ATTACHMENT 1
BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.

Project Name: Sunroad Centrum 6

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☒ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	⦿ Included on DMA Exhibit in Attachment 1a ○ Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	⦿ Included ○ Not included because the entire project will use infiltration BMPs
Attachment 1d	Form I-8, Categorization of Infiltration Feasibility Condition (Required unless the project will use harvest and use BMPs) Refer to Appendices C and D of the BMP Design Manual to complete Form I-8.	⦿ Included ○ Not included because the entire project will use harvest and use BMPs
Attachment 1e	Pollutant Control BMP Design Worksheets / Calculations (Required) Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines and site design credit calculations	☒ Included

Attachment 1a

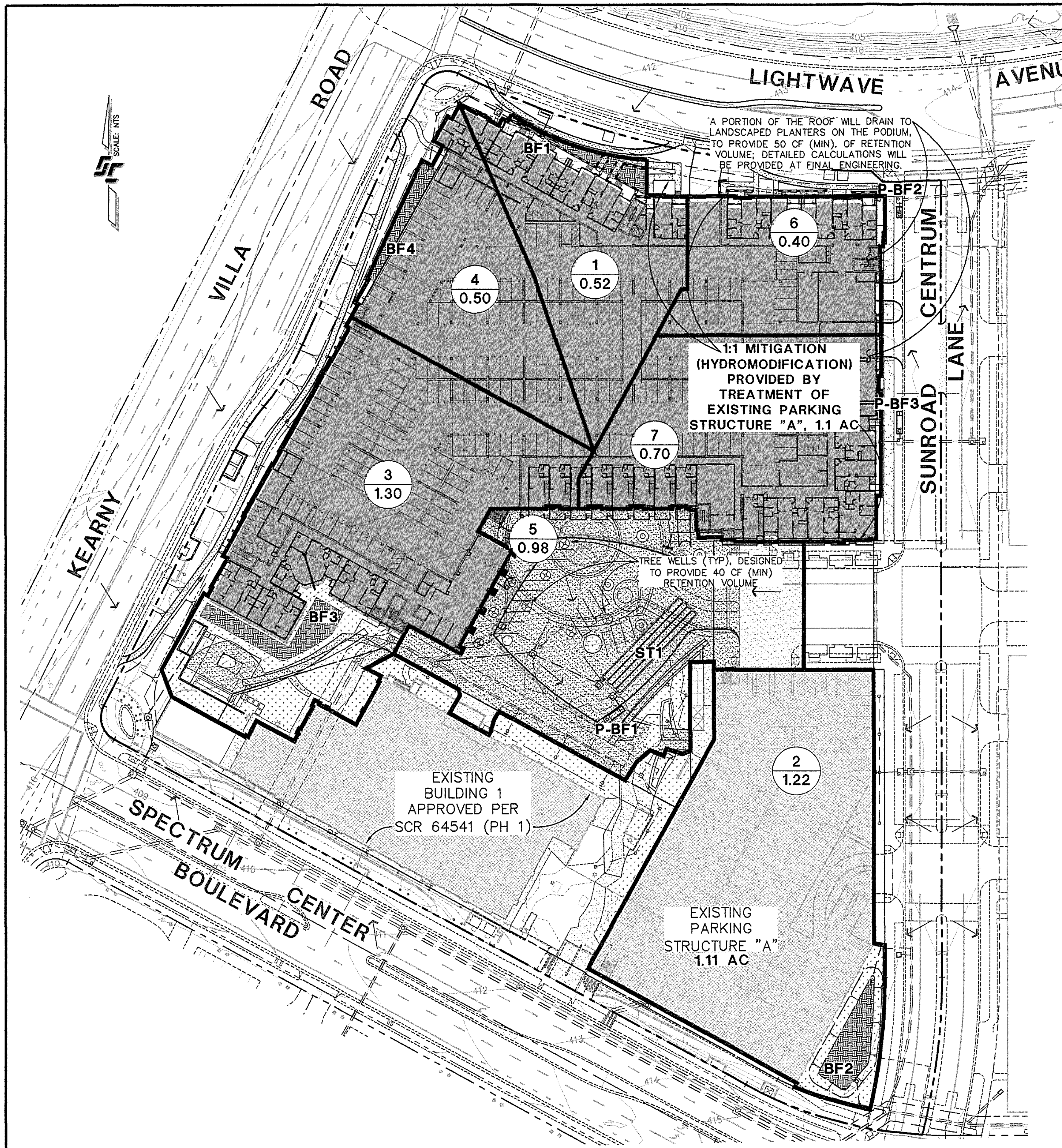
DMA Exhibit

Project Name: Sunroad Centrum 6

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify:

☒ Underlying hydrologic soil group
☒ Approximate depth to groundwater
☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☒ Critical coarse sediment yield areas to be protected
☒ Existing topography and impervious areas
☒ Existing and proposed site drainage network and connections to drainage offsite
☒ Proposed grading
☒ Proposed impervious features
☒ Proposed design features and surface treatments used to minimize imperviousness
☒ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
☒ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
☒ Structural BMPs (identify location, type of BMP, and size/detail)



LEGEND

EXISTING GROUND CONTOURS
410 —— INDEX
409 —— INTERMEDIATE

PROPOSED GROUND CONTOURS
410 —— INDEX
409 —— INTERMEDIATE

1 / 0.52 — DMA DESIGNATION — AREA (ACRES)

DMA BOUNDARY

FLOW DIRECTION

LAND USE:

PROPOSED BUILDING/: MULTI-STORY MINIMIZES AREA (SD-3 MINIMIZE IMPERVIOUS AREA)

PROPOSED IMPERVIOUS: MINIMUM WIDTHS USED (SD-3 MINIMIZE IMPERVIOUS AREA)

LANDSCAPE: PLANTER (SD-4 MINIMIZE SOIL COMPACTION) (SD-7 LANDSCAPE/PLANTER AREA WITH DROUGHT TOLERANT SPECIES)

EXISTING BUILDING

EXISTING IMPERVIOUS

STRUCTURAL TREATMENT BMPS:

BIOFILTRATION PLANTER (BF)

UNDERGROUND DETENTION FACILITY (ST)

PROPRIETARY BMP (P-BF), MODULAR WETLANDS OR CITY APPROVED EQUIVALENT

UNDERLYING HYDROLOGIC SOIL GROUP D
APPROXIMATE DEPTH TO GROUNDWATER > 20FT

DMA ID	AREA (SF)	DESCRIPTION	TYPE
1	22,651	21,401 SF BUILDING 270 SF SIDEWALK 980 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-1
2	53,133	48,282 SF BUILDING 2,791 SF LANDSCAPING 2,060 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-2
3	56,530	42,066 SF BUILDING 3,558 SF SIDEWALK 8,934 SF LANDSCAPING 1,972 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-3
4	21,630	20,715 SF BUILDING 915 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-4
5	42,691	39,925 SF DRIVELANE/SIDEWALK 2,766 SF LANDSCAPING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF1
6	17,400	17,400 SF BUILDING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF2
7	30,490	30,490 SF BUILDING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF3
TOTAL	244,525	180,354 SF BUILDING 43,753 SF SIDEWALK 14,491 SF LANDSCAPING 5,927 SF BIOFILTRATION	

STEVENS-CRESTO ENGINEERING, INC.
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REVISIONS

SUNROAD CENTRUM 6
SAN DIEGO, CALIFORNIA

EXHIBIT 1a
DRAINAGE MANAGEMENT AREAS

DATE: 05/22/18
SCE NO. 17006.01
SHEET 1a

Attachment 1c

Worksheet B.3-1, Harvest and Use Feasibility Screening Checklist

Worksheet B.3-1. Harvest and Use Feasibility Screening

Harvest and Use Feasibility Screening		Worsksheet B.3-1
1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season? ☐ Toilet and urinal flushing (Not currently approved by County DEH) ■ Landscape irrigation ☐ Other:______________		
2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2. [Provide a summary of calculations here]		
3. Calculate the DCV using worksheet B-2.1. [Provide a results here] *36-Hour Irrigation Demand: 390 GAL/AC (Table B.3-3 For Low Water Use)* *For total landscape area, including biofiltration: 0.47 AC (See Calculations in Drainage Study).* *Irrigation demand: 183 GAL, or 24 CF. Total demand: 24 CF* *DCV = 8,017 CF*		
3a. Is the 36-hour demand greater than or equal to the DCV? Yes / ✓No ⇨ ⇩	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV? Yes / ✓No ⇨ ⇩	3c. Is the 36-hour demand less than 0.25DCV? ✓Yes ⇩
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.

Attachment 1d

Worksheet C.4-1, Categorization of Infiltration Feasibility Condition

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]	Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Locations at percolation test boring P-1 through P-7	Design
Criteria 1: Infiltration Rate Screening	

1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ○ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ○ Yes; Continue to Step 1C. ○ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ○ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ○ Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ○ Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ○ Yes; continue to Step 1G. ○ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ○ Yes; answer "Yes" to Criteria 1 Result. ○ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ○ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ○ No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

The project known as Sunroad Centrum 6 is in the design phase. A qualified representative for NOVA Services directed the drilling of seven percolation test borings (P-1 through P-3 in 2016) (P-4 through P-7 in 2017) to depths of approximately 5 to 6.5 feet below ground surface with continuously sampled exploratory borings to accompany each test to a depth of 10 feet below the bottom of the potential BMP basin bottom. The tests were conducted in compliance with the Borehole Percolation Tests method (D.3.3.2) of the BMP manual. The percolation rates were converted to infiltration rates by the Porchet Method. A factor of safety of 2 was used resulting in rates of P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	○ Yes	○ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	○ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	○ No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	○ Yes	○ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	○Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○Yes	○ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	○Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	Yes	No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	Yes	No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	Full infiltration Condition Complete Part 2

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Locations P-1 through P-7	Design Phase
Criteria 3 : Infiltration Rate Screening	

3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ○ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ⊙ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ○ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ⊙ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ○ Yes; Continue to Criteria 4. ⊙ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

The project known as Sunroad Centrum 6 is in the design phase. A qualified representative for NOVA Services directed the drilling of seven percolation test borings (P-1 through P-3 in 2016) (P-4 through P-7 in 2017) to depths of approximately 5 to 6.5 feet below ground surface with continuously sampled exploratory borings to accompany each test to a depth of 10 feet below the bottom of the potential BMP basin bottom. The tests were conducted in compliance with the Borehole Percolation Tests method (D.3.3.2) of the BMP manual. The percolation rates were converted to infiltration rates by the Porchet Method. A factor of safety of 2 was used resulting in rates of P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	○ Yes	○ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	○ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	○ No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	○ Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	○ No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	○ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○Yes	○No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	○Yes	○No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○Yes	○No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○Yes	○No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○Yes	○No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Summarize findings and basis; provide references to related reports or exhibits.	

Part 2 – Partial Infiltration Geotechnical Screening Result[5]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	○ Partial Infiltration Condition ⦿ No Infiltration Condition

[5] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Attachment 1e

Pollutant Control BMP Design Worksheets/Calculations

And

Proprietary Biofiltration GULD Certification and Manufacturer's Specifications

Equation B.1-2: Estimating Runoff Factor of Area

$$C = \frac{\sum CxAx}{\sum Ax}$$

where:
Cx = Runoff factor for Area X
Ax = Tributary area X (acres)

DMA NAME	$C_{0.90}$ AREA (AC)	$C_{0.10}$ AREA (AC)	**RUNOFF FACTOR, C**	TOTAL BMP AREA (AC)
BF 1	0.48	0.00	**0.90**	0.48
BF 2	1.11	0.06	**0.86**	1.17
BF 3	1.05	0.21	**0.77**	1.26
BF 4	0.48	0.00	**0.90**	0.48
P-BF 1	0.92	0.06	**0.85**	0.98
P-BF 2	0.40	0.00	**0.90**	0.40
P-BF 3	0.70	0.00	**0.90**	0.70

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	BF1	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	21671	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85^{th} percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	975	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	9	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	15.6	inches
15	Total Depth Treated [Line 13 + Line 14]	45.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1463	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	385	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	731	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	563	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	585	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	585	sq. ft.
23	Provided BMP Footprint	980	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	BF2	

Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	51073	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.86	
3	85th percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2196	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	9	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	15.6	inches
15	Total Depth Treated [Line 13 + Line 14]	45.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3294	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	867	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	1647	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1267	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1318	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1318	sq. ft.
23	Provided BMP Footprint	2060	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	BF3	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	54558	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.77	
3	85^{th} percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2100	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	9	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	15.6	inches
15	Total Depth Treated [Line 13 + Line 14]	45.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3151	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	829	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	1575	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1212	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	1260	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1260	sq. ft.
23	Provided BMP Footprint	1972	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	BF4	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	20715	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85th percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	932	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	9	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	15.6	inches
15	Total Depth Treated [Line 13 + Line 14]	45.6	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1398	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	368	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	699	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	538	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	559	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	559	sq. ft.
23	Provided BMP Footprint	915	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

Sunroad Centrum 6
Proprietary Biofiltration
PBF1-PBF3

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Compact (high rate) biofiltration BMPs have a media filtration rate greater than 5 in/hr. and a media surface area smaller than 3% of contributing area times adjusted runoff factor. Compact biofiltration BMPs are typically proprietary BMPs that may qualify as biofiltration.

A compact biofiltration BMP may satisfy the pollutant control requirements for a DMA onsite in some cases. This depends on the characteristics of the DMA **and** the performance certification/data of the BMP. If the pollutant control requirements for a DMA are met onsite, then the DMA is not required to participate in an offsite storm water alternative compliance program to meet its pollutant control obligations.

An applicant using a compact biofiltration BMP to meet the pollutant control requirements onsite must complete Section 1 of this form and include it in the PDP SWQMP. A separate form must be completed for each DMA. In instances where the City Engineer does not agree with the applicant's determination, Section 2 of this form will be completed by the City and returned to the applicant.

Section 1: Biofiltration Criteria Checklist (Appendix F)

Refer to Part 1 of the Storm Water Standards to complete this section. When separate forms/worksheets are referenced below, the applicant must also complete these separate forms/worksheets (as applicable) and include in the PDP SWQMP. The criteria numbers below correspond to the criteria numbers in Appendix F.

Criteria	Answer	Progression
Criteria 1 and 3: What is the infiltration condition of the DMA? Refer to Section 5.4.2 and Appendix C of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance. Applicant must complete and include the following in the PDP SWQMP submittal to support the feasibility determination: • Infiltration Feasibility Condition Letter; or • Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B. Applicant must complete and include all applicable sizing worksheets in the SWQMP submittal	☐ Full Infiltration Condition	**Stop**. Compact biofiltration BMP is not allowed.
	☐ Partial Infiltration Condition	Compact biofiltration BMP is only allowed, if the target volume retention is met onsite (Refer to Table B.5-1 in Appendix B.5). Use Worksheet B.5-2 in Appendix B.5 to estimate the target volume retention (Note: retention in this context means reduction). If the required volume reduction is achieved **proceed to Criteria 2**. If the required volume reduction is not achieved, compact biofiltration BMP is not allowed. **Stop**.
	■ No Infiltration Condition	Compact biofiltration BMP is allowed if volume retention criteria in Table B.5-1 in Appendix B.5 for the no infiltration condition is met. Compliance with this criterion must be documented in the PDP SWQMP. If the criteria in Table B.5-1 is met **proceed to Criteria 2**. If the criteria in Table B.5-1 is not met, compact biofiltration BMP is not allowed. **Stop**.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Provide basis for Criteria 1 and 3: **<u>Feasibility Analysis:</u>** Summarize findings and include either infiltration feasibility condition letter or Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B in the PDP SWQMP submittal. **<u>If Partial Infiltration Condition:</u>** Provide documentation that target volume retention is met (include Worksheet B.5-2 in the PDP SWQMP submittal). Worksheet B.5-7 in Appendix B.5 can be used to estimate volume retention benefits from landscape areas. **<u>If No Infiltration Condition:</u>** Provide documentation that the volume retention performance standard is met (include Worksheet B.5-2 in the PDP SWQMP submittal) in the PDP SWQMP submittal. Worksheet B.5-6 in Appendix B.5 can be used to document that the performance standard is met.		

Criteria	Answer	Progression
Criteria 2: Is the compact biofiltration BMP sized to meet the performance standard from the MS4 Permit? Refer to Appendix B.5 and Appendix F.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	■ Meets Flow based Criteria	Use guidance from **Appendix F.2.2** to size the compact biofiltration BMP to meet the flow based criteria. Include the calculations in the PDP SWQMP. Use parameters for sizing consistent with manufacturer guidelines and conditions of its third party certifications (i.e. a BMP certified at a loading rate of 1 gpm/sq. ft. cannot be designed using a loading rate of 1.5 gpm/sq. ft.) **Proceed to Criteria 4.**
	☐ Meets Volume based Criteria	Provide documentation that the compact biofiltration BMP has a total static (i.e. non-routed) storage volume, including pore-spaces and pre-filter detention volume (Refer to Appendix B.5 for a schematic) of at least 0.75 times the portion of the DCV not reliably retained onsite. **Proceed to Criteria 4.**
	☐ Does not Meet either criteria	**Stop**. Compact biofiltration BMP is not allowed.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Provide basis for Criteria 2: Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., loading rate, etc., as applicable).		
Criteria	**Answer**	**Progression**
Criteria 4: Does the compact biofiltration BMP meet the pollutant treatment performance standard for the projects most significant pollutants of concern? Refer to Appendix B.6 and Appendix F.1 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	■ Yes, meets the TAPE certification.	Provide documentation that the compact BMP has an appropriate TAPE certification for the projects most significant pollutants of concern. **Proceed to Criteria 5.**
	☐ Yes, through other third-party documentation	Acceptance of third-party documentation is at the discretion of the City Engineer. The City engineer will consider, (a) the data submitted; (b) representativeness of the data submitted; and (c) consistency of the BMP performance claims with pollutant control objectives in Table F.1-2 and Table F.1-1 while making this determination. If a compact biofiltration BMP is not accepted, a written explanation/ reason will be provided in Section 2. **Proceed to Criteria 5.**
	☐ No	**Stop.** Compact biofiltration BMP is not allowed.
Provide basis for Criteria 4: Provide documentation that identifies the projects most significant pollutants of concern and TAPE certification or other third party documentation that shows that the compact biofiltration BMP meets the pollutant treatment performance standard for the projects most significant pollutants of concern.		

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 5: Is the compact biofiltration BMP designed to promote appropriate biological activity to support and maintain treatment process? Refer to Appendix F of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	■ Yes	Provide documentation that the compact biofiltration BMP support appropriate biological activity. Refer to Appendix F for guidance. **Proceed to Criteria 6.**
	☐ No	**Stop**. Compact biofiltration BMP is not allowed.
Provide basis for Criteria 5: Provide documentation that appropriate biological activity is supported by the compact biofiltration BMP to maintain treatment process.		
Criteria	**Answer**	**Progression**
Criteria 6: Is the compact biofiltration BMP designed with a hydraulic loading rate to prevent erosion, scour and channeling within the BMP?	■ Yes	Provide documentation that the compact biofiltration BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. **Proceed to Criteria 7.**
	☐ No	**Stop**. Compact biofiltration BMP is not allowed.
Provide basis for Criteria 6: Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., maximum tributary area, maximum inflow velocities, etc., as applicable).		

Compact (high rate) Biofiltration BMP Checklist			Form I-10
Criteria	**Answer**	**Progression**	
Criteria 7: Is the compact biofiltration BMP maintenance plan consistent with manufacturer guidelines and conditions of its third-party certification (i.e., maintenance activities, frequencies)?	■ Yes, and the compact BMP is privately owned, operated and not in the public right of way.	Submit a maintenance agreement that will also include a statement that the BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification. **Stop**. The compact biofiltration BMP meets the required criteria.	
	☐ Yes, and the BMP is either owned or operated by the City or in the public right of way.	Approval is at the discretion of the City Engineer. The city engineer will consider maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business or other relevant factors while making the determination. **Stop**. Consult the City Engineer for a determination.	
	☐ No	**Stop**. Compact biofiltration BMP is not allowed.	

Provide basis for Criteria 7:

Include copy of manufacturer guidelines and conditions of third-party certification in the maintenance agreement. PDP SWQMP must include a statement that the compact BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification.

Compact (high rate) Biofiltration BMP Checklist	Form I-10
Section 2: Verification (For City Use Only)	
Is the proposed compact BMP accepted by the City Engineer for onsite pollutant control compliance for the DMA?	☐ Yes ☐ No, See explanation below
Explanation/reason if the compact BMP is not accepted by the City for onsite pollutant control compliance:	

Worksheet B.6-1: Flow-Thru Design Flows

Flow-thru Design Flows (P-BF1)		Worksheet B.6-1		
1	DCV	DCV	1814	cubic-feet
2	DCV retained	$DCV_{retained}$	42	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 - Line 2 - 0.67*Line 3)	$DCV_{flow\text{-}thru}$	1772	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	0.976847	unitless
6	Design rainfall intensity	i=	0.2	in/hr
7	Area tributary to BMP (s)	A=	0.98	acres
8	Area-weighted runoff factor (estimate using Appendix B.2)	C=	0.85	unitless
9	Calculate Flow Rate = AF x (C x I x A)	Q=	0.16	cfs
10	Treatment Factor Per Appendix F.2.2		1.50	unitless
11	Required Treatment Flow = Q x 1.5	Q=	0.24	cfs

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	PBF1	
Sizing Method for Volume Retention Criteria		Worksheet B.5-2	

1	Area draining to the BMP	42,691	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.85	
3	85^{th} percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1814	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or enter 0.05	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = $0.0000013 \times \text{Line } 8^3 - 0.000057 \times \text{Line } 8^2 + 0.0086 \times \text{Line } 8 - 0.014$ When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	42	cu. ft.

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6				
	BMP ID	PBF1				

Volume Retention for No Infiltration Condition					Worksheet B.5-6	
1	Area draining to the biofiltration BMP				42691	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)				0.85	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]				36287	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]				1089	sq. ft.
5	Biofiltration BMP Footprint				54	sq. ft.
Landscape Area (must be identified on DS-3247)						
	Identification	A	B	C	D	E
6	Landscape area that meet the requirements in SD-4 and SD-5 Fact Sheet (sq. ft.)					
7	Impervious area draining to the landscape area (sq. ft.)					
8	Impervious to Pervious Area ratio [Line 7/Line 6]	0.00	0.00	0.00	0.00	0.00
9	Effective Credit Area If Line 8 >1.5, use Line 6; if not use Line 7/1.5	0	0	0	0	0
10	Sum of Landscape area [sum of Lines 9A-9E]				0	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]				54	sq. ft.
Volume Retention Performance Standard						
12	Is Line 11 ≥ Line 4?	No, Proceed to Line 13				
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]				0.05	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]				42	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]				39.9	cu. ft.
Site Design BMP						
	Identification	Site Design Type			Credit	
16	A	On-site Trees			40	cu. ft.
	B					cu. ft.
	C					cu. ft.
	D					cu. ft.
	E					cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Lines 16A-16E] Provide documentation of how the site design credit is calculated in the PDP SWQMP.				40	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met				

B.2.2 Adjustment to DCV

When the following site design BMPs are implemented the anticipated volume reduction from these BMPs shall be deducted from the DCV to estimate the volume for which the downstream structural BMP should be sized for:

- SD-1: Trees
- SD-8 Rain barrels

B.2.2.1 Trees

Applicants are allowed to take credit for installing new trees using Table B.2-2 or Equation B.2-1 as applicable, when trees are implemented in accordance with SD-1 fact sheet and meet the following criteria:

- Total tree credit volume is less than 0.25 DCV of the project footprint and
- Single tree credit volume is less than 400 ft^3.

Credit for trees that do not meet the above criteria shall be based on the criteria for sizing the tree as a storm water pollutant control BMP in SD-1 fact sheet. These credit calculations are based on an assumption that each tree and associated trench or box is considered a single BMP, with calculations based on the media storage volume and contributing area.

Table B.2-2 was developed assuming that the entire tributary area is impervious (use Equation B.2-1 if there are different types of surfaces in the contributing area) and an 85th percentile 24-hour rainfall depth of 0.5 inches. The procedure for estimating the tree credit volume using Table B.2-2:

- Delineate the tributary area to the tree and use this tributary area to determine the tree credit volume using Table B.2-2. Use linear interpolation if the tributary area is in between the areas listed in Table B.2-2. When the contributing area is greater than 10,667 ft^2 this simplified method is not allowed.
- Using the amount of soil volume installed to determine the credit using Table B.2-2. Use linear interpolation if the soil volume is in between the values listed in Table B.2-2. When the soil volume is greater than 1,333 ft^3 this simplified method is not allowed.
- Use the smaller tree credit volume of the two estimates.

Table B.2-2: Allowable Reduction in DCV

Tree Credit Volume (ft^3/tree)	Contributing Area (ft^2)	Soil Volume (ft^3)
10	267	33
50	1,333	167
100	2,667	333
150	4,000	500
200	5,333	667
300	8,000	1,000
400	10,667	1,333

← 19 TREES ARE CURRENTLY PROPOSED WITHIN DMA PBF1, APPROX HALF HAVE >267 SF TRIBUTARY. THE PROJECT WILL PROVIDE >40 CF RETENTION VOLUME, DETAILED CALCULATIONS WILL BE PROVIDED AT FINAL ENGINEERING

Worksheet B.6-1: Flow-Thru Design Flows

Flow-thru Design Flows (P-BF2)		Worksheet B.6-1		
1	DCV	DCV	783	cubic-feet
2	DCV retained	$DCV_{retained}$	0	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 - Line 2 - 0.67*Line 3)	$DCV_{flow-thru}$	783	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	1	unitless
6	Design rainfall intensity	i=	0.2	in/hr
7	Area tributary to BMP (s)	A=	0.4	acres
8	Area-weighted runoff factor (estimate using Appendix B.2)	C=	0.90	unitless
9	Calculate Flow Rate = AF x (C x I x A)	Q=	0.07	cfs
10	Treatment Factor Per Appendix F.2.2		1.50	unitless
11	Required Treatment Flow = Q x 1.5	Q=	0.11	cfs

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	PBF2	
Sizing Method for Volume Retention Criteria		Worksheet B.5-2	

1	Area draining to the BMP	17,400	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85^{th} percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	783	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or enter 0.05	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = $0.0000013 \times \text{Line } 8^3 - 0.000057 \times \text{Line } 8^2 + 0.0086 \times \text{Line } 8 - 0.014$ When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	18	cu. ft.

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6			
	BMP ID	PBF2			

Volume Retention for No Infiltration Condition — **Worksheet B.5-6**

1	Area draining to the biofiltration BMP	17400	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]	15660	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]	470	sq. ft.
5	Biofiltration BMP Footprint	32	sq. ft.

Landscape Area (must be identified on DS-3247)

	Identification	A	B	C	D	E
* 6	Landscape area that meet the requirements in SD-4 and SD-5 Fact Sheet (sq. ft.)	450				
* 7	Impervious area draining to the landscape area (sq. ft.)	1150				
8	Impervious to Pervious Area ratio [Line 7/Line 6]	2.56	0.00	0.00	0.00	0.00
9	Effective Credit Area If Line 8 >1.5, use Line 6; if not use Line 7/1.5	450	0	0	0	0

10	Sum of Landscape area [sum of Lines 9A-9E]	450	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]	482	sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	Volume Retention Performance Standard is Met. Stop	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	1.03	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	18	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	-0.54	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	A			cu. ft.
	B			cu. ft.
	C			cu. ft.
	D			cu. ft.
	E			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Lines 16A-16E] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		0	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

* IMPERVIOUS AREA WILL DRAIN TO LANDSCAPE AREA TO PROVIDE APPROPRIATE RETENTION VOLUME, DETAILED CALCULATIONS WILL BE PROVIDED AT FINAL ENGINEERING.

Worksheet B.6-1: Flow-Thru Design Flows

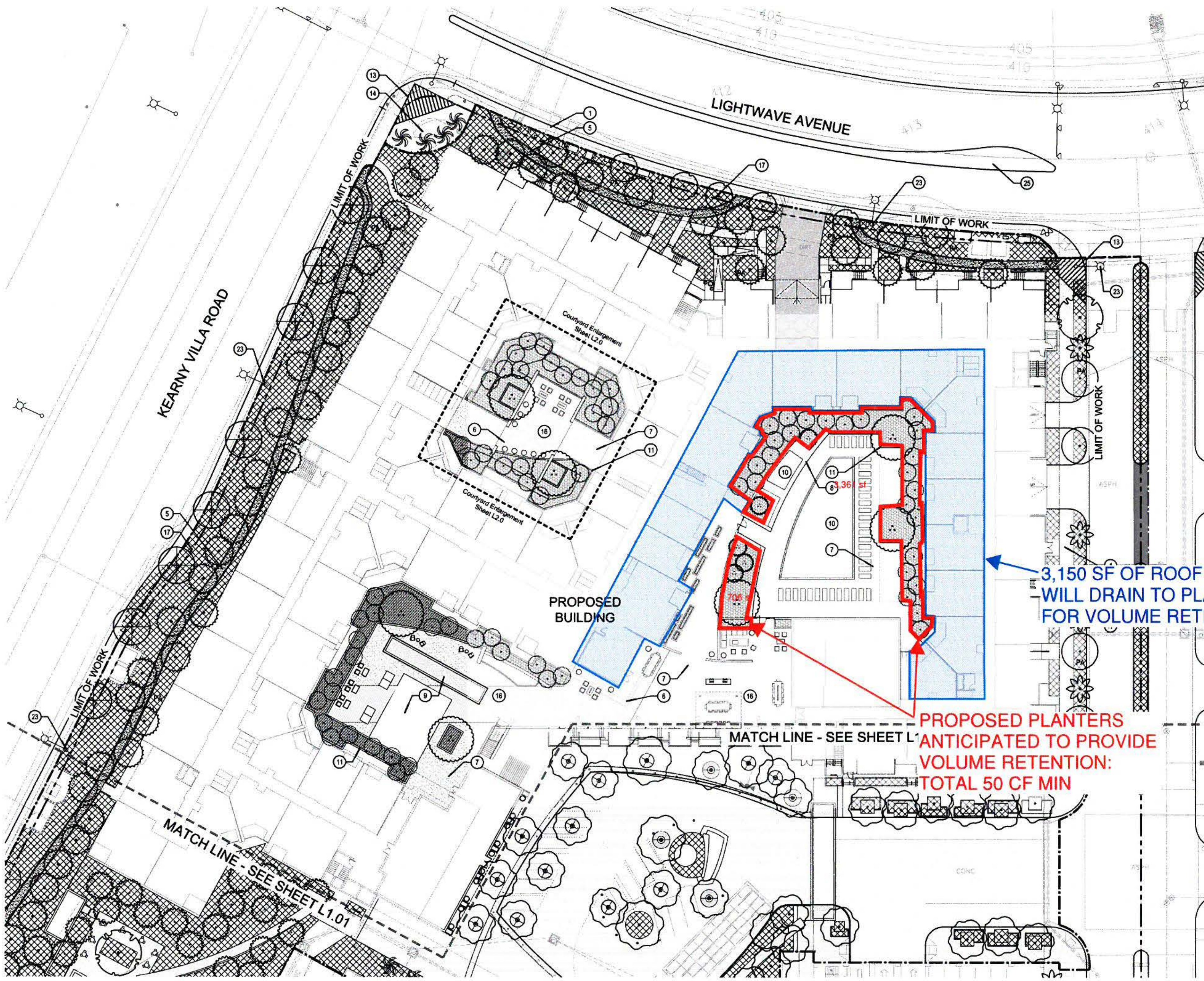
Flow-thru Design Flows (P-BF3)		Worksheet B.6-1		
1	DCV	DCV	1372	cubic-feet
2	DCV retained	$DCV_{retained}$	0	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 - Line 2 - 0.67*Line 3)	$DCV_{flow\text{-}thru}$	1372	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	1	unitless
6	Design rainfall intensity	i=	0.2	in/hr
7	Area tributary to BMP (s)	A=	0.7	acres
8	Area-weighted runoff factor (estimate using Appendix B.2)	C=	0.90	unitless
9	Calculate Flow Rate = AF x (C x I x A)	Q=	0.13	cfs
10	Treatment Factor Per Appendix F.2.2		1.50	unitless
11	Required Treatment Flow = Q x 1.5	Q=	0.19	cfs

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6	
	BMP ID	PBF3	
Sizing Method for Volume Retention Criteria		Worksheet B.5-2	

1	Area draining to the BMP	30,490	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85^{th} percentile 24-hour rainfall depth	0.6	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1372	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or enter 0.05	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = 0.0000013 x Line 8^3 - 0.000057 x Line 8^2 + 0.0086 x Line 8 - 0.014 When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	32	cu. ft.

The City of SAN DIEGO	Project Name	Centrum Apts Ph 6				
	BMP ID	PBF3				
Volume Retention for No Infiltration Condition			**Worksheet B.5-6**			
1	Area draining to the biofiltration BMP				30490	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)				0.9	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]				27441	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]				823	sq. ft.
5	Biofiltration BMP Footprint				68	sq. ft.
Landscape Area (must be identified on DS-3247)						
	Identification	**A**	**B**	**C**	**D**	**E**
* 6	Landscape area that meet the requirements in SD-4 and SD-5 Fact Sheet (sq. ft.)	800				
* 7	Impervious area draining to the landscape area (sq. ft.)	2000				
8	Impervious to Pervious Area ratio [Line 7/Line 6]	2.50	0.00	0.00	0.00	0.00
9	Effective Credit Area If Line 8 >1.5, use Line 6; if not use Line 7/1.5	800	0	0	0	0
10	Sum of Landscape area [sum of Lines 9A-9E]				800	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]				868	sq. ft.
Volume Retention Performance Standard						
12	Is Line 11 ≥ Line 4?	Volume Retention Performance Standard is Met. Stop				
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]				1.05	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]				32	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]				-1.6	cu. ft.
Site Design BMP						
	Identification	**Site Design Type**			**Credit**	
16	A					cu. ft.
	B					cu. ft.
	C					cu. ft.
	D					cu. ft.
	E					cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Lines 16A-16E] Provide documentation of how the site design credit is calculated in the PDP SWQMP.				0	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met				

* IMPERVIOUS AREA WILL DRAIN TO LANDSCAPE AREA TO PROVIDE APPROPRIATE RETENTION VOLUME, DETAILED CALCULATIONS WILL BE PROVIDED AT FINAL ENGINEERING.



PERIMETER TREES

SYMBOL	BOTANICAL NAME	COMMON NAME
Street Trees		
	Tipuana tipu Koelreuteria species Pyrus kawakamii *(Replace Existing Tree)	Tipu Tree Koelreuteria species Evergreen Pear
AutoCourt Tree		
	Cinnamomum camphora Olea europaea Ginkgo biloba Ulmus parvifolia 'Allee' Platanus acerifila	Camphor Tree Olive Maidenhair Tree Chinese Evergreen Elm Sycamore
Accent Tree		
	Jacaranda mimosifolia Magnolia grandiflora Olea europaea X Chitalpa tashkeutensis	Jacaranda Southern Magnolia Olive NCN
Architectural Edge		
	Koelreuteria Paniculata Lophostemon confertus Melaleuca quinquenervia Brachychiton populneus	Golden Rain Tree Brisbane Box Paperbark Tree Kurrajong
	Arbutus 'Marina' Agonis flexuosa Cupressus sempervirens Lophostemon confertus Pyrus kawakamii	Marina Arbutus Australian Willow Myrtle Italian cypress Brisbane Box Evergreen Pear
Palms		
	Syagrus romanzoffiana Phoenix dactylifera	Queen Palm Date Palm
Bamboo		
	Bambusa Multiplex Otatea acuminata 'Aztecorum'	Golden Goddess Bamboo Mexican Weeping Bamboo
Existing Trees *(Protect In Place)		
	Washingtonia robusta	Mexican Fan Palm
	Tipuana tipu	Tipu Tree

PERIMETER PLANTING (Plant Zone 23)

Shrubs & Groundcovers (Drip Irrigation System)		
	Agapanthus africanus 'Albus' Grevillea 'Noellii' Ligustrum japonica 'Texanum' Pittosporum tobira Rhaphiolepis indica 'Clara' Rhaphiolepis umbellata 'Minor' Strelitzia reginae Trachelospermum jasminoides Aspidistra elatior Callistemon c. 'Little John' Carissa macrocarpa 'Boxwood' Liriope gigantea Loropetalum c 'Razzleberry' Philodendron x 'Xanadu' Rhaphiolepis indica 'Clara' Rosmarinus o. 'Huntington Carpet' Pennisetum spathiolatum Cerex pansa Cerex preagracilis Juncus patens Lomandra 'Breeze Dwarf Leymus triticoides	White Lily of the Nile NCN Waxleaf Privet Dwarf Mock Orange Indian Hawthorn Dwarf Yeddo Hawthorn Bird of Paradise Star Jasmine Cast-Iron Plant Lemon Bottlebrush Carissa Lily Turf Razzleberry Loropetalum Xanadu Philodendron Indian Hawthorn Rosemary Slender Veldt Grass Sand Dune Sedge Slender Sedge California Gray Rush Dwarf Matt Rush Creeping Wild Rye

- All landscape and irrigation shall conform to the stands of the City-Wide Landscape Regulation and the City of San Diego Land Development Manual Landscape Standards and all other landscape related City and Regional Standards.
- A minimum root zone of 40sf in area shall be provided for all trees. The minmum dimension for this area shall be 5 feet, per SDMC 142.0403(b)(5).
- MINIMUM TREE SEPARATION DISTANCE:
  Traffic signals/ Stop signs: 20 Feet
  Underground utility lines: 5 Feet (10 Feet for Sewer)
  Above ground utility structures: 10 Feet
  Driveway (Entries): 10 Feet
  Intersections (Intersecting Curb Lines of two streets): 25 Feet
- Maintenance: Owner shall be responsible for the long term maintenance of all landscape areas. Landscape and irrigation areas in the public right of way shall be maintained by Owner. The landscape areas shall be maintained free of debris and litter, and all plant material shall be maintained in healthy growing condition. Diseased or dead plant material shall be satisfactorily treated or replaced per the conditions of permit.
- An automatic, electrically controlled irrigation system shall be provided as required by LDC 142.0403(c) for proper irrigation, development, and maintenance of the vegetation in healthy, disease-resistant condition. The design of the system shall provide adequate support for the vegetation selected.

WATER USE LEGEND

SYMBOL	DESCRIPTION
	Low to Moderate Water Use (45,369 sq.ft)
	Moderate to High Water Use (9,819 sq.ft)

PODIUM TREES

SYMBOL	BOTANICAL NAME	COMMON NAME
Accent Tree		
	Cinnamomum camphora Olea europaea Jacaranda mimosifolia Ulmus parvifolia 'Allee'	Camphor Tree Olive Jacaranda Chinese Evergreen Elm
Small Accent Tree		
	Jacaranda mimosifolia Magnolia grandiflora 'Little Gem' Lagerstroemia indica Prunus caroliniana x Chitalpa tashkentensis	Jacaranda Southern Magnolia Crape Myrtle Carolina Laurel Cherry Chitalpa 'Pink Dawn'
Foundation Tree		
	Arbutus 'Marina' Agonis flexuosa Cupressus sempervirens Lophostemon confertus Pyrus kawakamii	Marina Arbutus Australian Willow Myrtle Italian cypress Brisbane Box Evergreen Pear
Palms/ Palm-Like		
	Syagrus romanzoffiana Phoenix dactylifera	Queen Palm Date Palm

PODIUM PLANTING (Plant Zone 23)

Shrubs & Groundcovers (Spray Irrigation System)		
	Agave attenuata 'Nova' Agave 'Blue Glow' Grevillea 'Noellii' Ligustrum japonica 'Texanum' Rhaphiolepis indica 'Clara' Strelitzia reginae Trachelospermum asiaticum Trachelospermum jasminoides Carissa macrocarpa 'Tuttle' Phormium 'Apricot Queen' Loropetalum c 'Razzleberry' Philodendron x 'Xanadu' Lauris Nobilis Alpinia zerumbet 'Variegata' Arbutus unedo 'Compacta' Rhapheolepis Indica 'Ballerina' Nephrolepis cordifolia Pittosporum tobira Rosa 'Iceberg' Bougainvillea 'Oo La La' Rosmarinus 'Huntington Carpet' Liriope gigantea Pennisetum spathiolatum Chondropetalum tectorum Carex Divulsa Festuca o. glauca	Nova Foxtail Agave Blue Glow Agave NCN Waxleaf Privet Indian Hawthorn Bird of Paradise Asian Star Jasmine Star Jasmine Tuttle Carissa Apricot Queen New Zealand Fla Razzleberry Loropetalum Xanadu Philodendron Sweet Bay Variegated Shell Ginger Compact Strawberry Tree Dwarf India Hawthorn Sword Fern Dwarf Mock Orange White Shrub Rose Bougainvillea Huntington Carpet Rosemary Lily Turf Slender Veldt Grass Small Cape Rush Berkely Sedge NCN

KEY NOTE LEGEND

SYMBOL	DESCRIPTION
1	Existing Concrete Paving
2	Enhanced Pavers - Auto Court
3	Concrete Paving (On Grade)
4	Concrete Walk
5	Stabilized Decomposed Granite Jogging Path
6	Enhanced Pavers at Courtyards
7	Concrete Paving (On Podium)
8	Decking at Spa
9	Decomposed Granite/ Synthetic Turf
10	Pool and Spa
11	Raised Planters (On Podium)
12	Barrier Wall
13	Visibility Triangles
14	Existing Monument Sign (Protect In Place)

KEY NOTE LEGEND (Cont.)

SYMBOL	DESCRIPTION
15	Auto Court Parking
16	Amenity Area
17	Property Line
18	Existing Stabilized Decomposed Granite Jogging Path
19	Tree Seat Wall
20	Tree Grate
21	Auto Court Planter
22	Existing Sculpture (Relocated)
23	Street Light
24	Driveway Entry Raised Planters (On Podium)
25	Proposed Street Medium
26	Fuel Generator

SUNROAD CENTRUM

SUNROAD ENTERPRISES

Sunroad Enterprises
4445 Eastgate Mall Suite 400
San Diego, CA 92121

SUNROAD CENTRUM 6
SAN DIEGO, CA # 2017-0142

Landscape Plan
April 18, 2018

L1.2

0 15 30 60 Feet
Scale: 1" = 30'

EPTDESIGN
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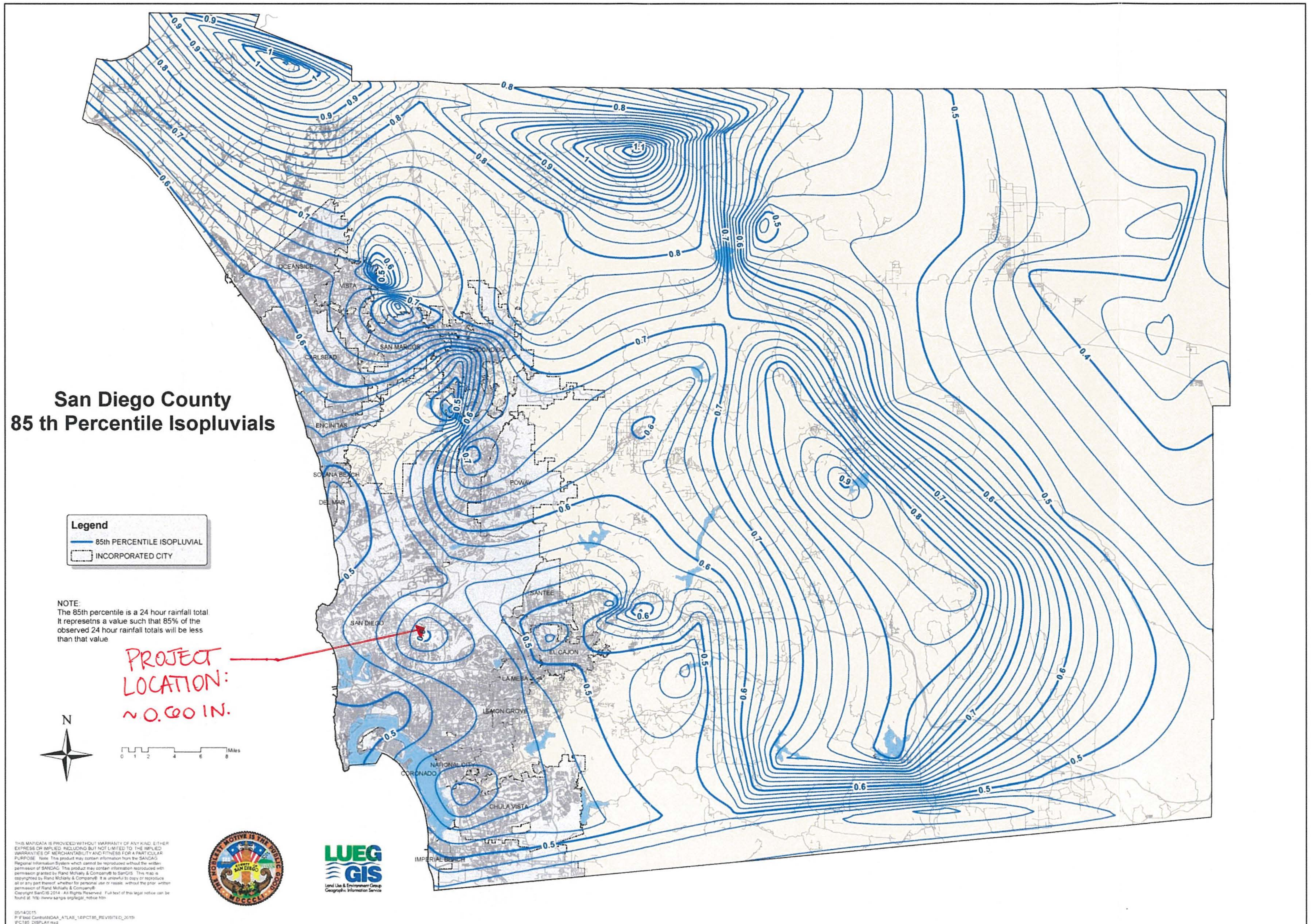
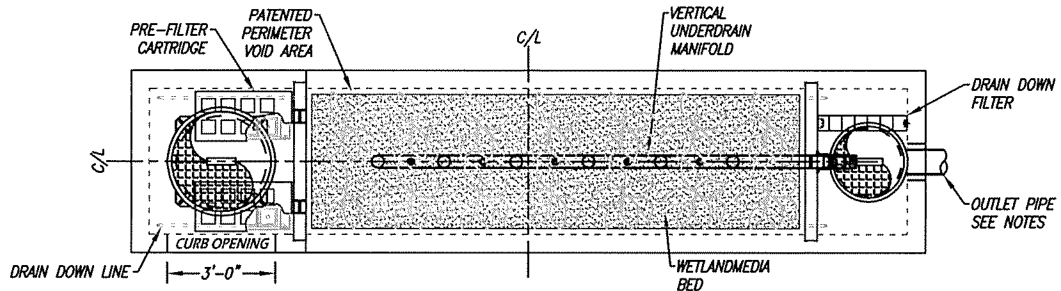


Figure B.1-1: 85th Percentile 24-hour Isopluvial Map

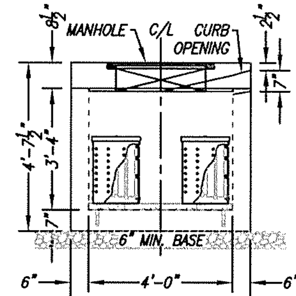
Proprietary Biofiltration GULD Certification and Manufacturer's Specifications

SITE SPECIFIC DATA

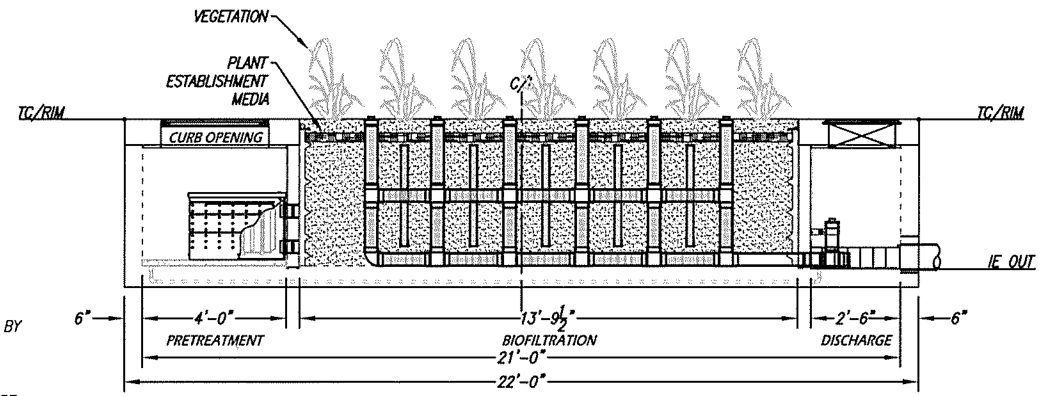
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			7.63
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.34"
MAXIMUM PICK WEIGHT (LBS)			43000
NOTES:			



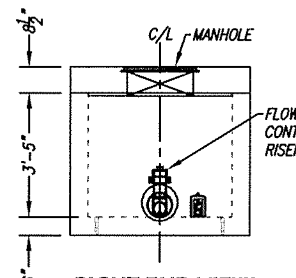
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

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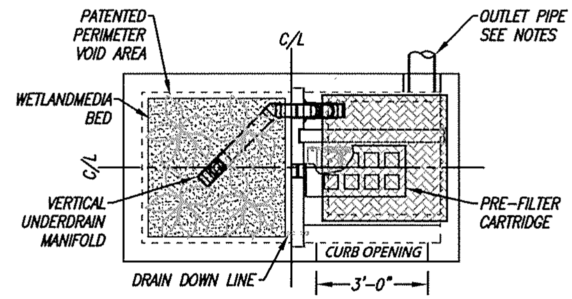
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

P-BF1

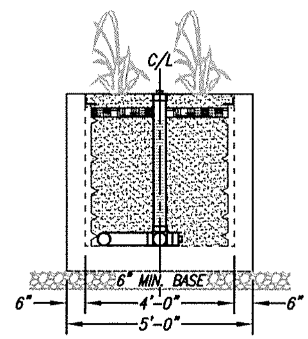
TREATMENT FLOW (CFS)	0.268
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MWS-L-4-21-C
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

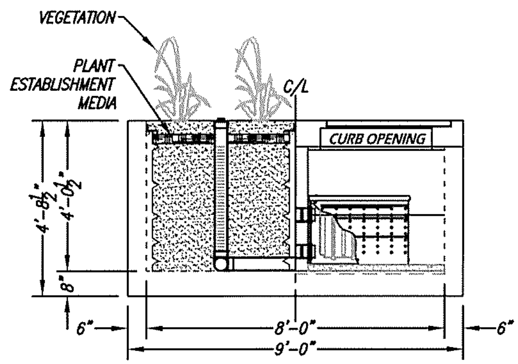
SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	36" X 36"	N/A	N/A
WETLANDMEDIA VOLUME (CY)			2.03
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø1.53"
MAXIMUM PICK WEIGHT (LBS)			15000
NOTES:			



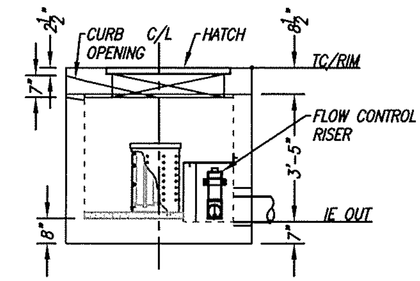
PLAN VIEW



LEFT END VIEW
BIOFILTRATION



ELEVATION VIEW



RIGHT END VIEW
PRETREATMENT/DISCHARGE

P-BF2

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.
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GENERAL NOTES

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TREATMENT FLOW (CFS)	0.115
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

MWS-L-4-8-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)			5.41
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.05"
MAXIMUM PICK WEIGHT (LBS)			36000
NOTES:			

INSTALLATION NOTES

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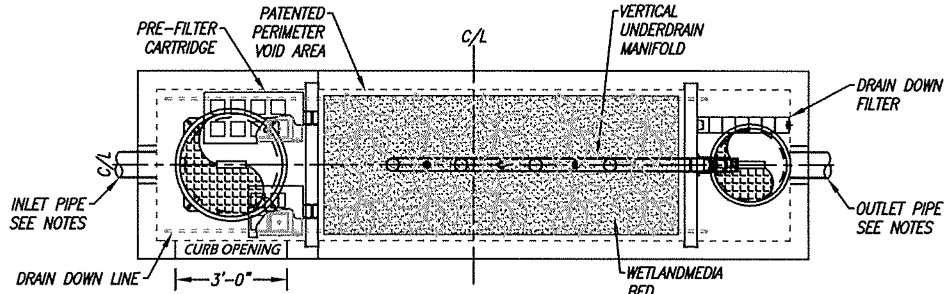
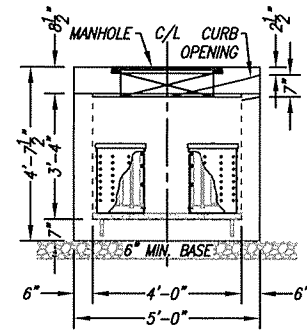
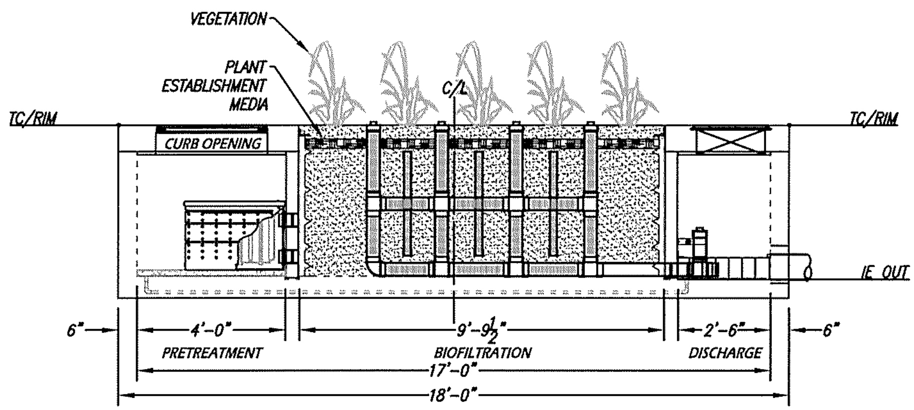


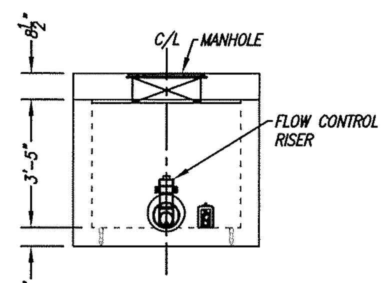
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

P-BF3

TREATMENT FLOW (CFS)	0.206
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

www.modularwetlands.com | (855) 5MOD-WET

MWS-L-4-17-C
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment
   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment
   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.
3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment
   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:
   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
   - Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
   - Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
   - Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the

first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

<u>Laboratory Testing</u>

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

<u>Field Testing</u>

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant: Greg Kent
Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92054
gkent@biocleanenvironmental.net

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

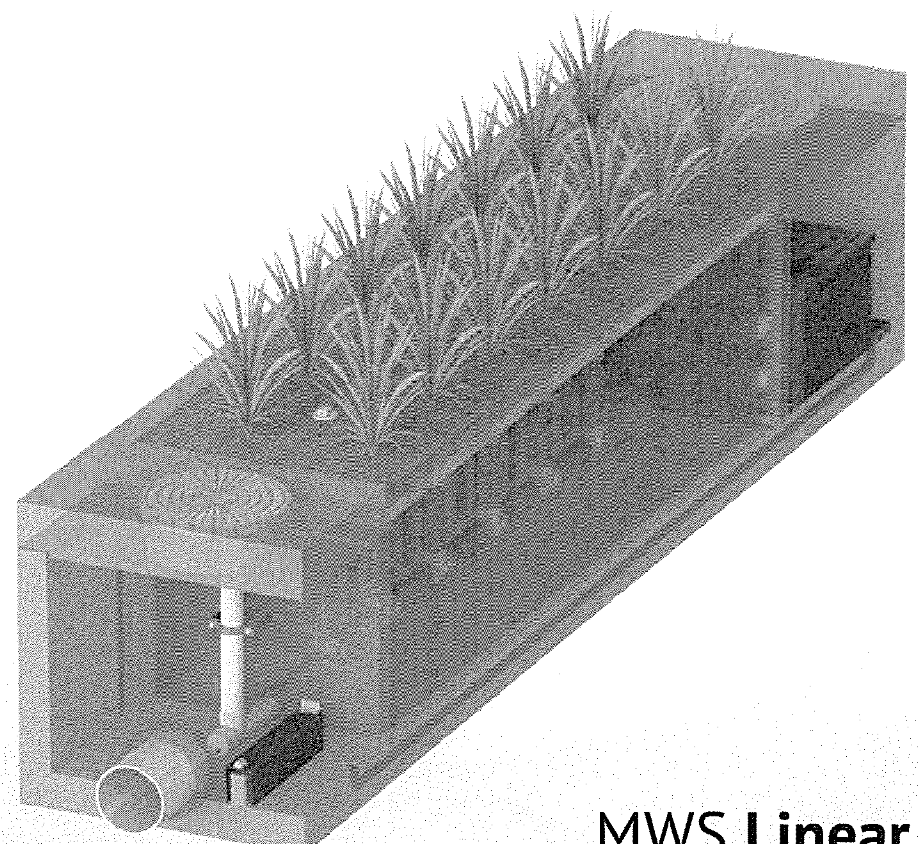
Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

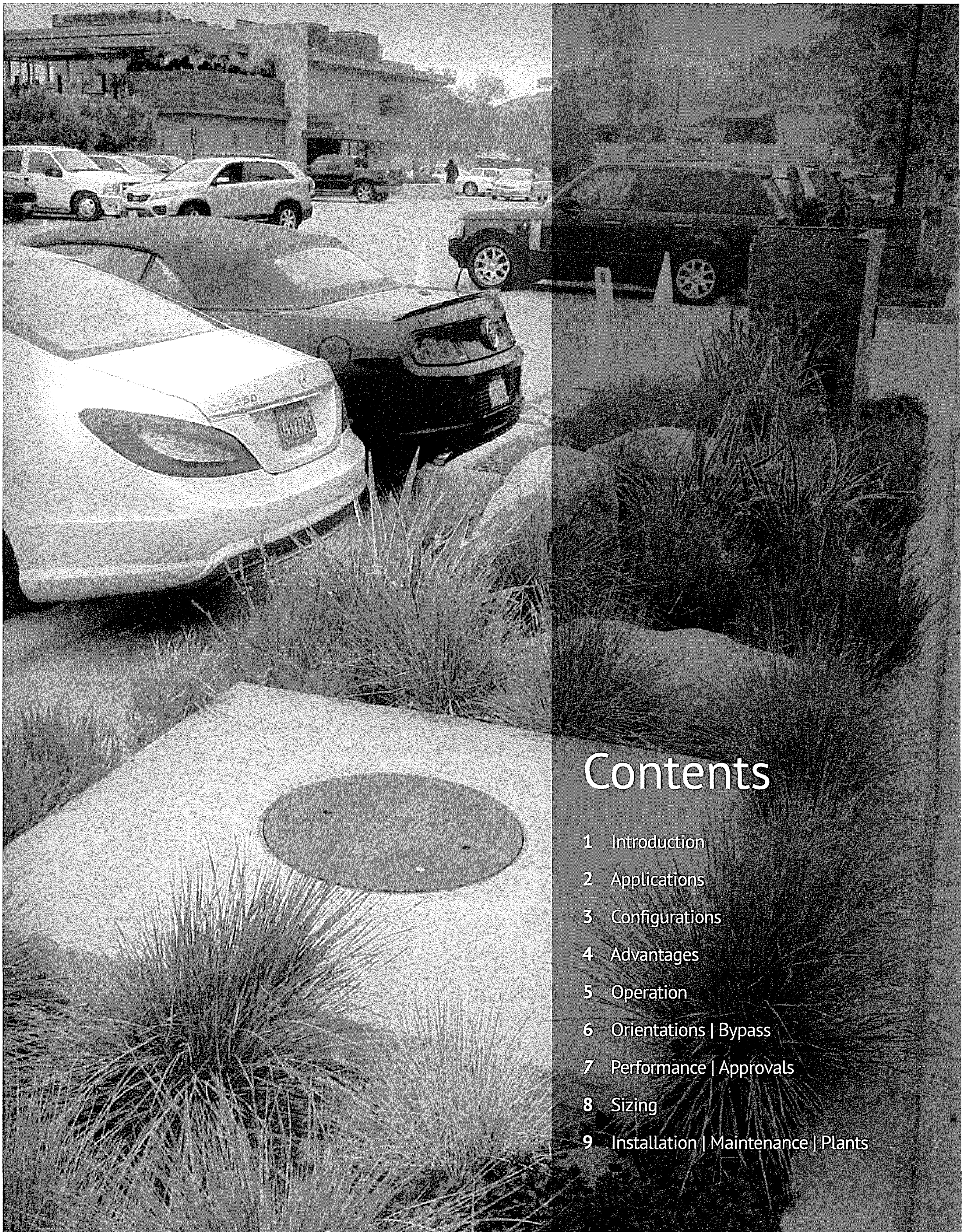
Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*



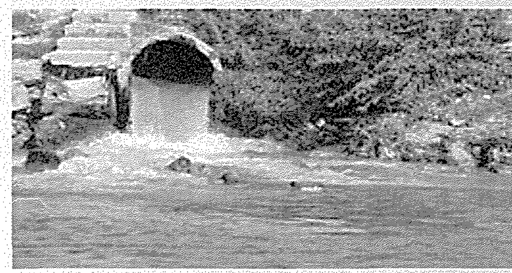
MWS **Linear**



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

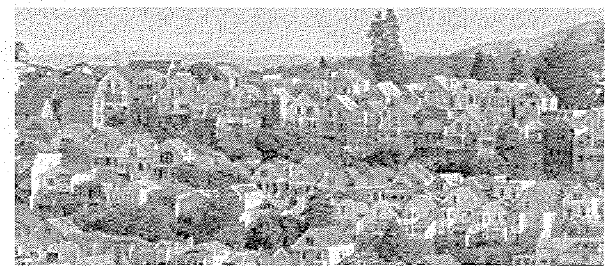
The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates 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.

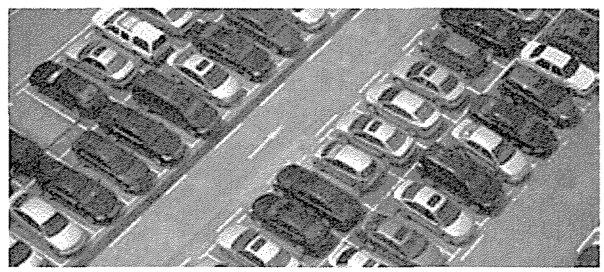


Residential

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.

