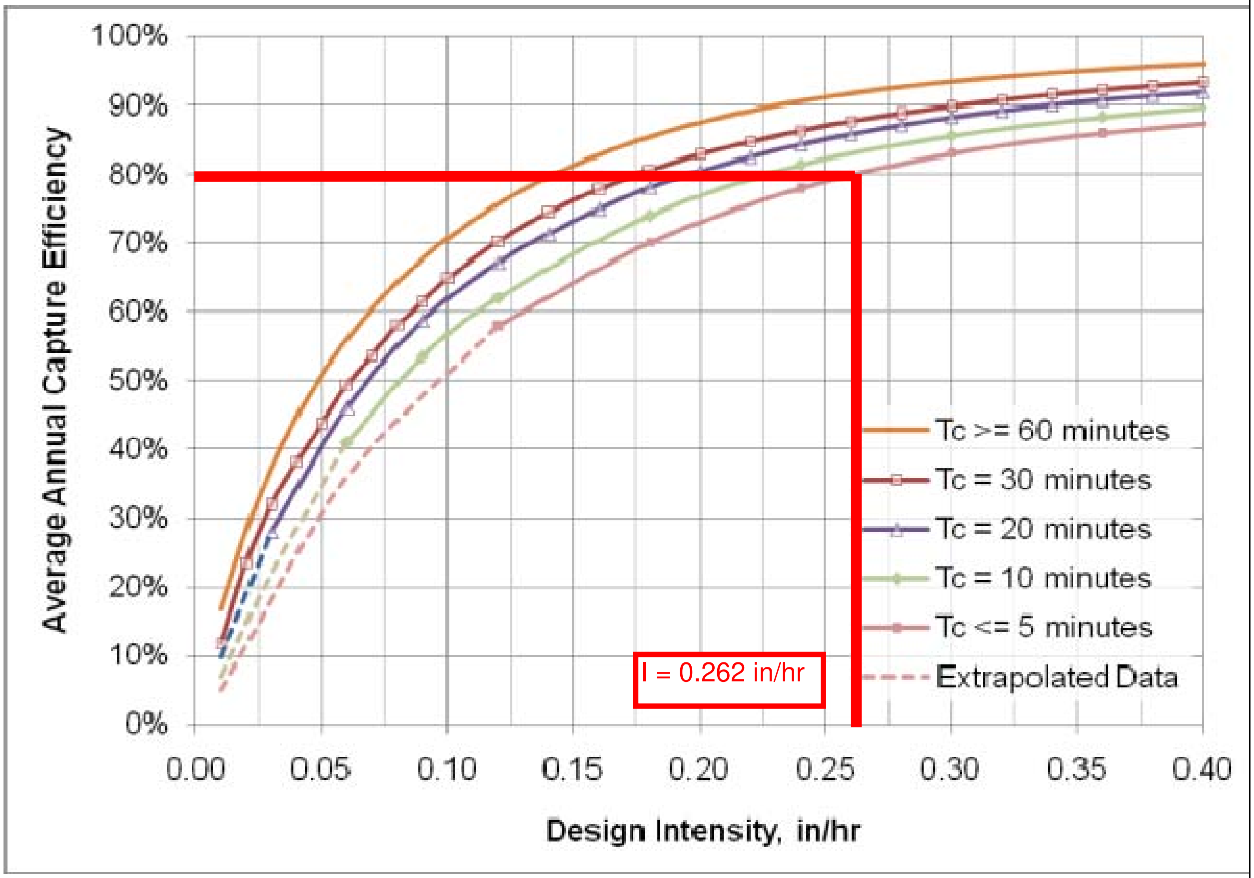


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 10

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.23	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.048	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **DMA 2**

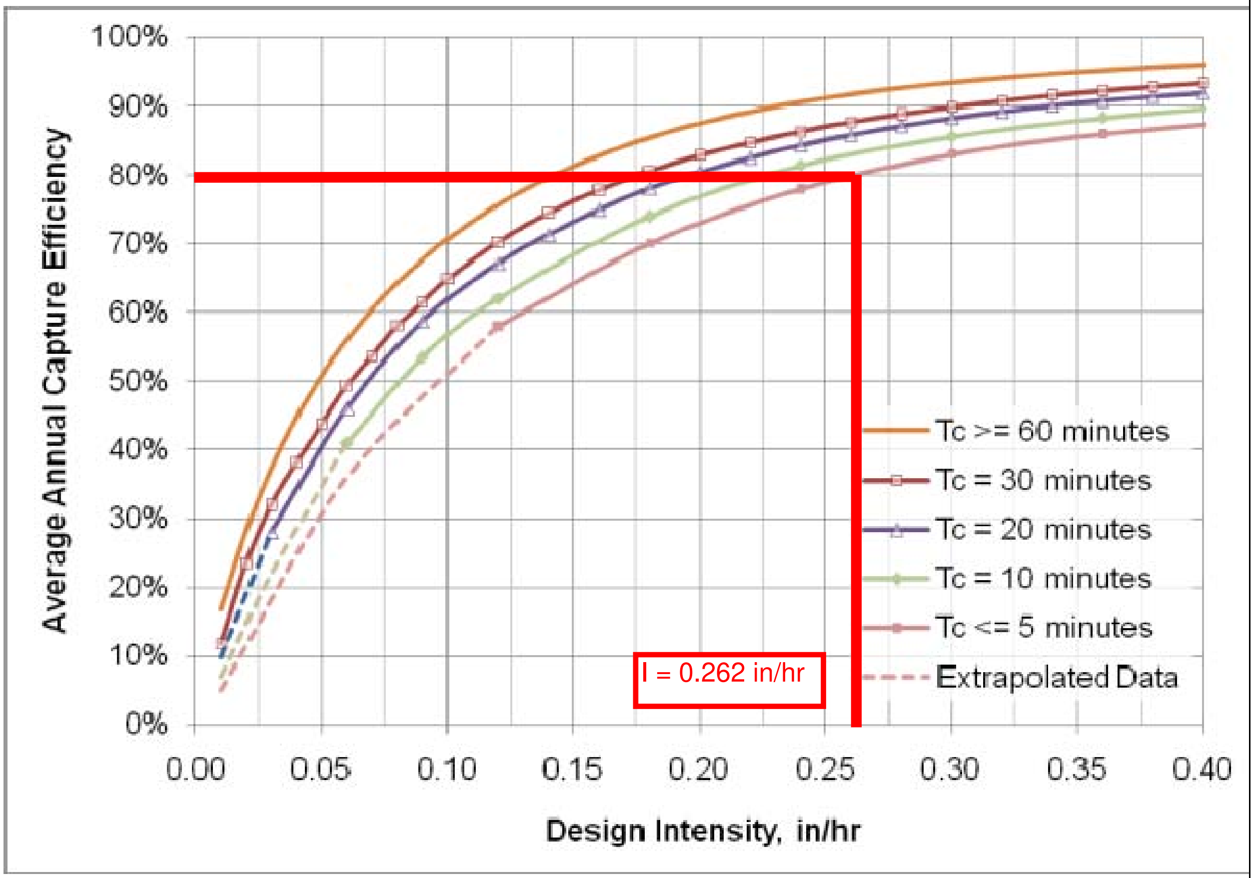
Graphical Operations

Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs DMA 11

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.89	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.79	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.391	cfs
Supporting Calculations				
Describe system: The surface runoff will be conveyed via overland flow to proposed Modular Wetland Unit for water quality treatment, prior to entering a private underground storm drain system				
Provide time of concentration assumptions: The Time of Concentration used for this worksheet was determined using Figure D-1 Time of Concentration Nomograph with Travel Time consideration from the O.C. Hydrology Manual 1986. See Attachment E.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **DMA 2**

Graphical Operations

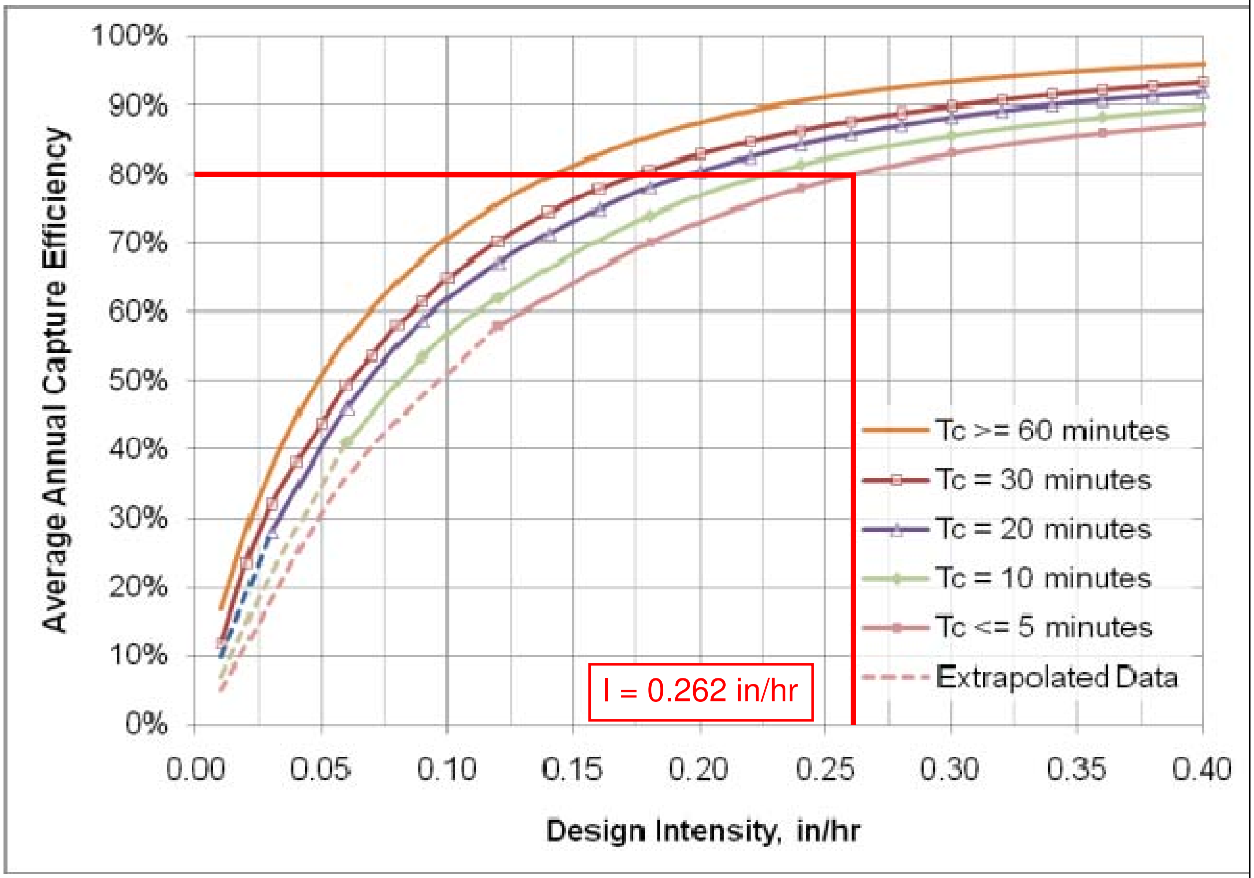


Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **OFFSITE -E Ball Road**

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5 min	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), A (acres)	A=	0.09	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	1.0	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.9	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.021	cfs
Supporting Calculations				
Describe system: The project proposes a 7' dedication along the easterly frontage of the site on E. Ball Road for the proposed public sidewalk. The additional generated low flow will be mitigated via the proposed Filterra unit near the entrance of the proposed site for water quality treatment prior to continue downstream along E. Ball Road.				
Provide time of concentration assumptions: The time of concentration is assumed to be 5 minutes as a conservative measure for preliminary design.				

Graphical Operations



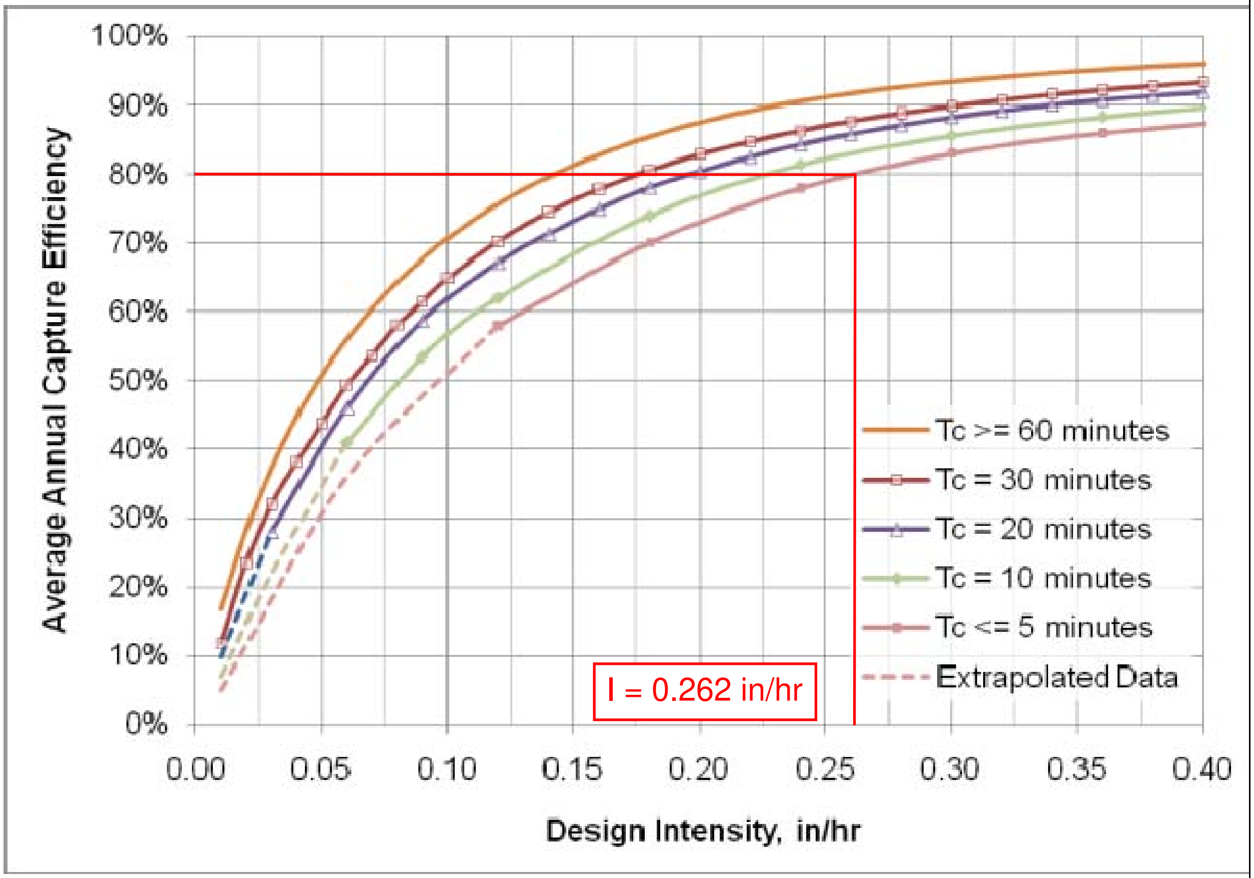
Provide supporting graphical operations. See Example III.7.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs OFFSITE -S Anaheim Blvd

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5 min	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.262	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.262	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.10	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	1.0	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.9	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.024	cfs
Supporting Calculations				
Describe system: The project proposes a 7’ dedication along the southerly frontage of the site on S. Anaheim Boulevard for the proposed public sidewalk. The additional generated low flow will be mitigated downstream to the proposed Filterra unit near the relocated existing catch basin for water quality treatment prior to entering the downstream drainage system.				
Provide time of concentration assumptions: The time of concentration is assumed to be 5 minutes as a conservative measure for preliminary design.				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs OFFSITE -S Anaheim Blvd

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet					
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	2	0.50
		Site soil variability	0.25	2	0.50
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.50
B	Design	Tributary area size	0.25	2	0.50
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	1	0.25
		Compaction during construction	0.25	2	0.50
		Design Safety Factor, $S_B = \Sigma p$			1.50
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				2.25	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				2.90	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT}$ / K_M				1.29	

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Per Geotechnical Feasibility Report prepared by Alta California Geotechnical Inc. dated June 7, 2021:

"Based on state-provided information historic high groundwater is greater than 50 feet below the ground surface (CDMG, 1997). A nearby well (State Well No. 338111N1179107W001) indicates that the groundwater was approximately 162 feet below the ground surface in October of 1996 (CDWR, 2021).

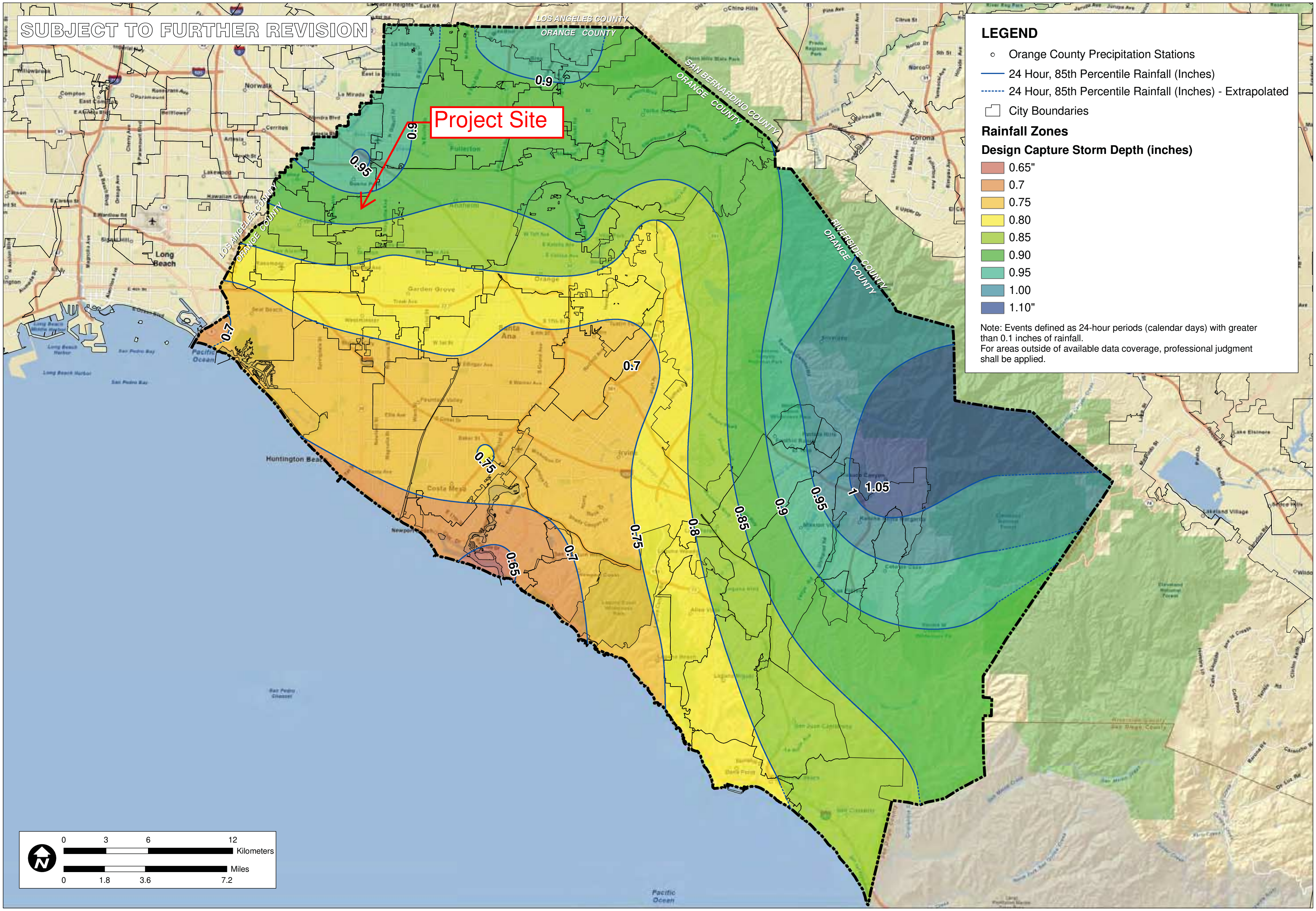
The onsite soils are primarily well consolidated mixtures of gravel, sand, silt and clay. These types of soils can possess moderate to low infiltration rates. Additionally, based on the anticipated unsuitable soil and compaction recommendations presented herein, the final distribution of the soils will include a compacted fill layer across the majority of the site. Compaction of the onsite soils will reduce the infiltration rates. Historic groundwater is greater than 50-feet."

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 J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		□	
3	Landscape irrigation		✓	
4	Other:________________________________		□	
5	What is the design capture storm depth? (Figure III.1)	d	0.85	inches
6	What is the project size?	A	10.10	ac
7	What is the acreage of impervious area?	IA	8.48	ac
	For projects with multiple types of demand (toilet flushing, irrigation demand, and/or other demand)			
8	What is the minimum use required for partial capture? (Table X.6)			gpd
9	What is the project estimated wet season total daily use (Section X.2)?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (Table X.7)			
12	What is the project estimated TUTIA?			
13	Is partial capture potentially feasible? (Line 12 > Line 11?)			
	For projects with only irrigation demand			
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8) 8.48x0.95	8.05		ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)	1.62		ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)	No		

Provide supporting assumptions and citations for controlling demand calculation:
Due to the proposed development type, density and amount of available landscaping, Harvest and Use BMPs for irrigation purposes will not be feasible.



TITLE
RAINFALL ZONES

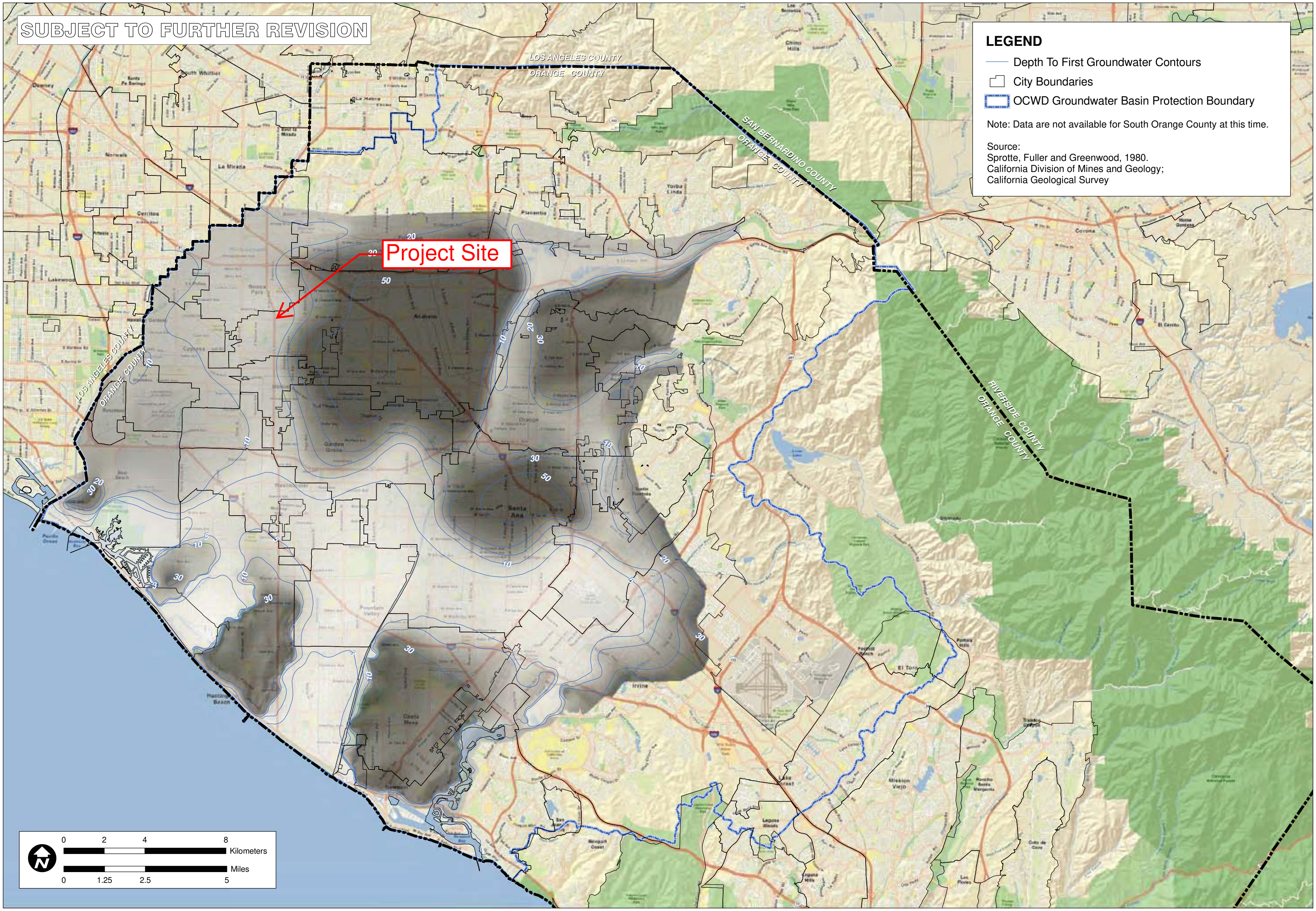
JOB
ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd



TITLE
NORTH ORANGE COUNTY MAPPED DEPTH TO FIRST GROUNDWATER

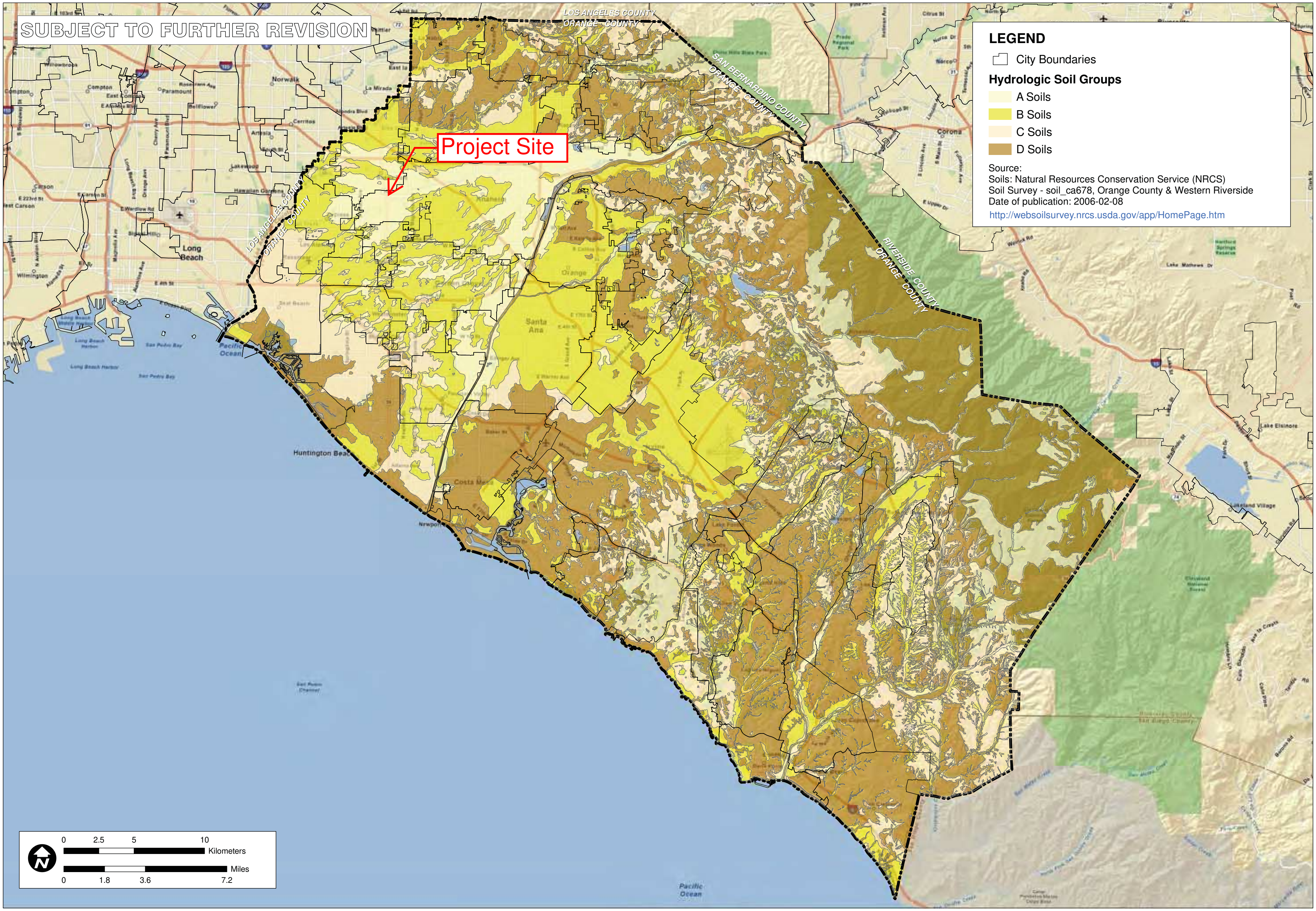
JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2d

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI2d_DepthToGroundwaterOverview_20110215.mxd



TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE 1" = 1.8 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

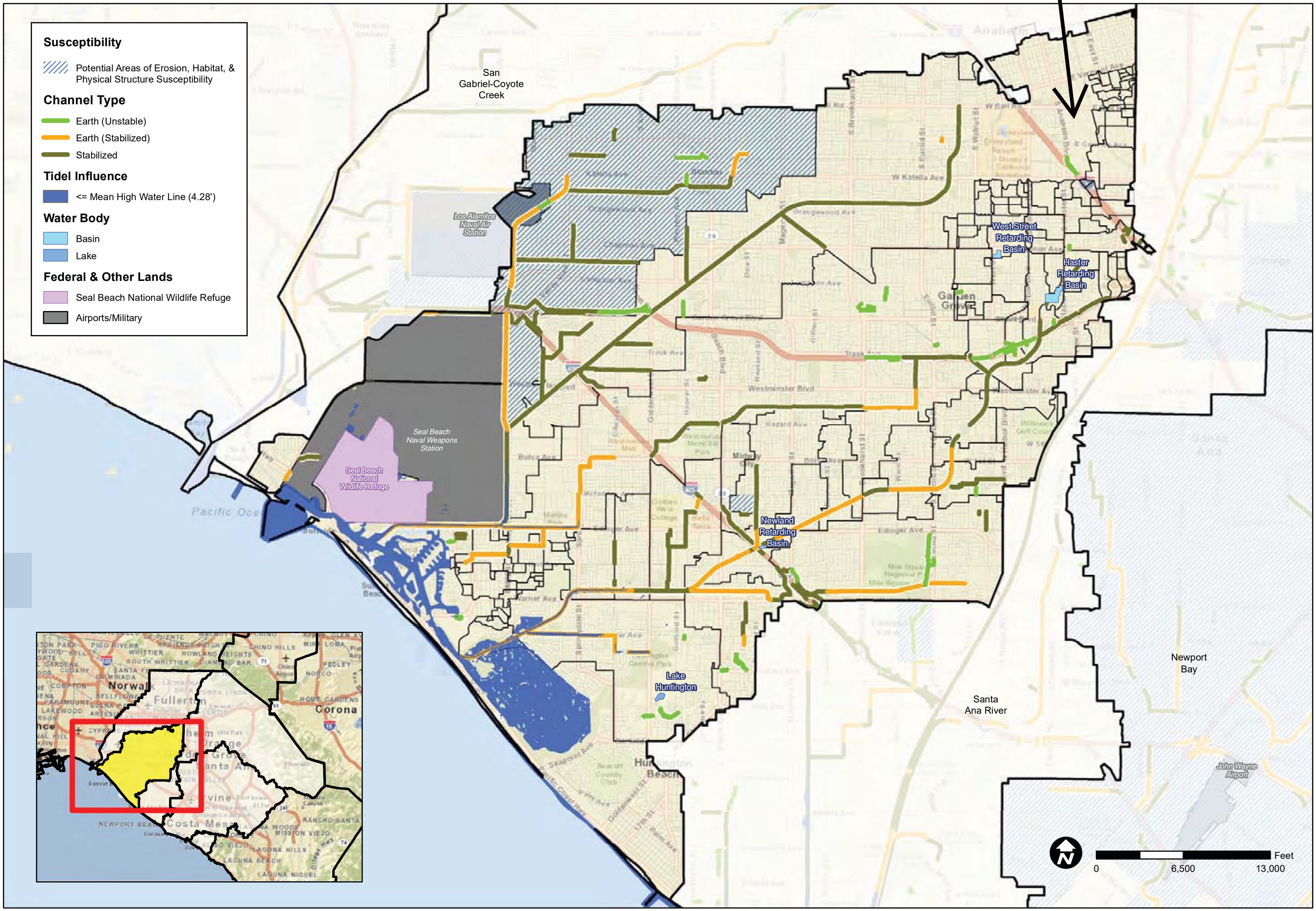
PACE Advanced Water Engineering

FIGURE
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasibility_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

PROJECT LOCATION

SUSCEPTIBILITY MAP UPATE (FEB 2013)



TITLE
SUSCEPTIBILITY ANALYIS
ANAHEIM BAY-
HUNTINGTON HARBOR

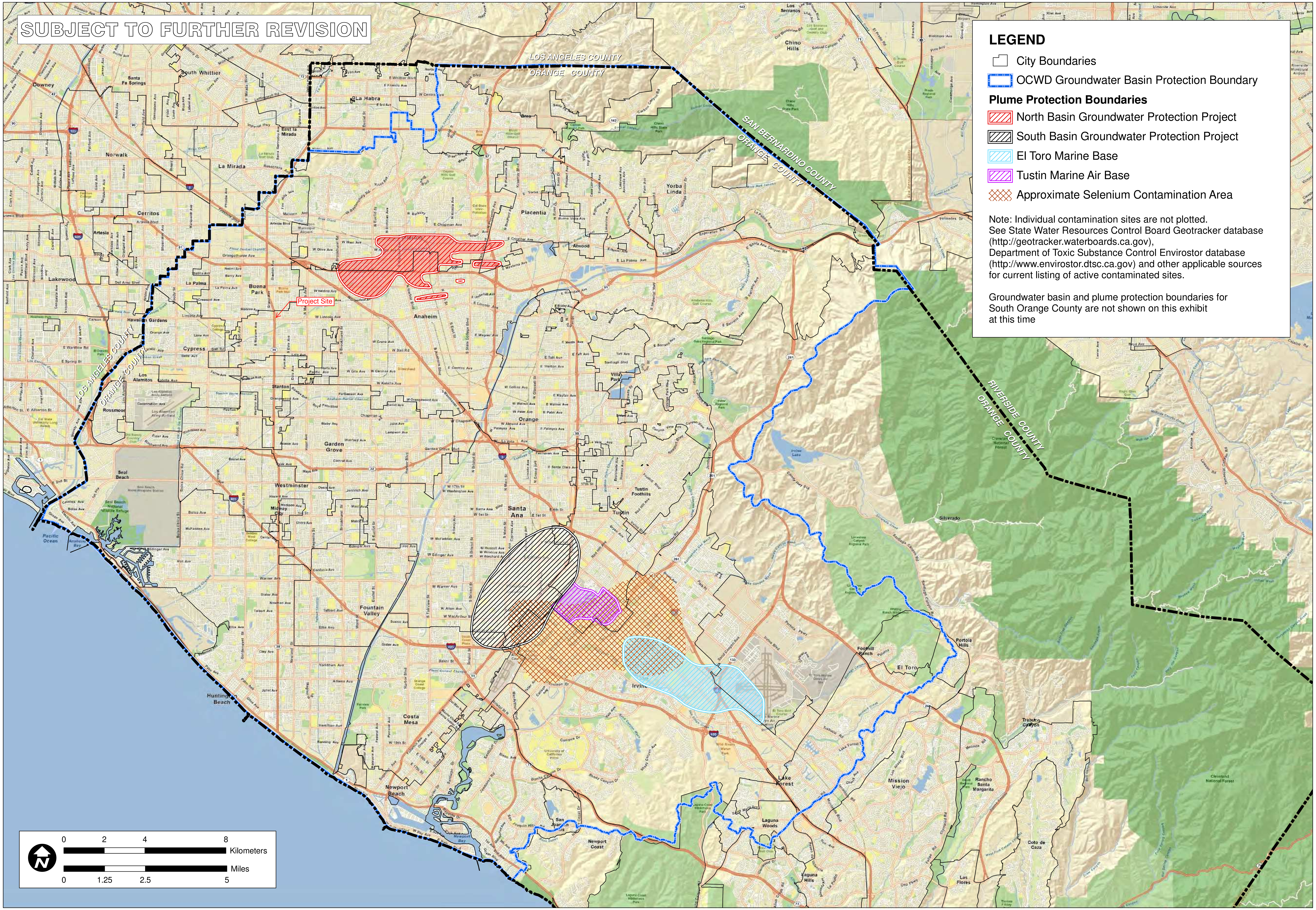
JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO. CA

SCALE	1" = 6500'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
2

P:\9526E\6-GIS\Mxds\Workspace\SusceptibleAnalysis_20100422\9526E_AnaheimBay_20100331.mxd



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TITLE
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2f

Attachment E
Operations & Maintenance

Operations and Maintenance (O&M) Plan

Water Quality Management Plan
For

TR 19140
E. Ball Road & S. Anaheim Blvd.
Anaheim, CA 92805

APN: 126-602-02,-04,-22,-31,-29,-33,-35

<u>Owner/ Developer:</u>
Toffoli Investments, LLC
3 Hughes
Irvine, CA 92618
Contact: Alan Toffoli, Principal
(949) 768-2535

<u>Homeowner's Association:</u>
To be determined

Exhibit A, Operations and Maintenance Plan

BMP Applicable? Yes/ No	BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation and Maintenance Responsibility
Non-Structural Source Control BMPs			
Yes	**N1. Education for Property Owners, Tenants, and Occupants** This will be addressed through educational materials. All included materials provide ways of mitigating stormwater pollution in everyday activities associated with residents as well as employees of the property management company and their sub-contractors. Practical informational materials are provided to residents, occupants, or tenants to increase the public's understanding of stormwater quality, sources of pollutants, and what they can do to reduce pollutants in stormwater.	HOA to provide educational materials, a copy of the approved WQMP and Operation & Maintenance Plan (O&M) to new property owners, tenants, occupants & employees, at time of hire, leasing and/ or home purchase.	HOA
Yes	**N2. Activity Restriction** Rules or guidelines for developments are established within the appropriate documents which prohibit activities that can result in discharges of pollutants.	HOA employees notified of activities that are prohibited by homeowners.	Restrictions identified in Employee Manual and reviewed yearly by employees.
Yes	**N3. Common Area Landscaped Management** Specific practices are followed and ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water, and reduce pesticide and fertilizer applications.	Professional landscape company to conduct maintenance of landscaping to meet current water efficiency and keep plants healthy and bio areas maintained with proper soil amendments. Regular maintenance once a week and monthly inspection to determine deficiencies	The HOA will maintain or hire professionals to manage the upkeep of the project's landscaped areas.
Yes	**N4. BMP Maintenance** In order to ensure adequate and comprehensive BMP implementation, all responsible parties are identified for implementing all non-structural and structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities.	A minimum 2 Inspections/ Cleanings per year per manufacturer's specifications prior to October 1st (before the rainy season)	HOA to hire professional BMP maintenance company to conduct regular inspections, repairs and cleaning per manufacturer's specifications.
No	**N5. Title 22 CCR Compliance** Hazardous waste is managed properly through compliance with applicable Title 22 regulations. Hazardous materials or wastes will be generated, handled, transported, or disposed of in association with the project; measures are taken to comply with applicable local, state, and federal regulation to avoid harm to humans and the environment.		

No	**N7. Spill Contingency Plan**		
No	**N8. Underground Storage Tank Compliance**		
Yes	**N10. Uniform Fire Code Implementation** HOA to comply with fire regulations and keep informed of the latest rules and requirements.	Comply with annual fire inspections and maintain building and access per the latest fire codes.	HOA
Yes	**N11. Common Area Litter Control** The proposed project will have various trash receptacles located near the common areas. Trash management and litter control procedures are specified within this report, including responsible parties, and implemented to reduce pollution of drainage water.	Once per week provide litter removal of site parking lot and landscape areas and to empty common area trash bins.	HOA
Yes	**N12. Employee Training** Practical informational materials and/or training are provided to employees at the initial time of hiring by the HOA to increase their understanding of stormwater quality, sources of pollutants, and their responsibility for reducing pollutants in stormwater.	The distribution of these materials will be the responsibility of the HOA at the initial hiring of the employee.	HOA
No	**N13. Housekeeping of Loading Docks**		
Yes	**N14. Common Area Catch Basin Inspection** In order to ensure adequate and comprehensive BMP implementation, all responsible parties are identified for implementing all non-structural and structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities.	Inspection twice per month of common areas where catch basins are located within the surrounding area and remove any trash/ debris.	HOA
Yes	**N15. Street Sweeping Private Streets and Parking Lots** Regular sweeping is conducted to reduce pollution of drainage water.	City's Street Sweeping Services or approved Private Company on a weekly basis	HOA
No	**N17. Retail Gasoline Outlets**		
Structural Source Control BMPs			
Yes	**Provide Storm Drain System Stenciling and Signage** Catch Basin Stenciling and Signage will be placed on all on-site catch basins to the satisfaction of the City Engineer.	Inspect and repair as needed all onsite storm drain stencilling & signage. Inspection should occur at minimum twice per year.	HOA
No	**Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction**		

No	**Design and Construct Trash and Waste Storage Areas to Reduce Pollutant Introduction (trash enclosures)**		
Yes	**Use Efficient Irrigation Systems and Landscape Design** Site efficient irrigation and landscaping has been implemented by the project's landscape architect to the satisfaction of the City Engineer and Planning Department.	HOA to provide maintenance of landscaping to meet current water efficiency standards, and keep plants healthily. Regular maintenance once a week and monthly inspection to determine any water deficiencies.	The HOA will maintain or hire professionals to manage the upkeep of the project's landscaped areas.
No	**Protect Slopes and Channels and Provide Energy Dissipation**		
No	**Loading Docks**		
No	**Maintenance Bays**		
No	**Vehicle Wash Areas**		
No	**Outdoor Processing Areas**		
No	**Equipment Wash Areas**		
No	**Fueling Areas**		
No	**Hillside Landscaping**		
No	**Wash Water Controls for Food Preparation Area**		
Treatment Control BMPs			
Yes	**Treatment Control BMP #1** **Maxwell Drywell System** See attached for specific BMP detail information pertaining to operation and maintenance.	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's specifications.	HOA will be required to hire a professional maintenance company to provide regular inspection, repairs and cleaning per manufacturer's specifications. All trash/ debris and loose sediment/ silt shall be removed per manufacturer's specifications.
Yes	**Treatment Control BMP #2** **ADS Stormtech Infiltration System** See attached for specific BMP detail information pertaining to operation and maintenance.	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's specifications.	HOA will be required to hire a professional maintenance company to provide regular inspection, repairs and cleaning per manufacturer's specifications. All trash/ debris and loose sediment/ silt shall be removed per manufacturer's specifications.
Yes	**Treatment Control BMP #3** **Modular Wetlands System Biofiltration Vaults w/ Dvert**	Inspections/ Cleanings should occur at least two times per year and before the start of	HOA will be required to hire a professional maintenance

	See attached for specific BMP detail information pertaining to operation and maintenance.	the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's specifications.	company to provide regular inspection, repairs and cleaning per manufacturer's specifications. All trash/ debris and loose sediment/ silt shall be removed per manufacturer's specifications.
Flood Control			
Yes	**ADS Detention Piping** ADS detention piping is provided onsite to mitigate flood control requirements and temporarily detain flows exceeding allowable discharge rate during large storm events. Piping should now allow standing water within system for more than 48 hours.	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Inspect for standing water 48 hours after major storm events.	HOA to inspect detention piping and schedule maintenance/cleanings when deficiencies or sediment buildup/ trash/ debris is observed. HOA to check for standing water following major storm events and contact manufacturer if standing water does not drain within 48 hours.

Required Permits

This section must list any permits required for the implementation, operation, and maintenance of the BMPs. Possible examples are:

- No required permits are needed for the implementation, operation, and maintenance of the previously listed BMPs.

Forms to Record the BMP Implementation, Maintenance, and Inspection

The form that will be used to record the implementation, maintenance, and inspection of the BMPs is attached.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

Notice to Owner:

The property is currently owned by Toffoli Investments, LLC. The Owner will be responsible for the long-term maintenance of the project's storm water facilities and conformance to this WQMP after construction is complete.

The owner is aware of the maintenance responsibilities of the proposed BMPs. A funding mechanism is in place to maintain the BMPs at the frequency stated in the WQMP.

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: ________________________________

Name of Person Performing Activity: ________________________________
(Printed)

Signature: ________________________________

BMP Name (As Shown on O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

Operation & Maintenance Plan - Attachments

- Torrent Resources Service + Maintenance
- ADS Isolator Row O&M Manual
- Modular Wetlands System, Maintenance Guidelines

NOT THE NEW WATER FEATURE YOU HAD IN MIND FOR YOUR PROPERTY?

TORRENT® RESOURCES

Drywells • Storm Drains • Catch Basins • Culverts • Headwalls • Underground Storage Tanks • Jet-Rod
SERVICE + MAINTENANCE

TORRENT RESOURCES STORMWATER SOLUTIONS

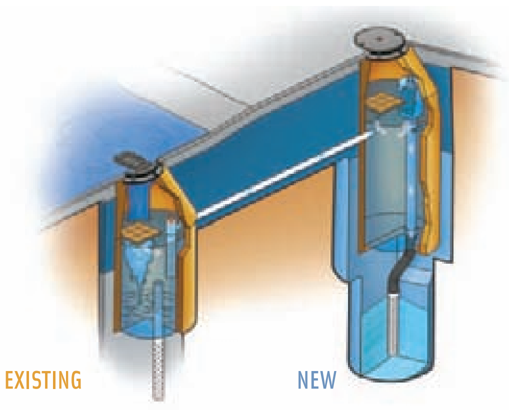
The Need for Maintenance

Like any other part of your infrastructure, drywells and other storm drain components need periodic maintenance to function at optimum levels. Over time, silt, sediment and debris build up in the system and reduce the drainage capability. This leads to water standing for periods of time longer than the state requirement. It also inconveniences customers at retail locations and residential areas. With Arizona leading the nation in cases of West Nile Virus and other diseases carried by mosquitoes, standing water is a particular concern. A lack of maintenance can eventually lead to costly repair to the system as well as the basins and parking lots in which they inhabit.

The Cleaning Process

The process starts with a thorough inspection of the drywells and other storm drain components. If the systems need to be serviced, it is imperative they are cleaned by someone familiar with the interworking of a drywell and compliant with the strict regulations of the ADEQ. The highly qualified Torrent Resources team offers:

• Certified Confined Space Entry • Disposal at an Approved Facility • Top of Line Equipment • Licensed, Bonded and Insured



Drywell Restoration

If your property has a non-functioning drywell, Torrent Resources has a solution. By adding a new drywell to your existing system, we effectively convert the single chamber drywell into a new state-of-the-art MaxWell® Plus system (shown in the illustration to the left).

The existing structure remains to receive water and trap additional debris while directing the treated flow to the new drywell. This retrofit makes the entire system far superior to the original design.

Industry Leader

As the Valley's #1 drywell contractor with over 65,000 systems installed, Torrent Resources has defined drywell design, installation, service and maintenance. Our drainage systems are specified by most Civil Engineers and Municipalities in the Southwest. With the largest, state-of-the-art equipment in the market, experienced construction crews and professional field supervisors, we are your experts when it comes to drainage solutions.

SERVICE AND MAINTENANCE IS ONE EASY CALL OR CLICK AWAY

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1509 E. Elwood Street Phoenix, Arizona 85040
Phone: 602-268-0785 • Fax: 602-268-0820
www.cleanmydrywell.com

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SCHEDULE YOUR FREE INITIAL DRAINAGE SITE REVIEW TODAY.

Isolator® Row
O&M Manual

The Isolator® Row

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) and Total Phosphorus (TP) removal with easy access for inspection and maintenance.

The Isolator Row

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-7200 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row and passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS geotextile fabric is placed between the stone and the Isolator Row chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the chamber's sidewall. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-7200 models as these chambers do not have perforated side walls.

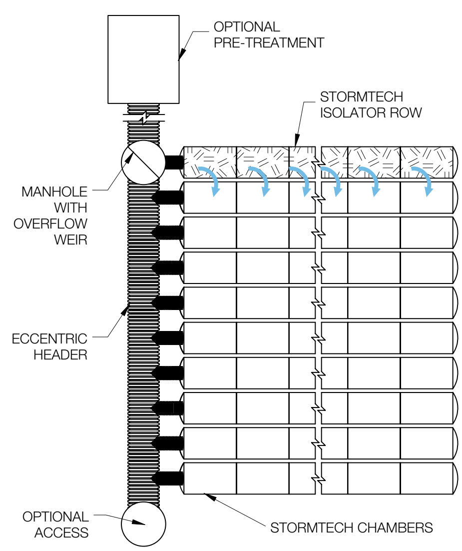
The Isolator Row is designed to capture the "first flush" runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row. After Stormwater flows through the Isolator Row and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row to minimize maintenance requirements and maintenance costs.

Note: *See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.*

Looking down the Isolator Row from the manhole opening, woven geotextile Fabric is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (*not to scale*)



Isolator Row Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the **actual frequency of inspection and maintenance practices.**

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

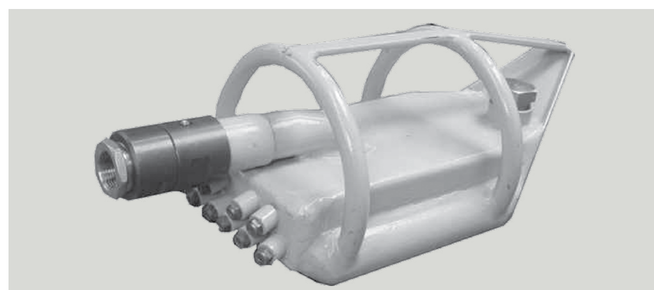
The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

Maintenance

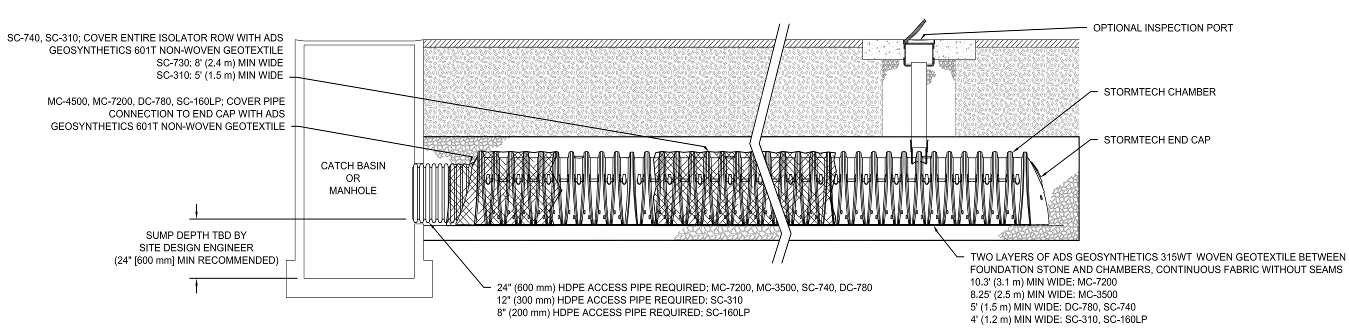
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row lengths up to 200" (61 m). **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**



StormTech Isolator Row (not to scale)

Note: *Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-7200 chamber models and is not required over the entire Isolator Row.*



Isolator Row Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row for sediment.

A) Inspection ports (if present)
   i. Remove lid from floor box frame
   ii. Remove cap from inspection riser
   iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
   iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Row
   i. Remove cover from manhole at upstream end of Isolator Row
   ii. Using a flashlight, inspect down Isolator Row through outlet pipe
      1. Mirrors on poles or cameras may be used to avoid a confined space entry
      2. Follow OSHA regulations for confined space entry if entering manhole
   iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

Step 2

Clean out Isolator Row using the JetVac process.

