Appendix K – Preliminary Hydrology and Water Quality Report

PRELIMINARY HYDROLOGY AND WATER QUALITY REPORT

for

Spieker Senior Continuing Care Community

850 Seven Hills Ranch Rd, Walnut Creek 94598
Permit Number: DP20-3018 & MS20-007

7/31/2020
Revised 02/17/2021

Spieker Development Partners
2 Las Estrellas Loop
Rancho Mission Viejo, CA 92694

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A. Introduction

Spieker Development Partners is proposing the development of a self-contained continuing care retirement community, or CCRC, offering continuing care contracts that provide for housing, resident services, and long-term nursing care for a resident's lifetime.

The purpose of this technical memorandum is to identify preliminary storm drainage infrastructure basis of design needed to serve the proposed Project.

B. Proposed Project

The CCRC project will include two main components: (1) Up to 360 Independent Living Units and amenities for residents capable of residing in the community without daily assistance; and (2) a Health Care Center for residents requiring daily assistance or daily medical attention, including up to 100 total skilled nursing, memory care, and assisted living units. The Project Improvements will include two types of independent living buildings: "apartment" style buildings and "cottage" style buildings that will be single-story in design and arranged along the south, west, and north perimeter of the Project Site, and adjoining the central drainage swale. The improvements also include a Clubhouse, Recreation Building, Maintenance Building, Health Care Center, and outdoor amenities to serve the needs of all CCRC residents. Site grading and construction of all buildings and improvements will be completed in a single "phase" over a total period of approximately 3-4 years.

C. Existing Storm Drainage

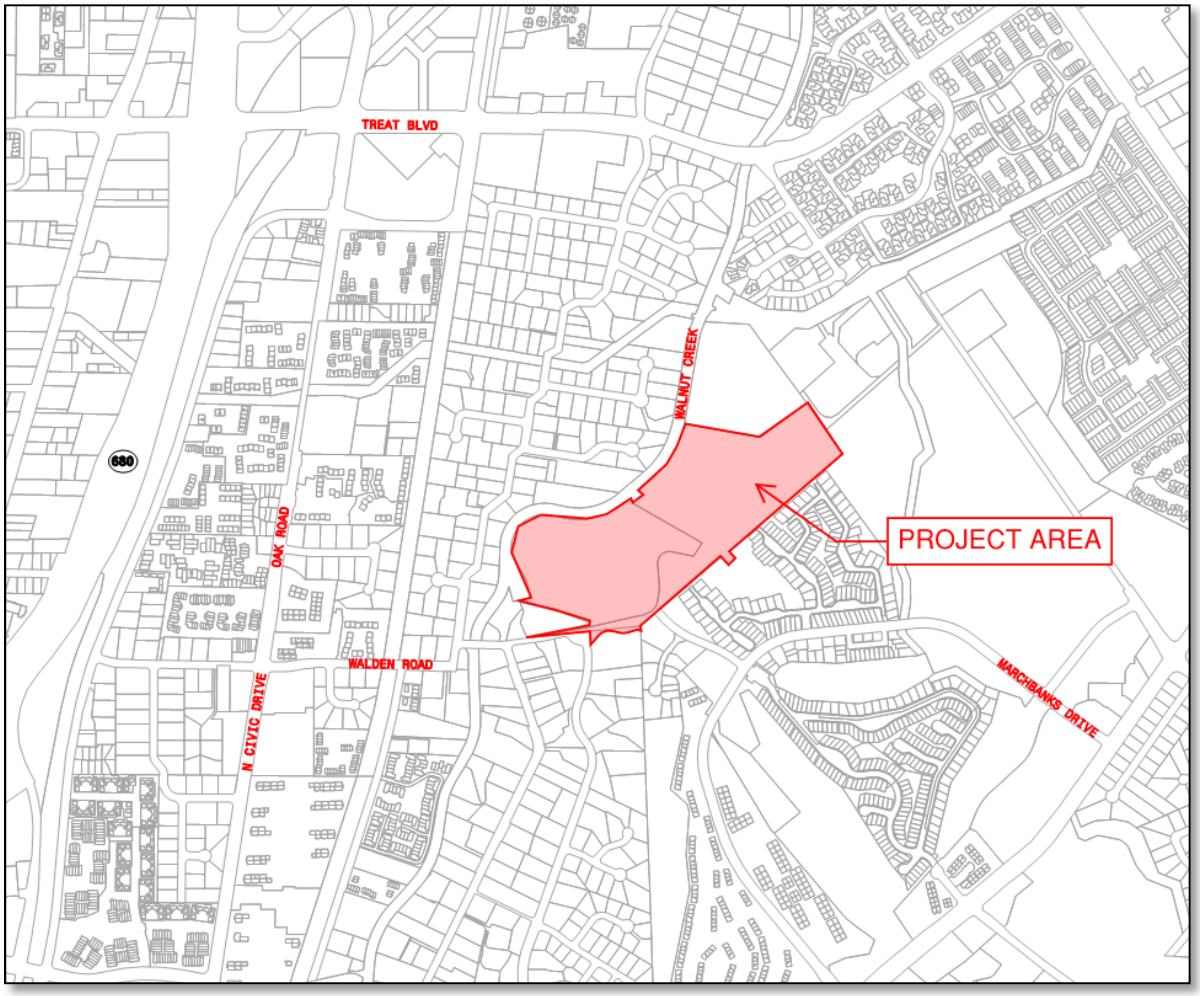
The existing drainage system is made up of natural channels, pipe culverts, and hillside sheet flow with approximately eight watersheds that outfall directly to the Walnut Creek Channel and to a surface drainage swale that enters Walnut Creek Channel north of the Contra Costa Canal. All of the existing culverts and outfalls to the Walnut Creek are at least 20' below the lowest design building lot elevation. There are total of six ultimate outfalls. These include:

1. To the west, runoff makes its way to a natural channel that feeds to a large concrete inlet structure within a Flood Control Easement that feeds into the Walnut Creek by way of a dual-box concrete culvert, noted as Outfall 1 in the appendices.
2. Along the north, the hills sheet flow offsite into the Lands of Contra Costa County Flood Control, where the maintenance road's roadside ditch collects the runoff and directs it into the channel with outfalls within the wall of the channel structure (noted as Outfall 2 in the appendices).
3. In the center of the site is a natural drainage channel that collects water from the largest shed in the project area, as well as approximately 15± acres of offsite area from the subdivision area to the south (noted as Outfall 3 in the appendices).
4. To the east, a small portion drains towards the Seven Hills School, noted as Outfall 4 in the appendices.
5. To the east, 1.05 acres sheet flows onto a separate portion of the Seven Hills School, noted as Outfall 5 in the appendices.

6. Also to the east is a shed of 6.28 acres that sheet flows onto two parcels owned by Walnut Creek (North San Carlos Road and the Equestrian Center parking lot), noted as Outfall 6 in the appendices.

   See **Appendix A** for a figure showing the site's existing drainage patterns, six main points of discharge and contributing offsite sheds.

Figure 1 – Vicinity Map



D. Proposed Drainage System

The proposed drainage system is designed to convey the 10-year design storm in the storm pipe with a hydraulic grade line below the rim of the structure. For storms larger than the 10-year event, including runoff from the 100-year storm runoff will be carried in the street. Low points in the street and terrain, where overland release or conveyance will flood property or has potential to damage surrounding areas, will be intercepted and conveyed in the storm system. The Contra Costa County drainage guidelines will be used to size the proposed storm drain system. Existing drainage patterns will be maintained by providing outlets from the storm drain system to existing

points of discharge and detaining as required to not exceed pre-project runoff. Given the project's design elevations and detention of additional runoff, we do not anticipate water levels in the Walnut Creek affecting the projects drainage design, nor do we anticipate requiring flap gates.