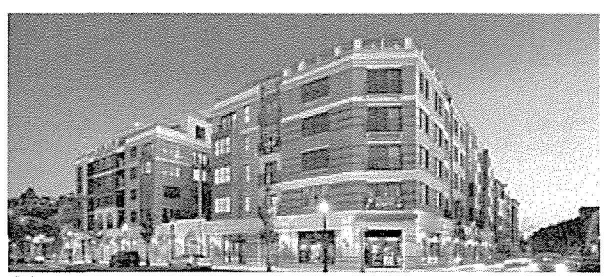


Parking Lots

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

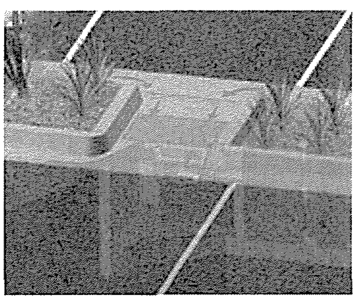
- Agriculture
- Reuse
- Low Impact Development
- Waste Water

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.

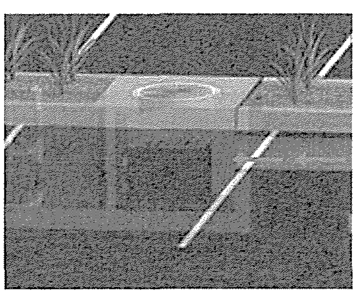
Curb Type

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

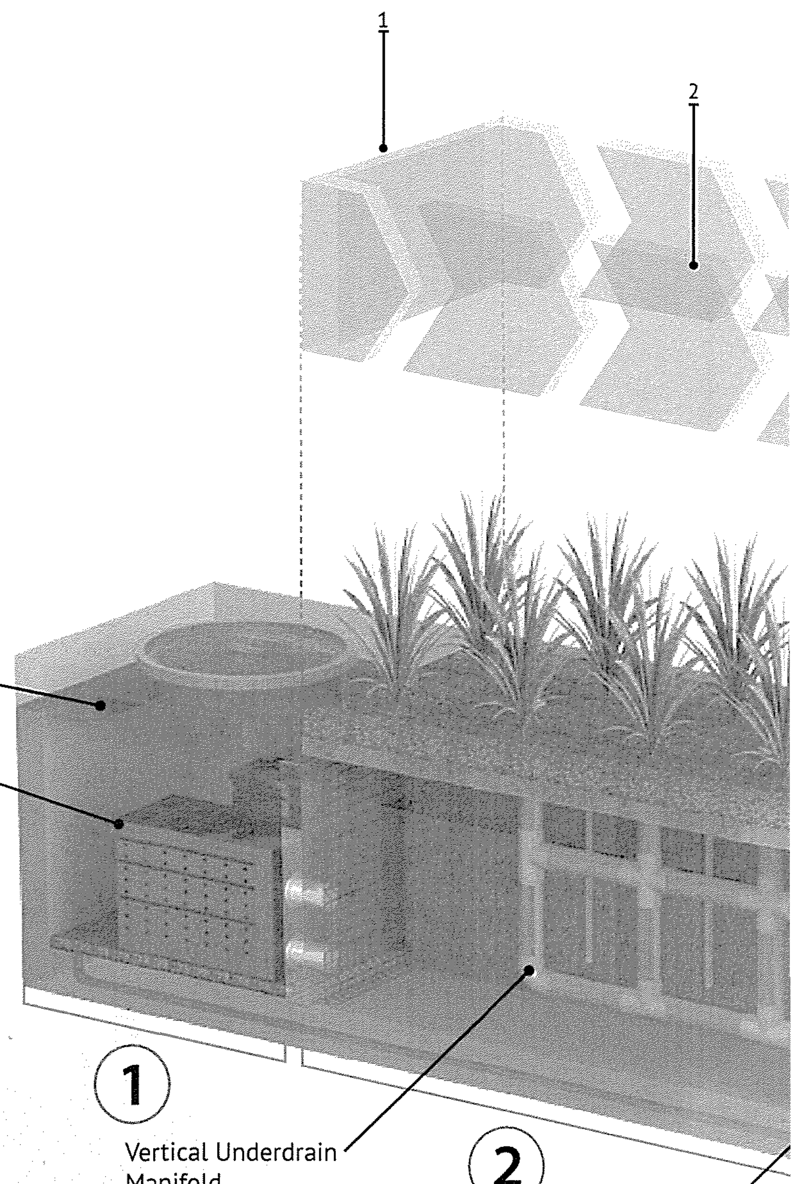
1 Pre-Treatment

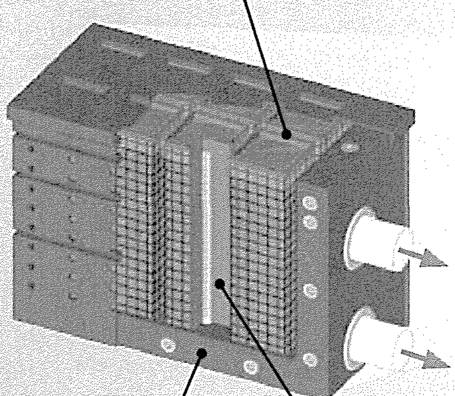
Separation

- 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





BioMediaGREEN

Wetland MEDIA™

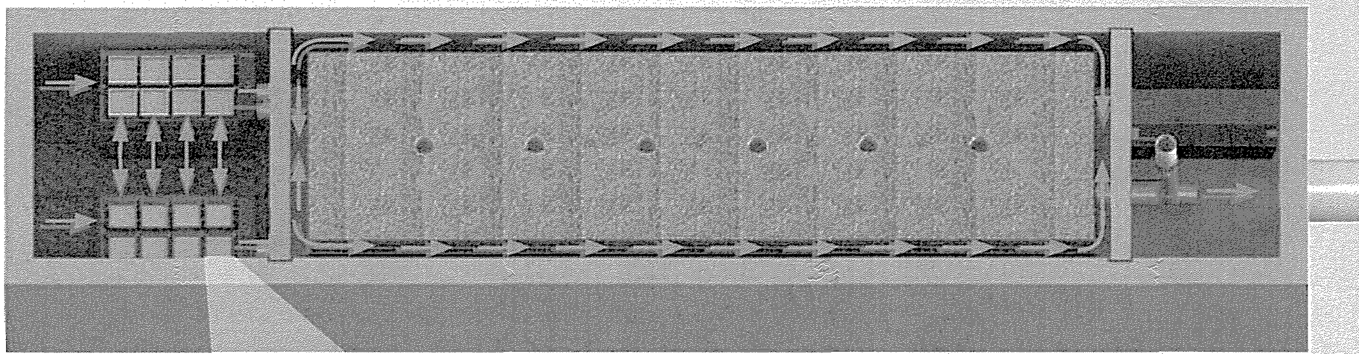
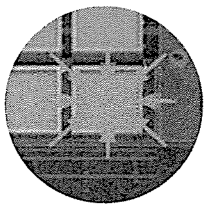


Fig. 2 - Top View



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

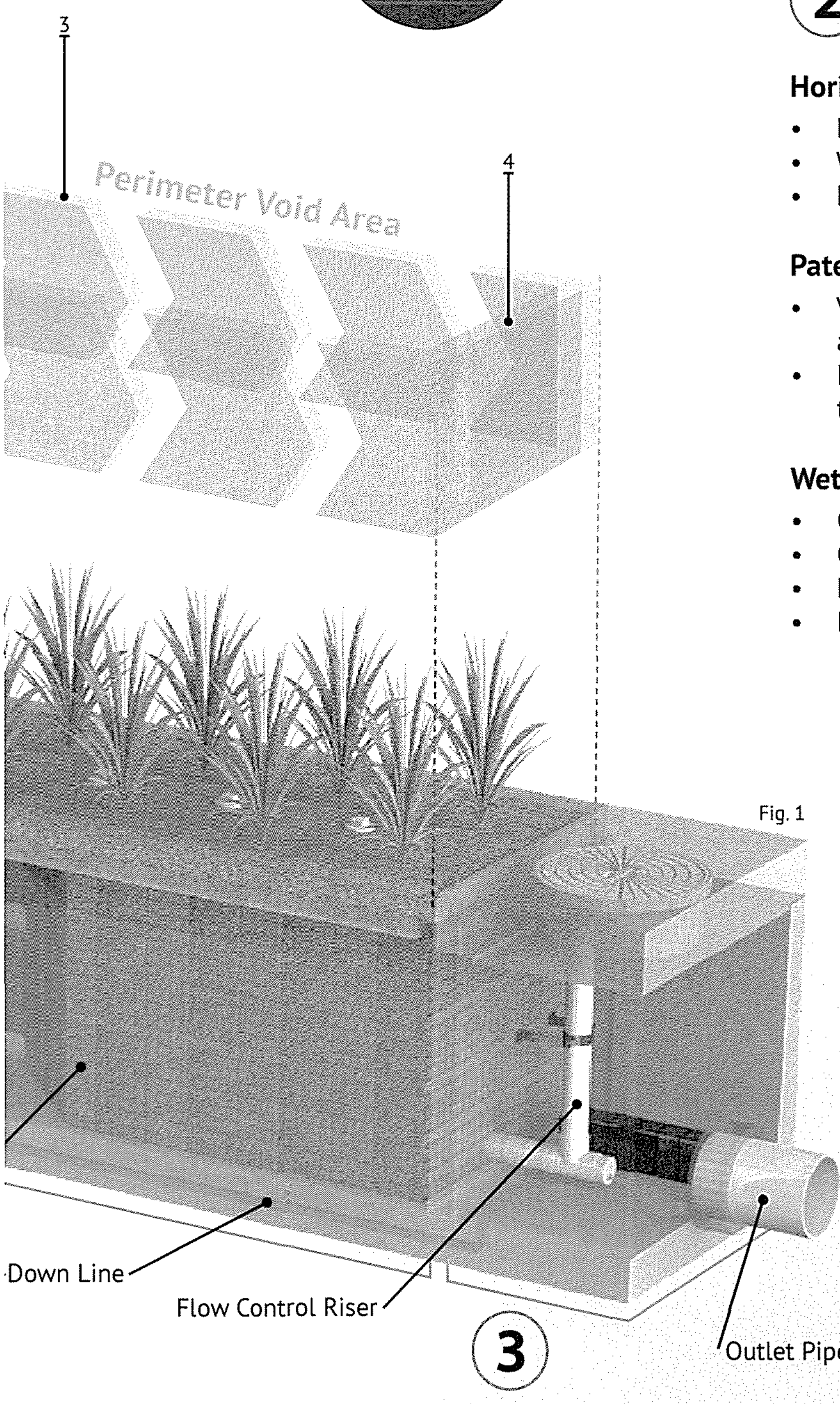


Fig. 1

3 Discharge

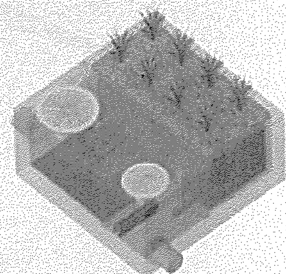
Flow Control

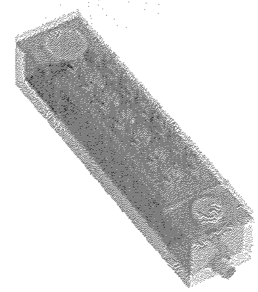
- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity.
- Extends the life of the media and improves performance

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.

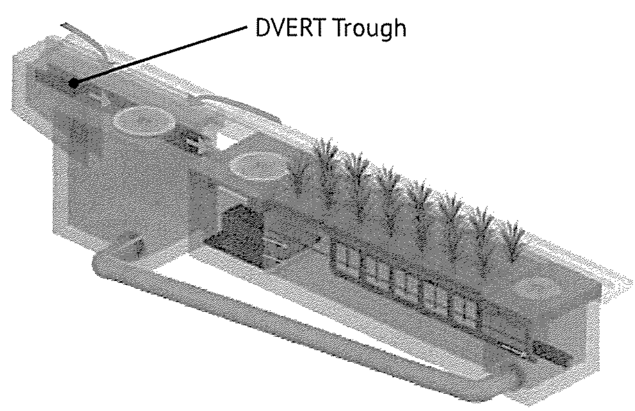
External Diversion Weir Structure

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 TAPE 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.

Maryland Department Of The Environment Approved

Granted ESD (Environmental Site Design) status for new construction, redevelopment and retrofitting when designed in accordance with the Design Manual.

MASTEP Evaluation

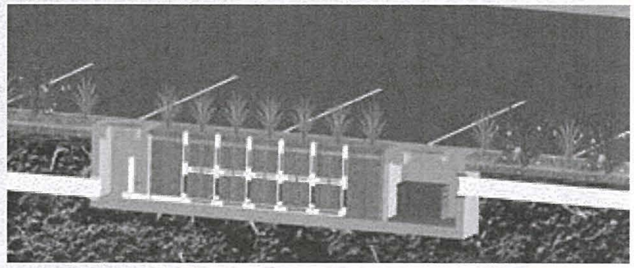
The University of Massachusetts at Amherst – Water Resources Research Center, issued a technical evaluation report noting removal rates up to 84% TSS, 70% Total Phosphorus, 68.5% Total Zinc, and more.

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, and 30% Total Nitrogen.

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.

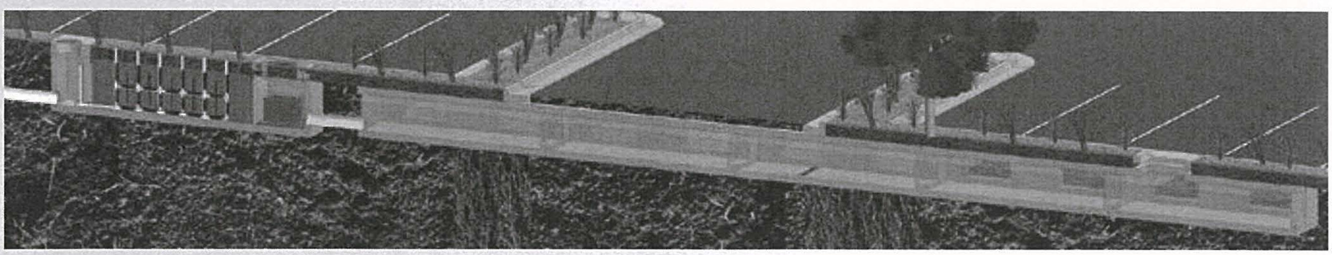


Treatment Flow Sizing Table

	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
PBF2	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
PBF3	MWS-L-4-17	4' x 17'	90 ft^2	0.206
	MWS-L-4-19	4' x 19'	103 ft^2	0.237
PBF1	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.

11

ATTACHMENT 2
BACKUP FOR PDP HYDROMODIFICATION CONTROL MEASURES

This is the cover sheet for Attachment 2.

☐ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Project Name: Sunroad Centrum 6

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☒ Included See Hydromodification Management Exhibit Checklist.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☒ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map (Required) Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2c	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	○ Not Performed ◉ Included ○ Submitted as separate stand-alone document
Attachment 2d	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	◉ Included ○ Submitted as separate stand-alone document
Attachment 2e	Vector Control Plan (Required when structural BMPs will not drain in 96 hours)	○ Included ◉ Not required because BMPs will drain in less than 96 hours

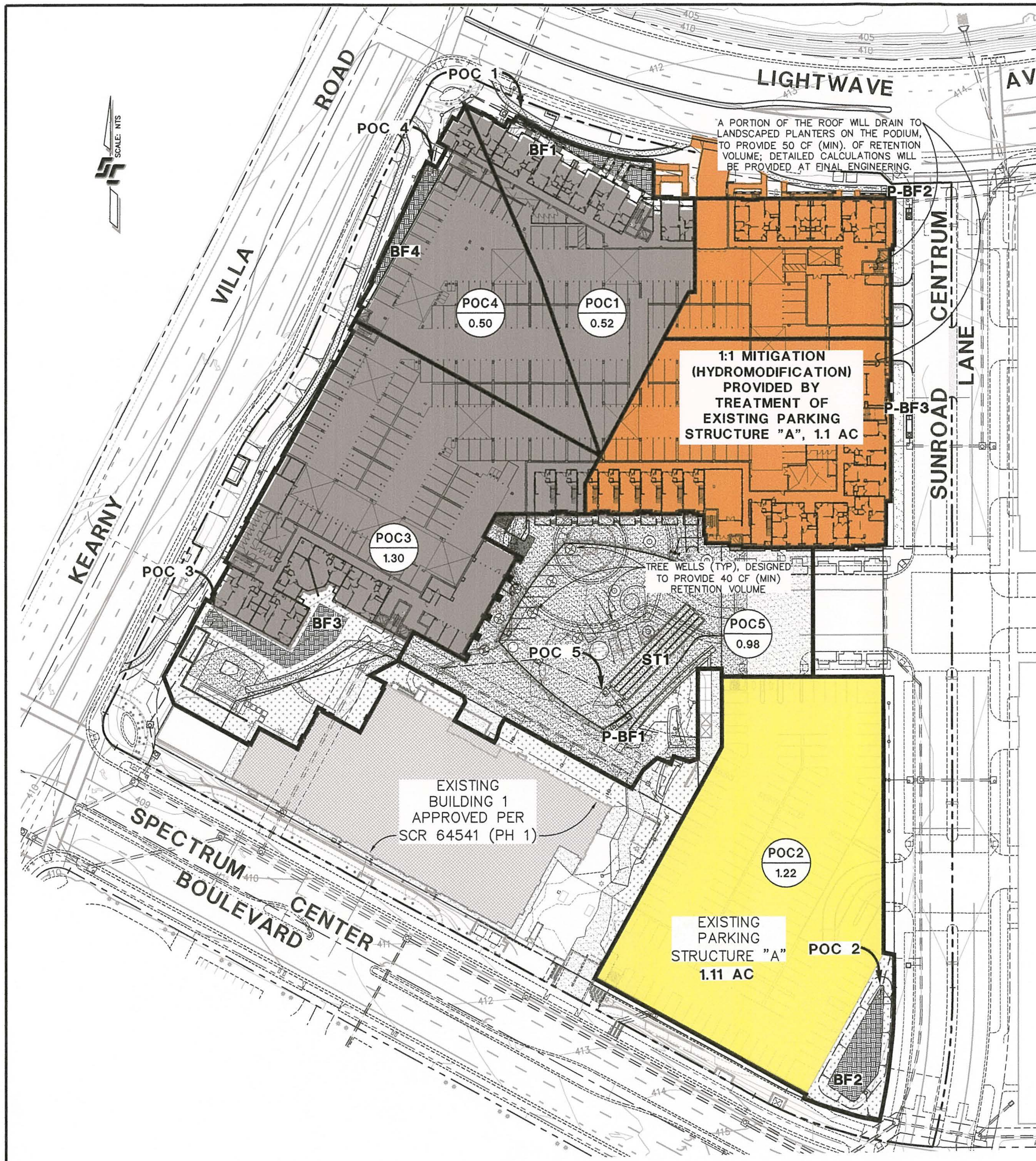
Attachment 2a

Hydromodification Management Exhibit

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

The Hydromodification Management Exhibit must identify:

☒ Underlying hydrologic soil group
☒ Approximate depth to groundwater
☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☒ Critical coarse sediment yield areas to be protected
☒ Existing topography
☒ Existing and proposed site drainage network and connections to drainage offsite
☒ Proposed grading
☒ Proposed impervious features
☒ Proposed design features and surface treatments used to minimize imperviousness
☒ Point(s) of Compliance (POC) for Hydromodification Management
☒ Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
☒ Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail)



LEGEND

EXISTING GROUND CONTOURS
410 —— INDEX
409 —— INTERMEDIATE

PROPOSED GROUND CONTOURS
410 —— INDEX
409 —— INTERMEDIATE

POC2 — POC DESIGNATION
1.22 — AREA (ACRES)

POC BOUNDARY

STRUCTURAL TREATMENT BMPS:

BIOFILTRATION PLANTER (BF)

UNDERGROUND DETENTION FACILITY (ST)

MODULAR WETLANDS: PROPRIETARY BMP (P-BF)

POINTS OF COMPLIANCE (POC) FOR HYDROMODIFICATION MANAGEMENT

UNDERLYING HYDROLOGIC SOIL GROUP D

APPROXIMATE DEPTH TO GROUNDWATER > 20FT

LAND USE:

PROPOSED BUILDING/: MULTI-STORY MINIMIZES AREA (SD-3 MINIMIZE IMPERVIOUS AREA)

PROPOSED IMPERVIOUS: MINIMUM WIDTHS USED (SD-3 MINIMIZE IMPERVIOUS AREA)

LANDSCAPE: PLANTER (SD-4 MINIMIZE SOIL COMPACTION) (SD-7 LANDSCAPE/PLANTER AREA WITH DROUGHT TOLERANT SPECIES)

EXISTING BUILDING

EXISTING IMPERVIOUS

1:1 MITIGATION:

1.10 AC — PROPOSED IMPERVIOUS SURFACE; 1:1 MITIGATION PROVIDED BY TREATMENT OF EXISTING PARKING STRUCTURE

1.11 AC — EXISTING IMPERVIOUS SURFACE; TREATMENT BY BF2 PROVIDES 1:1 MITIGATION

STEVENS-CRESTO ENGINEERING, INC.
CIVIL ENGINEERS - LAND PLANNERS - SURVEYORS
9665 CHESAPEAKE DRIVE
SUITE 200
SAN DIEGO, CA 92123-1352
PHONE: 858.694.5660
FAX: 858.694.5661
www.sceng.com

REVISIONS

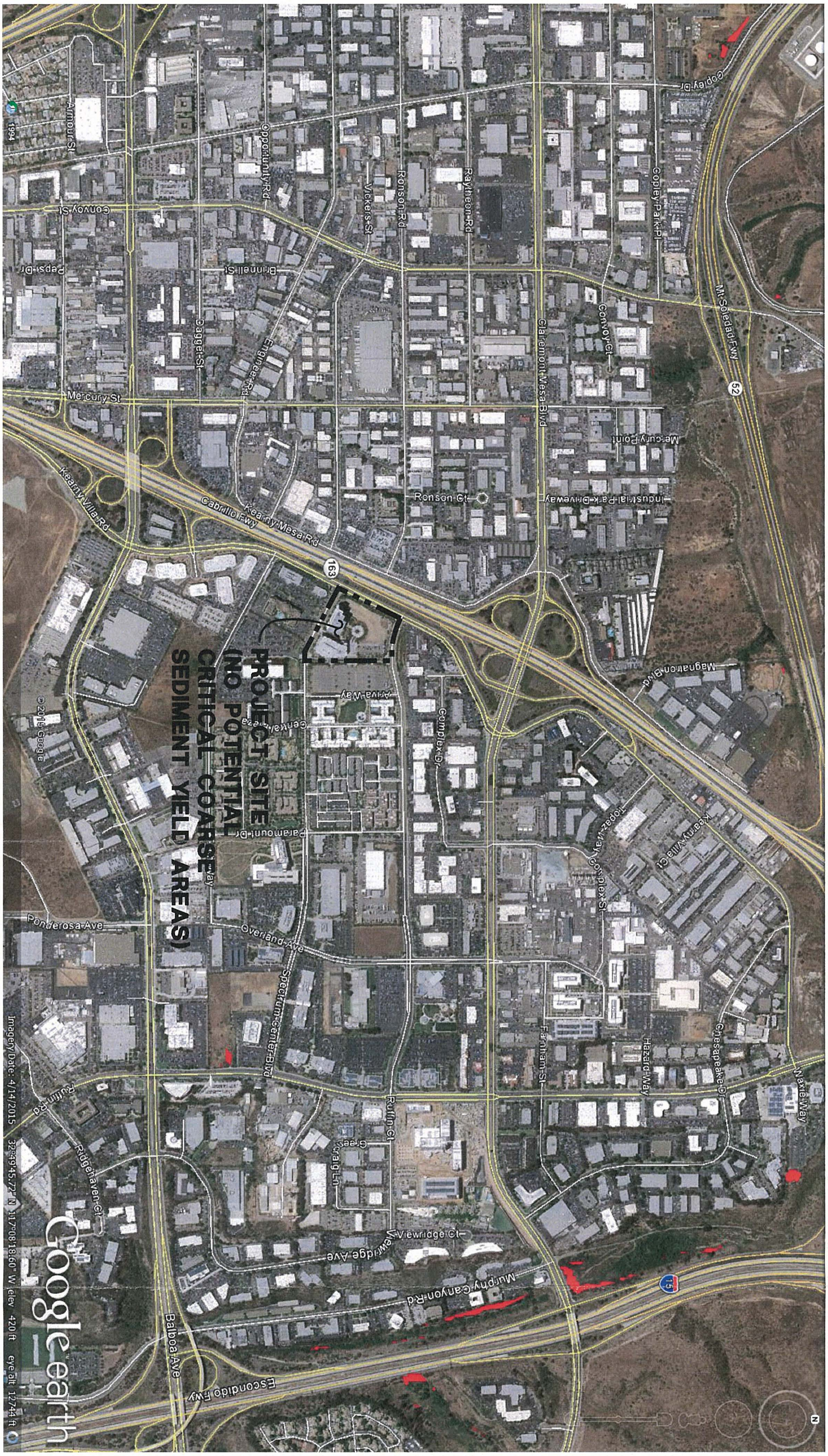
SUNROAD CENTRUM 6
SAN DIEGO, CALIFORNIA

EXHIBIT 2a
HYDROMODIFICATION MANAGEMENT

DATE: 05/22/18
SCE NO. 17006.01
SHEET 2a

Attachment 2b

Management of Critical Coarse Sediment Yield Areas



LEGEND

PROJECT BOUNDARY

POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS

SCALE: N.T.S.

SHEET 2b	DATE: 07/24/17 SCE NO. 17006.01	EXHIBIT 2b POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS MAP	SUNROAD CENTRUM 6 SAN DIEGO, CALIFORNIA	REVISIONS

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X:\2017\17006\CAD\REPORTS\PRELIM\WQ\17006 CRITICAL COARSE SEDIMENT YIELD AREAS.DWG

Attachment 2c

Geomorphic Assessment of Receiving Channels

The Geomorphic Assessment provided here was approved with the Centrumplace 2 SCR review. The proposed Sunroad Centrum 6 project is tributary to the same downstream storm drain systems as Centrumplace 2. As such, this report is applicable to the current Centrumplace 6 project.

HYDROMODIFICATION SCREENING

FOR

SUNROAD CENTRUM 2

May 29, 2015

REGISTERED PROFESSIONAL ENGINEER
WAYNE W. CHANG
No. 46548
Exp. 6/30/17
CIVIL
STATE OF CALIFORNIA

Wayne W. Chang, MS, PE 46548

ChangConsultants
Civil Engineering • Hydrology • Hydraulics • Sedimentation

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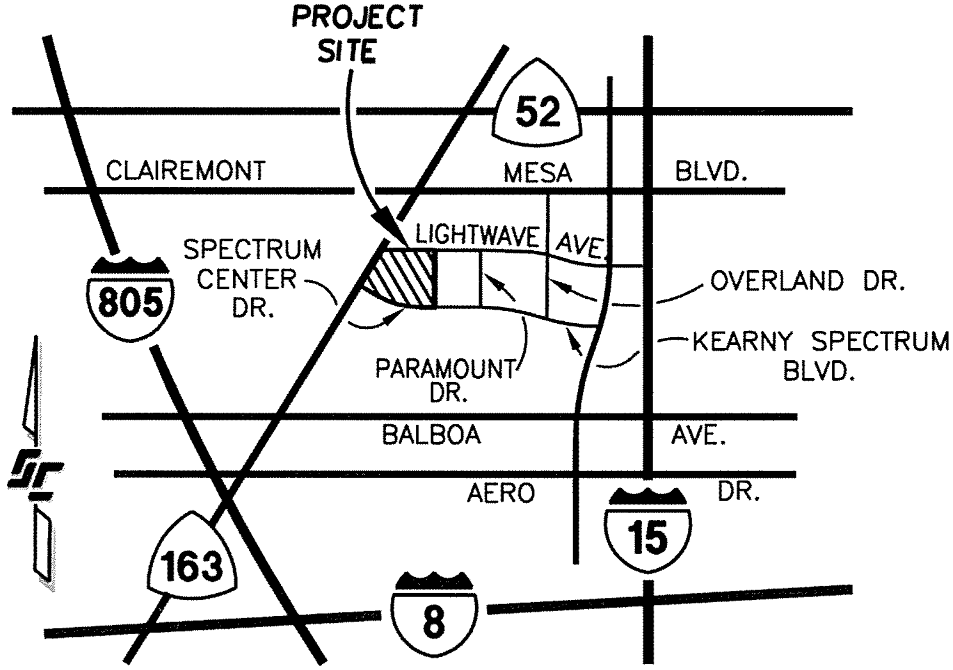
Rancho Santa Fe, CA 92067
(858) 692-0760

INTRODUCTION

The City of San Diego's January 14, 2011, *Storm Water Standards,* outline low flow thresholds for hydromodification analyses. The thresholds are based on a percentage of the pre-project 2-year flow (Q_2), i.e., $0.1Q_2$ (low flow threshold and high susceptibility to erosion), $0.3Q_2$ (medium flow threshold and medium susceptibility to erosion), or $0.5Q_2$ (high flow threshold and low susceptibility to erosion). A flow threshold of $0.1Q_2$ represents a natural downstream receiving conveyance system with a high susceptibility to bed and/or bank erosion. This is the default value used for hydromodification analyses and will result in the most conservative (largest) on-site facility sizing. A flow threshold of $0.3Q_2$ or $0.5Q_2$ represents downstream receiving conveyance systems with a medium or low susceptibility to erosion, respectively. In order to qualify for a medium or low erosion susceptibility rating, a project must perform a channel screening analysis based on the March 2010, *Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility,* developed by the Southern California Coastal Water Research Project (SCCWRP). The SCCWRP results are compared with the critical shear stress calculator results from the County of San Diego's BMP Sizing Calculator to establish the appropriate erosion susceptibility threshold of low, medium, or high.



VICINITY MAP
NO SCALE

This report provides a hydromodification screening analysis for the Sunroad Centrum 2 project being designed by Stevens-Cresto Engineering, Inc. The approximately 8.5 acre site is located on the east side of Kearny Villa Road (and Highway 163) between Lightwave Avenue and Spectrum Center Boulevard (see the Vicinity Map). The site is currently partially developed with a multi-story office building occupied by Ashford University, a parking structure, and ground-level parking. The project proposes to add a multi-story office building and parking structure to the site.

are metric. Metric units are used in this report only where given so in the HMP. Otherwise English units are used.

Downstream Domain of Analysis

The downstream domain of analysis location for the study area has been determined by assessing and comparing the four bullet items above. As discussed in the Introduction, the project runoff will be collected by public storm drain systems in the adjacent streets and then conveyed by the storm drains to an unnamed natural drainage course northwest of the site (see the Study Area Exhibit). The location where the storm drain discharges into the natural drainage course is the point of compliance (POC) for the project. The downstream domain of analysis is selected below this POC.

Per the first bullet item, the first grade control in the unnamed natural drainage course below the POC was determined through a site visit. The site visit revealed that the closest grade control occurs at the upstream end of the Caltrans storm drain system under State Route 52 on the north end of the drainage course (see Figure 4 and the Study Area Exhibit after this report text). The storm drain system is a non-erodible facility that will control the upstream channel bed grade, i.e., it will prevent the upstream natural channel from eroding below the culvert entrance's flowline elevation. Since the culvert is under a state highway, it has been engineered as a public improvement and can be considered a permanent facility.

The second bullet item is the tidal backwater or lentic (standing or still water such as ponds, pools, marshes, lakes, etc.) waterbody location. Based on review of Google Earth, there is no tidal backwater or lentic waterbody near the site. The nearest such waterbody is at Mission Bay, which is several miles from the POC. Therefore, the second bullet item criteria will not govern over the first bullet item criteria in establishing the downstream domain of analysis location.

The third bullet item is met when the unnamed natural drainage course confluences into a stream with an equal order or larger tributary drainage area. The unnamed natural watercourse does not confluence with another large stream between the POC and the permanent grade control. Therefore, the third bullet item criteria will not govern over the first bullet item criteria in establishing the downstream domain of analysis location.

The fourth bullet item was assessed by delineating the drainage area tributary to the unnamed natural drainage course first, and then determining if an additional 50 percent drainage area is accumulated below the POC. The 50 percent rather than 100 percent criteria applies because the unnamed drainage course is a stream system. The Study Area Exhibit shows that the area tributary to the unnamed natural drainage course at State Route 52 covers approximately 790.37 acres. The Study Area Exhibit reveals that unnamed drainage course will not accumulate 50 percent (395 acres) of this area below the POC. Therefore, the fourth bullet item criteria will not govern over the first bullet item criteria in establishing the downstream domain of analysis location.

Based on the above information, the permanent grade control formed by the Caltrans storm drain system is the first location that satisfies one of the four bullet criteria. The permanent grade control criterion indicates that the downstream domain of analysis location should be one reach

The mean annual precipitation was obtained from the rain gage closest to the site. This is the Western Regional Climate Center's Sea World rain gage (see Appendix A). The average annual rainfall measured at the Sea World gage for the period of record from 1999 to 2014 is 9.58 inches.

The above described values were input to a spreadsheet to calculate the simulated peak flow, screening index, and valley width index outlined in Form 1. The input data and results are tabulated in Appendix A. This completes the initial desktop analysis.

FIELD SCREENING

After the initial desktop analysis is complete, a field assessment must be performed. The field assessment is used to establish a natural channel's vertical and lateral susceptibility to erosion. SCCWRP states that although they are admittedly linked, vertical and lateral susceptibility are assessed separately for several reasons. First, vertical and lateral responses are primarily controlled by different types of resistance, which, when assessed separately, may improve ease of use and lead to increased repeatability compared to an integrated, cross-dimensional assessment. Second, the mechanistic differences between vertical and lateral responses point to different modeling tools and potentially different management strategies. Having separate screening ratings may better direct users and managers to the most appropriate tools for subsequent analyses.

The field screening tool uses combinations of decision trees and checklists. Decision trees are typically used when a question can be answered fairly definitively and/or quantitatively (e.g., d_{50} < 16 mm). Checklists are used where answers are relatively qualitative (e.g., the condition of a grade control). Low, medium, high, and very high ratings are applied separately to the vertical and lateral analyses. When the vertical and lateral analyses return divergent values, the most conservative value shall be selected as the flow threshold for the hydromodification analyses.

Vertical Stability

The purpose of the vertical stability decision tree (Figure 6-4 in the County of San Diego HMP) is to assess the state of the channel bed with a particular focus on the risk of incision (i.e., down cutting). The decision tree is included in Figure 7. The first step is to assess the channel bed resistance. There are three categories defined as follows:

1. Labile Bed – sand-dominated bed, little resistant substrate.

2. Transitional/Intermediate Bed – bed typically characterized by gravel/small cobble, Intermediate level of resistance of the substrate and uncertain potential for armoring.

3. Threshold Bed (Coarse/Armored Bed) – armored with large cobbles or larger bed material or highly-resistant bed substrate (i.e., bedrock).

Figures 5 and 6 contains photographs of the channel material within Reach 1. A gravelometer is included in Figure 6 for reference. Each square on the gravelometer indicates grain size in determined in the initial desktop analysis (see Appendix A). d_{50} is derived from a pebble count in which a minimum of 100 particles are obtained along transects at the site. SCCRWP states that if fines less than ½-inch thick are at a sample point, it is appropriate to sample the coarser buried substrate. The d_{50} value is the particle size in which 50 percent of the particles are smaller and 50 percent are larger. The pebble count result for Reach 1 is included in Appendix B. The result show a d_{50} of 64 millimeters (mm). The screening index value for the study reach is tabulated in Appendix A. The Mobility Index Threshold diagram shows that there is less than 50 percent probability of incision if the screening index value is less than 0.101 for a 64 mm d_{50}. The screening index value in Appendix A is 0.0065 for Reach 1, so the reach has much less than 50 percent probability of incision.

The overall vertical rating is determined from the Checklist 1, Checklist 2, and Screening Index Threshold results. The scoring is based on the following values:

Category A = 3, Category B = 6, Category C = 9

The vertical rating score for Reach 1 is based on these values and the equation:

$$\begin{aligned}\text{Vertical Rating} &= [(\text{armoring} \times \text{grade control})^{1/2} \times \text{screening index score}]^{1/2} \\ &= [(6 \times 3)^{1/2} \times 3]^{1/2} \\ &= 3.6\end{aligned}$$

Since the vertical rating is less than 4.5, Reach 1 has a low threshold for vertical susceptibility.

Lateral Stability

The purpose of the lateral decision tree (Figure 6-5 from County of San Diego HMP is included in Figure 8) is to assess the state of the channel banks with a focus on the risk of widening. Channels can widen from either bank failure or through fluvial processes such as chute cutoffs, avulsions, and braiding. Widening through fluvial avulsions/active braiding is a relatively straightforward observation. If braiding is not already occurring, the next logical step is to assess the condition of the banks. Banks fail through a variety of mechanisms; however, one of the most important distinctions is whether they fail in mass (as many particles) or by fluvial detachment of individual particles. Although much research is dedicated to the combined effects of weakening, fluvial erosion, and mass failure, SCCWRP found it valuable to segregate bank types based on the inference of the dominant failure mechanism (as the management approach may vary based on the dominant failure mechanism). A decision tree (Form 4 in Appendix B) is used in conducting the lateral susceptibility assessment. Definitions and photographic examples are also provided below for terms used in the lateral susceptibility assessment.

The first step in the decision tree is to determine if lateral adjustments are occurring. The adjustments can take the form of extensive mass wasting (greater than 50 percent of the banks are exhibiting planar, slab, or rotational failures and/or scalloping, undermining, and/or tension cracks). The adjustments can also involve extensive fluvial erosion (significant and frequent bank cuts on over 50 percent of the banks). Neither mass wasting nor extensive fluvial erosion was evident within Reach 1 during a field investigation. The drainage course has a generally trapezoidal cross-section with dense vegetation and banks that are not subject to stream erosion.

Figure 1. Looking Downstream from Point of Compliance

Figure 2. Dense Vegetation at Middle Portion of Drainage Course

Figure 5. Cobbles along Channel

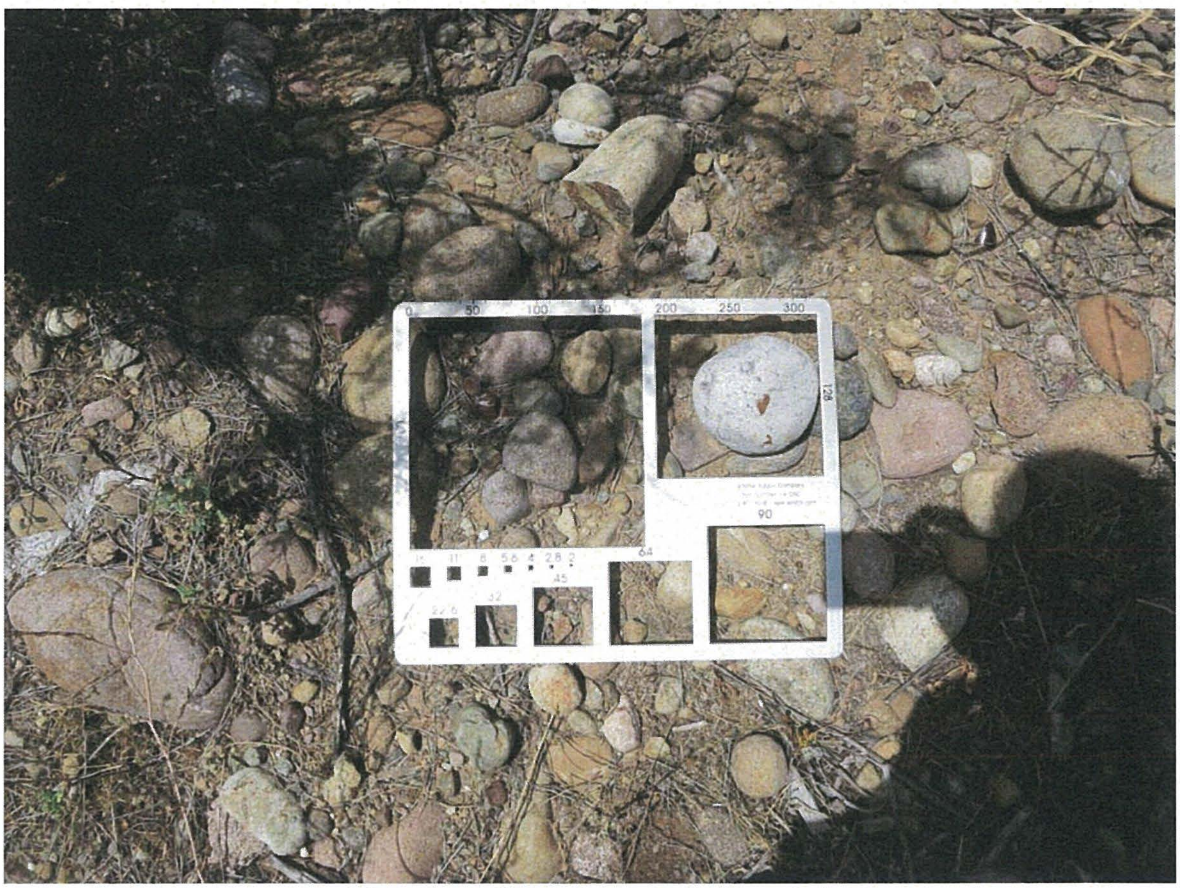


Figure 6. Gravelometer in Reach 1

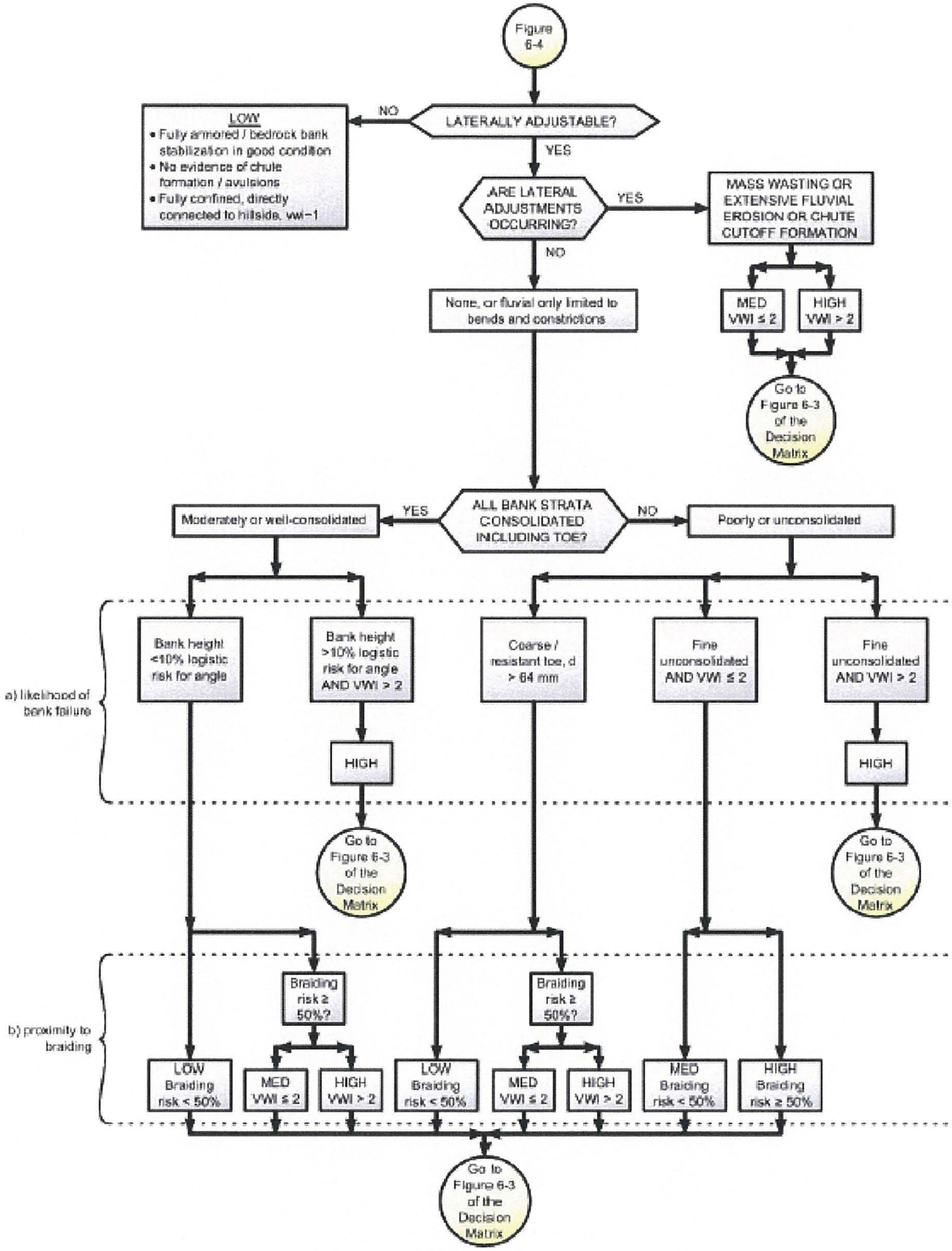


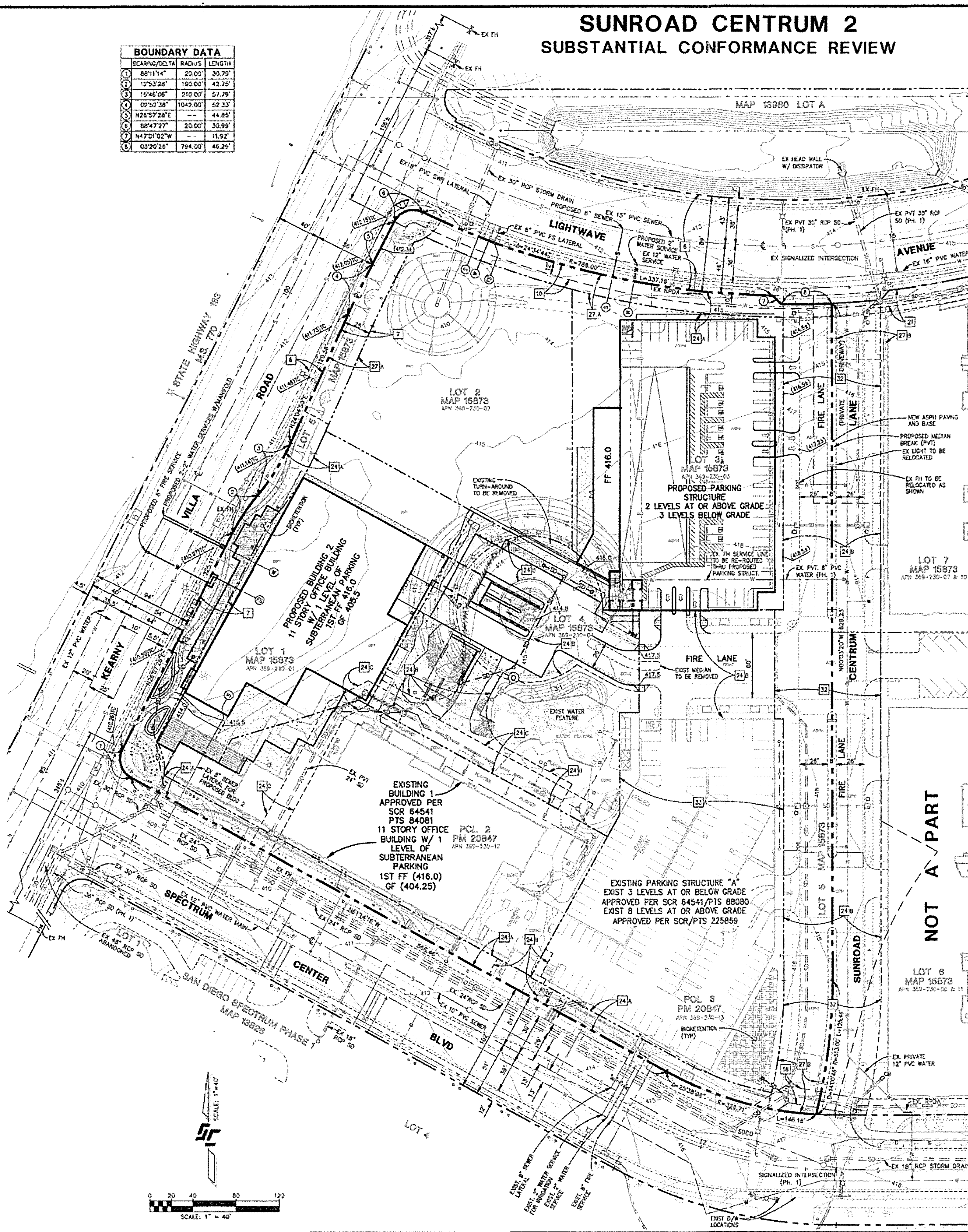
Figure 6-5. Lateral Channel Susceptibility

Figure 8. SCCWRP Lateral Channel Susceptibility Matrix

SUNROAD CENTRUM 2

SUBSTANTIAL CONFORMANCE REVIEW

BOUNDARY DATA			
	BEARING/DELTA	RADIUS	LENGTH
1	88°11'14"	20.00'	30.79'
2	12°53'28"	190.00'	42.75'
3	15°46'06"	210.00'	57.79'
4	02°52'38"	1042.00'	52.33'
5	N26°57'28"E	--	44.85'
6	88°47'27"	20.00'	30.99'
7	N47°01'02"W	--	11.92'
8	03°20'26"	794.00'	46.29'



LEGEND

DESCRIPTION	SYMBOL
PROJECT BOUNDARY	
PARCEL LINE	
EXISTING CONTOUR	400
PROPOSED CONTOUR	400
PROPOSED SPOT ELEVATION	410.25
DIRECTION OF SURFACE RUNOFF	
EXISTING CURB & GUTTER	
EXISTING CONCRETE SIDEWALK	
PROPOSED CURB	
PROPOSED CONCRETE	
PROPOSED CONC PAVEMENT	
PROPOSED ASPH PAVEMENT	
PROPOSED STABILIZED D.G. SURFACE	
PROPOSED BIORETENTION AREA	
PROPOSED STORM DRAIN (PVT)	SD
PROPOSED CATCH BASIN (PVT.)	
PROPOSED FIRE SERVICE	FS
PROPOSED SEWER SERVICE	S
PROPOSED WATER SERVICE	W
EXISTING STREET LIGHT	
EXISTING FIRE HYDRANT	
EXISTING CATCH BASIN/CURB INLET/C.O.	
EXISTING STORM DRAIN	SD
EXISTING SEWER MAIN	S
EXISTING WATER MAIN	W

BENCH MARK

BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE.
ELEVATION: 414.797 M.S.L.

GRADING TABULATIONS

TOTAL AMOUNT OF SITE TO BE GRADED: 3.05± ACRES.

PERCENT OF TOTAL SITE GRADED: 36%±.

AMOUNT OF EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER: 0.0 ACRES.

PERCENT OF TOTAL EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER: 0.0%

AMOUNT OF SITE WITH SLOPES SUBJECT TO ESL REGS: 0.0 ACRES.

PERCENT OF SITE WITH SLOPES SUBJECT TO ESL REGS: 0%

AMOUNT CUT: 55,500± CUBIC YARDS; MAXIMUM DEPTH OF CUT: 35 FEET± (1)

AMOUNT FILL: 400± CUBIC YARDS. MAXIMUM DEPTH OF FILL: 4 FEET±
(1) INCLUDES SUBTERRANEAN PARKING AREAS

MAXIMUM HEIGHT OF FILL SLOPES: 4 FEET± AT 2:1 (MAX.) SLOPE RATIO.

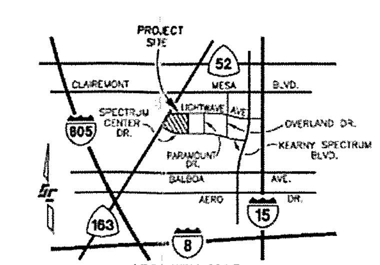
MAXIMUM HEIGHT OF CUT SLOPES: 0 FEET± AT 2:1 (MAX.) SLOPE RATIO.

AMOUNT OF EXPORT SOIL: 55,100± CUBIC YARDS.

RETAINING WALLS: 1 EA., LENGTH = 205 FEET±, MAX. HT. = 4 FEET±

NOTES

1. PUBLIC IMPROVEMENTS (NOT UTILITY CONNECTIONS, ETC.) SHOWN HEREON WILL BE CONSTRUCTED PER CITY STANDARDS AND APPROVED BY THE CITY ENGINEER PRIOR TO THE ISSUANCE OF PERMITS.
2. ALL PROPOSED GRADING WILL BE IN CONFORMANCE WITH APPLICABLE REQUIREMENTS OF THE SAN DIEGO MUNICIPAL CODE.
3. THE DRAINAGE SYSTEM PROPOSED FOR THIS DEVELOPMENT WILL BE APPROVED BY THE CITY ENGINEER IN CONJUNCTION WITH THE GRADING PLAN REVIEW AND PERMITTING.
4. THE PROJECT WILL COMPLY WITH NPDES AND SWRCB ORDER NO. 2009-0009-DWQ REQUIREMENTS, THE CITY HAS BEEN COPIED ON THE ACKNOWLEDGEMENT OF RECEIPT OF NOI, WDID NO. 9 37C346330.
5. POST INDICATOR VALVES, FIRE DEPARTMENT CONNECTIONS AND ALARM BELL ARE TO BE LOCATED ON THE ADDRESS/ACCESS SIDE OF STRUCTURE.
6. ALL PROPOSED PRIVATE SEWER FACILITIES SHALL HAVE PIPE SIZES AND SLOPES DESIGNED PER THE CALIFORNIA UNIFORM PLUMBING CODE.
7. ALL PROPOSED WATER, SEWER AND STORM DRAIN FACILITIES WITH THE PROJECT SITE WILL BE PRIVATE. NO PUBLIC MAINS ARE PROPOSED ON SITE WITH THIS PROJECT.
8. ONSITE IMPROVEMENTS SHOWN ARE CONSTRUCTED AS APPROVED PER SCR NO. 64541 & SCR/PTS 225859 AND PERMITTED PER DWG 34009-D/PTS 98300.



VICINITY MAP
NO SCALE

CLIENT:

SUNROAD ENTERPRISES
4445 EASTGATE MALL, SUITE 400
SAN DIEGO, CA 92121

ARCHITECT:

Gensler
225 Broadway
Suite 1600
San Diego CA 92101
Tel 619.557.2500
Fax 619.557.2520

CONSULTANTS:

STEVENS-CRESTO ENGINEERING, INC.
CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS

Issue	Date & Issue Description	By	Check

Seal/Signature

JOSEPH G. CRESTO
R.C.E. 45601
DATE

REGISTERED PROFESSIONAL ENGINEER
JOSEPH G. CRESTO
No. 45601
Exp. 12-31-16
CIVIL
STATE OF CALIFORNIA

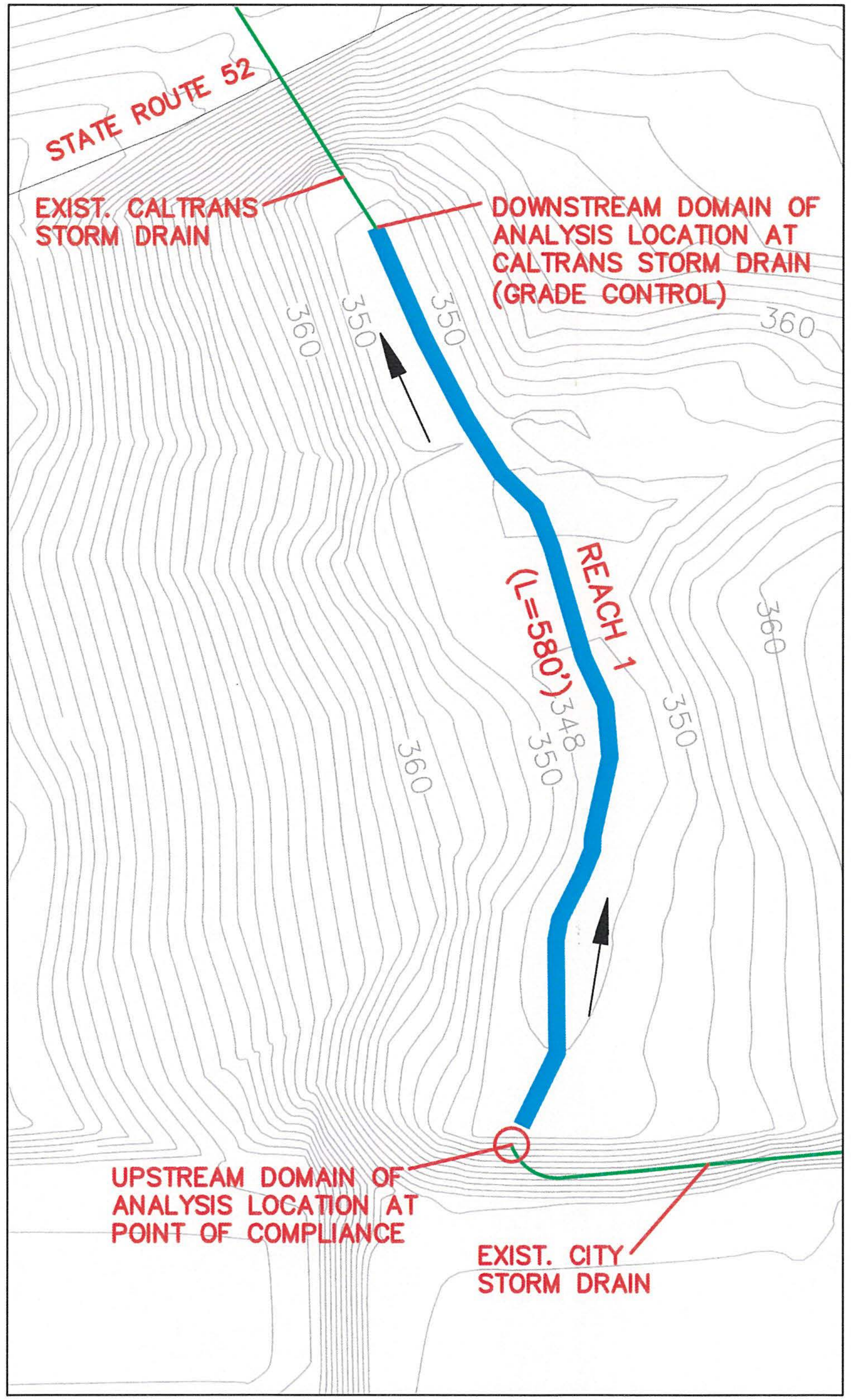
Project Name
CENTRUM 2

Project Number
15008.01

Description
CONCEPT GRADING/UTILITY PLAN

Scale
1" = 40'

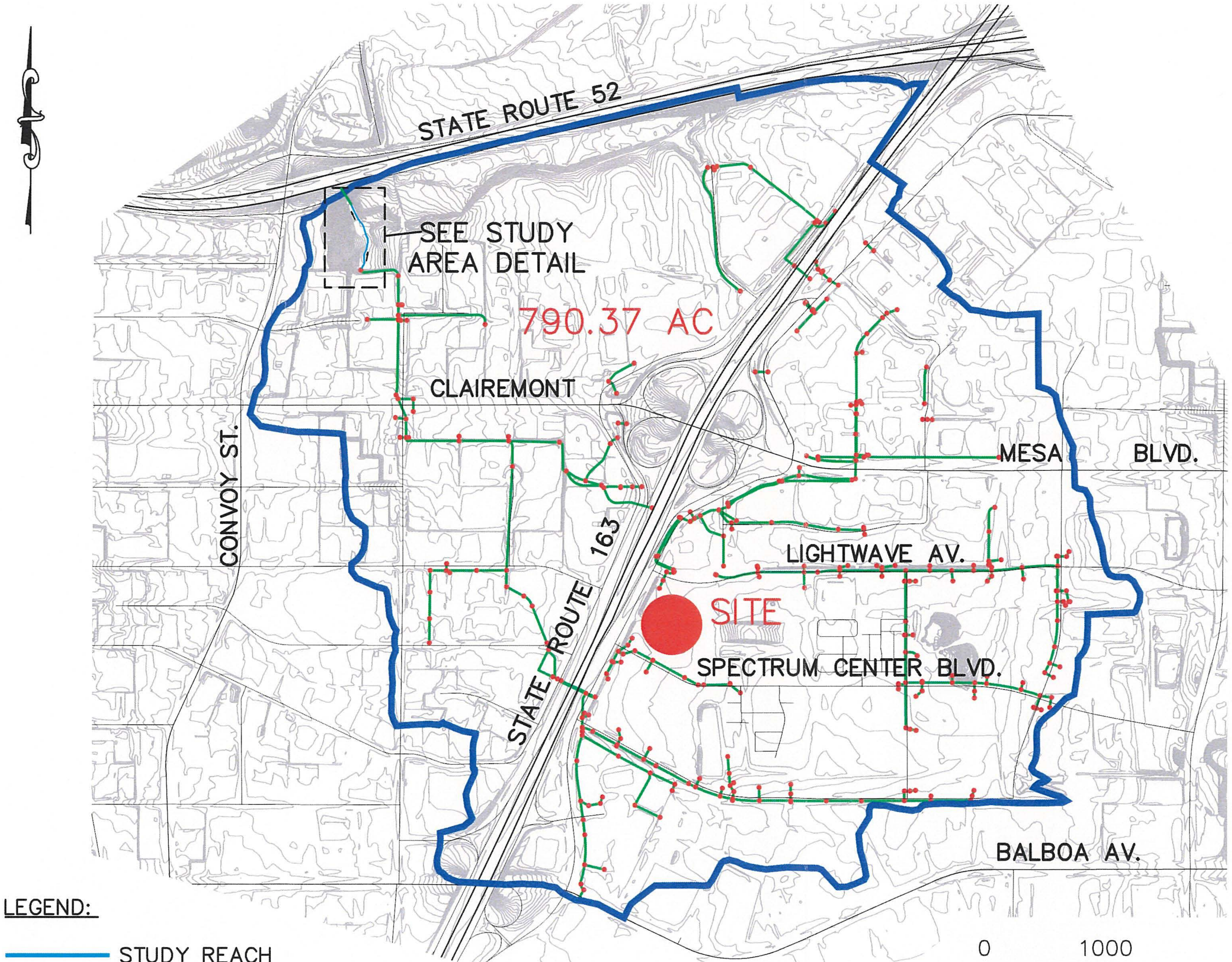
C2



STUDY AREA DETAIL

0 100

1 INCH = 100 FEET



LEGEND:

- STUDY REACH
- WATERSHED BOUNDARY
- 790.37 AC WATERSHED AREA
- EXISTING STORM DRAIN
- EXISTING CATCH BASN

0 1000

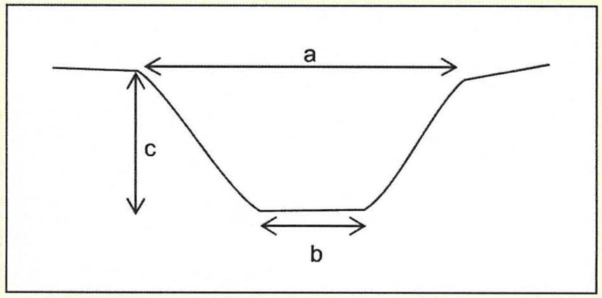
1 INCH = 1,000 FEET

STUDY AREA EXHIBIT
SPECTRUM CENTRUM 2

Critical Flow Calculator

enter all values in green cells
and drop down boxes

Inputs



a) Receiving channel width at top of bank (ft) - see figure on right	55.0
b) Channel width at bed (ft)	30.0
c) Bank height at top of bank (ft)	5.0
Channel gradient (ft/ft)	0.003
Receiving channel roughness	Same as above with more stones n=0.05

Channel materials (use weakest of bed or banks). If materials are varied use weakest material covering more than 20% of channel.