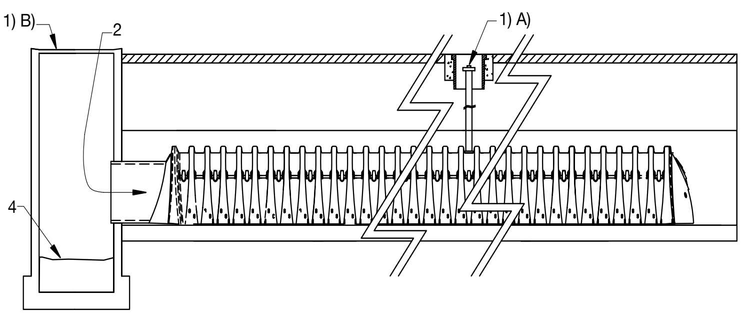
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sedi-ment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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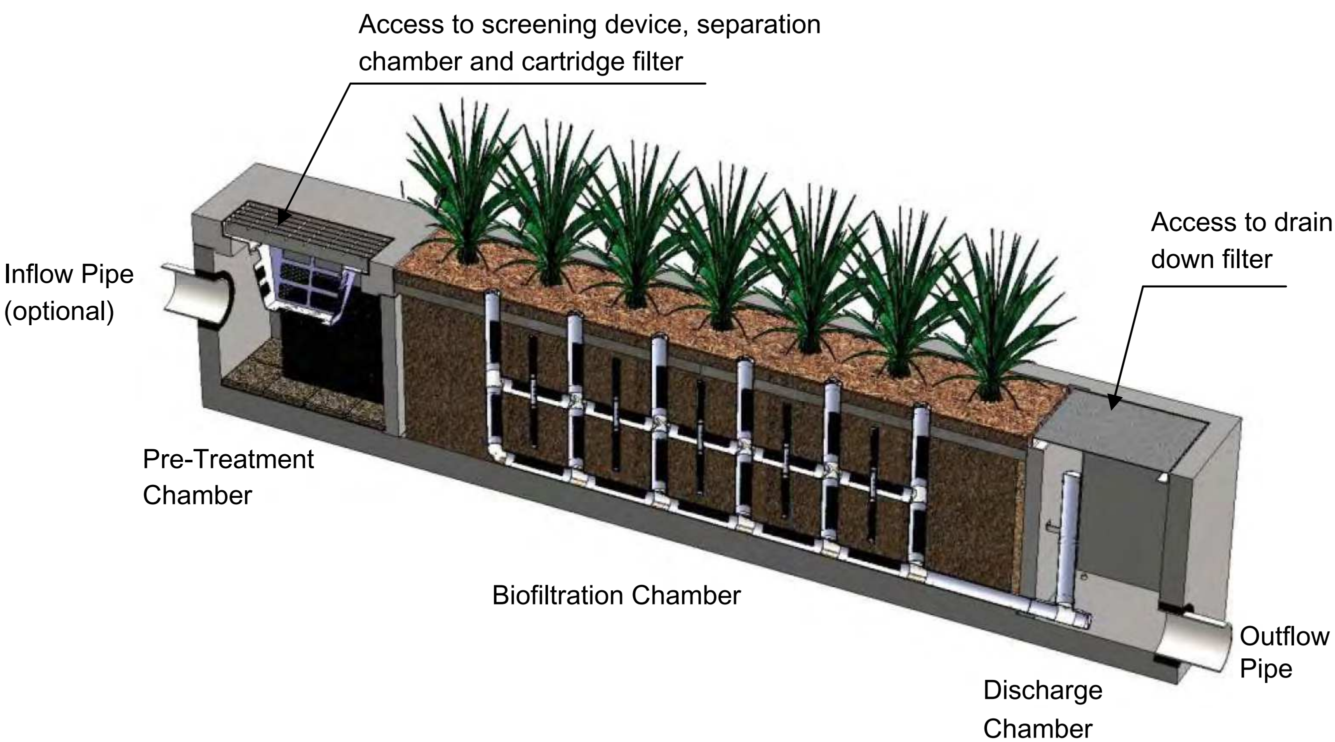
800-821-6710

Maintenance Guidelines for
Modular Wetland System - Linear

Maintenance Summary

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

System Diagram



Maintenance Procedures

Screening Device

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

Separation Chamber

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

Cartridge Filters

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

Drain Down Filter

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

Maintenance Notes

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

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

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

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

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

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

Maintenance Procedure Illustration

Screening Device

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

Separation Chamber

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

Cartridge Filters

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

Drain Down Filter

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

Trim Vegetation

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

Inspection Report
Modular Wetlands System

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________ Phone (   )   –

Inspector Name ______________________ Date ____/____/______ Time __________ AM / PM

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

Weather Condition ______________________ Additional Notes ______________________

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

Inspection Checklist

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

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

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

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ______________________________

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

Cleaning and Maintenance Report
Modular Wetlands System

Project Name ______________________

Project Address ______________________
(city) (Zip Code)

Owner / Management Company ______________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date ____/____/______ Time ____________ AM / PM

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

Weather Condition ______________________ Additional Notes ______________________

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

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

Comments:

Modular Wetland System - Linear (MWS-Linear)

Maintenance Schedule

MWS - LINEAR	Cleaning Required	Est. Cleaning Time
Year 1	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 2	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 3	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 4	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 5	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 6	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 7	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 8	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 9…	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals)	10 Minutes 25 Minutes 45 Minutes
Year 15	1) Clean Inlet Filter (6 Month Intervals) (does not apply to vault type) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media (12 month Intervals) 4) Remove & Replace Wetland Plants & Media (every 10-20 years)	10 Minutes 25 Minutes 45 Minutes 6 to 8 Hours
Procedure 1 **Clean Inlet Filter** (does not apply to vault type) 	Modular Wetland Systems, Inc. recommends the catch basin filter be inspected and cleaned a minimum of once every six months and replacement of hydrocarbon booms once a year. The procedure is easily done with the use of any standard vacuum truck. Before doing maintenance please use proper safety and traffic control. 1) Remove grate or manhole, remove the deflector shield (grate type only). Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training. 2) Remove all trash, debris, organics, and sediments collected by the inlet filter insert either manually or with the use of a vactor truck. 3) Evaluate hydrocarbon boom. If the boom is filled with hydrocarbons and oils it should be replaced. Attach new boom to basket with plastic ties through pre-drilled holes in basket. Place the deflector shield (grate type only) back into the filter. Hydrocarbon boom should be replaced annually. (The hydrocarbon boom may be classified as hazardous material and will have to be picked up and disposed of as hazardous waste).	**10 Minutes**

Procedure 2 **Vacuum Catch Basin** 	Modular Wetland Systems, Inc. recommends the separation chamber be inspected and cleaned a minimum of once a year. The procedure is easily done with the use of any standard vacuum truck. Before doing maintenance please use proper safety and traffic control. 1) Remove grate or manhole. 2) Remove catch basin filter. 3) Spray down pollutants accumulated on cartridge filters and catch basin walls. 4) Vacuum out sediments and debris accumulated on catch basin floor. 5) Replace catch basin filter, and replace grate or manhole cover.	**25 Minutes**
Procedure 3 **Replace BioMedia Green Media Filter**   	Modular Wetland Systems, Inc. recommends the BioMediaGREEN Cartridge Filters be inspected and cleaned a minimum of once a year. The procedure will require prior maintenance of catch basin. Before doing maintenance please use proper safety and traffic control. 1) Remove grate, remove catch basin filter. 2) Perform maintenance activities on catch basin. 3) Enter separation chamber, unscrew the two bolts holding the lid on the cartridge filter. This will expose the 14 pieces of BioMediaGREEN in each cartridge. 4) Evaluate media condition, replace if necessary. If the spaces between the media are filled with sediment and the surface of the media is dark brown or black the media should be replaced. The old media can be removed by hand by pulling the media pieces up out of the cartridge and taking them out of the catch basin. 5) Once all old media is removed, spray down the interior of the cartridge and vacuum out accumulated debris. 6) Use new pieces of BioMediaGREEN and slide down over the perforated PVC risers. The media will only go in one way for easy installation. Replace media over all risers. 5) Replace cartridge filter lid, replace catch basin filter, and replace grate or manhole cover. Modular Wetland Systems, Inc. recommends the drain down filter be inspected and maintained a minimum of once a year. 1) Open hatch of discharge chamber, enter chamber. 2) Unlatch fiberglass cover, remove media block, replace with new block, replace and latch cover. 3) Exit chamber, close and lock down the hatch.	**45 Minutes**
Procedure 4 **Replace Wetland Media** 	Modular Wetland Systems, Inc. recommends the wetland media be evaluated every 3 to 5 years to test flow rate. The media life is approximately 15 to 20 years. The wetland media is an expanded shale that can be ordered from the manufacturer or independent supplier. If the flow through the wetland filter is decreasing the internal inflow and outflow pipes leading to and from the wetland chamber can be jetted. If the flow through the wetland is still minimal then the media may need to be replaced. To replace the media the following steps are required. Before doing maintenance please use proper safety and traffic control. 1) Remove plants and dispose. Have new plants standing ready to plant. 2) Use a larger vacuum truck to remove the media from the wetland chamber. 3) Spray down the chamber walls and remove all sediment and water. 4) Replace with new wetland media and plant plants.	**6 to 8 Hours**

Modular Wetland System (MWS) – LINEAR

Maintenance Cost (per acre)

MWS - LINEAR	Cleaning Required	Yearly Maintenance Cost
Year 1	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 2	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 3	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 4	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 5	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 6	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 7	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 8	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 9	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media	\$80 / each (x2) \$350 / year \$500 / year
Year 10	1) Clean Inlet Filter (6 Month Intervals) 2) Vacuum Catch Basin (12 Month Intervals) 3) Replace BioMedia Green Filter Media 4) Remove & Replace Wetland Plants & Media	\$80 / each (x2) \$350/ year \$500 / year \$2,500
Total 1 - 10	**Total Maintenance Cost Over 10 Years**	**\$11,800**
Average Yearly Cost	**Assumes 10 Year Replacement of Wetland Media.**	**\$1,180 / Year**

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Attachment F
USDA Web Soil Survey & GeoTracker Exhibit

GREENLAW DEVELOPMENT
18301 Von Karmen Ave., Ste 250
Irvine, California 92612

May 4, 2022
Project Number 1-0394

Attention: Mr. Alan Toffoli

Subject: ***SUMMARY OF INFILTRATION TESTING***
1200 S. Anaheim Boulevard
City of Anaheim, California

Reference: See Appendix A

Dear Mr. Toffoli:

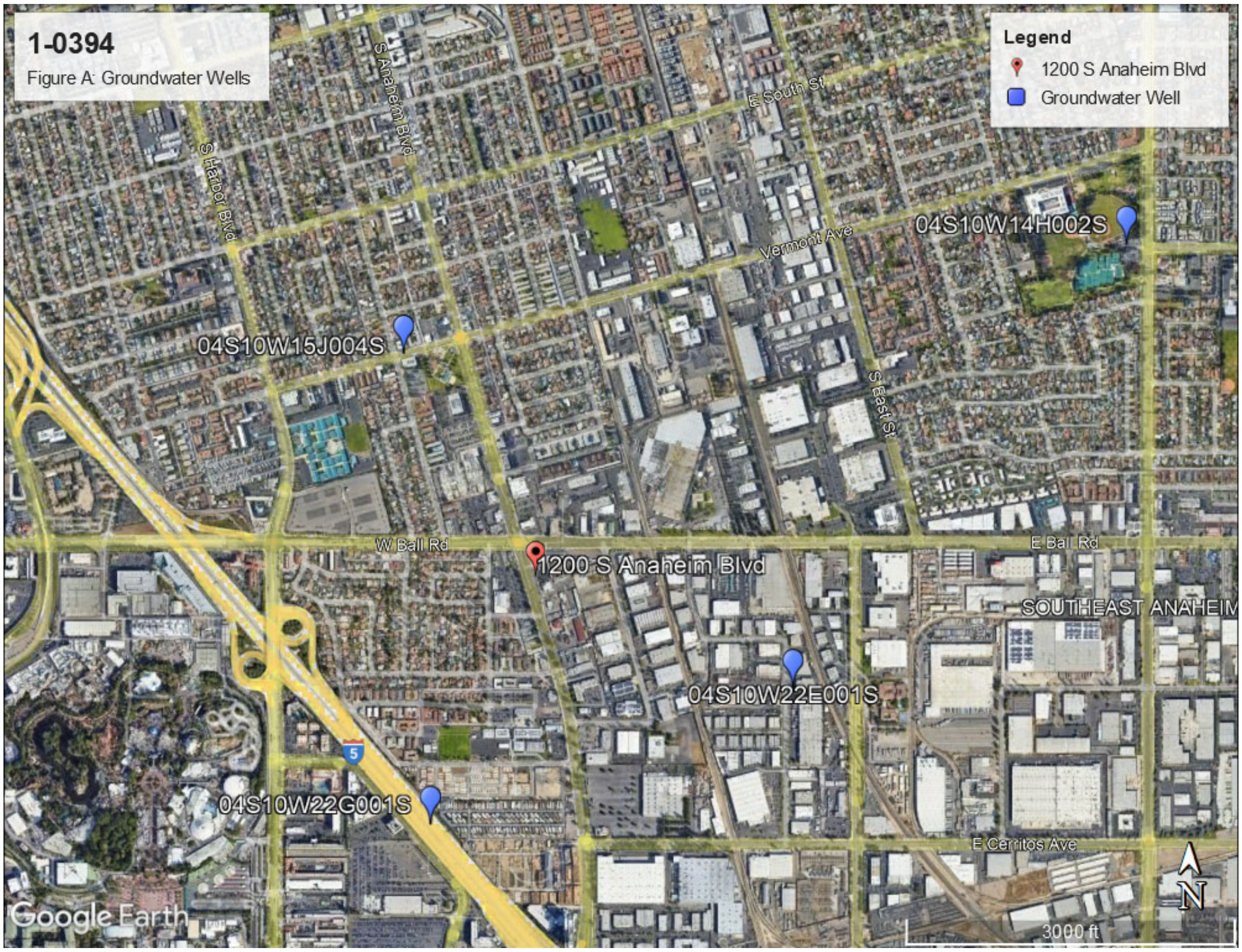
Presented herein is Alta California Geotechnical, Inc.'s (Alta's) summary of infiltration testing for the proposed residential project located at 1200 S. Anaheim Boulevard, in the City of Anaheim, California. The scope of this testing is based on Alta's subsurface investigation and typical WQMP requirements. Presented below is a summary of pertinent groundwater information, our infiltration testing, and conclusions and recommendations based on the data.

Site Geotechnical Conditions

Based on our literature review and subsurface investigation, the site is underlain by undocumented artificial fill and alluvium. Groundwater was not encountered during our subsurface investigation. Based on state-provided information, the historic-high groundwater is greater than 50 feet below the ground surface (CDMG, 1997). Groundwater data from two nearby wells, State Well Numbers: 04S10W22G001S and 04S10W22E001S, at elevations 145-ft and 138-ft, respectively, showed that groundwater was greater than 50 feet below the ground surface in 2010. Our borings conducted as part of our investigation did not encounter groundwater in the upper 50-feet. Per WQMP design requirements, we have reviewed public groundwater information from reasonably close wells with relatively recent data, focusing on readings in recent years. A summary of the data is presented in Table A and locations are shown on Figure A.

Table A
Public Groundwater Information
Pertinent to 1200 S. Anaheim Blvd, Anaheim, CA

State Well Number	Distance to Site (mi)	Ground Elevation	Recent Groundwater Elevations (year)
Site (Boring B-1)	-	150	>100 (2022)
04S10W22G001S	0.4	145	29 (1994)
04S10W22E001S	0.4	138	14 (2010)
04S10W15J004S	0.5	154	49 (2001)
04S10W14H002S	1.2	178	38 (1990)



The wells indicate the groundwater surface throughout the region has been significantly lowered from the historic high. The drawdown is likely attributable to both the pervasive drought in Southern California and the extensive groundwater pumping throughout this heavily urbanized area. The high groundwater elevations in the vicinity range from 14 to 49. Based on a site ground elevation of 150 and a recent high groundwater level of 49, we recommend that a groundwater depth of 101-feet (elevation 49) be utilized in the WQMP design.

Infiltration Testing

Two infiltration tests were recently conducted at locations shown on Plate 1, identified as P-1 and P-2. These tests were conducted in 10 and 15-feet deep borings, excavated with a hollow stem auger drill rig, utilizing percolation test methods in general conformance with the County of Orange Guidance Document for WQMP.

A summary of the test results is presented below in Table B. The results do not include a factor of safety. The data is presented in Appendix C.

Table B – Summary of Infiltration Testing (No Factor of Safety)		
Test Designation	P-1	P-2
Approximate Depth of Test	10 Feet	15 Feet
Final Time Interval	10 minutes	10 minutes
Radius of Test Hole	4 inches	4 inches
Average Head over Time (Havg)	106.8 inches	160.2 inches
Tested Infiltration Rate	2.9 in/hr	2.9 in/hr

Conclusions and Recommendations

Based on our testing, use of infiltration BMP's are feasible at the subject site at the locations tested. The WQMP designer should review the test results and determine if the proposed BMP system is appropriate for the site. A factor of safety should be applied to the results that is in accordance with City of Anaheim requirements.

From a geotechnical perspective, allowing storm water to infiltrate the onsite soil in concentrated areas increases the potential for settlement, liquefaction, and water-related damage to structures/improvements, such as wet slabs or pumping subgrade. Care should be taken in designing systems that control the storm water as much as possible. A methodology for dealing with overflow should the infiltration system become clogged or full should be developed and maintained.

It is recommended that the Project Geotechnical Consultant observe the BMP excavations during construction to verify that the infiltration rates presented herein are appropriate. If it is determined that rates may be variable, additional infiltration testing should be undertaken.

Limitations

The conclusions and recommendations presented in this report are based on our infiltration test results and experience with similar soil conditions on similar projects. Materials adjacent to or beneath those observed may have different characteristics than those observed, and no precise representations are made as to the quality or extent of the materials not observed.

If you have any questions or should you require any additional information, please contact the undersigned at (951) 509-7090. Alta appreciates the opportunity to provide geotechnical consulting services for your project.

Sincerely,
Alta California Geotechnical, Inc.

LOGAN MARQUETTE	SCOTT A. GRAY/RGE 2857
Civil Engineering Associate	Reg. Exp.: 12-31-22
	Registered Geotechnical Engineer
	President

Distribution: (1) Addressee

SAG:DAM 1-0394, May 4, 2022 (Infiltration Testing, 1200 South Anaheim Blvd)

APPENDIX A

REFERENCES

APPENDIX A

References

1. Alta California Geotechnical, Inc., 2021, Geotech Feasibility Report, Ball Ave and Anaheim Boulevard, City of Anaheim, County of Orange, California, dated June 7, 2021 (Project No. 1-0394).
2. California Division of Mines and Geology, 1997, Seismic Hazard Zone Report for the Anaheim and Newport 7.5-Minute Quadrangles, Orange County, California, Report 03.
3. California Department of Water Resources, Water Data Library (WDL) Station Map: https://wdl.water.ca.gov/waterdatalibrary/.

APPENDIX B

Boring Logs

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0394	PROJECT NAME	Anaheim		
DATE STARTED	4/26/22	GROUND ELEV.	147	BORING DESIG.	P-1
DATE FINISHED	4/26/22	GW DEPTH (FT)		LOGGED BY	LM
DRILLER	Martini	DRIVE WT.		NOTE	
TYPE OF DRILL RIG	8" Hollow Stem Auger	DROP			

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
						Asphalt, 4 inches AC/ 2 inches AB.				
	145				SM	**ALLUVIUM** (Qa): SILTY SAND, very fine to fine grained, grey brown. dry.				
5										
	140									
10										
						TOTAL DEPTH: 11.0 FEET. NO GROUNDWATER ENCOUNTERED.				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER
SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0394

PLATE B-13

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0394	PROJECT NAME	Anaheim		
DATE STARTED	4/26/22	GROUND ELEV.	150	BORING DESIG.	P-2
DATE FINISHED	4/26/22	GW DEPTH (FT)		LOGGED BY	LM
DRILLER	Martini	DRIVE WT.		NOTE	
TYPE OF DRILL RIG	8" Hollow Stem Auger	DROP			

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
	150					ASPHALT, 3.5 inches AC/ 1 inch AB				
					SM	**ALLUVIUM** (Qa): SILTY SAND, very fine to fine grained, grey brown, dry.				
5	145									
10	140				SP	@10.0ft.: SAND, fine to medium grained, brownish tan, dry.				
15	135									
						TOTAL DEPTH: 16.0 FEET. NO GROUNDWATER ENCOUNTERED.				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER
SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

APPENDIX C

INFILTRATION TEST DATA

Project Number	1-0394			
Test Designation	P-1	Date of Test	4/27/2022	
Boring Diameter (inches)	8	Test Type	Infiltration	
Time (minutes)	Depth of Boring (ft)	Initial Water Level (ft)	Final Water Level (ft)	Change in Height (ft)
30	10	0.00	4.30	-4.30
30	10	0.00	4.20	-4.20
10	10	0.00	2.30	-2.30
10	10	0.00	2.10	-2.10
10	10	0.00	2.20	-2.20
10	10	0.00	2.20	-2.20
10	10	0.00	2.20	-2.20
10	10	0.00	2.20	-2.20

Final Calculations

Initial Height (I) in inches	120.0		
Final height (F) in inches	93.6		
Change in Height (inches)	26.4		
Change in Time (minutes)	10		
Radius of Hole (inches)	4		
Havg (inches)	106.8	Havg=	(I-F)/2+I inches
Infiltration Rate (inch/hr)	2.91	Inf. Rate=	((I-F)(60min/hr)(Radius))/time(radius+2(Havg))

Plate C-1

Project Number	1-0394			
Test Designation	P-2	Date of Test	4/27/2022	
Boring Diameter (inches)	8	Test Type	Infiltration	

Time (minutes)	Depth of Boring (ft)	Initial Water Level (ft)	Final Water Level (ft)	Change in Height (ft)
30	15	0.00	3.50	-3.50
30	15	0.00	4.60	-4.60
10	15	0.00	3.30	-3.30
10	15	0.00	3.30	-3.30
10	15	0.00	3.30	-3.30
10	15	0.00	3.30	-3.30

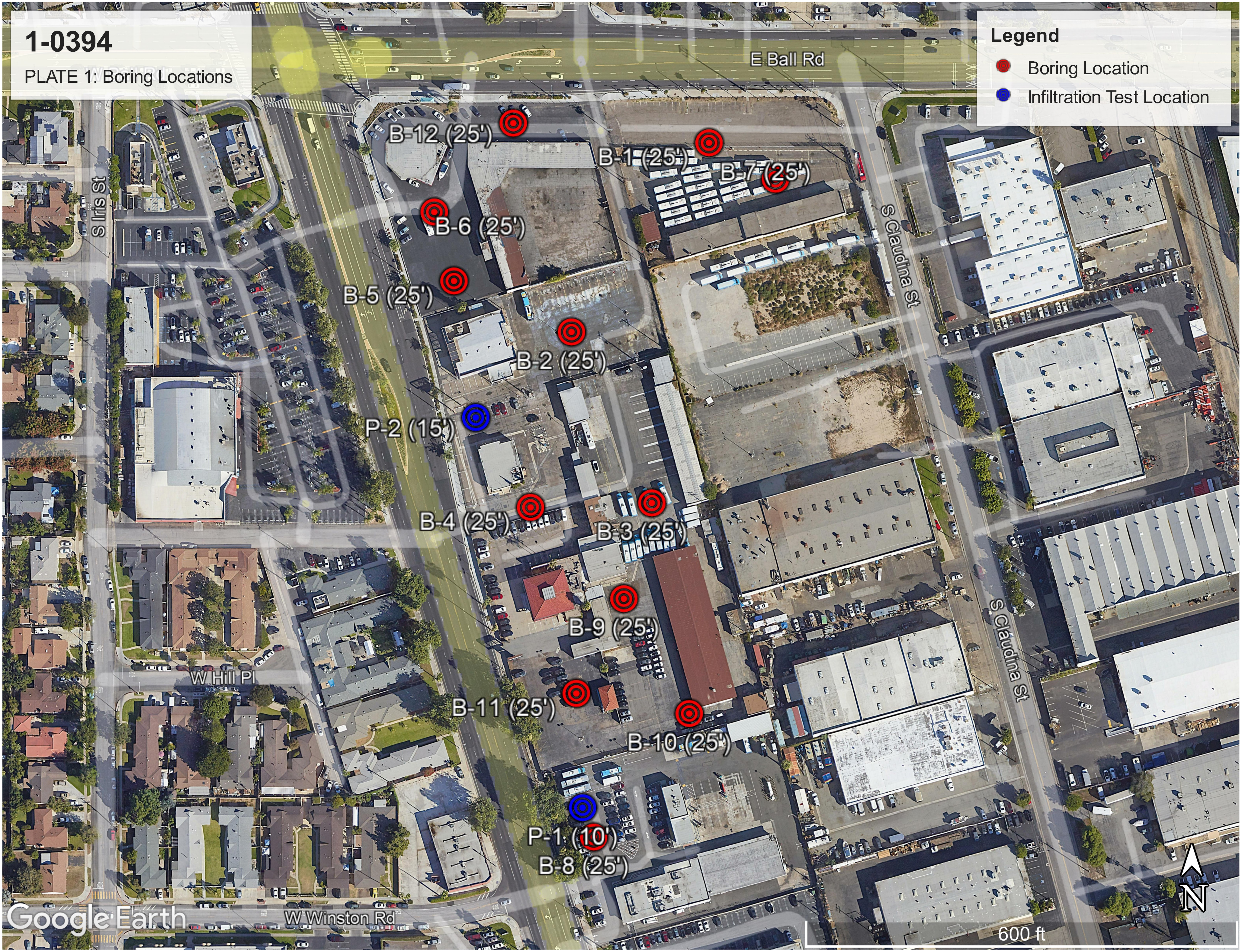
Final Calculations

Initial Height (I) in inches	180.0		
Final height (F) in inches	140.4		
Change in Height (inches)	39.6		
Change in Time (minutes)	10		
Radius of Hole (inches)	4		
Havg (inches)	160.2	Havg=	(I-F)/2+I inches
Infiltration Rate (inch/hr)	2.93	Inf. Rate=	((I-F)(60min/hr)(Radius))/time(radius+2(Havg))