The project will convey stormwater from roof areas and paved surfaces to bioretention facilities and flow through planters for treatment. Raised planters and in-ground bioretention facilities will collect runoff from roofs and interior courtyards. Streets will sheet flow to bioretention facilities in landscape areas. Bioretention facilities will be sized to provide detention, (see Section D.2).

Existing Kinross Drive drains to an inlet at the low point of the cul-de-sac which outfalls into a natural channel which runs along Seven Hills Ranch Road and crosses Homestead Avenue through a culvert. The off-site stormwater draining toward the Kinross Drive extension will be collected by inlets at the conform locations. The drainage will outfall on the south of the property into an interceptor ditch that is directed to the existing culvert under Homestead Avenue.

On the northerly end of the Project Site where the Health Care Center is planned, stormwater flows offsite to North San Carlos Drive and the Equestrian Center of Walnut Creek gravel parking lot. These two areas do not currently contain underground drainage systems. The project proposes to pipe the runoff off site and discharge to the existing drainage channel crossing North San Carlos Drive.

The proposed outfall includes approximately 1,000 linear feet of storm pipe off site. The design includes careful consideration of minimum pipe size, slope, and crossing conflicts. All design criteria are according to the City of Walnut Creek's Minimum Drainage standards. The project will oversize detention to ensure that the proposed condition does not produce additional flow to these two areas. The complete design of the outfall can be seen in the outfall memorandum (**See Appendix B**).

D.1 Stormwater Basis of Design

The following summarizes the criteria and parameters will be used for hydrologic and hydraulic analyses and for designing of storm drain system.

Design Runoff: Determination of site design runoff flow rates are based on the Rational Method. The Rational Method is defined as Q = C I A, where:

Q = peak flow (cfs)
C = runoff coefficient factor
I = rainfall intensity (in/hr)
A = area (acres)

Design Storm: All drainage facilities (i.e., inlets, pipes, ditches, street conveyance, outfalls) are evaluated using a 100-year design storm event as noted above.

Hydromodification: The project is subject to hydromodification requirements. While Walnut Creek is a hardened channel at the point of discharge from the project, this is not the case continuously to the Bay. Walnut Creek changes from a hardened channel to a natural channel downstream of Bancroft Road.

Datum: *Project plans and design* calculations will be based on NAVD 88 datum. The horizontal datum is California State Plane Zone III.

Computer Software: Bentley StormCAD V8i will be used to evaluate the performance of the proposed underground storm drainage pipe. This program is a Rational Method based program with hydraulic analysis for both free flow and pressure flow conditions.

Time of Concentration: The minimum time-of-concentration used is 5 minutes. A 5 minute time-of-concentration is also used where only streets are contributing flow to the inlet. Additional time-of-concentration for sheet flow across hillside and from gutter to the inlet will be calculated using Kirpich's equation provided below. The total initial time-of-concentration is used for evaluating inlet capacity. The storm drain system time-of-concentration is computed by the StormCAD program at different nodes using actual pipe flow velocity.

$$T_c = 0.0078 \left(\frac{L^{3/2}}{H^{1/2}} \right)^{0.77}$$

where: L = the maximum length of travel, in feet.
H = the difference in elevation along the effective slope line, in feet.
Tc = the additional time of concentration from gutter to inlet, in minutes

Rainfall Intensity: The Project site has a mean annual precipitation of 18.5-inches. The County Mean Annual Precipitation Map (MAP) and the Duration-Frequency-Depth curves were used to estimate the 10 and 100-year intensity. The resulting Intensity-Duration-Frequency curves were found and used in the rational equation.

Runoff Coefficient: Site soil conditions from the United Stated Natural Resources Conservation Service (NRCS) Web Soil Survey are utilized for the analyses. The soils within the developments drainage area are primarily classified as Hydrologic Soils Group D. The NRCS Curve Number (CN) method was used to determine rainfall excess. Antecedent moisture condition II (AMC II) was used for all drainage areas. A Curve Number of 80 was used for Residential land uses with Hydrologic Soils Group D.

Roughness Coefficient: A Manning's roughness coefficient of 0.013, 0.011 and 0.024 is used for concrete pipe, HDPE/PVC, and CMP pipes, respectively.

Head Losses: Head losses will be calculated using the HEC-22 energy method which considers bend angles, change in flow rate and change in pipe size.

Inlet Design: Inlet location and size will be based on the amount of flow that needs to be intercepted to maintain at least a 10-ft dry lane for access. Another factor that governs inlet design is the geometric design of the roadway. An inlet is required where the roadway transitions from a crowned street to a super elevated street and vice versa. Inlet interception capacity is based on inlet equations published in the Federal Highway Administration's Hydraulic

Engineering Circular No. 22 (HEC-22) Urban Drainage Design Manual. On steep gutter slopes where flow reaches high velocity, side opening inlets are used as they are efficient in capturing the entire flow approaching the inlet.

Offsite Drainage Delineations: The Contra Costa County Lidar in combination with project topographic survey, City block maps, GIS system information, and, parcel data, were used to delineate the offsite drainage areas tributary to the project. Please refer to **Appendices A and B** for offsite drainage area delineations.

Hydrologic Model: The analyses utilizes XPSWMM dynamic flow model to calculate runoff hydrographs and to analyze stage, storage, infiltration, and discharge as a function of time throughout the storm event. Nodes are used to define inlets, storage areas, manholes and other junctions. Links are used to define pipes, channels and roadways. The XPSWMM hydraulic engine solves the complete St. Venant (Dynamic Flow) equations for gradually varied, one dimensional, unsteady flow throughout the drainage network. The calculations accurately models backwater effects, reverse flow, surcharging, and pressure flow. The model allows for looped system with multiple connections and accounts for storage in conduits (**See Appendix C**).

Channel and Overland Flow Roughness: The following Manning's Roughness coefficients were used for the surface flow conveyance:

Ditch/Swale/Channel – 0.06
Asphalt – 0.013

Tailwater Conditions – Free outfall condition was assumed due to relative elevation different between proposed project elevations and existing outfall elevations.

D.2 Hydrologic and Hydraulic Analyses

The existing site is undeveloped and relatively steep with six distinct points of discharge, and is being redeveloped to flatten large portions of the site and replace with roofs and paved surfaces. In order to understand the impact of post-project runoff quantities, a dynamic model such as XPSWMM is used to conduct hydrologic and hydraulic analyses for pre- and post-project conditions.

The analyses utilizes XPSWMM dynamic flow model to calculate runoff hydrographs and to analyze stage, storage, infiltration, and discharge as a function of time throughout the storm event. Nodes are used to define inlets, storage areas, manholes and other junctions. Links are used to define pipes, channels and roadways. The existing system information was derived from field survey, County aerial survey, city utility maps and field observations.

The analyses utilizes a 10 and 100-year design storm to evaluate the storm drain system, overland flow, and ponding depths. The County Storm Drain Design Criteria was used to calculate the runoff generated from different tributary drainage areas, time-of-concentration, and storm intensities. Please refer to **Appendix C** for discussion about model setup and the parameters used for the analyses.

Analyses Results

The analyses show that the post-project conditions increase peak runoff in both the 10 and 100-year storm events. **Appendix C** includes the XPSWMM analysis, which indicates the following detention requirements:

Outfall 1: 7,951 CF of detention
Outfall 2: No detention required
Outfall 3: 51 CF (100-year governs)
Outfall 4: No detention required
Outfall 5: No detention required
Outfall 6: 5,867 CF of detention

Treatment facilities have been preliminarily oversized to account for design changes and anticipation of detention requirements. Each bioretention area is assumed to be 15" lower than the surrounding grade with the outlet structure designed so that a maximum of 12" of ponding occurs. The typical 6" of ponding required in bioretention facilities and raised planters has not be accounted for in the storage provided. Instead, the 6" above the typical 6" of ponding used for treatment has been used in the storage calculations. In addition, the 40% void space in the 33" permeable rock section in accordance with Chapter 3 of the County C.3 guidebook has also been accounted for. The results shown in Table 1 below are the surface area and volume requirements provided by the IMP calculator (**See Appendix H**). The surface area and volume provided is a reflection of the treatment facilities shown in **Appendix B** with the typical sections described above. The requirements of the IMP calculator were greater than the results found in the XPSWMM model and have been shown here to represent the maximum surface area and volume requirements.