- unconsolidated sandy loam 0.035 lb/sq ft
- alluvial silt (non coloidal) 0.045 lb/sq ft
- medium gravel 0.12 lb/sq ft
- alluvial silt/clay 0.26 lb/sq ft
- 2.5 inch cobble 1.1 lb/sq ft
- enter own d50 (variable)
- vegetation (bed and banks) 0.6 lb/sq ft

Select method of calculating Q2

- Input own Q2
- Calculate Q2 using USGS regression

Receiving water watershed annual precip (inches)	9.6	Receiving water watershed area at PoC (sq mi)	1.2
Project watershed annual precipitation (inches)	9.6	Project watershed area draining to PoC (sq mi)	1.2

Outputs - Flow control range

Receiving water Q2	6.3	**Point of Compliance low flow rate (cfs)**	**3.2**
Project site Q2	6.3	**Low flow class**	**0.5Q2**
		Channel vulnerability	**Low**

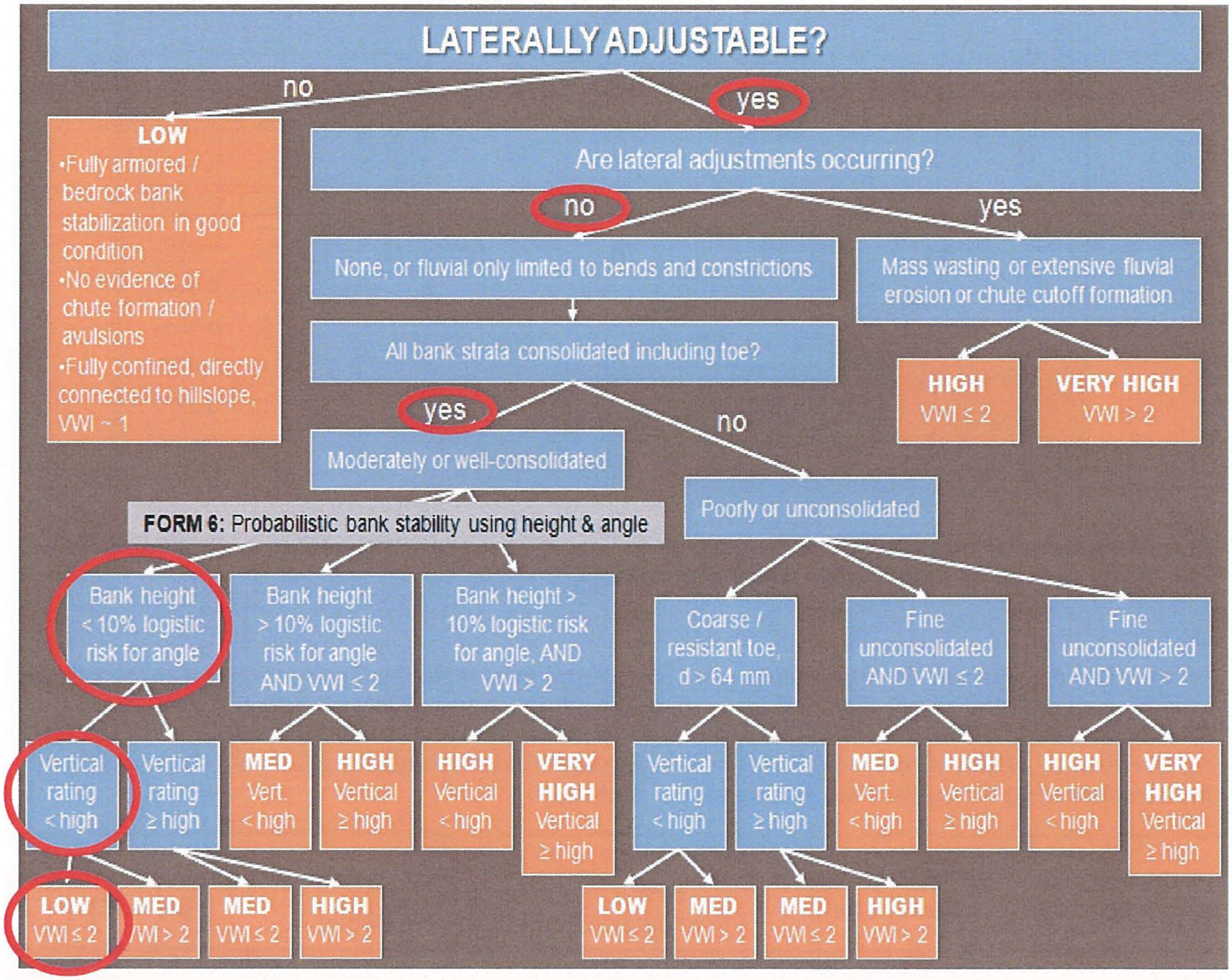
	Reach 1
#	Diameter, mm
89	128
90	128
91	128
92	128
93	128
94	128
95	128
96	128
97	180
98	180
99	180
100	180

PEBBLE COUNT

#	Reach 1 Diameter, mm
1	8
2	8
3	8
4	16
5	16
6	16
7	16
8	16
9	22.6
10	22.6
11	22.6
12	22.6
13	22.6
14	22.6
15	22.6
16	32
17	32
18	32
19	32
20	32
21	32
22	32
23	32
24	32
25	32
26	32
27	45
28	45
29	45
30	45
31	45
32	45
33	45
34	45
35	45
36	45
37	45
38	45
39	45
40	64
41	64
42	64
43	64

FORM 4: LATERAL SUSCEPTIBILTY FIELD SHEET

Circle appropriate nodes/pathway for proposed site
OR use sequence of questions provided in Form 5.



(Sheet 1 of 1)

REACH 1 RESULTS

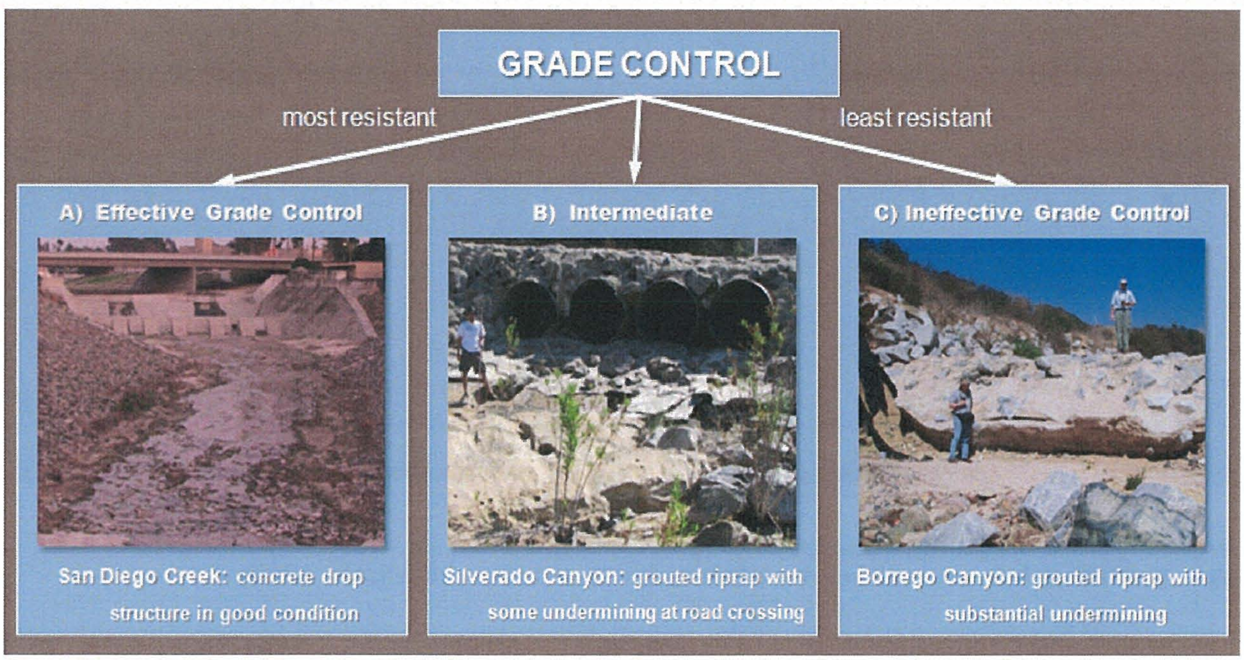
Form 3 Checklist 2: Grade Control

X A Grade control is present with spacing <50 m or $2/S_v$ m

- No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures undermined
- Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout
- If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as 'grade control', it should be of demonstrable strength as indicated by field testing such as hammer test/borings and/or inspected by appropriate stakeholder

□ B Intermediate to A and C – artificial or geologic grade control present but spaced 2/Sv m to 4/Sv m or potential evidence of failure or hardpan of uncertain resistance

□ C Grade control absent, spaced >100 m or $>4/S_v$ m, or clear evidence of ineffectiveness



Form 3 Figure 3. Grade-control (condition) photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used in conjunction with Form 3 Checklist 2.

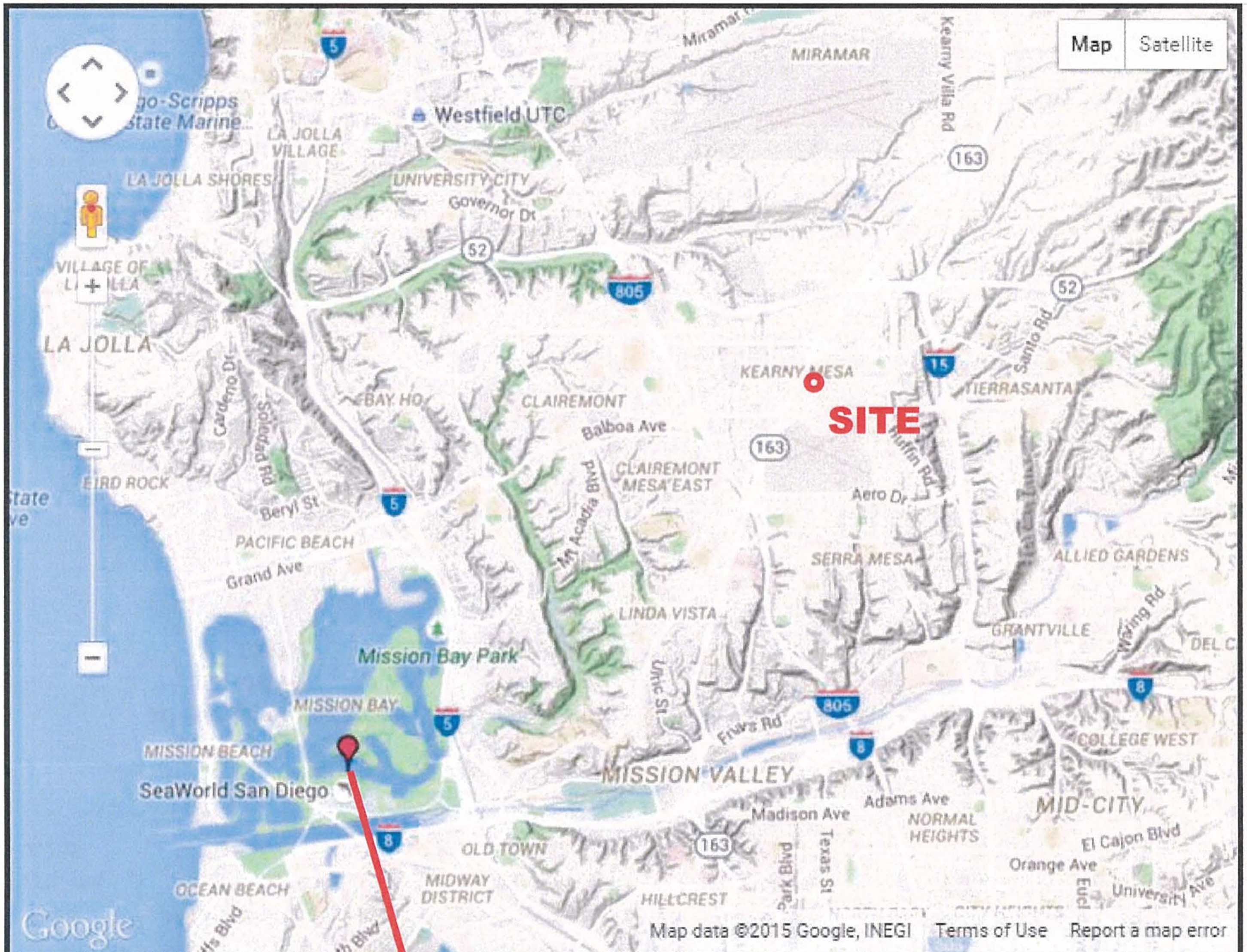
(Sheet 3 of 4)

REACH 1 RESULTS

APPENDIX B

SCCWRP FIELD SCREENING DATA

US COOP Station Map



SEA WORLD RAIN GAGE

FORM 1: INITIAL DESKTOP ANALYSIS

Complete all shaded sections.

IF required at multiple locations, circle one of the following site types:

Applicant Site / Upstream Extent / Downstream Extent

Location: Latitude: 32.8367 Longitude: -117.1501

Description (river name, crossing streets, etc.): Sunroad Centrum 2

GIS Parameters: The International System of Units (SI) is used throughout the assessment as the field standard and for consistency with the broader scientific community. However, as the singular exception, US Customary units are used for contributing drainage area (A) and mean annual precipitation (P) to apply regional flow equations after the USGS. See SCCWRP Technical Report 607 for example measurements and "Screening Tool Data Entry.xls" for automated calculations.

Form 1 Table 1. Initial desktop analysis in GIS.

	Symbol	Variable	Description and Source	Value
Watershed properties (English units)	A	Area (mi^2)	Contributing drainage area to screening location via published Hydrologic Unit Codes (HUCs) and/or ≤ 30 m National Elevation Data (NED), USGS seamless server	See attached Form 1 table on next page for calculated values for study reach.
	P	Mean annual precipitation (in)	Area-weighted annual precipitation via USGS delineated polygons using records from 1900 to 1960 (which was more significant in hydrologic models than polygons delineated from shorter record lengths)	
Site properties (SI units)	S_v	Valley slope (m/m)	Valley slope at site via NED, measured over a relatively homogenous valley segment as dictated by hillslope configuration, tributary confluences, etc., over a distance of up to ~500 m or 10% of the main-channel length from site to drainage divide	
	W_v	Valley width (m)	Valley bottom width at site between natural valley walls as dictated by clear breaks in hillslope on NED raster, irrespective of potential armoring from floodplain encroachment, levees, etc. (imprecise measurements have negligible effect on rating in wide valleys where VWI is >> 2, as defined in lateral decision tree)	

Form 1 Tabl e 2. Simplif ied peak flo w, screening index, and valley width index. Values for this table should be calculated in the sequence shown in this table, using values from Form 1 Table 1.

Symbol	Dependent Variable	Equation	Required Units	Value
Q_{10cfs}	10-yr peak flow (ft^3/s)	$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$	A (mi^2) P (in)	See attached Form 1 table on next page for calculated values for study reach.
Q_{10}	10-yr peak flow (m^3/s)	$Q_{10} = 0.0283 * Q_{10cfs}$	Q_{10cfs} (ft^3/s)	
INDEX	10-yr screening index ($m^{1.5}/s^{0.5}$)	$INDEX = S_v * Q_{10}^{0.5}$	Sv (m/m) Q_{10} (m^3/s)	
W_{ref}	Reference width (m)	$W_{ref} = 6.99 * Q_{10}^{0.438}$	Q_{10} (m^3/s)	
VWI	Valley width index (m/m)	$VWI = W_v/W_{ref}$	W_v (m) W_{ref} (m)	

(Sheet 1 of 1)

Attachment 2d

Flow Control Facility Design

BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	STEVENS CRESTO ENGINEERING	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	369-230-01, 02, 03, 04 & 14	Low Flow Threshold:	0.5Q2
BMP Name:	BF-1	BMP Type:	Biofiltration w/ Impermeable Liner
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size		
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	Surface Area	Surface Volume	Subsurface Volume	Surface Area (sf)	Surface Volume (cf)	Subsurface Volume (cf)
PER TO IMP	21,671	D	Flat	BUILDING & SW	1.0	0.085	0.0708	0.051	1842	1534	1105
Total BMP Area	21,671										

Minimum BMP Size	1842.035	1534	1105	TOTAL VOLUME: 2,639 CF
Proposed BMP Size*	980	2164	588	2,752 CF
Soil Matrix Depth	24.00	in		
Minimum Ponding Depth	17.29	in		
Maximum Ponding Depth	49.00	in		
Selected Ponding Depth	25.00	in		

Notes:

1. Runoff factors which are used for hydromodification management flow control (Table G.2-1) are different from the runoff factors used for pollutant control BMP sizing (Table B.1-1). Table references are taken from the San Diego Region Model BMP Design Manual,

Describe the BMP's in sufficient detail in your PDP SWQMP to demonstrate the area, volume, and other criteria can be met within the constraints of the site.

BMP's must be adapted and applied to the conditions specific to the development project such as unstable slopes or the lack of available head.
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NOTE: CALCULATIONS ARE PROVIDED FOR FEASIBILITY PURPOSES ONLY. PER TOTAL VOLUME CALCULATION, BMP IS ADEQUATELY SIZED TO PROVIDE HYDROMODIFICATION MITIGATION VOLUMES REQUIRED. THE PROVIDED AREA IS ALSO ADEQUATE FOR POLLUTANT CONTROL, SEE ATTACHMENT 1e. CONTINUOUS SIMULATION MODELING WILL BE UTILIZED AT FINAL ENGINEERING TO REFINE BMP DESIGN AND MINIMIZE PONDING DEPTH.

BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	VENS CRESTO ENGINEER	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	59-230-01, 02, 03, 04 & 1	Low Flow Threshold:	0.5Q2
BMP Name	BF-1	BMP Type:	Biofiltration w/ Impermeable Liner

DMA Name	Rain Gauge	Pre-developed Condition			Q_2 Sizing Factor	DMA Area (ac)	Orifice Flow - $\%Q_2$	Orifice Area
		Soil Type	Cover	Slope	(cfs/ac)		(cfs)	(in^2)
PER TO IMP	Lindbergh	D	Scrub	Flat	0.05	0.497	0.012	**0.30**
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					

0.012	**0.30**	**0.62**
Tot. Allowable Orifice Flow (cfs)	**Tot. Allowable Orifice Area (in^2)**	**Max Orifice Diameter (in)**

0.012	**0.28**	0.60
Actual Orifice Flow (cfs)	Actual Orifice Area (in^2)	Selected Orifice Diameter (in)

Drawdown (Hrs)	49.0

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BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	STEVENS CRESTO ENGINEERING	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	369-230-01, 02, 03, 04 & 14	Low Flow Threshold:	0.5Q2
BMP Name:	BF-2	BMP Type:	Biofiltration w/ Impermeable Liner
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size		
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	Surface Area	Surface Volume	Subsurface Volume	Surface Area (sf)	Surface Volume (cf)	Subsurface Volume (cf)
PER TO IMP	48,282	D	Flat	Building	1.0	0.085	0.0708	0.051	4104	3418	2462
PER TO PER	2,791	D	Flat	Landscape	0.1	0.085	0.0708	0.051	24	20	14
Total BMP Area	51,073										

Minimum BMP Size	4127.6935	3438	2477
Proposed BMP Size*	2060	4721	1236
Soil Matrix Depth	24.00	in	
Minimum Ponding Depth	18.53	in	
Maximum Ponding Depth	58.44	in	
Selected Ponding Depth	26.00	in	

TOTAL VOLUME:
5,915 CF
5,957 CF

Notes:

1. Runoff factors which are used for hydromodification management flow control (Table G.2-1) are different from the runoff factors used for pollutant control BMP sizing (Table B.1-1). Table references are taken from the San Diego Region Model BMP Design Manual,

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BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	VENS CRESTO ENGINEER	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	59-230-01, 02, 03, 04 & 1	Low Flow Threshold:	0.5Q2
BMP Name	BF-2	BMP Type:	Biofiltration w/ Impermeable Liner

DMA Name	Rain Gauge	Pre-developed Condition			Q_2 Sizing Factor	DMA Area (ac)	Orifice Flow - $\%Q_2$	Orifice Area
		Soil Type	Cover	Slope	(cfs/ac)		(cfs)	(in^2)
PER TO IMP	Lindbergh	D	Scrub	Flat	0.05	1.108	0.028	**0.68**
PER TO PER	Lindbergh	D	Scrub	Flat	0.05	0.064	0.002	**0.04**
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					

0.029	**0.72**	**0.95**
Tot. Allowable Orifice Flow (cfs)	**Tot. Allowable Orifice Area (in^2)**	**Max Orifice Diameter (in)**

0.029	**0.71**	**0.95**
Actual Orifice Flow (cfs)	Actual Orifice Area (in^2)	Selected Orifice Diameter (in)

Drawdown (Hrs)	42.7

NOTE: CALCULATIONS ARE PROVIDED FOR FEASIBILITY PURPOSES ONLY. PER TOTAL VOLUME CALCULATION, BMP IS ADEQUATELY SIZED TO PROVIDE HYDROMODIFICATION MITIGATION VOLUMES REQUIRED. THE PROVIDED AREA IS ALSO ADEQUATE FOR POLLUTANT CONTROL, SEE ATTACHMENT 1e. CONTINUOUS SIMULATION MODELING WILL BE UTILIZED AT FINAL ENGINEERING TO REFINE BMP DESIGN AND MINIMIZE PONDING DEPTH.

BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	STEVENS CRESTO ENGINEERING	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	369-230-01, 02, 03, 04 & 14	Low Flow Threshold:	0.5Q2
BMP Name:	BF-3	BMP Type:	Biofiltration w/ Impermeable Liner
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size		
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	Surface Area	Surface Volume	Subsurface Volume	Surface Area (sf)	Surface Volume (cf)	Subsurface Volume (cf)
PER TO IMP	45,624	D	Flat	Building/ Concrete	1.0	0.085	0.0708	0.051	3878	3230	2327
PER TO PER	8,934	D	Flat	Landscape	0.1	0.085	0.0708	0.051	76	63	46
Total BMP Area	54,558										

Minimum BMP Size	3953.979	3293	2372	TOTAL VOLUME: 5,665 CF
Proposed BMP Size*	1972	4519	1183	5,702 CF
Soil Matrix Depth	24.00	in		
Minimum Ponding Depth	18.54	in		
Maximum Ponding Depth	61.05	in		
Selected Ponding Depth	26.00	in		

Notes:

1. Runoff factors which are used for hydromodification management flow control (Table G.2-1) are different from the runoff factors used for pollutant control BMP sizing (Table B.1-1). Table references are taken from the San Diego Region Model BMP Design Manual,

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BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	VENS CRESTO ENGINEER	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	59-230-01, 02, 03, 04 & 1	Low Flow Threshold:	0.5Q2
BMP Name	BF-3	BMP Type:	Biofiltration w/ Impermeable Liner

DMA Name	Rain Gauge	Pre-developed Condition			Q_2 Sizing Factor	DMA Area (ac)	Orifice Flow - $\%Q_2$	Orifice Area
		Soil Type	Cover	Slope	(cfs/ac)		(cfs)	(in^2)
PER TO IMP	Lindbergh	D	Scrub	Flat	0.05	1.047	0.026	**0.64**
PER TO PER	Lindbergh	D	Scrub	Flat	0.05	0.205	0.005	**0.13**
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					

0.031	**0.76**	**0.99**
Tot. Allowable Orifice Flow (cfs)	**Tot. Allowable Orifice Area (in^2)**	**Max Orifice Diameter (in)**

0.029	**0.71**	**0.95**
Actual Orifice Flow (cfs)	Actual Orifice Area (in^2)	Selected Orifice Diameter (in)

Drawdown (Hrs)	40.9

NOTE: CALCULATIONS ARE PROVIDED FOR FEASIBILITY PURPOSES ONLY. PER TOTAL VOLUME CALCULATION, BMP IS ADEQUATELY SIZED TO PROVIDE HYDROMODIFICATION MITIGATION VOLUMES REQUIRED. THE PROVIDED AREA IS ALSO ADEQUATE FOR POLLUTANT CONTROL, SEE ATTACHMENT 1e. CONTINUOUS SIMULATION MODELING WILL BE UTILIZED AT FINAL ENGINEERING TO REFINE BMP DESIGN AND MINIMIZE PONDING DEPTH.

BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	STEVENS CRESTO ENGINEERING	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	369-230-01, 02, 03, 04 & 14	Low Flow Threshold:	0.5Q2
BMP Name:	BF-4	BMP Type:	Biofiltration w/ Impermeable Liner
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size			
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	Surface Area	Surface Volume	Subsurface Volume	Surface Area (sf)	Surface Volume (cf)	Subsurface Volume (cf)	
PER TO IMP	20,715	D	Flat	Building	1.0	0.085	0.0708	0.051	1761	1467	1056	
												TOTAL VOLUME:
Total BMP Area	20,715							Minimum BMP Size	1760.775	1467	1056	2,523 CF
								Proposed BMP Size*	915	2021	549	2,570 CF
								Soil Matrix Depth		24.00	in	
								Minimum Ponding Depth		17.73	in	
								Maximum Ponding Depth		52.48	in	
								Selected Ponding Depth		25.00	in	

Notes:

1. Runoff factors which are used for hydromodification management flow control (Table G.2-1) are different from the runoff factors used for pollutant control BMP sizing (Table B.1-1). Table references are taken from the San Diego Region Model BMP Design Manual,

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BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	VENS CRESTO ENGINEER	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	59-230-01, 02, 03, 04 & 1	Low Flow Threshold:	0.5Q2
BMP Name	BF-4	BMP Type:	Biofiltration w/ Impermeable Liner

DMA Name	Rain Gauge	Pre-developed Condition			Q_2 Sizing Factor (cfs/ac)	DMA Area (ac)	Orifice Flow - $\%Q_2$ (cfs)	Orifice Area (in^2)
		Soil Type	Cover	Slope				
PER TO IMP	Lindbergh	D	Scrub	Flat	0.05	0.476	0.012	**0.29**
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					
			Scrub					

0.012	**0.29**	**0.61**
Tot. Allowable Orifice Flow (cfs)	**Tot. Allowable Orifice Area (in^2)**	**Max Orifice Diameter (in)**

0.012	**0.28**	**0.60**
Actual Orifice Flow (cfs)	Actual Orifice Area (in^2)	Selected Orifice Diameter (in)

Drawdown (Hrs)	45.7

NOTE: CALCULATIONS ARE PROVIDED FOR FEASIBILITY PURPOSES ONLY. PER TOTAL VOLUME CALCULATION, BMP IS ADEQUATELY SIZED TO PROVIDE HYDROMODIFICATION MITIGATION VOLUMES REQUIRED. THE PROVIDED AREA IS ALSO ADEQUATE FOR POLLUTANT CONTROL, SEE ATTACHMENT 1e. CONTINUOUS SIMULATION MODELING WILL BE UTILIZED AT FINAL ENGINEERING TO REFINE BMP DESIGN AND MINIMIZE PONDING DEPTH.

BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	STEVENS CRESTO ENGINEERING	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	369-230-01, 02, 03, 04 & 14	Low Flow Threshold:	0.5Q2
BMP Name:	ST-1	BMP Type:	Cistern
BMP Native Soil Type:	D	BMP Infiltration Rate (in/hr):	0.024

Areas Draining to BMP						HMP Sizing Factors			Minimum BMP Size		
DMA Name	Area (sf)	Soil Type	Pre-project Slope	Post Project Surface Type	Runoff Factor (Table G.2-1)[1]	N/A	Cistern Volume	N/A	N/A	Cistern Volume (cf)	N/A
PER TO IMP	39,925	D	Flat	Asphalt/ Concrete	1.0	N/A	0.1	N/A	N/A	3993	N/A
PER TO PER	2,766	D	Flat	Landscape	0.1	N/A	0.1	N/A	N/A	28	N/A
Total BMP Area	42,691										
								Minimum BMP Size		4020	
								Proposed BMP Size*	1350	N/A	N/A
										Minimum Cistern Depth	N/A	in
										Maximum Cistern Depth	N/A	in
										Selected Cistern Depth	42.00	in
										Selected Cistern Volume	4725	cubic feet

Notes:

1. Runoff factors which are used for hydromodification management flow control (Table G.2-1) are different from the runoff factors used for pollutant control BMP sizing (Table B.1-1). Table references are taken from the San Diego Region Model BMP Design Manual,

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BMP Sizing Spreadsheet V2.0			
Project Name:	SUNROAD CENTRUM 6	Hydrologic Unit:	TECOLOTE 906.50
Project Applicant:	VENS CRESTO ENGINEER	Rain Gauge:	Lindbergh
Jurisdiction:	CITY OF SAN DIEGO	Total Project Area:	373,309
Parcel (APN):	59-230-01, 02, 03, 04 & 1	Low Flow Threshold:	0.5Q2
BMP Name	ST-1	BMP Type:	Cistern

DMA Name	Rain Gauge	Pre-developed Condition			Q_2 Sizing Factor	DMA Area (ac)	Orifice Flow - $\%Q_2$	Orifice Area
		Soil Type	Cover	Slope	(cfs/ac)		(cfs)	(in^2)
PER TO IMP	Lindbergh	D	Scrub	Flat	0.05	0.917	0.023	**0.39**
PER TO PER	Lindbergh	D	Scrub	Flat	0.05	0.063	0.002	**0.03**
			Scrub					
			Scrub					
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			Scrub					

0.025	**0.42**	**0.73**
Tot. Allowable Orifice Flow (cfs)	**Tot. Allowable Orifice Area (in^2)**	**Max Orifice Diameter (in)**

0.026	**0.42**	**0.73**
Actual Orifice Flow (cfs)	Actual Orifice Area (in^2)	Selected Orifice Diameter (in)

Drawdown (Hrs)	SEE CALCS THAT FOLLOW

NOTE: CALCULATIONS ARE PROVIDED FOR FEASIBILITY PURPOSES ONLY. PER TOTAL VOLUME CALCULATION, BMP IS ADEQUATELY SIZED TO PROVIDE HYDROMODIFICATION MITIGATION VOLUMES REQUIRED. THE PROVIDED AREA IS ALSO ADEQUATE FOR POLLUTANT CONTROL, SEE ATTACHMENT 1e. CONTINUOUS SIMULATION MODELING WILL BE UTILIZED AT FINAL ENGINEERING TO REFINE BMP DESIGN AND MINIMIZE PONDING DEPTH.

Hydrograph Report

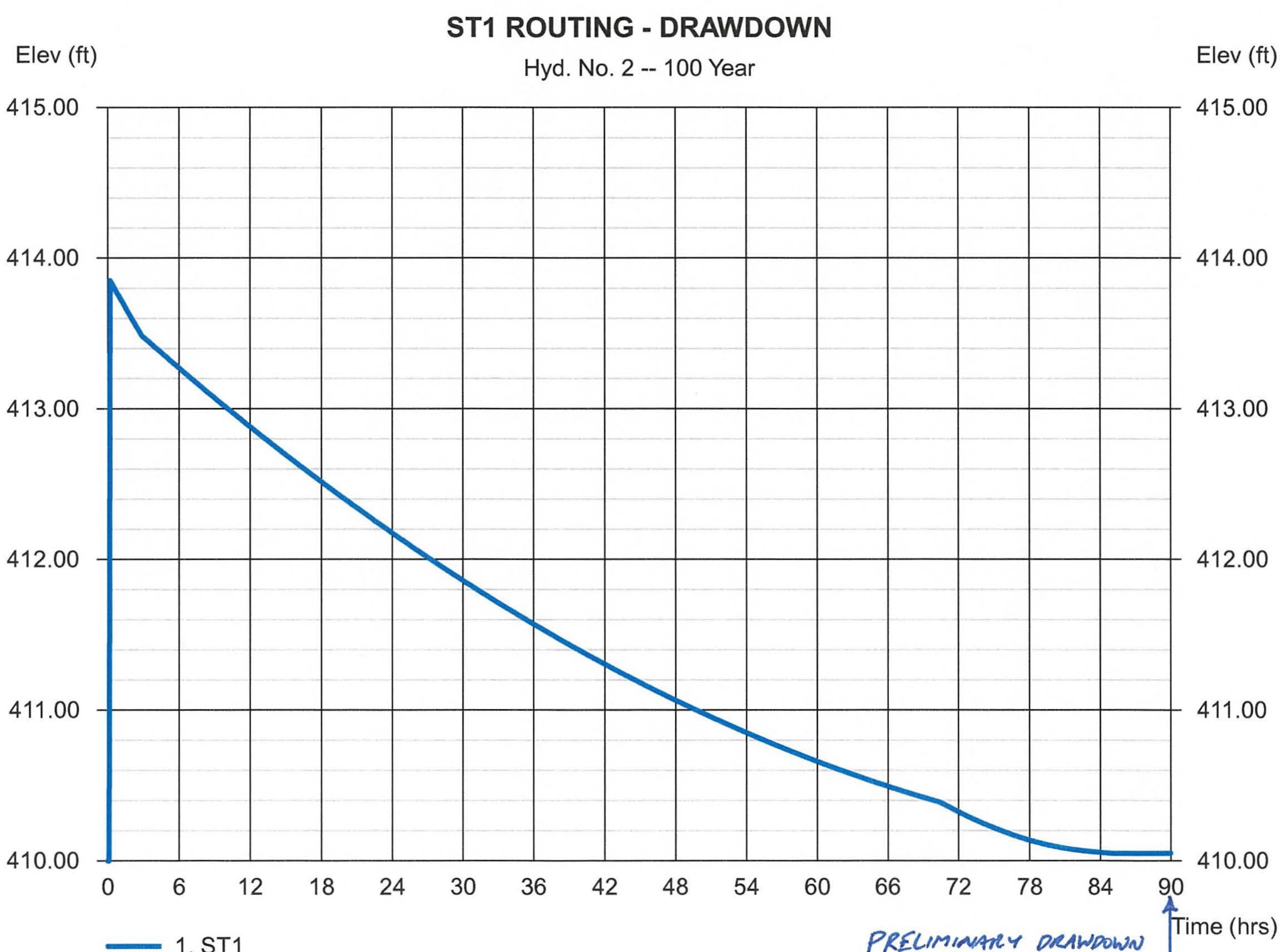
Hydraflow Hydrographs by Intelisolve v9.23 Thursday, Nov 9, 2017

Hyd. No. 2

ST1 ROUTING - DRAWDOWN

Hydrograph type	= Reservoir	Peak discharge	= 0.027 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.20 hrs
Time interval	= 6 min	Hyd. volume	= 4,682 cuft
Inflow hyd. No.	= 1 - ST1 INFLOW - DRAWDOWN	Max. Elevation	= 413.85 ft
Reservoir name	= ST1	Max. Storage	= 4,704 cuft

Storage Indication method used.



PRELIMINARY DRAWDOWN TIME ~90 HOURS.
CONTINUOUS SIMULATION MODELING WILL BE USED AT FINAL ENG. TO INCREASE ORIFICE + REDUCE DRAWDOWN

1

ATTACHMENT 3
STRUCTURAL BMP MAINTENANCE INFORMATION

This is the cover sheet for Attachment 3.

Project Name: Sunroad Centrum 6

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 3a	Structural BMP Maintenance Thresholds and Actions (Required)	☒ Included See Structural BMP Maintenance Information Checklist.
Attachment 3b	Maintenance Agreement (Form DS-3247) (when applicable)	○ Included ◉ Not Applicable

Project Name: Sunroad Centrum 6

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Preliminary Design / Planning / CEQA level submittal:

- Attachment 3a must identify:

  ☒ Typical maintenance indicators and actions for proposed structural BMP(s) based on Section 7.7 of the BMP Design Manual

- Attachment 3b is not required for preliminary design / planning / CEQA level submittal.

Final Design level submittal:

Attachment 3a must identify:

☐ Specific maintenance indicators and actions for proposed structural BMP(s). This shall be based on Section 7.7 of the BMP Design Manual and enhanced to reflect actual proposed components of the structural BMP(s)
☐ How to access the structural BMP(s) to inspect and perform maintenance
☐ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
☐ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
☐ When applicable, frequency of bioretention soil media replacement
☐ Recommended equipment to perform maintenance
☐ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management

Attachment 3b: For private entity operation and maintenance, Attachment 3b must include a Storm Water Management and Discharge Control Maintenance Agreement (Form DS-3247). The following information must be included in the exhibits attached to the maintenance agreement:

☐ Vicinity map
☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant control obligations.
☐ BMP and HMP location and dimensions
☐ BMP and HMP specifications/cross section/model
☐ Maintenance recommendations and frequency
☐ LID features such as (permeable paver and LS location, dim, SF).

Biofiltration Maintenance Indicators and Actions are summarized as follows:

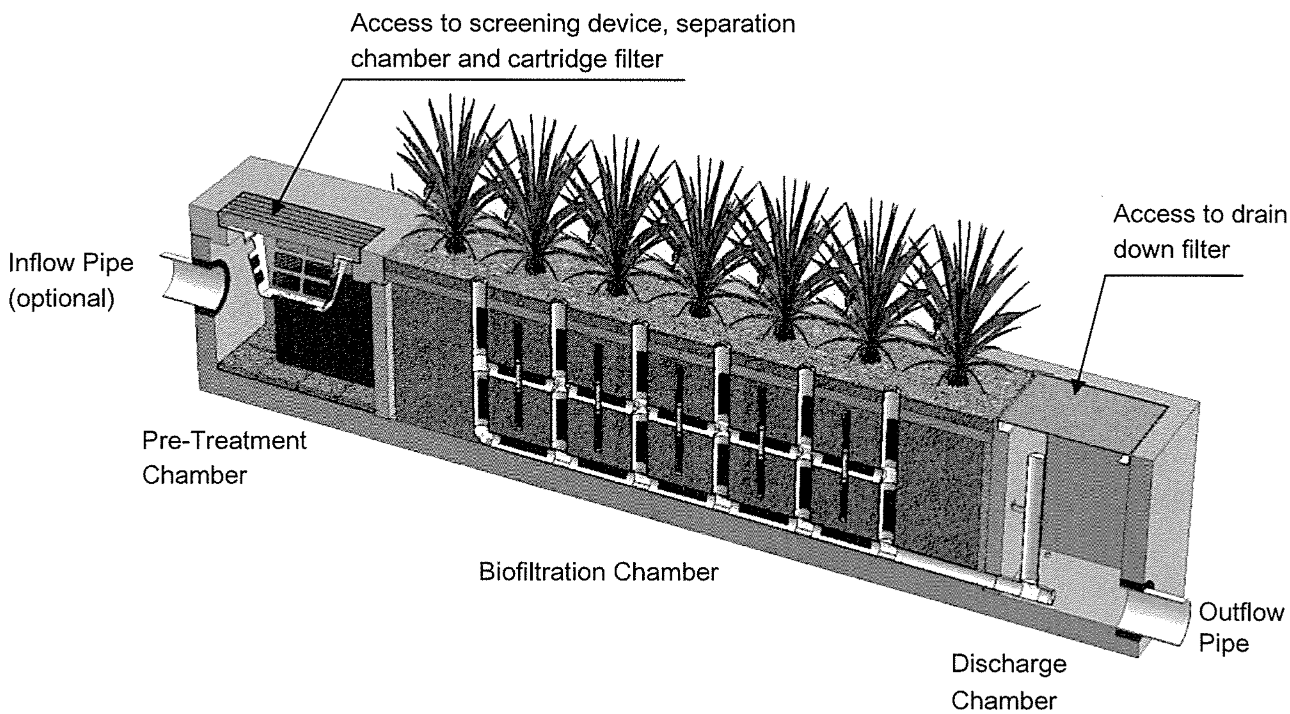
Typical Maintenance Indicator(s) for Vegetated BMPs	Maintenance Actions
Accumulation of sediment, litter, or debris	Remove and properly dispose of accumulated materials, without damage to the vegetation.
Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans.
Overgrown vegetation	Mow or trim as appropriate, but not less than the design height of the vegetation per original plans when applicable (e.g. a vegetated swale may require a minimum vegetation height).
Erosion due to concentrated irrigation flow	Repair/re-seed/re-plant eroded areas and adjust the irrigation system.
Erosion due to concentrated storm water runoff flow	Repair/re-seed/re-plant eroded areas, and make appropriate corrective measures such as adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.
Standing water in vegetated swales	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, loosening or replacing top soil to allow for better infiltration, or minor re-grading for proper drainage. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.
Standing water in bioretention, biofiltration with partial retention, or biofiltration areas, or flow-through planter boxes for longer than 96 hours following a storm event*	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, clearing underdrains (where applicable), or repairing/replacing clogged or compacted soils.
Obstructed inlet or outlet structure	Clear obstructions.
Damage to structural components such as weirs, inlet or outlet structures	Repair or replace as applicable.
*These BMPs typically include a surface ponding layer as part of their function which may take 96 hours to drain following a storm event.	

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



MODULAR WETLANDS

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.

MODULAR WETLANDS

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.

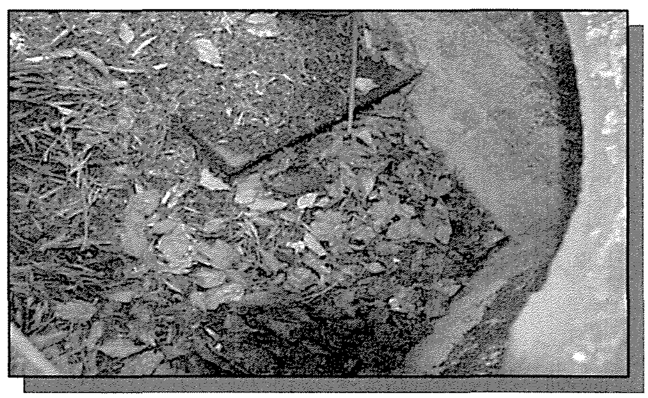
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

MODULAR WETLANDS

Maintenance Procedure Illustration

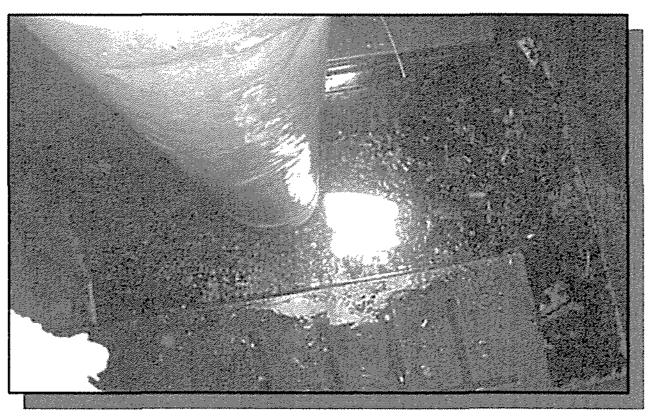
<u>Screening Device</u>

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.



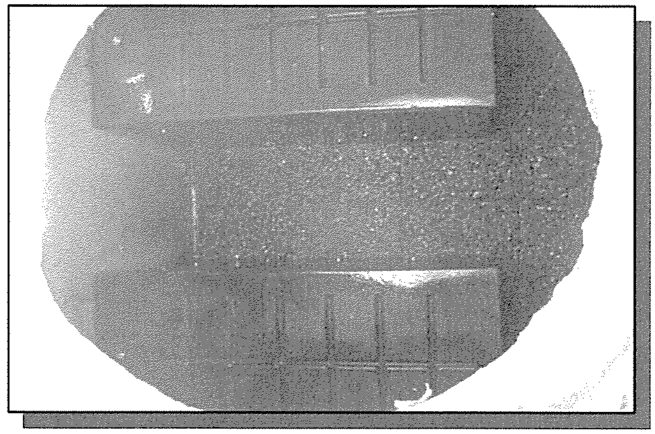
<u>Separation Chamber</u>

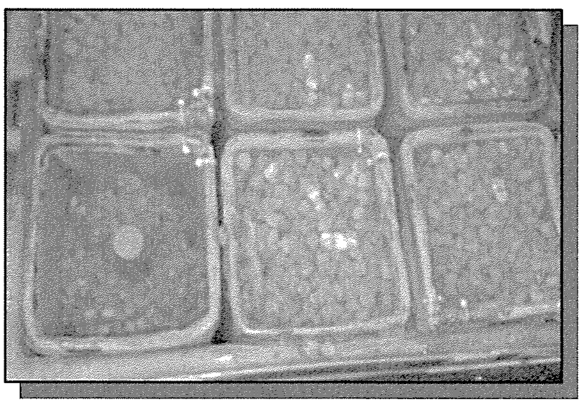
The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

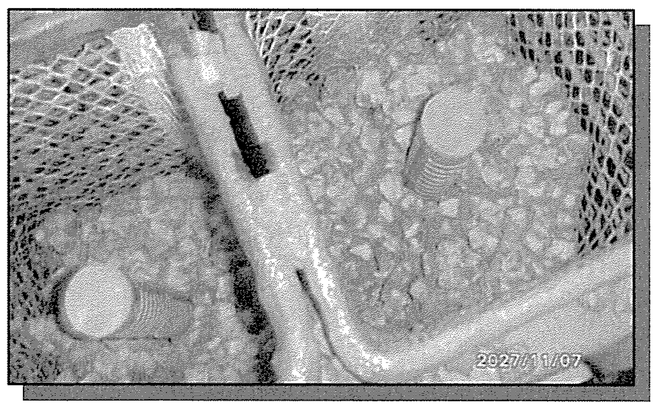


Cartridge Filters

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.

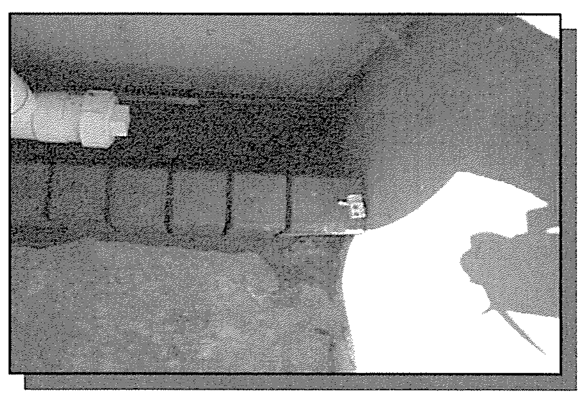






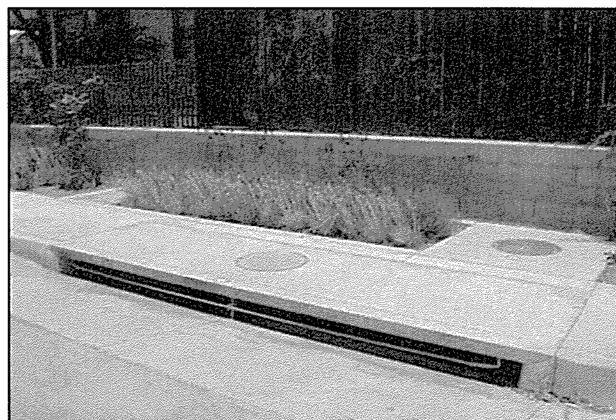
Drain Down Filter

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.



STORMTECH DETENTION MODULE

Note: It is not anticipated that these modules will require regular maintenance. Specifications are provided here for reference.

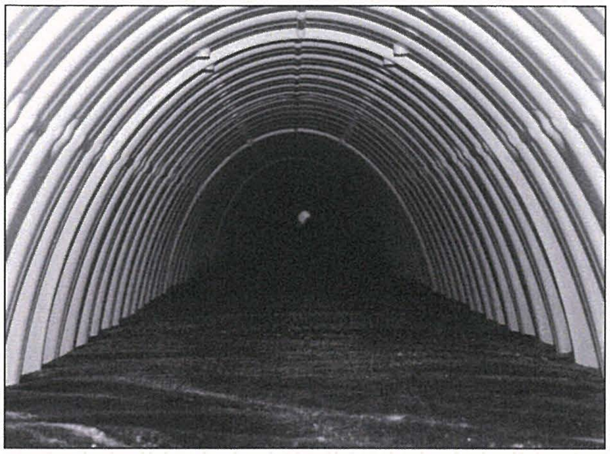
STORMTECH DETENTION SYSTEM MAINTENANCE

NOTE: Given that tributary runoff will be treated in biofiltration planters prior to entering the Stormtech system, significant sediment accumulation is not anticipated. As a result, systems should require very little or no regular maintenance.

1.0 The Isolator® Row

1.1 INTRODUCTION

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



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

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

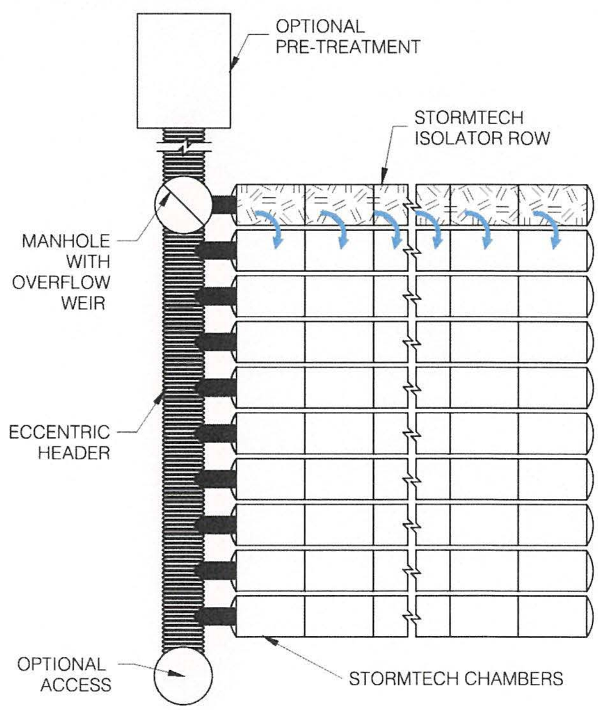
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means 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.

StormTech Isolator Row with Overflow Spillway
(not to scale)



STORMTECH DETENTION SYSTEM MAINTENANCE

NOTE: Given that tributary runoff will be treated in biofiltration planters prior to entering the Stormtech system, significant sediment accumulation is not anticipated. As a result, systems should require very little or no regular maintenance.

2.0 Isolator Row Inspection/Maintenance

StormTech

2.1 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.

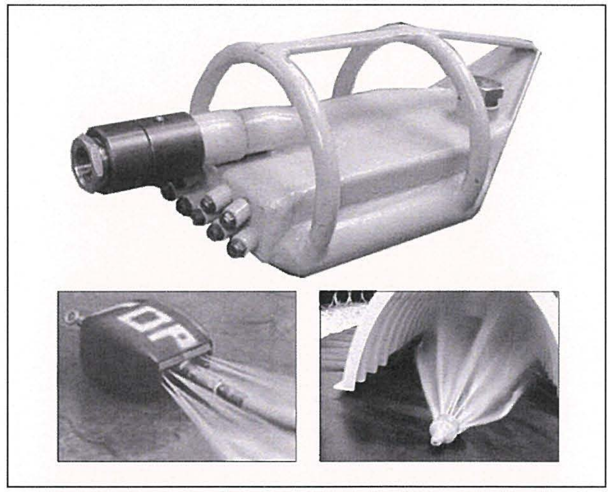
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

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.

2.2 MAINTENANCE

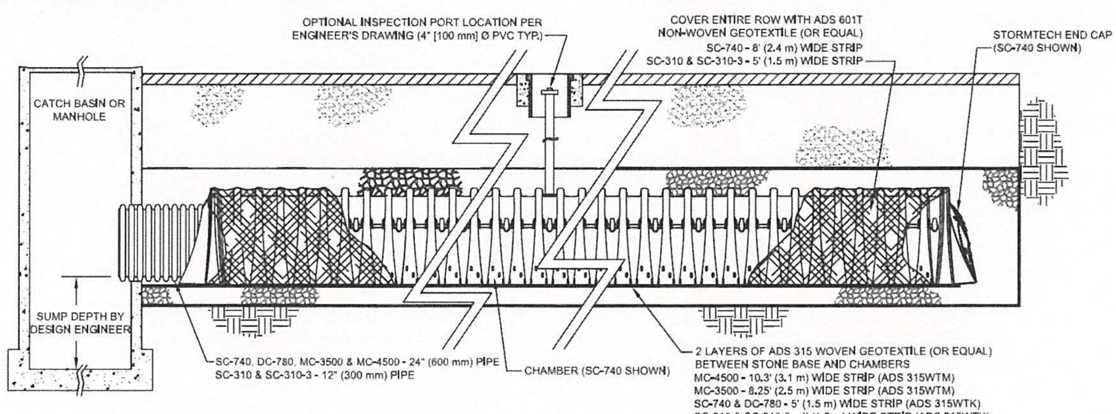
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via 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.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

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. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **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)



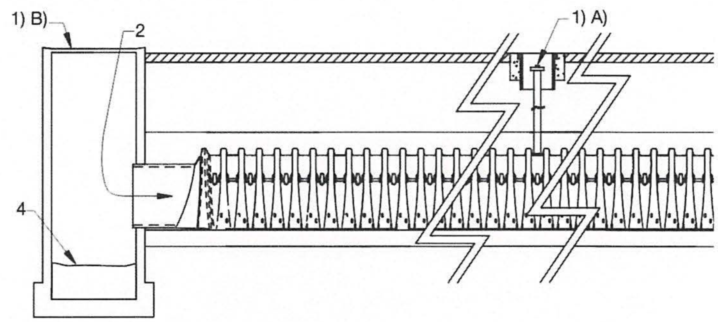
NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

STORMTECH DETENTION SYSTEM MAINTENANCE

NOTE: Given that tributary runoff will be treated in biofiltration planters prior to entering the Stormtech system, significant sediment accumulation is not anticipated. As a result, systems should require very little or no regular maintenance.

3.0 Isolator Row Step By Step Maintenance Procedures

StormTech Isolator Row (not to scale)



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 Rows

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 culvert 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: Fixed point to chamber bottom (1)	Stadia Rod Readings: Fixed point to top of sediment (2)	Sediment Depth (1) - (2)	Observations/Actions	Inspector
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

StormTech®

Detention • Retention • Water Quality

A division of ADS

70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

13

ATTACHMENT 4
COPY OF PLAN SHEETS SHOWING PERMANENT STORM WATER BMPS

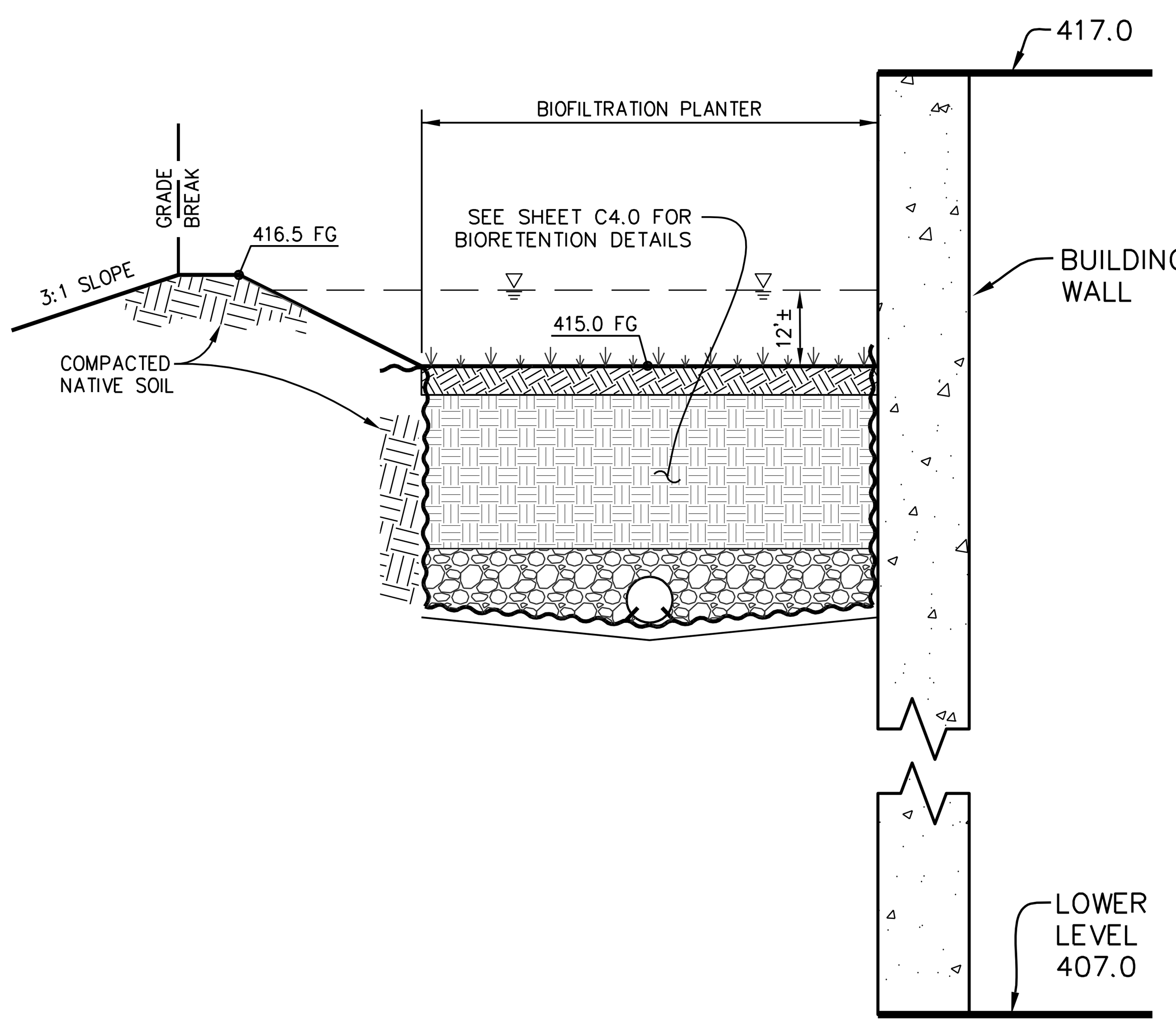
This is the cover sheet for Attachment 4.

Project Name: Sunroad Centrum 6

Use this checklist to ensure the required information has been included on the plans:

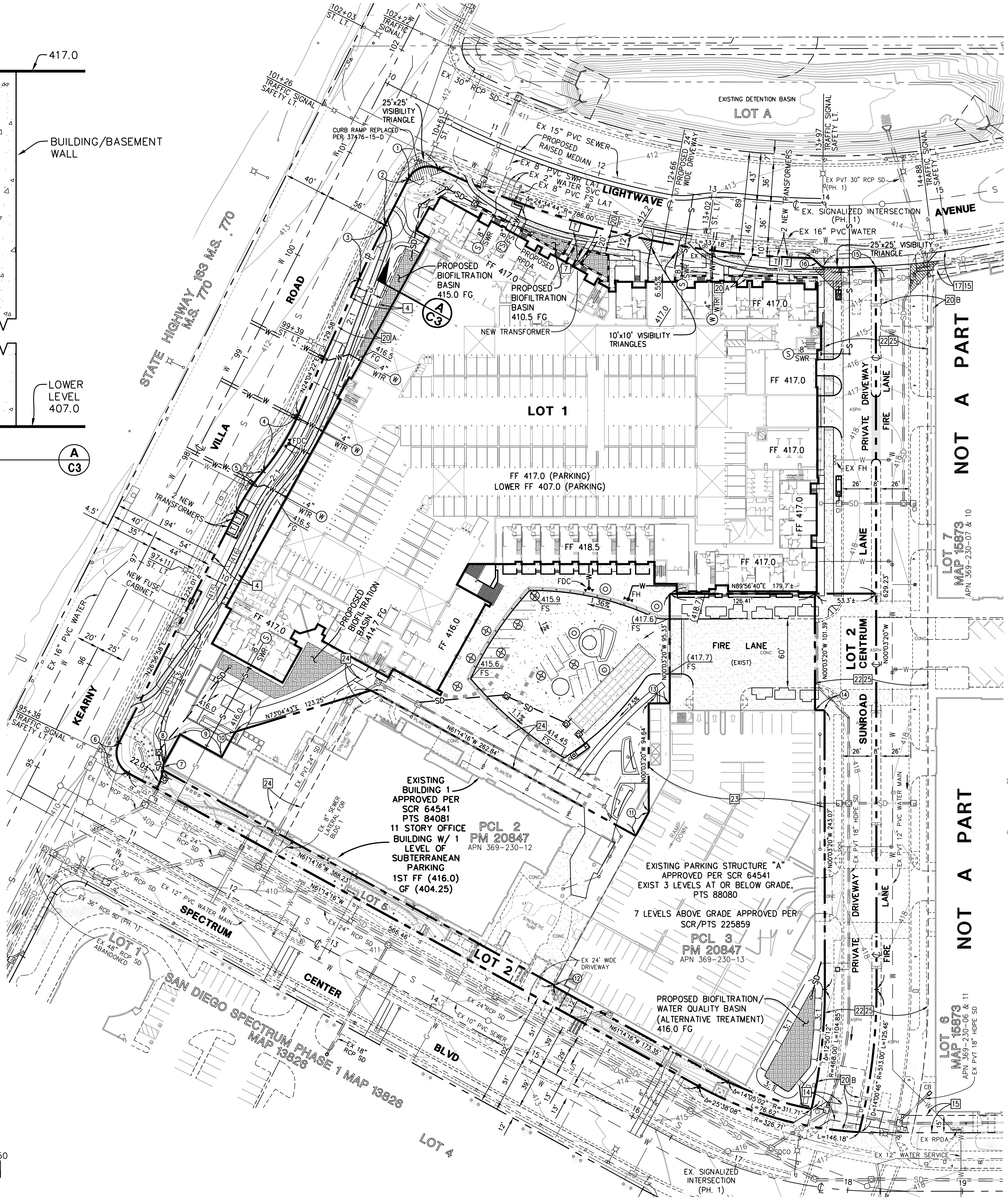
The plans must identify:

☒ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
☒ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
☒ Details and specifications for construction of structural BMP(s)
☐ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
☐ How to access the structural BMP(s) to inspect and perform maintenance
☐ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
☐ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
☐ Recommended equipment to perform maintenance
☐ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
☐ Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
☐ All BMPs must be fully dimensioned on the plans
☐ When propritery BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.