Plate C-2

1-0394

PLATE 1: Boring Locations



United States Department of Agriculture

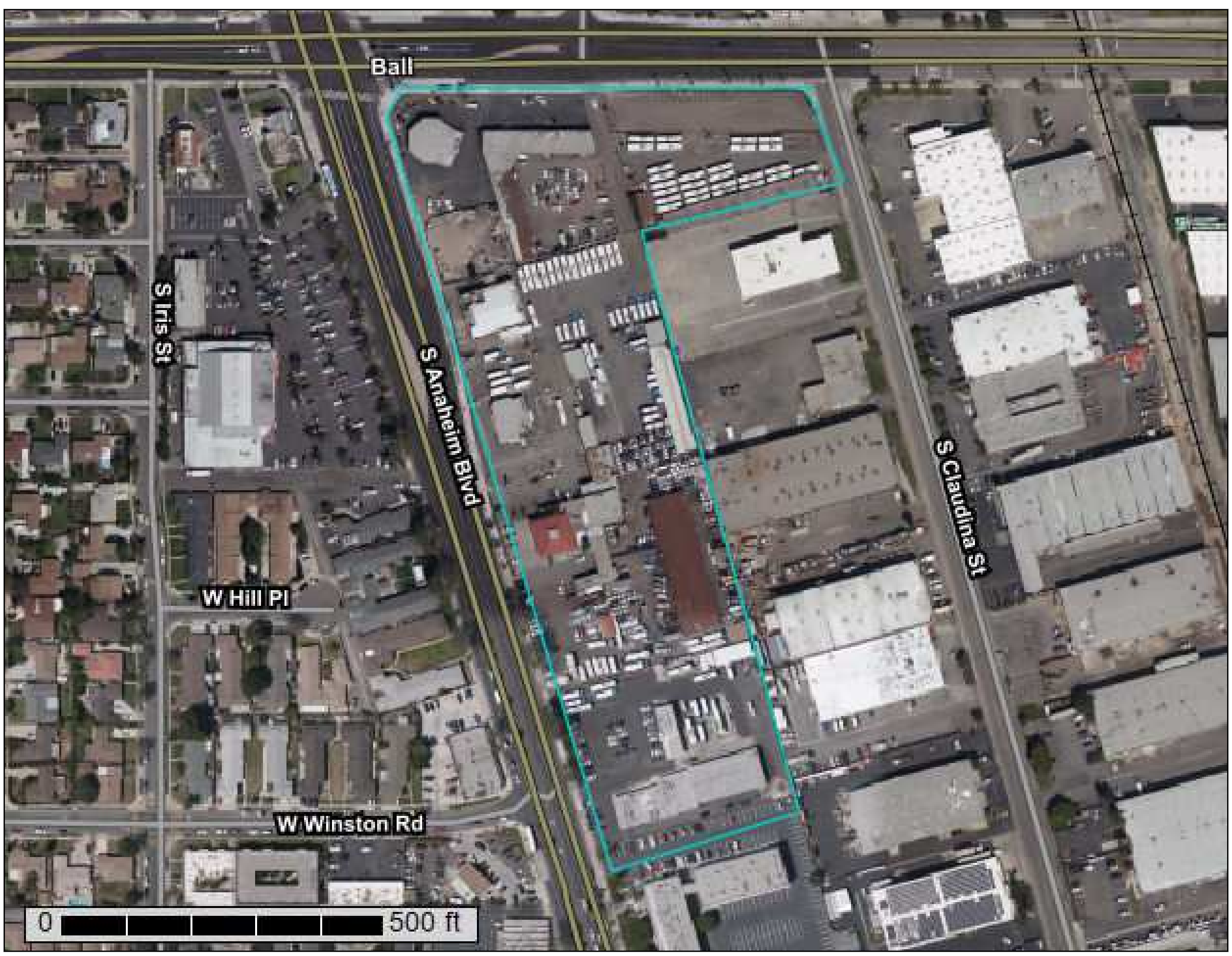
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Orange County and Part of Riverside County, California



March 31, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,160 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 14, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 13, 2018—Mar 30, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
163	Metz loamy sand	0.1	0.6%
164	Metz loamy sand, moderately fine substratum	10.2	99.4%
Totals for Area of Interest		**10.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Orange County and Part of Riverside County, California

163—Metz loamy sand

Map Unit Setting

National map unit symbol: hcn8
Elevation: 30 to 2,500 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed

Typical profile

H1 - 0 to 17 inches: loamy sand
H2 - 17 to 63 inches: stratified sand to fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R019XD035CA
Hydric soil rating: No

Minor Components

San emigdio, fine sandy loam

Percent of map unit: 4 percent

Hydric soil rating: No

Hueneme, fine sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 4 percent
Landform: Fans
Hydric soil rating: Yes

Corralitos, loamy sand

Percent of map unit: 4 percent
Hydric soil rating: No

Metz, mod fine substratum

Percent of map unit: 4 percent
Hydric soil rating: No

164—Metz loamy sand, moderately fine substratum

Map Unit Setting

National map unit symbol: hcn9
Elevation: 0 to 600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 63 to 65 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

A - 0 to 17 inches: loamy sand
C1 - 17 to 40 inches: stratified sand to sandy clay loam
C2 - 40 to 46 inches: silty clay loam
C3 - 46 to 60 inches: stratified sand to sandy clay loam

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R019XD035CA
Hydric soil rating: No

Minor Components

Metz, loamy sand

Percent of map unit: 10 percent
Landform: Alluvial fans, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hueneme, fine sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

San emigdio

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Corralitos, loamy sand

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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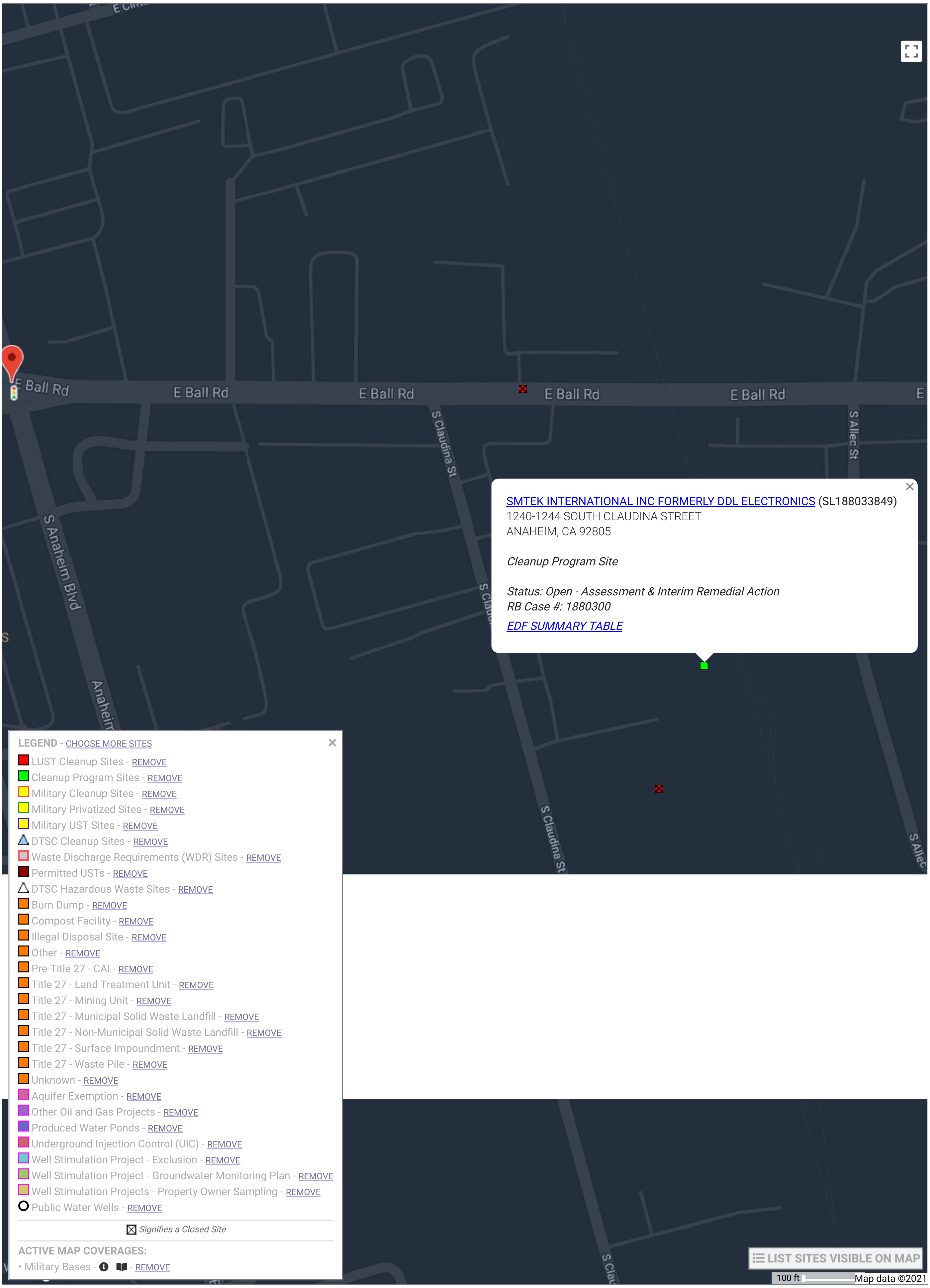

[SMTEK INTERNATIONAL INC FORMERLY DDL ELECTRONICS](SL188033849) (SL188033849)
1240-1244 SOUTH CLAUDINA STREET
ANAHEIM, CA 92805

Cleanup Program Site

Status: Open - Assessment & Interim Remedial Action
RB Case #: 1880300
EDF SUMMARY TABLE

LEGEND - CHOOSE MORE SITES

- LUST Cleanup Sites - REMOVE
- Cleanup Program Sites - REMOVE
- Military Cleanup Sites - REMOVE
- Military Privatized Sites - REMOVE
- Military UST Sites - REMOVE
- DTSC Cleanup Sites - REMOVE
- Waste Discharge Requirements (WDR) Sites - REMOVE
- Permitted USTs - REMOVE
- DTSC Hazardous Waste Sites - REMOVE
- Burn Dump - REMOVE
- Compost Facility - REMOVE
- Illegal Disposal Site - REMOVE
- Other - REMOVE
- Pre-Title 27 - CAI - REMOVE
- Title 27 - Land Treatment Unit - REMOVE
- Title 27 - Mining Unit - REMOVE
- Title 27 - Municipal Solid Waste Landfill - REMOVE
- Title 27 - Non-Municipal Solid Waste Landfill - REMOVE
- Title 27 - Surface Impoundment - REMOVE
- Title 27 - Waste Pile - REMOVE
- Unknown - REMOVE
- Aquifer Exemption - REMOVE
- Other Oil and Gas Projects - REMOVE
- Produced Water Ponds - REMOVE
- Underground Injection Control (UIC) - REMOVE
- Well Stimulation Project - Exclusion - REMOVE
- Well Stimulation Project - Groundwater Monitoring Plan - REMOVE
- Well Stimulation Projects - Property Owner Sampling - REMOVE
- Public Water Wells - REMOVE

Signifies a Closed Site

ACTIVE MAP COVERAGES:
• Military Bases - REMOVE

LIST SITES VISIBLE ON MAP

100 ft Map data ©2021

Sites Shown on Map: 12 Total Sites 2 Open Sites 9 Closed Sites 2 Sites w/Water Quality Data

Attachment G
Notice of Transfer

Water Quality Management Plan
Notice of Transfer of Responsibility

Submission of this Notice of Transfer of Responsibility constitutes notice to the City of Anaheim that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/ her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Previous Responsibility Party Information

Company/ Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

II. Information about Site Transferred

Name of Project	
Title of WQMP Applicable to Site:	
Street Address of Site	
Tract Number(s) for Site	Lot Numbers
Date WQMP Prepared (or Revised)	

III. New Owner/ New Responsible Party Information

Company/ Individual Name		Contact Person	
Street Address		Title	
City	State	Zip	Phone

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner	General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any)
Lot/ Tract Number(s) of Site Transferred to New Owner	
Remaining Lot/ Tract Number(s) to WQMP still held by Owner (if any)	
Date of Ownership Transfer	

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/ parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of the project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by the Previous Owner. Those portions retained by the Previous Owner shall be labeled "Previous Owner," and those portions previously transferred by the Previous Owner shall be labeled as "Previously Transferred."

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Owner is now the Responsible Party of record for the WQMP for this portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the New Owner.

Print Name of Previous Owner Representative	Title
Signature of Previous Owner Representative	Date

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

Print Name of New Owner Representative	Title
Signature of New Owner Representative	Date

Attachment H
Final Conditions of Approval

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F2: Hydrology/Drainage Study

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PRELIMINARY HYDROLOGY AND DRAINAGE STUDY E. BALL ROAD & S. ANAHEIM BOULEVARD ANAHEIM, CA TTM 19140 OTH 2021-01375

Project Address:

1200 S. Anaheim Boulevard
Anaheim, CA 92805

Prepared For:

Toffoli Investments, LLC.
3 Hughes
Irvine, CA 92618
Alan Toffoli
(949) 768-2535

Prepared By:

C&V Consulting Inc.
9830 Irvine Center Drive
Irvine, CA 92618
Dane McDougall, P.E.
(949) 916-3800

DEPARTMENT OF PUBLIC WORKS
DEVELOPMENT SERVICES
APPROVED
Cesar Morales, Associate Engineer
6/27/2022, 8:56:27 AM
ANAH-OTH2021-01375
Cesar Morales

Prepared: March 2022
Revised: June 2022

TABLE OF CONTENTS

Preliminary Hydrology and Drainage Study
for
E. Ball Road & S. Anaheim Boulevard
Anaheim, CA, 92805

ACKNOWLEDGEMENT AND SIGNATURE PAGE

This Preliminary Hydrology and Drainage Study was prepared by C&V Consulting, Inc. under the supervision of Dane McDougall, P.E.

Dane McDougall, R.C.E. 80705
President, C&V Consulting, Inc.

6/2/2022
Date

1.0 SITE DESCRIPTION

The proposed development encompasses nine (9) parcels consisting of 10.68 gross acres and 10.13 net acres as shown on the ALTA prepared by C&V Consulting, Inc. The site is "L" in shape and is located at the southeast corner of E. Ball Road & S. Anaheim Boulevard, in the City of Anaheim, County of Orange. The site is bound by E. Ball Road to the north, S. Anaheim Boulevard to the west, & S. Claudina Street to the east and existing vacant and occupied commercial developments to the south and east.

2.0 EXISTING CONDITIONS

The existing site consists of various vacant and occupied commercial buildings and parking lots serving auto repair/rental shops, an Anaheim Resort Transportation Facility, and storage containers. The existing area was determined to be nearly 100% impervious based on the ALTA/Topographic Survey prepared by C&V Consulting, Inc. dated July 2019.

The existing drainage pattern of the site consists of five drainage area labeled X1 through X5 on the Pre-Existing condition hydrology map located in Appendix A. All site drainage either enters E. Ball Rd. or S. Anaheim Blvd.

The northeasterly portion of the site (Area X1) generally sheet flows to E. Ball Road, traveling via onsite ribbon gutter and discharging through an existing parkway culvert. Once stormwater enters E. Ball Rd it flows in a westerly direction in E. Ball Rd. until it is intercepted by a curb inlet catch basin located on the south side of E. Ball Rd. at the intersection of Technology Cir. and Ball Rd. This catch basin is connected to an existing 51" City of Anaheim RCP. Flows are then directed through the Anaheim Barber City Channel, ultimately converging to the Bolsa Chica Channel discharging into Huntington Harbor.

The remaining portions of the site (Areas X2, X3, X4, and X5) all discharge into different location along S. Anaheim Blvd. The northwesterly portion of the site (Area X2) generally sheet flows over the existing parking lot and enters S. Anaheim Blvd. at this portion of the site's driveway entrance on S. Anaheim Blvd. There are no existing drainage facilities in the portion of the site. Once flows from Area X2 enter S Anaheim Blvd. they are intercepted by an existing curb inlet catch basin located approximately 200' south of the intersection of E. Ball Rd. and S Anaheim Blvd. Area X3, sheet flows over the vacant parking lot in northerly direction until it reaches an existing ribbon in Area X4. Once flows enter the ribbon gutter in Area X4, they are conveyed in westerly direction until they sheet flow over the existing driveway in this portion of the site. Once stormwater from Areas X3 and X4 enter S. Anaheim Blvd. they flow in a southerly direction until they are intercepted by an existing catch basin located approximately 750' south of the intersection of E. Ball Rd. and S Anaheim Blvd. The southerly section of the site (Area X5) sheet flows over the existing asphalt pavement in a westerly direction until it ultimately enters S Anaheim Blvd. over the driveway entrance at this portion of the site. Once in S Anaheim Blvd. it flows in a southerly direction until it is intercepted by a catch basin at the intersection of E Palais Rd. and S Anaheim Blvd. south of the project site.

All runoff entering S. Anaheim Boulevard right of way flows in the southerly direction and is captured by existing City of Anaheim catch basins. These catch basins are connected to an existing 36" City of Anaheim RCP that flows in a southerly direction until it converges with an existing 96" City of Anaheim RCP draining in the westerly direction along Katella Ave. Flows are then directed through the Anaheim Barber City Channel, ultimately converging to the Bolsa Chica Channel discharging into Huntington Harbor.

The Orange County Flood Control District (OCFCD) Drainage Facilities Maps were utilized to verify the drainage pattern of site runoff and tributary offsite run-on. The topographic survey was utilized to identify existing onsite high points and overall site conveyance of storm water runoff. Refer to Appendix D for OCFCD drainage maps.

Per the City of Anaheim, Master Plan of Storm Drainage for Anaheim Barber City Channel Tributary Area, June 2009, the project site is located within Drainage Basin 22. Drainage Basin 22 has a tributary drainage area of approximately 940 acres consisting of one drainage area.

Refer to the "Existing Conditions Hydrology Map" located within Appendix A of this study for additional information.

3.0 PURPOSE OF STUDY

This preliminary hydrology and drainage study will estimate the amount of stormwater runoff tributary to E. Ball Road & S. Anaheim Boulevard, generated by the project site in the existing and proposed conditions. This study will determine whether detention or other peak flow mitigation methods will be required by comparing the proposed and existing condition peak flow rates for the 10-, 25-, and 100-year storm events.

4.0 PROPOSED CONDITIONS

The proposed development consists of one (1) lot subdivision at approximately 10.13 net acres and will consist of 248 residential townhomes and flats and a retail space. The proposed development includes drive aisles, parking, landscaping, walkways, patios, and common open space areas. The site will be accessible via four (4) proposed driveway entrances/exits along E. Ball Road & S. Anaheim Boulevard. During preliminary engineering the proposed impervious and pervious area calculations were estimated using the AES 2014 land use type: Condominiums was utilized to represent the anticipated pervious coverage of the proposed site. During final engineering all impervious areas will be calculated in more detail to refine all peak flow rates.

The proposed site will be graded to convey stormwater as surface flow towards proposed curb-inlet catch basins, located at relative low points on-site. The site will mirror the existing drainage pattern as closely as possible, with a portion draining into E. Ball Rd. and a portion draining into S. Anaheim Blvd. The curb inlet type Modular Wetland Systems (MWS) will pre-treat low flows for quality treatment and allow larger storm events to bypass the MWS and enter the detention and infiltration treatment system. Flows from the northeastern portion of the site be directed to one low point along E. Ball Road and another along S Claudina St. The curb inlet MWS along Claudina St. driveway entrance will convey flows via storm drain pipe to a drywell system located at the E. Ball Rd. driveway entrance. At this point flows from the E. Ball Rd. curb inlet MWS will confluence at the drywell system. Flows will mitigated out of the site via a proposed parkway culvert into E Ball Rd. once the underground detention and infiltration system is at full capacity and flows from this portion enter E. Ball Rd., they will follow the historic drainage pattern.

Similarly, the western portion of site will convey flows in a westerly direction to eight (8) curb inlet MWS located at the end of drive aisles adjacent to S Anaheim Blvd. All eight of these MWS will be connected via storm drain pipe to an underground detention and infiltration trench located at the southerly driveway entrance into S Anaheim Blvd. Like the northeastern portion of the site flows will then be mitigated out of the site via a proposed parkway culvert into S. Anaheim Blvd. Once flows enter E. Ball Rd. they will follow the historic drainage pattern.

In the event the storm drain system becomes clogged or overwhelmed by extraordinary storm events, emergency overflow will be directed as sheet flow towards E. Ball Road & S. Anaheim Boulevard and overflow into the right-of-way via each proposed driveway entrance.

According to the Federal Emergency Management Agency (FEMA), FIRM rate map Number 06059C0134J, revised December 3, 2009, the site is located within the flood zone as follows: Zone X – *"0.2% Annual Chance Flood Hazard"*

For preliminary hydrologic purposes, subareas that created a major confluence was analyzed and all remaining subareas were analyzed as Addition to Subarea to calculate the preliminary proposed conditions peak flow rate and time of concentration. This yields a more conservative outcome and will be verified during final engineering.

Refer to “Proposed Conditions Preliminary Hydrology Map” in Appendix A within this study for additional information.

5.0 METHODOLOGY

The site was analyzed using the Orange County Hydrology Manual, Local Drainage Manual and Advanced Engineering Solutions (AES) 2014 hydrology software. The initial subarea was analyzed for acreage, land use, soil type, peak flow rate and time of concentration according to the Rational Method. The site was graded to allow for low points throughout the site to direct stormwater runoff to several sump areas equipped with curb inlet catch basins.

A combination of Initial Subareas and Addition to Subareas was utilized in AES to analyze the proposed storm drain system. In the proposed condition, there are two primary storm drain main lines which confluence just before the discharge location. For each storm drain main line, the most upstream catch basin was analyzed as an Initial Subarea. At each downstream junction which accepts additional flows, the tributary catch basin was analyzed as an Addition to Subarea. This yielded a total flow that enters either E. Ball Rd. or S. Anaheim St.

The percentage impervious was calculated for the existing condition based on aerial topography and the proposed condition was assumed based on proposed land type. Then, based on the assumed or calculated impervious fraction a corresponding land use available in AES was selected. In accordance with the Orange County Hydrology Manual all habitable structures must have a finished floor elevation to allow one 1’ of freeboard during the 100-year storm event and the curb opening catch basin and onsite conveyance storm drain pipes will be sized to convey runoff from the 50-year storm event.

6.0 RESULTS

Pre-Developed Hydrology Summary				
Area ID	**Total Area (AC)**	**Q10 (CFS)**	**Q25 (CFS)**	**Q100 (CFS)**
X1	1.41	3.54	4.24	5.42
X2	1.98	6.24	7.44	9.54
X3	0.81	2.19	2.62	3.35
X4	4.11	10.98	13.14	16.86
X5	1.82	4.83	5.77	7.39
Site Total	**10.13**	**27.78**	**33.21**	**42.56**

Post-Developed Hydrology Summary				
Area ID	**Total Area (AC)**	**Q10 (CFS)**	**Q25 (CFS)**	**Q100 (CFS)**
A1	0.14	0.5	0.59	0.77
A2	1.51	3.94	4.77	6.26
A3	2.62	5.51	6.64	8.53
A4	1.23	2.54	3.06	3.94
A5	0.24	0.49	0.59	0.76
A6	0.24	0.49	0.59	0.76
A7	1.51	3.02	3.65	4.70
A8	0.24	0.47	0.57	0.73
A9	0.28	0.54	0.65	0.84
A10	0.23	0.44	0.53	0.69
A11	1.89	3.58	4.34	5.60
Site Total	**10.13**	**21.52**	**25.98**	**33.58**

Summary of Flow Rates			
Storm Event	**Existing Conditions**	**Proposed Conditions**	**% Decrease**
	Peak Flow Rate (CFS)		
10-Year	27.78	21.52	22.5%
25-Year	33.21	25.98	21.8%
100-Year	42.56	33.58	21.1%

Catch Basin Sizing
Catch basin sizing is based on the 25-year storm event. Catch basin sizing is provided in Appendix D of this report.

Pipe Sizing
Pipe Sizing will be analyzed using WSPG software to verify hydraulic grade line (HGL) based on the 100-year storm event peak flow rates and will be provided during final engineering for proposed onsite conveyance pipe

100-Year Water Surface Elevations
Water surface elevation calculations for the 100-year storm event peak flow rates will verify that the proposed finish floor elevations are set at least 1' above the water surface elevation. Calculations for 100-year water surface elevations will be provided during final engineering.

7.0 CONCLUSION

The results from this hydrology and hydraulic study utilizing methods provided by Orange County demonstrate that the proposed condition stormwater peak flows from the subject site will be lower than the existing condition stormwater peak flows as indicated in the Summary Table in Section 6 of this report for different year storm events. This is mainly due to the increase of pervious surface in the proposed development and elongation of the flow path in the proposed condition. The additional detention and infiltration per water quality requirement will further reduce stormwater runoffs tributary to the downstream system. During final engineering, impervious area for proposed conditions will be calculated in more detail based on the finalized landscape plan. The proposed peak flow rates will be re-evaluated to reflect the actual proposed conditions. However, the proposed development is likely to generate lower peak flows. Since the peak flow runoff from the proposed conditions is less than that of the existing conditions, additional onsite detention is not required per hydrologic requirement.

Stormwater generated from small rainfalls, or first flush of heavy rainfalls will be treated onsite via proposed onsite curb inlet MWS Biofiltration Vaults prior to be infiltrating or discharging to either S. Anaheim St. or E. Ball Rd. Refer to the separately prepared preliminary WQMP report for more details about water quality management.

The preliminary grading and drainage for the site has been designed to limit the diversion of existing flow patterns and maintain the overflow pathways to the extent feasible for the developed site conditions while also satisfying requirements established by governing agencies. The proposed storm drain outfall points are the same as the existing condition to maintain the historic drainage pattern.

8.0 DESIGN ASSUMPTIONS

1. The property is in the City of Anaheim, Orange County rainfall region.

2. 100-year storm event flood level protection analysis required for habitable structures per the requirements of the Orange County Flood Control District Design Manual.

3. Site located within Hydrologic Soil Type “B” per the Orange County Public Works (OCPW) Technical Guidance Document (TGD) NRCS Hydrologic Soil Groups map.

4. Assumed Commercial land use for the existing conditions and Condominiums land use for proposed condition based on land use references within Advanced Engineering Software (AES) 2014.

5. Peak flow rates and time of concentrations were calculated based on the Rational Method utilizing the AES 2014 software.