Table 1: Required Volume and Surface Area versus Provided Volume and Surface Area

Outfall #	DMA Area	Required Surface Area (SF)	Total Surface Area Provided (CF)	Required Detention Volume (CF)	Total Detention Volume Provided(CF)
1	1,8,9	14,593	27,491	28,307	31,795
2	2	N/A	N/A	0	N/A
3	4	22,463	36,160	43,587	57,856
4	5	N/A	N/A	0	N/A
5	6	N/A	N/A	0	N/A
6	7	9,973	12,014	19,345	19,811

D.3 Interceptor Channel Analysis

Existing Drainage

The existing channel is a natural channel roughly sloped 4% from east to west along the southern end of the site. The existing drainage area that feeds into the channel (Existing DMA 9) is located at the southern end of the site, and totals about 25.69 acres. A small portion of this area falls within the project boundary, and the large remainder lies outside of the property line, but drains onsite. The areas of the onsite and offsite portions of DMA 9 are approximately 0.48 acres and 25.21 acres, respectively. Combining the values from both the onsite and offsite portions, the pre-project peak flow rates for the 10 and 100-year storm events are 20.95 cfs and 37.64 cfs (**Appendix D**).

Proposed Drainage

The proposed channel is a concrete V-ditch according to county standards, sloping east to west at varying slope along the southern end of the site, roughly following the property line from Kinross Drive to the existing channel along Seven Hills Ranch Road. The channel is approximately 2.1 feet deep. See **Appendix E** for cross-section of proposed channel.

The proposed drainage area that feeds into the channel (Post DMA 9) is located at the southern end of the site, and totals about 25.5 acres. A small portion of this area falls within the project boundary, which is split into two by the Kinross Drive extension, and bound in the west by proposed pavement. The large remainder of the DMA area lies outside of the property line, which extends southeast away from the site, but drains onsite. The areas of the onsite and offsite portions of DMA 9 are approximately 0.29 acres and 25.21 acres, respectively. Combining the values from both the onsite and offsite portions, the post-project peak flows for the 10 and 100-year storm events are 20.96 cfs and 37.18 cfs (**Appendix D**). Using the calculated flow, the channel depth during the 10 and 100-year events would approximately reach 1.14 feet and 150 feet, which does not surpass the maximum depth in order to accommodate the required 3" freeboard at a 1.0% minimum slope (**Appendix F**).

The proposed 36" upstream culvert crosses Kinross Drive adjacent to the project boundary. The culvert has a flow capacity of 44.8 cfs at a 1% slope, which exceeds the peak flow produced by Post DMA 9 during the 100-year event (**Appendix G**).

Downstream Analysis & Entitlements

The combined post-project peak flow for both the 10 and 100-year storm events are less than the combined pre-project flow, and therefore the installation of the interceptor channel should not have an impact on downstream infrastructure.

The proposed interceptor channel will be completely contained within the proposed project boundary and will terminate at the existing channel along Seven Hills Ranch Road; therefore, we do not anticipate the requirement of any drainage easements.

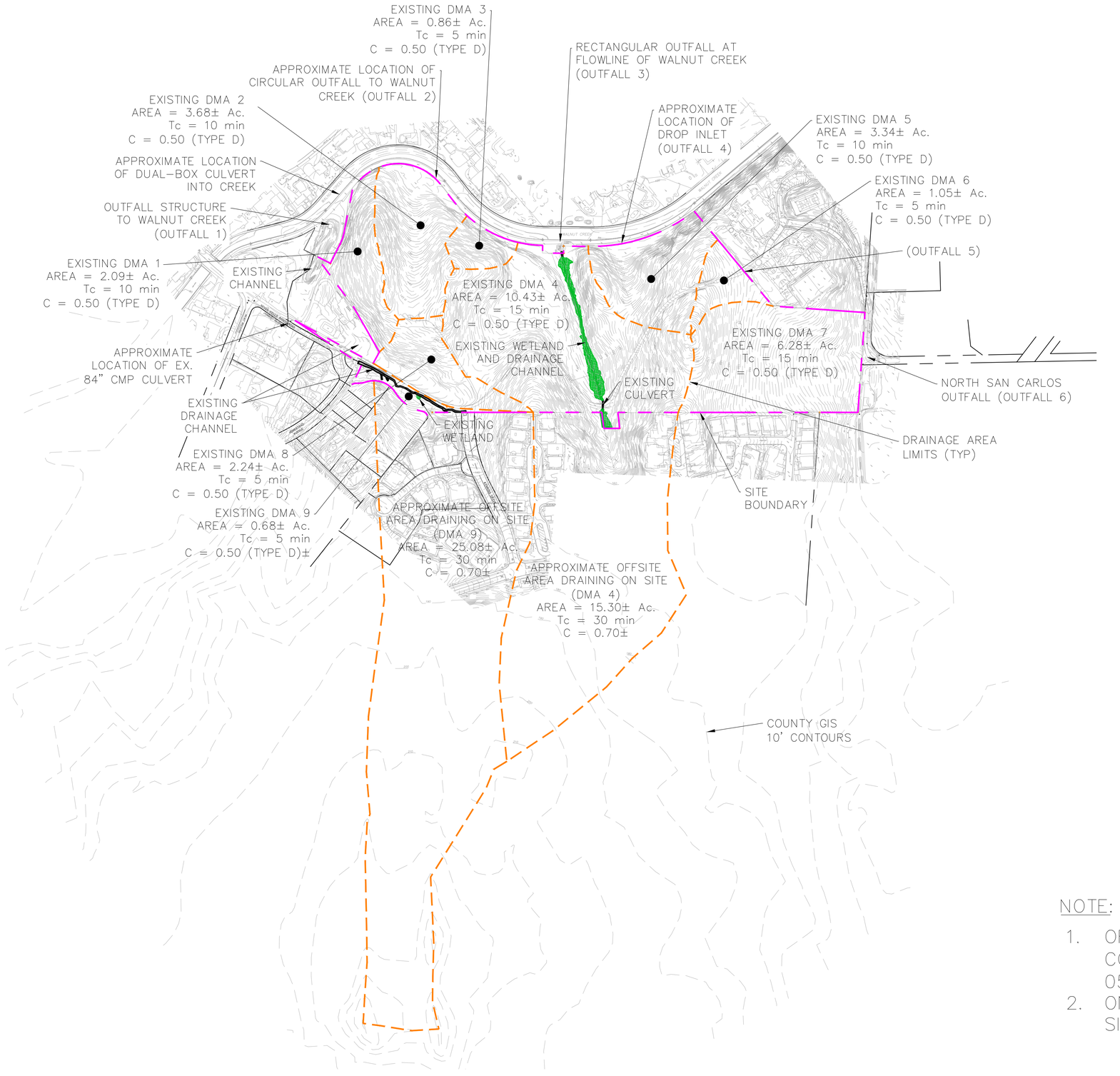
E. Conclusion

The Project will maintain existing drainage patterns and approximate existing points of discharge. The project is subjected to Hydromodification Management (HMP) due to Walnut Creek becoming a natural channel before reaching the Bay. The project creates an increase in impervious area and will detain excess post-project runoff through the required bioretention facilities, raised planters, above ground dry pond, and large diameter storm drains. The project is subjected to San Francisco Municipal Regional Permit (MRP) C.3 treatment requirements. To comply with Provision C.3, the project will use Integrated Management Practices (IMP) that will implement Low Impact Development (LID) treatment facilities that may include any of the combination of the following: bioretention facilities, flow through planters, pervious pavements, depressed landscaped areas, and green roofs in series with cisterns, vaults, and/or dry wells. A preliminary location of the stormwater treatment and drainage facilities is shown in **Appendix B**.