SECTION

NO SCALE



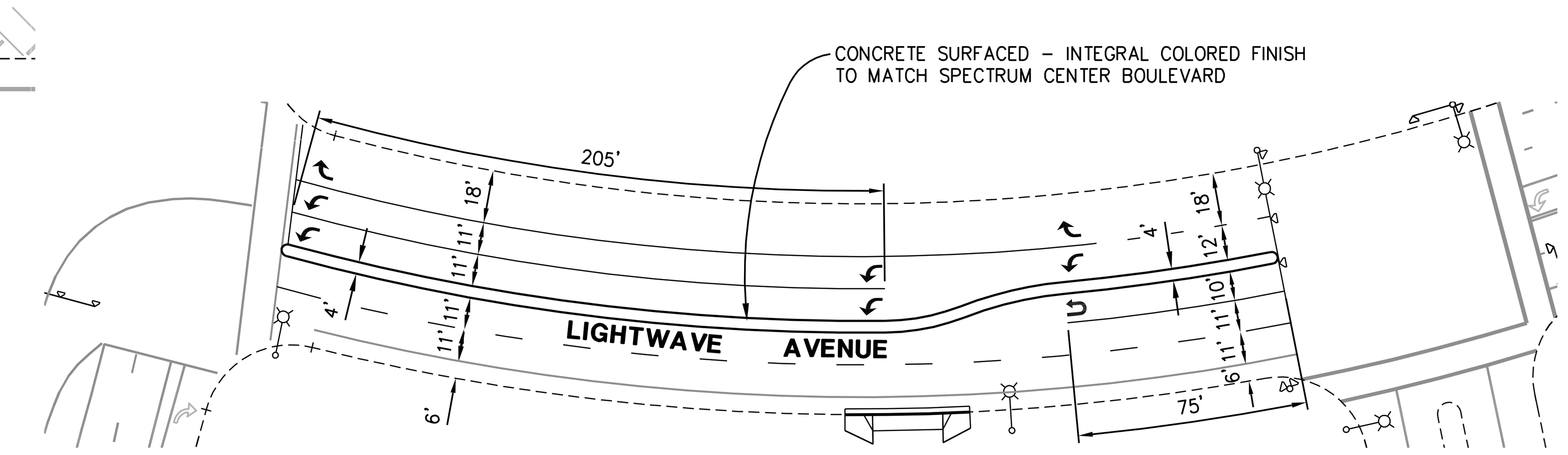
GRADING TABULATION

TOTAL SITE AREA: 5.83 ACRES GROSS.
TOTAL AMOUNT OF SITE TO BE GRADED: 4.85 ACRES.
PERCENT OF TOTAL SITE GRADED = 83%.
AMOUNT OF EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER: 0 ACRES.
PERCENT OF TOTAL EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER = 0% (SITE HAS BEEN PREVIOUSLY GRADED)
AMOUNT OF SITE WITHIN HILLSIDE REVIEW: 0 ACRES.
PERCENT OF TOTAL SITE WITHIN HILLSIDE REVIEW = 0%.
AMOUNT OF CUT: 49,800 CUBIC YARDS±; MAXIMUM DEPTH OF CUT: 19 FEET± (SUBTERRANEAN GARAGE)
AMOUNT OF FILL: 5,400 CUBIC YARDS±;
MAXIMUM HEIGHT OF FILL SLOPES: 5'±
MAXIMUM HEIGHT OF CUT SLOPES: N/A (NO CUT SLOPES)
AMOUNT OF IMPORT/EXPORT SOIL: 44,400 CUBIC YARDS± (EXPORT)
RETAINING WALLS: 175 LF, 6" MAX HT.

NOTES:
STREET LIGHTS AROUND PROJECT PERIMETER TO BE UPGRADED TO CURRENT CITY STANDARDS AND WILL INCLUDE FIXTURE TYPE UPGRADED TO LED TO CONFORM TO CURRENT REQUIREMENTS.

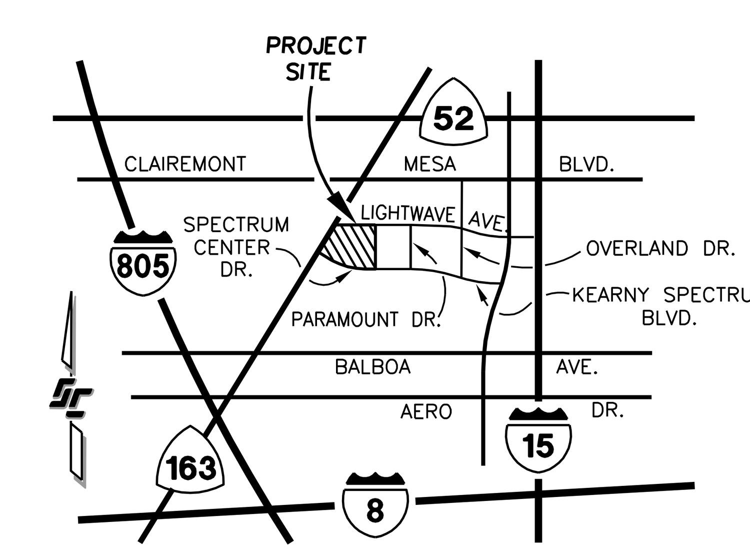
BOUNDARY DATA

	BEARING/DELTA	RADIUS	LENGTH
1	88°47'27"	20.00'	30.96'
2	N26°57'28"E	--	44.85'
3	02°52'38"	1042.00'	52.33'
4	15°46'01"	210.00'	57.79'
5	12°53'28"	190.00'	42.75'
6	88°11'14"	20.00'	30.79'
7	5°57'03"	47.50'	4.93'
8	N28°45'44"E	--	30.19'
9	N61°14'16"W	--	41.22'
10	N28°45'44"E	--	25.20'
11	N28°45'14"E	--	23.45'
12	N28°45'14"E	--	1.02'
13	N89°56'40"E	--	18.36'
14	N89°56'40"E	--	8.31'
15	03°20'26"	794.00'	46.29'
16	N47°01'02"W	--	11.92'



LIGHTWAVE AVE MEDIAN

SCALE: 1"= 50'



VICINITY MAP

NO SCALE

SUNROAD CENTRUM

SUNROAD ENTERPRISES

Sunroad Enterprises
4445 Eastgate Mall Suite 400
San Diego, CA 92121

SUNROAD CENTRUM 6
SAN DIEGO, CA

VESTING TENTATIVE MAP NO. 2003387
PLANNED DEVELOPMENT PERMIT NO. 2003388
AUGUST 1, 2017
REV. NOV. 16, 2017
REV. APRIL 18, 2018
REV. JUNE 27, 2018

REGISTERED PROFESSIONAL ENGINEER
No. 45601
Exp. 12-31-18
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STEVENS·CRESTO ENGINEERING, INC.
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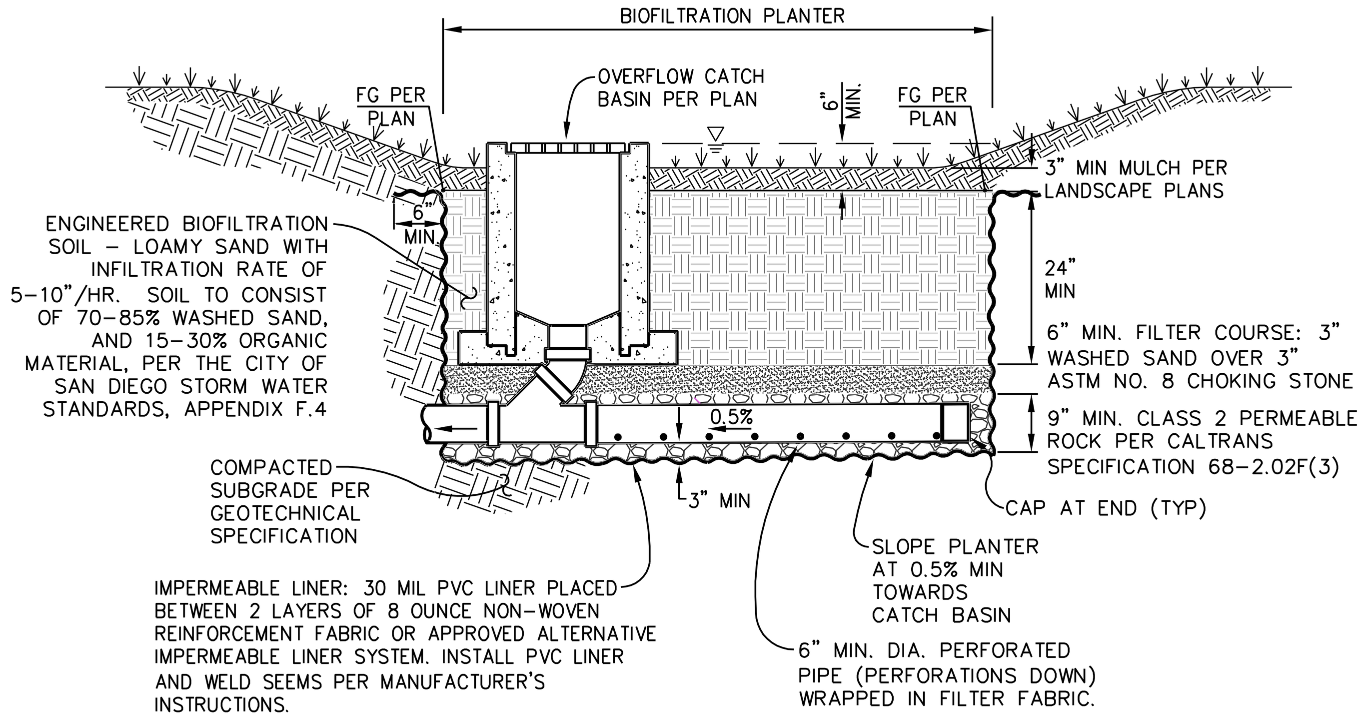


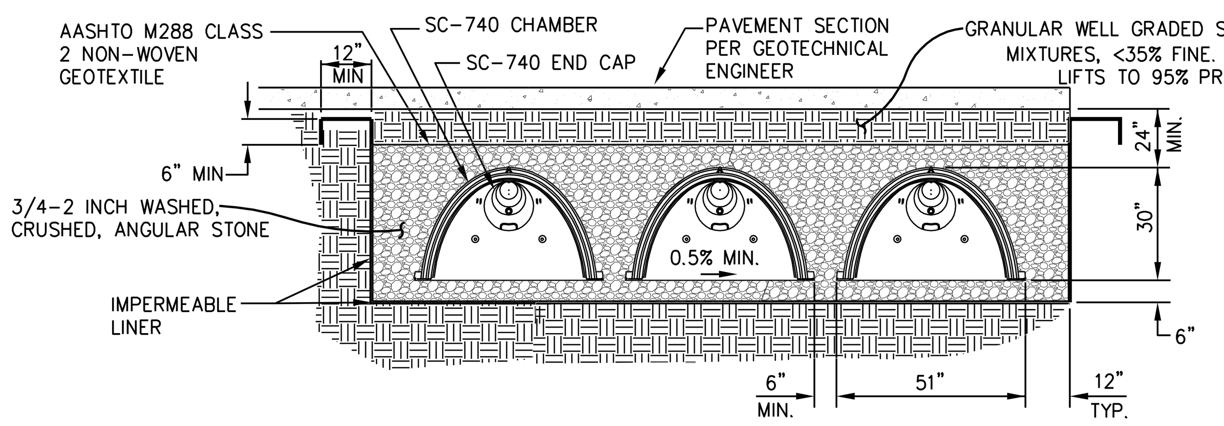
TYPICAL BIOFILTRATION DETAIL (A / C4.0)

NO SCALE

PRELIMINARY DESIGN (SEE NOTE)

BMP	AREA (SF)	VOLUME (CF)	LOW FLOW ORIFICE (IN)
BF1	980	2,752	0.60
BF2	2,060	5,957	0.95
BF3	1,972	5,702	0.95
BF4	915	2,570	0.60

NOTE: PRELIMINARY DESIGN, PER SIZING FACTORS FROM APPENDIX G OF THE STORM WATER STANDARDS, IS PROVIDED FOR FEASIBILITY PURPOSES ONLY; CONTINUOUS SIMULATION WILL BE PERFORMED AT FINAL ENGINEERING TO REDUCE VOLUME REQUIREMENTS AND INCREASE LOW FLOW ORIFICE SIZES.



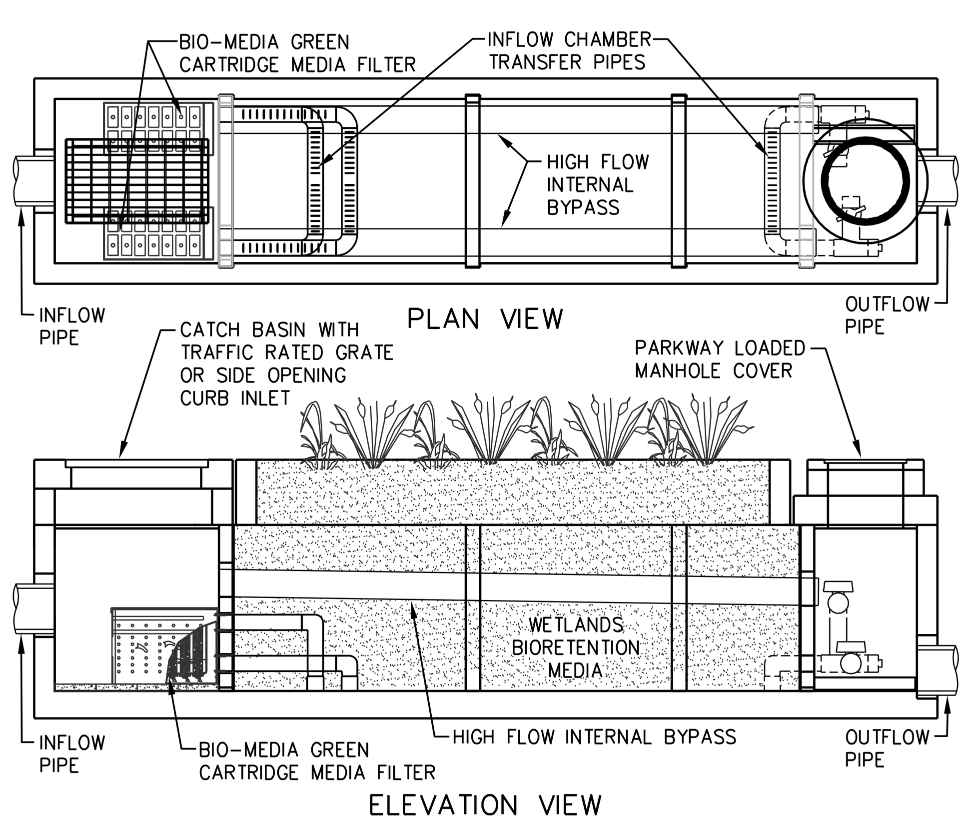
TYPICAL UNDERGROUND DETENTION DETAIL (B / C4.0)

NO SCALE

PRELIMINARY DESIGN (SEE NOTE)

BMP	VOLUME (CF)	LOW FLOW ORIFICE (IN)
ST1	4,725	0.73

NOTE: PRELIMINARY DESIGN, PER SIZING FACTORS FROM APPENDIX G OF THE STORM WATER STANDARDS, IS PROVIDED FOR FEASIBILITY PURPOSES ONLY; CONTINUOUS SIMULATION WILL BE PERFORMED AT FINAL ENGINEERING TO REDUCE VOLUME REQUIREMENTS AND INCREASE LOW FLOW ORIFICE SIZES.



TYPICAL PROPRIETARY BIOFILTRATION (MODULAR WETLANDS OR CITY APPROVED EQUIVALENT) (C / C4.0)

NO SCALE

DMA SUMMARY TABLE

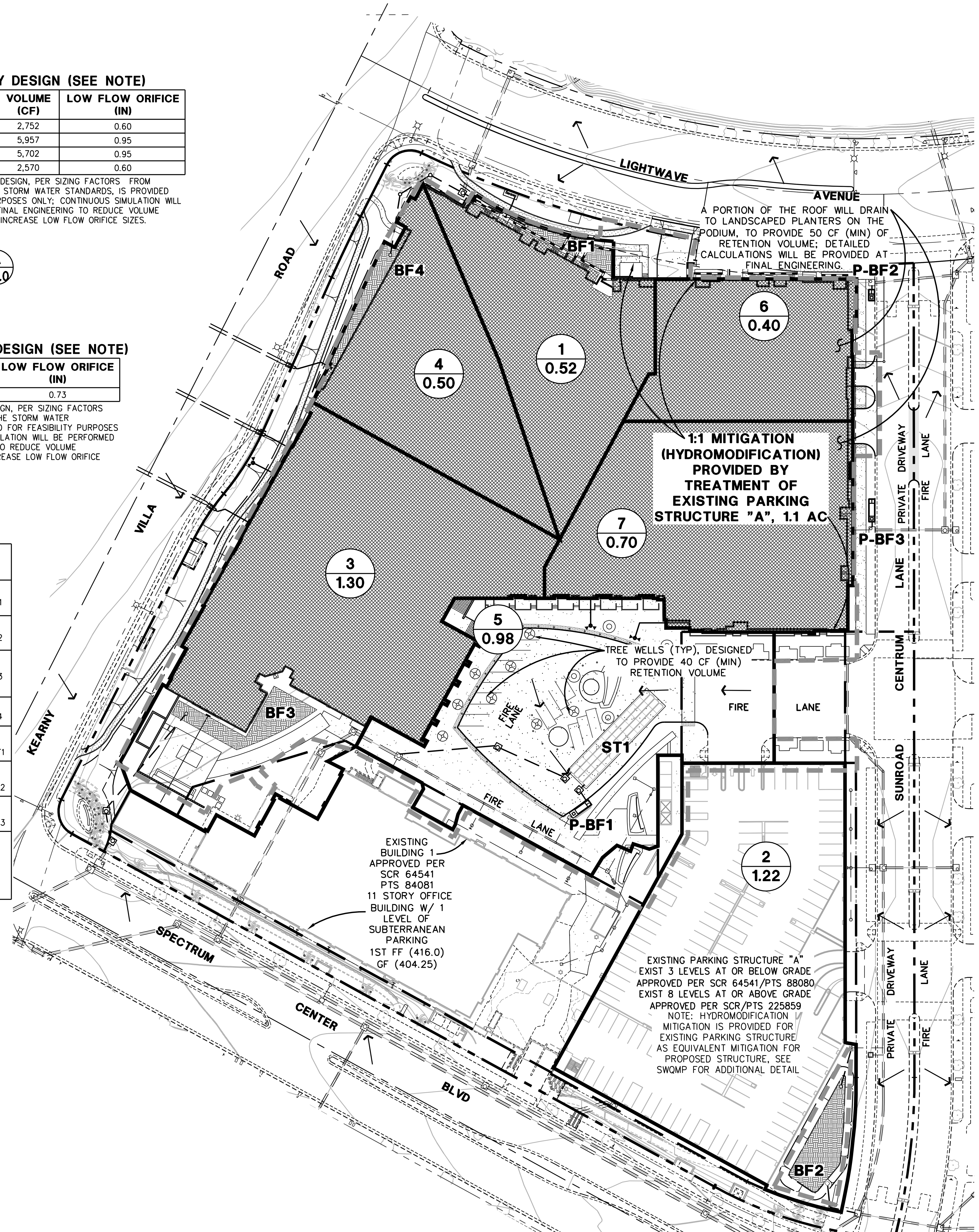
DMA ID	AREA (SF)	DESCRIPTION	TYPE
1	22,651	21,401 SF BUILDING 270 SF SIDEWALK 980 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-1
2	53,133	48,282 SF BUILDING 2,791 SF LANDSCAPING 2,060 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-2
3	56,530	42,066 SF BUILDING 3,558 SF SIDEWALK 8,934 SF LANDSCAPING 1,972 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-3
4	21,630	20,715 SF BUILDING 915 SF BIOFILTRATION	DRAINS TO BMP BIOFILTRATION BF-4
5	42,691	39,925 SF DRIVELANE/ SIDEWALK 2,766 SF LANDSCAPING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF1
6	17,400	17,400 SF BUILDING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF2
7	30,490	30,490 SF BUILDING	DRAINS TO BMP PROPRIETARY BIOFILTRATION P-BF3
TOTAL	244,525	180,354 SF BUILDING 43,753 SF SIDEWALK 14,491 SF LANDSCAPING 5,927 SF BIOFILTRATION	

SITE DESIGN, SOURCE CONTROL AND POLLUTANT CONTROL BMP OPERATION & MAINTENANCE PROCEDURE

STORM WATER MANAGEMENT AND DISCHARGE CONTROL MAINTENANCE AGREEMENT APPROVAL NO.: TO BE DETERMINED AT FINAL ENGINEERING

O&M RESPONSIBLE PARTY DESIGNEE: PROPERTY OWNER

BMP DESCRIPTION	INSPECTION FREQUENCY	MAINTENANCE FREQUENCY	MAINTENANCE METHOD	QUANTITY
SITE DESIGN ELEMENTS				
DESCRIPTION: **BIOFILTRATION**	MONTHLY	MONTHLY/ AS NEEDED	LANDSCAPE MAINT./ REMOVE TRASH	5,927 SF
SOURCE CONTROL ELEMENTS				
DESCRIPTION: **SWEEPING**	MONTHLY	MONTHLY/ AS NEEDED	SWEEP PAVED AREAS	43,753 SF PROPOSED PAVING
DESCRIPTION: **LANDSCAPE MAINTENANCE**	MONTHLY	MONTHLY/ AS NEEDED	PRUNING, WEEDING, CLEAN UP DEAD VEGETATION (MINIMIZE USE OF PESTICIDES AND FERTILIZERS)	14,491 SF PROPOSED LANDSCAPE
POLLUTANT CONTROL BMP(S)				
DESCRIPTION: **BIOFILTRATION**	MONTHLY	MONTHLY/ AS NEEDED	LANDSCAPE MAINT./ REMOVE TRASH	5,927 SF
DESCRIPTION: **PROPRIETARY BIOFILTRATION**	6 MONTHS	6 MONTHS	LANDSCAPE MAINT./ REMOVE TRASH & DEBRIS/ REPLACE FILTER CARTRIDGE	1 (MWS-L-4-21-C) 1 (MWS-L-4-8-C) 1 (MWS-L-4-17-C)
HMP FACILITY (IF SEPARATE)				
DESCRIPTION: **UNDERGROUND DETENTION**	TWICE/YEAR	AS NEEDED	AS NEEDED: NO REGULAR MAINTENANCE ANTICIPATED	1 (STORMTECH, OR SIMILAR)
HMP EXEMPT	NO			



0 25 50 100 150

SCALE: 1"=50'

LEGEND

ITEM	SYMBOL	DETAIL
PROJECT BOUNDARY		
PROPERTY LINE		
DMA BOUNDARY		
DMA DESIGNATION AND AREA (AC)	1 / 0.52	
EXISTING STORM DRAIN	SD	
PROPOSED STORM DRAIN		
DIRECTION OF FLOW ON GRADE (TYP.)		
IMPERVIOUS SURFACE (SIDEWALK, CONCRETE, BUILDING)		
PROPOSED BIOFILTRATION (WATER QUALITY AND HYDROMODIFICAITION)		A / C4.0
PROPOSED STORMTECH CHAMBERS (HYDROMODIFICATION ONLY)		B / C4.0
PROPOSED PROPRIETARY BIOFILTRATION (WATER QUALITY ONLY)		C / C4.0

STORM WATER QUALITY NOTES / CONSTRUCTION BMP'S

1. THIS PROJECT SHALL COMPLY WITH ALL REQUIREMENTS OF THE STATE PERMIT; CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SAN DIEGO, ORDER NO. 2009-0009-DWQ, NPDES NO. CAS000002, (AVAILABLE AT http://www.swrcb.ca.gov/water_issues/programs/stormwater) AND THE CITY OF SAN DIEGO LAND DEVELOPMENT CODE (http://clerkdoc.sannet.gov/legtrain/mc/MuniCodeChapter14/Ch14Art02Division02 AND http://www.sandiego.gov/development-services/industry/stormwater.shtml). NOTES BELOW REPRESENT KEY MINIMUM REQUIREMENTS FOR CONSTRUCTION BMP'S.
2. SUFFICIENT BMPS MUST BE INSTALLED TO PREVENT SILT, MUD OR OTHER CONSTRUCTION DEBRIS FROM BEING TRACKED INTO THE ADJACENT STREET(S) OR STORM WATER CONVEYANCE SYSTEMS DUE TO CONSTRUCTION VEHICLES OR ANY OTHER CONSTRUCTION ACTIVITY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CLEARING ANY SUCH DEBRIS THAT MAY BE IN THE STREET AT THE END OF EACH WORK DAY OR AFTER A STORM EVENT THAT CAUSES A BREECH IN THE INSTALLED CONSTRUCTION BMPS.
3. ALL STOCKPILES OF UNCOMPACTED SOIL AND/OR BUILDING MATERIALS THAT ARE INTENDED TO BE LEFT UNPROTECTED FOR A PERIOD GREATER THAN SEVEN CALENDAR DAYS ARE TO BE PROVIDED WITH EROSION AND SEDIMENT CONTROLS. SUCH SOIL MUST BE PROTECTED EACH DAY WHEN THE PROBABILITY OF RAIN IS 40% OR GREATER.
4. A CONCRETE WASHOUT SHALL BE PROVIDED ON ALL PROJECTS WHICH PROPOSE THE CONSTRUCTION OF ANY CONCRETE IMPROVEMENTS WHICH ARE TO BE POURED IN PLACE ON SITE.
5. ALL EROSION/ SEDIMENT CONTROL DEVICES SHALL BE MAINTAINED IN WORKING ORDER AT ALL TIMES.
6. ALL SLOPES THAT ARE CREATED OR DISTURBED BY CONSTRUCTION ACTIVITY MUST BE PROTECTED AGAINST EROSION AND SEDIMENT TRANSPORT AT ALL TIMES.
7. THE STORAGE OF ALL CONSTRUCTION MATERIALS AND EQUIPMENT MUST BE PROTECTED AGAINST ANY POTENTIAL RELEASE OF POLLUTANTS INTO THE ENVIRONMENT.

PROJECT COVERAGE UNDER THE CONSTRUCTION GENERAL PERMIT

SUNROAD CENTRUM 6 PROPOSES GREATER THAN AN ACRE OF SOIL DISTURBANCE. AS SUCH, THE PROJECT WILL APPLY FOR COVERAGE UNDER STATE WATER RESOURCES CONTROL BOARD ORDER NO. 2009-0009-DWQ. IN ACCORDANCE WITH THE CITY OF SAN DIEGO STORM WATER STANDARDS, A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) WILL BE PREPARED FOR THE PROJECT.

PRIORITY DEVELOPMENT DETERMINATION

SUNROAD CENTRUM 6 PROPOSES >1 ACRE OF RESIDENTIAL DEVELOPMENT. AS SUCH, AND PER THE STORM WATER REQUIREMENTS APPLICABILITY CHECKLIST ON THIS SHEET, THE PROJECT IS A PRIORITY DEVELOPMENT PROJECT.

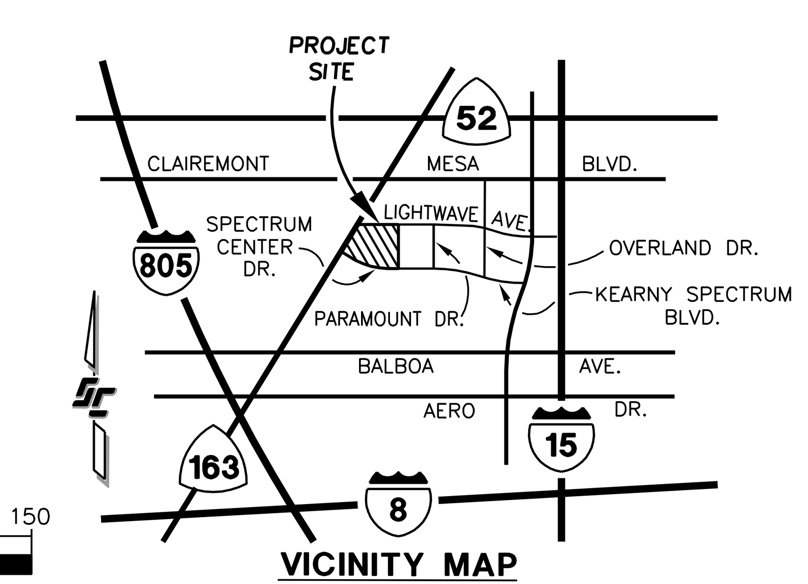
PERMANENT POST-CONSTRUCTION BMP NOTES

AS A PRIORITY DEVELOPMENT PROJECT, POST-CONSTRUCTION TREATMENT CONTROL BMP'S ARE PROPOSED AT THE PROJECT. BIOFILTRATION, PROPRIETARY BIOFILTRATION, AND UNDERGROUND DETENTION WILL BE USED TO PROVIDE WATER QUALITY AND HYDROMODIFICATION MITIGATION FOR THE NEW IMPERVIOUS SURFACE AREA. FACILITIES ARE SIZED PER THE DCV CALCULATION CRITERIA IN THE STORM WATER STANDARDS MANUAL, SEE THE SWQMP FOR ADDITIONAL DETAIL.

HYDROMODIFICATION MITIGATION

AS A PRIORITY DEVELOPMENT PROJECT, SUNROAD CENTRUM 6 PROPOSES HYDROMODIFICATION BMPS TO SATISFY THE MITIGATION CRITERIA REQUIRED IN THE CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD ORDER NO. R9-2013-0001, IT'S SUBSEQUENT AMENDMENTS, AND THE CITY OF SAN DIEGO STORM WATER STANDARDS MANUAL. THE HYDROMODIFICATION MITIGATION CRITERIA APPLIES TO ALL PRIORITY DEVELOPMENT PROJECTS REGARDLESS OF SIZE, UNLESS QUALIFYING FOR AN EXEMPTION ALLOWED WITHIN THE APPROVED HMP.

BIOFILTRATION PLANTERS WILL BE USED TO PROVIDE WATER QUALITY AND HYDROMODIFICATION MITIGATION FOR THE NEW IMPERVIOUS SURFACE AREA. SIZING OF THE FACILITIES, FOR DESIGN FEASIBILITY PURPOSES, HAVE BEEN CALCULATED USING THE BMP SIZING SPREADSHEET, SEE THE SWQMP FOR ADDITIONAL DETAIL. IT IS ANTICIPATED THAT CONTINUOUS SIMULATION MODELING WILL BE USED AT FINAL ENGINEERING TO REDUCE SIZES AND PONDING DEPTHS OF FACILITIES.



VICINITY MAP

NO SCALE

SUNROAD CENTRUM

Sunroad Enterprises
4445 Eastgate Mall Suite 400
San Diego, CA 92121

SUNROAD CENTRUM 6
SAN DIEGO, CA

VESTING TENTATIVE MAP NO. 2003387
PLANNED DEVELOPMENT PERMIT NO. 2003388

AUGUST 1, 2017
REV. NOV. 16, 2017
REV. APRIL 18, 2018
REV. JUNE 27, 2018

REGISTERED PROFESSIONAL ENGINEER No. 45601 Exp. 12-31-18 CIVIL STATE OF CALIFORNIA

CONCEPT STORM WATER BMP

C4.0

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ATTACHMENT 5
DRAINAGE REPORT

Attach project's drainage report. Refer to Drainage Design Manual to determine the reporting requirements.

STEVENS · CRESTO ENGINEERING, INC.

PRELIMINARY DRAINAGE STUDY

FOR:

SUNROAD CENTRUM 6,
VTM NO. 2003387/ PDP NO. 2003388

(ADDENDUM TO APPROVED STUDY FOR CENTRUM 12)

San Diego, CA 92123
APN: 369-230-01, 02, 03, 04 & 14

Prepared For:
SUNROAD ENTERPRISES
4445 Eastgate Mall, Suite 400
San Diego, CA 92121

Prepared By:
STEVENS CRESTO ENGINEERING INC.
9665 Chesapeake Drive, Suite 200
San Diego, CA 92123

Contact: Bryan T. Hill, Senior Engineer
Telephone: 858-694-5660
Email: bth@scengr.com

SCE Project No.: 17006.01
Date: 11/09/17
Project No.: 565879

PRELIMINARY DRAINAGE STUDY

FOR:

SUNROAD CENTRUM 6,
VTM NO. 2003387/ PDP NO. 2003388

(ADDENDUM TO APPROVED STUDY FOR CENTRUM 12)

San Diego, CA 92123

Certification

This Drainage Study has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer (Engineer) attests to the technical information contained herein and the engineering data upon which the following design, recommendations, conclusions, and decisions are based.

STEVENS CRESTO ENGINEERING, INC.
9665 Chesapeake Drive
Suite 200
San Diego, CA 92123
Tel: (858) 694-5660

REGISTERED PROFESSIONAL ENGINEER
BRYAN T. HILL
No. 69339
Exp. 6-30-18
CIVIL
STATE OF CALIFORNIA

11/9/17

Bryan T. Hill — Date
R.C.E. 69339

TABLE OF CONTENTS

1

SECTION 1

SUMMARY

Purpose of Study

This addendum has been prepared to address the addition of the Sunroad Centrum 6 development to the previously approved "Drainage Study for Centrum 12", dated 06/27/06. Sunroad Centrum 6 will construct a new building at the southeast corner of Kearny Villa Road and Lightwave Avenue. The "Drainage Study for Centrum 12" anticipated the development of Sunroad Centrum 6, and utilized a runoff coefficient of 0.85 for all areas proposed to be developed by Sunroad Centrum 6. See Section 3 for the "Drainage Study for Centrum 12", provided for reference, and Section 4 for sheets from City of San Diego DWG: 34009-D, the Fine Grading Plan for Centrum 12, which show the anticipated future building footprint in the location of Sunroad Centrum 6; the proposed project generally conforms to the anticipated footprint. This addendum has been prepared to accompany the Vesting Tentative Map (VTM) Review for Sunroad Centrum 6. A detailed analysis of the proposed development, including hydraulic calculations for all tributary storm drain, will be completed at final engineering.

Proposed Hydrology

The proposed Sunroad Centrum 6 development generally maintains drainage patterns and discharge points shown on Exhibit "B" – Proposed Condition, from the "Drainage Study for Centrum 12". This exhibit is included in Section 3 with the approximate location of Sunroad Centrum 6 added in red.

Basins

Sunroad Centrum 6 is contained primarily within Basins A, B, E, and G on Exhibit "B"- Proposed Condition. The proposed building will either split roof drainage areas to maintain the basin delineation or will implement detention to ensure that the peak flow rates at Nodes 003, 011, 019, and 033 are not exceeded. Detailed calculations will be provided at final engineering.

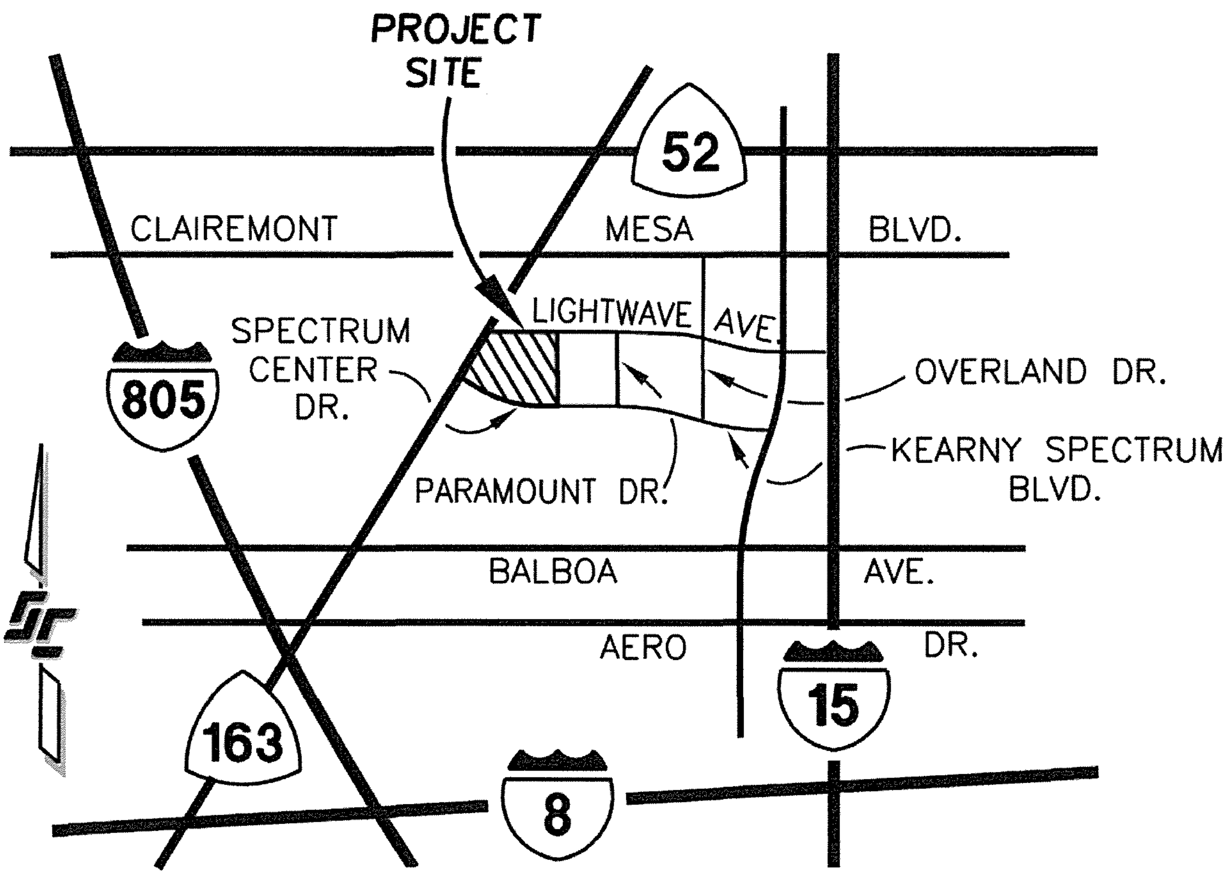
CONCLUSION

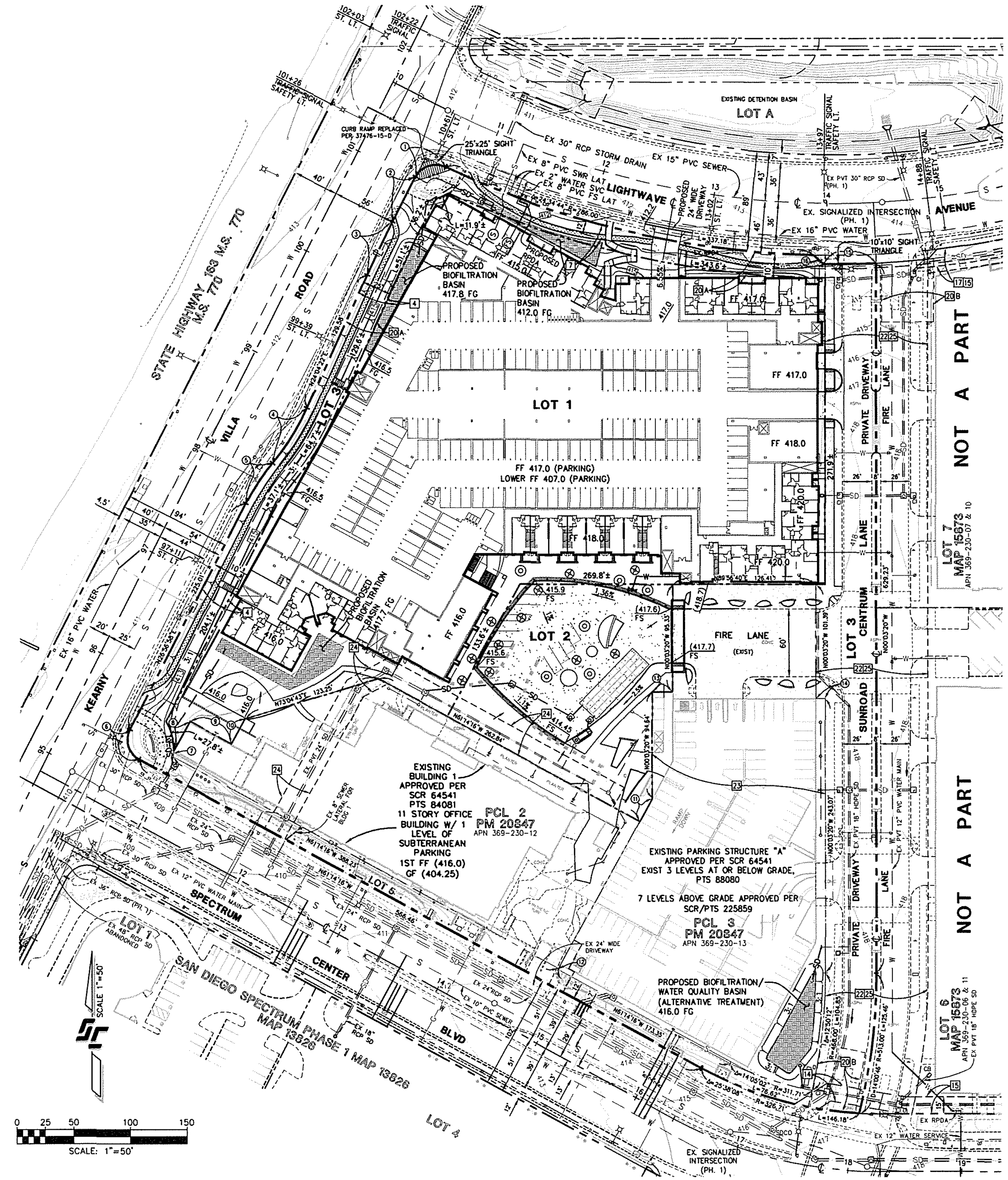
The Sunroad Centrum 6 project is a development that was anticipated in the "Drainage Study for Centrum 12". That drainage study utilized a highly impervious runoff coefficient of 0.85 for all areas proposed to be developed by Sunroad Centrum 6, and the proposed project generally honors the drainage patterns shown on Exhibit "B" – Proposed Condition. As a result, the "Drainage Study for Centrum 12" provides adequate analysis of the proposed Sunroad Centrum 6 project for the VTM. A detailed analysis of the proposed development, including hydraulic calculations for all tributary storm drain, will be completed at final engineering.

2

SECTION 2

VICINITY MAP
(NO SCALE)





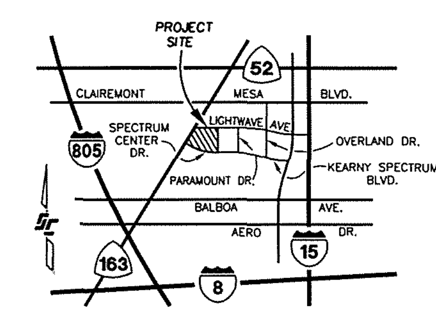
GRADING TABULATION

TOTAL SITE AREA: 5.83 ACRES GROSS.
TOTAL AMOUNT OF SITE TO BE GRADED: 4.85 ACRES.
PERCENT OF TOTAL SITE GRADED = 83%
AMOUNT OF EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER: 0 ACRES.
PERCENT OF TOTAL EXISTING SITE WITH NATURAL 25% SLOPES OR GREATER = 0%
(SITE HAS BEEN PREVIOUSLY GRADED)
AMOUNT OF SITE WITHIN HILLSIDE REVIEW: 0 ACRES.
PERCENT OF TOTAL SITE WITHIN HILLSIDE REVIEW = 0%
AMOUNT OF CUT: 48,500 CUBIC YARDS±; MAXIMUM DEPTH OF CUT: 12 FEET± (SUBTERRANEAN GARAGE)
AMOUNT OF FILL: 5,400 CUBIC YARDS±;
MAXIMUM HEIGHT OF FILL SLOPES: 5'±
MAXIMUM HEIGHT OF CUT SLOPES: N/A (NO CUT SLOPES)
AMOUNT OF IMPORT/EXPORT SOIL: 43,100 CUBIC YARDS± (EXPORT)
RETAINING WALLS: 105 LF, 4' MAX HT.

NOTES:
STREET LIGHTS AROUND PROJECT PERIMETER TO BE UPGRADED TO CURRENT CITY STANDARDS AND WILL INCLUDE FIXTURE TYPE UPGRADED TO LED AND SPACING TO CONFORM TO CURRENT REQUIREMENTS.

BOUNDARY DATA

	BEARING/DELTA	RADIUS	LENGTH
1	88°47'27"	20.00'	30.96'
2	N26°57'28"E	--	44.85'
3	02°52'38"	1042.00'	52.33'
4	15°46'01"	210.00'	57.79'
5	12°53'28"	190.00'	42.75'
6	88°11'14"	20.00'	30.79'
7	5°57'03"	47.50'	4.93'
8	N28°45'44"E	--	30.19'
9	N61°14'16"W	--	41.22'
10	N28°45'44"E	--	25.20'
11	N28°45'14"E	--	23.45'
12	N28°45'14"E	--	1.02'
13	N89°56'40"E	--	18.36'
14	N89°56'40"E	--	8.31'
15	03°20'26"	794.00'	46.29'
16	N47°01'02"W	--	11.92'



VICINITY MAP
NO SCALE

SUNROAD CENTRUM

SUNROAD ENTERPRISES

Sunroad Enterprises
4445 Eastgate Mall Suite 400
San Diego, CA 92121

WERMERS PROPERTIES DEVELOPMENT ACQUISITION MANAGEMENT

Wermers Properties
5120 Shoreham Place, #150
San Diego, CA 92122

SUNROAD CENTRUM 6
SAN DIEGO, CA

AUGUST 1, 2017
VESTING TENTATIVE MAP NO. 2003387
PLANNED DEVELOPMENT PERMIT NO. 2003388
AUGUST 1, 2017
REV. NOV. 8, 2017

REGISTERED PROFESSIONAL ENGINEER
JOSEPH G. CRESTO
No. 45601
Exp. 12-31-18
CIVIL
STATE OF CALIFORNIA

CONCEPT GRADING &
UTILITY PLAN

C3.0

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3

SECTION 3

"DRAINAGE STUDY FOR: CENTRUM 12"

STEVENS · CRESTO ENGINEERING, INC.

DRAINAGE STUDY FOR:

CENTRUM 12

SAN DIEGO, CA

Prepared for:
SUNROAD ENTERPRISES
4445 Eastgate Mall, Suite 400
San Diego, CA 92121

Prepared by:
STEVENS CRESTO ENGINEERING INC.
9665 Chesapeake Drive, Suite 320
San Diego, CA 92123

DATE: 02/01/06
REVISED: 06/27/06
SCE Project: 00018.14

W.O. No.: 426200
P.T.S. No.: 98300
DWG. No.: 34009-D

DRAINAGE STUDY FOR:

CENTRUM 12

SAN DIEGO, CA

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SECTION 1

SUMMARY

Purpose of Study

Centrum 12, the first phase of a multiphase commercial subdivision, is located in the community of Kearny Mesa, in the City of San Diego and is bound by Kearny Villa Road to the west, Paramount Drive to the east, Lightwave Avenue to the north, and Spectrum Center Boulevard to the south. The project is part of the redevelopment of the former General Dynamics Convair plant in Kearny Mesa.

Legal description for the proposed commercial development is: Parcels 1 thru 7, and 13 of P.M. No. 18972, according to Map thereof, filed in the Office of the County Recorder of San Diego County, May 24, 2002 as File No. 2002-0444396 of Official Records, Parcel 1 of P.M. No. 19193, according to Map thereof, filed in the Office of the County Recorder of San Diego County, March 28, 2003 as File No. 2003-0354510 of Official Records, and Parcel 1 of P.M. No. 19312, according to Map thereof, filed in the Office of the County Recorder of San Diego County, September 3, 2003 as File No. 2003-1073075 of Official Records, all in the City of San Diego, County of San Diego, State of California.

This report analyzes fifty-year storm runoff rates generated from the proposed redevelopment and accompanies the Grading and Improvement Plan for Centrum 12.

In preparing this report, we have reviewed and incorporated by reference the approved study, "Drainage Study (for) San Diego Spectrum (dated March 26, 1999)" prepared by Kimley-Horn and Associates (KHA). Runoff for basins within the Drainage Study for San Diego Spectrum utilized HEC-1 modeling. As a result of the HEC-1 modeling for this region, the runoff rates reported within the KHA drainage study, used to size the existing storm drain infrastructure in the area, is less than runoff rates calculated using the City mandated Rational Method for basin area of this size. Therefore, based on hydraulic analysis of the fifty–year storm event, the existing storm drain system in Spectrum Center Boulevard is unable to convey the higher runoff rate, generated from the Rational Method, without storm water runoff ponding up out of adjacent curb inlets and cleanouts in Spectrum Center Boulevard.

The issue of increased runoff rates generated utilizing the Rational Method as opposed to the HEC-1 modeling has been raised, addressed, and approved by the City of San Diego, Subdivision Engineer and documented in Memorandum dated October 5, 2000 (included in Appendix A, Section 5). Conclusions of the Memorandum, states the City, "...will accept some surcharge in the laterals and in the private, on-site systems, as long as the calculated HGL using the higher Rational Method Q's, is below the ground elevations on the site."

To circumvent the impact of utilizing the City's mandated Rational Method, the existing storm drain system in Kearny Villa Road and Spectrum Center Boulevard will be up-sized and a new system will be constructed, paralleling the existing system in Spectrum Center Boulevard, to convey runoff from the project (See proposed hydraulic calculations in Section 3 and Improvement Plan for Centrum 12 for hydraulic grade lines in the proposed storm drain system included in Section 4).

Existing Hydrology

The 26-acre project, in its existing condition, is a vacant rough graded site that drains to three separate desilting basins. See Exhibit "A" in Section 4 for a graphic depicting the existing drainage condition. This study breaks the existing on-site drainage basins into two major basins, "A", and "B" and are described as follows:

Basin "A" is approximately 16.82-acres and is subdivided into two sub-basins, "A1" and "A2". Two separate desiltation basins located at the northwest and northeast corners of the site collect runoff generated by each sub-basin. Sub-Basin "A1" is approximately 1.28-acres and runoff generated within this basin is conveyed, via overland flow, to the desilting basin at the northeast corner of the site. Sub-basin "A2" is approximately 15.54-acres and runoff generated within this basin is conveyed, via overland and open channel ditch flow, to the desilting basin at the northwest corner of the site. Ultimately, runoff from Basin "A" is conveyed to a private detention basin, per TM-96-0165, W.O. 980969, DWG No. 29636-4-D, located at the northwest corner of Kearny Villa Road and Lightwave Avenue.

Basin "B" is approximately 9.51-acres and runoff generated within the basin is conveyed, via overland flow, to the desilting pond located at the southwest corner of the site. Ultimately, runoff from Basin "B" enters the public storm drain system in Spectrum Center Boulevard via a 24" RCP storm drain lateral per DWG. No. 29636-25-D.

Proposed Hydrology

The initial phase of project will consist of a 12-story office building with one level of subterranean parking, a 3-level below-grade parking structure, and associated on-grade parking lots. Proposed drainage basins will generally match existing basins and storm drain outfall points. A private on-site drainage system will collect and convey runoff within the project site. See Exhibit "B", in Section 4, for a graphic depicting the proposed site plan and drainage conditions. Exhibit "C" (and calculations which follow it), within Section 3, depict the drainage basin tributary to the on-site desiltation basin being constructed east of the drive lane and adjacent to Lightwave Avenue.

Desiltation Basin:
The desiltation basin accepts runoff from rough graded areas of the tributary basins shown on Exhibit "C." However, as noted on Exhibit "C" only 7.2 acres of this tributary basin is un-planted; the rough graded areas east of the temporary parking up to the lot line are planted and irrigated, as a Best Management Practice, per Building Department Permit Number PTS 84081. Resultantly, the desiltation pond is sized for the tributary area which is un-planted.

Proposed basins "A" through "H" are described as follows:
Basin "A" is approximately 1.28-acres and a runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. The fifty-year storm peak runoff rate for Basin "A" is approximately 4.6-cfs at the outfall point, located at the existing desilting basin in the northwest corner of the project site. Runoff is conveyed into Lightwave Avenue, via an existing 24" RCP storm drain lateral and ultimately to an existing detention basin located at the northwest corner of Lightwave and Kearny Villa Road.

Basin "B" is approximately 14.01-acres and generates a fifty-year storm peak runoff rate of approximately 35.7-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. The outfall is a proposed 30" RCP storm drain lateral, located at the proposed signalized driveway on Lightwave Avenue. Ultimately, runoff is conveyed to the existing detention basin located at the northwest corner of Lightwave and Kearny Villa Road.

Basin "C" is approximately 1.30-acres and generates a fifty-year storm peak runoff rate of approximately 4.0-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. The outfall is located at the existing desilting basin at the northeast side of the project. The existing desilting basin initially served the multi-family development, east of the project site, before the development was constructed. Currently, the multi-family development area collects runoff within the development, via a private drainage system, and conveys it to the public storm drain in Lightwave Avenue per DWG No. 32556-D. Ultimately, runoff from both the multi-family development and Basin "C" is conveyed to the existing detention basin located at the northwest corner of Lightwave Avenue and Kearny Villa Road.

Basin "D" is approximately 5.56-acres and generates a fifty-year storm peak runoff rate of approximately 16.3-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. The outfall is a proposed 24" RCP storm drain lateral, located at the proposed signalized driveway on Spectrum Center Boulevard.

Basin "E" is approximately 2.42-acres and generates a fifty-year storm peak runoff rate of approximately 8.6-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. Runoff is conveyed into a proposed public 24" RCP storm drain in Spectrum Center Boulevard via a private 24" RCP storm drain lateral. See Exhibit "B" in Section 4 for a graphic depicting the proposed drainage condition.

Basin "F" is approximately 0.31-acres and generates a fifty-year storm peak runoff rate of approximately 1.1-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. Basin "F" consists of landscaped slopes along Spectrum Center Boulevard. Runoff from Basin "F" is conveyed onto Spectrum Center Boulevard via overland sheet flow to an existing curb inlet at the intersection of Spectrum Center Boulevard and Kearny Villa Road.

Basin "G" is approximately 1.41-acres and generates a fifty-year storm peak runoff rate of approximately 5.0-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations for the full development of the commercial site. Runoff generated from Basin "G" is conveyed to an existing desilting basin located at the southwest corner of the site and ultimately outfalls into the back of the existing curb inlet in Spectrum Center Boulevard. In the fully developed condition, runoff generated in Basin "G" will be routed to the private on-site drainage system serving Basin "E". Therefore, said private system serving Basin "E" is designed to convey runoff from both Basin "E" and "G", and is incorporated into the hydraulic grade line (HGL) shown on the proposed 24" RCP storm drain in Spectrum Center Boulevard.

Basin "H" is approximately 0.02-acres and generates a fifty-year storm peak runoff rate of approximately 0.1-cfs. A runoff coefficient of 0.85 was utilized in the runoff calculations. Basin "H" consists of a private driveway for access in and out of the subterranean parking structure beneath the proposed building. Runoff will be collect by a private drainage system and treated with and sand-oil separator before pumped into the proposed storm drain system in Spectrum Center Boulevard via a 6" PVC lateral.

Procedure

1. Runoff rates were determined by the rational method: Q= CIA

    a. Runoff coefficients (C) of 0.85, for the proposed development, were utilized in the runoff calculations.

    b. 50-year storm intensities (I_{50}), were determined by the Intensity-Duration-Frequency Curves per City of San Diego's Drainage Design Manual (April 1984).

    c. Drainage basin area(s) (A), in acres, are delineated and quantified as shown on Exhibits "A" and "B" in Sections 4.

2. Storm drain hydraulic analysis and pipe sizing is based on the fifty-year storm event, Manning's equation; where, a roughness coefficient (n) of 0.010 for PVC and HDPE, and 0.013 for were utilized for hydraulic calculations using "Flowmaster" software. Head loss through storm drain structures is based on velocity head determined by Manning's equation and/or the Continuity equation. Structure loss coefficients were determine from equation 3-20 and table 3-8 in the San Diego County Drainage Design Manual, May 2005.

Conclusion

This report quantifies the Rational Method fifty-year peak runoff rate generated from the full development of the project site. As stated previously, the existing storm drain infrastructure to serve developments in this area were designed utilizing HEC-1 modeling, a less conservative approach to the City of San Diego's mandated Rational Method for basin areas currently draining to existing downstream infrastructures in the Spectrum area.

Utilizing Rational Method for the full development of Centrum 12, the existing downstream storm drain infrastructure in Kearny Villa Road and Spectrum Center Boulevard would not have the hydraulic capacity to convey the storm water runoff generated from the developed site without exceeding the system capacity and causing storm water to pond up out of curb inlets and cleanouts.

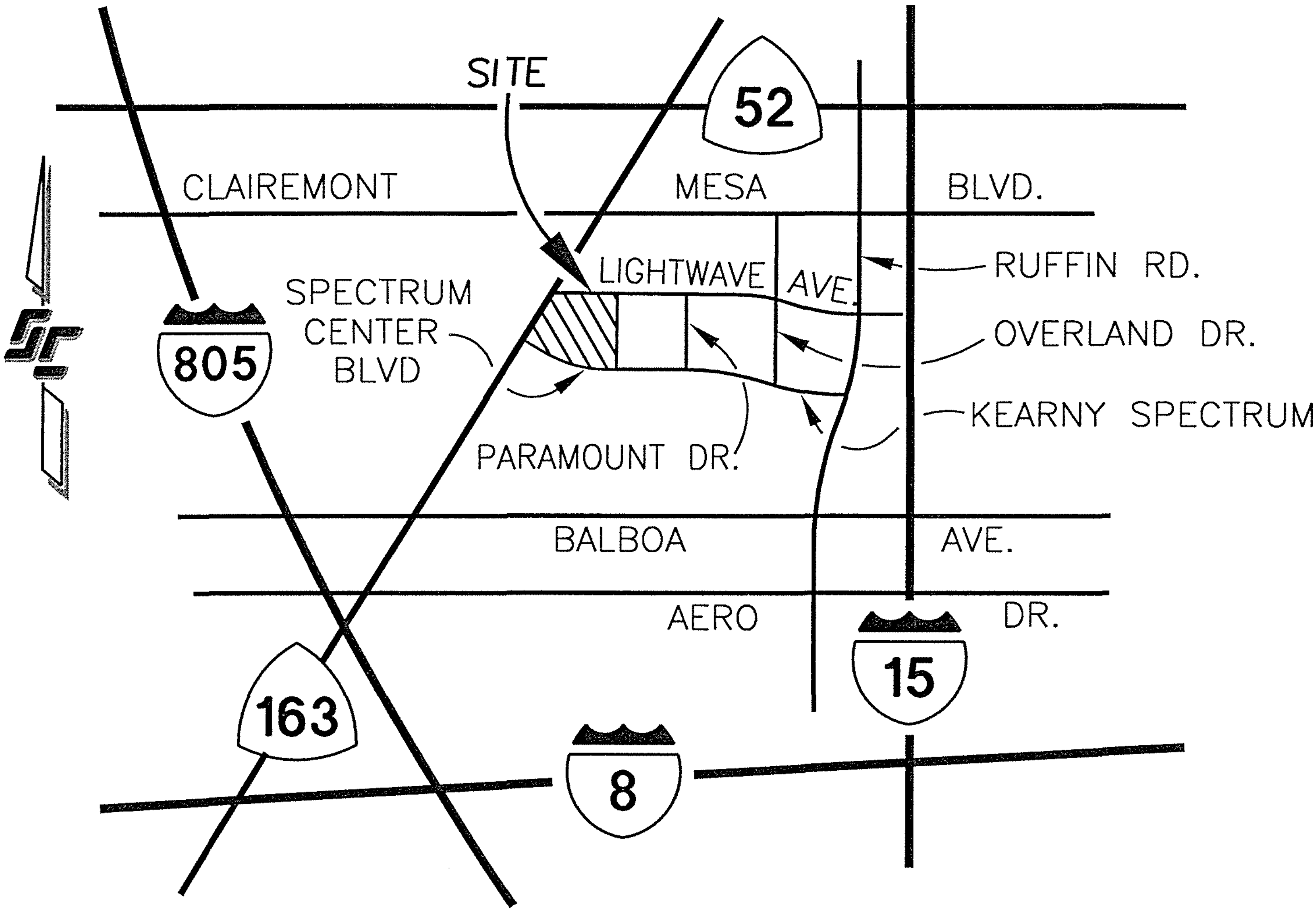
To circumvent the impact of utilizing the City's mandated Rational Method, the existing storm drain system in Kearny Villa Road and Spectrum Center Boulevard will be up-sized and a new system will be constructed, paralleling the existing system in Spectrum Center Boulevard, to convey runoff from the project. Based on the hydraulic analysis of the proposed storm drain system in Section 3, there will be pressure flow condition in the pipes however, water tight joints are specified on the construction documents and HGL will remain below ground in both the proposed public and private storm drain systems.

This project has honored the City's memorandum by satisfying the understandings stated in memorandum in Appendix A, Section 5.

2

SECTION 2

VICINITY MAP



VICINITY MAP
NO SCALE

3

SECTION 3

PROPOSED HYDROLOGY AND HYDRAULIC CALCULATIONS

CENTRUM 12

PROPOSED CONDITION

(Rational Method Procedure)

San Diego, CA

RUN:

BASIN INFORMATION							FOR REFERENCE ONLY
DRAINAGE BASIN	AREA ac.	RUNOFF COEFF	T_C min	C x A	I_{50} in/hr	Q_{50} cfs	
A	1.28	0.85	5.0	1.09	4.20	4.6	
B	14.01	0.85	12.4	11.91	3.00	35.7	
C	1.30	0.85	7.4	1.11	3.60	4.0	
D	5.56	0.85	8.5	4.73	3.40	16.1	
E	2.42	0.85	6.7	2.06	4.20	8.6	
F	0.31	0.85	5.0	0.26	4.20	1.1	
G	1.41	0.85	5.0	1.20	4.20	5.0	
H	0.02	0.85	5.0	0.02	4.20	0.1	

HYDROLOGY

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PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY JPB CHK
DATE 2/01/06

BASIN 'A' (Tc & RUNOFF CALS)

TRAVEL TIME FROM NODE 001 TO 002

L = 210 ft (OVERLAND SHEET FLOW)

S ≅ 1.0%

C = 0.85

$$T_1 = \frac{1.8(1.1 - C)\sqrt{L}}{S^{1/3}} = 3.9 \text{ MINUTES}$$

TRAVEL TIME FROM NODE 002 TO 003

L = 80 ft (EX. BROW DITCH)

S = 0.5%

$A_{(NODE\ 002)} = A/2 = 1.28/2 = 0.64$ AC

C = 0.85

$Tc_{(NODE\ 002)} = 3.9$ MINUTES ⇒ USE 5.0 MINUTES

$I_{50} = 4.2$ IN/HR

$Q_{50\ (NODE\ 002)} = C \times I_{50} \times A = 0.85 \times 3.6 \times 0.64 = 2.3$ cfs

$V_{(DITCH)} = 2.6$ fps

$T_2 = L/V = (100 \text{ ft} / 2.6 \text{ fps})(1 \text{ MIN.}/60 \text{ s}) = 0.6$ MINUTES

$Tc_{(BASIN\ 'A')} = T_1 + T_2 = 3.9 + 0.6 = 4.5$ MINUTES ⇒ USE 5.0 MINUTES

$I_{50} = 4.2$ IN/HR

C = 0.85

$A_{(BASIN\ 'A')} = 1.28$ AC.