9.0 REFERENCES

1. Orange County Hydrology Manual 1986 (1996 Addendum)

2. City of Anaheim Master Plan of Storm Drainage for Anaheim-Barber City Channel Tributary Area

3. Orange County Flood Control District Design Manual 2000

4. Orange County Drainage Facilities Map Nos. 14 & 21

APPENDIX A
HYDROLOGY MAPS

Existing Conditions Hydrology Map

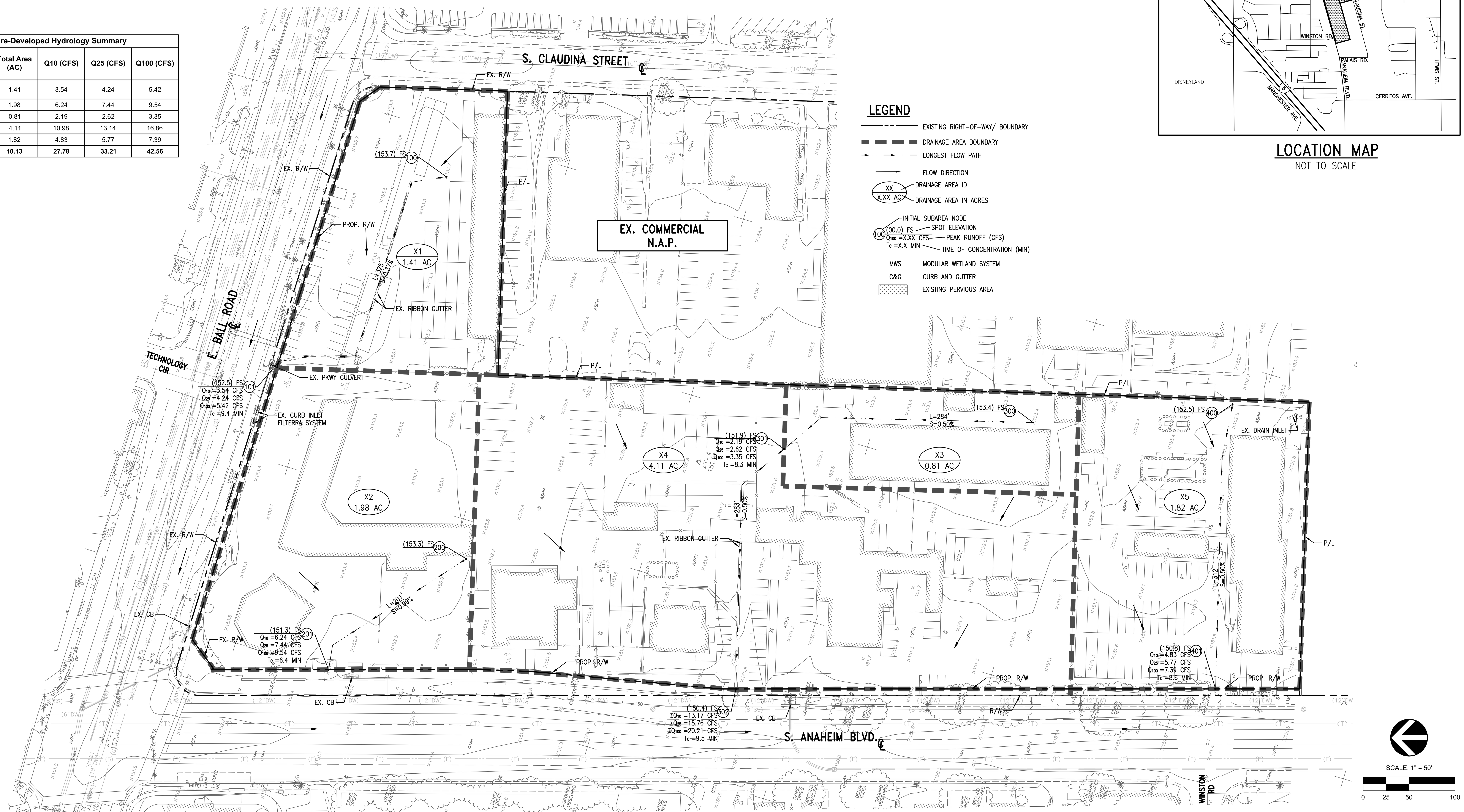
EXISTING CONDITIONS HYDROLOGY MAP

E. BALL ROAD & S. ANAHEIM BLVD.

TTM 19140

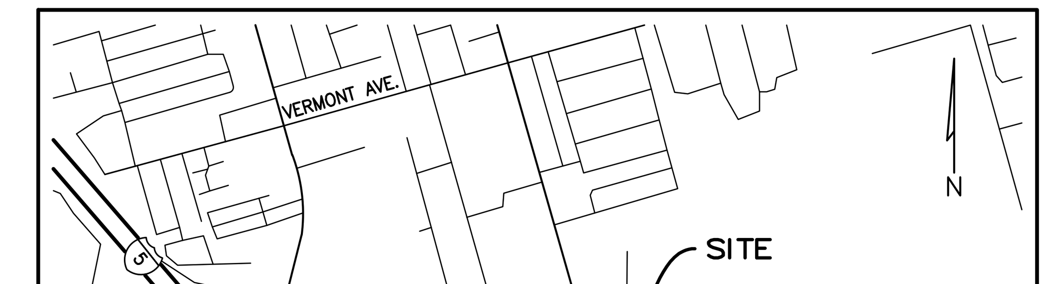
Pre-Developed Hydrology Summary

Area ID	Total Area (AC)	Q10 (CFS)	Q25 (CFS)	Q100 (CFS)
X1	1.41	3.54	4.24	5.42
X2	1.98	6.24	7.44	9.54
X3	0.81	2.19	2.62	3.35
X4	4.11	10.98	13.14	16.86
X5	1.82	4.83	5.77	7.39
Site Total	10.13	27.78	33.21	42.56



LEGEND

- EXISTING RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE AREA BOUNDARY
- LONGEST FLOW PATH
- FLOW DIRECTION
- XX — DRAINAGE AREA ID
- X.XX AC — DRAINAGE AREA IN ACRES
- 100 — INITIAL SUBAREA NODE
- (00.0) FS — SPOT ELEVATION
- Q100 =X.XX CFS — PEAK RUNOFF (CFS)
- Tc =X.X MIN — TIME OF CONCENTRATION (MIN)
- MWS — MODULAR WETLAND SYSTEM
- C&G — CURB AND GUTTER
- EXISTING PERVIOUS AREA



LOCATION MAP

NOT TO SCALE

DEVELOPER :	REVISIONS				
NO.	DATE	INITIAL	DESCRIPTION	APP	DATE

PREPARED FOR:

TOFFOLI INVESTMENTS, LLC
3 HUGHES, IRVINE, CALIFORNIA 92618

PREPARED BY:

C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING
9830 IRVINE CENTER DRIVE
IRVINE, CALIFORNIA 92618
(949) 916-3800
INFO@CVC-INC.NET
WWW.CVC-INC.NET

REGISTERED PROFESSIONAL ENGINEER — DANE P. MCDOUGALL — C 80705 — CIVIL — STATE OF CALIFORNIA

EXISTING CONDITIONS HYDROLOGY MAP		OTH-2021-01375
BALL ANAHEIM AVENUE MIXED USE DEVELOPMENT		DATE: 03/24/2022
		SHEET 1 OF 1
SCALE: AS SHOWN	DRAWN BY: EP	CHECKED BY: DM
CITY OF ANAHEIM		

Proposed Conditions Hydrology Map

PROPOSED CONDITIONS HYDROLOGY MAP

E. BALL ROAD & S. ANAHEIM BLVD.

TTM 19140

Post-Developed Hydrology Summary				
Area ID	Total Area (AC)	Q10 (CFS)	Q25 (CFS)	Q100 (CFS)
A1	0.14	0.5	0.59	0.77
A2	1.51	3.94	4.77	6.26
A3	2.62	5.51	6.64	8.53
A4	1.23	2.54	3.06	3.94
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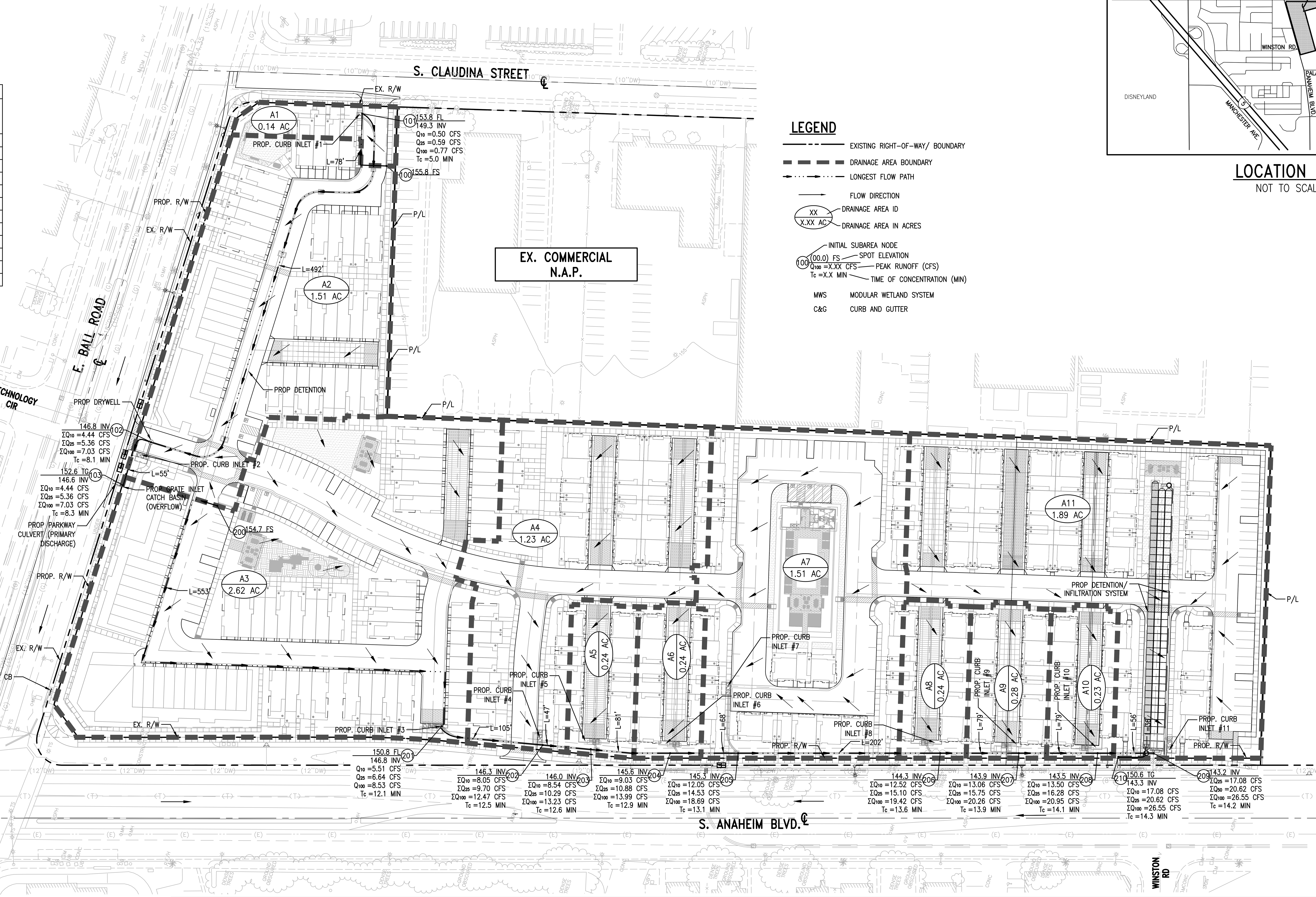
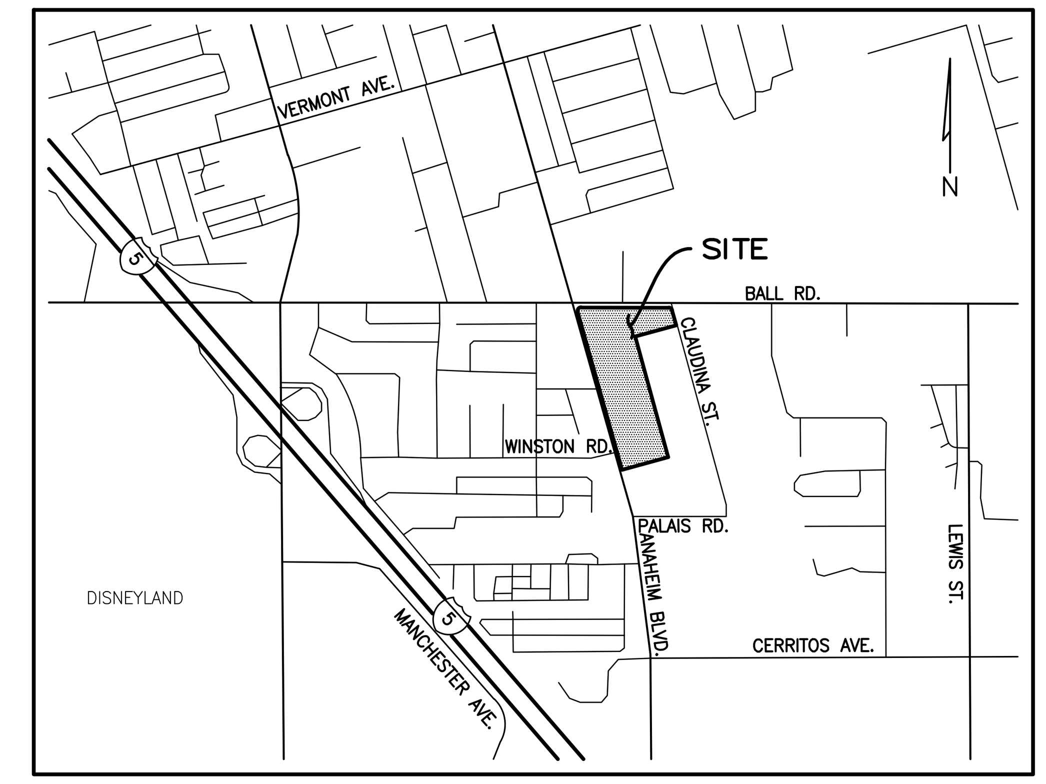
A7	1.51	3.02	3.65	4.70
A8	0.24	0.47	0.57	0.73
A9	0.28	0.54	0.65	0.84
A10	0.23	0.44	0.53	0.69
A11	1.89	3.58	4.34	5.60
Site Total	10.13	21.52	25.98	33.58

SITE IMPERVIOUSNESS SUMMARY	
PRE-DEVELOPMENT	90 %
POST-DEVELOPMENT	65 %

NOTE: IMPERVIOUSNESS ARE ASSUMPTIONS BASED ON OC HYDROLOGY MANUAL PER LAND USE OF DEVELOPMENT TYPE.





LOCATION MAP

NOT TO SCALE

SCALE: 1" = 50'

0 25 50 100

DEVELOPER :	REVISIONS			
NO.	DATE	INITIAL	DESCRIPTION	APP / DATE

PREPARED FOR:

TOFFOLI INVESTMENTS, LLC

3 HUGHES, IRVINE, CALIFORNIA 92618

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REGISTERED PROFESSIONAL ENGINEER
DANE P. MCDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

PROPOSED CONDITIONS HYDROLOGY MAP	OTH-2021-01375	
BALL ANAHEIM AVENUE MIXED USE DEVELOPMENT	DATE: 6/2/2022	
	SHEET 1 OF 1	
SCALE: AS SHOWN	DRAWN BY: EP	CHECKED BY: DM
CITY OF ANAHEIM		

APPENDIX B
HYDROLOGY CALCULATIONS

Existing Conditions Hydrology Calculations (10-year, 25-year, & 100-year Storm Events)

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2014 Advanced Engineering Software (aes)
              Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                            Analysis prepared by:





 ************************* DESCRIPTION OF STUDY *************************
* OTH-2021-01375                                                           *
* EXISTING Q10                                                             *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03X10.DAT
  TIME/DATE OF STUDY: 09:36 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   26.0      1.0    0.020/0.020/ ---    0.33    1.50 0.0313 0.083 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   325.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.70  DOWNSTREAM(FEET) =    152.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.423
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.823
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.41      0.30     0.100    56    9.42
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.54
  TOTAL AREA(ACRES) =      1.41   PEAK FLOW RATE(CFS) =      3.54

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.30  DOWNSTREAM(FEET) =    151.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.377
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.531
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.98      0.30     0.100    56    6.38
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      6.24
  TOTAL AREA(ACRES) =      1.98   PEAK FLOW RATE(CFS) =      6.24

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   284.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.40  DOWNSTREAM(FEET) =    151.90
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.311
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.034
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.81      0.30     0.100    56    8.31
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.19
  TOTAL AREA(ACRES) =      0.81   PEAK FLOW RATE(CFS) =      2.19

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    151.90
  DOWNSTREAM NODE ELEVATION(FEET) =    150.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   283.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.083
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.13
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.998
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        4.11      0.30     0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      7.59
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  26.69
  AVERAGE FLOW DEPTH(FEET) =   0.13   FLOOD WIDTH(FEET) =    5.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.18   Tc(MIN.) =    8.49
  SUBAREA AREA(ACRES) =    4.11       SUBAREA RUNOFF(CFS) =   10.98
  EFFECTIVE AREA(ACRES) =    4.92     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      13.14
  ** PIPE SIZED TO MAXIMIZE V-GUTTER FLOW AT DOWNSTREAM NODE **
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.66
  PIPE-FLOW(CFS) =       2.19
  PIPEFLOW TRAVEL TIME(MIN.) =   1.29    Tc(MIN.) =   9.60
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.794
  SUBAREA AREA(ACRES) =    4.11      SUBAREA RUNOFF(CFS) =   10.22
  EFFECTIVE AREA(ACRES) =    4.92    AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.16  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        4.9        PEAK FLOW RATE(CFS) =      12.24
```

```
  *NOTE: V-GUTTER CAPACITY MAY BE EXCEEDED*
  V-GUTTER HYDRAULICS BASED ON MAINLINE Tc :
  V-GUTTER HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) =   10.05

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOOD WIDTH(FEET) =    5.00
  FLOW VELOCITY(FEET/SEC.) =  35.32   DEPTH*VELOCITY(FT*FT/SEC) =   4.70
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     567.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   312.00
  ELEVATION DATA: UPSTREAM(FEET) =    152.50  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.576
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.980
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.82      0.30     0.100    56    8.58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.83
  TOTAL AREA(ACRES) =      1.82   PEAK FLOW RATE(CFS) =      4.83
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =      8.58
  EFFECTIVE AREA(ACRES) =      1.82  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      4.83
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
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            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* OTH-2021-01375                                                           *
* EXISTING Q25                                                             *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03X25.DAT
  TIME/DATE OF STUDY: 09:40 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   26.0      1.0    0.020/0.020/ ---    0.33    1.50 0.0313 0.083 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   325.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.70  DOWNSTREAM(FEET) =    152.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.423
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.370
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.41      0.30     0.100    56    9.42
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.24
  TOTAL AREA(ACRES) =      1.41   PEAK FLOW RATE(CFS) =      4.24

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.30  DOWNSTREAM(FEET) =    151.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.377
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.203
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.98      0.30     0.100    56    6.38
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.44
  TOTAL AREA(ACRES) =      1.98   PEAK FLOW RATE(CFS) =      7.44

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   284.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.40  DOWNSTREAM(FEET) =    151.90
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.311
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.618
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.81      0.30     0.100    56    8.31
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.62
  TOTAL AREA(ACRES) =      0.81   PEAK FLOW RATE(CFS) =      2.62

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    151.90
  DOWNSTREAM NODE ELEVATION(FEET) =    150.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   283.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.083
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.13
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.582
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        4.11      0.30     0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      9.10
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  31.99
  AVERAGE FLOW DEPTH(FEET) =   0.13   FLOOD WIDTH(FEET) =    5.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.15   Tc(MIN.) =    8.46
  SUBAREA AREA(ACRES) =    4.11       SUBAREA RUNOFF(CFS) =   13.14
  EFFECTIVE AREA(ACRES) =    4.92     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      15.73
  ** PIPE SIZED TO MAXIMIZE V-GUTTER FLOW AT DOWNSTREAM NODE **
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.85
  PIPE-FLOW(CFS) =       2.62
  PIPEFLOW TRAVEL TIME(MIN.) =   1.23    Tc(MIN.) =   9.54
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.347
  SUBAREA AREA(ACRES) =    4.11      SUBAREA RUNOFF(CFS) =   12.27
  EFFECTIVE AREA(ACRES) =    4.92    AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.16  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        4.9        PEAK FLOW RATE(CFS) =      14.69
```

```
  *NOTE: V-GUTTER CAPACITY MAY BE EXCEEDED*
  V-GUTTER HYDRAULICS BASED ON MAINLINE Tc :
  V-GUTTER HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) =   12.07

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOOD WIDTH(FEET) =    5.00
  FLOW VELOCITY(FEET/SEC.) =  42.43   DEPTH*VELOCITY(FT*FT/SEC) =   5.64
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     567.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   312.00
  ELEVATION DATA: UPSTREAM(FEET) =    152.50  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.576
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.554
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.82      0.30     0.100    56    8.58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.77
  TOTAL AREA(ACRES) =      1.82   PEAK FLOW RATE(CFS) =      5.77
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =      8.58
  EFFECTIVE AREA(ACRES) =      1.82  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      5.77
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* OTH-2021-01375                                                           *
* EXISITNG Q100                                                            *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03X100.DAT
  TIME/DATE OF STUDY: 09:44 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   26.0      1.0    0.020/0.020/ ---    0.33    1.50 0.0313 0.083 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   325.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.70  DOWNSTREAM(FEET) =    152.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.423
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.303
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.41      0.30     0.100    76    9.42
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.42
  TOTAL AREA(ACRES) =      1.41   PEAK FLOW RATE(CFS) =      5.42

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   201.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.30  DOWNSTREAM(FEET) =    151.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.377
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.382
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.98      0.30     0.100    76    6.38
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      9.54
  TOTAL AREA(ACRES) =      1.98   PEAK FLOW RATE(CFS) =      9.54

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   284.00
  ELEVATION DATA: UPSTREAM(FEET) =    153.40  DOWNSTREAM(FEET) =    151.90
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.311
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.624
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.81      0.30     0.100    76    8.31
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.35
  TOTAL AREA(ACRES) =      0.81   PEAK FLOW RATE(CFS) =      3.35

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =    151.90
  DOWNSTREAM NODE ELEVATION(FEET) =    150.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   283.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.083
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.588
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        4.11      0.30     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     11.69
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  41.10
  AVERAGE FLOW DEPTH(FEET) =   0.13   FLOOD WIDTH(FEET) =    5.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.11   Tc(MIN.) =    8.43
  SUBAREA AREA(ACRES) =    4.11       SUBAREA RUNOFF(CFS) =   16.86
  EFFECTIVE AREA(ACRES) =    4.92     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.9         PEAK FLOW RATE(CFS) =      20.18
  ** PIPE SIZED TO MAXIMIZE V-GUTTER FLOW AT DOWNSTREAM NODE **
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.11
  PIPE-FLOW(CFS) =       3.35
  PIPEFLOW TRAVEL TIME(MIN.) =   1.15    Tc(MIN.) =   9.46
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.294
  SUBAREA AREA(ACRES) =    4.11      SUBAREA RUNOFF(CFS) =   15.77
  EFFECTIVE AREA(ACRES) =    4.92    AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.16  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =        4.9        PEAK FLOW RATE(CFS) =      18.88
```

```
  *NOTE: V-GUTTER CAPACITY MAY BE EXCEEDED*
  V-GUTTER HYDRAULICS BASED ON MAINLINE Tc :
  V-GUTTER HYDRAULICS COMPUTED USING ESTIMATED FLOW(CFS) =   15.53

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOOD WIDTH(FEET) =    5.00
  FLOW VELOCITY(FEET/SEC.) =  54.59   DEPTH*VELOCITY(FT*FT/SEC) =   7.26
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     567.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   312.00
  ELEVATION DATA: UPSTREAM(FEET) =    152.50  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.576
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.542
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.82      0.30     0.100    76    8.58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      7.39
  TOTAL AREA(ACRES) =      1.82   PEAK FLOW RATE(CFS) =      7.39
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =      8.58
  EFFECTIVE AREA(ACRES) =      1.82  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      7.39
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Proposed Conditions Hydrology Calculations (10-year, 25-year, & 100-year Storm Events)

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                           Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* OTH-2021-01375                                                           *
* PROPOSED Q10                                                             *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03P10.DAT
  TIME/DATE OF STUDY: 10:54 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   26.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.167 0.0150
  2   24.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    78.00
  ELEVATION DATA: UPSTREAM(FEET) =    155.80  DOWNSTREAM(FEET) =    153.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        0.14      0.30     0.350    56    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   149.30  DOWNSTREAM(FEET) =   146.80
  FLOW LENGTH(FEET) =   492.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.37
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.50
  PIPE TRAVEL TIME(MIN.) =   3.46    Tc(MIN.) =    8.46
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.46
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.004
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.51      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    3.94
```

```
  EFFECTIVE AREA(ACRES) =      1.65   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       4.30

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.60
  FLOW LENGTH(FEET) =    55.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.78
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.30
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =    8.70
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     625.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   553.00
  ELEVATION DATA: UPSTREAM(FEET) =    154.70  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.126
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.443
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        2.62      0.30     0.350    56   12.13
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      5.51
  TOTAL AREA(ACRES) =      2.62   PEAK FLOW RATE(CFS) =      5.51

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.30
  FLOW LENGTH(FEET) =   105.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.42
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.51
  PIPE TRAVEL TIME(MIN.) =   0.40    Tc(MIN.) =   12.52
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     658.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.52
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.399
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.23      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.23      SUBAREA RUNOFF(CFS) =    2.54
  EFFECTIVE AREA(ACRES) =      3.85   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        3.8       PEAK FLOW RATE(CFS) =       7.95

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.30  DOWNSTREAM(FEET) =   146.00
  FLOW LENGTH(FEET) =    47.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.27
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.95
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   12.67
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.67
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.383
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.49
  EFFECTIVE AREA(ACRES) =      4.09   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.1       PEAK FLOW RATE(CFS) =       8.38

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.00  DOWNSTREAM(FEET) =   145.60
  FLOW LENGTH(FEET) =    81.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.98
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.38
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =   12.94
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     786.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.94
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.354
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.49
  EFFECTIVE AREA(ACRES) =      4.33   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.3       PEAK FLOW RATE(CFS) =       8.76

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.60  DOWNSTREAM(FEET) =   145.30
  FLOW LENGTH(FEET) =    68.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.79
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       8.76
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =   13.18
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =     854.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.18
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.330
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.51      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    3.02
  EFFECTIVE AREA(ACRES) =      5.84   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        5.8       PEAK FLOW RATE(CFS) =      11.69

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    206.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.30  DOWNSTREAM(FEET) =   144.30
  FLOW LENGTH(FEET) =   202.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.43
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.69
  PIPE TRAVEL TIME(MIN.) =   0.62    Tc(MIN.) =   13.80
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =    1056.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.80
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.269
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
```

```
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.47
  EFFECTIVE AREA(ACRES) =      6.08   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.1       PEAK FLOW RATE(CFS) =      11.84

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   144.30  DOWNSTREAM(FEET) =   143.90
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.49
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      11.84
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =   14.04
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    207.00 =    1135.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    207.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.04
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.247
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.28      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.28      SUBAREA RUNOFF(CFS) =    0.54
  EFFECTIVE AREA(ACRES) =      6.36   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.4       PEAK FLOW RATE(CFS) =      12.26

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.90  DOWNSTREAM(FEET) =   143.50
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  16.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.53
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.26
```

```
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =   14.28
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1214.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.28
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.225
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.23      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.44
  EFFECTIVE AREA(ACRES) =      6.59   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.6       PEAK FLOW RATE(CFS) =      12.58

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.50  DOWNSTREAM(FEET) =   143.20
  FLOW LENGTH(FEET) =    56.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.68
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.58
  PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =   14.44
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    209.00 =    1270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    209.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.44
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.211
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.89      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.89      SUBAREA RUNOFF(CFS) =    3.58
```

```
  EFFECTIVE AREA(ACRES) =      8.48   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        8.5       PEAK FLOW RATE(CFS) =      16.07

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    210.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.20  DOWNSTREAM(FEET) =   143.10
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  19.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.73
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.07
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   14.57
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    210.00 =    1306.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.5  TC(MIN.) =     14.57
  EFFECTIVE AREA(ACRES) =      8.48  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =      16.07
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2014 Advanced Engineering Software (aes)
             Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* OTH-2021-01375                                                           *
* PROPOSED Q25                                                             *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03P25.DAT
  TIME/DATE OF STUDY: 11:01 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   26.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.167 0.0150
  2   24.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    78.00
  ELEVATION DATA: UPSTREAM(FEET) =    155.80  DOWNSTREAM(FEET) =    153.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        0.14      0.30     0.350    56    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.59
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.59