ATTACHMENTS

Appendix A: Existing Drainage Map
Appendix B: Post Development Drainage Map
Appendix C: XPSWMM Results
Appendix D: Pre and Post-Project Peak Flow Rates
Appendix E: Interceptor Channel Cross-Section
Appendix F: Post-Project Flow Depths
Appendix G: Culvert Flow Capacity
Appendix H: IMP Calculator Summary Report

APPENDIX A



NOTE:

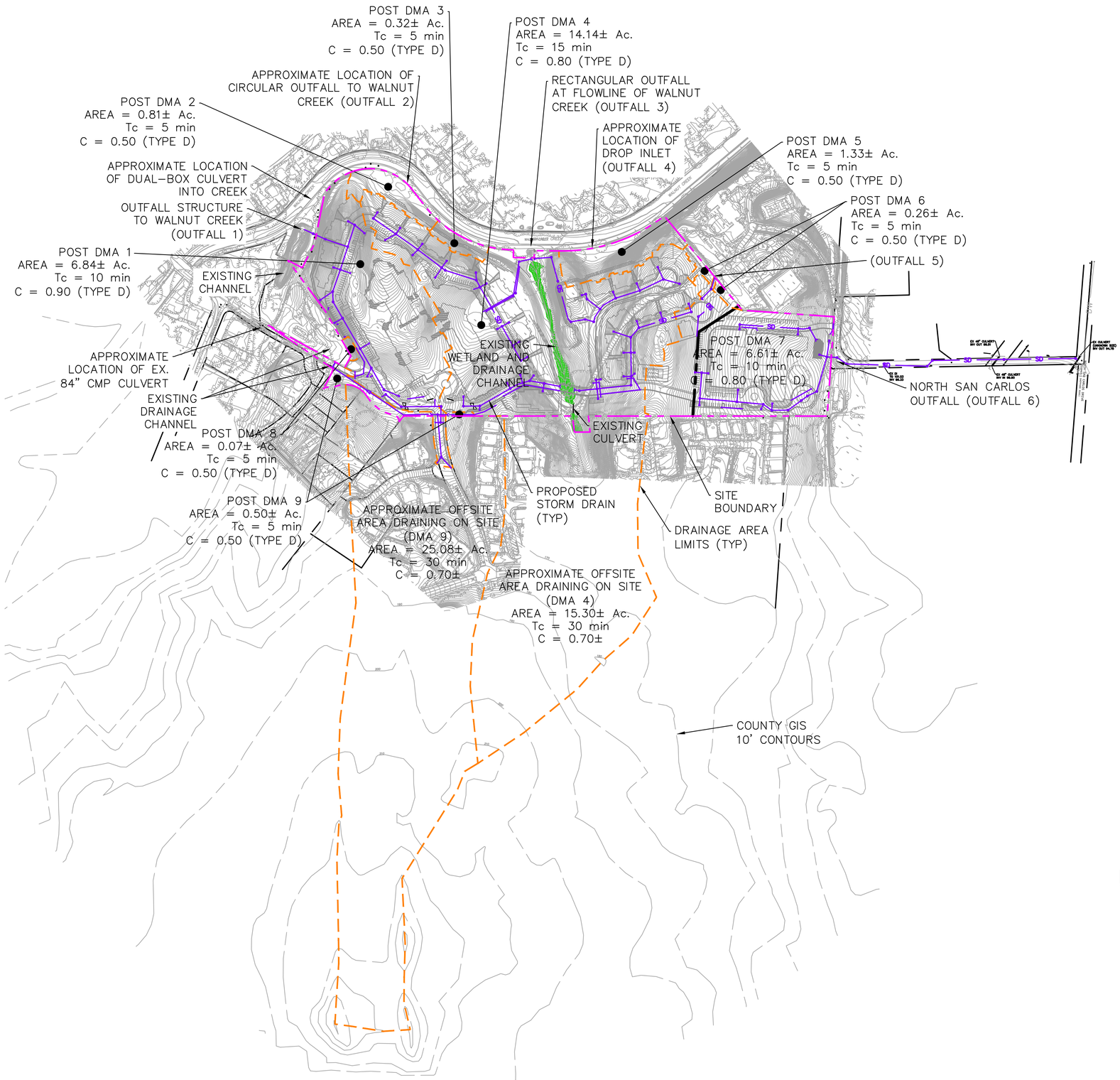
1. OFFSITE DRAINAGE AREAS DELINEATED FROM COUNTY GIS 10' CONTOURS, DATED 05-09-2017.
2. ONSITE DRAINAGE AREAS DELINEATED FROM SITE SURVEY PERFORMED ON 07-14-2020.

GRAPHIC SCALE
0 200 400

BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

APPENDIX A – EXISTING DRAINAGE MAP

APPENDIX B



NOTE:

1. OFFSITE DRAINAGE AREAS DELINEATED FROM COUNTY GIS 10' CONTOURS, DATED 05–09–2017.
2. ONSITE DRAINAGE AREAS DELINEATED FROM SITE SURVEY PERFORMED ON 07–14–2020.

EXHIBIT – POST DEVELOPMENT DRAINAGE MAP

SPIEKER SENIOR CONTINUING CARE FACILITY 12–17–2020 2021–02–17_PROPOSED_DMAS.DWG

GRAPHIC SCALE
0 200 400

BKF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

APPENDIX C

Name	Subcatchment	Node Name	Catchment Max Flow cfs	Catchment Time to Peak hr	Rainfall Reference	Catchment Rainfall Intensity	Catchment Total Rainfall Depth	Area acres	Impervious Percentage %	Ground Elevation (Spill Crest)	Invert Elevation ft	Max Water Elevation ft	Max Water Depth ft	Ponding Type	1D/2D Water Transfer ft^3	Volume of Ponded Flow Stored	Flood Loss ft^3	Continuity Error Volume ft^3
Outfall 1	1	Outfall 1	1.992	12.008	10-YEAR	1.520	3.407	2.240	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	158652.098
Outfall 1	2		29.650	12.017	10-YEAR	1.520	3.407	27.930	35.200									
Outfall 2	1	Outfall 2	4.091	12.008	10-YEAR	1.520	3.407	4.600	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	26840.934
Outfall 3	1	Outfall 3	33.981	12.017	10-YEAR	1.520	3.407	25.700	44.300	102.000	99.000	105.704	3.714	Allowed	0.000	231969.210	0.000	33868.653
Outfall 4	1	Outfall 4	2.971	12.008	10-YEAR	1.520	3.407	3.340	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	19488.852
Outfall 5	1	Outfall 5	0.978	12.008	10-YEAR	1.520	3.407	1.100	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	43178.894
Outfall 6	2	Outfall 6	5.604	12.008	10-YEAR	1.520	3.407	6.300	10.000	102.000	101.000	101.000	0.000	Allowed	0.000	0.000	0.000	0.000