$Q_{50\ (BASIN\ 'A'/NODE\ 003)} = C \times I_{50} \times A = \boxed{4.6 \text{ cfs}}$

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NODE 002 TO 003 (EXIST. BROW DITCH)
Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Slope	0.005000	ft/ft
Discharg	2.30	cfs

Options	
Current Roughness Methc	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficiei	0.019	
Water Surface Elev	0.93	ft
Elevation Range	.00 to 1.50	
Flow Area	0.9	ft²
Wetted Perimeter	2.64	ft
Top Width	1.87	ft
Actual Depth	0.93	ft
Critical Elevation	0.80	ft
Critical Slope	0.011331	ft/ft
Velocity	2.64	ft/s
Velocity Head	0.11	ft
Specific Energy	1.04	ft
Froude Number	0.68	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
-0+10	-0+01	0.035
-0+01	0+01	0.019
0+01	0+10	0.035

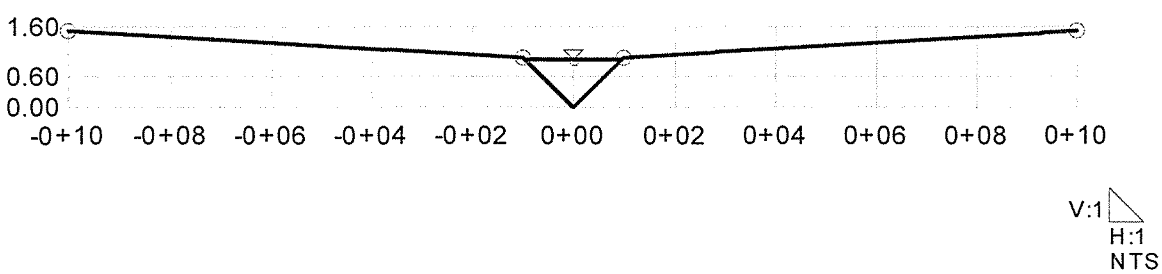
Natural Channel Points

Station (ft)	Elevation (ft)
-0+10	1.50
-0+01	1.00
0+00	0.00
0+01	1.00
0+10	1.50

Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Section Data		
Mannings Coefficiei	0.019	
Slope	0.005000	ft/ft
Water Surface Elev	0.93	ft
Elevation Range	.00 to 1.50	
Discharge	2.30	cfs



PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY JPB CHK
DATE 2/01/06

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BASIN 'B' (Tc & RUNOFF CALCS.)

$A = A_{B1} + A_{B2} + A_{B3} + A_{B4} + A_{B5} + A_{B6} = 12.36 + 0.18 + 0.15 + 0.22 + 0.17 + 0.93 = 14.01$ AC.
$C = 0.85$ (FULLY DEVELOPED)

TRAVEL TIME FROM NODE 006 TO 007
$L = 60$ ft (SHEET FLOW)
$S = 1.0\%$
$$T_1 = \frac{1.8(1.1-C)\sqrt{L}}{S^{1/3}} = 3.5 \text{ MINUTES}$$

TRAVEL TIME FROM NODE 007 TO 008
$L = 670$ ft (CONCENTRATED FLOW)
$S = 1.0\% \Rightarrow \Delta E = 6.7$ ft
$$T_2 = (11.9L^3/\Delta E)^{0.385} = 6.7 \text{ MINUTES}$$

TRAVEL TIME FROM NODE 008 TO 009
$L = 400$ ft (BROW DITCH)
$S = 1\%$
$A_{(NODE\ 008)} = 7.15$ AC.
$Tc_{(NODE\ 008)} = 3.5 + 6.7 = 10.2$ MINUTES
$I_{50(NODE\ 008)} = 3.2$ IN/HR
$C = 0.85$
$Q_{50(NODE\ 008)} = C \times I_{50(NODE\ 007)} \times A_{(NODE\ 007)} = \underline{19.5 \text{ cFs}}$
$V = 3.1$ fps
$T_3 = L/V = (400 \text{ ft}/3.1 \text{ fps})(1 \text{ min}/60 \text{ sec}) = 2.2$ MINUTES

SEE NEXT PAGE FOR CONTINUATION

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$T_c = T_1 + T_2 + T_3 = 3.5 + 6.7 + 2.2 = 12.4$ MINUTES

$I_{50\,(BASIN\ 'B')} = 3.0$ IN/HR

$A = 14.01$ AC

$Q_{50\,(BASIN\ 'B')} = C \times I_{50\,(BASIN\ 'B')} \times A = \boxed{35.7 \text{ CFS}}$

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NODE 008 TO 009 (BROW DITCH)
Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Slope	0.010000	ft/ft
Discharg	19.50	cfs

Options	
Current Roughness Methc	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.022	
Water Surface Elev	1.49	ft
Elevation Range	.00 to 1.50	
Flow Area	6.3	ft²
Wetted Perimeter	20.57	ft
Top Width	19.71	ft
Actual Depth	1.49	ft
Critical Elevation	1.48	ft
Critical Slope	0.011008	ft/ft
Velocity	3.08	ft/s
Velocity Head	0.15	ft
Specific Energy	1.64	ft
Froude Number	0.96	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
-0+10	-0+01	0.035
-0+01	0+01	0.019
0+01	0+10	0.035

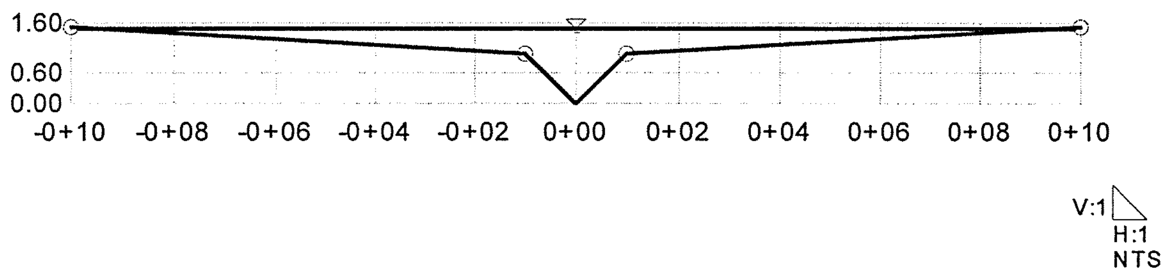
Natural Channel Points

Station (ft)	Elevation (ft)
-0+10	1.50
-0+01	1.00
0+00	0.00
0+01	1.00
0+10	1.50

Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Section Data		
Mannings Coefficiei	0.022	
Slope	0.010000	ft/ft
Water Surface Elev	1.49	ft
Elevation Range	.00 to 1.50	
Discharge	19.50	cfs



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BASIN 'C'

A = 1.30 AC.

* C = 0.85

TRAVEL TIME FROM NODE 010 TO 011 (OVERLAND SHEET FLOW)

L = 60 Ft

S = 1%

$$T_i = \frac{1.8(1.1 - C)\sqrt{L}}{S^{1/3}} = 3.5 \text{ MINUTES}$$

TRAVEL TIME FROM NODE 011 TO 012 (CONCENTRATED FLOW)

L = 320 Ft

S = 1% ⇒ ΔE = 3.2 Ft

$$T_F = \left(11.9\, L^3 / \Delta E\right)^{0.385} = 3.9 \text{ MINUTES}$$

$$T_C = T_i + T_F = 3.5 + 3.9 = \underline{7.4 \text{ MINUTES}}$$

$$I_{50} = 3.6 \text{ IN/HR}$$

$$Q_{50(A1)} = C \times I_{50} \times A = 0.85 \times 3.6 \times 1.28 = \boxed{4.0 \text{ cFs}}$$

* RUNOFF COEFFICIENT (C) OF 0.85 IS BASED UPON FULL DEVELOPMENT OF CENTRUM

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BASIN 'D'

SUB-BASIN 'D1': $A = 2.65$ AC.
$C = 0.85$

TRAVEL TIME FROM NODE 013 TO 014 (OVERLAND SHEET FLOW)
$L = 60$ Ft
$S = 1\%$
$T_i = \frac{1.8(1.1-C)\sqrt{L}}{S^{1/3}} = 3.5$ MINUTES

TRAVEL TIME FROM NODE 014 TO 015 (CONCENTRATED FLOW)
$L = 410$ Ft
$S = 1\% \Rightarrow \Delta E\ 4.1$ Ft
$T_F = (11.9\,L^3/\Delta E)^{0.385} = 4.7$ MINUTES

$T_C = 3.5 + 4.7 = 8.2$ MINUTES

$I_{50} = 3.5$ IN/HR

Q_{50} @ NODE 015 $= C \times I_{50} \times A = \boxed{7.9 \text{ cFS}}$

TRAVEL TIME FROM NODE 015 TO 016:
$L = 120$ Ft (18" RCP)
$S = 1.0\%$
$Q = 7.9$ cFS
$V = 6.5$ fps
$T = L/V = (120 \text{ Ft} / 6.5 \text{ fps})(1 \text{ MIN.} / 60 \text{ sec}) = 0.3$ MINUTES

$T_{C\,(BASIN\,'D')} = T_{C\,(NODE\ 015)} + T = 8.2 + 0.3 = 8.5$ MINUTES

$I_{50\,(BASIN\,'D')} = 3.4$ IN/HR

$\Sigma A_{(D2 \rightarrow D8)} = 2.91$ AC.

$Q_{50\,(NODE\ 015)} = Q_{50\,(BASIN\,'D')} = 7.9 \text{ cFS} + C \times \Sigma A_{(D2 \rightarrow D8)} \times 3.4 \text{ IN/HR} = \boxed{16.3 \text{ cFS}}$

(SEE PAGE 14 OF THIS SECTION FOR CONTINUATION OF HYDROLOGY CALCS. FOR PROPOSED STORM DRAIN IN SPECTRUM CENTER BLVD. & KEARNY VILLA RD.)

NODE 015 TO 016 (18" RCP)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

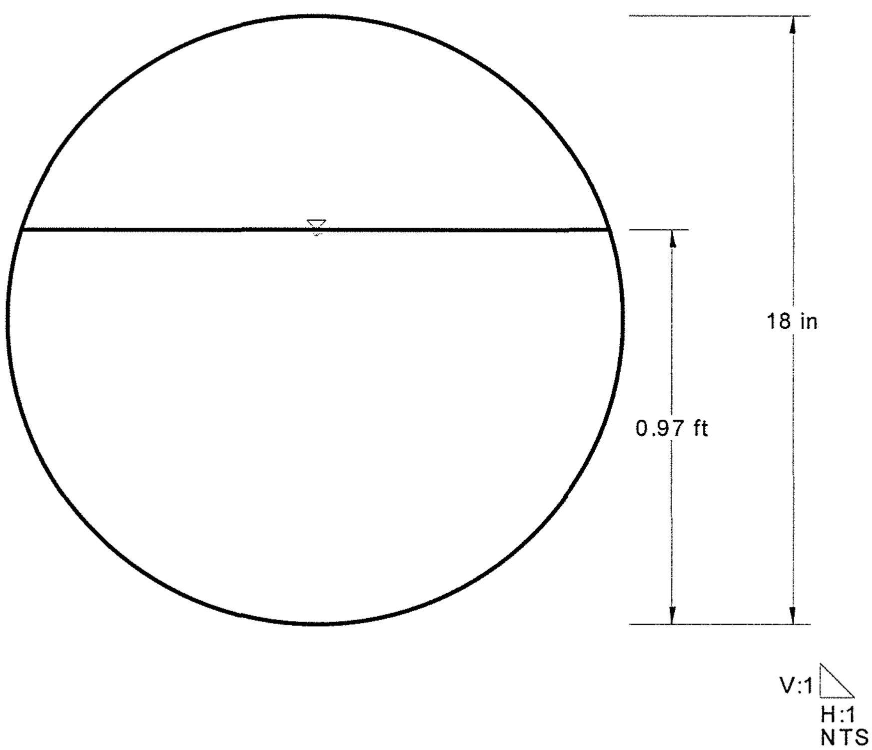
Input Data		
Mannings Coeffic	0.013	
Slope	0.010000	ft/ft
Diameter	18	in
Discharge	7.90	cfs

Results		
Depth	0.97	ft
Flow Area	1.2	ft²
Wetted Perime	2.81	ft
Top Width	1.43	ft
Critical Depth	1.09	ft
Percent Full	64.7	%
Critical Slope	0.007356	ft/ft
Velocity	6.53	ft/s
Velocity Head	0.66	ft
Specific Energ;	1.63	ft
Froude Numbe	1.25	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.005657	ft/ft
Flow Type	Supercritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	0.010000	ft/ft
Depth	0.97	ft
Diameter	18	in
Discharge	7.90	cfs



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BASIN 'E'

TRAVEL TIME FROM NODE 030 TO 031 (OVERLAND SHEET FLOW):

$$T_1 = 1.8(1-C)\sqrt{L} / S^{1/3} = 1.8(1-0.85)\sqrt{120'} / 2.9^{1/3}$$

$$T_1 = 2.1 \text{ MIN.}$$

NODE 031 TO 032 (GUTTER FLOW):

ASSUME $T_c = 5.0$ MIN.; $I_{50} = 4.2$ IN/HR

$A_{E4} = 0.29$ AC., $C = 0.85$

$Q_{50} = C \times I_{50} \times A_{E4} = \underline{1.0 \text{ cfs}}$

$S = 2\%$
$L = 130'$
$V = 2.8$ fps

$T_2 = L/V = (130 \text{ ft} / 2.8 \text{ fps})(1 \text{ min}/60 \text{ s}) = 0.8$ MIN.

NODE 032 TO 033 (PIPE FLOW)

$L = \pm 420'$

ASSUME $\Rightarrow$ $Q = C \times I_{50} \times A_{E4} = 0.85 \times 4.2 \times 0.29 = 1.0$ cfs

V_{PIPE} (12" PVC @ 0.5%) = 3.7 fps

$T_3 = (420 \text{ ft} / 3.7 \text{ fps})(1 \text{ min}/60 \text{ s}) = 1.9$ MIN.

$\Sigma T_c = 2.1 + 0.8 + 1.9 = 4.8$ MINUTES $\Rightarrow$ USE 5.0 MINUTES; $I_{50} = 4.2$ IN/HR

$Q_{50 \text{ (BASIN 'E')}} = C \times I_{50} \times \Sigma A_E = 0.85 \times 4.2 \text{ IN/HR} \times 2.42 \text{ AC.} = \boxed{8.6 \text{ cfs}}$

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BASIN 'F'

$A = A_{(F1)} + A_{(F2)} = 0.15 + 0.16 = 0.31$ AC.

$C = 0.85$

$T_c = 5.0$ MINUTES

$I_{50} = 4.2$ IN/HR

$Q_{50} = C \times I_{50} \times A = \boxed{1.1 \text{ cfs}}$

BASIN 'G'

$A = 1.41$ AC.

$C = 0.85$

$T_c = 5.0$ MINUTES

$I_{50} = 4.2$ IN/HR

$Q_{50} = C \times I_{50} \times A = \boxed{5.0 \text{ cfs}}$

BASIN 'H'

$A = 0.02$ AC.

$C = 0.85$

$T_c = 5.0$ MINUTES

$I_{50} = 4.2$ IN/HR

$Q_{50} = C \times I_{50} \times A = \boxed{0.1 \text{ cfs}}$

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CONTINUED FROM NODE 015, ON PAGE 9 OF THIS SECTION

TRAVEL TIME FROM NODE 016 TO 017 (24" RCP @ 0.5%)

Q_{50} = 16.3 cfs
L = 330 ft
V = 5.8 fps

T = L/V = (330 ft / 5.8 fps)(1 min./60s) = 1.0 MINUTE

$\Sigma T_{c\,(NODE\ 017)} = T_{c\,(BASIN\ D)} + T = 8.5 + 1.0 = 9.5$ MINUTES

$I_{50\,(NODE\ 017)} = 3.3$ IN/HR

$Q_{50\,(NODE\ 017)} = 16.3$ cfs $+ C \times I_{50\,(NODE\ 017)} \times A_{(BASIN\ H)}$

= 16.3 cfs + 0.85 x 3.3 IN/HR x 0.02 AC

= $\boxed{16.4 \text{ cfs}}$

TRAVEL TIME FROM NODE 017 TO 018 (24" RCP @ 0.5%)

L = 235 ft, Q = 16.4 cfs
V = 5.8 fps
T = L/V = (235 ft / 5.8 fps)(1 min./60s) = 0.7 MINUTES

$\Sigma T_{c\,(NODE\ 018)} = T_{c\,(NODE\ 017)} + T = 9.5 + 0.7 = 10.2$ MINUTES

$I_{50\,(NODE\ 018)} = 3.3$ IN/HR

(INTERIM, EXCLUDING BASIN 'G') → $Q_{50\,(NODE\ 018)} = 16.4$ cfs $+ C \times I_{50\,(NODE\ 018)} \times A_{(BASIN\ E)}$
= 16.4 cfs + 0.85 x 3.3 IN/HR x 2.42 AC.
= $\boxed{23.2 \text{ cfs}}$ — INTERIM CONDITION (W/O BASIN 'G')

(FINAL, INCLUDING BASIN 'G') $Q_{50\,(NODE\ 018)} = 16.4 + C \times I_{50\,(NODE\ 018)} \times (A_{(BASIN\ E)} + A_{(BASIN\ G)})$
= 16.4 + 0.85 x 3.3 x (2.42 + 1.41)
= $\boxed{27.1 \text{ cfs}}$ — FINAL CONDITION (W/ BASIN 'G')

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NODE 016 TO 017 (24" RCP @ 0.5%)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

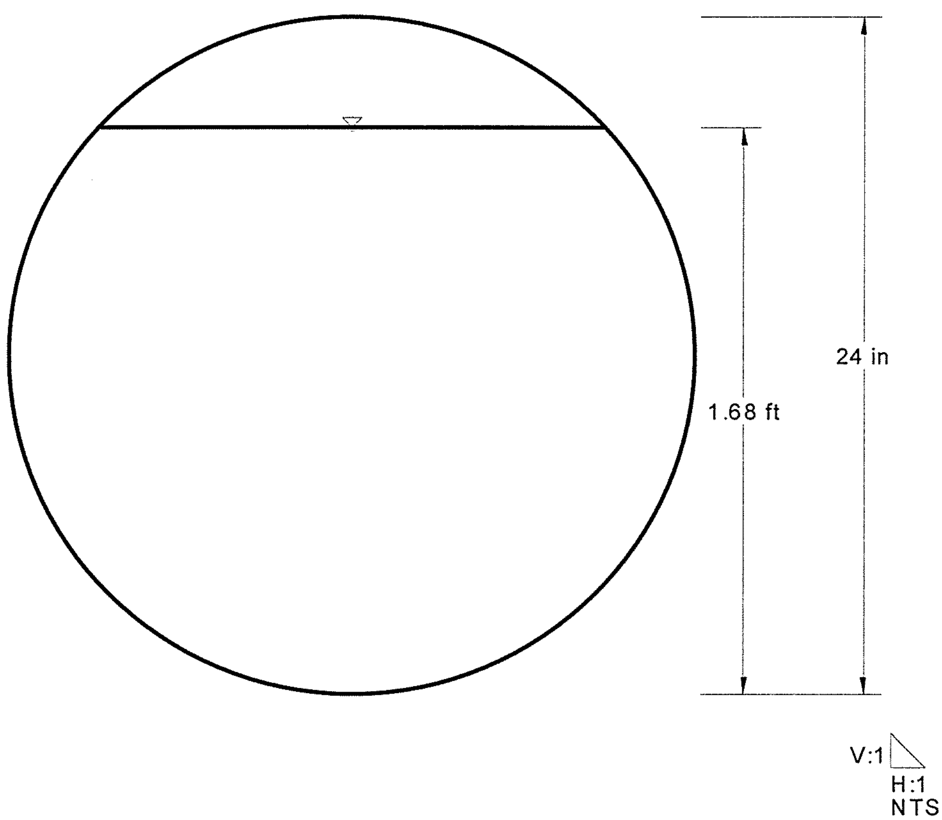
Input Data		
Mannings Coeffic	0.013	
Slope	0.005000	ft/ft
Diameter	24	in
Discharge	16.30	cfs

Results		
Depth	1.68	ft
Flow Area	2.8	ft²
Wetted Perime	4.63	ft
Top Width	1.47	ft
Critical Depth	1.46	ft
Percent Full	83.8	%
Critical Slope	0.006710	ft/ft
Velocity	5.80	ft/s
Velocity Head	0.52	ft
Specific Energ	2.20	ft
Froude Numbe	0.74	
Maximum Disc	17.21	cfs
Discharge Full	16.00	cfs
Slope Full	0.005192	ft/ft
Flow Type	Subcritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	0.005000	ft/ft
Depth	1.68	ft
Diameter	24	in
Discharge	16.30	cfs



NODE 017 TO 018 (24" RCP @ 0.5%)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

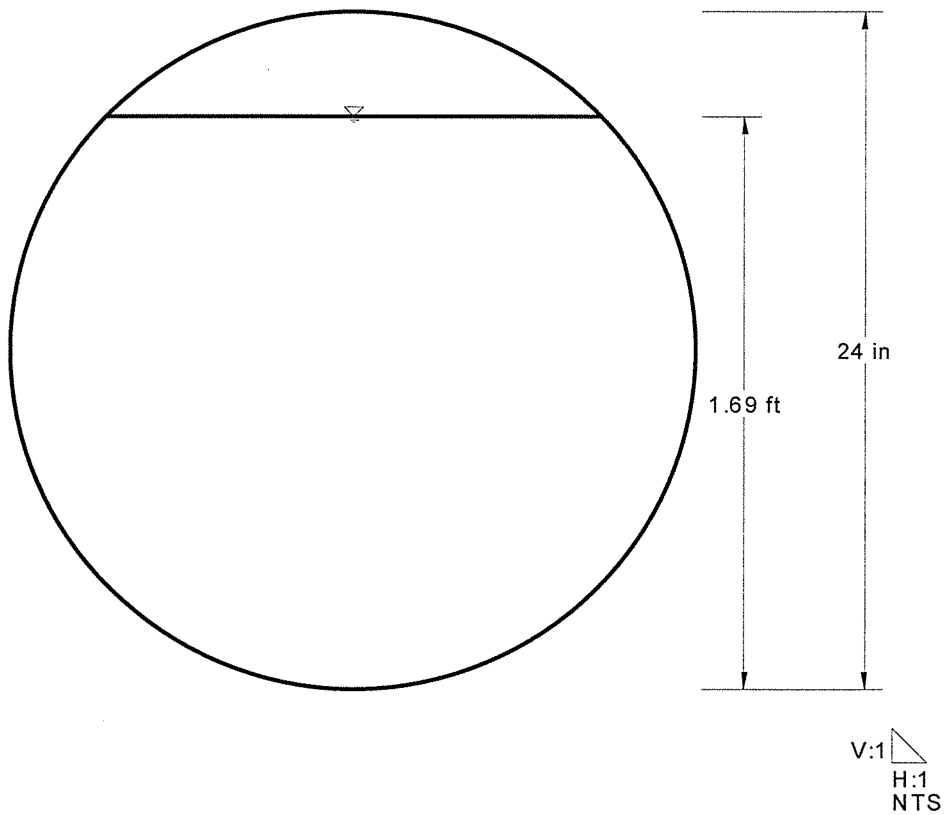
Input Data		
Mannings Coeffic	0.013	
Slope	0.005000	ft/ft
Diameter	24	in
Discharge	16.40	cfs

Results		
Depth	1.69	ft
Flow Area	2.8	ft²
Wetted Perime	4.66	ft
Top Width	1.45	ft
Critical Depth	1.46	ft
Percent Full	84.4	%
Critical Slope	0.006742	ft/ft
Velocity	5.80	ft/s
Velocity Head	0.52	ft
Specific Energ	2.21	ft
Froude Numbe	0.73	
Maximum Disc	17.21	cfs
Discharge Full	16.00	cfs
Slope Full	0.005256	ft/ft
Flow Type	Subcritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	0.005000	ft/ft
Depth	1.69	ft
Diameter	24	in
Discharge	16.40	cfs



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TRAVEL TIME FROM 018 TO 019 (24" RCP @ 0.5%) - PRESSURE FLOW

Q_{50} = 27.1 cfs (UTIMATE)
L = 112 ft

$V = Q/A = 27.1 \text{ cfs} / 3.14 \text{ ft}^2 = 8.6 \text{ fps}$

$T = L/V = (112 \text{ ft} / 8.6 \text{ fps})(1 \text{ min.} / 60 \text{s}) = 0.2$ MINUTES

$\sum T_{c\,(NODE\ 019)} = T_{c\,(NODE\ 018)} + T = 10.2 + 0.2 = 10.4$ MINUTES

$I_{50\,(NODE\ 019)} = 3.2$ IN/HR

$Q_{50\,(NODE\ 019)} = 27.1 \text{ cfs} + \left(C_{(F)} \times A_{(F)} + C_{(OS7)} \times A_{(OS7)}\right) \times I_{50\,(NODE\ 019)}$

$= 27.1 \text{ cfs} + (0.85 \times 0.31 + 0.95 \times 2.57)\ 3.2$

$= \boxed{35.8 \text{ cfs}}$

TRAVEL TIME FROM 019 TO 020 (36" RCP @ 0.7%)

L = 99 ft , Q_{50} = 35.8 cfs
V = 7.9 fps

$T = L/V = (99 \text{ ft} / 7.9 \text{ fps})(1 \text{ min.} / 60 \text{s}) = 0.2$ MINUTES

$\sum T_{c\,(NODE\ 020)} = T_{c\,(NODE\ 019)} + T = 10.4 + 0.2 = 10.6$ MINUTES

$I_{50\,(NODE\ 020)} = 3.2$ IN/HR

$Q_{50\,(NODE\ 020)} = 35.8 \text{ cfs} + [C_{(OS1)} \times A_{(OS1)} + C_{(OS2)} \times A_{(OS2)} + C_{(OS3)} \times A_{(OS3)} + C_{(OS4)} \times A_{(OS4)} + C_{(OS5)} \times A_{(OS5)} + C_{(OS6)} \times A_{(OS6)}] \times I_{50}$

$= 35.8 + (0.95 \times 1.05 + 0.95 \times 1.05 + 0.85 \times 2.19 + 0.85 \times 1.00 + 0.85 \times 2.33 + 0.95 \times 1.29)\ 3.2$ IN/HR

$= \boxed{61.1 \text{ cfs}}$

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NODE 019 TO 020 (30" RCP @ 0.7%)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

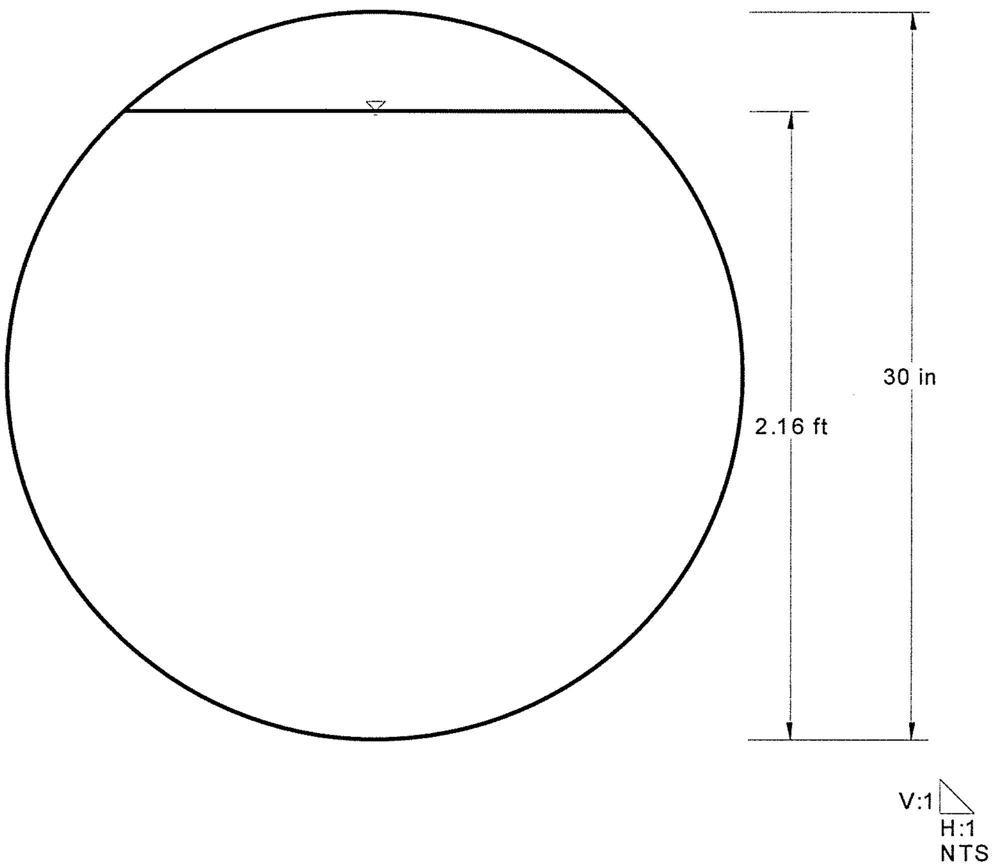
Input Data		
Mannings Coeffic	0.013	
Slope	007000	ft/ft
Diameter	30	in
Discharge	35.80	cfs

Results		
Depth	2.16	ft
Flow Area	4.5	ft²
Wetted Perime	5.97	ft
Top Width	1.71	ft
Critical Depth	2.03	ft
Percent Full	86.5	%
Critical Slope	0.007750	ft/ft
Velocity	7.93	ft/s
Velocity Head	0.98	ft
Specific Energ:	3.14	ft
Froude Numbe	0.86	
Maximum Disc	36.91	cfs
Discharge Full	34.32	cfs
Slope Full	0.007619	ft/ft
Flow Type	Subcritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	007000	ft/ft
Depth	2.16	ft
Diameter	30	in
Discharge	35.80	cfs



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TRAVEL TIME FROM NODE 020 TO 021 (36" RCP @ 0.78%)

$Q = 61.1$ cfs

$V = 9.5$ fps

$L = 100$ ft

$T = L/V = (100 \text{ ft} / 9.5 \text{ fps})(1 \text{ min.} / 60\text{s}) = 0.2$ MINUTES

$\Sigma Tc_{(NODE\ 021)} = Tc_{(NODE\ 020)} + T = 10.7 + 0.2 = 10.8$ MINUTES

$I_{50\,(NODE\ 021)} = 3.1$ IN/HR

$Q_{50\,(NODE\ 021)} = 61.1 \text{ cfs} + C_{(0510)} * A_{(0510)} \times I_{50}$

$= 61.1 \text{ cfs} + 0.90 \times 2.20 \times 3.1$

$= \boxed{67.2 \text{ cfs}}$

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NODE 020 TO 021 (36" RCP @ 0.78%)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	007800	ft/ft
Diameter	36	in
Discharge	61.10	cfs

Results		
Depth	2.57	ft
Flow Area	6.5	ft²
Wetted Perime	7.11	ft
Top Width	2.10	ft
Critical Depth	2.52	ft
Percent Full	85.8	%
Critical Slope	0.008043	ft/ft
Velocity	9.47	ft/s
Velocity Head	1.39	ft
Specific Energ:	3.97	ft
Froude Numbe	0.95	
Maximum Disc	63.36	cfs
Discharge Full	58.90	cfs
Slope Full	0.008393	ft/ft
Flow Type	Subcritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	007800	ft/ft
Depth	2.57	ft
Diameter	36	in
Discharge	61.10	cfs

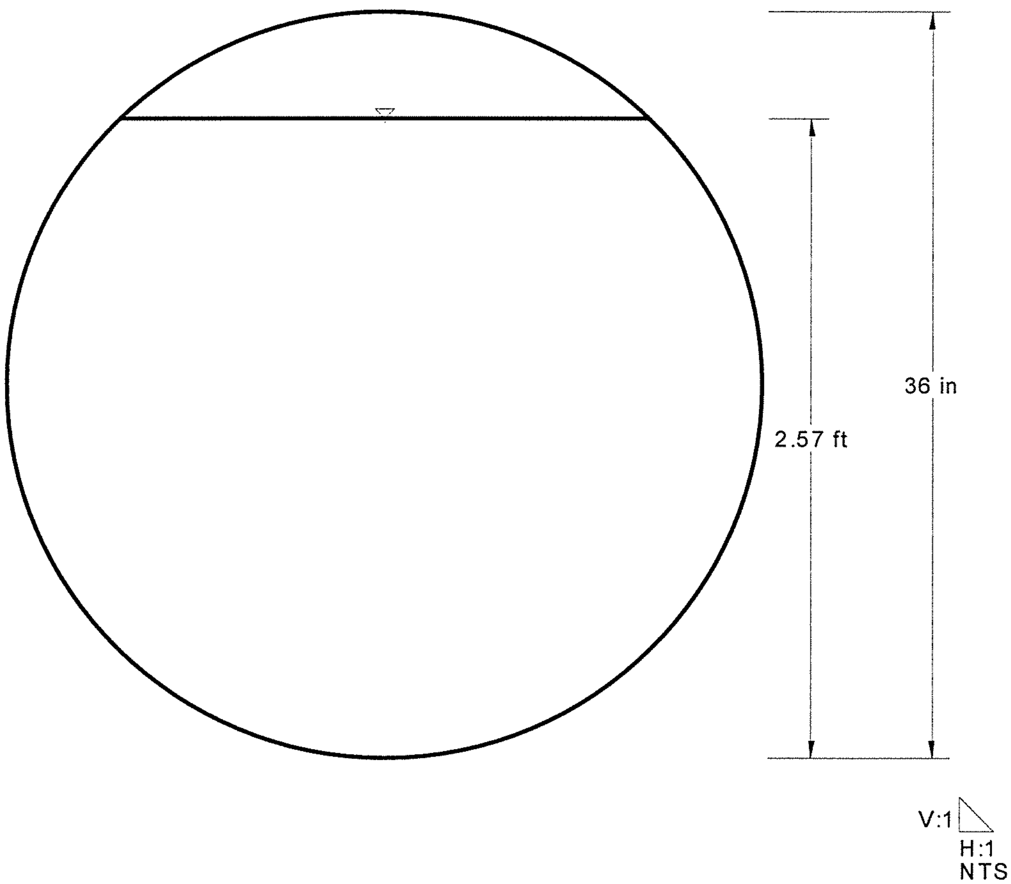


TABLE 2

RUNOFF COEFFICIENTS (RATIONAL METHOD)

DEVELOPED AREAS (URBAN)

Land Use	Coefficient, C Soil Type (1)
Residential:	D
Single Family	.55
Multi-Units	.70
Mobile Homes	.65
Rural (lots greater than 1/2 acre)	.45
Commercial (2) 80% Impervious	.85
Industrial (2) 90% Impervious	.95

NOTES:

(1) Type D soil to be used for all areas.

(2) Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in no case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness = 50%

Tabulated imperviousness = 80%

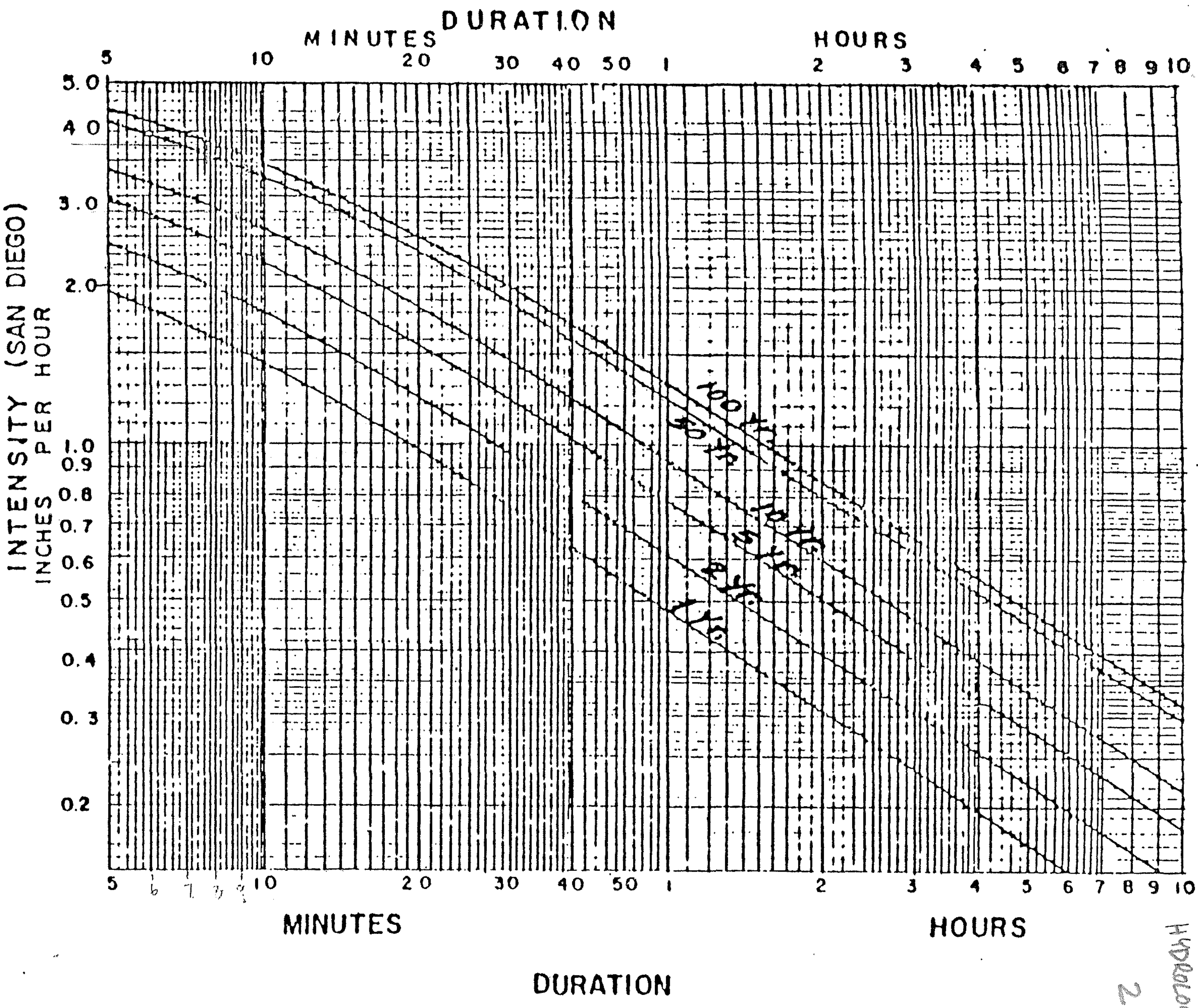
$$\text{Revised C} = \frac{50}{80} \times 0.85 = 0.53$$

RAINFALL INTENSITY - DURATION - FREQUENC[Y] CURVES for COUNTY OF SAN DIEGO

APPENDIX I

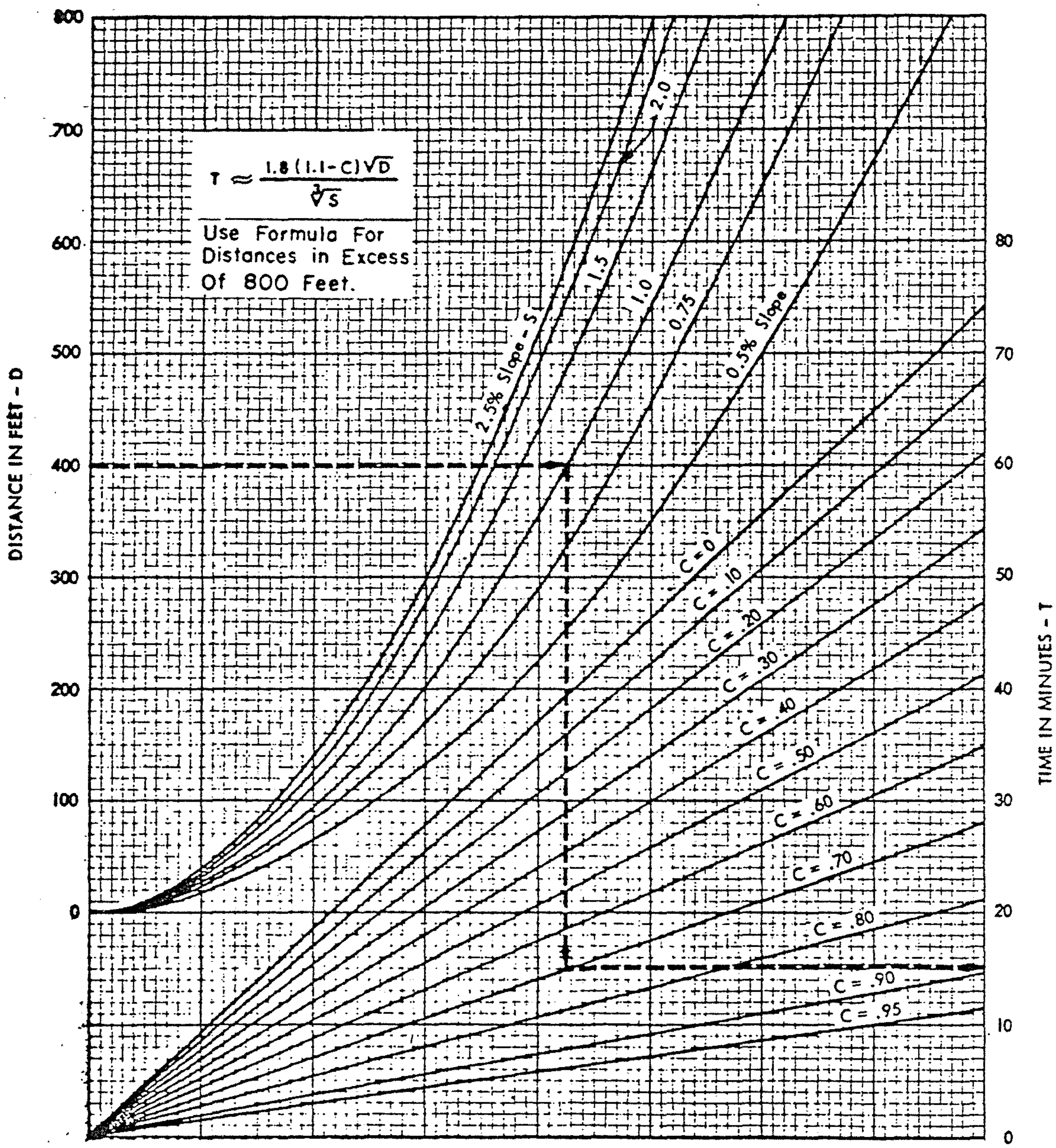
ELEV.	FACTOR
0–1500	1.00
1500–3000	1.25
3000–4000	1.42
4000–5000	1.60
5000–6000	1.70
DESERT	1.25

To obtain correct intensity, multiply intensity on chart by factor for design elevation.



HYDROLOGY REF.
2 OF 5

URBAN AREAS OVERLAND TIME OF FLOW CURVES



Surface Flow Time Curves

EXAMPLE:

GIVEN: LENGTH OF FLOW = 400 FT.
SLOPE = 1.0 %
COEFFICIENT OF RUNOFF C = .70

READ: OVERLAND FLOWTIME = 15 MINUTES

HYDROLOGY REF. 4 OF 5

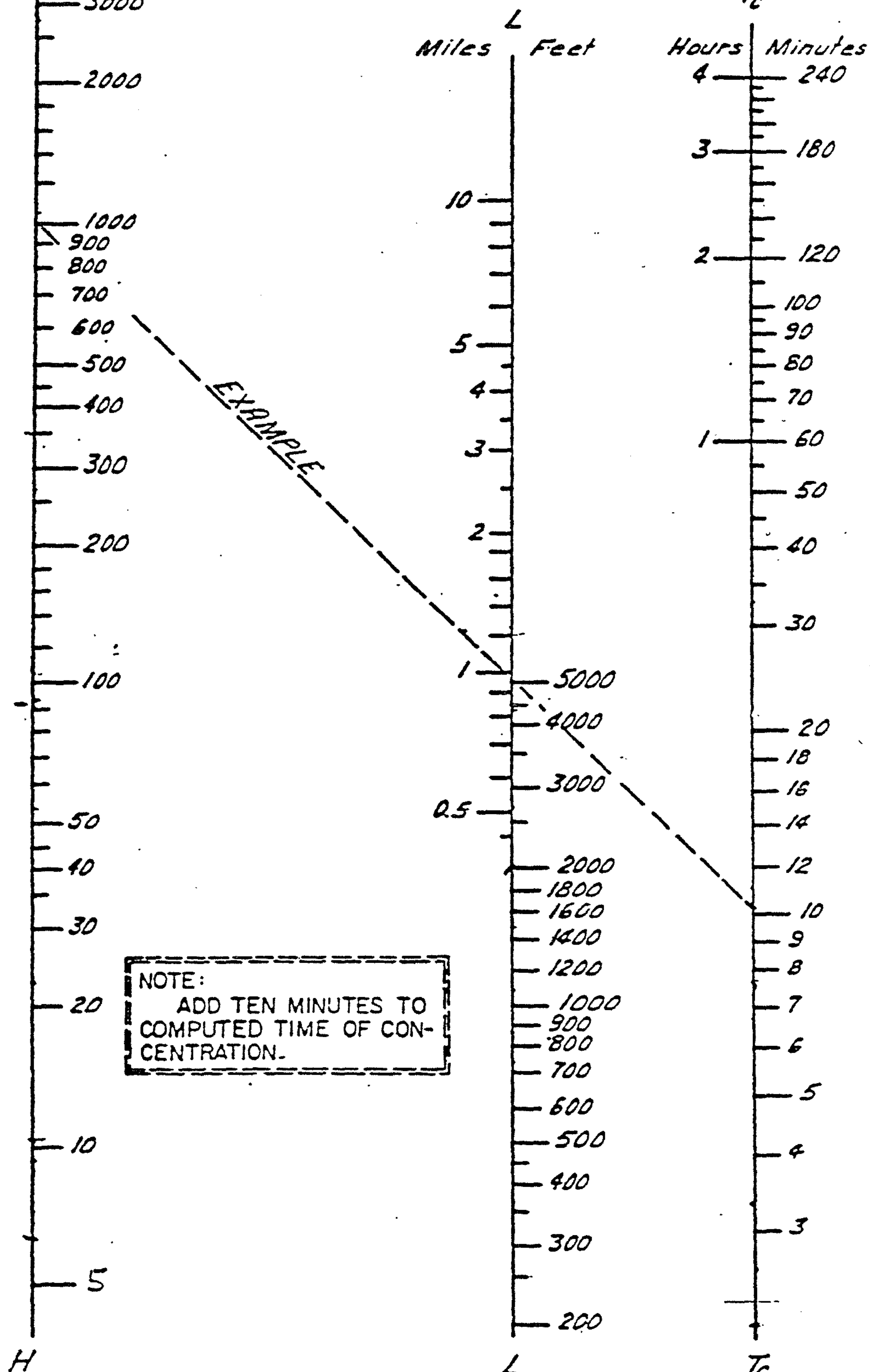
EQUATION

$$T_c = \left(\frac{11.9 L^3}{H}\right)^{.385}$$

T_c = Time of concentration (HOURS)

L = Length of watershed (MILES)

H = Difference in elevation along effective slope line (See Appendix X-B)



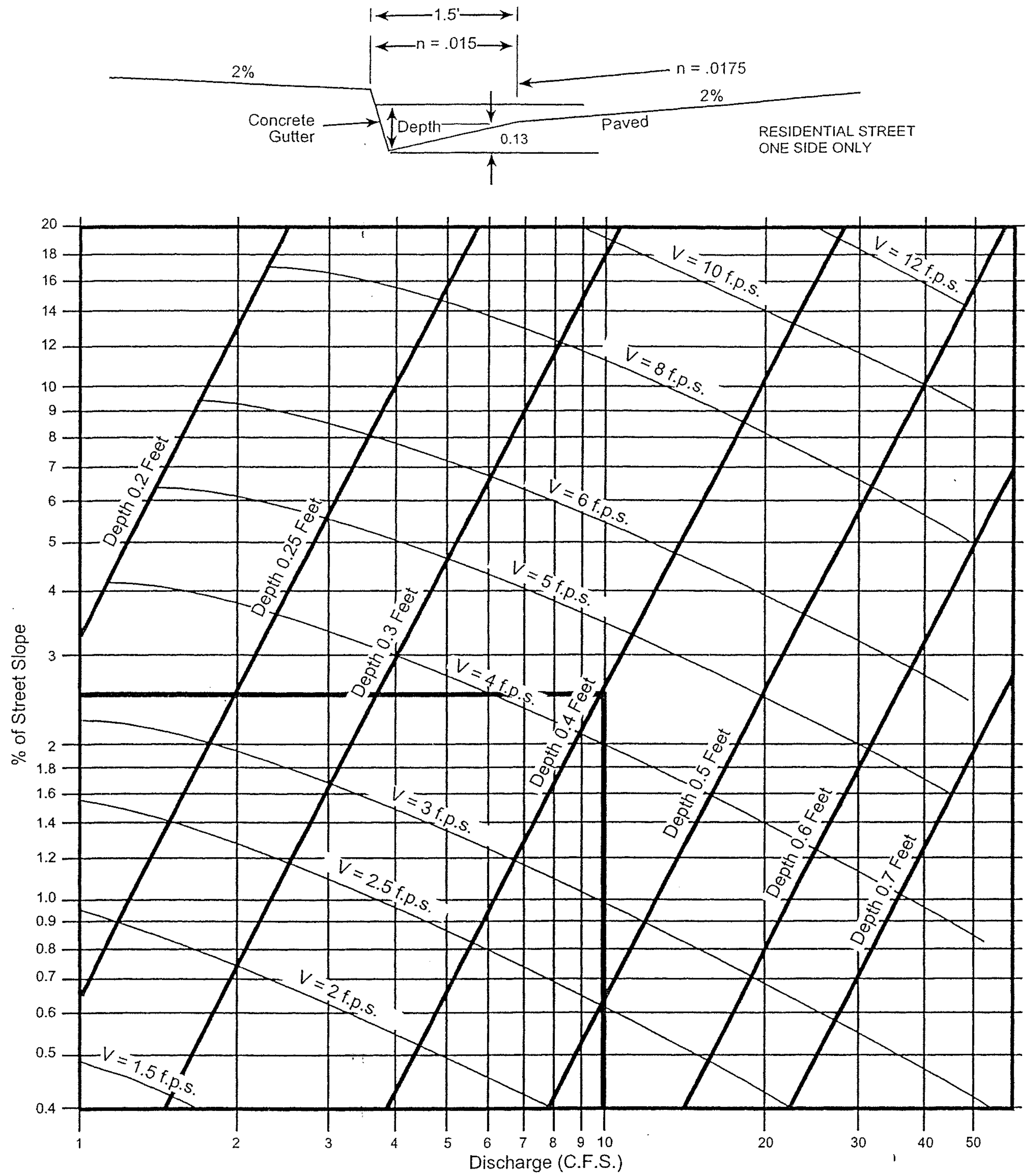
SAN DIEGO COUNTY
DEPARTMENT OF SPECIAL DISTRICT SERVICES
DESIGN MANUAL

APPROVED ____________

NOMOGRAPH FOR DETERMINATION OF TIME OF CONCENTRATION (T_c) FOR NATURAL WATERSHEDS

DATE ____________

APPENDIX



EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE **3-6**

Gutter and Roadway Discharge - Velocity Chart

PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY JPB CHK
DATE 2/01/06

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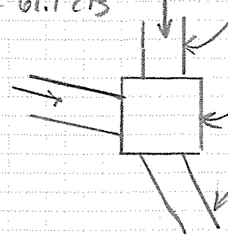
HYDRAULIC ANALYSIS

(PROPOSED STORM DRAIN IN KEARNY VILLA RD. & SPECTRUM CENTER BLVD.)

NODE 021

PROP. 36" RCP @ 0.78%
$Q_{50(IN)} = 61.1$ cfs

EXISTING 30" RCP @ 1%
$Q_{50(IN)} = 6.1$ cfs



EX. AS C.O. ~402.1 FL

EXIST. 48" RCP @ 0.9% (OPEN CHANNEL)
$Q_{50(OUT)} = 67.2$ cfs

36" RCP (IN):
$Q_{50} = 61.1$ cfs
$S = 0.84\%$
$V = 9.9$ fps
$k = 0.1(b/D_o)(1 - \sin\theta) + 1.4(b/D_o)^{0.15}$ $\quad \sin\theta = 0.97$
$H_L = kV^2/2g = 1.5$ ft

30" RCP (IN):
$Q_{50} = 6.1$ cfs
$S = 1\%$
$V = 6.0$ fps
$K = 0.13$
$H_L = kV^2/2g = 0.1$ ft

$WSE_{(NODE\ 022)} = 402.1 + 1.5 + 0.1 + 2.0 = \boxed{405.7}$

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NODE 021 (36" RCP IN)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

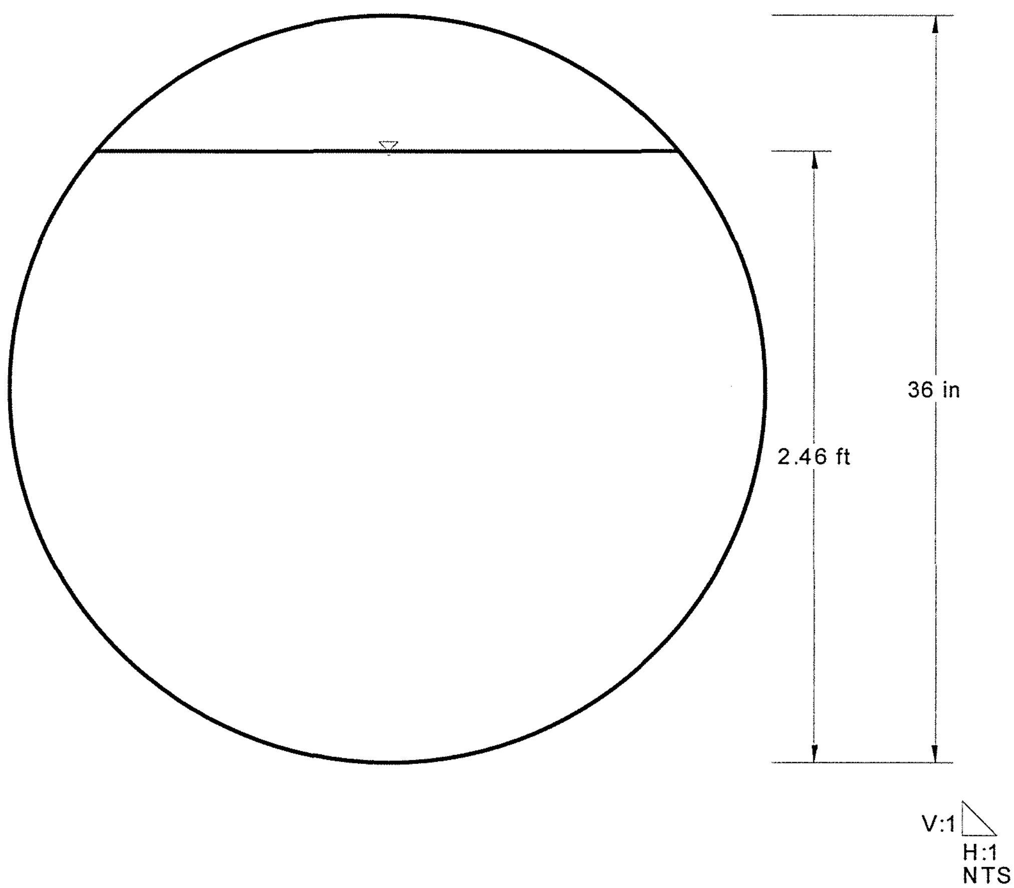
Input Data		
Mannings Coeffic	0.013	
Slope	0.008400	ft/ft
Diameter	36	in
Discharge	61.10	cfs

Results		
Depth	2.46	ft
Flow Area	6.2	ft²
Wetted Perime	6.79	ft
Top Width	2.31	ft
Critical Depth	2.52	ft
Percent Full	81.9	%
Critical Slope	0.008043	ft/ft
Velocity	9.86	ft/s
Velocity Head	1.51	ft
Specific Energ:	3.97	ft
Froude Numbe	1.06	
Maximum Disc	65.75	cfs
Discharge Full	61.13	cfs
Slope Full	0.008393	ft/ft
Flow Type	Supercritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	0.008400	ft/ft
Depth	2.46	ft
Diameter	36	in
Discharge	61.10	cfs



NODE 021 ~ 48" RCP (OUT)
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

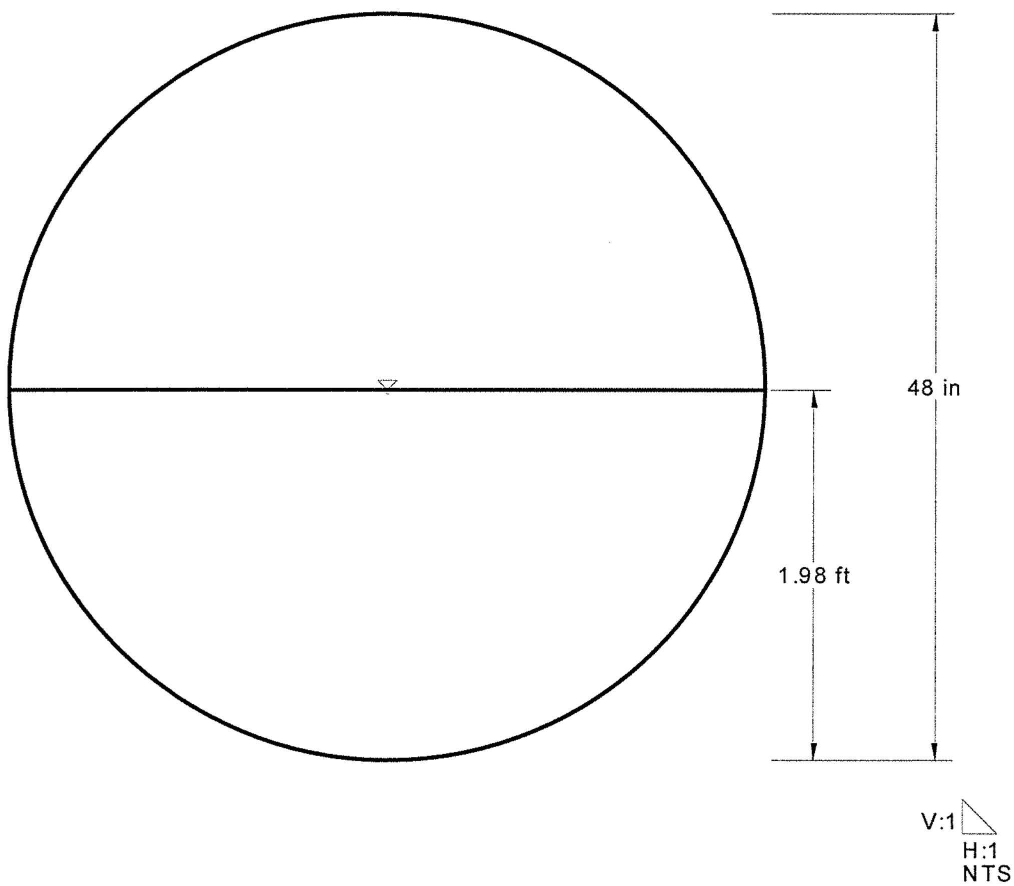
Input Data		
Mannings Coeffic	0.013	
Slope	0.009000	ft/ft
Diameter	48	in
Discharge	67.20	cfs

Results		
Depth	1.98	ft
Flow Area	6.2	ft^2
Wetted Perime	6.25	ft
Top Width	4.00	ft
Critical Depth	2.48	ft
Percent Full	49.6	%
Critical Slope	0.004412	ft/ft
Velocity	10.81	ft/s
Velocity Head	1.81	ft
Specific Energ:	3.80	ft
Froude Numbe	1.53	
Maximum Disc	146.58	cfs
Discharge Full	136.26	cfs
Slope Full	0.002189	ft/ft
Flow Type	Supercritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.013	
Slope	0.009000	ft/ft
Depth	1.98	ft
Diameter	48	in
Discharge	67.20	cfs



PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY JAB CHK
DATE 2/01/06

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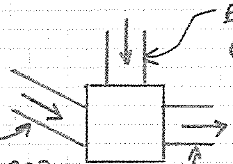
NODE 020: (PROP. A5 CLEANOUT)

EXISTING 30" RCP @ 1.3%
$Q_{50(IN)} = 25.3$ cfs



PROP. 30" RCP
$Q_{50(IN)} = 35.8$ cfs
$S = 0.7\%$
$S_f = 0.8\%$

PROP. 36" RCP @ 0.84%
$Q_{50(OUT)} = 61.1$ cfs

EXIST. 30" RCP (IN): $Q_{50} = 25.3$ cfs (SUBMERGED/PRESSURE)

$S = 1.3\%$

$V = Q/A = 25.3/4.91 = 5.2$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(5/3)(1-\sin 90) + 1.4(5/3)^{0.15}\sin 90$

$= 1.51$

$H_L = K\,V^2/2g = 0.6$ ft

PROP. 30" RCP (IN): $Q_{50} = 35.8$ cfs (SUBMERGED/PRESSURE)

$S = 0.7\%$, $S_f = 0.8\%$

$V = Q/A = 35.8/4.91 = 7.3$ fps

$K = 0.1(5/3)(1-\sin 55) + 1.4(5/3)^{0.15}\sin 55$

$= 1.3$

$H_L = K\,V^2/2g = 1.1$ ft

$WSE_{(NODE\ 020)} = 405.7 + 0.6 + 1.1 = \boxed{407.4}$

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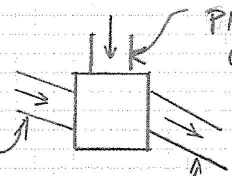
CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS	PROJECT NO. 00018.14
	PROJECT CENTRUM 12
	BY JPB CHK
	DATE 2/01/06

NODE 019 : (PROP. AS CLEANOUT)

PROP. 30" RCP @ 0.5%
$Q_{50\,(IN)} = 27.1$ cfs



EXIST. 24" RCP
@ 0.9%
$Q_{50\,(IN)} = 8.7$ cfs

PROP. 30" RCP @ 0.7%
$Q_{50\,(OUT)} = 35.8$ cfs

PROP. 30" RCP (IN):

$Q_{50} = 27.1$ cfs (SUBMERGED/PRESSURE)

$S = 0.5\%$,

$V = Q/A = 27.1/4.91 = 5.5$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(5.0/3)(1-\sin 55) + 1.4(5.0/3)^{0.15}\sin 55$

$= 1.27$

$H_L = K\,V^2/2g = 0.6$ ft

EXIST. 24" RCP (IN):

$Q_{50} = 8.7$ cfs (SUBMERGED/PRESSURE)

$S = 0.9\%$

$V = Q/A = 8.7/3.14 = 2.8$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(5/3)(1-\sin 0) + 1.4(5/3)^{0.15}\sin 0$

$= 0.17$

$H_L = K\,V^2/2g = 0.02 \rightarrow$ SAY 0

PROP. 30" RCP (OUT) :

$Q_{50} = 35.8$ cfs

$S_f = ((Q \times n)/(0.46\,D^{8/3}))^2 = 0.08$

$WSE_{(NODE\ 019)} = 407.4 + 0.6 + \underbrace{0.1}_{S_F} = \boxed{408.1}$

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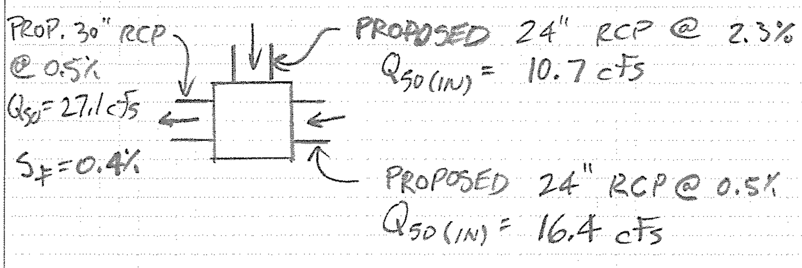
NODE 018: (PROP. A4 CLEANOUT)



PROP. 24" RCP (IN): $Q_{50} = 10.7$ cfs (SUBMERGED/PRESSURE)

$S = 2.3\%$

$V = Q/A = 10.7/3.14 = 3.4$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(4.5/2.5)(1-\sin 90) + 1.4(4.5/2.5)^{0.15}\sin 90$

$= 1.53$

$H_L = KV^2/2g = 0.33$ ft

PROP. 24" RCP (IN): $Q_{50} = 16.4$ cfs (SUBMERGED/PRESSURE)

$S = 0.5\%$,

$V = Q/A = 16.4/3.14 = 5.2$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(4.5/2.5)(1-\sin 0) + 1.4(4.5/2.5)^{0.15}\sin 0$

$= 0.18$

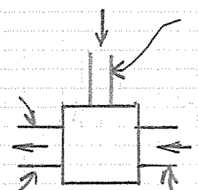
$H_L = K\,V^2/2g = 0.1$ ft

$WSE = 408.1 + 0.3 + 0.1 = \boxed{408.5}$

NODE 017: (PROP. A4 CLEANOUT)

PROPOSED 6" PVC @ 13.1%
$Q_{50} = 0.1$ cfs

$S = S_F$



PROPOSED 24" RCP @ 0.5%
$Q_{50\,(IN)} = 16.3$ cfs

PROP. 24" RCP
@ 0.5%
$Q_{50\,(OUT)} = 16.4$ cfs

PROP. 24" RCP (IN): $Q_{50} = 16.3$ cfs (SUBMERGED/PRESSURE)

$S = 0.5\%$

$V = Q/A = 16.3/3.14 = 5.2$ fps

$K = 0.1(b/D_o)(1-\sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(4.5/2)(1-\sin 0) + 1.4(4.5/2)^{0.15}\sin 0$

$= 0.23$

$H_L = KV^2/2g = 0.1$ Ft

$WSE_{(NODE\ 017)} = 408.5 + 0.1 = \boxed{408.6}$

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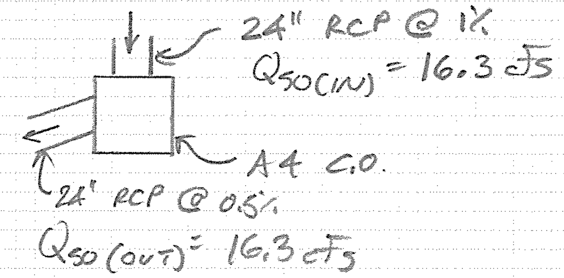
NODE 016:



24" RCP (IN): $Q_{50(IN)} = 16.3$ cfs (OPEN CHANNEL)

$S = 1.0\%$

$V = 7.8$ cfs

$$K = 0.1(b/D_o)(1 - \sin\theta) + 1.4(b/D_o)^{0.15} \sin\theta$$

$$= 0.1(4.5/2)(1 - \sin 61) + 1.4(4.5/2)^{0.15} \sin 61$$

$$= 1.41$$

$$H_L = K V^2/2g = 1.3 \text{ Ft}$$

$$WSE_{(NODE\ 016)} = 409.1 + 1.3 = \boxed{410.4}$$

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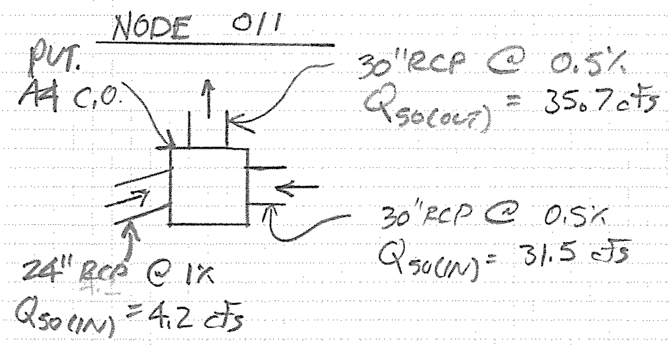
PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY JPB CHK
DATE 2/01/06

HYDRAULIC ANALYSIS
(PROPOSED PVT. 30" RCP LATERAL IN LIGHTWAVE AVENUE)



30" RCP (OUT): $Q_{50} = 35.7$ cfs

$S = 0.5\%$

$S_f = \left[(Q \times n)/(0.46\,D^{8/3})\right]^2$

$= 0.7\%$

$H_{L(Sf)} = (S_f - S_o)L$

$= (0.007 - 0.005)\,114$

$= \boxed{0.2\text{ Ft}}$

30" RCP (IN): $Q_{50} = 31.5$ cfs (FULL/PRESSURE)

$S = 0.5\%$

$V = Q/A = 31.5/4.91 = 6.4$ fps

$K = 0.1(b/D_o)(1 - \sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta =$

$= 0.1(4.5/2.5)(1 - \sin 90) + 1.4(4.5/2.5)^{0.15}\sin 90$

$= 1.53$

$H_L = k\,V^2/2g = \boxed{1.0\text{ Ft}}$

24" RCP (IN): $Q_{50} = 4.2$ cfs (FULL/PRESSURE)

$S = 0.5\%$

$V = Q/A = 4.1/3.14 = 1.3$ fps

$K = 0.1(b/D_o)(1 - \sin\theta) + 1.4(b/D_o)^{0.15}\sin\theta$

$= 0.1(4.5/2.5)(1 - \sin 38) + 1.4(4.5/2.5)^{0.15}\sin 38$

$= 1.01$

$H_L = KV^2/2g = \boxed{0.02\text{ Ft}} \rightarrow$ SAY 0.1 Ft

$\Sigma H_L = 0.2 + 1.0 + 0.1 = \boxed{1.3\text{ Ft}}$

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v_2 = outflow velocity (ft/s); and
g = gravitational acceleration (32.2 ft/s^2).