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   149.30  DOWNSTREAM(FEET) =   146.80
  FLOW LENGTH(FEET) =   492.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.48
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.59
  PIPE TRAVEL TIME(MIN.) =   3.31    Tc(MIN.) =    8.31
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.31
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.618
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.51      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    4.77
```

```
  EFFECTIVE AREA(ACRES) =      1.65   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       5.22

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.60
  FLOW LENGTH(FEET) =    55.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.92
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.22
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    8.54
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     625.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   553.00
  ELEVATION DATA: UPSTREAM(FEET) =    154.70  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.126
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.922
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        2.62      0.30     0.350    56   12.13
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      6.64
  TOTAL AREA(ACRES) =      2.62   PEAK FLOW RATE(CFS) =      6.64

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.30
  FLOW LENGTH(FEET) =   105.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.54
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.64
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =   12.51
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     658.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.51
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.870
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS                B       1.23      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.23      SUBAREA RUNOFF(CFS) =    3.06
  EFFECTIVE AREA(ACRES) =      3.85   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        3.8       PEAK FLOW RATE(CFS) =       9.58

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.30  DOWNSTREAM(FEET) =   146.00
  FLOW LENGTH(FEET) =    47.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.67
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.58
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =   12.65
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.65
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.853
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS                B       0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.59
  EFFECTIVE AREA(ACRES) =      4.09   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.1       PEAK FLOW RATE(CFS) =      10.11

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.00  DOWNSTREAM(FEET) =   145.60
  FLOW LENGTH(FEET) =    81.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.13
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     10.11
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =   12.91
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     786.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.91
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.819
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.59
  EFFECTIVE AREA(ACRES) =      4.33   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.3       PEAK FLOW RATE(CFS) =      10.58

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.60  DOWNSTREAM(FEET) =   145.30
  FLOW LENGTH(FEET) =    68.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.08
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =      10.58
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =   13.14
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =     854.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.14
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.792
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS                B       1.51      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    3.65
  EFFECTIVE AREA(ACRES) =      5.84   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        5.8       PEAK FLOW RATE(CFS) =      14.12

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    206.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.30  DOWNSTREAM(FEET) =   144.30
  FLOW LENGTH(FEET) =   202.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.60
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.12
  PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =   13.74
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =    1056.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.74
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.722
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS                B       0.24      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
```

```
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.57
  EFFECTIVE AREA(ACRES) =      6.08   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.1       PEAK FLOW RATE(CFS) =      14.32

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   144.30  DOWNSTREAM(FEET) =   143.90
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.66
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.32
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =   13.97
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    207.00 =    1135.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    207.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.97
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.697
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.28      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.28      SUBAREA RUNOFF(CFS) =    0.65
  EFFECTIVE AREA(ACRES) =      6.36   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.4       PEAK FLOW RATE(CFS) =      14.83

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.90  DOWNSTREAM(FEET) =   143.50
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.68
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      14.83
```

```
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =   14.20
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1214.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.20
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.672
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.23      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.53
  EFFECTIVE AREA(ACRES) =      6.59   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.6       PEAK FLOW RATE(CFS) =      15.22

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.50  DOWNSTREAM(FEET) =   143.20
  FLOW LENGTH(FEET) =    56.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.84
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.22
  PIPE TRAVEL TIME(MIN.) =   0.16    Tc(MIN.) =   14.36
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    209.00 =    1270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    209.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.36
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.655
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.89      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.89      SUBAREA RUNOFF(CFS) =    4.34
```

```
  EFFECTIVE AREA(ACRES) =      8.48   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        8.5       PEAK FLOW RATE(CFS) =      19.46

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    210.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.20  DOWNSTREAM(FEET) =   143.10
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  22.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.87
  ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.46
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   14.49
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    210.00 =    1306.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.5  TC(MIN.) =     14.49
  EFFECTIVE AREA(ACRES) =      8.48  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =      19.46
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2014 Advanced Engineering Software (aes)
              Ver. 21.0  Release Date: 06/01/2014  License ID 1580

                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* OTH-2021-01375                                                           *
* PROPOSED Q100                                                            *
* GLPX-003                                                                 *
 **************************************************************************

  FILE NAME: GL03P100.DAT
  TIME/DATE OF STUDY: 11:03 03/25/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   26.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.167 0.0150
  2   24.0      1.0    0.020/0.020/ ---    0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  5.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    78.00
  ELEVATION DATA: UPSTREAM(FEET) =    155.80  DOWNSTREAM(FEET) =    153.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        0.14      0.30     0.350    76    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.77
  TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.77

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   149.30  DOWNSTREAM(FEET) =   146.80
  FLOW LENGTH(FEET) =   492.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.68
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.77
  PIPE TRAVEL TIME(MIN.) =   3.06    Tc(MIN.) =    8.06
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.06
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.708
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.51      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    6.26
```

```
  EFFECTIVE AREA(ACRES) =      1.65   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       6.83

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.60
  FLOW LENGTH(FEET) =    55.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.23
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.83
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =    8.27
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     625.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   553.00
  ELEVATION DATA: UPSTREAM(FEET) =    154.70  DOWNSTREAM(FEET) =    150.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.126
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.724
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        2.62      0.30     0.350    76   12.13
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      8.53
  TOTAL AREA(ACRES) =      2.62   PEAK FLOW RATE(CFS) =      8.53

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.80  DOWNSTREAM(FEET) =   146.30
  FLOW LENGTH(FEET) =   105.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.92
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.53
  PIPE TRAVEL TIME(MIN.) =   0.36    Tc(MIN.) =   12.48
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     658.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.48
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.663
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.23      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.23      SUBAREA RUNOFF(CFS) =    3.94
  EFFECTIVE AREA(ACRES) =      3.85   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        3.8       PEAK FLOW RATE(CFS) =      12.33

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.30  DOWNSTREAM(FEET) =   146.00
  FLOW LENGTH(FEET) =    47.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  17.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.85
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.33
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   12.62
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     705.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.62
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.641
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.24      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      4.09   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.1       PEAK FLOW RATE(CFS) =      13.02

****************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   146.00  DOWNSTREAM(FEET) =   145.60
  FLOW LENGTH(FEET) =    81.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  16.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.53
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     13.02
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =   12.86
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     786.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.86
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.601
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       0.24      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      4.33   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        4.3       PEAK FLOW RATE(CFS) =      13.62

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.60  DOWNSTREAM(FEET) =   145.30
  FLOW LENGTH(FEET) =    68.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.30
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
```

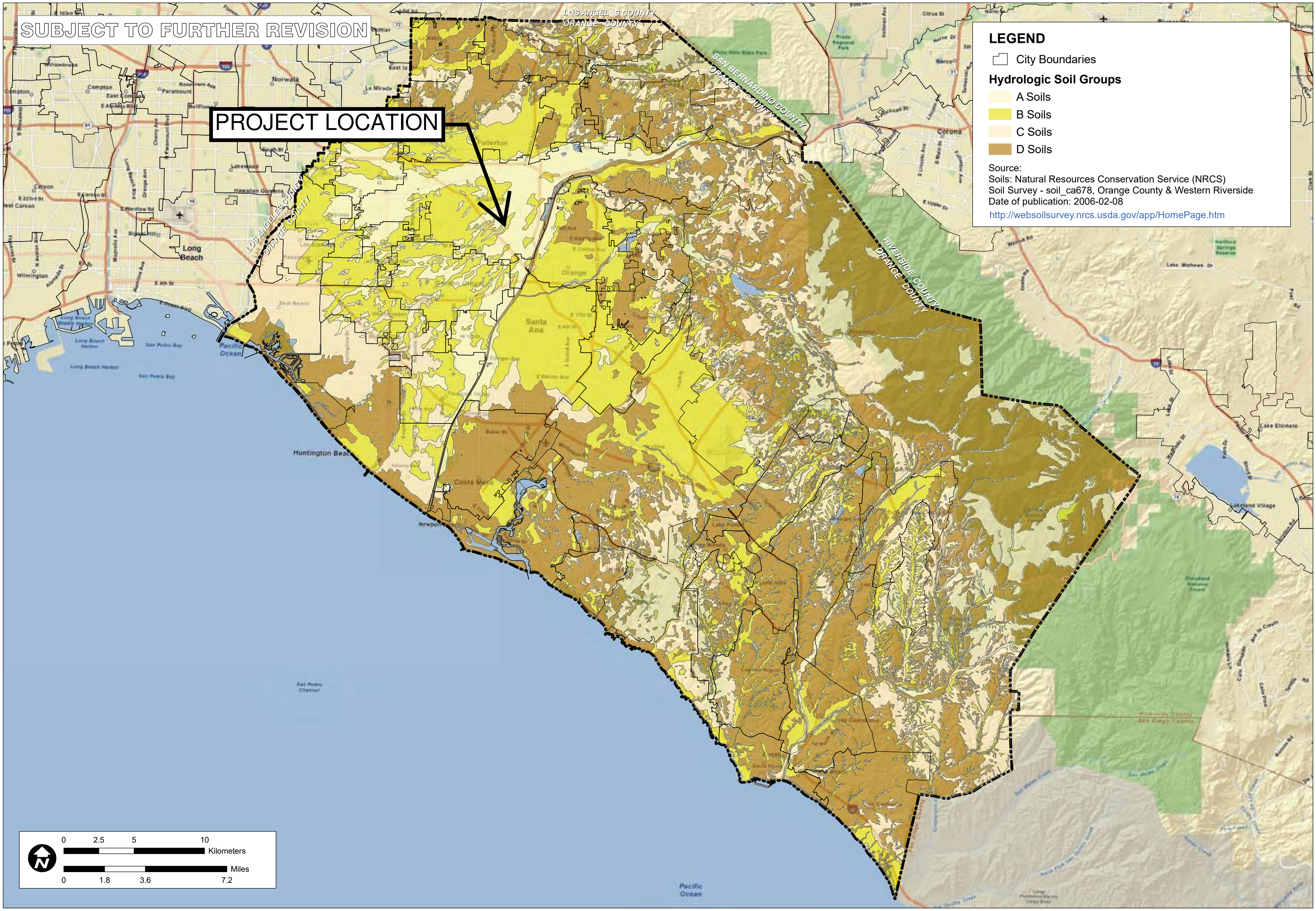
```
  PIPE-FLOW(CFS) =      13.62
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =   13.07
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =     854.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.567
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       1.51      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.51      SUBAREA RUNOFF(CFS) =    4.70
  EFFECTIVE AREA(ACRES) =      5.84   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        5.8       PEAK FLOW RATE(CFS) =      18.20

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    206.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   145.30  DOWNSTREAM(FEET) =   144.30
  FLOW LENGTH(FEET) =   202.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.00
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      18.20
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   13.63
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =    1056.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.63
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.482
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       0.24      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
```

```
  SUBAREA AREA(ACRES) =    0.24      SUBAREA RUNOFF(CFS) =    0.73
  EFFECTIVE AREA(ACRES) =      6.08   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.1       PEAK FLOW RATE(CFS) =      18.48

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   144.30  DOWNSTREAM(FEET) =   143.90
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.08
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      18.48
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =   13.85
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    207.00 =    1135.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    207.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.85
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.451
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.28      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.28      SUBAREA RUNOFF(CFS) =    0.84
  EFFECTIVE AREA(ACRES) =      6.36   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.4       PEAK FLOW RATE(CFS) =      19.15

****************************************************************************
  FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.90  DOWNSTREAM(FEET) =   143.50
  FLOW LENGTH(FEET) =    79.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.11
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.15
```

```
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =   14.07
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    208.00 =    1214.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    208.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.421
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.23      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.69
  EFFECTIVE AREA(ACRES) =      6.59   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        6.6       PEAK FLOW RATE(CFS) =      19.66

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.50  DOWNSTREAM(FEET) =   143.20
  FLOW LENGTH(FEET) =    56.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.28
  ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.66
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   14.22
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    209.00 =    1270.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    209.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.22
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.400
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        1.89      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.89      SUBAREA RUNOFF(CFS) =    5.60
```

```
  EFFECTIVE AREA(ACRES) =      8.48   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        8.5       PEAK FLOW RATE(CFS) =      25.15

****************************************************************************
  FLOW PROCESS FROM NODE    209.00 TO NODE    210.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   143.20  DOWNSTREAM(FEET) =   143.10
  FLOW LENGTH(FEET) =    36.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  33.0 INCH PIPE IS  25.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.19
  ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      25.15
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   14.33
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    210.00 =    1306.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.5  TC(MIN.) =     14.33
  EFFECTIVE AREA(ACRES) =      8.48  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =      25.15
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX C
OCPW TGD Soils Map



TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2a

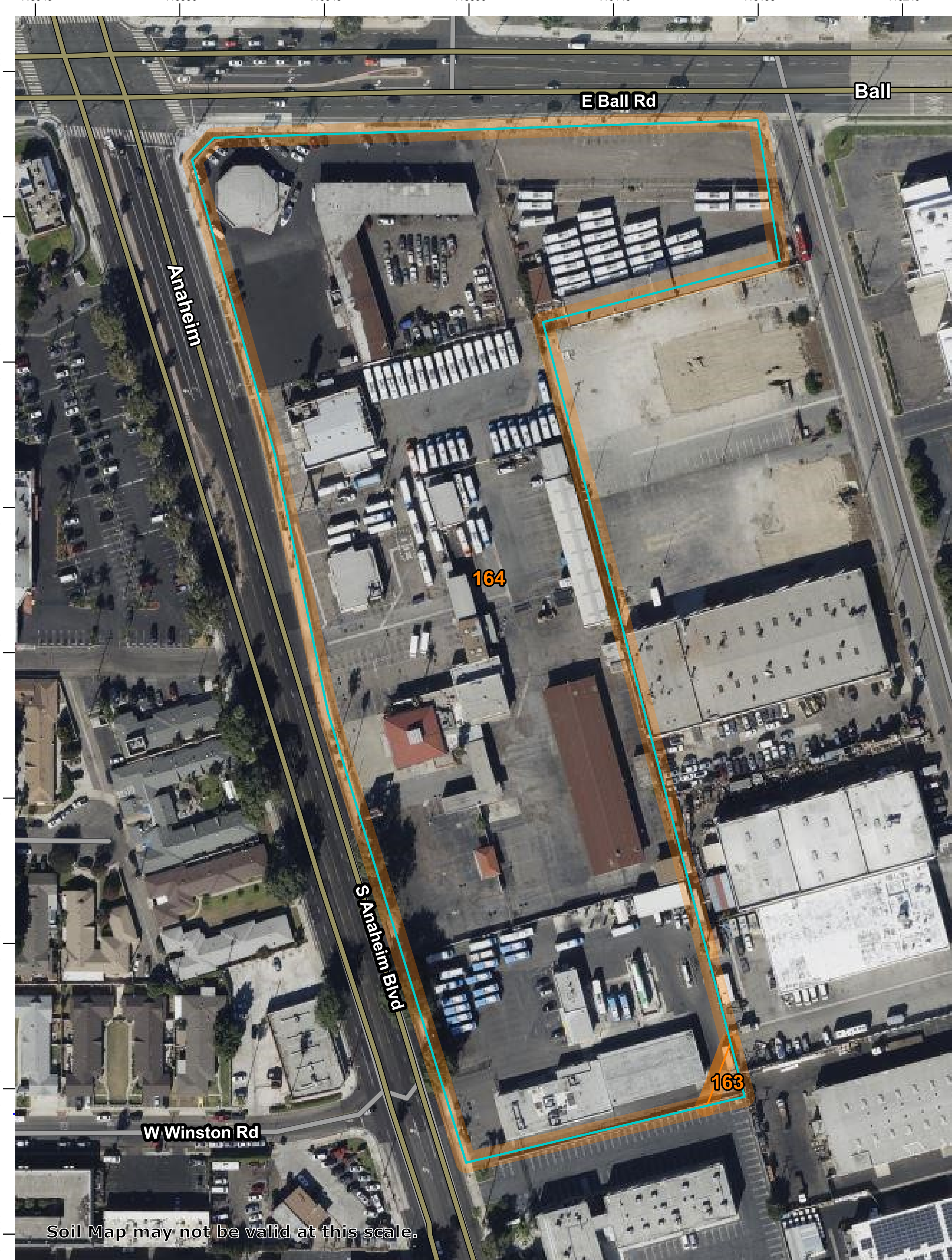
P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasibility_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

Soil Map—Orange County and Part of Riverside County, California

117° 54' 30" W | 117° 54' 17" W

415940 415990 416040 416090 416140 416190 416240

33° 49' 5" N | 33° 49' 5" N



3742360 3742310 3742260 3742210 3742160 3742110 3742060 3742010 3741960

33° 48' 51" N | 33° 48' 51" N

415940 415990 416040 416090 416140 416190 416240

117° 54' 30" W | 117° 54' 17" W

Map Scale: 1:2,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 19, 2020—Dec 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
163	Metz loamy sand	0.0	0.3%
164	Metz loamy sand, moderately fine substratum	10.3	99.7%
Totals for Area of Interest		**10.3**	**100.0%**

Orange County and Part of Riverside County, California

164—Metz loamy sand, moderately fine substratum

Map Unit Setting

National map unit symbol: hcn9
Elevation: 0 to 600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 63 to 65 degrees F
Frost-free period: 320 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

A - 0 to 17 inches: loamy sand
C1 - 17 to 40 inches: stratified sand to sandy clay loam
C2 - 40 to 46 inches: silty clay loam
C3 - 46 to 60 inches: stratified sand to sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R019XD035CA - SANDY (1975)
Hydric soil rating: No

Minor Components

Metz, loamy sand
Percent of map unit: 10 percent
Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hueneme, fine sandy loam
Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Corralitos, loamy sand
Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

San emigdio
Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 15, Sep 13, 2021

APPENDIX D
Hydraulic Calculations

Onsite Private
Catch Basin Sizing

Hydraulic Analysis Report

Project Data

Project Title: GLPX Catch Basin Sizing

Designer:

Project Date: Friday, March 25, 2022

Project Units: U.S. Customary Units

Notes:

Curb and Gutter Analysis: CB#1

Notes: Drainage Area A1

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 0.5900 cfs

Gutter Result Parameters

Width of Spread: 3.6597 ft

Gutter Depression: 1.1340 in

Area of Flow: 0.2048 ft^2

Eo (Gutter Flow to Total Flow): 0.8977

Gutter Depth at Curb: 2.0123 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 3.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 5.7000 ft

Effective Perimeter: 5.7000 ft

Area: 2.0000 ft^2

Effective Area: 2.0000 ft^2

Depth at curb face (upstream of local depression): 0.1265 ft

Computed Width of Spread at Sag: 1.6011 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#2

Notes: Drainage Area A2

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 4.7700 cfs

Gutter Result Parameters

Width of Spread: 10.5284 ft

Gutter Depression: 1.1340 in

Area of Flow: 1.1794 ft^2

Eo (Gutter Flow to Total Flow): 0.4241

Gutter Depth at Curb: 3.6608 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 6.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 8.7000 ft

Effective Perimeter: 8.7000 ft

Area: 4.0000 ft^2

Effective Area: 4.0000 ft^2

Depth at curb face (upstream of local depression): 0.3845 ft

Computed Width of Spread at Sag: 14.4978 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#3

Notes: Drainage Area A3

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 6.6400 cfs

Gutter Result Parameters

Width of Spread: 12.0656 ft

Gutter Depression: 1.1340 in

Area of Flow: 1.5267 ft^2

Eo (Gutter Flow to Total Flow): 0.3707

Gutter Depth at Curb: 4.0298 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 7.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 9.7000 ft

Effective Perimeter: 9.7000 ft

Area: 4.6667 ft^2

Effective Area: 4.6667 ft^2

Depth at curb face (upstream of local depression): 0.4458 ft

Computed Width of Spread at Sag: 17.5636 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#4

Notes: Drainage Area A4

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 3.9400 cfs

Gutter Result Parameters

Width of Spread: 9.7143 ft

Gutter Depression: 1.1340 in

Area of Flow: 1.0146 ft^2

Eo (Gutter Flow to Total Flow): 0.4582

Gutter Depth at Curb: 3.4654 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 5.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 7.7000 ft

Effective Perimeter: 7.7000 ft

Area: 3.3333 ft^2

Effective Area: 3.3333 ft^2

Depth at curb face (upstream of local depression): 0.3672 ft

Computed Width of Spread at Sag: 13.6328 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#5, 6, 8, 9, 10

Notes: Catch Basins #5, 6, 8, 9, & 10 are all in a similar condition. The largest 25-year storm event was analyzed between drainage Areas A5, A6, A8, A9, & A10.

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 0.5900 cfs

Gutter Result Parameters

Width of Spread: 3.6597 ft

Gutter Depression: 1.1340 in

Area of Flow: 0.2048 ft^2

Eo (Gutter Flow to Total Flow): 0.8977

Gutter Depth at Curb: 2.0123 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 3.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 5.7000 ft

Effective Perimeter: 5.7000 ft

Area: 2.0000 ft^2

Effective Area: 2.0000 ft^2

Depth at curb face (upstream of local depression): 0.1265 ft

Computed Width of Spread at Sag: 1.6011 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#7

Notes: Drainage Area A7

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 3.6500 cfs

Gutter Result Parameters

Width of Spread: 9.4026 ft

Gutter Depression: 1.1340 in

Area of Flow: 0.9550 ft^2

Eo (Gutter Flow to Total Flow): 0.4725

Gutter Depth at Curb: 3.3906 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 5.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 7.7000 ft

Effective Perimeter: 7.7000 ft

Area: 3.3333 ft^2

Effective Area: 3.3333 ft^2

Depth at curb face (upstream of local depression): 0.3489 ft

Computed Width of Spread at Sag: 12.7206 ft

Flow type: Weir Flow

Efficiency: 1.0000

Curb and Gutter Analysis: CB#11

Notes: Drainage Area A11

Gutter Input Parameters

Longitudinal Slope of Road: 0.0200 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Depressed Gutter Geometry

Cross-Slope of Gutter: 0.0830 ft/ft

Manning's n: 0.0150

Gutter Width: 1.5000 ft

Design Flow: 4.3400 cfs

Gutter Result Parameters

Width of Spread: 10.1197 ft

Gutter Depression: 1.1340 in

Area of Flow: 1.0950 ft^2

Eo (Gutter Flow to Total Flow): 0.4406

Gutter Depth at Curb: 3.5627 in

Inlet Input Parameters

Inlet Location: Inlet in Sag

Percent Clogging: 0.0000 %

Inlet Type: Curb Opening

Length of Inlet: 7.0000 ft

Curb opening height: 6.0000 in

Local Depression: 2.0000 in

Inlet Result Parameters

Perimeter: 9.7000 ft

Effective Perimeter: 9.7000 ft

Area: 4.6667 ft^2

Effective Area: 4.6667 ft^2

Depth at curb face (upstream of local depression): 0.3357 ft

Computed Width of Spread at Sag: 12.0616 ft

Flow type: Weir Flow

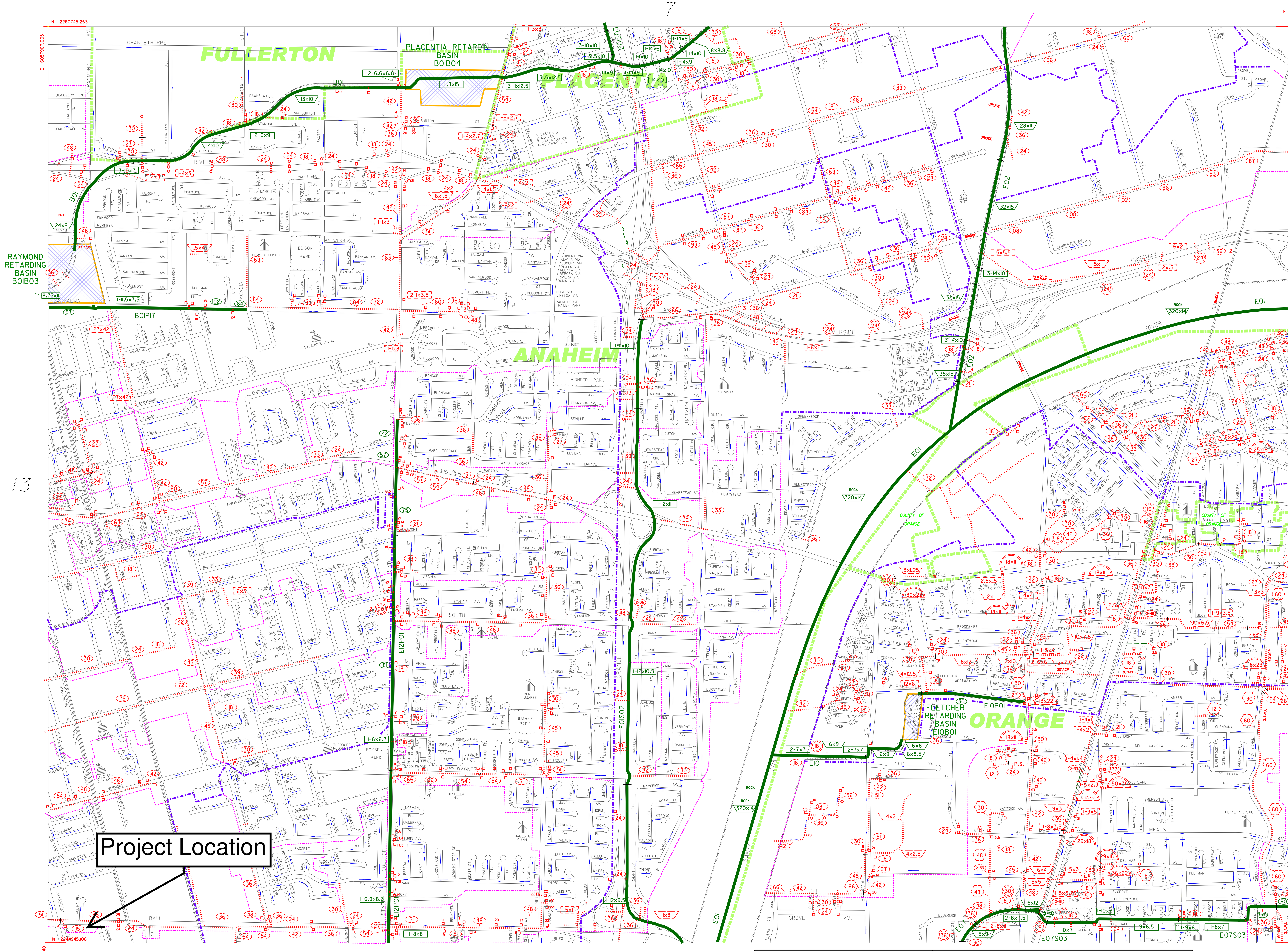
Efficiency: 1.0000

Pipe Sizing

To be provided in Final Engineering.

APPENDIX E
Reference Material

OCFCD Drainage Maps



NOTICE

The drainage information has been prepared for information purposes only. The location, ownership, facility information and limits have been determined from available information provided by public agencies, but may not be exact, accurate, or up-to-date. The user of this information is responsible for verifying exact location, ownership, accuracy, and the regional versus local character of drainage facilities.