10 - YEAR PRE-PROJECT CONDITIONS

Name	Subcatchment	Node Name	Catchment Max Flow cfs	Catchment Time to Peak hr	Rainfall Reference	Catchment Rainfall Intensity	Total Surface Runoff in	Catchment Total Rainfall Depth	Area acres	Impervious Percentage %	Ground Elevation (Spill Crest)	Invert Elevation ft	Max Water Elevation ft	Total Runoff Depth in	Max Water Depth ft	Ponding Type	1D/2D Water Transfer ft^3	Volume of Ponded Flow Stored	Continuity Error Volume ft^3
Outfall 1	1	Outfall 1	10.021	12.000	10-YEAR	1.520	1.990	3.407	6.840	89.700	102.000	101.000	105.801	1.990	4.801	Allowed	0.000	0.000	255685.938
Outfall 1	2		28.069	12.008	10-YEAR	1.520		3.407	25.570	37.800									
Outfall 2	1	Outfall 2	0.978	12.008	10-YEAR	1.520	1.607	3.407	1.100	10.000	102.000	101.000	102.756	1.607	1.756	Allowed	0.000	0.000	6391.620
Outfall 3	1	Outfall 3	31.374	12.033	10-YEAR	1.520	2.000	3.407	29.400	38.700	102.000	101.000	105.624	2.000	4.624	Allowed	0.000	0.000	213288.416
Outfall 4	1	Outfall 4	1.156	12.008	10-YEAR	1.520	1.607	3.407	1.300	10.000	102.000	101.000	102.828	1.607	1.828	Allowed	0.000	0.000	7556.840
Outfall 5	1	Outfall 5	0.267	12.008	10-YEAR	1.520	1.607	3.407	0.300	10.000	102.000	101.000	102.261	1.607	1.261	Allowed	0.000	0.000	1733.347
Outfall 6	2	Outfall 6	9.857	12.000	10-YEAR	1.520	2.986	3.407	6.600	95.800	102.000	101.000	104.584	2.986	3.584	Allowed	0.000	0.000	71462.344

10 - YEAR POST-PROJECT CONDITIONS

Name	Subcatchment	Node Name	Catchment Max Flow cfs	Catchment Time to Peak hr	Rainfall Reference	Catchment Rainfall Intensity	Catchment Total Rainfall Depth	Area acres	Impervious Percentage %	Ground Elevation (Spill Crest)	Invert Elevation ft	Max Water Elevation ft	Max Water Depth ft	Ponding Type	1D/2D Water Transfer ft^3	Volume of Ponded Flow Stored	Flood Loss ft^3	Continuity Error Volume ft^3
Outfall 1	1	Outfall 1	3.727	12.008	100-YEAR	2.240	5.195	2.240	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	158652.098
Outfall 1	2		51.542	12.017	100-YEAR	2.240	5.195	27.930	35.200									
Outfall 2	1	Outfall 2	7.653	12.008	100-YEAR	2.240	5.195	4.600	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	26840.934
Outfall 3	1	Outfall 3	53.711	12.008	100-YEAR	2.240	5.195	25.700	44.300	102.000	99.000	105.704	3.714	Allowed	0.000	231969.210	0.000	33868.653
Outfall 4	1	Outfall 4	5.557	12.008	100-YEAR	2.240	5.195	3.340	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	19488.852
Outfall 5	1	Outfall 5	1.830	12.008	100-YEAR	2.240	5.195	1.100	10.000	103.000	102.000	102.000	0.000	Allowed	0.000	0.000	0.000	43178.894
Outfall 6	2	Outfall 6	10.482	12.008	100-YEAR	2.240	5.195	6.300	10.000	102.000	101.000	101.000	0.000	Allowed	0.000	0.000	0.000	0.000

100 - YEAR PRE-PROJECT CONDITIONS

Name	Subcatchment	Node Name	Catchment Max Flow cfs	Catchment Time to Peak hr	Rainfall Reference	Catchment Rainfall Intensity	Total Surface Runoff in	Catchment Total Rainfall Depth	Area acres	Impervious Percentage %	Ground Elevation (Spill Crest)	Invert Elevation ft	Max Water Elevation ft	Total Runoff Depth in	Max Water Depth ft	Ponding Type	1D/2D Water Transfer ft^3	Volume of Ponded Flow Stored	Continuity Error Volume ft^3
Outfall 1	1	Outfall 1	15.119	12.000	100-YEAR	2.240	3.630	5.195	6.840	89.700	102.000	101.000	106.359	3.630	5.359	Allowed	0.000	0.000	451813.662
Outfall 1	2		48.232	12.008	100-YEAR	2.240		5.195	25.570	37.800									
Outfall 2	1	Outfall 2	1.830	12.008	100-YEAR	2.240	3.139	5.195	1.100	10.000	102.000	101.000	103.150	3.139	2.150	Allowed	0.000	0.000	12502.329
Outfall 3	1	Outfall 3	54.066	12.025	100-YEAR	2.240	3.641	5.195	29.400	38.700	102.000	101.000	106.210	3.641	5.210	Allowed	0.000	0.000	388349.639
Outfall 4	1	Outfall 4	2.163	12.008	100-YEAR	2.240	3.139	5.195	1.300	10.000	102.000	101.000	103.260	3.139	2.260	Allowed	0.000	0.000	14779.017
Outfall 5	1	Outfall 5	0.499	12.008	100-YEAR	2.240	3.139	5.195	0.300	10.000	102.000	101.000	102.469	3.139	1.469	Allowed	0.000	0.000	3398.633
Outfall 6	2	Outfall 6	14.723	12.000	100-YEAR	2.240	4.763	5.195	6.600	95.800	102.000	101.000	105.021	4.763	4.021	Allowed	0.000	0.000	114032.568

100 - YEAR POST-PROJECT CONDITIONS

APPENDIX D

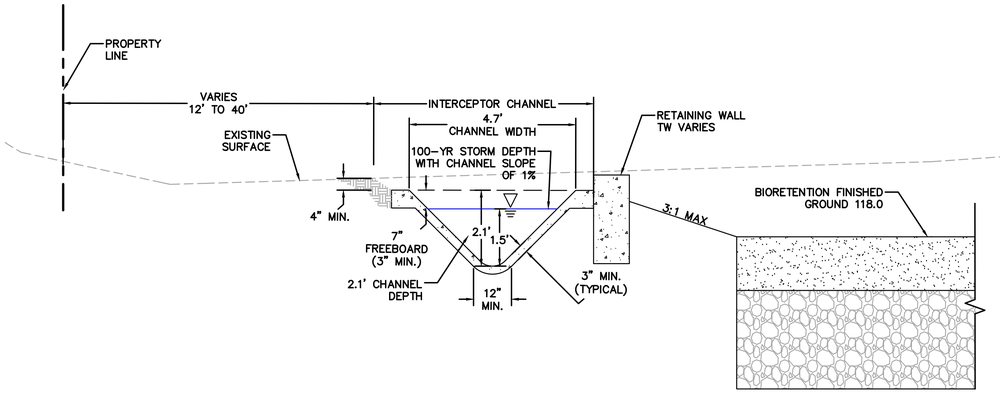
Project MAP 18.5 in

Recurrance Interval (Years)	Pre-Project			Post-Project		
	DMA 9 (Offsite)			**DMA 9 (Offsite)**		
	Area	25.21	Ac	Area	25.21	Ac
	Tc	30	min	Tc	30	min
100	C	0.7	unitless	C	0.7	unitless
	I	1.64	in/hr	I	1.64	in/hr
	f	1.25	unitless	f	1.25	unitless
	Q	**36.48**	**cfs**	**Q**	**36.48**	**cfs**
	DMA 9 (Offsite)			**DMA 9 (Offsite)**		
	Area	25.21	Ac	Area	25.21	Ac
	Tc	30	min	Tc	30	min
10	C	0.7	unitless	C	0.7	unitless
	I	1.14	in/hr	I	1.14	in/hr
	f	1	unitless	f	1	unitless
	Q	**20.29**	**cfs**	**Q**	**20.29**	**cfs**
	DMA 9 (Onsite)			**DMA 9 (Onsite)**		
	Area	0.48	Ac	Area	0.29	Ac
	Tc	5	min	Tc	5	min
100	C	0.5	unitless	C	0.5	unitless
	I	3.84	in/hr	I	3.84	in/hr
	f	1.25	unitless	f	1.25	unitless
	Q	**1.16**	**cfs**	**Q**	**0.70**	**cfs**
	DMA 9 (Onsite)			**DMA 9 (Onsite)**		
	Area	0.48	Ac	Area	0.29	Ac
	Tc	5	min	Tc	5	min
10	C	0.5	unitless	C	0.5	unitless
	I	2.76	in/hr	I	2.76	in/hr
	f	1	unitless	f	1	unitless
	Q	**0.67**	**cfs**	**Q**	**0.40**	**cfs**