Basic Structure Loss Coefficient (K_o)

The initial or basic loss at a clean-out structure is defined as:

$$K_O = 0.1\left(\frac{b}{D_O}\right)(1-\sin\theta)+1.4\left(\frac{b}{D_O}\right)^{0.15}\sin\theta \qquad (3\text{-}20)$$

where ...

K_O = initial or basic loss coefficient;
b = drainage structure diameter or equivalent diameter (ft);
D_o = outflow pipe diameter (ft); and
θ = deflection angle.

This basic equation is valid only when the water level in the receiving inlet, junction, or cleanout is above the invert of the incoming pipe. In cases where this is not true, the structure losses are assumed to be zero. For non-circular drainage structures, the equivalent structure diameter is defined as the diameter of a circular structure having the equivalent area of the actual non-circular one. Table 3-8 and Figure 3-7 (page 3-25) present basic head loss for standard clean-outs in the San Diego region.

Table 3-8 Equivalent Diameters for San Diego Regional Standard Cleanouts

SDRSD Standard Cleanout	Length (ft)	Width (ft)	Area (ft^2)	Equivalent Diameter b (ft)
A-4	4	4	16	4.5
A-5	5	4	20	5.0
A-6	6	4	24	5.5
A-7	7	4	28	6.0
A-8	8	4	32	6.4

Relative Pipe Diameter and Flow Depth Correction Factor (C_D)

Equation 3-21 describes the correction factor that accounts for the relative pipe diameter and flow depth within a drainage structure. The relative flow depth correction factor depends on the depth of flow within the structure, which in this case is measured relative to the crown of the outlet pipe. When the flow depth in the structure above the crown of the outlet pipe (d_{out}-D_o) is much higher relative to the outlet pipe diameter (D_o) (i.e., there is submerged flow or a high-pressure condition), the correction factor is based on the relative diameters of the inflow and outflow pipes. In cases where the relative flow depth is lower, or not significantly larger than the diameter of the outlet pipe, the correction factor is a function of the flow depth relative depth to the outlet pipe diameter. For practical purposes, the correction factor for relative pipe diameter and flow depth need not be greater than C_D=3.0.

6" PVC
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.010
Diameter	6 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	0.52	0.50	2.63	0.2	1.57	0.00
C.010000	0.73	0.50	3.71	0.2	1.57	0.00
C.015000	0.89	0.50	4.55	0.2	1.57	0.00
C.020000	1.03	0.50	5.25	0.2	1.57	0.00
C.025000	1.15	0.50	5.87	0.2	1.57	0.00
C.030000	1.26	0.50	6.43	0.2	1.57	0.00
C.035000	1.36	0.50	6.95	0.2	1.57	0.00
C.040000	1.46	0.50	7.43	0.2	1.57	0.00
C.045000	1.55	0.50	7.88	0.2	1.57	0.00
C.050000	1.63	0.50	8.31	0.2	1.57	0.00
C.055000	1.71	0.50	8.71	0.2	1.57	0.00
C.060000	1.79	0.50	9.10	0.2	1.57	0.00
C.065000	1.86	0.50	9.47	0.2	1.57	0.00
C.070000	1.93	0.50	9.83	0.2	1.57	0.00
C.075000	2.00	0.50	10.17	0.2	1.57	0.00
C.080000	2.06	0.50	10.51	0.2	1.57	0.00
C.085000	2.13	0.50	10.83	0.2	1.57	0.00
C.090000	2.19	0.50	11.14	0.2	1.57	0.00
C.095000	2.25	0.50	11.45	0.2	1.57	0.00
C.100000	2.31	0.50	11.75	0.2	1.57	0.00

8" PVC
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.010
Diameter	8 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	1.11	0.67	3.18	0.3	2.09	0.00
C.010000	1.57	0.67	4.50	0.3	2.09	0.00
C.015000	1.92	0.67	5.51	0.3	2.09	0.00
C.020000	2.22	0.67	6.36	0.3	2.09	0.00
C.025000	2.48	0.67	7.12	0.3	2.09	0.00
C.030000	2.72	0.67	7.79	0.3	2.09	0.00
C.035000	2.94	0.67	8.42	0.3	2.09	0.00
C.040000	3.14	0.67	9.00	0.3	2.09	0.00
C.045000	3.33	0.67	9.55	0.3	2.09	0.00
C.050000	3.51	0.67	10.06	0.3	2.09	0.00
C.055000	3.68	0.67	10.55	0.3	2.09	0.00
C.060000	3.85	0.67	11.02	0.3	2.09	0.00
C.065000	4.00	0.67	11.47	0.3	2.09	0.00
C.070000	4.16	0.67	11.91	0.3	2.09	0.00
C.075000	4.30	0.67	12.32	0.3	2.09	0.00
C.080000	4.44	0.67	12.73	0.3	2.09	0.00
C.085000	4.58	0.67	13.12	0.3	2.09	0.00
C.090000	4.71	0.67	13.50	0.3	2.09	0.00
C.095000	4.84	0.67	13.87	0.3	2.09	0.00
C.100000	4.97	0.67	14.23	0.3	2.09	0.00

10" PVC
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data		
Mannings Coeffic	C.010	
Diameter	10	in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	2.01	0.83	3.69	0.5	2.62	0.00
C.010000	2.85	0.83	5.22	0.5	2.62	0.00
C.015000	3.49	0.83	6.40	0.5	2.62	0.00
C.020000	4.03	0.83	7.38	0.5	2.62	0.00
C.025000	4.50	0.83	8.26	0.5	2.62	0.00
C.030000	4.93	0.83	9.04	0.5	2.62	0.00
C.035000	5.33	0.83	9.77	0.5	2.62	0.00
C.040000	5.70	0.83	10.44	0.5	2.62	0.00
C.045000	6.04	0.83	11.08	0.5	2.62	0.00
C.050000	6.37	0.83	11.68	0.5	2.62	0.00
C.055000	6.68	0.83	12.25	0.5	2.62	0.00
C.060000	6.98	0.83	12.79	0.5	2.62	0.00
C.065000	7.26	0.83	13.31	0.5	2.62	0.00
C.070000	7.54	0.83	13.82	0.5	2.62	0.00
C.075000	7.80	0.83	14.30	0.5	2.62	0.00
C.080000	8.06	0.83	14.77	0.5	2.62	0.00
C.085000	8.30	0.83	15.22	0.5	2.62	0.00
C.090000	8.54	0.83	15.67	0.5	2.62	0.00
C.095000	8.78	0.83	16.10	0.5	2.62	0.00
C.100000	9.01	0.83	16.51	0.5	2.62	0.00

12" PVC /HDPE
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.010
Diameter	12 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	3.27	1.00	4.17	0.8	3.14	0.00
C.010000	4.63	1.00	5.90	0.8	3.14	0.00
C.015000	5.67	1.00	7.22	0.8	3.14	0.00
C.020000	6.55	1.00	8.34	0.8	3.14	0.00
C.025000	7.32	1.00	9.32	0.8	3.14	0.00
C.030000	8.02	1.00	10.21	0.8	3.14	0.00
C.035000	8.66	1.00	11.03	0.8	3.14	0.00
C.040000	9.26	1.00	11.79	0.8	3.14	0.00
C.045000	9.82	1.00	12.51	0.8	3.14	0.00
C.050000	10.36	1.00	13.19	0.8	3.14	0.00
C.055000	10.86	1.00	13.83	0.8	3.14	0.00
C.060000	11.34	1.00	14.44	0.8	3.14	0.00
C.065000	11.81	1.00	15.03	0.8	3.14	0.00
C.070000	12.25	1.00	15.60	0.8	3.14	0.00
C.075000	12.68	1.00	16.15	0.8	3.14	0.00
C.080000	13.10	1.00	16.68	0.8	3.14	0.00
C.085000	13.50	1.00	17.19	0.8	3.14	0.00
C.090000	13.89	1.00	17.69	0.8	3.14	0.00
C.095000	14.27	1.00	18.18	0.8	3.14	0.00
C.100000	14.65	1.00	18.65	0.8	3.14	0.00

18" PVC/HDPE
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.010
Diameter	18 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	9.66	1.50	5.46	1.8	4.71	0.00
C.010000	13.65	1.50	7.73	1.8	4.71	0.00
C.015000	16.72	1.50	9.46	1.8	4.71	0.00
C.020000	19.31	1.50	10.93	1.8	4.71	0.00
C.025000	21.59	1.50	12.22	1.8	4.71	0.00
C.030000	23.65	1.50	13.38	1.8	4.71	0.00
C.035000	25.55	1.50	14.46	1.8	4.71	0.00
C.040000	27.31	1.50	15.45	1.8	4.71	0.00
C.045000	28.97	1.50	16.39	1.8	4.71	0.00
C.050000	30.53	1.50	17.28	1.8	4.71	0.00
C.055000	32.02	1.50	18.12	1.8	4.71	0.00
C.060000	33.45	1.50	18.93	1.8	4.71	0.00
C.065000	34.81	1.50	19.70	1.8	4.71	0.00
C.070000	36.13	1.50	20.44	1.8	4.71	0.00
C.075000	37.40	1.50	21.16	1.8	4.71	0.00
C.080000	38.62	1.50	21.86	1.8	4.71	0.00
C.085000	39.81	1.50	22.53	1.8	4.71	0.00
C.090000	40.96	1.50	23.18	1.8	4.71	0.00
C.095000	42.09	1.50	23.82	1.8	4.71	0.00
C.100000	43.18	1.50	24.44	1.8	4.71	0.00

24" PVC /HDPE
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data		
Mannings Coeffic	C.010	
Diameter	24	in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	20.79	2.00	6.62	3.1	6.28	0.00
C.010000	29.41	2.00	9.36	3.1	6.28	0.00
C.015000	36.02	2.00	11.46	3.1	6.28	0.00
C.020000	41.59	2.00	13.24	3.1	6.28	0.00
C.025000	46.50	2.00	14.80	3.1	6.28	0.00
C.030000	50.94	2.00	16.21	3.1	6.28	0.00
C.035000	55.02	2.00	17.51	3.1	6.28	0.00
C.040000	58.82	2.00	18.72	3.1	6.28	0.00
C.045000	62.38	2.00	19.86	3.1	6.28	0.00
C.050000	65.76	2.00	20.93	3.1	6.28	0.00
C.055000	68.97	2.00	21.95	3.1	6.28	0.00
C.060000	72.03	2.00	22.93	3.1	6.28	0.00
C.065000	74.97	2.00	23.87	3.1	6.28	0.00
C.070000	77.80	2.00	24.77	3.1	6.28	0.00
C.075000	80.54	2.00	25.64	3.1	6.28	0.00
C.080000	83.18	2.00	26.48	3.1	6.28	0.00
C.085000	85.74	2.00	27.29	3.1	6.28	0.00
C.090000	88.22	2.00	28.08	3.1	6.28	0.00
C.095000	90.64	2.00	28.85	3.1	6.28	0.00
C.100000	92.99	2.00	29.60	3.1	6.28	0.00

18 " RCP
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.013
Diameter	18 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.150000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	7.43	1.50	4.20	1.8	4.71	0.00
C.010000	10.50	1.50	5.94	1.8	4.71	0.00
C.015000	12.86	1.50	7.28	1.8	4.71	0.00
C.020000	14.85	1.50	8.41	1.8	4.71	0.00
C.025000	16.61	1.50	9.40	1.8	4.71	0.00
C.030000	18.19	1.50	10.30	1.8	4.71	0.00
C.035000	19.65	1.50	11.12	1.8	4.71	0.00
C.040000	21.01	1.50	11.89	1.8	4.71	0.00
C.045000	22.28	1.50	12.61	1.8	4.71	0.00
C.050000	23.49	1.50	13.29	1.8	4.71	0.00
C.055000	24.63	1.50	13.94	1.8	4.71	0.00
C.060000	25.73	1.50	14.56	1.8	4.71	0.00
C.065000	26.78	1.50	15.15	1.8	4.71	0.00
C.070000	27.79	1.50	15.73	1.8	4.71	0.00
C.075000	28.77	1.50	16.28	1.8	4.71	0.00
C.080000	29.71	1.50	16.81	1.8	4.71	0.00
C.085000	30.62	1.50	17.33	1.8	4.71	0.00
C.090000	31.51	1.50	17.83	1.8	4.71	0.00
C.095000	32.37	1.50	18.32	1.8	4.71	0.00
C.100000	33.22	1.50	18.80	1.8	4.71	0.00
C.105000	34.04	1.50	19.26	1.8	4.71	0.00
C.110000	34.84	1.50	19.71	1.8	4.71	0.00
C.115000	35.62	1.50	20.16	1.8	4.71	0.00
C.120000	36.39	1.50	20.59	1.8	4.71	0.00
C.125000	37.14	1.50	21.01	1.8	4.71	0.00
C.130000	37.87	1.50	21.43	1.8	4.71	0.00
C.135000	38.59	1.50	21.84	1.8	4.71	0.00
C.140000	39.30	1.50	22.24	1.8	4.71	0.00
C.145000	40.00	1.50	22.63	1.8	4.71	0.00
C.150000	40.68	1.50	23.02	1.8	4.71	0.00

24" RCP

Table
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.013
Diameter	24 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	16.00	2.00	5.09	3.1	6.28	0.00
C.010000	22.62	2.00	7.20	3.1	6.28	0.00
C.015000	27.71	2.00	8.82	3.1	6.28	0.00
C.020000	31.99	2.00	10.18	3.1	6.28	0.00
C.025000	35.77	2.00	11.39	3.1	6.28	0.00
C.030000	39.18	2.00	12.47	3.1	6.28	0.00
C.035000	42.32	2.00	13.47	3.1	6.28	0.00
C.040000	45.24	2.00	14.40	3.1	6.28	0.00
C.045000	47.99	2.00	15.27	3.1	6.28	0.00
C.050000	50.58	2.00	16.10	3.1	6.28	0.00
C.055000	53.05	2.00	16.89	3.1	6.28	0.00
C.060000	55.41	2.00	17.64	3.1	6.28	0.00
C.065000	57.67	2.00	18.36	3.1	6.28	0.00
C.070000	59.85	2.00	19.05	3.1	6.28	0.00
C.075000	61.95	2.00	19.72	3.1	6.28	0.00
C.080000	63.98	2.00	20.37	3.1	6.28	0.00
C.085000	65.95	2.00	20.99	3.1	6.28	0.00
C.090000	67.86	2.00	21.60	3.1	6.28	0.00
C.095000	69.72	2.00	22.19	3.1	6.28	0.00
C.100000	71.53	2.00	22.77	3.1	6.28	0.00

30" RCP
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	C.013
Diameter	30 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
C.005000	29.00	2.50	5.91	4.9	7.85	0.00
C.010000	41.01	2.50	8.36	4.9	7.85	0.00
C.015000	50.23	2.50	10.23	4.9	7.85	0.00
C.020000	58.00	2.50	11.82	4.9	7.85	0.00
C.025000	64.85	2.50	13.21	4.9	7.85	0.00
C.030000	71.04	2.50	14.47	4.9	7.85	0.00
C.035000	76.73	2.50	15.63	4.9	7.85	0.00
C.040000	82.03	2.50	16.71	4.9	7.85	0.00
C.045000	87.01	2.50	17.72	4.9	7.85	0.00
C.050000	91.71	2.50	18.68	4.9	7.85	0.00
C.055000	96.19	2.50	19.60	4.9	7.85	0.00
C.060000	100.47	2.50	20.47	4.9	7.85	0.00
C.065000	104.57	2.50	21.30	4.9	7.85	0.00
C.070000	108.52	2.50	22.11	4.9	7.85	0.00
C.075000	112.32	2.50	22.88	4.9	7.85	0.00
C.080000	116.01	2.50	23.63	4.9	7.85	0.00
C.085000	119.58	2.50	24.36	4.9	7.85	0.00
C.090000	123.04	2.50	25.07	4.9	7.85	0.00
C.095000	126.42	2.50	25.75	4.9	7.85	0.00
C.100000	129.70	2.50	26.42	4.9	7.85	0.00

36" RCP
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data		
Mannings Coeffic	0.013	
Diameter	36	in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.005000	47.16	3.00	6.67	7.1	9.42	0.00
0.010000	66.69	3.00	9.44	7.1	9.42	0.00
0.015000	81.68	3.00	11.56	7.1	9.42	0.00
0.020000	94.32	3.00	13.34	7.1	9.42	0.00
0.025000	105.45	3.00	14.92	7.1	9.42	0.00
0.030000	115.52	3.00	16.34	7.1	9.42	0.00
0.035000	124.77	3.00	17.65	7.1	9.42	0.00
0.040000	133.39	3.00	18.87	7.1	9.42	0.00
0.045000	141.48	3.00	20.02	7.1	9.42	0.00
0.050000	149.13	3.00	21.10	7.1	9.42	0.00
0.055000	156.41	3.00	22.13	7.1	9.42	0.00
0.060000	163.37	3.00	23.11	7.1	9.42	0.00
0.065000	170.04	3.00	24.06	7.1	9.42	0.00
0.070000	176.46	3.00	24.96	7.1	9.42	0.00
0.075000	182.65	3.00	25.84	7.1	9.42	0.00
0.080000	188.64	3.00	26.69	7.1	9.42	0.00
0.085000	194.45	3.00	27.51	7.1	9.42	0.00
0.090000	200.08	3.00	28.31	7.1	9.42	0.00
0.095000	205.57	3.00	29.08	7.1	9.42	0.00
0.100000	210.91	3.00	29.84	7.1	9.42	0.00

48" RCP
Rating Table for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

Input Data	
Mannings Coeffic	0.013
Diameter	48 in

Attribute	Minimum	Maximum	Increment
Slope (ft/ft)	0.005000	0.100000	0.005000

Slope (ft/ft)	Discharge (cfs)	Depth (ft)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.005000	101.57	4.00	8.08	12.6	12.57	0.00
0.010000	143.64	4.00	11.43	12.6	12.57	0.00
0.015000	175.92	4.00	14.00	12.6	12.57	0.00
0.020000	203.13	4.00	16.16	12.6	12.57	0.00
0.025000	227.11	4.00	18.07	12.6	12.57	0.00
0.030000	248.78	4.00	19.80	12.6	12.57	0.00
0.035000	268.72	4.00	21.38	12.6	12.57	0.00
0.040000	287.27	4.00	22.86	12.6	12.57	0.00
0.045000	304.70	4.00	24.25	12.6	12.57	0.00
0.050000	321.18	4.00	25.56	12.6	12.57	0.00
0.055000	336.85	4.00	26.81	12.6	12.57	0.00
0.060000	351.83	4.00	28.00	12.6	12.57	0.00
0.065000	366.20	4.00	29.14	12.6	12.57	0.00
0.070000	380.02	4.00	30.24	12.6	12.57	0.00
0.075000	393.36	4.00	31.30	12.6	12.57	0.00
0.080000	406.26	4.00	32.33	12.6	12.57	0.00
0.085000	418.77	4.00	33.32	12.6	12.57	0.00
0.090000	430.91	4.00	34.29	12.6	12.57	0.00
0.095000	442.71	4.00	35.23	12.6	12.57	0.00
0.100000	454.22	4.00	36.15	12.6	12.57	0.00

Computation of grated inlet capacity in sump condition.

Model: QUIKSET "DB-1212". A precast concrete box with a cast iron grate.

Grate Size:	12 inches square
Rim bar size:	1 inch
Grate bar size:	1 inch
Opening width:	1 inch

Using Bureau of Public Roads chart 1073.02;

Q, flow into inlet (CFS)
P, perimeter of grate (feet) P= 3.33 feet
H, head (feet of water over grate top)
A, area of grate opening (square feet) A= 0.35 Sq ft

EQUATIONS: for heads less than 0.4 feet.
Q = P * 3.0 * H ^(3/2)

for heads over 1.4 feet.
Q = A * 5.37 * H^(1.2)

for heads between 0.4 and 1.4 feet,
(use value for 0.4 feet).

Table of flow values vs head levels.

Head (feet)	Flow Capacity
0.10	0.32 CFS
0.20	0.89 CFS
0.30	1.64 CFS
0.40	2.53 CFS
0.50	2.53 CFS
0.60	2.53 CFS
0.70	2.53 CFS
0.80	2.53 CFS
0.90	2.53 CFS
1.00	2.53 CFS
1.10	2.53 CFS
1.20	2.53 CFS
1.30	2.53 CFS
1.40	2.21 CFS
1.50	2.28 CFS
1.60	2.36 CFS
1.70	2.43 CFS
1.80	2.50 CFS
1.90	2.57 CFS
2.00	2.64 CFS

Computation of grated inlet capacity in sump condition.

Model: QUIKSET "DB-1818". A precast concrete box with a cast iron grate.

Grate Size: 18 inches square
Rim bar size: 1 inch
Grate bar size: 1 inch
Opening width: 1 inch

Using Bureau of Public Roads chart 1073.02;

Q, flow into inlet (CFS)
P, perimeter of grate (feet) P= 5.33 feet
H, head (feet of water over grate top)
A, area of grate opening (square feet) A= 0.89 Sq ft

EQUATIONS: for heads less than 0.4 feet.
Q = P * 3.0 * H ^(3/2)

for heads over 1.4 feet.
Q = A * 5.37 * H^(1.2)

for heads between 0.4 and 1.4 feet,
(use value for 0.4 feet).

Table of flow values vs head levels.

Head (feet)	Flow Capacity
0.10	0.51 CFS
0.20	1.43 CFS
0.30	2.63 CFS
0.40	4.05 CFS
0.50	4.05 CFS
0.60	4.05 CFS
0.70	4.05 CFS
0.80	4.05 CFS
0.90	4.05 CFS
1.00	4.05 CFS
1.10	4.05 CFS
1.20	4.05 CFS
1.30	4.05 CFS
1.40	5.65 CFS
1.50	5.85 CFS
1.60	6.04 CFS
1.70	6.22 CFS
1.80	6.40 CFS
1.90	6.58 CFS
2.00	6.75 CFS

Computation of grated inlet capacity in sump condition.

Model: QUIKSET "DB-2424". A precast concrete box with a cast iron grate.

Grate Size: 24 inches square
Rim bar size: 1 inch
Grate bar size: 1 inch
Opening width: 1 inch

Using Bureau of Public Roads chart 1073.02;

Q, flow into inlet (CFS)
P, perimeter of grate (feet) P= 7.33 feet
H, head (feet of water over grate top)
A, area of grate opening (square feet) A= 1.68 Sq ft

EQUATIONS: for heads less than 0.4 feet.
Q = P * 3.0 * H ^(3/2)

for heads over 1.4 feet.
Q = A * 5.37 * H^(1.2)

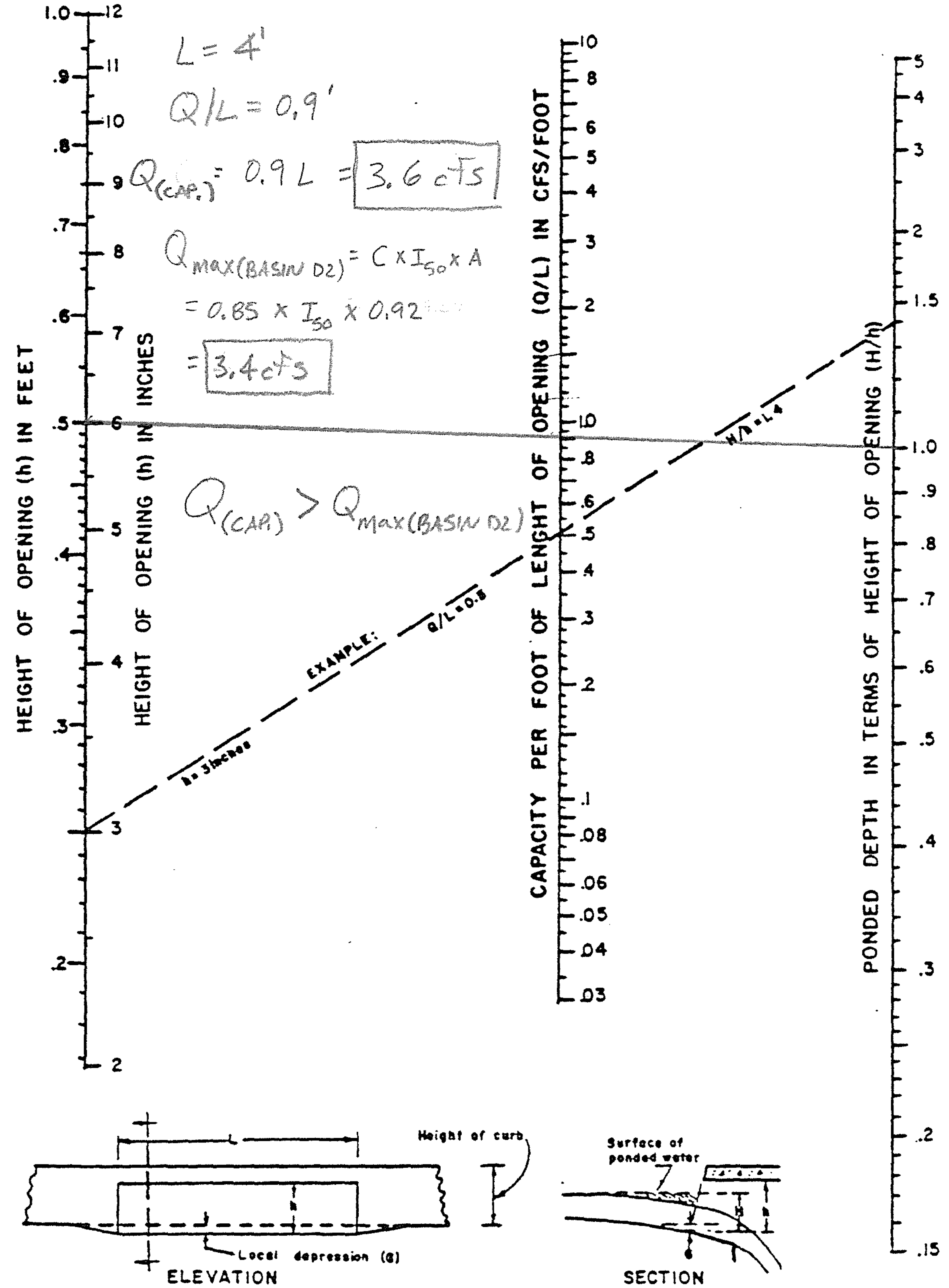
for heads between 0.4 and 1.4 feet,
(use value for 0.4 feet).

Table of flow values vs head levels.

Head (feet)	Flow Capacity
0.10	0.70 CFS
0.20	1.97 CFS
0.30	3.61 CFS
0.40	5.57 CFS
0.50	5.57 CFS
0.60	5.57 CFS
0.70	5.57 CFS
0.80	5.57 CFS
0.90	5.57 CFS
1.00	5.57 CFS
1.10	5.57 CFS
1.20	5.57 CFS
1.30	5.57 CFS
1.40	10.68 CFS
1.50	11.05 CFS
1.60	11.42 CFS
1.70	11.77 CFS
1.80	12.11 CFS
1.90	12.44 CFS
2.00	12.76 CFS

FOR TYPE 'B' C.I. IN BASINS B2 → B5, D2, AND D5 → D7

CHART 1-103.6C



$L = 4'$

$Q/L = 0.9'$

$Q_{(CAP.)} = 0.9L = \boxed{3.6 \text{ cfs}}$

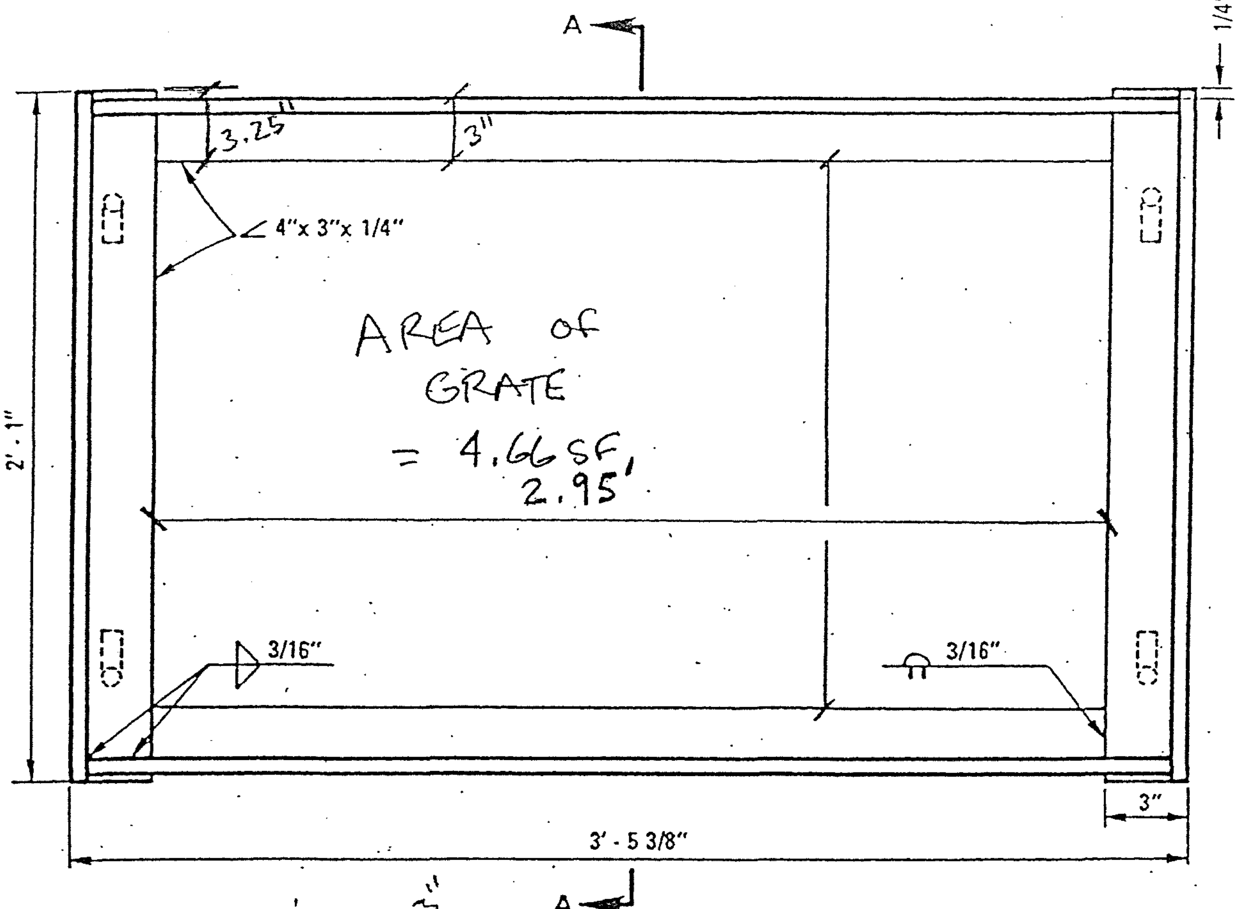
$Q_{max(BASIN\ D2)} = C \times I_{50} \times A$

$= 0.85 \times I_{50} \times 0.92$

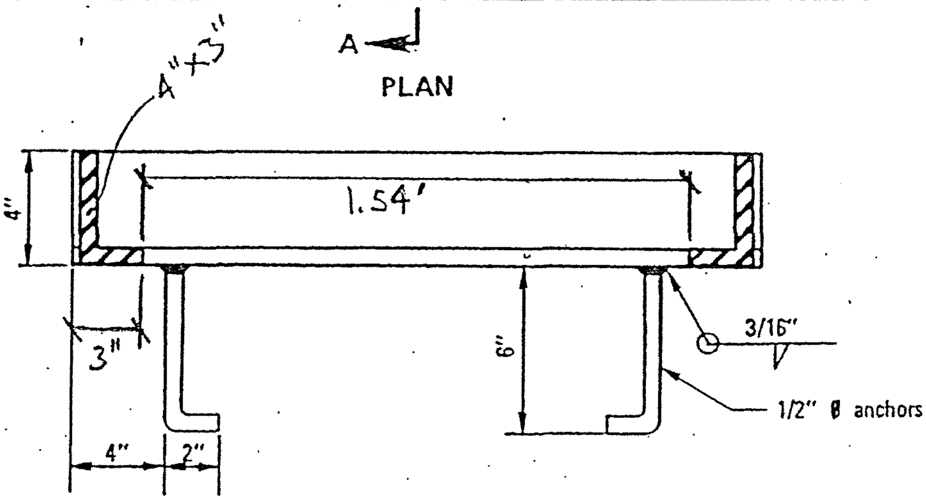
$= \boxed{3.4 \text{ cfs}}$

$Q_{(CAP.)} > Q_{max(BASIN\ D2)}$

REV.		CITY OF SAN DIEGO - DESIGN GUIDE	SHT. NO.
		NOMOGRAM—CAPACITY, CURB INLET AT SAG	



PLAN



SECTION A–A

$P = 2(2.95) + 2(1.54) = 8.98$

SUMP ⇒ H = Curb height minus 0.1' freeboard

⇒ $H = 0.4'$

⇒ $Q = 3(P)(H)^{3/2} = 6.8\ \text{CFS}$

NOTES

1. Hot dip galvanize all parts after fabrication.

Revision	By	Approved	Date		
Note 1	[illegible]	M.B	5-86	SAN DIEGO REGIONAL STANDARD DRAWING	RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE [signature] Dec. 1975 Coordinator R.C.E. 19807 Date
				WELDED STEEL GRATE FRAME (TYPE "I" CATCH BASIN)	DRAWING NUMBER D-13

RIPRAP SIZING FOR PROPOSED 30" RCP LATERAL IN LIGHTWAVE AVE.

200-1.6.3 Quality Requirements

Page 45 - First paragraph, second sentence change "60 days" to "30 days".

200-1.7 Selection of Riprap and Filter Blanket Material

Table 200-1.7

Velocity Meters/Sec (Ft/Sec) (1)	Rock Class (2)	Rip Rap Thickness "T"	Filter Blanket Upper Layer(s) (3)			
			Option 1 Sect. 200 (4)	Option 2 Sect.400 (4)	Option 3 (5)	Lower Layer (6)
2 (6-7)	No. 3 Backing	0.6	5 mm (3/16")	C2	D.G.	----
2.2 (7-8)	No. 2 Backing	1.0	6 mm (1/4")	B3	D.G.	----
2.6 (8-9.5)	Facing	1.4	9.5 mm (3/8")	----	D.G.	----
3 (9.5-11)	Light	2.0	12.5 mm (½")	----	25mm (3/4"- 1-1/2")	----
3.5 (11-13)	220 kg (1/4 Ton)	2.7	19 mm (3/4")	----	25mm (3/4"- 1-1/2")	SAND
4 (13-15)	450 kg (½ Ton)	3.4	25 mm (1")	----	25mm (3/4"- 1-1/2")	SAND
4.5 (15-17)	900 kg (1 Ton)	4.3	37.5 mm (1-1/2")	----	TYPE B	SAND
5.5 (17-20)	1.8Tonne (2 Ton)	5.4	50 mm (2")	----	TYPE B	SAND

See Section 200-1.6. see also Table 200-1.6 (A)

Practical use of this table is limited to situations where "T" is less than inside diameter.

(1) Average velocity in pipe or bottom velocity in energy dissipater, whichever is greater.

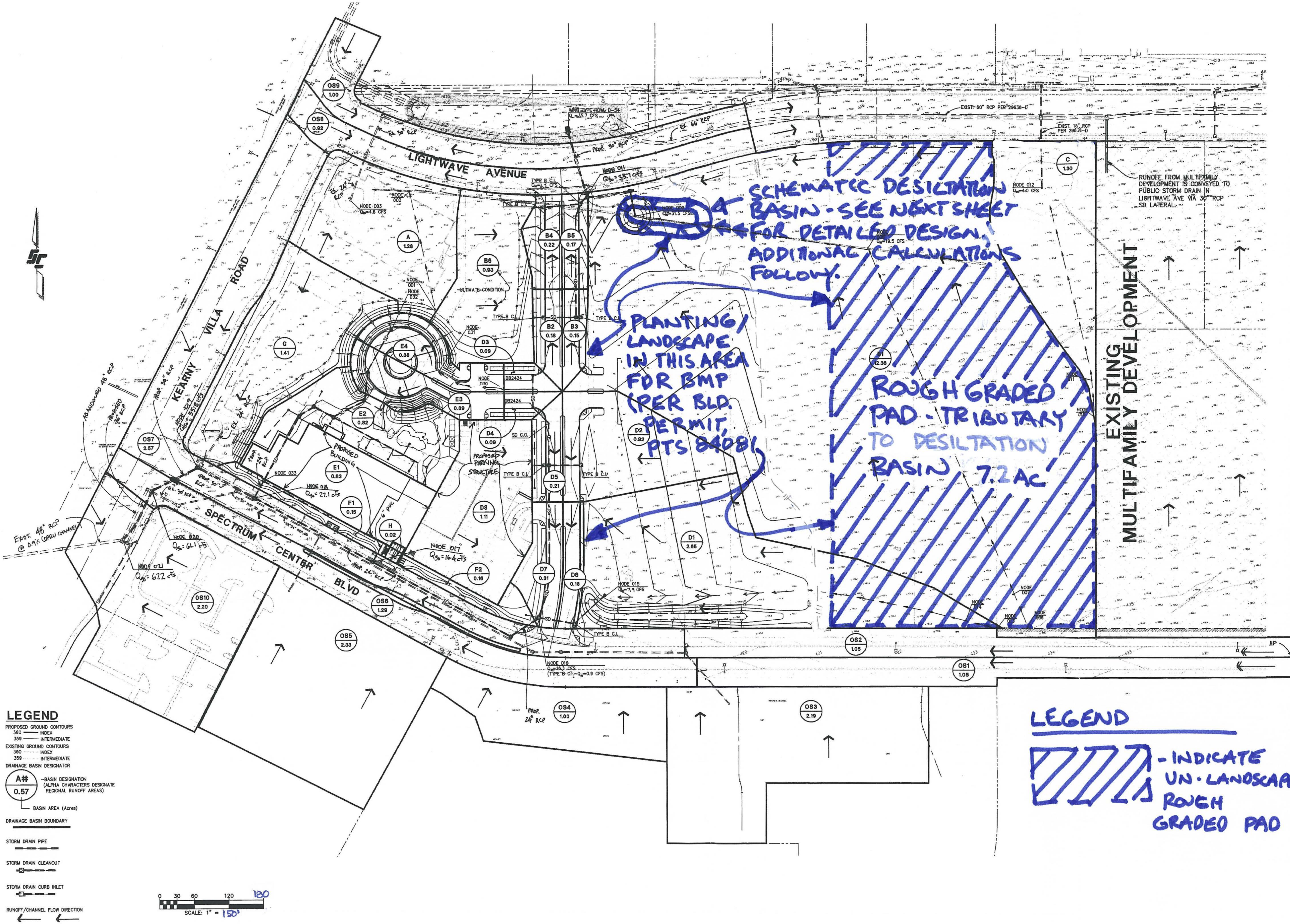
(2) If desired rip rap and filter blanket class is not available, use next larger class.

(3) Filter blanket thickness = 0.3 Meter (1 Foot) or "T", whichever is less.

(4) Standard Specifications for Public Works Construction.

(5) D.G. = Disintegrated Granite, 1mm to 10mm.

P.B. = Processed Miscellaneous Base.



STEVENS-CRESTO ENGINEERING, CIVIL ENGINEERS • LAND PLANNERS • SURVEYORS
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SUITE 107
SAN DIEGO, CA 92123-1324
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FAX: 858.69
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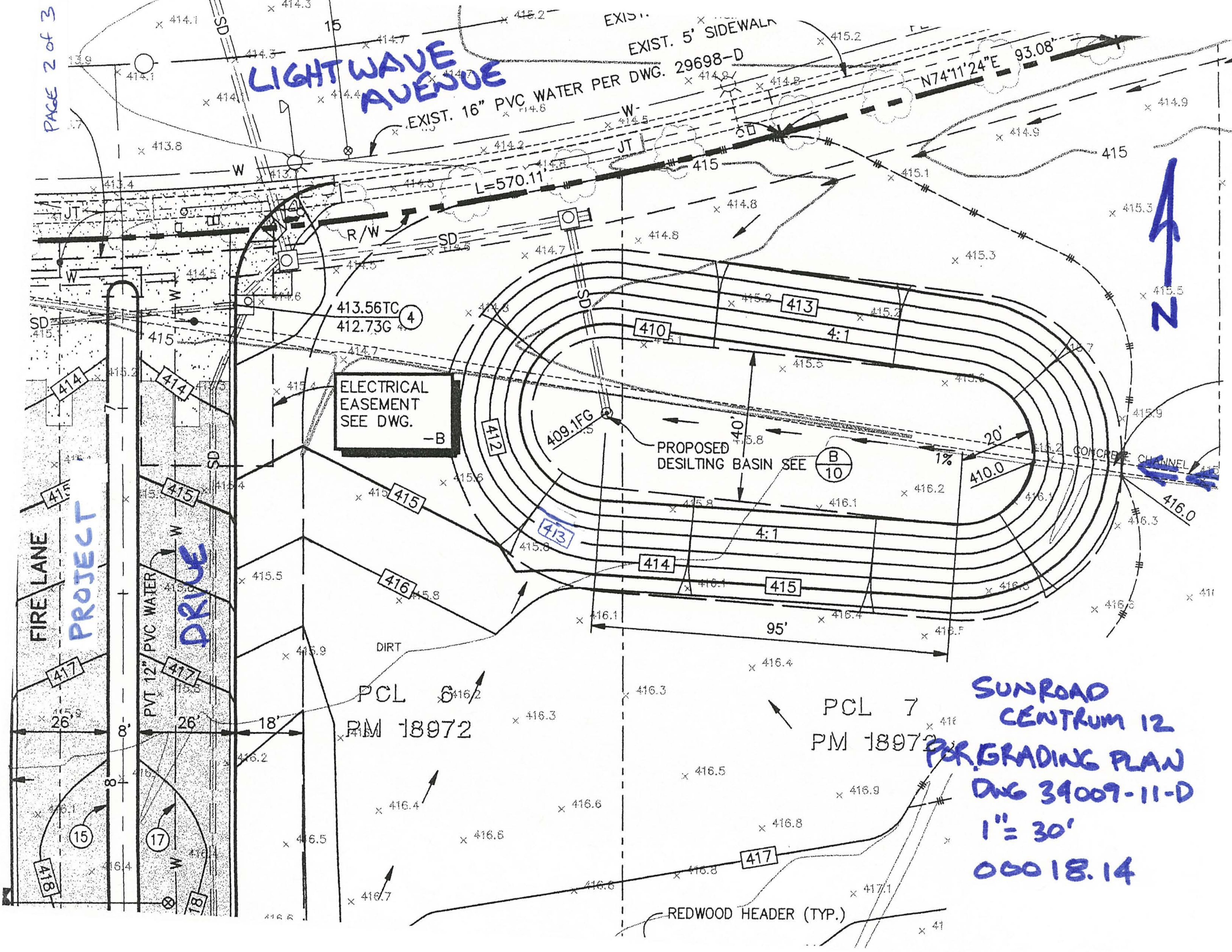
REVISIONS

CENTRUM 12
KEARNY MESA, CALIFORNIA

EXHIBIT "C"
DESILTATION BASIN
TRIBUTARY BASIN EXHIBIT

DATE: 06/27/06
SCE NO. 00018.14
SHEET C


LIGHTWAVE AVENUE
EXIST. 5' SIDEWALK
EXIST. 16" PVC WATER PER DWG. 29698-D
N74°11'24"E 93.08'
L=570.11'
R/W
413.56TC
412.73G
4
ELECTRICAL EASEMENT SEE DWG. -B
409.1FG
PROPOSED DESILTING BASIN SEE B/10
4:1
40'
20'
1%
410.0
95'
CONCRETE CHANNEL
416.0
FIRE LANE
PROJECT DRIVE
PVT 12" PVC WATER
26'
8'
26'
18'
15
17
DIRT
PCL 6 PM 18972
PCL 7 PM 18972
REDWOOD HEADER (TYP.)
N
SUNROAD CENTRUM 12
POR. GRADING PLAN
DWG 34007-11-D
1" = 30'
00018.14

STEVENS · CRESTO ENGINEERING, INC.
CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS

SHEET 1 OF 3
PROJECT NO. 00018.14
PROJECT CENTRUM 12
BY RDH CHK
DATE 6/27/06

DESILTATION BASIN SIZEING CALCULATIONS

EXHIBIT C, UN-LANDSCAPED, ROUGH GRADED PAD, TRIBUTARY TO DESILTATION BASIN, ADJACENT TO LIGHTWAVE AVENUE, EAST OF PROJECT DRIVE.

TRIBUTARY DRAINAGE BASIN AREA = 7.2AC

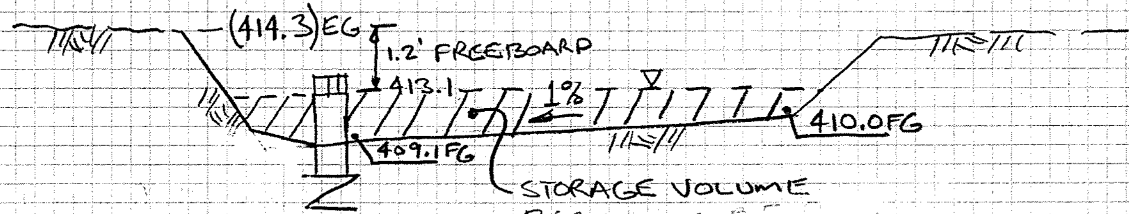
CRITERIA:

Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet of storage per acre draining into the sediment basin. The length of the basin shall be more twice the width of the basin. The length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than three feet nor greater than five feet for safety reasons and for maximum efficiency.

DESILTATION BASIN STORAGE VOLUME:

$7.2 * (3{,}600\ ft^3/AC) = 25{,}920\ cf$

DESILTATION BASIN GEOMETRY



VOLUME PROVIDED

BOTTOM AREA = 5,002 SF
TOP AREA = 10,063 SF

DEPTH $\bar{D} = \frac{(413.1-409.1)+(413.1-410.1)}{2} = 3.5\ ft$

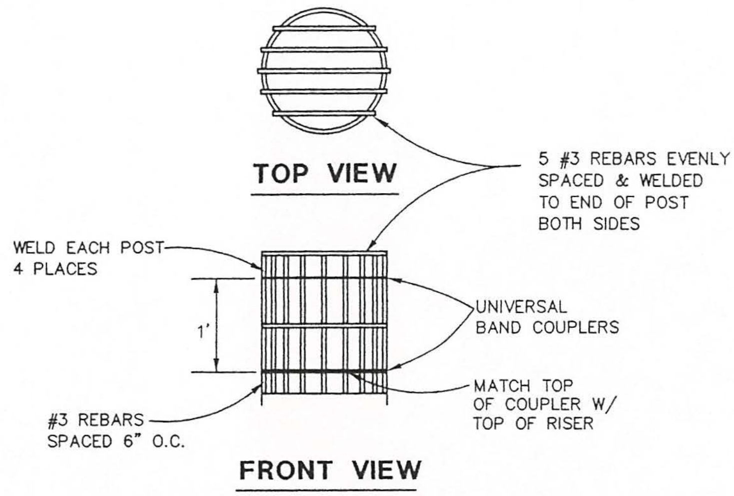
VOLUME $= \left(\frac{5{,}002+10{,}063}{2}\right)(3.5\ ft) = 26{,}364\ cf$ (AT TOP OF RISER 'ELEVATION 413.1')

CONCLUSION:

VOLUME REQUIRED = 25,920 cf
VOLUME PROVIDED = 26,364 cf

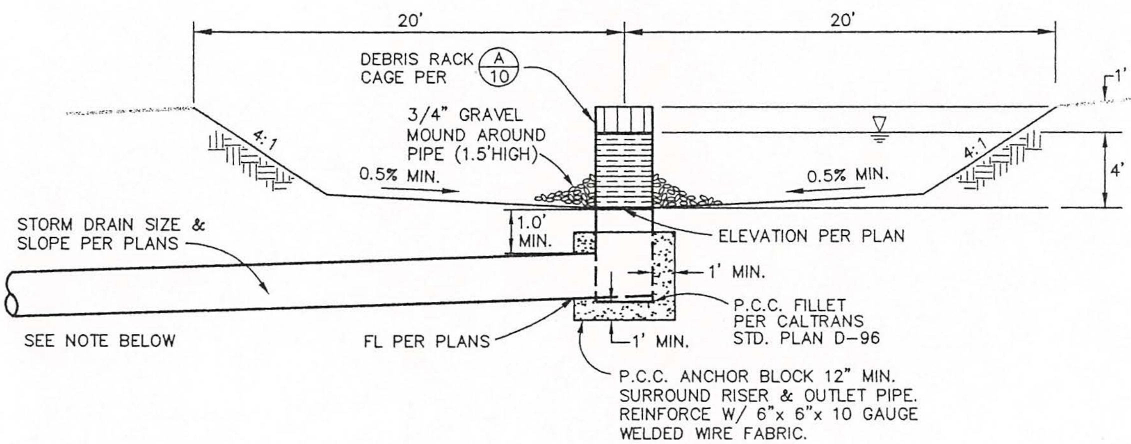
⟹ DESILTATION POND PROVIDES ADEQUATE STORAGE VOLUME

9665 CHESAPEAKE DRIVE, SUITE 320 • SAN DIEGO, CA • 92123
PHONE 858.694.5660 • FAX 858.694.5661



DEBRIS RACK CAGE (A/10)

NO SCALE



NOTE: TRENCH BACKFILL SHALL CONSIST OF NATIVE MATERIALS, APPROVED BY THE SOILS ENGINEER PRIOR TO PLACEMENT. OPEN-GRADED, HIGHLY PERMEABLE MATERIAL SHALL NOT BE USED AS BACKFILL.

CMP RISER, HOT-DIPPED GALVANIZED 12-GAUGE, 2-2/3 INCH X 1/2 INCH CORRUGATIONS. DIAMETER PER PLANS. CUT FIVE HORIZONTAL SLOTS OF 1/4 INCH X 10 INCHES (EQUALLY SPACED AROUND CIRCUMFERENCE). FIRST ROW TO BE 4 INCHES BELOW UNIVERSAL BAND COUPLER. SECOND ROW TO BE STAGGERED AT 5-1/3 INCHES BELOW FIRST ROW. CONTINUE STAGGERED ROWS UNTIL 24 INCHES ABOVE SOFFET OF PRIVATE STORM DRAIN PIPE.

MAINTENANCE

SEDIMENT SHALL BE REMOVED WHENEVER IT ACCUMULATES TO WITHIN 1' OF THE TOP OF RISER. SEDIMENT SHALL BE DISPOSED OF IN SUCH A MANNER THAT WILL PREVENT ITS RETURN TO THE DESILTING BASIN OR MOVEMENT INTO DOWNSTREAM AREAS DURING SUBSEQUENT RUNOFF. THE DESILTING BASINS ARE PRIVATE FACILITIES, AND THE CITY WILL NOT BE RESPONSIBLE FOR THEIR MAINTENANCE.