Additional information may be obtained from public plans and recorded deeds. Facility designations included with this information are for convenience only and are not controlling or intended to imply ownership by the County or the Orange County Flood Control District (OCFCD). The information is being provided as a courtesy and neither the County of Orange nor OCFCD assume any liabilities for inaccuracy of the information.

To notify OC Public Works Flood Control Section of additions or corrections, please contact Sal Gutierrez at (714) 834–5396 or by email at sal.gutierrez@ocpw.ocgov.com

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	APR.27.2010	14	MAPS–113–3

Channel Drainage Area Boundary
Major Sub–Area Drainage Boundary
Minor Sub–Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
OCFCD Basins or Reservoirs

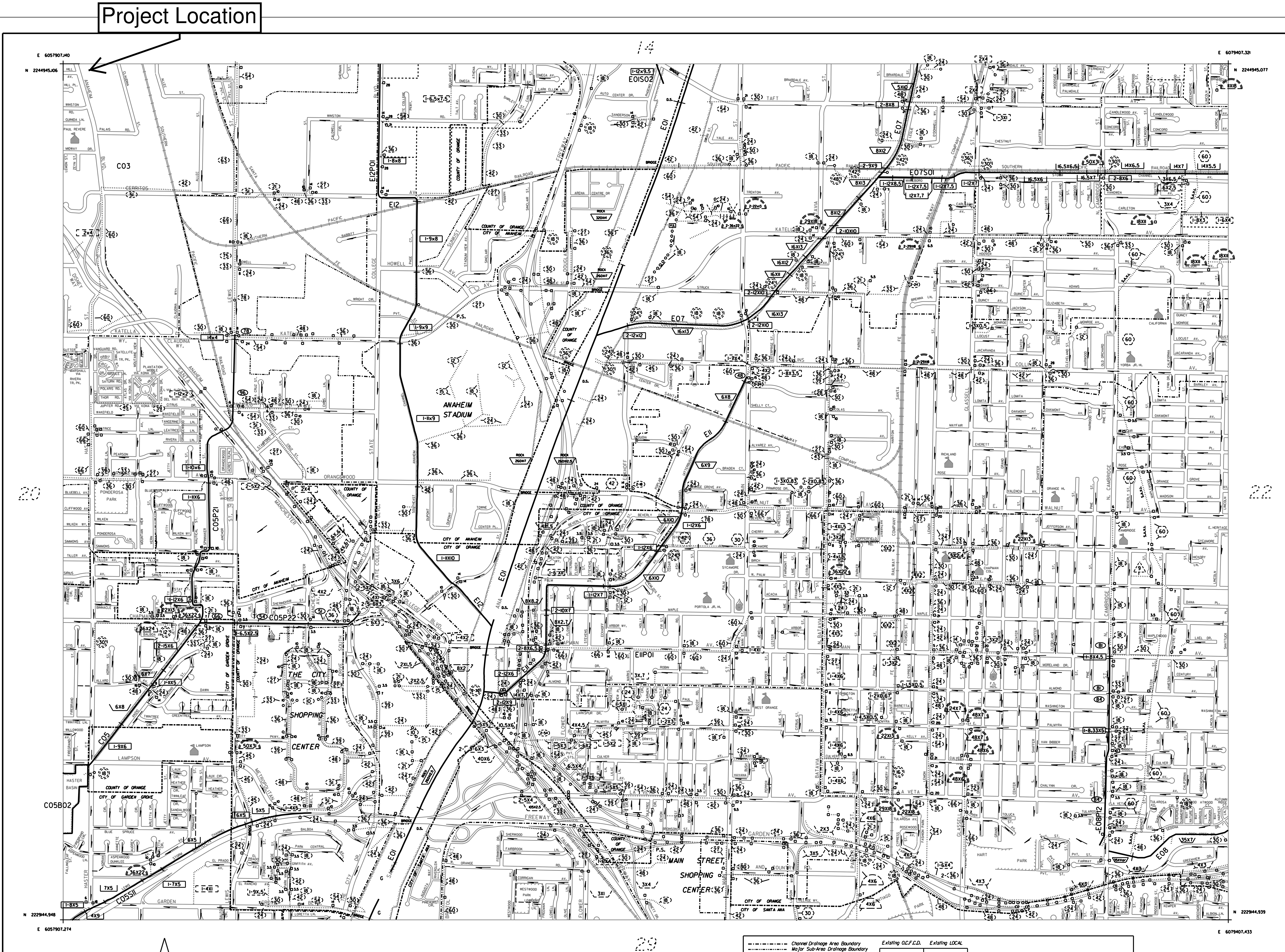
Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D. LOCAL

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels–span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Metal Sheet Channel (MSC) (Base width by pile height in feet/Sheet pile total length)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)

14 14



N
Scale: 1"=600'

21

NOTICE

This drainage map has been prepared for information purposes only. The location and ownership of facilities have been determined from available information provided by public agencies, but may not be exact. The user of this map is responsible for verifying exact location, ownership and regional versus local character of drainage facilities.
Additional information may be obtained from public plans and recorded deeds.
Character designations shown on this map are for convenience only and are not controlling.
Neither the County of Orange nor The Orange County Flood Control District (OCFCD) assume any liabilities for inaccuracy of this map.

Call: Alan Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
AVU	JAN.12/2000	21	MAPS-113-3

Channel Drainage Area Boundary
Major Sub-Area Drainage Boundary
Minor Sub-Area Drainage Boundary
Existing O.C.F.C.D. Facility
Existing Local Facility
Existing Retarding Basin or Reservoir
Natural Watercourse
City Limits
G G Greenbelt
P.S. P.S. Pump Station
Catch Basin (length in feet)
Drop Inlet or Other Entry
Ownership (if other than city or county)
P Private
S State
F Federal

Existing O.C.F.C.D. / Existing LOCAL

Earth Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Trapezoidal Channel (base width by height in feet)
Reinforced Concrete Rectangular Channel (base width by height in feet)
Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
Reinforced Concrete Pipe (RCP) (diameter in inches)
Corrugated Metal Pipe (CMP) (diameter in inches)
Concrete Pipe (diameter in inches)
Concrete Oval Pipe (width by height in inches)
Steel Pipe (diameter in inches)
Reinforced Concrete Arch (base span by height in inches)
Corrugated Metal Arch (base span by height in inches)

21

Pages from the City of Anaheim Master Plan of Storm Drainage for Anaheim Barber City Channel

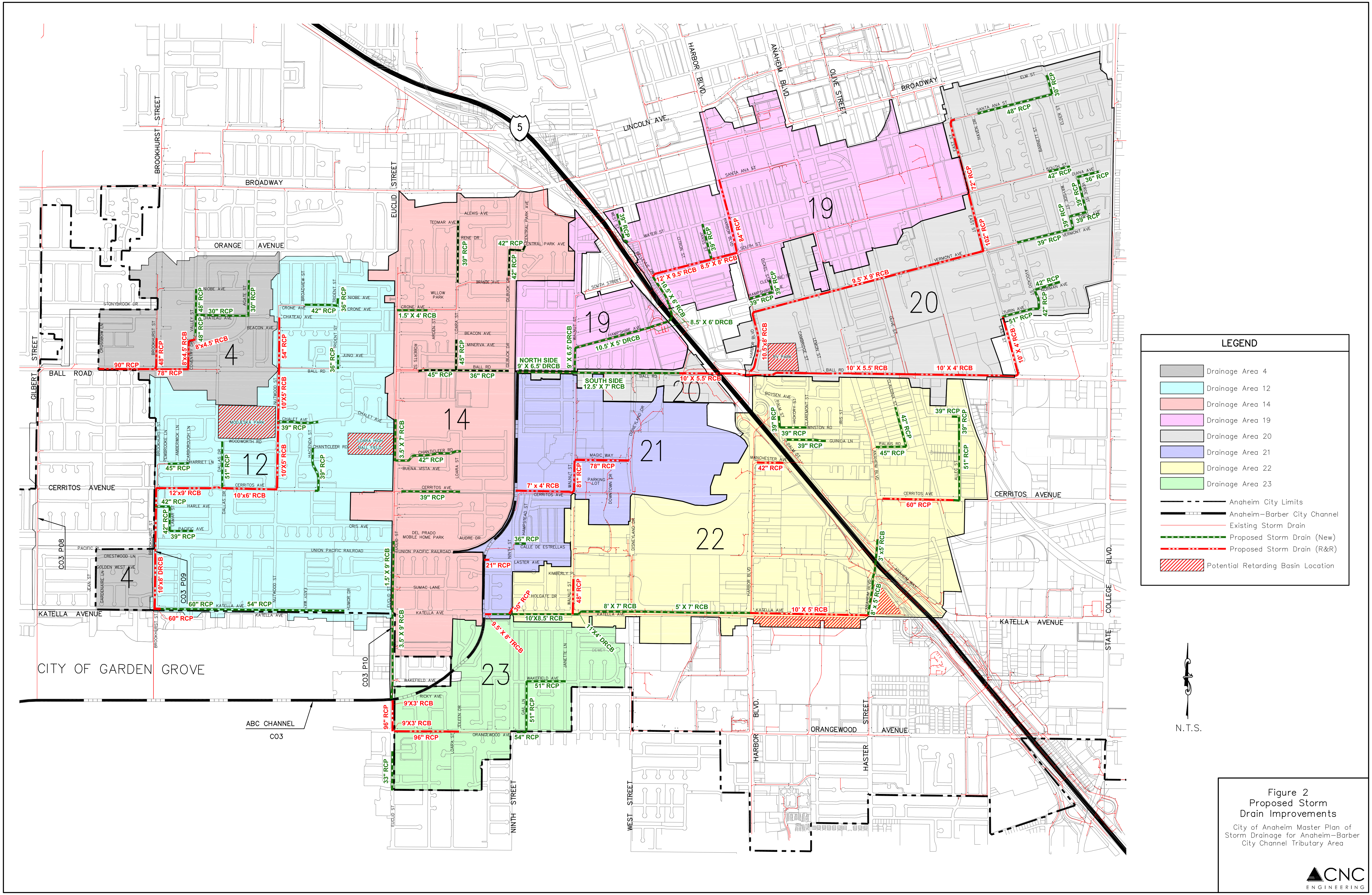


Figure 2
Proposed Storm Drain Improvements
City of Anaheim Master Plan of Storm Drainage for Anaheim–Barber City Channel Tributary Area
CNC ENGINEERING

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F3: Sewer Study

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P S O M A S

TECHNICAL MEMORANDUM

To: Keith Linker

From: Mike Swan

Date: April 12, 2022

Subject: Sewer Study – Ball Road and Anaheim Boulevard – TM 19140
City Project Tracking No.: OTH2021-01390

The purpose of this memorandum is to document a sewer study prepared for the proposed Ball Road and Anaheim Blvd. site by Toffoli Investments (Tentative Map 19140) consisting of 249 townhome dwelling units (DU) and 4,500 square foot (sf) of retail space. The site consists of Assessor Parcel Nos. (APNs) 082-461-23, -24, -25, -31, -34, -35, -39, with an area of approximately 10.5 acres. The project would include the demolition of the existing commercial structures on the site. The site is located on the southeast corner of Ball Road and Anaheim Boulevard as shown on Figure 1.

Sewage from the existing site currently discharges to the 15-inch sewer along Ball Road and the 8-inch sewer along Anaheim Blvd. According to the Central Anaheim Master Plan of Sanitary Sewers (CAMPSS), dated December 2017, and the updated modeling from the South Central Anaheim Sewer Study (SCASS) dated May 2020, sewer generation from the site and adjacent parcels to the north and south in the Existing and Buildout System computer model scenarios were loaded as commercial use, based on parcel acreage, to the existing 15-inch sewer flowing west on Ball Road and the 8-inch sewer flowing south on Anaheim Blvd.

In the current model sewage from the project site discharges to manholes SW096101 and SW086205 on Ball Road and SW086216 and SW086223 on Anaheim Blvd. The existing commercial load of 12.4 gallons per minute (gpm), or about 17,816 gallons per day (gpd), for the project site of 10.5 acres will be removed from these four manholes bordering the project site. Sewage from the proposed 139 townhome DUs will add an average flow of 23.17 gpm, or 33,360 gpd, to a proposed manhole south of SW086230 on Anaheim Blvd and Winston Road. The use of an on-site private lift station is not needed since the residential flow is proposed to be split between the two discharge manholes for the project. The remaining proposed 110 townhome DUs, and 4,500 sf of retail space will add an average flow of 18.94 gpm, or 27,278 gpd, to manhole SW096206 on Ball Road. The existing and proposed manhole loading with flow generation is summarized in Table 1. Flow factors are in gpd/acre, gpd/DU, and gpd/thousand square feet (ksf). The existing downstream sewer collection system and the location of the proposed project site are shown on Figure 2. In addition, the proposed La Quinta Inn Hotel, Midway Apartments, Legacy and Avanti Townhomes development sewer flow generations from recent sewer studies were loaded in both the existing and buildout model runs. The locations of these four proposed developments for which recent sewer studies were conducted are labeled on Figure 1.

The proposed average flow factor for townhome units is 240 gpd/DU based on the Central Anaheim Master Plan of Sanitary Sewers (CAMPSS) and 195 gpd/ksf for commercial based on industry standards. As shown in Table 1, the average daily flow increase (net additional flow) to the Ball Road and Anaheim Blvd. sewer collection system is 21,541 gpd and 21,280 gpd, respectively. Although the total proposed flow from the project site is 60,638gpd, for a total average daily flow increase to the sewer collection system of 42,821 gpd, the separate flow split values are most important, since they flow to separate downstream collection systems and discharge to separate Orange County Sanitation District (OC San) trunk sewers.

Table 1 – Existing and Proposed Manhole Flow Loading

Manhole Number	Existing/ Proposed	Units			Flow Factor (gpd/unit)	Exsiting Flow Rate (gpd)	Proposed Flow Rate (gpd)
		Acres	DU	ksf			
Existing Manhole Flow Loading							
SW096101							
Commercial - Auto Dealership	Exisiting	1.45			1,700	2,470	-
SW086205							
Commercial - Auto Dealership	Existing	1.92			1,700	3,266	-
SW086216							
Commercial - Retail	Existing	1.30			1,700	2,210	-
SW086223							
Commercial - Auto Dealership	Existing	5.81			1,700	9,871	-
Total Existing Flow						**17,816**	-
Proposed Manhole Flow Loading							
SW096206							
Townhomes	Proposed		110		240	-	26,400
Commercial - Retail	Proposed			4.5	195	-	878
Total Flow to SW096206 on Ball Road							**27,278**
Average Flow Increase on Ball Road							**21,541**
SW086230							
Townhomes	Proposed		139		240	-	33,360
Total Flow to SW086230 on Anaheim Blvd.							**33,360**
Average Flow Increase on Anaheim Blvd.							**21,280**
Total Proposed Flow							**60,638**
Average Flow Increase							**42,821**

<u>Project Analysis</u>

The proposed project flows were analyzed separately for the sewage discharging to these two separate systems, Anaheim Blvd. and Ball Road.

<u>Anaheim Boulevard Analysis</u>

The Existing Condition Scenario plus the peak project flow over a 24-hour simulation period and the maximum depth-to-Diameter (d/D) ratios for the sewer collection system from the latest hydraulic model is shown in Table 2 for Anaheim Blvd. tributary flow. As seen in Table 2, there are deficiencies present in the southerly and northerly Katella Avenue lines for two sewer segments between Walnut and 9th Street and three segments just upstream of Disneyland Drive.

The sewer system manholes are shown in detail in the immediate vicinity of the project on Figure 1 with manhole numbers corresponding to the Upstream and Downstream IDs in Table 2. The entire downstream sewer collection system is shown graphically on Figure 2 with manhole numbers labeled at key locations.

Flow from the project runs southerly on Anaheim Blvd., westerly in Midway Drive, southerly in Harbor Blvd. and westerly in Katella Avenue to Euclid Street. The model pipe alignment was adjusted to match manhole locations found on Google Earth street view on Anaheim Blvd. adjacent to the project, where the project is proposed to discharge. The current model and district maps showed the pipe going to the westerly side of the street and then back to the easterly side. The as-builts provided had different lengths between manholes north of Palais Road compared to the distances found in Google Earth. The model was updated to match as-built slopes along Anaheim Blvd. On Harbor Blvd. there are two parallel sewers west of the 5 Freeway and Manchester Avenue. At manhole SW086326 on Manchester just east of Harbor, tributary flows split into an 18-inch line running down the west side of Harbor and a 15-inch down the east side. Both of these sewer lines connect to the northerly line on Katella Avenue and continue to flow westerly. The SCASS identified improvement projects that would free up capacity along the northerly Katella line. The developer of the 110 W. Midway project was conditioned to design and construct an improvement to divert flow from the north Katella line to the south line. The model was adjusted based on the currently recommended alternative from that preliminary design report (PDR) to send 100 percent of the flow, about 937 gpm, from the 15" easterly Harbor Blvd. line to the southerly Katella Avenue line. That PDR showed that flows downstream of the diversion manhole at Harbor and Katella are better balanced in terms improving available capacity and this sewer study assumes the diversion that is currently under design and is a condition of the development of the Midway project would be in place prior to occupancies on the subject project. Downstream of Harbor Blvd., the northerly line is 21-inch in diameter increasing to 24-inch at Disneyland Dr. It then increases to 27-inch after Walnut Street before discharging to the OC San trunk sewer system in Euclid Street. Downstream of Harbor Blvd. the southerly line is 24-inch all the way to Euclid where it also discharges to the OC San system. It should be noted that the southerly Katella line also has two diversion manholes, one at West Street and 9th Street. For the West Street diversion it goes to a 24-inch sewer that runs southerly down West Street and westerly in Elanor Drive and Wakefield Avenue to 9th Street where it connects to a 24-inch sewer running south in 9th Street to Orangewood Avenue where it discharges to an OC San trunk sewer.

From Table 1, the additional average flow from the Project tributary to the Anaheim Blvd. system totals 21,280 gpd, which converts to 37 gpm of additional peak flow using a peaking factor of 2.5 for residential. The flow splits approximately in half at SW086326 to the easterly and westerly Harbor lines and the easterly Harbor line is proposed to be diverted to the southerly Katella line. Therefore, the additional peak flow to each of the Katella lines is less than 18 gpm each. The proposed diversion improvement project at the Harbor and Katella intersection will essentially resolve existing plus near term capacity issues down to Walnut Street and the development is contributing less than an additional 0.5% of the design capacity in terms of flow to the deficient two reaches of sewer in the northerly Katella line just downstream of Walnut Street.

Downstream of the project there is a capacity deficient sewer segment on the northerly Katella Avenue line. There is a maximum d/D of 1.0, well above the d/D criteria of 0.75 for lines 12 inches in diameter and larger. Based on this analysis, the system has capacity deficiencies in the downstream collection system from the proposed project. However these deficiencies have come up in previous sewer studies and as a parallel system, if the northerly line does flow full, it will eventually spill into the southerly line at certain existing points where the parallel lines are interconnected and there should not be sewer spills.

The Buildout Condition Scenario plus the project flows and d/D ratios for the sewer collection system from the hydraulic model are shown in Table 3. As seen in Table 3, Buildout Scenario, there are deficiencies present in the southerly and northerly Katella Avenue line for thirteen sewer segments just upstream of Disneyland Drive and two segments between Walnut and 9th Street. However, ten of these segments have d/D ratios of 0.75 to 0.76, only slightly over the 0.75 criteria and three segments of the 24" deficient pipelines just upstream of Disneyland Drive have a max d/D of 0.80 which is an excess capacity of 254 gpm. The same parallel system in Katella Avenue line described above in the Existing Scenario applies to the Buildout Scenario as well. In the Buildout Scenario, the flows are slightly higher but the full flows shown are actually just over 1.0 with the highest Q over Q_{full} being only 1.07. So the hydraulic grade line will not surcharge these manholes appreciably and the sewer has 10 to 12 feet of cover in these reaches.

Ball Road Analysis

The Existing Condition Scenario plus the peak project flow over a 24-hour simulation period and the maximum depth-to-Diameter (d/D) ratios for the sewer collection system from the latest hydraulic model is shown in Table 4 for Ball Road tributary flow. The CAMPSS identified a 20 linear foot segment of 15-inch pipeline just downstream of where flow is diverted to the southerly Ball Road sewer via a 21-inch siphon on Lemon Street. The current model reflects changes made in the recent SCASS Ball Road System Update Tech Memo dated June 2020 where this pipeline was confirmed to have a diameter of 24-inches by City maintenance staff. There is a maximum d/D of 0.62 in this system, well below the d/D criteria of 0.75 for lines 12 inches in diameter and larger. Based on this analysis, the system has no capacity deficient pipelines in the downstream collection system due to development of the proposed project.

Flow from the project runs westerly on Ball Road from Technology Circle. There are two large diameter, parallel sewers in Ball Road west of Lemon Street. The project area is tributary to the southerly Ball Road pipeline downstream of Lemon Street, the northerly line is 18-inch in diameter increasing to 24-inch at Harbor Blvd. and then connecting to the southerly line at manhole SW075202. The southerly line is 24-inch from Lemon Street to Walnut Street where it increases to 33-inch and eventually discharges to the OC San trunk sewer system in Euclid Street.

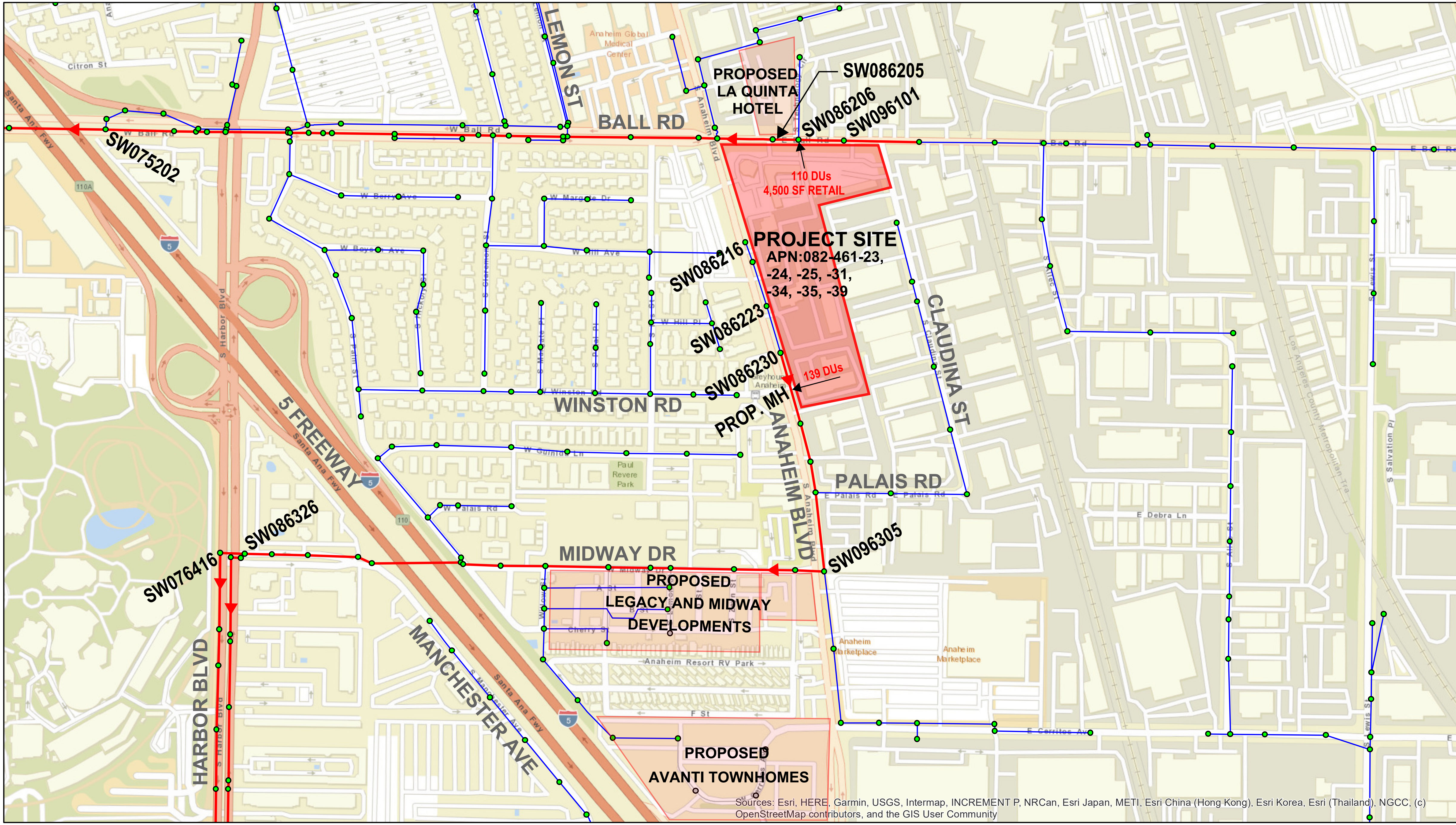
The Buildout Condition Scenario plus the project flows and d/D ratios for the sewer collection system from the hydraulic model are shown in Table 5. As seen in Table 5, Buildout Scenario, there are no deficiencies present in the Ball Road line. The same parallel system in Ball Road described above in the Existing Scenario applies to the Buildout Scenario as well. In the Buildout

Scenario, the corresponding southerly Ball Road sewer reach has a maximum d/D value of 0.66 downstream of Walnut Street, which is acceptable for a 33-inch pipe.

Conclusion

Sewer system improvements upstream of Harbor and Katella are not required for the proposed project consisting of 139 DUs discharging at Anaheim Blvd. However, model results show insufficient capacity within certain segments of the northerly Katella sewer of the parallel Katella system that are exacerbated by the increased sewer flow generated by the proposed project for both existing and buildout scenarios. The proposed project could move forward assuming the Midway project addresses the recommended diversion improvements at the Harbor and Katella intersection from the SCASS to alleviate these capacity deficient sewer segments. In the case that the Midway project fails to move ahead of this development, then the deficiencies would need to be addressed by the proposed project. Sewer system improvements are not required on Ball Road due to the development of the proposed project consisting of 110 DUs, and 4,500sf retail space tributary to that system.