Pre-Project Totals (cfs)	
10-Year	20.95
100-Year	37.64

Post-Project Totals (cfs)	
10-Year	20.69
100-Year	37.18

APPENDIX E



SECTION A
NTS

LEGEND

- EXISTING CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- FLOW ARROW
- RETAINING WALL
- BIORETENTION FACILITY
- FLOW THROUGH PLANTERS
- ABOVE GROUND DETENTION BASIN
- EXISTING WETLANDS
- GRADING LIMITS

ABBREVIATIONS

BC	BEGINNING OF CURVE
BFG	BIORETENTION FINISHED GRADE
BW	BOTTOM OF WALL
EG	EXISTING GRADE
EL, ELEV.	ELEVATION
EP	EDGE OF PAVEMENT
EW	END OF WALL
EX.(E)	EXISTING
(F)	FUTURE
FC	FACE OF CURB
FF	FINISHED FLOOR
FG	FINISHED GRADE
FL	FLOW LINE
FP	FINISHED PAVEMENT
FS	FINISHED SURFACE
FT	FEET
GB	GRADE BREAK
GRD, GRND	GROUND
HP	HIGH POINT
LG	LIP OF GUTTER
MA	MATCH
TC	TOP OF CURB
TP	TOP OF PAVEMENT
TS	TOP OF SLOPE
TW	TOP OF WALL

EARTHWORK QUANTITIES

RAW CUT = 225,000± CUBIC YARDS
RAW FILL = 150,000± CUBIC YARDS
NET = 75,000± CUBIC YARDS OF EXPORT

APPENDIX E - INTERCEPTOR CHANNEL CROSS-SECTION

GRAPHIC SCALE
0 60 120

BKF
1646 N. CALIFORNIA BLVD
SUITE 400
WALNUT CREEK, CA 94596
(925) 940-2200
www.bkf.com

APPENDIX F

INTERCEPTOR CHANNEL CAPACITY
POST-PROJECT CONDITIONS

Interceptor Channel - 10 Year
SSCCC

Man-Made Channels
CIVIL TOOLS PRO
English Units
02-10-2021 12:24:51

Results

Flow Depth	=	1.14	ft
Flowrate	=	20.96	cfs
Bottom Width	=	1.00	ft
Side Slope (H:V)	=	1.0000	H:V
Channel Slope (V:H)	=	0.0100	V:H
Manning's N	=	0.012	
Wetted Area	=	2.44	sq ft
Wetted Perimeter	=	4.23	ft
Velocity	=	8.59	fps
Froude No.	=	1.75	
Flow Regime	=	Super-Critical	

Interceptor Channel - 100 Year
SSCCC

Man-Made Channels
CIVIL TOOLS PRO
English Units
02-10-2021 12:24:16

Results

Flow Depth	=	1.50	ft
Flowrate	=	37.18	cfs
Bottom Width	=	1.00	ft
Side Slope (H:V)	=	1.0000	H:V
Channel Slope (V:H)	=	0.0100	V:H
Manning's N	=	0.012	
Wetted Area	=	3.75	sq ft
Wetted Perimeter	=	5.24	ft
Velocity	=	9.91	fps
Froude No.	=	1.80	
Flow Regime	=	Super-Critical	

APPENDIX G

Project Name: Spieker Senior Continuing Care Community
Project Type: Treatment and Flow Control
Location: Walnut Creek
APN: 172-150-012, 172-080-007
Drainage Area: 1080912 sf
Mean Annual Precipitation: 18.5 in

I. Self-Treating Areas

DMA Name	Area (sq ft)
ST1	29600
ST2	31671
ST3	4424
ST4	3992
ST5	1530
ST6	17220
ST7	20280
ST8	7953
ST9	14269
ST10	7008
ST11	7437
ST12	19762
ST13	11452

II. Self-Retaining Areas

DMA Name	Area (sq ft)
SR1	17143
SR2	27341
SR3	17216

IV. Areas Draining to IMPs

IMP Name: IMP1 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T1	14,309	Concrete or Asphalt	1.00	14,309				
			Total	14,309				
					Area	0.050	1.075	769	992
					Surface Volume	0.042	1.075	646	496
					Subsurface Volume	0.055	1.075	846	1,091
								Maximum Underdrain Flow (cfs)	0.02
								Orifice Diameter (in)	0.99

IMP Name: IMP2 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T2	17,036	Concrete or Asphalt	1.00	17,036				
			Total	17,036				
					Area	0.050	1.075	916	936
					Surface Volume	0.042	1.075	769	468
					Subsurface Volume	0.055	1.075	1,007	1,030
								Maximum Underdrain Flow (cfs)	0.03
								Orifice Diameter (in)	1.08

IMP Name: IMP3 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
T3	12,097	Concrete or Asphalt	1.00	12,097		Rain		

		IMP Sizing Factor	Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Total	12,097				
Area		0.050	1.075	650	665
Surface Volume		0.042	1.075	546	332
Subsurface Volume		0.055	1.075	715	732
Maximum Underdrain Flow (cfs)					0.02
Orifice Diameter (in)					0.91

IMP Name: IMP4 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
T4	15,063	Concrete or Asphalt	1.00	15,063				
Total				15,063				
Area					0.050	1.075	809	1,224
Surface Volume					0.042	1.075	680	612
Subsurface Volume					0.055	1.075	890	13,468
Maximum Underdrain Flow (cfs)								0.02
Orifice Diameter (in)								1.01

IMP Name: IMP5 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
T5	14,411	Concrete or Asphalt	1.00	14,411				
Total				14,411				
Area					0.050	1.075	774	911
Surface Volume					0.042	1.075	651	455
Subsurface Volume					0.055	1.075	852	1,002
Maximum Underdrain Flow (cfs)								0.02
Orifice Diameter (in)								0.99

IMP Name: IMP6 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
T6	12,166	Concrete or Asphalt	1.00	12,166				
Total				12,166				
Area					0.050	1.075	654	654
Surface Volume					0.042	1.075	549	327
Subsurface Volume					0.055	1.075	719	719
Maximum Underdrain Flow (cfs)								0.02
Orifice Diameter (in)								0.91

IMP Name: IMP7 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
T7	10,176	Concrete or Asphalt	1.00	10,176				
Total				10,176				
Area					0.050	1.075	547	841
Surface Volume					0.042	1.075	459	420
Subsurface Volume					0.055	1.075	602	925
Maximum Underdrain Flow (cfs)								0.02
Orifice Diameter (in)								0.83

IMP Name: IMP8 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T8	17,068	Concrete or Asphalt	1.00	17,068
			Total	17,068

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	917	995
Surface Volume	0.042	1.075	770	497
Subsurface Volume	0.055	1.075	1,009	1,095
Maximum Underdrain Flow (cfs)				0.03
Orifice Diameter (in)				1.08

IMP Name: IMP9 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T9	7,783	Concrete or Asphalt	1.00	7,783
			Total	7,783

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	418	1,043
Surface Volume	0.042	1.075	351	522
Subsurface Volume	0.055	1.075	460	1,147
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.73

IMP Name: IMP10 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T10	13,236	Concrete or Asphalt	1.00	13,236
			Total	13,236

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	711	1,002
Surface Volume	0.042	1.075	597	501
Subsurface Volume	0.055	1.075	782	1,102
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.95

IMP Name: IMP11 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T11	6,021	Concrete or Asphalt	1.00	6,021
			Total	6,021

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	324	356
Surface Volume	0.042	1.075	272	178
Subsurface Volume	0.055	1.075	356	392
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.64

IMP Name: IMP12 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T12	8,007	Concrete or Asphalt	1.00	8,007
			Total	8,007

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	430	750
Surface Volume	0.042	1.075	361	375