DESILTING BASIN (B/10)

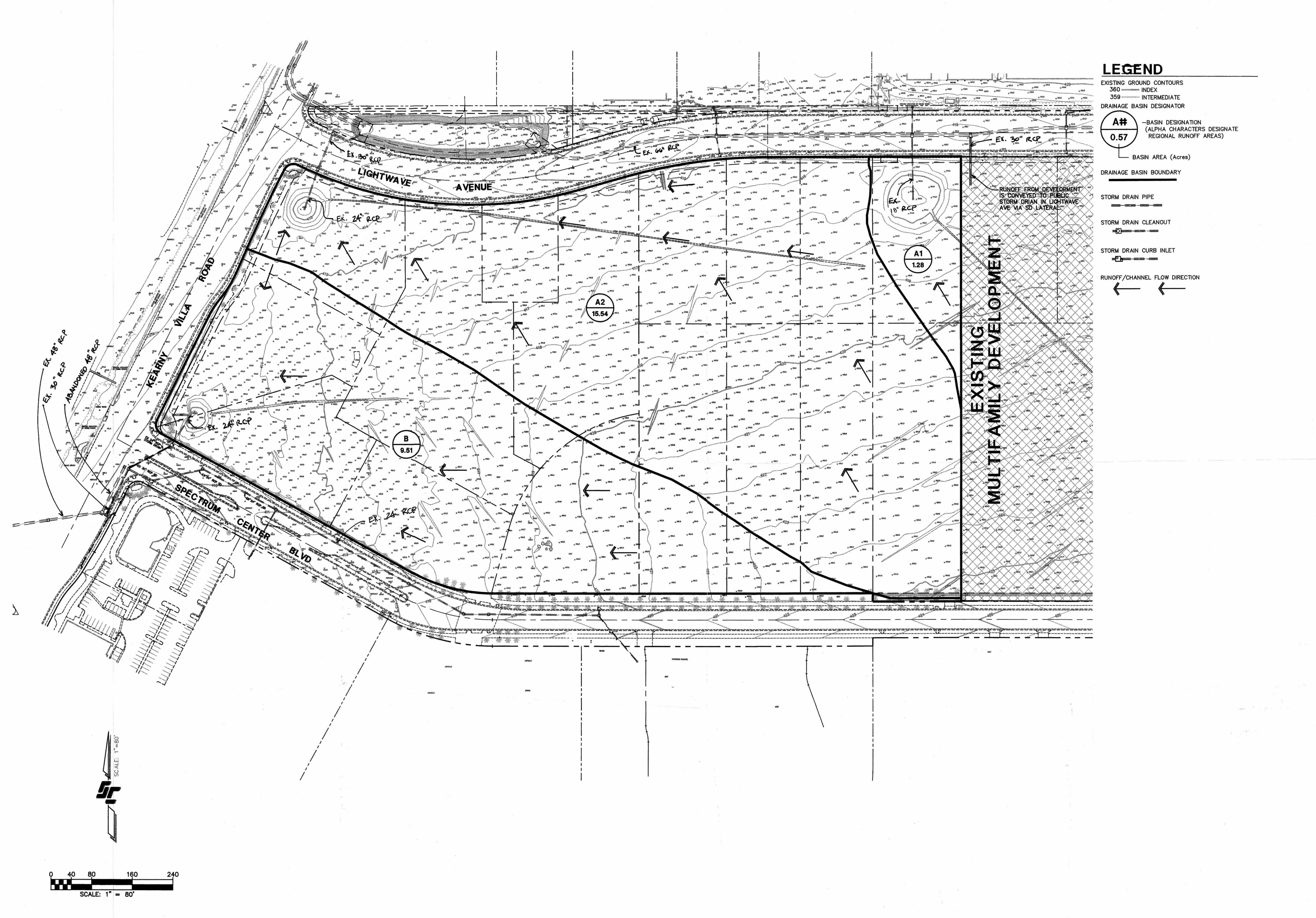
NO SCALE

POR.
GRADING PLAN
SHEET 34009-10-D

4

SECTION 4

EXHIBITS



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FAX: 858.694.5661
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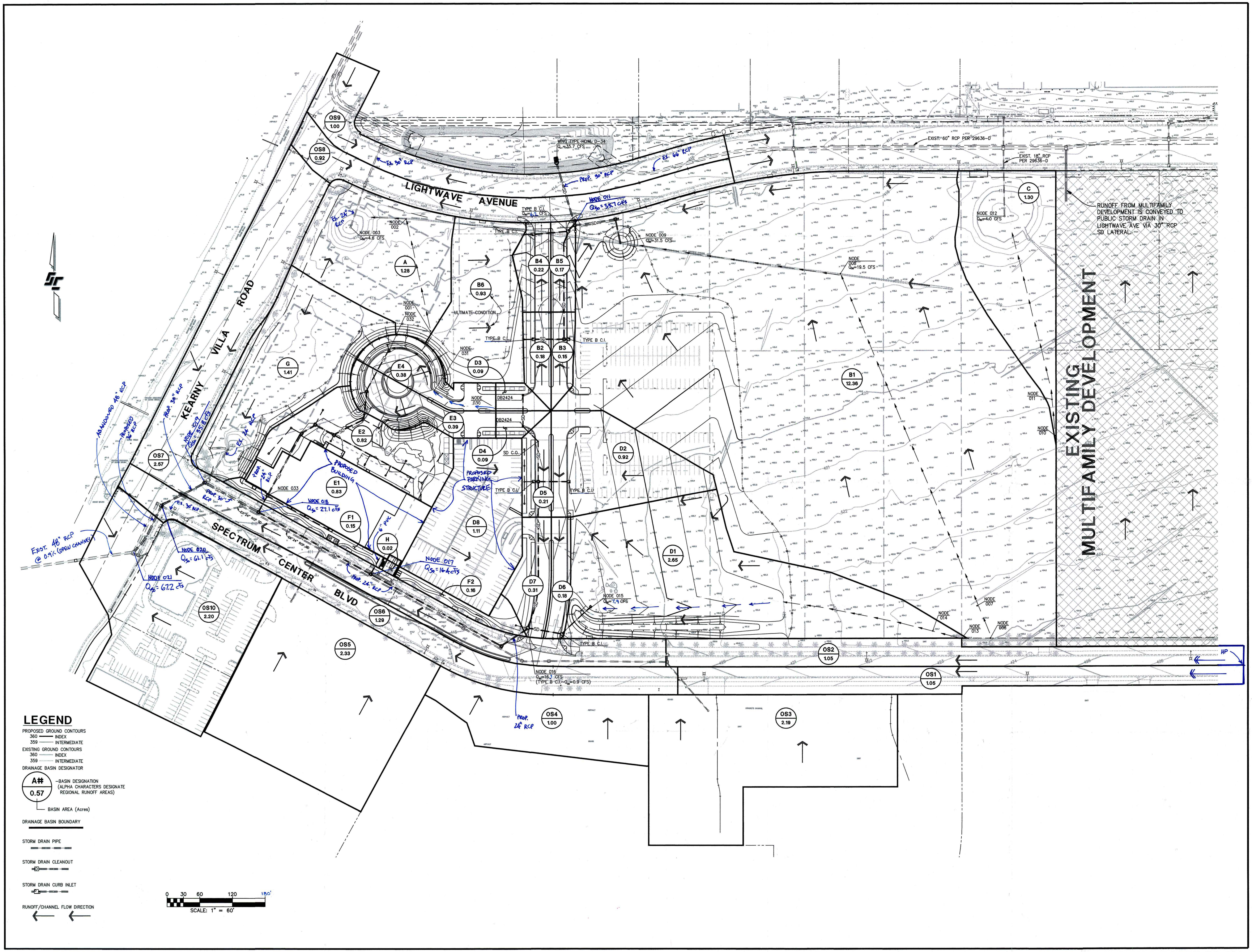
REVISIONS

SUNROAD CENTRUM 12
KEARNY MESA, CALIFORNIA

EXHIBIT "A"
EXISTING CONDITION

DATE: 2/01/06
SCE NO. 00018.14
SHEET
A
1 OF 1 SHEETS



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REVISIONS

CENTRUM 12

KEARNY MESA, CALIFORNIA

EXHIBIT "B"
PROPOSED CONDITION

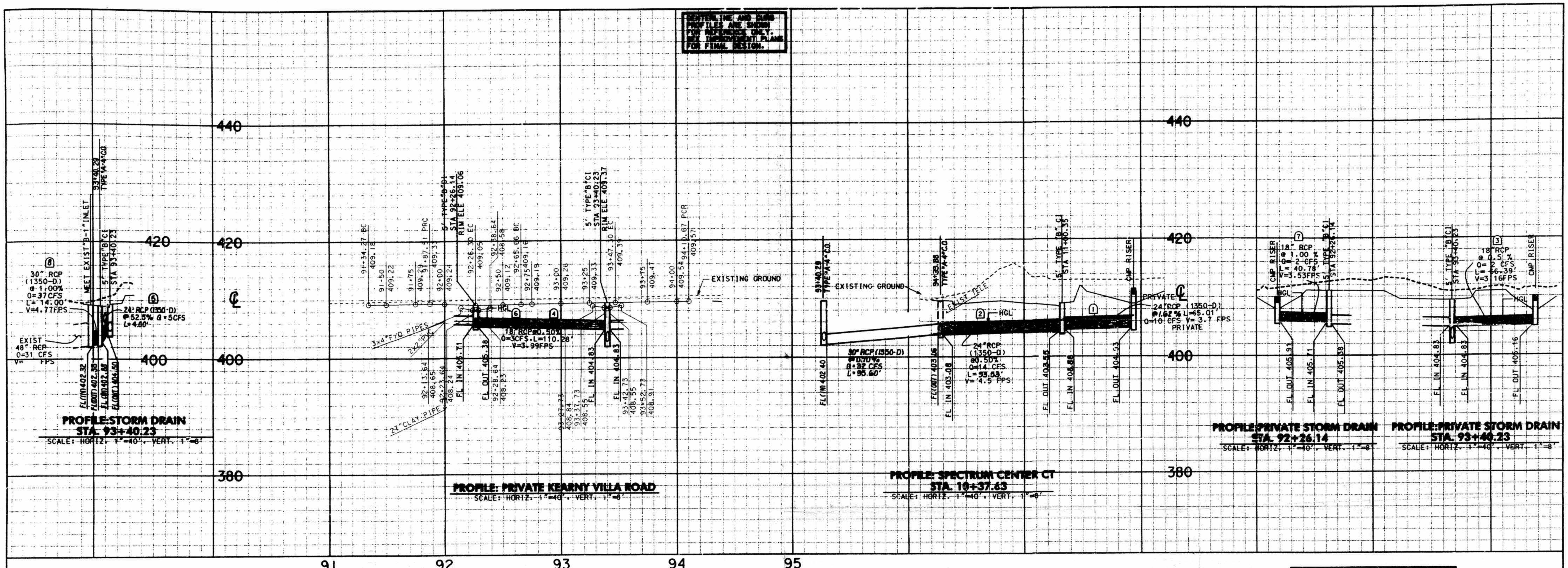
DATE: 2/01/06

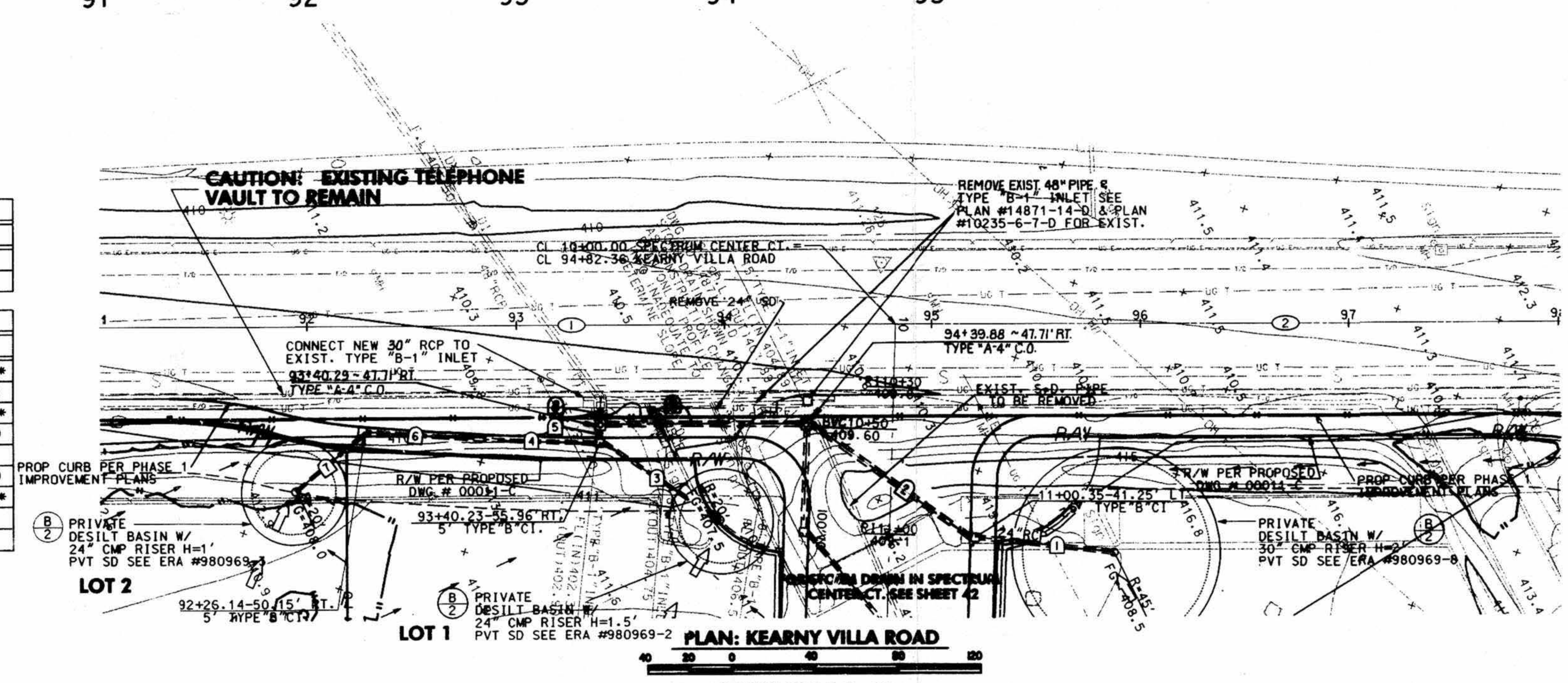
SCE NO. 00018.14

SHEET

B

1 OF 1 SHEETS





CENTERLINE DATA				
NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N26°56'58"E		383.11'	
2	N26°56'58"E		316.89'	

STORM DRAIN DATA				
NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N33°18'26"E		65.01'	24"RCP(1350-D)*
2	N62°03'38"E		93.53'	24"RCP(1350-D)
3	N60°52'12"E		66.39'	18"RCP(1350-D)*
4	03°41'03"	1132.27'	72.81'	18"RCP(1350-D)
5	N62°41'34"W		4.00'	24"RCP(1350-D)
6	N31°05'33"E		37.47'	18"RCP(1350-D)
7	N13°14'37"W		40.78'	18"RCP(1350-D)*
8	N62°31'48"W		6.00'	30"RCP (1350-D)
9	N26°56'58"E		95.60'	30"RCP (1350-D)

* PRIVATE STORM DRAIN

Kimley-Horn and Associates, Inc.
Engineering, Planning and Environmental Consultants
517 Fourth Avenue - Suite 301 - San Diego, Ca. - 92107
Tel: (619) 234-9411 Fax: (619) 234-9433

CAUTION!! LOCATION OF EXISTING UTILITIES ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.

BENCH MARK

THE NORTHEAST BRASS PLUG IN TOP OF DRAINAGE INLET ON KEARNY VILLA ROAD AT BALBOA AVENUE ACCORDING TO CITY OF SAN DIEGO VERTICAL CONTROL DATA.
ELEVATION: 414.797 DATUM: M.S.L.

ENGINEER OF WORK

Timothy J. DeWitt 4-16-99
TIMOTHY J. DEWITT R.C.E. 46579 DATE

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY JOHN DEWITT No. 46579 Exp. 06\30\99 CIVIL
STATE OF CALIFORNIA

PID\PCD NO. 96-0165

PRIVATE CONTRACT J-095217.02

PLANS FOR THE IMPROVEMENT OF

STORM DRAIN IN
KEARNY VILLA ROAD

CITY OF SAN DIEGO, CALIFORNIA
ENGINEERING DEPARTMENT
SHEET 25 OF 51 SHEETS

W.O. NO. TM-96-0165 980969

FOR CITY ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	KHA			MAY 13 99
AS-BUILT	KHA	D.E.S.	5/6/02	SEP 9 02

CONTRACTOR CASS CONST. DATE STARTED 6/99
INSPECTOR HANI ASSI DATE COMPLETED 7/9/01

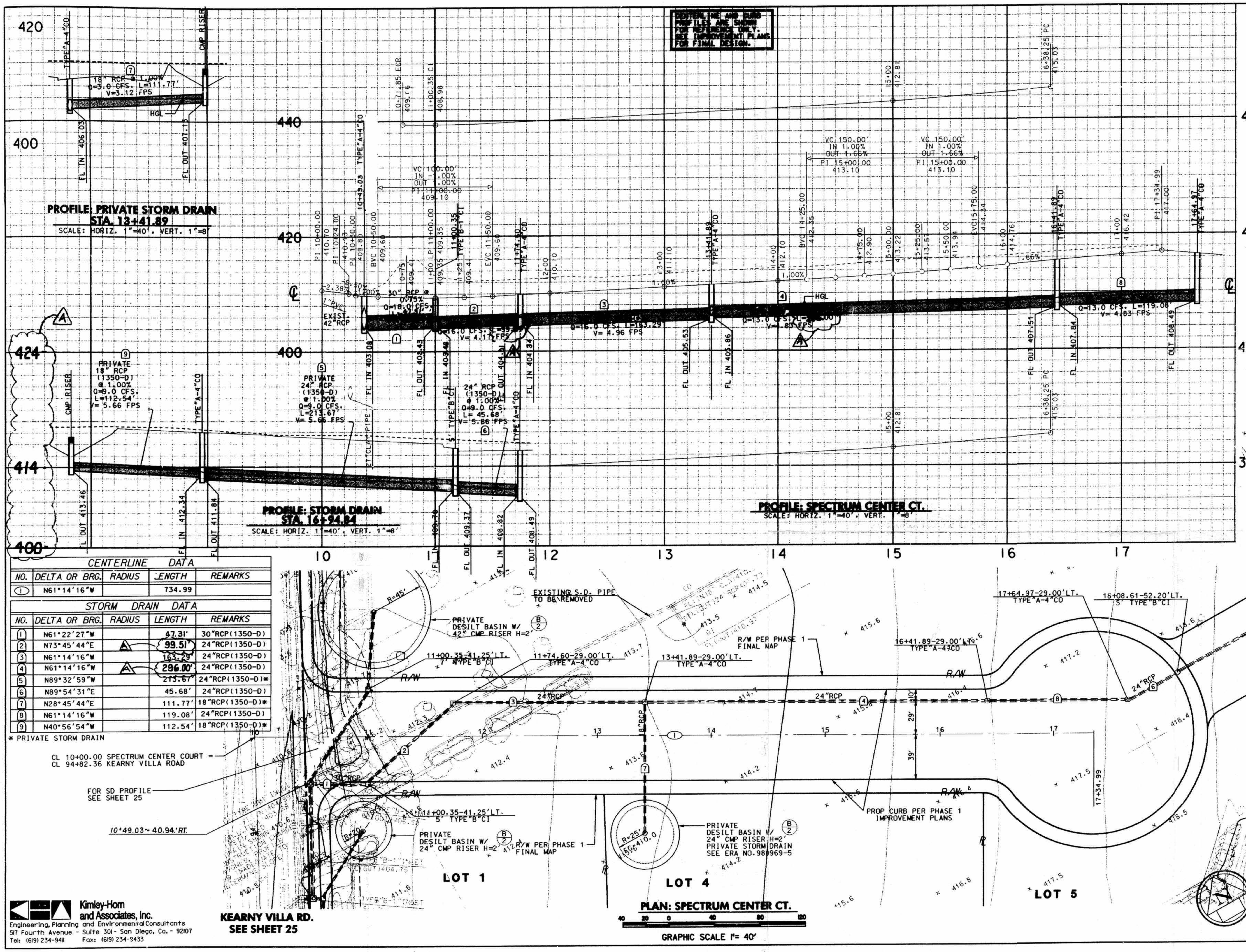
1882-6289
NAD 83
242-1729
LAMBERT COORDINATES

29636-25-D

PLOTTED : 15 APR 1999 s:\dgn\095217.01\170\gp25.dgn

AS-BUILT

FILMED FROM THE ORIGINAL
BEST QUALITY OBTAINABLE



CAUTION!!
LOCATION OF EXISTING UTILITIES ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.

BENCH MARK

THE NORTHEAST BRASS PLUG IN TOP OF DRAINAGE INLET ON KEARNY VILLA ROAD AT BALBOA AVENUE ACCORDING TO CITY OF SAN DIEGO VERTICAL CONTROL DATA.
ELEVATION: 414.797 DATUM: M.S.L.

CENTERLINE DATA				
NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N61°14'16"W		734.99	

STORM DRAIN DATA				
NO.	DELTA OR BRG.	RADIUS	LENGTH	REMARKS
1	N61°22'27"W		47.31'	30"RCP(1350-D)
2	N73°45'44"E	A	99.51'	24"RCP(1350-D)
3	N61°14'16"W		163.29'	24"RCP(1350-D)
4	N61°14'16"W	A	296.00'	24"RCP(1350-D)
5	N89°32'59"W		213.67'	24"RCP(1350-D)*
6	N89°54'31"E		45.68'	24"RCP(1350-D)
7	N28°45'44"E		111.77'	18"RCP(1350-D)*
8	N61°14'16"W		119.08'	24"RCP(1350-D)
9	N40°56'54"W		112.54'	18"RCP(1350-D)*

* PRIVATE STORM DRAIN

CL 10+00.00 SPECTRUM CENTER COURT =
CL 94+82.36 KEARNY VILLA ROAD

FOR SD PROFILE SEE SHEET 25

10+49.03~40.94'RT.

Kimley-Horn and Associates, Inc.
Engineering, Planning and Environmental Consultants
517 Fourth Avenue - Suite 301 - San Diego, Ca. - 92107
Tel: (619) 234-9411 Fax: (619) 234-9433

ENGINEER OF WORK

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY JOHN DEWITT
No. 46579
Exp. 06\30\99
CIVIL
STATE OF CALIFORNIA

4-16-99
TIMOTHY J. DEWITT R.C.E. 46579 DATE

PID\PCD NO. 96-0165

PRIVATE CONTRACT J-095217.02

PLANS FOR THE IMPROVEMENT OF :

STORM DRAIN IN SPECTRUM CENTER COURT

CITY OF SAN DIEGO, CALIFORNIA
ENGINEERING DEPARTMENT
SHEET 42 OF 51 SHEETS

FOR CITY ENGINEER 4/28/99 DATE

W.O. NO. TM-96-0165 980969

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	KHA			MAY 13 99
A CHANGE	KHA		9/24/99	OCT 8 99
AS-BUILT	KHA	P.E.S.	5/6/02	SEP 3 02

CONTRACTOR CASS CONST. DATE STARTED 6/99
INSPECTOR HANI ASSI DATE COMPLETED 1/9/01

1882-6289
NAD 83
242-1729
LAMBERT COORDINATES

29636-42-D

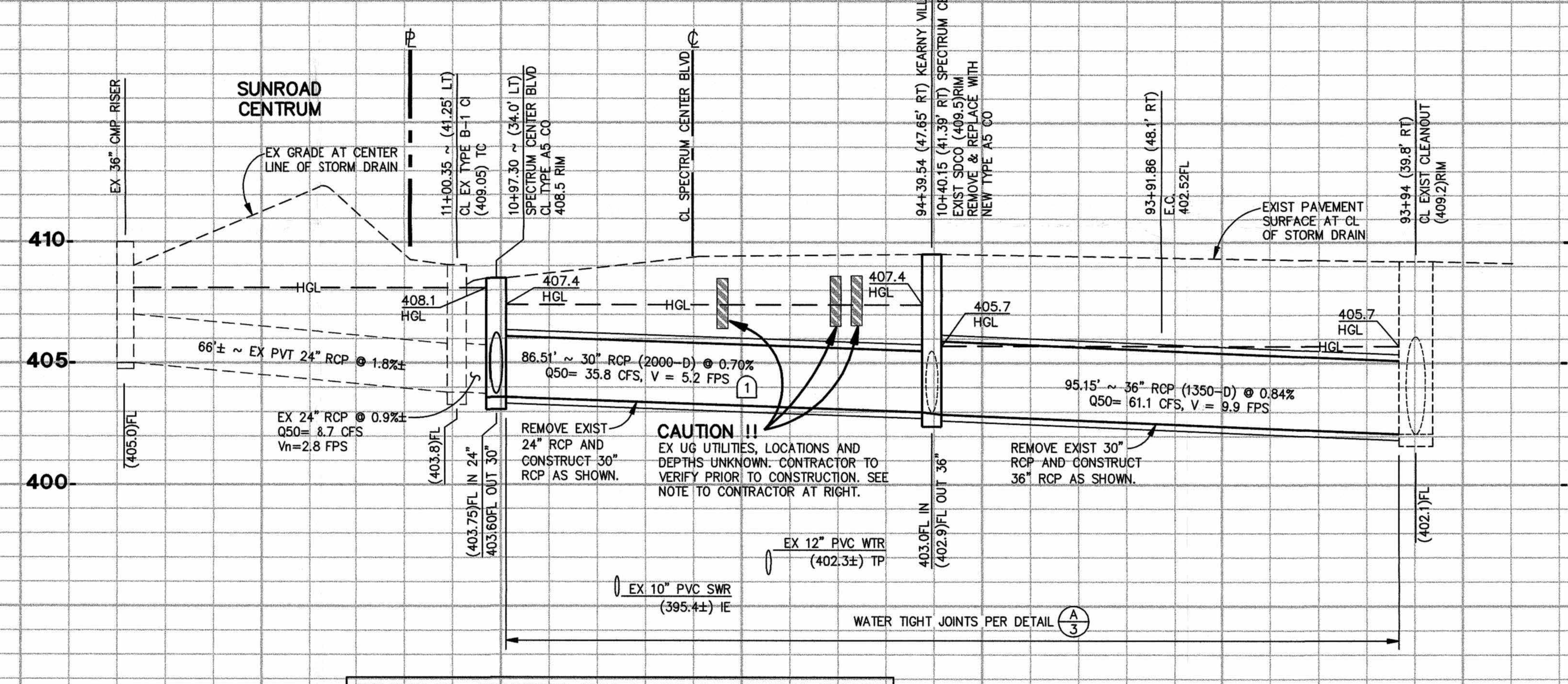
A REVISE STORM DRAIN PIPE LENGTHS & GRID ELEV.

AS-BUILT

PLOTTED : 22 APR 1999 s:\dgn\095217.01\170lgp42.dgn

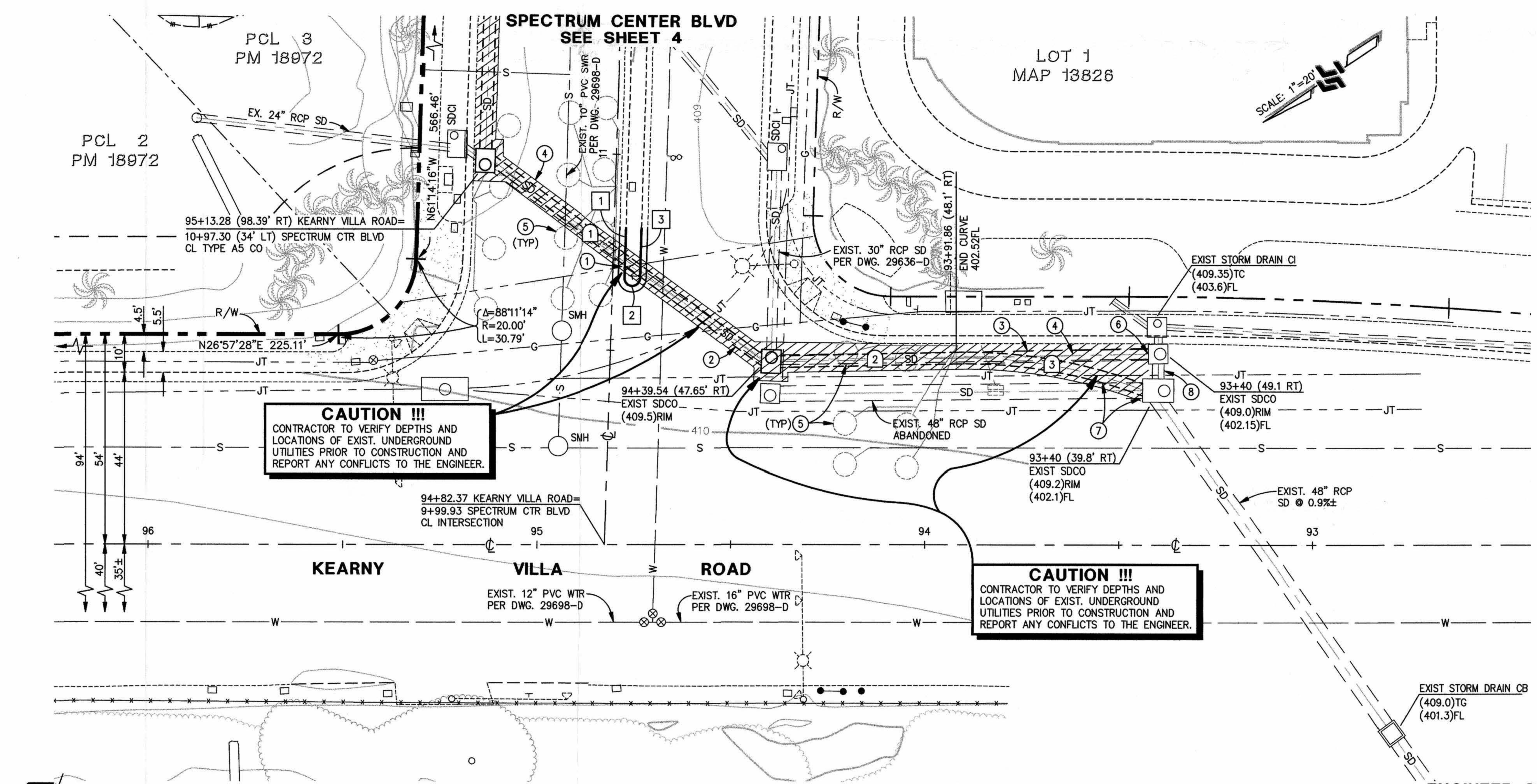
CONSTRUCTION CHANGE

FILMED FROM THE ORIGINAL
BEST QUALITY OBTAINABLE



PROFILE: KEARNY VILLA ROAD STORM DRAIN

SCALE: 1"= 20' HORIZ.; 1"= 4' VERT.



PLAN: KEARNY VILLA ROAD STORM DRAIN

SCALE: 1"=20'

SCALE: 1" = 20'

NOTE TO CONTRACTOR:
PRIOR TO ORDERING MATERIALS FOR STORM DRAIN WORK SHOWN ON THIS SHEET, POTHOLE ALL EXISTING UTILITIES AT CROSSINGS TO VERIFY FEASIBILITY OF PROPOSED CONSTRUCTION. REPORT ANY CONFLICTS TO ENGINEER OF WORK. CHANGES TO THIS DESIGN MAY REQUIRE A CONSTRUCTION CHANGE APPROVED BY THE CITY ENGINEER.

CURB DATA

NO.	BEARING–DELTA	RADIUS	LENGTH	REMARKS
1	N61°14'16"W	--	13.00'	6" TYPE B-2 MEDIAN
2	Δ =180°00'00"	2.00'	6.28'	6" TYPE B-2 MEDIAN
3	N61°14'16"W	--	13.00'	6" TYPE B-2 MEDIAN

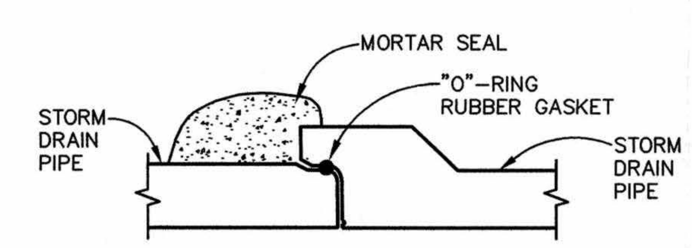
STORM DRAIN DATA (1350-D)

NO.	BEARING–DELTA	RADIUS	LENGTH	REMARKS
1	N63°10'34"E	--	86.51'	30" RCP (WTJ)
2	N25°44'04"E	--	45.64'	36" RCP (WTJ)
3	Δ =21°49'13"	130.00'	49.5'±	36" RCP (WTJ, BEVELED)
4				

(WTJ) INDICATES WATER TIGHT JOINTS PER DETAIL A/3

CONSTRUCTION NOTES

1. REMOVE AND REPLACE MEDIAN CURB (TYPE B-2) AND MEDIAN SURFACE TO ALLOW STORM DRAIN CONSTRUCTION (MATCH EXIST FINISHES).
2. EXIST 24" RCP SD PER DWG 29636-D TO BE REMOVED AND REPLACED WITH 30" RCP.
3. EXIST 30" RCP SD PER DWG 29636-D TO BE REMOVED AND REPLACED WITH 36" RCP.
4. TRENCH RESURFACING PER SDG-107
5. REPLACE TRAFFIC SIGNAL DETECTOR LOOPS AS REQ'D PER CITY SPECS.
6. PLUG EXISTING 30" OPENING AT NORTH SIDE OF EXISTING CLEANOUT; ABANDON IN PLACE (OR REMOVE IF DIRECTED BY THE CITY ENGINEER) PORTION OF EXISTING 30" RCP THAT IS NOT IN CONFLICT WITH PROPOSED 36" RCP. ABANDONMENT PER GREENBOOK SPECIFICATIONS.
7. PORTION OF EXISTING 48" RCP ABANDONED STORM DRAIN, REMOVE AS REQUIRED TO MAKE NEW CONNECTION SHOWN.
8. EXISTING 30" RCP STORM DRAIN PER DWG 29636-D TO REMAIN, PROTECT IN PLACE.



WATER TIGHT JOINT DETAIL A/3

(W.T.J) NO SCALE

STEVENS·CRESTO ENGINEERING, INC.
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PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

ENGINEER OF WORK

JOSEPH G. CRESTO
R.C.E. 45601
DATE

REGISTERED PROFESSIONAL ENGINEER JOSEPH G. CRESTO No. 45601 Exp. 12-31-06 CIVIL STATE OF CALIFORNIA

BENCH MARK
BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE
ELEV: 414.797 M.S.L.

PRIVATE CONTRACT

IMPROVEMENT PLAN FOR:

KEARNY VILLA ROAD
STORM DRAIN REPLACEMENT

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 3 OF SHEETS

W.O. NO. ______
P.T.S NO. ______
V.T.M. ______

FOR CITY ENGINEER ______ DATE ______

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

-3-D

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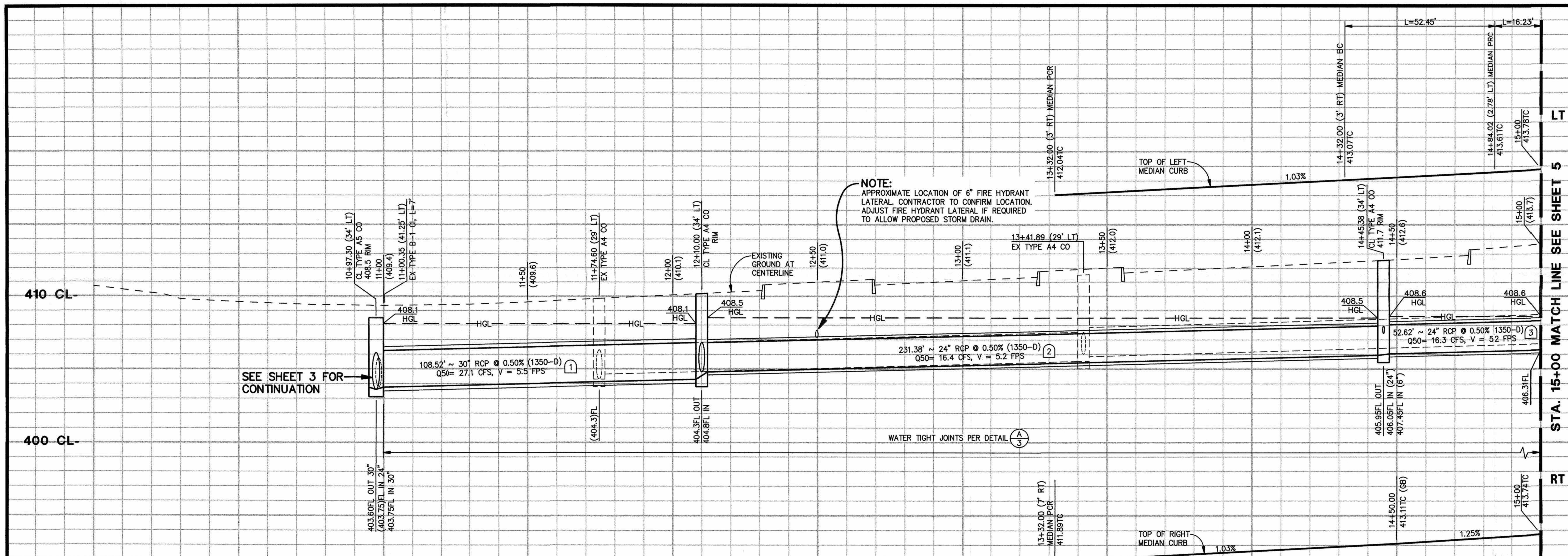
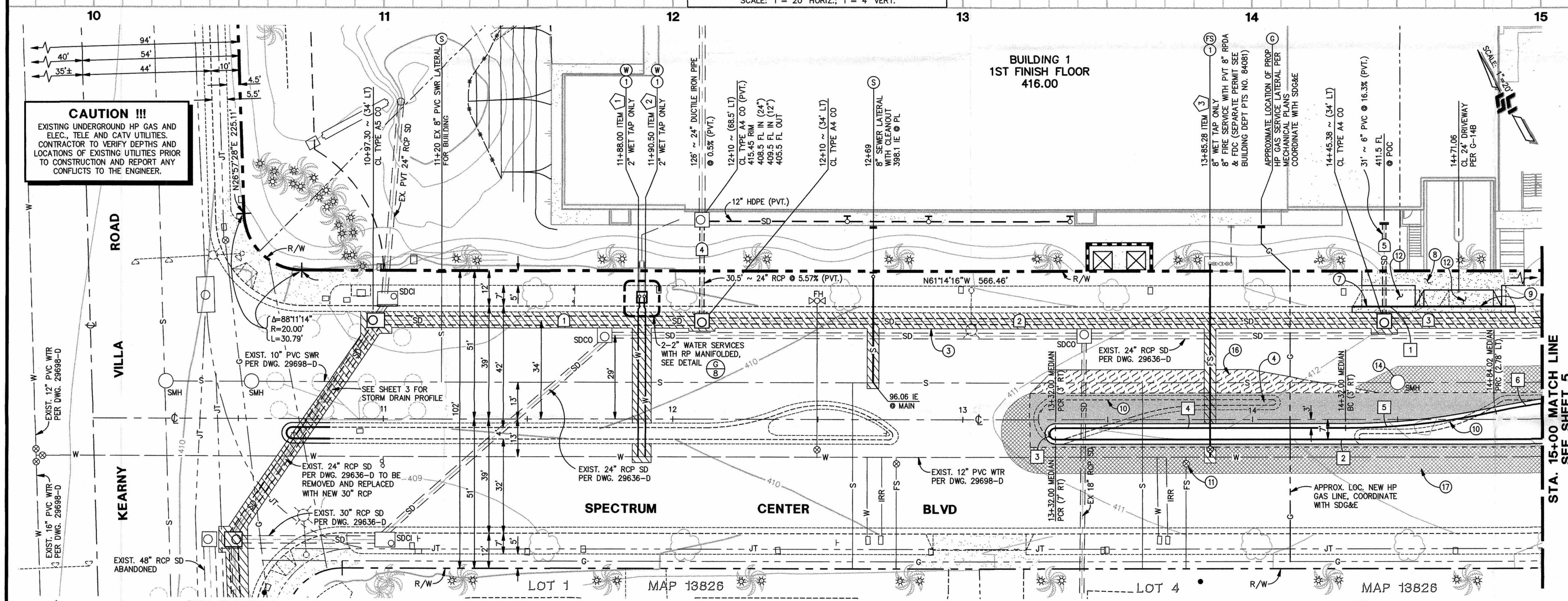
NOT FOR CONSTRUCTION



PROFILE: SPECTRUM CENTER BLVD

SCALE: 1"= 20' HORIZ.; 1"= 4' VERT.



PLAN: SPECTRUM CENTER BLVD

SCALE: 1"=20'

SCALE: 1" = 20'

CURB DATA				
NO.	BEARING-DELTA	RADIUS	LENGTH	REMARKS
1	N61°14'16"W	--	19.76'	6" TYPE "H" C & G
2	N61°14'16"W	--	168.00'	6" TYPE B-2 MEDIAN
3	Δ =180°00'00"	2.00'	6.28'	6" TYPE B-2 MEDIAN
4	N61°14'16"W	--	100.00'	6" TYPE B-2 MEDIAN
5	Δ =12°40'49"	237.00'	52.45'	6" TYPE B-2 MEDIAN
6	Δ =05°22'25"	173.00'	16.23'	6" TYPE B-2 MEDIAN

STORM DRAIN DATA (PVT.) (1350-D)				
NO.	BEARING-DELTA	RADIUS	LENGTH	REMARKS
1	N61°14'16"W	--	108.52'	30" RCP (WTJ)
2	N61°14'16"W	--	231.38'	24" RCP (WTJ)
3	N61°14'16"W	--	52.62'	24" RCP (WTJ)
4	N28°45'44"E	--	30.50'	24" RCP (WTJ)
5	N28°45'44"E	--	31.00'	6" PVC (SDR-35)

(WTJ) INDICATES WATER TIGHT JOINTS PER DETAIL A/3

CONSTRUCTION NOTES

1. CONTRACTOR TO PROVIDE ALL NECESSARY LABOR AND MATERIALS FOR INSTALLATION OF WATER LATERALS. CITY FORCES TO PROVIDE LABOR ONLY FOR THE WET TAP INSTALLATION.
2. SAWCUT LINE LIMIT
3. TRENCH RESURFACING PER SDG-107
4. SCHEDULE "J" PAVEMENT PER SDG-113
7. 6" TYPE "H" CURB AND GUTTER PER RSD G-2
8. 4" P.C.C. NON-CONTIGUOUS SIDEWALK PER RSD G-7, G-9 AND G-11.
9. PCC DRIVEWAY PER RSD G-14B
10. REMOVE EXISTING CONCRETE CURB & GUTTER OR MEDIAN CURB
11. ADJUST GATE VALVE BOX TO NEW GRADE
12. REMOVE EXISTING PCC DRIVEWAY
14. ADJUST MH FRAME AND COVER TO NEW GRADE.
16. COLD PLANE EXIST ASPHALT 2" DEEP AT CONTACT BETWEEN NEW AND EXIST PAVEMENT. PROVIDE 2" MIN OVERLAY ON COLD PLANED AREA FOR SMOOTH TRANSITION.
17. COLD PLANE EXIST ASPHALT 6' (MIN) WIDE AND 2" DEEP AT CONTACT BETWEEN NEW AND EXIST PAVEMENT. PROVIDE 2" OVERLAY ON COLD PLANED AREA FOR SMOOTH TRANSITION. SEE DETAIL A/5

PRIVATE CONTRACT

IMPROVEMENT PLAN FOR:

SPECTRUM CENTER BOULEVARD

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 4 OF SHEETS

W.O. NO. ______
P.T.S NO. ______
V.T.M. ______

FOR CITY ENGINEER ______ DATE ______

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

-4-D

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PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

ENGINEER OF WORK

REGISTERED PROFESSIONAL ENGINEER
JOSEPH G. CRESTO
No. 45601
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

JOSEPH G. CRESTO ______ DATE
R.C.E. 45601

BENCH MARK

BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE
ELEV: 414.797 M.S.L.

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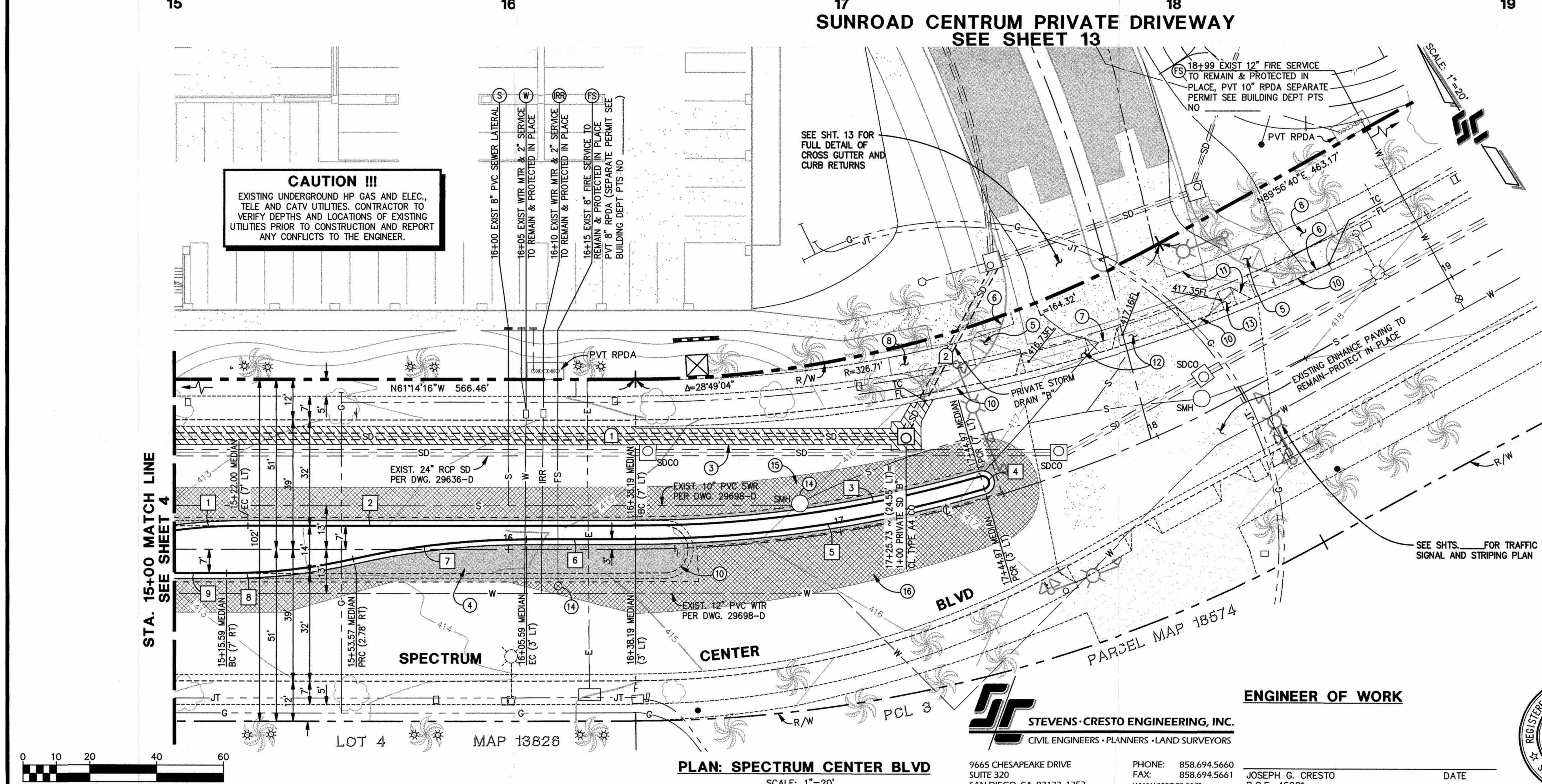
NOT FOR CONSTRUCTION

PROFILE: PVT STORM DRAIN "B" SPECTRUM CENTER BLVD

SCALE: 1"=20' HORIZ.; 1"=4' VERT.

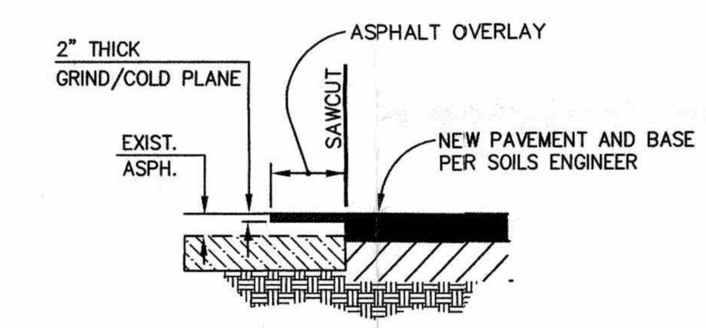
PROFILE: SPECTRUM CENTER BLVD

SCALE: 1"= 20' HORIZ.; 1"= 4' VERT.



PLAN: SPECTRUM CENTER BLVD

SCALE: 1"=20'



PAVEMENT JOINT DETAIL

PER CONSTRUCTION NOTE 17 SHT. 4

NO SCALE

A/5

CURB DATA

NO.	BEARING-DELTA	RADIUS	LENGTH	REMARKS
	Δ =07°18'24"	173.00'	22.06'	6" TYPE B-2 MEDIAN
	N61°14'16"W	--	116.19'	6" TYPE B-2 MEDIAN
3	Δ =16°11'54"	370.71'	104.80'	6" TYPE B-2 MEDIAN
4	Δ =180°00'00"	2.00'	6.28'	6" TYPE B-2 MEDIAN
5	Δ =16°11'54"	374.71'	105.94'	6" TYPE B-2 MEDIAN
6	N61°14'16"W	--	32.60'	6" TYPE B-2 MEDIAN
7	Δ =12°40'49"	237.00'	52.45'	6" TYPE B-2 MEDIAN
8	Δ =12°40'49"	173.00'	38.29'	6" TYPE B-2 MEDIAN
9	N61°14'16"W	--	15.59'	6" TYPE B-2 MEDIAN

STORM DRAIN DATA (PVT.) (1350-D)

NO.	BEARING-DELTA	RADIUS	LENGTH	REMARKS
1	N61°14'16"W	--	217.31'	24" RCP (WTJ)
2	N57°32'48"E	--	55.02'	24" RCP (WTJ)

(WTJ) INDICATES WATER TIGHT JOINTS PER DETAIL A/3

CONSTRUCTION NOTES

3. TRENCH RESURFACING PER SDG-107
4. SCHEDULE "J" PAVEMENT PER SDG-113
5. PEDESTRIAN RAMP (TYPE A) PER RSD SDG-132, SDG-130 & SDG-137
6. 6" CURB INTEGRAL TO CROSS GUTTER
7. CONCRETE CROSS GUTTER PER G-12
8. 4" P.C.C. NON-CONTIGUOUS SIDEWALK PER RSD G-7, G-9 AND G-11.
10. REMOVE EXISTING CONCRETE CURB & GUTTER OR MEDIAN CURB
11. REMOVE EXISTING PCC SIDEWALK
12. REMOVE EXISTING PCC DRIVEWAY
13. REMOVE EXISTING PEDESTRIAN RAMP
14. ADJUST FRAME AND COVER TO NEW GRADE.
15. COLD PLANE EXIST ASPHALT 2" DEEP AT CONTACT BETWEEN NEW AND EXIST PAVEMENT. PROVIDE 2"-3.5" OVERLAY ON COLD PLANED AREA FOR SMOOTH TRANSITION.
16. COLD PLANE EXIST ASPHALT 2" DEEP AT CONTACT BETWEEN NEW AND EXIST PAVEMENT. PROVIDE 2" MIN OVERLAY ON COLD PLANED AREA FOR SMOOTH TRANSITION.

STEVENS·CRESTO ENGINEERING, INC.
CIVIL ENGINEERS · PLANNERS · LAND SURVEYORS
9665 CHESAPEAKE DRIVE
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SAN DIEGO, CA 92123-1352
PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

ENGINEER OF WORK

JOSEPH G. CRESTO
R.C.E. 45601
DATE

REGISTERED PROFESSIONAL ENGINEER · JOSEPH G. CRESTO · No. 45601 · Exp. 12-31-06 · CIVIL · STATE OF CALIFORNIA

BENCH MARK

BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE
ELEV: 414.797 M.S.L.

PRIVATE CONTRACT

IMPROVEMENT PLAN FOR:

SPECTRUM CENTER BOULEVARD

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 5 OF SHEETS

W.O. NO. ______
P.T.S NO. ______
V.T.M. ______

______ FOR CITY ENGINEER ______ DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

-5-D

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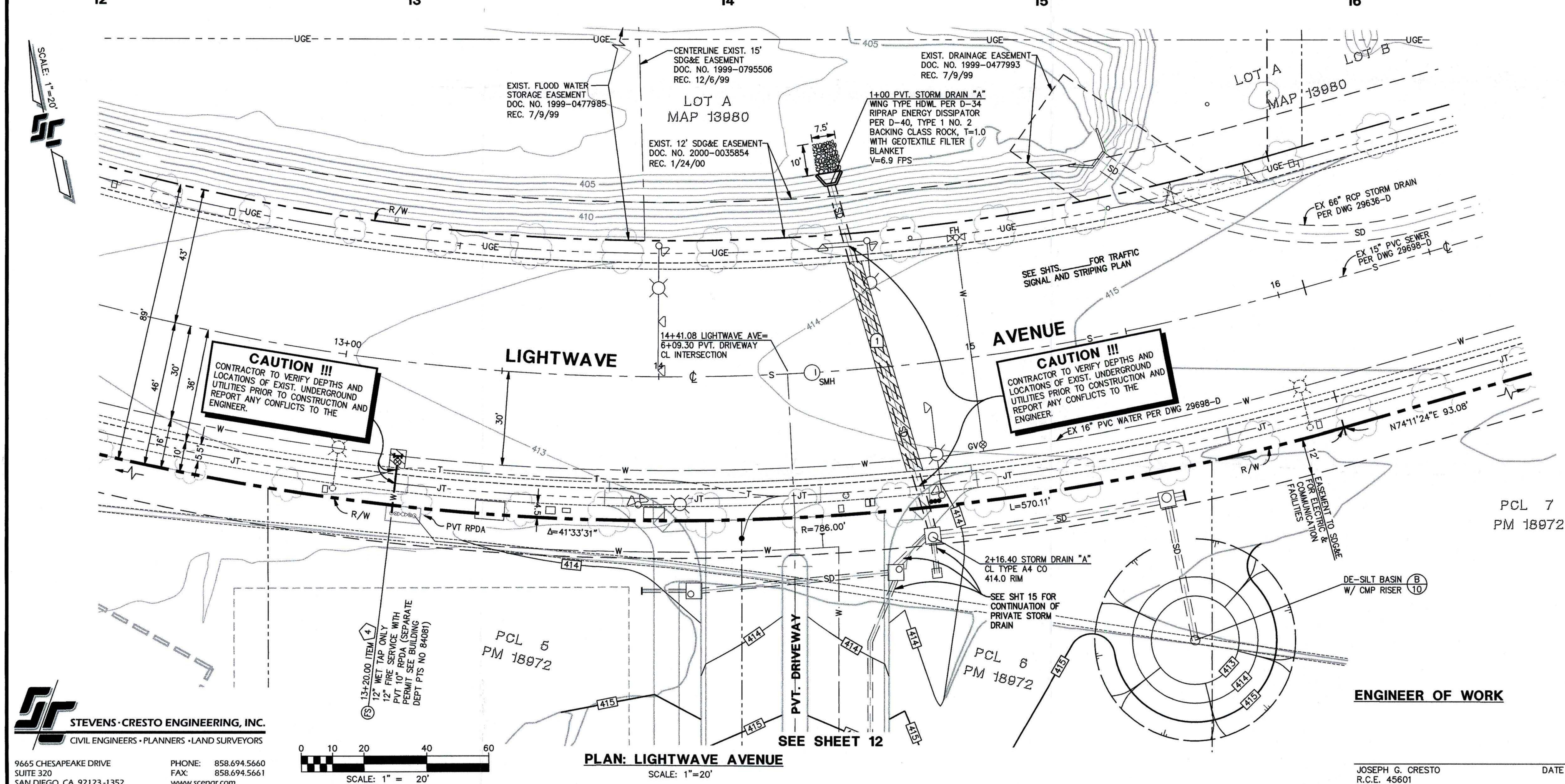

STORM DRAIN DATA (PVT.)				
NO.	BEARING-DELTA	RADIUS	LENGTH	REMARKS
1	N16°23'49"W	--	114.40'	30" RCP (WTJ)

(WTJ) INDICATES WATER TIGHT JOINTS PER DETAIL A/3

THE WORK INCLUDED UNDER THE ENGINEERING PERMIT FOR THESE DRAWINGS INCLUDES GRADING AND DRAINAGE. PRIVATE IMPROVEMENTS SHOWN HEREON ARE COVERED UNDER SEPARATE BUILDING PERMIT FOR THIS DEVELOPMENT.

STEVENS·CRESTO ENGINEERING, INC.
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PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

ENGINEER OF WORK

JOSEPH G. CRESTO
R.C.E. 45601
DATE

REGISTERED PROFESSIONAL ENGINEER JOSEPH G. CRESTO No. 45601 Exp. 12-31-06 CIVIL STATE OF CALIFORNIA

PRIVATE CONTRACT

IMPROVEMENT PLAN FOR:

LIGHTWAVE AVENUE

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 6 OF SHEETS

W.O. NO. ______
P.T.S NO. ______
V.T.M. ______

FOR CITY ENGINEER ______ DATE ______

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

-6-D

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NOT FOR CONSTRUCTION

5

SECTION 5

APPENDIX A

~ 095217010

00018.02 | MKS

GOVT / IN | MKS

Kimley-Horn
and Associates, Inc.

agreed
M. Sammak
10/17/00

Suite 301
517 Fourth Avenue
San Diego, California
92101

Memorandum

To: File, Distribution

From: John Morris, Chuck Spinks

Date: October 11, 2000

Subject: Meeting with Mo Sammak, Senior Civil Engineer, City of San Diego, Land Development Review Division.

- A meeting was held with Mo Sammak at 3:30 on Wednesday, October 4 to discuss an hydrology issue for the Spectrum project. The issue is the higher Q's calculated for the private systems in the individual lots using the standard City Rational Method than the design Q's for the public system calculated using HEC-1.

- The detention basins, the back bone system in the streets, and the public laterals connecting this system to the individual lots, were designed for the 50 year Q using HEC-1. The storm drain laterals to the individual lots where placed at a flat slope to keep the connection point on each individual lot as low as practical. The low connection point increases the flexibility for the design of the on-site private systems, which is important on the very flat Spectrum project.

- The 50 year Q's calculated using the Rational Method for the individual lots are usually slightly larger than the Q's calculated using HEC-1. As a result, the laterals connecting to the main system may be surcharged using the higher Rational Method Q's.

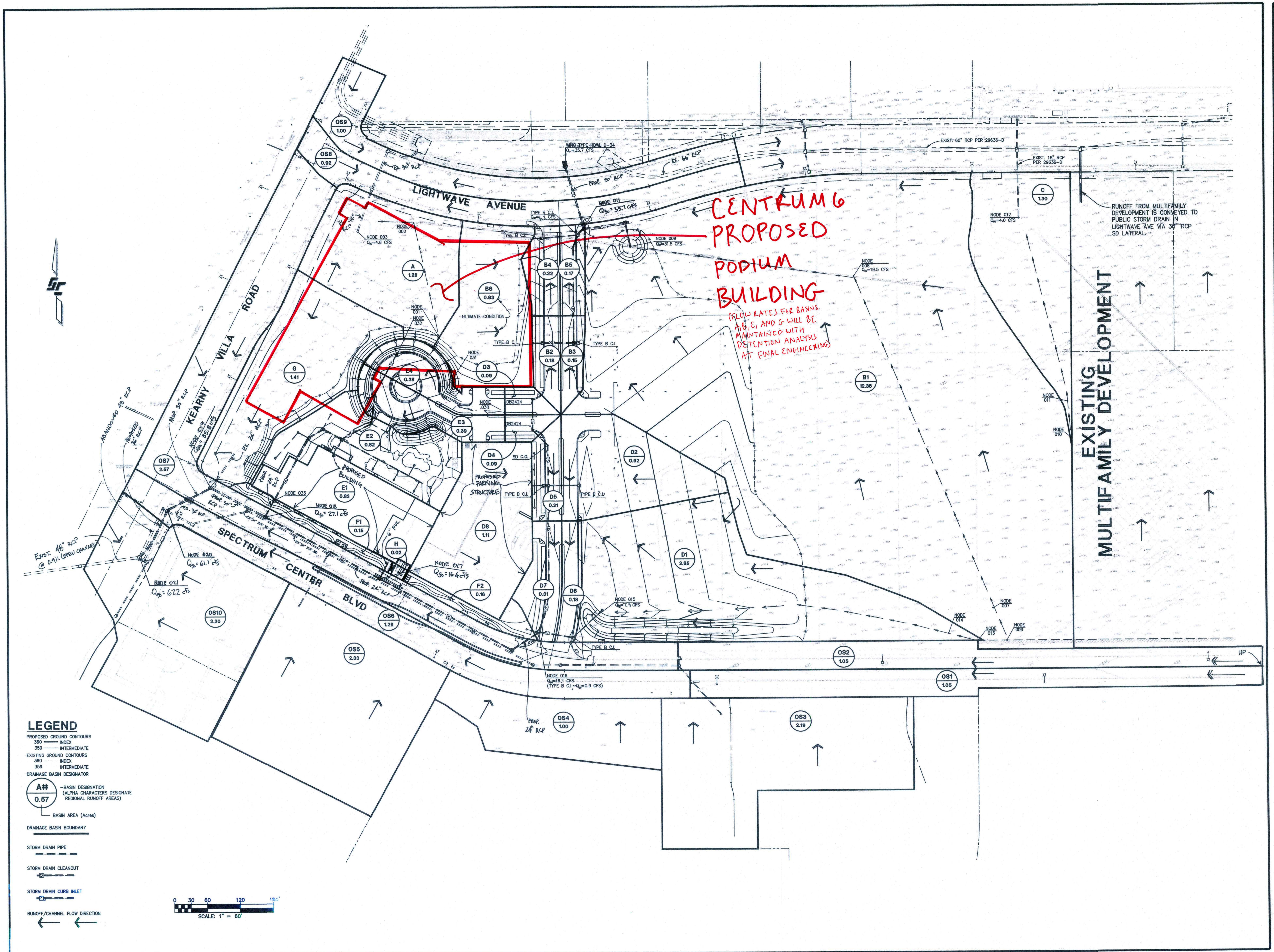
TEL 619 234 9411
FAX 619 234 9433

Kimley-Horn
and Associates, Inc.

Conclusion

- Mo is very comfortable with the public system design. It has been approved and signed by the City, and constructed according to the approved plans.
- Mo will accept some surcharge in the laterals and in the private, on-site systems, as long as the calculated HGL using the higher Rational Method Q's, is below the ground elevations on the site.
- Mo will ensure that the Plan Check process will not be delayed because of this issue.

Distribution: Mo Sammak- City of San Diego
Jack Ritchie- Lennar Partners



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SUITE 107
SAN DIEGO, CA 92123-1324
PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

REVISIONS

CENTRUM 12

KEARNY MESA, CALIFORNIA

EXHIBIT "B"

PROPOSED CONDITION

DATE: 2/01/06

SCE NO. 00018.14

SHEET B

1 OF 1 SHEETS

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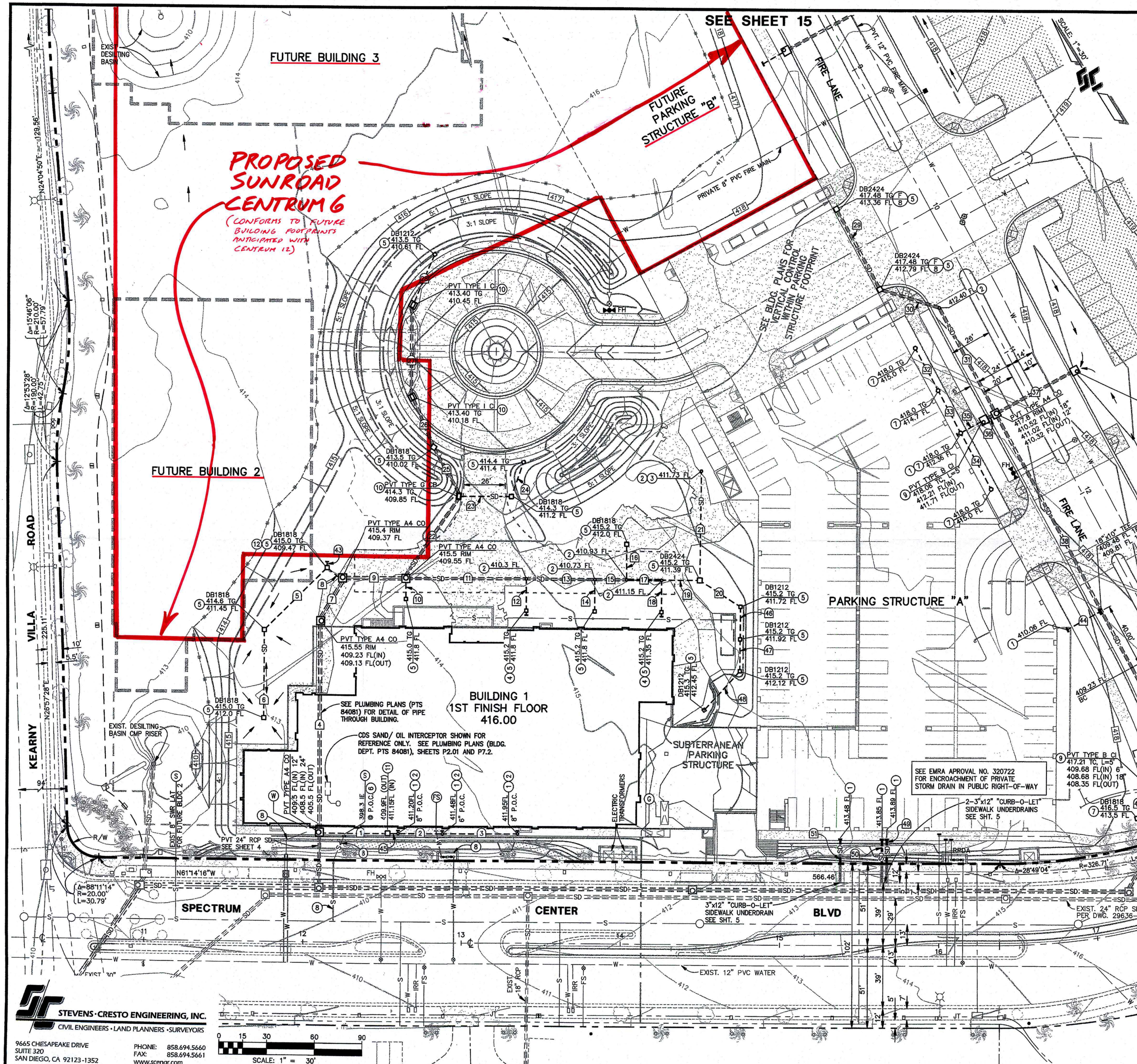
4

SECTION 4

CITY OF SAN DIEGO DRAWING NO. 34009-14-D AND 34009-15-D



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PHONE: 858.694.5660
FAX: 858.694.5661
www.scengr.com

SCALE: 1" = 30'

PRIVATE UTILITY CONSTRUCTION NOTES

1. P.O.C. FOR ROOF DRAIN – SEE PLUMBING PLANS FOR CONTINUATION.
2. PRIVATE STORM DRAIN CLEANOUT PER RSD S-3, TYPE B.
3. STUB OUT FOR FUTURE CONNECTION.
4. PROVIDE 6" STUB FOR ROOF DRAIN CONNECTION.
5. PRECAST CONCRETE CATCH BASIN PER DETAIL C/8 (DB1212 U.N.O.) USE TYPE 1 OUTLET UNLESS NOTED OTHERWISE.
6. P.O.C. FOR BUILDING SEWER – (5' OUTSIDE BUILDING ENVELOPE) SEE PLUMBING PLANS FOR CONTINUATION.
7. PRIVATE PLASTIC CATCH BASIN, SEE DETAIL H/8
8. PRIVATE SEWER AND WATER BY SEPARATE PERMIT. SEE PRIVATE SITE UTILITY PLAN WITHIN ARCHITECTURAL SET (BLDG. DEPT. PROJ. NO. PTS 84081). SEE "PRIVATE WATER, SEWER AND FIRE SERVICE NOTE" BELOW.
9. STORM WATER BMP FILTER INSERT PER E/8
10. STORM WATER BMP FILTER INSERT PER F/8
11. 3' x 3' PRECAST CONCRETE BOX W/ GALV. STEEL GRATE. INSTALL BIOCLEAN/ SUNTREE TECHNOLOGIES CURB INLET BASKET SYSTEM (23¾" WIDE) WITH SHELF ON UPSTREAM SIDE OF BOX (SIMILAR TO DETAIL E/8). INCLUDE STORM BOOMS IN BASKET.
12. P.O.C. FOR FUTURE BUILDING 2 ROOF DRAINS, PROVIDE 3' LONG 12" PVC STUB & PLUG AT NORTH SIDE OF BOX @ 1% (PIPE NO. 43) FL @ PLUG = 409.5

STORM DRAIN DATA (PVT.)