Attachments: Figures 1 & 2, Tables 2 through 5, Site Plan Exhibit TM-8 and TM-9

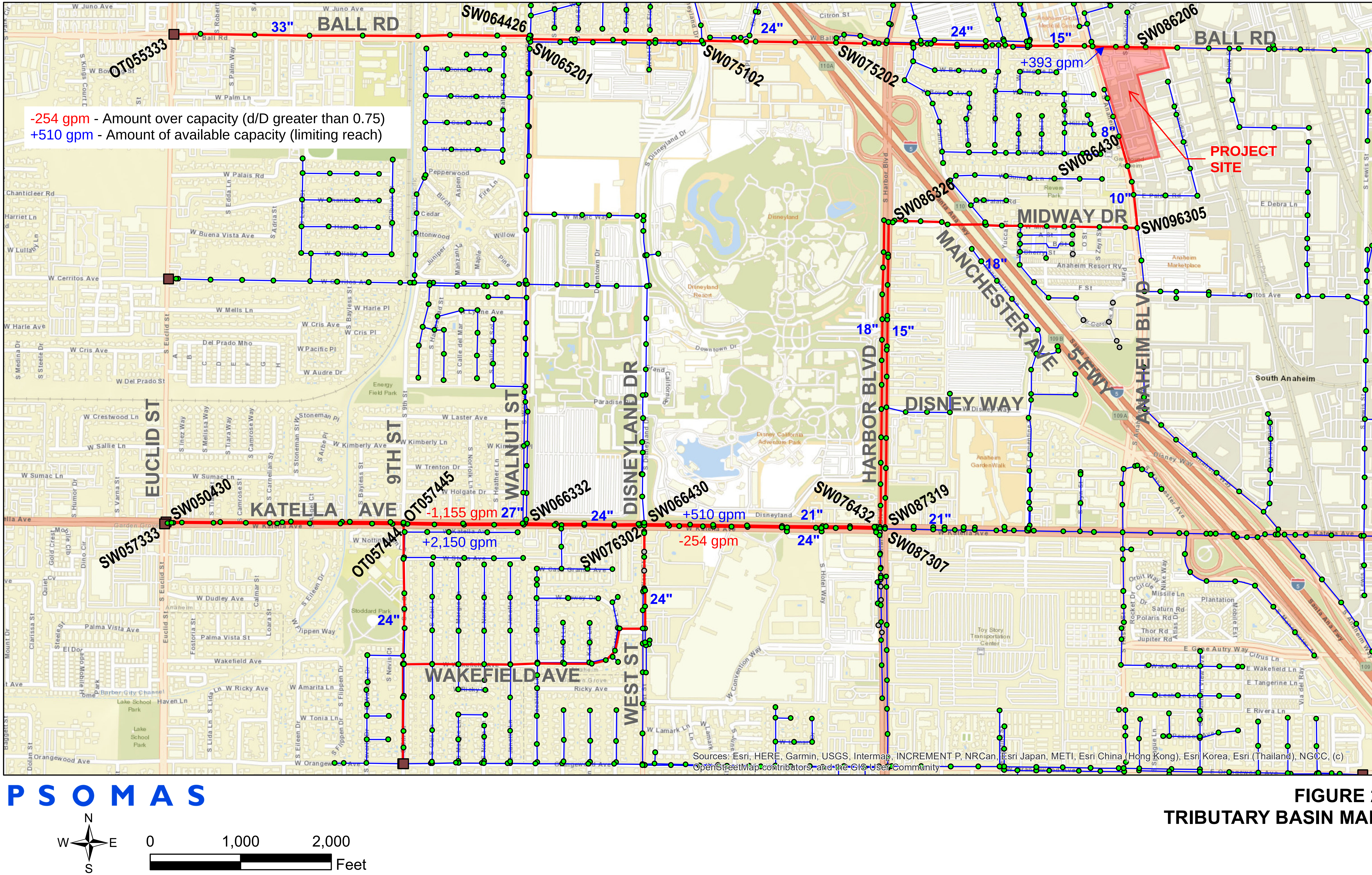


PSOMAS

N W E S

0 500 1,000 Feet

FIGURE 1
LOCATION MAP



PSOMAS

FIGURE 2
TRIBUTARY BASIN MAP

Table 2 - Existing Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D Ratio
ANAHEIM BLVD	Winston	SW086230-SW096115	8	353	0.003	58	0.29
		SW096115-SW096301	8	279	0.003	58	0.29
	Palais	SW096301-SW096302	8	145	0.009	59	0.30
		SW096302-SW096305	8	368	0.003	93	0.32
MIDWAY DR	Anaheim	SW096305-SW086411	12	135	0.006	161	0.27
		SW086411-SW086409	12	284	0.002	194	0.37
	Zeyn	SW086409-SW086408	12	292	0.002	194	0.37
	Lemon	SW086408-SW086407	12	93	0.003	194	0.35
		SW086407-SW086406	15	196	0.002	202	0.28
	Clementine	SW086406-SW086405	15	292	0.002	202	0.27
	Willow	SW086405-SW086313	15	207	0.002	474	0.43
	Yucca	SW086313-SW086312	15	174	0.001	480	0.51
	5-FWY	SW086312-SW086321	15	14	0.023	480	0.24
		SW086321-SW086322	18	412	0.002	601	0.39
MANCHESTER AVE		SW086322-SW086323	18	70	0.002	601	0.39
		SW086323-SW086324	18	232	0.002	601	0.40
		SW086324-SW086325	18	167	0.002	601	0.40
		SW086325-SW086326	18	126	0.002	681	0.42
EASTERLY HARBOR		SW086326-SW086327	15	26	0.003	328	0.32
		SW086327-SW086309	15	46	0.002	328	0.38
		SW086309-SW086310	15	357	0.002	328	0.37
		SW086310-SW065317	15	31	0.002	328	0.37
		SW065317-SW086311	15	306	0.002	450	0.44
		SW086311-SW087101	15	339	0.002	517	0.48
		SW087101-SW087102	15	41	0.002	567	0.50
		SW087102-SW087103	15	297	0.002	609	0.52
		SW087103-SW087104	15	43	0.002	633	0.54
		SW087104-SW087105	15	291	0.001	670	0.56
		SW087105-SW087106	15	340	0.001	693	0.62
	Disney	SW087106-SW087304	15	340	0.001	755	0.60
		SW087304-SW087305	15	330	0.003	850	0.61
		SW087305-SW087306	15	333	0.002	899	0.63
		SW087306-SW087319	15	319	0.005	901	0.63
	Harbor	SW087319-SW087307	15	19	0.015	901	0.37
WESTERLY HARBOR		SW086326-SW076416	18	114	0.011	353	0.19
		SW076416-SW075417	18	355	0.002	353	0.29
		SW075417-SW076418	18	167	0.005	840	0.37
		SW076418-SW076419	18	297	0.001	840	0.37
		SW076419-SW076420	18	276	0.002	840	0.52
		SW076420-SW076421	18	226	0.001	840	0.52
		SW076421-SW076422	18	228	0.001	839	0.52
		SW076422-SW076423	18	270	0.001	839	0.52
		SW076423-SW076224	18	267	0.001	839	0.58
	Disney	SW076224-SW076425	18	312	0.002	839	0.49
		SW076425-SW076402	18	189	0.002	839	0.47
		SW076402-SW076403	18	238	0.002	839	0.46
		SW076403-SW076404	18	236	0.002	839	0.46
	Katella	SW076404-SW076432	18	235	0.003	840	0.41

Table 2 cont. - Existing Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D Ratio
NORTHERLY KATELLA	Harbor	SW087319-SW076432	21	56	0.002	-	0.00
		SW076432-SW076431	21	41	0.002	840	0.39
		SW076431-SW076430	21	23	0.053	840	0.17
		SW076430-SW076429	21	267	0.002	840	0.39
		SW076429-SW076428	21	265	0.002	920	0.41
		SW076428-SW076427	21	39	0.018	921	0.23
		SW076427-SW076417	21	449	0.002	930	0.41
		SW076417-SW076312	21	384	0.002	1,094	0.45
		SW076312-SW076311	21	374	0.002	1,833	0.62
		SW076311-SW076310	21	253	0.002	1,833	0.62
		SW076310-SW076309	21	249	0.002	1,833	0.62
		SW076309-SW066430	21	261	0.002	1,833	0.62
	Disneyland	SW066430-SW066424	24	44	0.002	2,560	0.61
		SW066424-SW066428	24	19	0.002	2,289	0.57
		SW066428-SW066427	24	265	0.002	2,289	0.57
		SW066427-SW066423	24	332	0.002	2,289	0.57
		SW066423-SW066426	24	314	0.002	2,289	0.57
		SW066426-SW066332	24	340	0.002	2,289	0.57
	Walnut	SW066332-OT066331	24	25	0.002	2,377	0.58
		OT066331-OT066329	27	661	0.002	5,355	1.00
		OT066329-OT057445	27	658	0.002	5,355	1.00
	9th	OT057445-OT057447	27	143	0.009	5,351	0.49
		OT057447-OT057448	27	450	0.008	5,351	0.49
		OT057448-OT057449	27	83	0.014	5,351	0.42
		OT057449-OT057450	27	566	0.005	5,352	0.57
		OT057450-OT057342	27	98	0.005	5,368	0.57
		OT057342-OT057339	27	681	0.005	5,368	0.57
	Euclid	OT057339-SW050430	27	603	0.007	5,368	0.53
SOUTHERLY KATELLA	Harbor	SW087307-SW076411	24	56	0.002	2,664	0.60
		SW076411-SW076424	24	52	0.002	2,664	0.60
		SW076424-SW076410	24	278	0.002	3,325	0.70
		SW076410-SW076409	24	159	0.002	3,326	0.70
		SW076409-SW076408	24	159	0.002	3,340	0.71
	Hotel	SW076408-SW076407	24	60	0.002	3,375	0.71
		SW076407-SW076405	24	318	0.002	3,374	0.71
		SW076405-SW076433	24	56	0.002	3,399	0.72
		SW076433-SW076308	24	379	0.002	3,399	0.72
		SW076308-SW076307	24	176	0.002	3,399	0.72
		SW076307-SW076306	24	202	0.002	3,399	0.72
		SW076306-SW076305	24	113	0.002	3,399	0.72
		SW076305-SW076304	24	262	0.002	3,597	0.75
		SW076304-SW076303	24	110	0.002	3,597	0.75
		SW076303-SW076302	24	279	0.002	3,597	0.75
	Disneyland	SW076302-SW066417	24	53	0.002	955	0.34
		SW066417-SW066422	24	276	0.002	1,226	0.38
		SW066422-SW066421	24	331	0.002	1,234	0.38
		SW066421-SW066420	24	250	0.002	1,254	0.39
		SW066420-SW066419	24	80	0.002	1,421	0.42

Table 2 cont. - Existing Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D Ratio
SOUTHERLY KATELLA	Walnut	SW066419-SW066418	24	338	0.002	1,421	0.42
		SW066418-SW066328	24	329	0.002	1,421	0.42
		SW066328-SW066327	24	331	0.002	1,421	0.42
		SW066327-SW066325	24	327	0.002	1,422	0.42
		SW066325-SW066324	24	299	0.002	1,422	0.42
	9th	SW066324-OT057444	24	43	0.002	1,422	0.42
		OT057444-SW057450	24	120	0.002	819	0.31
		SW057450-SW057442	24	225	0.002	819	0.31
		SW057442-SW057441	24	350	0.002	849	0.32
		SW057441-SW057440	24	338	0.002	849	0.32
		SW057440-SW057341	24	362	0.002	861	0.32
		SW057341-SW057340	24	79	0.002	861	0.32
		SW057340-SW057339	24	267	0.002	885	0.32
		SW057339-SW057338	24	356	0.002	885	0.32
		SW057338-SW057337	24	350	0.002	885	0.32
		SW057337-SW057336	24	94	0.002	885	0.32
		SW057336-SW057335	24	19	0.033	885	0.16
		SW057335-SW057334	24	44	0.007	885	0.23
	Euclid	SW057334-SW057333	24	36	0.007	885	0.23

Table 3 - Buildout Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D
ANAHEIM BLVD	Winston	SW086230-SW096115	8	353	0.003	59	0.29
		SW096115-SW096301	8	279	0.003	59	0.29
	Palais	SW096301-SW096302	8	145	0.009	60	0.30
		SW096302-SW096305	8	368	0.003	103	0.34
MIDWAY DR	Anaheim	SW096305-SW086411	12	135	0.006	187	0.29
		SW086411-SW086409	12	284	0.002	220	0.39
	Zeyn	SW086409-SW086408	12	292	0.002	220	0.39
	Lemon	SW086408-SW086407	12	93	0.003	220	0.38
		SW086407-SW086406	15	196	0.002	230	0.30
	Clementine	SW086406-SW086405	15	292	0.002	230	0.29
	Willow	SW086405-SW086313	15	207	0.002	509	0.45
	Yucca	SW086313-SW086312	15	174	0.001	515	0.53
	5-FWY	SW086312-SW086321	15	14	0.023	515	0.25
		SW086321-SW086322	18	412	0.002	643	0.41
MANCHESTER AVE		SW086322-SW086323	18	70	0.002	643	0.40
		SW086323-SW086324	18	232	0.002	643	0.41
		SW086324-SW086325	18	167	0.002	643	0.41
		SW086325-SW086326	18	126	0.002	768	0.45
EASTERLY HARBOR		SW086326-SW086327	15	26	0.003	362	0.34
		SW086327-SW086309	15	46	0.002	362	0.41
		SW086309-SW086310	15	357	0.002	362	0.39
		SW086310-SW065317	15	31	0.002	362	0.39
		SW065317-SW086311	15	306	0.002	484	0.46
		SW086311-SW087101	15	339	0.002	551	0.49
		SW087101-SW087102	15	41	0.002	601	0.52
		SW087102-SW087103	15	297	0.002	643	0.54
		SW087103-SW087104	15	43	0.002	666	0.55
		SW087104-SW087105	15	291	0.001	704	0.57
		SW087105-SW087106	15	340	0.001	729	0.65
	Disney	SW087106-SW087304	15	340	0.001	792	0.62
		SW087304-SW087305	15	330	0.003	886	0.63
		SW087305-SW087306	15	333	0.002	936	0.65
		SW087306-SW087319	15	319	0.005	937	0.65
	Harbor	SW087319-SW087307	15	19	0.015	937	0.38
WESTERLY HARBOR		SW086326-SW076416	18	114	0.011	406	0.21
		SW076416-SW075417	18	355	0.002	406	0.31
		SW075417-SW076418	18	167	0.005	893	0.38
		SW076418-SW076419	18	297	0.001	893	0.54
		SW076419-SW076420	18	276	0.002	893	0.54
		SW076420-SW076421	18	226	0.001	893	0.54
		SW076421-SW076422	18	228	0.001	893	0.54
		SW076422-SW076423	18	270	0.001	893	0.54
		SW076423-SW076224	18	267	0.001	893	0.60
	Disney	SW076224-SW076425	18	312	0.002	893	0.50
		SW076425-SW076402	18	189	0.002	893	0.48
		SW076402-SW076403	18	238	0.002	893	0.48
		SW076403-SW076404	18	236	0.002	893	0.48
	Katella	SW076404-SW076432	18	235	0.003	894	0.42

Table 3 cont. - Buildout Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D
NORTHERLY KATELLA	Harbor	SW087319-SW076432	21	56	0.002	-	0.00
		SW076432-SW076431	21	41	0.002	894	0.40
		SW076431-SW076430	21	23	0.053	893	0.17
		SW076430-SW076429	21	267	0.002	894	0.40
		SW076429-SW076428	21	265	0.002	974	0.42
		SW076428-SW076427	21	39	0.018	975	0.23
		SW076427-SW076417	21	449	0.002	984	0.43
		SW076417-SW076312	21	384	0.002	1,148	0.46
		SW076312-SW076311	21	374	0.002	1,887	0.63
		SW076311-SW076310	21	253	0.002	1,887	0.63
		SW076310-SW076309	21	249	0.002	1,887	0.63
		SW076309-SW066430	21	261	0.002	1,887	0.63
	Disneyland	SW066430-SW066424	24	44	0.002	2,610	0.61
		SW066424-SW066428	24	19	0.002	2,336	0.58
		SW066428-SW066427	24	265	0.002	2,336	0.57
		SW066427-SW066423	24	332	0.002	2,336	0.57
		SW066423-SW066426	24	314	0.002	2,336	0.57
		SW066426-SW066332	24	340	0.002	2,336	0.57
	Walnut	SW066332-OT066331	24	25	0.002	2,429	0.59
		OT066331-OT066329	27	661	0.002	5,553	1.00
		OT066329-OT057445	27	658	0.002	5,553	1.00
	9th	OT057445-OT057447	27	143	0.009	5,547	0.50
		OT057447-OT057448	27	450	0.008	5,547	0.50
		OT057448-OT057449	27	83	0.014	5,547	0.43
		OT057449-OT057450	27	566	0.005	5,548	0.58
		OT057450-OT057342	27	98	0.005	5,566	0.58
		OT057342-OT057339	27	681	0.005	5,566	0.58
	Euclid	OT057339-SW050430	27	603	0.007	5,566	0.54
SOUTHERLY KATELLA	Harbor	SW087307-SW076411	24	56	0.002	2,845	0.63
		SW076411-SW076424	24	52	0.002	2,845	0.63
		SW076424-SW076410	24	278	0.002	3,594	0.75
		SW076410-SW076409	24	159	0.002	3,652	0.76
		SW076409-SW076408	24	159	0.002	3,666	0.76
	Hotel	SW076408-SW076407	24	60	0.002	3,666	0.76
		SW076407-SW076405	24	318	0.002	3,666	0.76
		SW076405-SW076433	24	56	0.002	3,666	0.76
		SW076433-SW076308	24	379	0.002	3,666	0.76
		SW076308-SW076307	24	176	0.002	3,666	0.76
		SW076307-SW076306	24	202	0.002	3,666	0.76
		SW076306-SW076305	24	113	0.002	3,666	0.76
		SW076305-SW076304	24	262	0.002	3,864	0.80
		SW076304-SW076303	24	110	0.002	3,864	0.80
		SW076303-SW076302	24	279	0.002	3,864	0.80
	Disneyland	SW076302-SW066417	24	53	0.002	1,003	0.34
		SW066417-SW066422	24	276	0.002	1,277	0.39
		SW066422-SW066421	24	331	0.002	1,285	0.39
		SW066421-SW066420	24	250	0.002	1,305	0.40
		SW066420-SW066419	24	80	0.002	1,475	0.42

Table 3 cont. - Buildout Land Use Scenario Plus Project - Anaheim Blvd. System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D
SOUTHERLY KATELLA	Walnut	SW066419-SW066418	24	338	0.002	1,475	0.42
		SW066418-SW066328	24	329	0.002	1,475	0.42
		SW066328-SW066327	24	331	0.002	1,475	0.42
	9th	SW066327-SW066325	24	327	0.002	1,476	0.42
		SW066325-SW066324	24	299	0.002	1,476	0.42
		SW066324-OT057444	24	43	0.002	1,476	0.42
		OT057444-SW057450	24	120	0.002	845	0.31
		SW057450-SW057442	24	225	0.002	845	0.31
		SW057442-SW057441	24	350	0.002	878	0.32
		SW057441-SW057440	24	338	0.002	878	0.32
		SW057440-SW057341	24	362	0.002	891	0.32
		SW057341-SW057340	24	79	0.002	891	0.32
		SW057340-SW057339	24	267	0.002	916	0.33
		SW057339-SW057338	24	356	0.002	916	0.33
		SW057338-SW057337	24	350	0.002	916	0.33
		SW057337-SW057336	24	94	0.002	916	0.33
		SW057336-SW057335	24	19	0.033	916	0.16
		SW057335-SW057334	24	44	0.007	916	0.24
	Euclid	SW057334-SW057333	24	36	0.007	916	0.24

Table 4 - Existing Land Use Scenario Plus Project - Ball Road System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D Ratio
BALL ROAD	Technology Cir	SW086206-SW086205	15	120	0.002	603.8	0.49
		SW086205-SW086204	15	257	0.002	607.3	0.51
	Anaheim Blvd	SW086204-SW086203	15	87	0.004	640.7	0.45
		SW086203-SW086202	15	314	0.003	640.7	0.48
		SW086202-ADDED MH	15	294	0.003	645.1	0.48
	Lemon St	ADDED MH-SW086201	24	20	0.003	1,696.1	0.41
		SW086201-SW086108	24	250	0.001	1,698.2	0.51
		SW086108-SW086107	24	75	0.001	1,698.2	0.51
	Claremont St	SW086107-SW086106	24	66	0.001	1,728.4	0.51
		SW086106-SW086105	24	390	0.001	1,728.4	0.51
		SW086105-SW086104	24	290	0.001	1,730.6	0.51
		SW086104-SW086103	24	41	0.001	1,730.6	0.51
		SW086103-SW086102	24	66	0.001	1,730.6	0.51
		SW086102-SW086101	24	87	0.001	1,730.5	0.52
	Palm St	SW086101-SW086133	24	10	0.001	1,841.6	0.53
		SW086133-SW075204	24	289	0.001	1,841.6	0.53
	Harbor Blvd	SW075204-SW075206	24	86	0.002	1,841.6	0.52
		SW075206-SW075203	24	50	0.002	1,841.6	0.52
		SW075203-SW075205	24	102	0.001	2,224.2	0.59
		SW075205-SW075202	24	319	0.001	2,255.2	0.59
		SW075202-SW075201	24	447	0.003	2,916.2	0.55
		SW075201-SW075104	24	437	0.004	2,916.2	0.51
		SW075104-SW075103	24	108	0.004	2,916.2	0.51
		SW075103-SW075102	24	489	0.004	2,916.2	0.50
	Disneyland Dr	SW075102-SW075101	24	510	0.004	2,921.6	0.52
		SW075101-SW065203	24	468	0.004	2,921.6	0.51
		SW065203-SW065215	24	420	0.004	2,921.6	0.51
		SW065215-SW065202	24	40	0.004	2,921.6	0.51
		SW065202-SW065201	24	454	0.004	2,921.6	0.51
	Walnut St	SW065201-SW064427	33	39	0.003	7,239.2	0.61
		SW064427-SW064426	33	9	0.005	7,423.6	0.50
		SW064426-SW064317	33	357	0.005	7,423.6	0.50
		SW064317-SW064316	33	521	0.005	7,423.6	0.50
		SW064316-OT064315	33	353	0.005	7,423.5	0.50
		OT064315-OT055436	33	613	0.003	7,423.4	0.62
		OT055436-OT055435	33	586	0.003	7,423.3	0.62
		OT055435-OT055336	33	603	0.003	7,423.2	0.62
		OT055336-OT055334	33	599	0.003	7,423.2	0.62
	Euclid St	OT055334-OT055333	33	296	0.003	7,423.1	0.62

Table 5 - Buildout Land Use Scenario Plus Project - Ball Road System

Street	Cross Street	Upstrm MH-Dwnstrm MH	Size (in)	Length (ft)	Slope (ft/ft)	Peak Flow (gpm)	d/D
BALL ROAD	Technology Cir	SW086206-SW086205	15	120	0.002	677.3	0.53
		SW086205-SW086204	15	257	0.002	680.7	0.55
	Anaheim Blvd	SW086204-SW086203	15	87	0.004	715.6	0.48
		SW086203-SW086202	15	314	0.003	715.6	0.51
		SW086202-ADDED MH	24	294	0.003	720.9	0.51
	Lemon St	ADDED MH-SW086201	24	20	0.003	1,862.5	0.43
		SW086201-SW086108	24	250	0.001	1,864.7	0.54
		SW086108-SW086107	24	75	0.001	1,864.6	0.54
	Claremont St	SW086107-SW086106	24	66	0.001	1,897.8	0.54
		SW086106-SW086105	24	390	0.001	1,897.8	0.54
		SW086105-SW086104	24	290	0.001	1,900.4	0.54
		SW086104-SW086103	24	41	0.001	1,900.4	0.54
		SW086103-SW086102	24	66	0.001	1,900.4	0.54
		SW086102-SW086101	24	87	0.001	1,900.3	0.55
	Palm St	SW086101-SW086133	24	10	0.001	2,017.2	0.56
		SW086133-SW075204	24	289	0.001	2,017.2	0.57
	Harbor Blvd	SW075204-SW075206	24	86	0.002	2,017.2	0.55
		SW075206-SW075203	24	50	0.002	2,017.1	0.55
		SW075203-SW075205	24	102	0.001	2,427.8	0.62
		SW075205-SW075202	24	319	0.001	2,458.7	0.63
		SW075202-SW075201	24	447	0.003	3,169.9	0.58
		SW075201-SW075104	24	437	0.004	3,169.9	0.54
		SW075104-SW075103	24	108	0.004	3,169.9	0.54
		SW075103-SW075102	24	489	0.004	3,169.8	0.53
	Disneyland Dr	SW075102-SW075101	24	510	0.004	3,175.3	0.55
		SW075101-SW065203	24	468	0.004	3,175.2	0.54
		SW065203-SW065215	24	420	0.004	3,175.2	0.54
		SW065215-SW065202	24	40	0.004	3,175.2	0.54
		SW065202-SW065201	24	454	0.004	3,175.2	0.54
	Walnut St	SW065201-SW064427	33	39	0.003	7,809.2	0.65
		SW064427-SW064426	33	9	0.005	8,010.5	0.52
		SW064426-SW064317	33	357	0.005	8,010.5	0.52
		SW064317-SW064316	33	521	0.005	8,010.4	0.52
		SW064316-OT064315	33	353	0.005	8,010.3	0.52
		OT064315-OT055436	33	613	0.003	8,010.3	0.65
		OT055436-OT055435	33	586	0.003	8,010.1	0.65
		OT055435-OT055336	33	603	0.003	8,010.1	0.65
		OT055336-OT055334	33	599	0.003	8,010.0	0.65
	Euclid St	OT055334-OT055333	33	296	0.003	8,009.9	0.65

DEVELOPER :	REVISIONS					
NO.	DATE	INITIAL	DESCRIPTION		APP	DATE

DEVELOPER :

TOFFOLI INVESTMENTS, LLC

3 HUGHES, IRVINE, CALIFORNIA 92618

SOILS ENGINEER :

ALTA CALIFORNIA GEOTECHNICAL, INC.
170 N. MAPLE STREET, SUITE 108
CORONA, CA 92880
PHONE (951) 509-7090

PREPARED BY :

C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING
9830 IRVINE CENTER DRIVE
IRVINE, CALIFORNIA 92618
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REGISTERED PROFESSIONAL ENGINEER
DANE P. MCDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

TENTATIVE
TRACT MAP 19140
PRELIMINARY UTILITY PLAN

TM-8

DATE: 3/30/2022

SHEET 8 OF 12

SCALE: AS SHOWN | DRAWN BY: JM | CHECKED BY: JC

CITY OF ANAHEIM

NO.	DATE	INITIAL	DESCRIPTION		APP	DATE

REVISIONS

DEVELOPER :

TOFFOLI INVESTMENTS, LLC
3 HUGHES, IRVINE, CALIFORNIA 92618

SOILS ENGINEER :
ALTA CALIFORNIA GEOTECHNICAL, INC.
170 N. MAPLE STREET, SUITE 108
CORONA, CA 92880
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PREPARED BY :
C&V CONSULTING, INC.
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9830 IRVINE CENTER DRIVE
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REGISTERED PROFESSIONAL ENGINEER
DANE P. MCDOUGALL
C 80705
CIVIL
STATE OF CALIFORNIA

TENTATIVE TRACT MAP 19140
FIRE ACCESS PLAN

TM-9
DATE: 3/23/2022
SHEET 9 OF 12

SCALE: AS SHOWN
DRAWN BY: JM
CHECKED BY: JC

CITY OF ANAHEIM

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