Subsurface Volume	0.055	1.075	473	825
			Maximum Underdrain Flow (cfs)	0.01
			Orifice Diameter (in)	0.74

IMP Name: IMP13 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T13	10,410	Concrete or Asphalt	1.00	10,410				
			Total	10,410				
				Area	0.050	1.075	559	697
				Surface Volume	0.042	1.075	470	349
				Subsurface Volume	0.055	1.075	615	767
							Maximum Underdrain Flow (cfs)	0.02
							Orifice Diameter (in)	0.84

IMP Name: IMP14 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T14	7,527	Concrete or Asphalt	1.00	7,527				
			Total	7,527				
				Area	0.050	1.075	405	913
				Surface Volume	0.042	1.075	340	457
				Subsurface Volume	0.055	1.075	445	1,004
							Maximum Underdrain Flow (cfs)	0.01
							Orifice Diameter (in)	0.72

IMP Name: IMP15 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T15	3,784	Concrete or Asphalt	1.00	3,784				
			Total	3,784				
				Area	0.050	1.075	203	390
				Surface Volume	0.042	1.075	171	195
				Subsurface Volume	0.055	1.075	224	429
							Maximum Underdrain Flow (cfs)	0.01
							Orifice Diameter (in)	0.51

IMP Name: IMP16 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T16	26,961	Concrete or Asphalt	1.00	26,961				
			Total	26,961				
				Area	0.050	1.075	1,449	1,520
				Surface Volume	0.042	1.075	1,217	760
				Subsurface Volume	0.055	1.075	1,594	1,672
							Maximum Underdrain Flow (cfs)	0.04
							Orifice Diameter (in)	1.36

IMP Name: IMP17 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff	IMP Sizing

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T17	11,123	Concrete or Asphalt	1.00	11,123
			Total	11,123

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	598	842
Surface Volume	0.042	1.075	502	421
Subsurface Volume	0.055	1.075	658	926
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.87

IMP Name: IMP18 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T18	67,881	Concrete or Asphalt	1.00	67,881
			Total	67,881

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	3,648	3,765
Surface Volume	0.042	1.075	3,064	1,883
Subsurface Volume	0.055	1.075	4,013	4,142
Maximum Underdrain Flow (cfs)				0.11
Orifice Diameter (in)				2.15

IMP Name: IMP19 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T19	12,833	Concrete or Asphalt	1.00	12,833
			Total	12,833

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	690	774
Surface Volume	0.042	1.075	579	387
Subsurface Volume	0.055	1.075	759	851
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.94

IMP Name: IMP20 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T20	4,435	Concrete or Asphalt	1.00	4,435
			Total	4,435

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	238	740
Surface Volume	0.042	1.075	200	370
Subsurface Volume	0.055	1.075	262	814
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.55

IMP Name: IMP21 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T21	4,767	Concrete or Asphalt	1.00	4,767
			Total	4,767

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	256	611
Surface Volume	0.042	1.075	215	306
Subsurface Volume	0.055	1.075	282	672
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.57

IMP Name: IMP22 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T22	6,785	Concrete or Asphalt	1.00	6,785
			Total	6,785

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	365	850
Surface Volume	0.042	1.075	306	425
Subsurface Volume	0.055	1.075	401	935
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.68

IMP Name: IMP23 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T23	10,495	Concrete or Asphalt	1.00	10,495
			Total	10,495

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	564	1,904
Surface Volume	0.042	1.075	474	952
Subsurface Volume	0.055	1.075	620	2,094
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.85

IMP Name: IMP24 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T24	10,494	Concrete or Asphalt	1.00	10,494
			Total	10,494

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	564	1,064
Surface Volume	0.042	1.075	474	532
Subsurface Volume	0.055	1.075	620	1,170
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.85

IMP Name: IMP25 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T25	10,161	Concrete or Asphalt	1.00	10,161
			Total	10,161

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	546	1,534
Surface Volume	0.042	1.075	459	767
Subsurface Volume	0.055	1.075	601	1,687
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.83

IMP Name: IMP26 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T26	2,416	Concrete or Asphalt	1.00	2,416
			Total	2,416

	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	130	169

Surface Volume	0.042	1.075	109	85
Subsurface Volume	0.055	1.075	143	186
Maximum Underdrain Flow (cfs)				0.00
Orifice Diameter (in)				0.41

IMP Name: IMP27 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T27	9,252	Concrete or Asphalt	1.00	9,252				
			Total	9,252				
				Area	0.050	1.075	497	1,233
				Surface Volume	0.042	1.075	418	617
				Subsurface Volume	0.055	1.075	547	1,356
				Maximum Underdrain Flow (cfs)				0.02
				Orifice Diameter (in)				0.79

IMP Name: IMP28 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T28	16,290	Concrete or Asphalt	1.00	16,290				
			Total	16,290				
				Area	0.050	1.075	875	947
				Surface Volume	0.042	1.075	735	474
				Subsurface Volume	0.055	1.075	963	1,042
				Maximum Underdrain Flow (cfs)				0.03
				Orifice Diameter (in)				1.05

IMP Name: IMP29 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T29	17,503	Concrete or Asphalt	1.00	17,503				
			Total	17,503				
				Area	0.050	1.075	941	1,191
				Surface Volume	0.042	1.075	790	596
				Subsurface Volume	0.055	1.075	1,035	1,310
				Maximum Underdrain Flow (cfs)				0.03
				Orifice Diameter (in)				1.09

IMP Name: IMP30 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T30	5,125	Concrete or Asphalt	1.00	5,125				
			Total	5,125				
				Area	0.050	1.075	275	360
				Surface Volume	0.042	1.075	231	180
				Subsurface Volume	0.055	1.075	303	396
				Maximum Underdrain Flow (cfs)				0.01
				Orifice Diameter (in)				0.59

IMP Name: IMP31 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff	IMP Sizing

				Factor
T31	11,601	Concrete or Asphalt	1.00	11,601
			Total	11,601

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	623	768
Surface Volume	0.042	1.075	524	384
Subsurface Volume	0.055	1.075	686	845
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.89

IMP Name: IMP32 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T32	6,726	Concrete or Asphalt	1.00	6,726
			Total	6,726

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	361	422
Surface Volume	0.042	1.075	304	211
Subsurface Volume	0.055	1.075	398	464
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.68

IMP Name: IMP33 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T33	7,291	Concrete or Asphalt	1.00	7,291
			Total	7,291

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	392	820
Surface Volume	0.042	1.075	329	410
Subsurface Volume	0.055	1.075	431	902
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.71

IMP Name: IMP34 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T34	14,018	Concrete or Asphalt	1.00	14,018
			Total	14,018

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	753	1,217
Surface Volume	0.042	1.075	633	609
Subsurface Volume	0.055	1.075	829	1,339
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.98

IMP Name: IMP35 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T35	4,302	Concrete or Asphalt	1.00	4,302
			Total	4,302

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	231	871
Surface Volume	0.042	1.075	194	436
Subsurface Volume	0.055	1.075	254	958
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.54

IMP Name: IMP36 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T36	24,976	Concrete or Asphalt	1.00	24,976
			Total	24,976

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,342	1,377
Surface Volume	0.042	1.075	1,127	689
Subsurface Volume	0.055	1.075	1,476	1,515

Maximum Underdrain Flow (cfs)	0.04
Orifice Diameter (in)	1.31

IMP Name: IMP37 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T37	20,228	Concrete or Asphalt	1.00	20,228
			Total	20,228

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,087	1,168
Surface Volume	0.042	1.075	913	584
Subsurface Volume	0.055	1.075	1,196	1,285

Maximum Underdrain Flow (cfs)	0.03
Orifice Diameter (in)	1.17

IMP Name: IMP38 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T38	3,111	Concrete or Asphalt	1.00	3,111
			Total	3,111

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	167	181
Surface Volume	0.042	1.075	140	91
Subsurface Volume	0.055	1.075	184	199

Maximum Underdrain Flow (cfs)	0.01
Orifice Diameter (in)	0.46

IMP Name: IMP39 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T39	6,693	Concrete or Asphalt	1.00	6,693
			Total	6,693

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	360	766
Surface Volume	0.042	1.075	302	383
Subsurface Volume	0.055	1.075	396	843

Maximum Underdrain Flow (cfs)	0.01
Orifice Diameter (in)	0.68

IMP Name: IMP40 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T40	4,459	Concrete or Asphalt	1.00	4,459
			Total	4,459

IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume

Area	0.050	1.075	240	240
Surface Volume	0.042	1.075	201	120
Subsurface Volume	0.055	1.075	264	264
			Maximum Underdrain Flow (cfs)	0.01
			Orifice Diameter (in)	0.55

IMP Name: IMP41 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T41	6,666	Concrete or Asphalt	1.00	6,666				
			Total	6,666				
					Area	0.050	1.075	358	1,284
					Surface Volume	0.042	1.075	301	642
					Subsurface Volume	0.055	1.075	394	1,412
								Maximum Underdrain Flow (cfs)	0.01
								Orifice Diameter (in)	0.67

IMP Name: IMP42 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T42	9,847	Concrete or Asphalt	1.00	9,847				
			Total	9,847				
					Area	0.050	1.075	529	583
					Surface Volume	0.042	1.075	445	292
					Subsurface Volume	0.055	1.075	582	641
								Maximum Underdrain Flow (cfs)	0.02
								Orifice Diameter (in)	0.82

IMP Name: IMP43 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T43	6,945	Concrete or Asphalt	1.00	6,945				
			Total	6,945				
					Area	0.050	1.075	373	473
					Surface Volume	0.042	1.075	314	237
					Subsurface Volume	0.055	1.075	411	520
								Maximum Underdrain Flow (cfs)	0.01
								Orifice Diameter (in)	0.69

IMP Name: IMP44 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
T44	6,986	Concrete or Asphalt	1.00	6,986				
			Total	6,986				
					Area	0.050	1.075	375	869
					Surface Volume	0.042	1.075	315	435
					Subsurface Volume	0.055	1.075	413	956
								Maximum Underdrain Flow (cfs)	0.01
								Orifice Diameter (in)	0.69

IMP Name: IMP45 (Soil Type: D)

IMP Type: Bioretention Facility
Soil Type: D

DMA Name	DMA Area	Post-Project Surface	DMA Runoff	DMA Area x

	(sq ft)	Type	Factor	Runoff Factor
T45	7,895	Concrete or Asphalt	1.00	7,895
			Total	7,895

	IMP Sizing			
	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	424	1,587
Surface Volume	0.042	1.075	356	794
Subsurface Volume	0.055	1.075	467	1,746
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.73

IMP Name: IMP46 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T46	20,950	Concrete or Asphalt	1.00	20,950
			Total	20,950

	IMP Sizing			
	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,126	1,204
Surface Volume	0.042	1.075	946	602
Subsurface Volume	0.055	1.075	1,238	1,324
Maximum Underdrain Flow (cfs)				0.03
Orifice Diameter (in)				1.20

IMP Name: IMP47 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T47	14,436	Concrete or Asphalt	1.00	14,436
			Total	14,436

	IMP Sizing			
	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	776	815
Surface Volume	0.042	1.075	652	408
Subsurface Volume	0.055	1.075	853	897
Maximum Underdrain Flow (cfs)				0.02
Orifice Diameter (in)				0.99

IMP Name: IMP48 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T48	17,110	Concrete or Asphalt	1.00	17,110
			Total	17,110

	IMP Sizing			
	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	919	1,120
Surface Volume	0.042	1.075	772	560
Subsurface Volume	0.055	1.075	1,011	1,232
Maximum Underdrain Flow (cfs)				0.03
Orifice Diameter (in)				1.08

IMP Name: IMP49 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T49	24,813	Concrete or Asphalt	1.00	24,813
			Total	24,813

	IMP Sizing			
	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,333	1,424
Surface Volume	0.042	1.075	1,120	712
Subsurface Volume	0.055	1.075	1,467	1,566
Maximum Underdrain Flow (cfs)				0.04
Orifice Diameter (in)				1.30

IMP Name: IMP50 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T50	26,106	Concrete or Asphalt	1.00	26,106
			Total	26,106

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,403	1,407
Surface Volume	0.042	1.075	1,178	704
Subsurface Volume	0.055	1.075	1,543	1,548
Maximum Underdrain Flow (cfs)				0.04
Orifice Diameter (in)				1.33

IMP Name: IMP51 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T51	40,434	Concrete or Asphalt	1.00	40,434
			Total	40,434

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	2,173	3,401
Surface Volume	0.042	1.075	1,825	1,701
Subsurface Volume	0.055	1.075	2,390	3,741
Maximum Underdrain Flow (cfs)				0.07
Orifice Diameter (in)				1.66

IMP Name: IMP52 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T52	7,275	Concrete or Asphalt	1.00	7,275
			Total	7,275

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	391	395
Surface Volume	0.042	1.075	328	198
Subsurface Volume	0.055	1.075	430	435
Maximum Underdrain Flow (cfs)				0.01
Orifice Diameter (in)				0.70

IMP Name: IMP53 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T53	27,480	Concrete or Asphalt	1.00	27,480
			Total	27,480

	IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.050	1.075	1,477	1,845
Surface Volume	0.042	1.075	1,240	923
Subsurface Volume	0.055	1.075	1,624	2,030
Maximum Underdrain Flow (cfs)				0.05
Orifice Diameter (in)				1.37

IMP Name: IMP54 (Soil Type: D)

IMP Type: Bioretention Facility

Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T54	6,986	Concrete or Asphalt	1.00	6,986
			Total	6,986

IMP Sizing Factor	Rain Adjust-ment Factor	Minimum Area or Volume	Proposed Area or Volume

Area	0.050	1.075	375	403
Surface Volume	0.042	1.075	315	202
Subsurface Volume	0.055	1.075	413	443
			Maximum Underdrain Flow (cfs)	0.01
			Orifice Diameter (in)	0.69

IMP Name: IMP55 (Soil Type: D)

IMP Type: Flow-Through Planter
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T55	49,071	Concrete or Asphalt	1.00	49,071
		Total		49,071

	IMP Sizing			
	IMP Sizing Factor	**Rain Adjust-ment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
Area	0.050	1.075	2,637	2,783
Surface Volume	0.042	1.075	2,215	1,392
Subsurface Volume	0.055	1.075	2,901	3,062
			Maximum Underdrain Flow (cfs)	0.08
			Orifice Diameter (in)	1.71

IMP Name: IMP56 (Soil Type: D)

IMP Type: Flow-Through Planter
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T56	59,999	Concrete or Asphalt	1.00	59,999
		Total		59,999

	IMP Sizing			
	IMP Sizing Factor	**Rain Adjust-ment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
Area	0.050	1.075	3,224	3,677
Surface Volume	0.042	1.075	2,708	1,839
Subsurface Volume	0.055	1.075	3,547	4,045
			Maximum Underdrain Flow (cfs)	0.10
			Orifice Diameter (in)	1.89

IMP Name: IMP57 (Soil Type: D)

IMP Type: Flow-Through Planter
Soil Type: D

DMA Name	DMA Area (sq ft)	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
T57	51,860	Concrete or Asphalt	1.00	51,860
		Total		51,860

	IMP Sizing			
	IMP Sizing Factor	**Rain Adjust-ment Factor**	**Minimum Area or Volume**	**Proposed Area or Volume**
Area	0.050	1.075	2,787	3,948
Surface Volume	0.042	1.075	2,341	1,974
Subsurface Volume	0.055	1.075	3,066	4,343
			Maximum Underdrain Flow (cfs)	0.09
			Orifice Diameter (in)	1.76