NO.	LENGTH	SLOPE	SIZE	REMARKS
1	40.00'	1.00%	12"	HDPE
2	28.00'	1.00%	10"	PVC
3	47.00'	1.00%	8"	PVC
4	126.00'	0.50%	24"	DIP – SEE PLUMBING
5	55.00'	3.6%	8"	PVC
6	55.00'	1.00%	6"	PVC
7	26.41'	0.50%	24"	HDPE
8	10.00'	1.00%	12"	PVC
9	36.00'	0.50%	24"	HDPE
10	10.50'	21.4%	6"	PVC
11	73.50'	1.00%	15"	HDPE
12	19.50'	7.70%	6"	PVC
13	43.00'	1.00%	15"	HDPE
14	19.50'	5.50%	6"	PVC
15	20.00'	1.00%	15"	HDPE
16	22.00'	4.90%	8"	PVC
17	22.00'	1.00%	12"	HDPE
18	19.50'	1.00%	8"	PVC
19	24.00'	1.00%	8"	PVC
20	30.00'	1.00%	8"	PVC
21	67.77'	0.50%	6"	PVC
22	57.84'	0.50%	18"	HDPE
23	32.03'	4.21%	8"	PVC
24	22.52'	1.00%	6"	PVC
25	33.14'	0.50%	18"	HDPE
26	32.27'	0.50%	6"	PVC
27	54.45'	0.50%	12"	HDPE
28	32.27'	0.50%	8"	PVC
29	57.00'	1.00%	12"	HDPE
30	38.89'	1.00%	12"	HDPE
31	72.50'	1.90%	12"	HDPE
32	30.00'	1.00%	6"	PVC
33	30.00'	7.80%	6"	PVC
34	40.00'	6.60%	6"	PVC
35	14.75'	1.00%	12"	HDPE
36	4.25'	2.80%	18"	HDPE
37	52.25'	0.50%	18"	HDPE
38	177.15'	0.60%	18"	HDPE
39	88.92'	0.60%	18"	HDPE, R=200'
40	69.92'	1.00%	18"	HDPE
41	60.57'	1.00%	18"	HDPE
42	20.00'	19%	8"	PVC
43	3.00'	1.00%	12"	PVC
44	24.50'	1.00%	10"	PVC
45	5.00'	1.00%	12"	PVC
46	20.00'	1.00%	8"	PVC
47	20.00'	1.00%	6"	PVC
48	33.00'	1.00%	6"	PVC
49	15.50'	2.00%	6"	PVC
50	15.50'	2.00%	6"	PVC
51	15.50'	2.00%	6"	PVC

- ALL PVC STORM DRAIN PIPE SHALL CONFORM TO SDR-35.
- PIPE LENGTHS SHOWN ARE TO INSIDE FACE OF STRUCTURE FOR CAST-IN-PLACE STRUCTURES AND TO CENTER OF PRECAST CATCH BASINS.
- HDPE PIPE SHALL HAVE WATER-TIGHT JOINTS.
- ALL BEDDING FOR STORM DRAIN PIPE SHALL BE PER RSD S-4 (TYPE C).

PRIVATE WATER, SEWER AND FIRE SERVICE NOTE

1. ALL PROPOSED PRIVATE SEWER AND WATER IMPROVEMENTS SHOWN ON THESE PLANS ARE FOR REFERENCE ONLY TO AVOID CONFLICTS AND TO SHOW CONNECTIONS TO PUBLIC SEWER AND WATER LATERALS AND MAINS. CITY ENGINEER SIGNATURE DOES NOT CONSTITUTE APPROVAL OF PRIVATE SEWER AND WATER SHOWN ON THESE PLANS. ALL PROPOSED PRIVATE SEWER AND WATER SHOWN ON THESE PLANS SHALL BE INSTALLED UNDER SEPARATE PLUMBING PERMIT ISSUED BY THE CITY OF SAN DIEGO.
2. ALL PLANS FOR PRIVATE FIRE SERVICE MAINS AND PRIVATE FIRE HYDRANTS MUST BE SUBMITTED SEPARATELY TO FIRE PLAN CHECK FOR APPROVAL PRIOR TO INSTALLATION. ALL PRIVATE FIRE SYSTEMS WILL BE DESIGNED IN ACCORDANCE WITH CALIFORNIA BUILDING CODE; CALIFORNIA FIRE CODE; AND NFPA 24, PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES. PLANS SHALL BE SINGLE LINE DRAWINGS SHOWING ALL OF THE APPLICABLE REQUIREMENTS OF THE CODES SPECIFIED ABOVE.

THE WORK INCLUDED UNDER THE ENGINEERING PERMIT FOR THESE DRAWINGS INCLUDES GRADING AND DRAINAGE. PRIVATE IMPROVEMENTS SHOWN HEREON ARE COVERED UNDER SEPARATE BUILDING PERMIT FOR THIS DEVELOPMENT.

ENGINEER OF WORK

Joseph G. Cresto 8/8/06
JOSEPH G. CRESTO DATE
R.C.E. 45601

REGISTERED PROFESSIONAL ENGINEER
JOSEPH G. CRESTO
No. 45601
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

BENCH MARK

BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE
ELEV: 414.797 M.S.L.

PRIVATE CONTRACT

PRIVATE STORM DRAIN PLAN FOR:

SUNROAD CENTRUM 12

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 14 OF 33 SHEETS

W.O. NO. 426200
P.T.S NO. 98300

FOR CITY ENGINEER 8/15/06 DATE

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

34009-14-D

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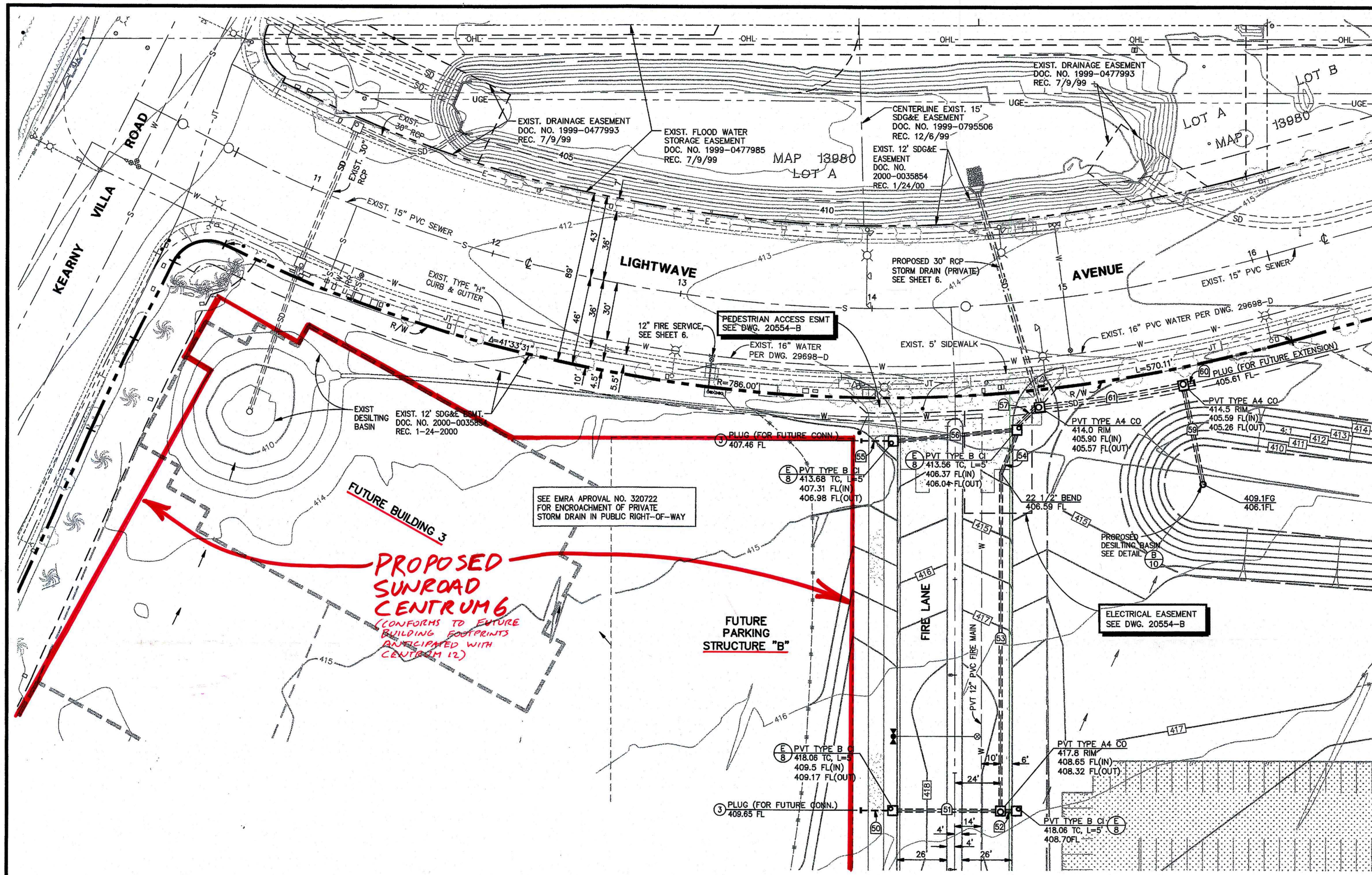

SEE SHEET 14 FOR CONTINUATION

PRIVATE UTILITY CONSTRUCTION NOTES

1. P.O.C. FOR ROOF DRAIN – SEE PLUMBING PLANS FOR CONTINUATION.
2. PRIVATE STORM DRAIN CLEANOUT PER RSD S-3, TYPE B.
3. STUB OUT FOR FUTURE CONNECTION.
4. PROVIDE 6" STUB FOR ROOF DRAIN CONNECTION.
5. PRECAST CONCRETE CATCH BASIN PER DETAIL C/8 (DB1212 U.N.O.) USE TYPE 1 OUTLET UNLESS NOTED OTHERWISE.
6. P.O.C. FOR BUILDING SEWER – (5' OUTSIDE BUILDING ENVELOPE) SEE PLUMBING PLANS FOR CONTINUATION.
7. PRIVATE PLASTIC CATCH BASIN, SEE DETAIL H/8
8. PRIVATE SEWER AND WATER BY SEPARATE PERMIT. SEE PRIVATE SITE UTILITY PLAN WITHIN ARCHITECTURAL SET (BLDG. DEPT. PROJ. NO. PTS 84081). SEE PRIVATE WATER, SEWER AND FIRE SERVICE NOTE AT BOTTOM (THIS SHEET).

STORM DRAIN DATA (PVT.)

NO.	LENGTH	SLOPE	SIZE	REMARKS
50	14.75'	1.00%	12"	HDPE
51	52.25'	1.00%	18"	HDPE
52	4.25'	1.00%	18"	HDPE
53	172.88'	1.00%	18"	HDPE
54	21.56'	1.00%	18"	HDPE
55	14.75'	1.00%	12"	HDPE
56	60.77'	1.00%	18"	HDPE
57	13.63'	1.00%	24"	HDPE
59	50.00'	1.00%	24"	HDPE
60	4.00'	0.50%	30"	HDPE
61	71.60'	0.50%	30"	HDPE, R=795.00'
62				
63				
64				
65				

- ALL PVC STORM DRAIN PIPE SHALL CONFORM TO SDR-35.
- PIPE LENGTHS SHOWN ARE TO INSIDE FACE OF STRUCTURE FOR CAST-IN-PLACE STRUCTURES AND TO CENTER OF PRECAST CATCH BASINS.
- HDPE PIPE SHALL HAVE WATER-TIGHT JOINTS.
- ALL BEDDING FOR STORM DRAIN PIPE SHALL BE PER RSD S-4 (TYPE C).

PRIVATE WATER, SEWER AND FIRE SERVICE NOTE

1. ALL PROPOSED PRIVATE SEWER AND WATER IMPROVEMENTS SHOWN ON THESE PLANS ARE FOR REFERENCE ONLY TO AVOID CONFLICTS AND TO SHOW CONNECTIONS TO PUBLIC SEWER AND WATER LATERALS AND MAINS. CITY ENGINEER SIGNATURE DOES NOT CONSTITUTE APPROVAL OF PRIVATE SEWER AND WATER SHOWN ON THESE PLANS. ALL PROPOSED PRIVATE SEWER AND WATER SHOWN ON THESE PLANS SHALL BE INSTALLED UNDER SEPARATE PLUMBING PERMIT ISSUED BY THE CITY OF SAN DIEGO.
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THE WORK INCLUDED UNDER THE ENGINEERING PERMIT FOR THESE DRAWINGS INCLUDES GRADING AND DRAINAGE. PRIVATE IMPROVEMENTS SHOWN HEREON ARE COVERED UNDER SEPARATE BUILDING PERMIT FOR THIS DEVELOPMENT.

ENGINEER OF WORK

REGISTERED PROFESSIONAL ENGINEER JOSEPH G. CRESTO No. 45601 Exp. 12-31-06 CIVIL STATE OF CALIFORNIA

JOSEPH G. CRESTO
R.C.E. 45601
DATE 8/8/06

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0 15 30 60 90
SCALE: 1" = 30'

BENCH MARK

BRASS PLUG IN TOP OF CURB INLET AT THE NE CORNER OF KEARNY VILLA ROAD AND BALBOA AVENUE
ELEV: 414.797 M.S.L.

PRIVATE CONTRACT

PRIVATE STORM DRAIN PLAN FOR:

SUNROAD CENTRUM 12

SUNROAD CENTRUM 12

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 15 OF 33 SHEETS

W.O. NO. 426200
P.T.S NO. 98300

FOR CITY ENGINEER — DATE 8/15/06

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	SCE			
AS-BUILTS				

1882-6289
NAD83 COORDINATES

242-1729
LAMBERT COORDINATES

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

34009-15-D

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ATTACHMENT 6
GEOTECHNICAL AND GROUNDWATER INVESTIGATION REPORT

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]	Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Locations at percolation test boring P-1 through P-7	Design
Criteria 1: Infiltration Rate Screening	

1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ○ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ○ Yes; Continue to Step 1C. ○ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ○ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ○ Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ○ Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ○ Yes; continue to Step 1G. ○ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ○ Yes; answer "Yes" to Criteria 1 Result. ○ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ○ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ○ No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

The project known as Sunroad Centrum 6 is in the design phase. A qualified representative for NOVA Services directed the drilling of seven percolation test borings (P-1 through P-3 in 2016) (P-4 through P-7 in 2017) to depths of approximately 5 to 6.5 feet below ground surface with continuously sampled exploratory borings to accompany each test to a depth of 10 feet below the bottom of the potential BMP basin bottom. The tests were conducted in compliance with the Borehole Percolation Tests method (D.3.3.2) of the BMP manual. The percolation rates were converted to infiltration rates by the Porchet Method. A factor of safety of 2 was used resulting in rates of P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	○ Yes	○ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	○ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	○ No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	○ Yes	○ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	○Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○Yes	○ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	○Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	○ Yes	○ No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	○ No

Summarize findings and basis; provide references to related reports or exhibits.

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	○ Full infiltration Condition ⊙ Complete Part 2

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		**Project Phase:**
Locations P-1 through P-7		Design Phase
Criteria 3 : Infiltration Rate Screening		
3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ○ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ⦿ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.	
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ○ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ⦿ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.	
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ○ Yes; Continue to Criteria 4. ⦿ No: Skip to Part 2 Result.	
Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate). The project known as Sunroad Centrum 6 is in the design phase. A qualified representative for NOVA Services directed the drilling of seven percolation test borings (P-1 through P-3 in 2016) (P-4 through P-7 in 2017) to depths of approximately 5 to 6.5 feet below ground surface with continuously sampled exploratory borings to accompany each test to a depth of 10 feet below the bottom of the potential BMP basin bottom. The tests were conducted in compliance with the Borehole Percolation Tests method (D.3.3.2) of the BMP manual. The percolation rates were converted to infiltration rates by the Porchet Method. A factor of safety of 2 was used resulting in rates of P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour.		

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	○ Yes	○ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	○ Yes	○ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	○ No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	○ Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	○ No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	○ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	○ No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	○ Yes	○ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	○ No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○ Yes	○ No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Summarize findings and basis; provide references to related reports or exhibits.	

Part 2 – Partial Infiltration Geotechnical Screening Result[5]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	○ Partial Infiltration Condition ⦿ No Infiltration Condition

[5] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

REPORT
PRELIMINARY GEOTECHNICAL INVESTIGATION

Sunroad Centrum 6
Spectrum Center Boulevard and Lightwave Avenue
San Diego, California

PREPARED FOR

SUNROAD
ENTERPRISES

Sunroad Enterprises
4445 Eastgate Mall, Suite 400
San Diego, California 92121

PREPARED BY

NOVA

NOVA Services, Inc.
4373 Viewridge Avenue, Suite B
San Diego, CA 92123

November 14, 2017
NOVA Project 1015310

NOVA
GEOTECHNICAL ■ MATERIALS ■ SPECIAL INSPECTIONS
SBE ■ SLBE ■ SCOOP

Mr. Craig Bachmann, Director of Construction
Sunroad Enterprises
4445 Eastgate Mall, Suite 400
San Diego, California 92121

November 14, 2017
Project No. 1015310

Subject: Report
Preliminary Geotechnical Investigation
Sunroad Centrum 6
Spectrum Center Boulevard and Lightwave Avenue
San Diego, California

Dear Mr. Bachmann:

NOVA Services, Inc. (NOVA) is pleased to forward herewith the above-referenced report. Work related to this report was completed by NOVA for Sunroad Enterprises in accordance with your request.

NOVA appreciates the opportunity to provide construction and design services to Sunroad Enterprises on its projects. Should you have any questions regarding this report or other matters, please contact the undersigned at (858) 292-7575.

Sincerely,

NOVA Services, Inc.

Wail Mokhtar
Project Manager

Bryan Miller-Hicks, C.E.G. 1323
Senior Geologist

PROFESSIONAL GEOLOGIST
BRYAN MILLER-HICKS
No. 1323
CERTIFIED ENGINEERING GEOLOGIST
Exp. 5/31/19
STATE OF CALIFORNIA

John F. O'Brien, P.E., G.E.
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REGISTERED PROFESSIONAL ENGINEER
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651
expires 3-31-2019
GEOTECHNICAL
STATE OF CALIFORNIA

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REPORT
PRELIMINARY GEOTECHNICAL INVESTIGATION
Sunroad Centrum 6
Kearny Villa Road and Lightwave Avenue, San Diego, California

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1.0 INTRODUCTION

1.1 Terms of Reference

1.1.1 General

This report provides recommendations for the design of foundations and development of permanent stormwater infiltration Best Management Practices ('BMPs') for the multi-family residential development now known as Sunroad Centrum 6. The work reported herein was completed by NOVA Services, Inc. (NOVA) for Sunroad Enterprises.

Sunroad Centrum 6 is sited on an undeveloped parcel located at the southeast corner of Kearny Villa Road and Lightwave Avenue in San Diego (hereafter, "the site"). Figure 1-1 depicts the site vicinity.

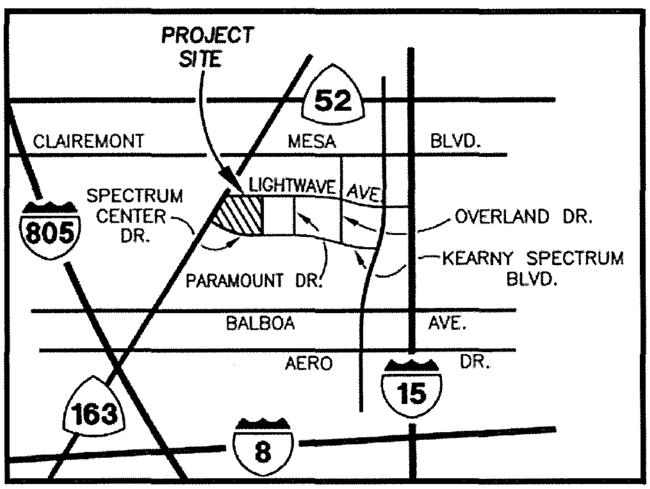


Figure 1-1. Vicinity Map

1.2 Objective, Scope, and Limitations of This Work

1.2.1 Objective

The objective of the work reported herein is twofold, namely: (i) to provide recommendations for the development of foundations for structures and related earthwork; and, (ii) to provide recommendations for siting and design of permanent stormwater infiltration Best Management Practices ('BMPs').

1.2.2 Scope

In order to accomplish this objective, NOVA undertook the scope of services as described below.

- Task 1, Background Review. Reviewed background data, principally prior site-specific geotechnical reporting, topographic maps, and geologic data. Preliminary development plans were reviewed. Structural design for the proposed development is not yet available.

- Task 2, Supplemental Infiltration Testing. Conducted infiltration testing at the design location of stormwater infiltration BMPs. This testing supplements similar work by NOVA in 2016.

- Task 3, Engineering Evaluations. Utilizing existing site data and information gained from coordination with the Architect, Structural Engineer, and Civil Engineer, NOVA completed engineering evaluations related to foundations and stormwater infiltration.

- Task 4, Reporting. Preparation of this report provides recommendations related to design and construction of foundations and permanent stormwater infiltration BMPs.

1.2.3 Limitations

The recommendations for design and construction included in this report are not final. These recommendations are developed by NOVA using judgment and opinion and based on the information available at the time of the report. NOVA can finalize its recommendations only by observing actual subsurface conditions revealed during construction. NOVA cannot assume responsibility or liability for the report's recommendations if NOVA does not perform construction observation.

This report does not address any environmental assessment or investigation for the presence or absence of hazardous, toxic or regulated materials in the soil, groundwater, or surface water within or beyond the site.

1.3 Understood Use of This Report

NOVA expects that the findings and recommendations provided herein will be utilized by the Design Team in certain decision-making regarding design and construction of the planned development.

NOVA's recommendations are based on our current understanding and assumptions regarding project development. Effective use of this report by the Design Team should include review by NOVA of the final design. Such review is important for both (i) conformance with the recommendations provided herein, and (ii) consistency with NOVA's understanding of the planned development.

1.4 Report Organization

The remainder of this report is organized as abstracted below.

- Section 2 reviews available project information.
- Section 3 describes field exploration by NOVA.
- Section 4 describes the surface and subsurface conditions.
- Section 5 reviews geologic and soil hazards that may affect the site.
- Section 6 provides recommendations for earthwork and foundation design.
- Section 7 discusses design and implementation of temporary shoring.
- Section 8 provides recommendations for development of pavements.
- Section 9 provides recommendations for development of stormwater infiltration BMPs.
- Section 10 provides a list of the principal references utilized in the development of the report.

Figures that directly support discussion in the text are embedded therein. Larger scale plots of subsurface information are provided as Plates immediately following the text of the report. The report is supported by five appendices. Appendix A provides guidance regarding the use and limitations of the report. Appendices B and E provide boring logs by NOVA and Geocon, respectively. Appendix C provides infiltration worksheets. Appendix D provides records of laboratory testing by NOVA.

2.0 PROJECT INFORMATION

2.1 Site Description

2.1.1 Location

The planned development will be located on an approximately three-acre parcel located at the southeast corner of the intersection of Kearney Villa Road and Lightwave Avenue in San Diego. Figure 2-1 depicts the location and limits of the site.

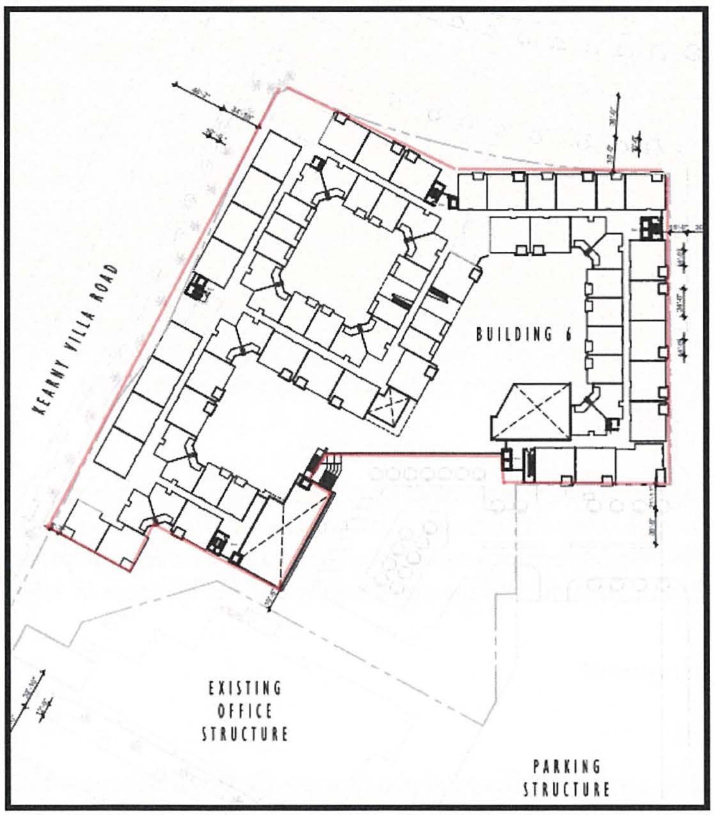


Figure 2-1. Site Location and Limits
(source: KTGY 2017)

2.1.2 Site Use

Current

The site itself is currently cleared and undeveloped. For the past several years the site has been used as a parking and materials staging area for construction in the near vicinity. Figure 2-2 (following page) provides a 2015 aerial view of the site showing the approximate limits of the planned residential development and its use as a construction support area.

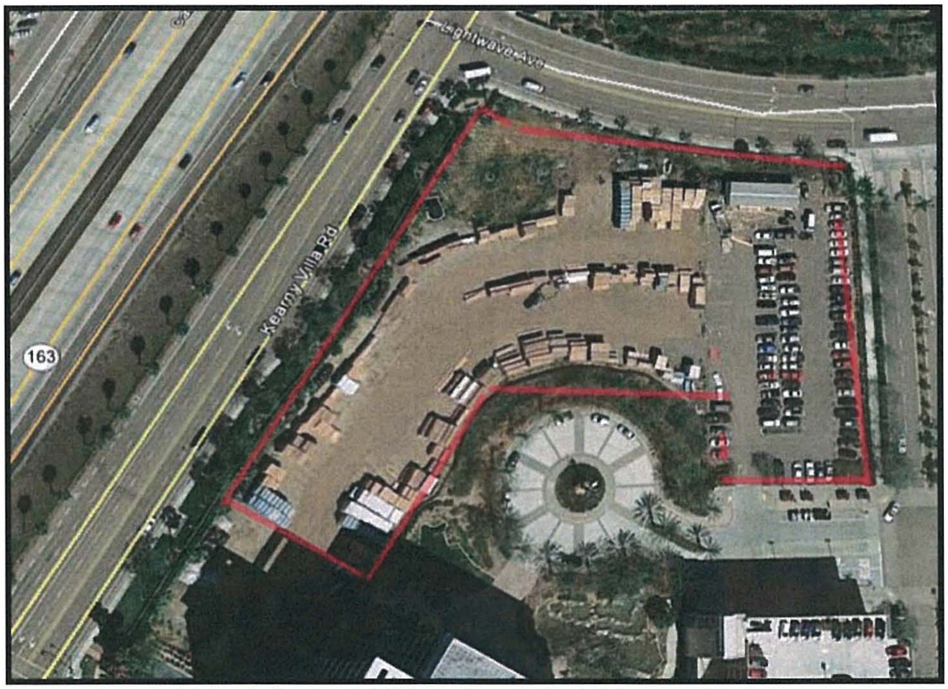


Figure 2-2. Aerial Photo Depicting Current Site Use
(source: adapted from Google Earth 2015)

Historic

The site and the area around it were used by General Dynamics from the 1950's until 1998 when the 232–acre site area was sold to Lennar Partners for development as a planned business community. When the site area was owned by General Dynamics, the property was used by its missile defense business unit until the company exited that business in 1992.

2.2 Planned Development

2.2.1 Architectural

NOVA's understanding of current architectural planning for the development is based upon review of preliminary architectural documentation by KTGY Architects (reference, *Sunroad Centrum 6 & 7, Schematic Design*, KTGY Architects + Planners, 2017-0142, July 26, 2017 (hereafter, "KTGY 2017")

Concept/feasibility level design by KTGY Architecture + Planning (KTGY) indicates that the 550-unit residential development will rise to seven levels above ground- about 85 feet above the surrounding ground. Four levels of apartment units will be developed atop three levels of parking for about 770 cars. The parking will include one level below grade. Figures 2-3 and 2-4 (following page) reproduce architectural graphics that depict the planned structure, including development of the structure above the parking deck.

Figure 2-3. Conceptual Development Plan
(source: KTGY 2017)

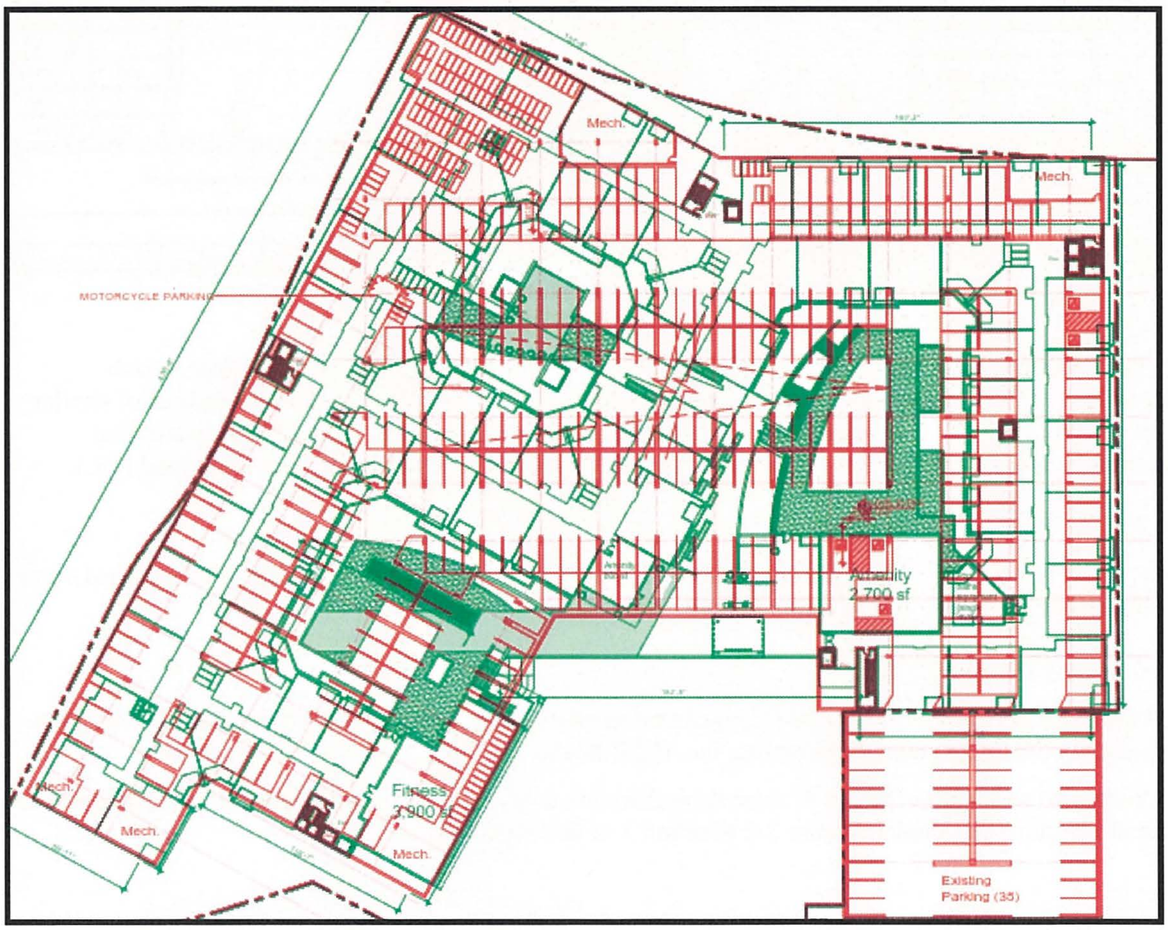


Figure 2-4. Extent of the Subterranean Level
(source: KTGY 2017)

2.2.2 Structural

Design is in preliminary stages. No detail regarding structural design is currently available.

Figure 2-5 provides an elevation view of the planned development. The structure will rise about 85 feet above the surrounding ground, with five levels of residential apartments set atop three levels of parking. A single below grade garage level is planned.

Though the structural design has not yet begun, NOVA expects that the apartments will be developed in 'Type III over Type I' construction. This design concept allows up to six levels (or 85 feet) of Type III wood framed structure to rise above a Type I reinforced concrete podium. NOVA thus expects that the garage levels will be constructed of reinforced concrete. The residential units above the garage will be wood framed, sitting atop a three-level reinforced concrete podium.

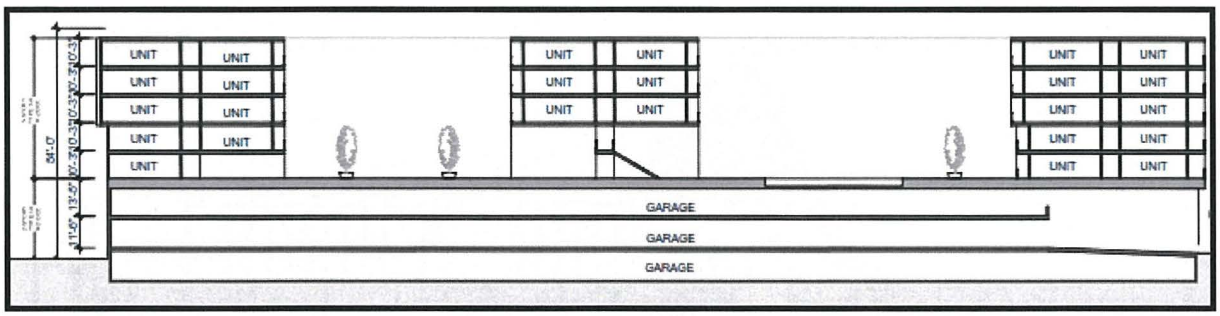


Figure 2-5. Elevation View
(source: KTGY 2017)

Similar structures have been founded on both post-tensioned and conventionally reinforced slab foundations. NOVA expects the average bearing stress across ground supported foundations of similar structures will be in the range of 600 to 800 pounds per square foot (psf). NOVA anticipates that maximum column loads will be on the order of 650 kips, to include about 550 kips dead load (DL).

2.2.3 Potential for Earthwork

The project will include substantial earthwork. Excavation to about 12 feet depth will be required across the limits of the subterranean parking garage.

2.2.4 Stormwater BMPs

Current planning for stormwater BMP's includes bioretention basins provided in the Storm Drain Plan provided by Stevens Cresto Engineering, Inc. (SCE 2016).

Planning also anticipates the use of several biofiltration areas. The areas are planned to be installed at the general locations depicted in Figure 3-2 (Section 3 of this report).

2.3 Previous Geotechnical Documentation

2.3.1 General

With the exception of site-specific infiltration testing conducted in as a part of Task 2 for this report, recommendations provided herein have been developed utilizing prior site-specific geotechnical reporting by NOVA and others. This reporting is listed in the following subsections.

2.3.2 Prior Reporting by Others

Geotechnical Investigation, Sunroad Spectrum Phase 1, Building Pads A, B, 1 Through 6, And Parking Structure, San Diego, CA, Geocon Inc., November 13, 2000 ("Geocon 2000").

Update Geotechnical Investigation, Sunroad Centrum, Spectrum Center Boulevard and Kearney Villa Road, San Diego, CA, Geocon Inc., Project No. 06505-22-02, Mar 22, 2005 ("Geocon 2005").

Geotechnical Investigation, Centrum 2, Spectrum Center Boulevard and Kearney Villa Road, San Diego, CA, Geocon Inc., Project No. 06505-52-04, Nov 22, 2010 ("Geocon 2010").

Additional Geotechnical Recommendations, Sunroad Centrum 2, Spectrum Center Boulevard and Kearny Villa Rd., San Diego, CA, Geocon Inc., November 23, 2011 ("Geocon 2011").

2.3.3 Prior Reporting by NOVA

Addendum Geotechnical Investigation, Sunroad Parking Structure, Spectrum Ctr. Boulevard & Kearney Villa Road, San Diego, California, NOVA Services, Inc., Project 2014116, February 25, 2014 ("NOVA 2014").

Report, Percolation-Infiltration Study, Centrum Place, Spectrum Ctr., Boulevard And Kearny Villa Road, NOVA Services, Inc., Project 1015310.1, May 27, 2016 ("NOVA 2016").

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 Overview

Characterization of the subsurface within the limits of the planned Sunroad Centrum 6 development is developed in three series of site characterization, as described below.

1. Geocon 2005. The findings of a preliminary geotechnical investigation addressing different planning for use of the site is provided in *Update Geotechnical Investigation, Sunroad Centrum, San Diego, California,* Geocon Incorporated, Project 0605-22-02, March 22, 2005 (hereafter, 'Geocon 2005'). The work included borings extending to 60 feet below ground surface.

2. NOVA 2016. NOVA completed a series of six engineering borings and three percolation tests in April 2016. The scope of that work was focused towards assessment of infiltration and undertaken in recognition of work already reported in Geocon 2005, intending to supplement that information. The findings of the work are provided in *Report, Percolation-Infiltration Study, Centrum Place, Spectrum Ctr., Boulevard and Kearny Villa Road*, NOVA Services, Inc., Project 1015310.1, May 27, 2016 (hereafter, 'NOVA 2016').

3. NOVA 2017. Work related to Task 2 of this report included completion of percolation testing at the currently planned locations of stormwater infiltration BMPs.

The following subsections describe findings of each of the above studies.

3.2 Geocon 2005

Geocon 2005 reports the findings of a preliminary geotechnical investigation, addressing development of the site area for office towers and subterranean parking. The work reported in Geocon 2005 included borings and related laboratory testing within the limits of the planned Sunroad Centrum 6 development. The report incorporates the findings of previous subsurface exploration in the site area.

Table 3-1 abstracts the indications of the borings reported in Geocon 2005. Figure 3-1 (following page) describes the location of these borings relative to the planned Centrum 6 development. Plate 1, provided at the end of this report, depicts the locations of these borings in larger scale.

Table 3-1. Abstract of the Engineering Borings Reported in Geocon 2005

Boring Reference	Approximate Ground Surface Elevation (feet, msl)	Total Depth Below Ground Surface (feet)	Thickness of Fill (feet)
B-1A	+417	60	1
B-2A	+417	60	10
B-4	+416	14	4
B-4A	+417	45	1
B-5	+418	10	2
B-6	+416	11	2
B-7	+417	10	7
B-17	+417	10	2

Notes: No groundwater was encountered in any of the borings

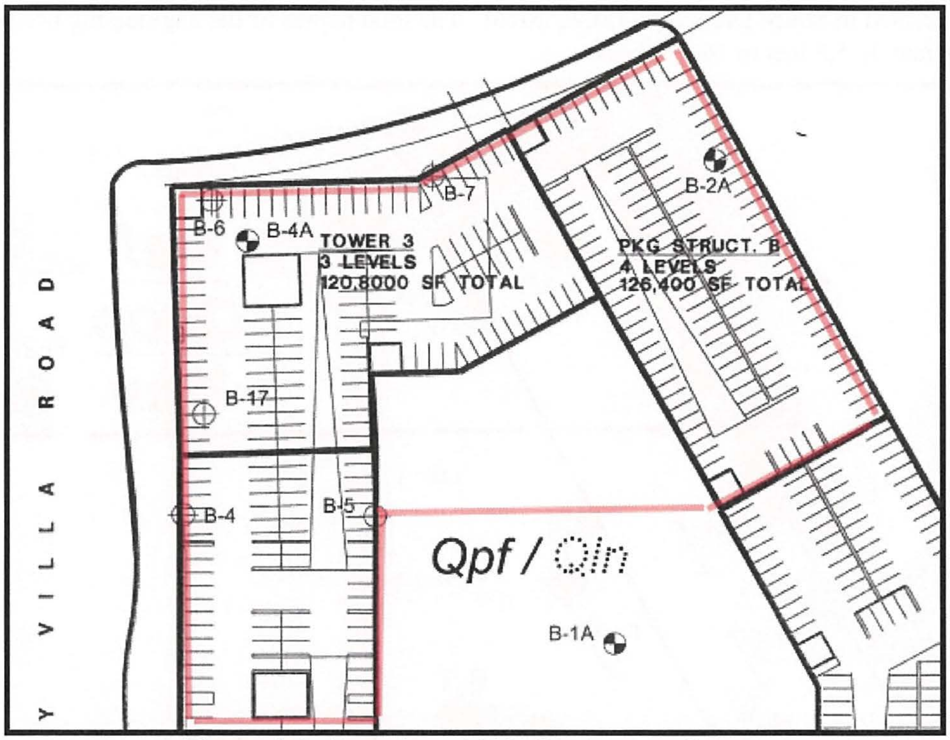


Figure 3-1. Location of 2005 Borings by Geocon
(source: Geocon 2005)

3.3 NOVA 2016 and NOVA 2017

3.3.1 General

NOVA conducted its field exploration in two events, as described below.

1. Event 1, April 27 and April 28, 2016. This work included six engineering borings (referenced as B-1 through B-6) and three percolation test borings (referenced as P-1 through P-3).

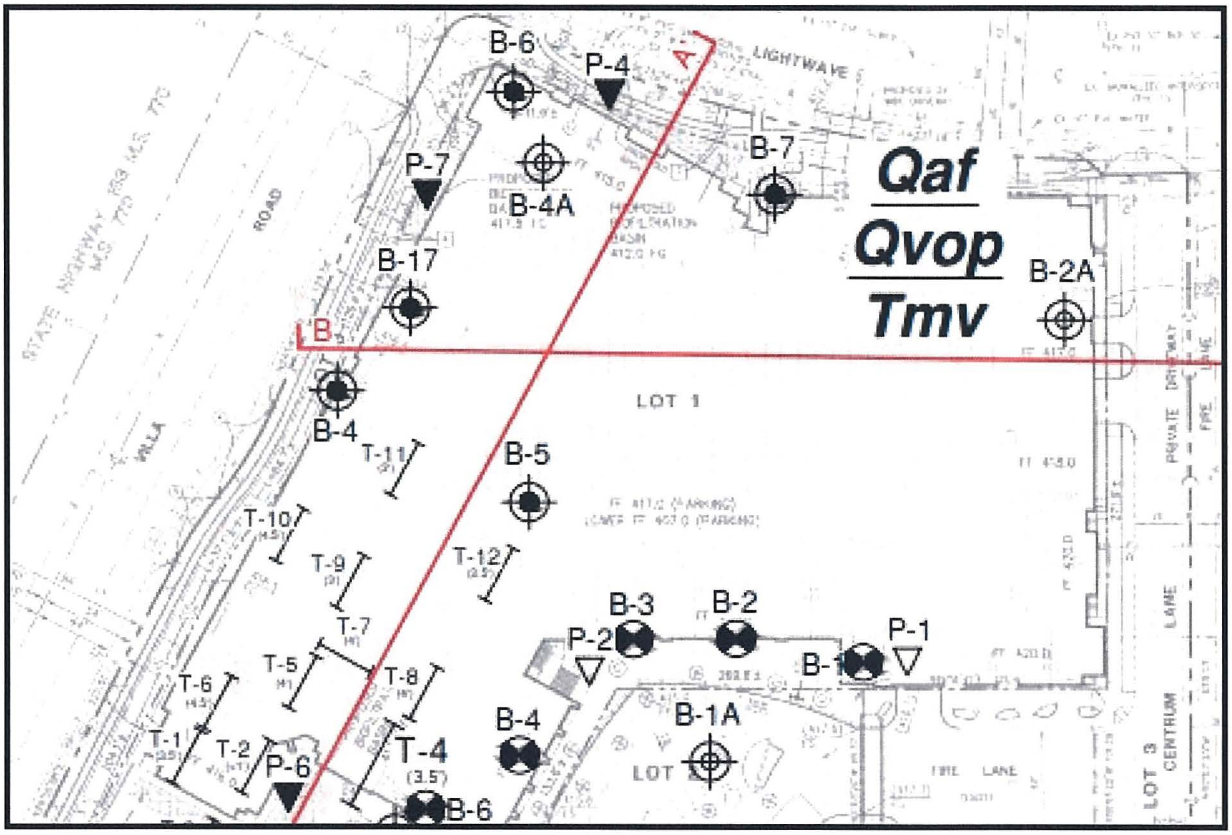
2. Event 2, November 9, 2017. Four percolation tests (referenced as P-4 through P-7) and a single engineering boring were completed.

The engineering borings and percolation/ infiltration borings in each event were completed by specialty subcontractors retained by NOVA, working under the continuous supervision of a NOVA geologist. The work by NOVA was completed in recognition of the work already completed and reported in Geocon 2005. Thus, the subsurface exploration was focused toward development of data in areas then planned for stormwater BMP's including bioretention basins and several biofiltration areas. The locations of engineering borings and related percolation testing were located as shown in Figure 3-2 (following page).

The following subsections describe the conduct of the engineering borings and percolation testing.

3.3.2 Engineering Borings

Engineering borings were advanced by a truck-mounted drilling rig utilizing hollow stem drilling equipment. Boring locations were determined in the field based on the proposed retention/biofiltration locations presented in Storm Drain Plan (SCE, 2016). The total depths of the engineering borings ranged from approximately 5.5 feet to 16 feet bgs.



Key to Symbols

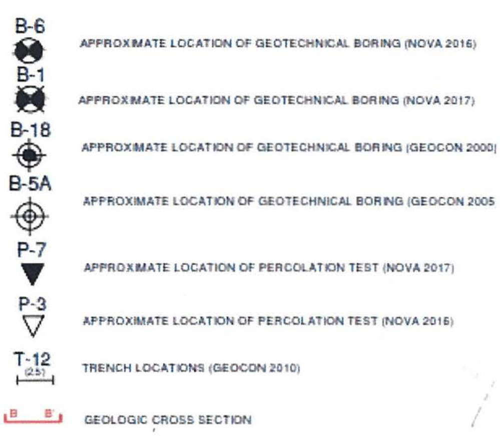


Figure 3-2. Locations of the Borings and Percolation Testing

Plates 1-3, provided immediately following the text of this report, depict the above information in larger scale.

Table 3-2 provides an abstract of the indications of the engineering borings by NOVA.

Table 3-2. Abstract of the Engineering Borings Reported in NOVA 2016

Boring Reference	Approximate Ground Surface Elevation (feet, msl)	Total Depth Below Ground Surface (feet)	Thickness of Artificial Fill (feet)
B-1	416	5.5	1
B-2	416	16	2
B-3	416	6.5	1
B-4	415.5	16	1
B-5	415.5	5.5	1
B-6	415.5	6.5	1

Notes:
1. No groundwater was encountered in any of the borings.
2. Very Old Paralic (Qvop8) deposits underlie the artificial fill.

The borings were completed under the direction of a geologist from NOVA who directed sampling and maintained a log of the subsurface materials that were encountered.

Soil samples recovered from the engineering borings were transferred to NOVA's geotechnical laboratory where a geotechnical engineer reviewed the soil samples and the field logs. Representative soil samples were selected and tested in NOVA's materials laboratory to check visual classifications and to determine pertinent engineering properties.

Both disturbed and relatively undisturbed samples were recovered from the borings, sampling of soils is described below.

1. The Modified California sampler ('ring sampler', after ASTM D 3550) was driven using a 140-pound hammer falling for 30 inches with a total penetration of 18 inches, recording blow counts for every 6 inches of penetration.

2. The Standard Penetration Test sampler ('SPT', after ASTM D 1586) was driven in the same manner as the ring sampler, recording blow counts in the same fashion. SPT blow counts for the final 12 inches of penetration comprise the SPT 'N' value, an index of soil consistency.

3. Bulk samples were recovered from the upper 5 feet of the subsurface, providing composite samples for testing of soil moisture and density relationships and corrosivity.

Logs of the borings are provided in Appendix B.

3.3.3 Percolation Testing

General

Due to design changes that relocated stormwater infiltration BMPs, NOVA completed an aggregate of seven percolation tests in two events, as described below.

1. Event 1, April 2016. Three (3) percolation tests, P-1 through P-3, were completed.
2. Event 2, November 2011. Four (4) percolation tests, P-4 through P-7, were completed.

Description of the Testing

All of the percolation testing was completed following recommendations presented in the County of San Diego BMP Design Manual. The locations of the tests are shown in Figure 3-2. Plate 2, provided at the end of the text of the report, shows these locations in larger scale.

Once the test borings were drilled to the design depth, the borings were converted to percolation wells by placing an approximately 2-inch layer of ¾-inch gravel on the bottom, then extending 3-inch diameter Schedule 40 perforated PVC pipe to the ground surface. The ¾-inch gravel was used to fill the annular space around the perforated pipe to at least 12-inches below existing finish grade to minimize the potential of soil caving.

The percolation test holes were pre-soaked before testing and immediately prior to testing. The pre-soak process consisted of filling the hole twice with water before testing. Water levels were recorded every 30 minutes for six hours (minimum of 12 readings), or until the water percolation stabilized after each reading, the water level was raised to close to the previous water level to maintain a near constant head before subsequent readings.

Summary of Results

Table 3-3 abstracts the indications of the percolation testing. Note that percolation rate is not infiltration rate. Discussion regarding infiltration rate and recommendations for design of stormwater infiltration BMPs is provided in Section 9.

Table 3-3. Abstract of the Percolation Testing by NOVA in April 2016 and November 2017

Date	Boring	Approx. Elevation (feet, msl)	Total Depth (feet)	Approximate Percolation Test Elev. (feet, msl)	Percolation Rate (in/hour) 2	Subsurface Units Tested1
04/2016	P-1	+416	6	+410	.24	Qvop8
04/2016	P-2	+416	6.3	+409.7	.21	Qvop8
04/2016	P-3	+415.5	5.5	+410	1.20	Qvop8
11/2017	P-4	+413	5	+408	0.96	Qvop8
11/2017	P-5	+415	5	+410	0.96	Qafu
11/2017	P-6	+415	5	+410	0.48	Qvop8
11/2017	P-7	+413	5	+408	0.96	Qvop8

Notes:
1. The referenced geologic units are Old Paralic Deposits (Qvop8) and artificial fill (Qafu).
2. Readings for P-3 at 10-minute intervals due to high percolation rate.

Closure

At the conclusion of the percolation testing, the upper sections of the PVC pipe were removed and the resulting holes backfilled with soil cuttings to match the existing surfacing.

3.4 Laboratory Testing by Geocon 2005

3.4.1 Strength and Compressibility

In situ testing conducted in the borings reported in Geocon 2005 show that the naturally occurring sandstones that underlie the site are of high strength and low compressibility. These geologic units commonly refused the standard penetration test ('SPT', after ASTM D 1586) sampler, with SPT blow counts ('N') commonly greater than 100 blows per foot.

Geocon 2005 supplements the *in situ* testing with limited scope laboratory testing. Direct shear testing of sandstones and artificial fill from within the limits of the planned Centrum 6 building are tabulated in Table 3-4.

Table 3-4. Summary of the Direct Shear Testing Reported by Geocon 20005

Boring	Sample Depth (feet)	Dry Density (lb/ft^3)	Moisture Content (%)	Cohesion (lb/ft^2)	Friction Angle (°)	Subsurface Unit Tested[1,2]
B-1A	3	107	7	400	30	Qvop8
B-1A	9	111	14	144	36	Qvop8
B-2A	3	109	13	124	41	Qafu
B-4A	2	87	10	605	29	Qvop8
B-4A	8	104	14	572	30	Qvop8

Notes:
1. Qvop8 indicates Very Old Paralic Deposits.
2. Qafu indicates undocumented artificial fill, a soil sourced from the Qvop8 deposits

It should be noted that the data provided in Table 3-4 are conservative estimates of the shear strength of the geologic unit (i.e., Very Old Paralic, Qvop8) tested. The energy required to penetrate the drive sampling device (i.e., the Modified California sampler, ASTM D 3550) substantially diminishes the strength and stiffness of the samples recovered.

3.4.2 Chemical

Limited scope chemical testing was undertaken to assess the potential for sulfate attack to concrete. Table 3-5 summarizes this data.

Table 3-5. Summary of the Water Soluble Sulfate Testing Reported by Geocon 20005

Boring	Sample Depth (feet)	Water Soluble Sulfates (%)
B-1A	1	0.013
B-3A	5	0.050

3.5 Laboratory Testing by NOVA 2016

Soil samples recovered from the engineering borings were transferred to NOVA's geotechnical laboratory where a geotechnical engineer reviewed the soil samples and the field logs.

Representative soil samples were selected and tested in NOVA's materials laboratory to check visual classifications and to determine pertinent engineering properties. The laboratory program included visual classifications of all soil samples as well as gradation testing (ASTM D422) undertaken for the purposes of soil characterization.

Geologic logging of the borings indicates that the subsurface is dominated by sandstones of the Very Old Paralic Deposits Unit 8. Testing of uncemented/disturbed portions of the formation shows the formation to consist of silty fine to medium sands, 'SM' after ASTM D2487.

Table 3-6 summarizes the laboratory testing completed for NOVA 2016.

Table 3-6. Abstract of the Gradation Testing Reported in NOVA 2016

Boring	Sample Depth (feet)	Percent Passing U.S. No 200 Sieve (0.074 mm)	Soil Classification after ASTM D2487
1	5	20	SM
2	5	39	SM
2	6.5	27	SM
2	8	23	SM
2	9.5	18	SM
3	5	27	SM
4	5	22	SM
4	6.5	22	SM
4	8	26	SM
4	9.5	36	SM
4	11	37	SM
4	12.5	26	SM
4	14	26	SM

4.0 SITE CONDITIONS

4.1 Geologic Setting

4.1.1 Regional

The project area is located in the coastal portion of the Peninsular Range geomorphic province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California. The province varies in width from approximately 30 to 100 miles.

This area of the Province has undergone several episodes of marine inundation and subsequent marine regression (coastline changes) throughout the last 54 million years. These events have resulted in the deposition of a thick sequence of marine and nonmarine sedimentary rocks on the basement igneous rocks of the Southern California Batholith and metamorphic rocks.

Gradual emergence of the region from the sea occurred in Pleistocene time, and numerous wave-cut platforms, most of which were covered by relatively thin marine and nonmarine terrace deposits, formed as the sea receded from the land. Accelerated fluvial erosion during periods of heavy rainfall, along with the lowering of base sea level during Quaternary times, resulted in the rolling hills, mesas, and deeply incised canyons which characterize the landforms in western San Diego County.

4.1.2 Site Specific

The site is situated within the coastal plain zone of the Peninsular Ranges geomorphic province. The geology of the area is controlled by both alluvial and marine influences. This plain is underlain by near-shore marine sedimentary rocks deposited at various intervals from the late-Mesozoic era through the Quaternary period. The Coastal Plain increases in elevation from west to east across marine terrace surfaces uplifted during Pleistocene time. Sedimentary rocks consist of sandstones, siltstones, and claystones that were deposited during the Cretaceous, Tertiary, and Quaternary periods.

Geologic units encountered by the subsurface investigation include sandstones of the Very Old Paralic deposits (Qvop8) and Mission Valley Formation (Tmv). Figure 4-1 (following page) depicts the surface geology of the site area from which it can be seen that Very Old Paralic deposits (Qvop8) are mapped to occur widely as the surficial geologic formation in the site area.

The Very Old Paralic deposits are shallow marine and nonmarine (talus and slopewash) terrace deposits of early Pleistocene age. The Paralics were deposited on a currently-raised 6 mile-wide wavecut platform. Soils of this unit are typically consolidated, light brown to reddish brown, clean to silty, medium- to coarse-grained sand and gravels with localized interbeds of clayey sand and sandy clay (i.e., localized back-beach lagoonal deposits).

The paralics occur widely, found from the International Border to northern Carlsbad and comprising the dominant near-surface geologic formation in much of San Diego. The unit ranges to 65 feet in thickness but is generally less than 50 feet in thickness.

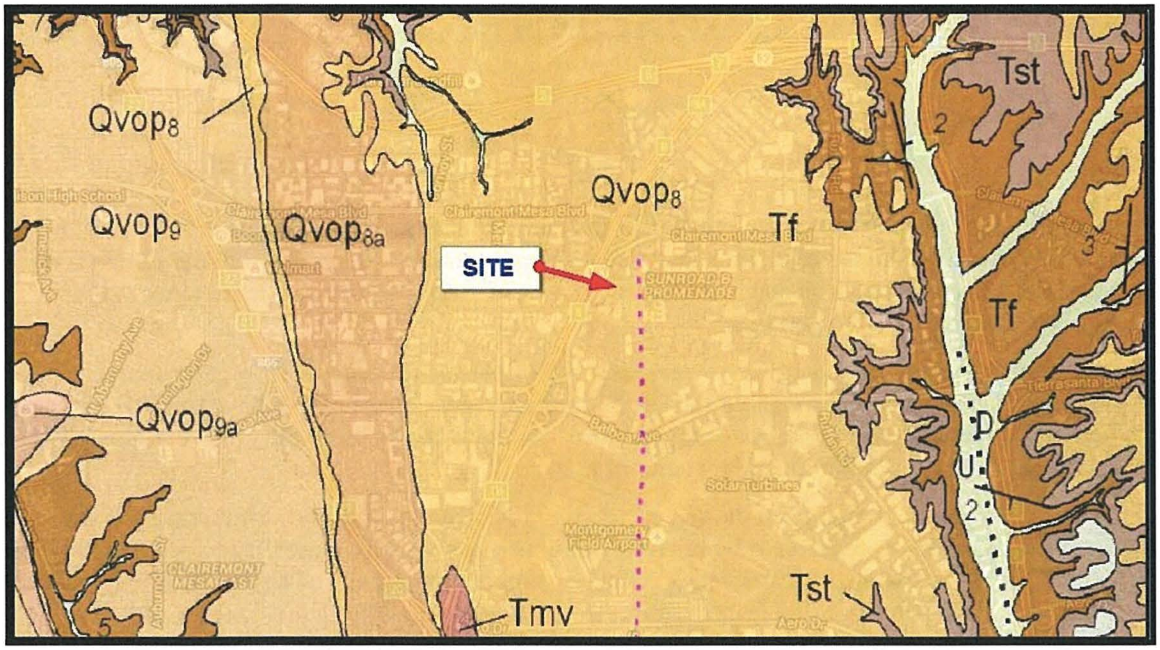


Figure 4-1. Geologic Map of the Site Vicinity

4.2 Site Conditions

4.2.1 Surface

The site area is cleared, covered with a thin veneer of fill and light grasses. Current surface elevations range from about +413 to +417 feet mean sea level (msl).

Figure 4-2. Surface Conditions

4.2.2 Subsurface

Reporting by Geocon, confirmed by additional work by NOVA, indicates that the site is underlain by a sequence of fill and naturally occurring soils that may be characterized for the purposes of this report as below.

1. Unit 1a, Undocumented Fill (Qfu). The site is covered by a veneer of artificial fill typically less than three feet in thickness, though varying locally to as much as 10 feet. Tables 3-1 and 3-2 summarize the thickness of fill encountered at each of the borings.

   The fill occurs as a medium dense silty and clayey sand with varying amounts of gravel and cobbles, likely sourced from the Unit 2 Paralics. Records regarding placement of the fill are unavailable, such that the fill is considered 'undocumented'- subject to wide variations in quality.

2. Unit 2, Very Old Paralics ($Qvop_8$). Formerly referenced as the Lindavista Formation, the Very Old Paralics include very dense silty sandstone with varying amounts of gravel and cobbles. As is discussed in Section 3, testing of uncemented/disturbed portions of the formation characterizes these materials as silty fine to medium sands, 'SM' after ASTM D2487. This unit is the likely source of the Unit 1 fill.

3. Unit 3, Mission Valley (Tmv). The Mission Valley Formation is expected to underlie Unit 2 at depths ranging from 17 to 21 feet below the existing ground surface. Soils of this unit are similar in nature to the soils of Unit 2- very dense silty and clayey sands with gravel and cobbles- but also includes interbeds of cemented materials (siltstone and sandstone).

The excavation for the subterranean parking level is expected to expose soils of both Unit 2 and Unit 3. These soils are suitable to support the structure. While these soils will be suitable to support the parking structure, excavation could locally be difficult.

4.2.3 Groundwater

Static

No groundwater was encountered in the borings by NOVA to a depth of 16.5 feet below ground surface (about El +400 feet msl). Geocon did not encounter groundwater in borings that extended to 60 feet below ground surface (to about El +355 feet msl).

Perched

Infiltrating storm water from prolonged wet periods can 'perch' atop localized zones of lower permeability soil that exist above the static groundwater level. Localized perched groundwater conditions may also develop once development completes and landscape irrigation commences.

No perched groundwater was observed during the work of NOVA 2016 or reported by others.

4.2.4 Surface Water

No surface water was evident on the site at the time of NOVA's fieldwork. NOVA did not observe any visual evidence of seeps, springs, erosion, staining, discoloration, etc. that would indicate recent problems with surface water.

5.0 REVIEW OF GEOLOGIC AND SOIL HAZARDS

5.1 Overview

This section provides review of soil and geologic-related hazards common to this region of California, considering each for its potential to affect the planned development.

The primary hazards identified by this review are abstracted below.

1. Seismic. The site is at risk for moderate-to-severe ground shaking in response to a large-magnitude earthquake during the lifetime of the planned development. While there is no risk of liquefaction or related seismic phenomena, strong ground motion could affect the site. This circumstance is common to all civil works in this area of California.

2. Undocumented Fill. No records exist regarding the quality of the Unit 1 fill that covers the site. Moreover, site records discussed in Section 2 herein indicate the thickness of the fill varies widely. This fill is potentially compressible beneath shallow foundations.

The following subsections describe NOVA's review of soil and geologic hazards.

5.2 Geologic Hazards

5.2.1 Strong Ground Motion

The site is not located within a currently designated Alquist-Priolo Earthquake Zone. No known active faults are mapped on the site area. The nearest known active fault is the Rose Canyon fault system, located approximately 2 miles west of the site. This system has the potential to be a source of strong ground motion.

The seismicity of the site was evaluated utilizing a web-based analytical tool provided by the USGS. This evaluation shows the site may be subjected to a Magnitude 7 seismic event, with a corresponding risk-based Peak Ground Acceleration (PGA_M) of $PGA_M \sim 0.41$ g.

5.2.2 Seismic Safety Study

According to our review of the City of San Diego Seismic Safety Study (City of San Diego, 2008), the site is located within Hazard Category 51 corresponding to "level mesas - underlain by terrace deposits and bedrock; nominal risk".

5.2.3 Fault Rupture

No evidence of faulting was observed during NOVA's geologic reconnaissance of the site. No active faulting is otherwise mapped within the vicinity of the site. Because of the lack of known active faults on the site, the potential for surface rupture at the site is considered low. Shallow ground rupture due to shaking from distant seismic events is not considered a significant hazard, although it is a possibility at any site.

Figure 5-1 (following page) maps faults in the site vicinity.

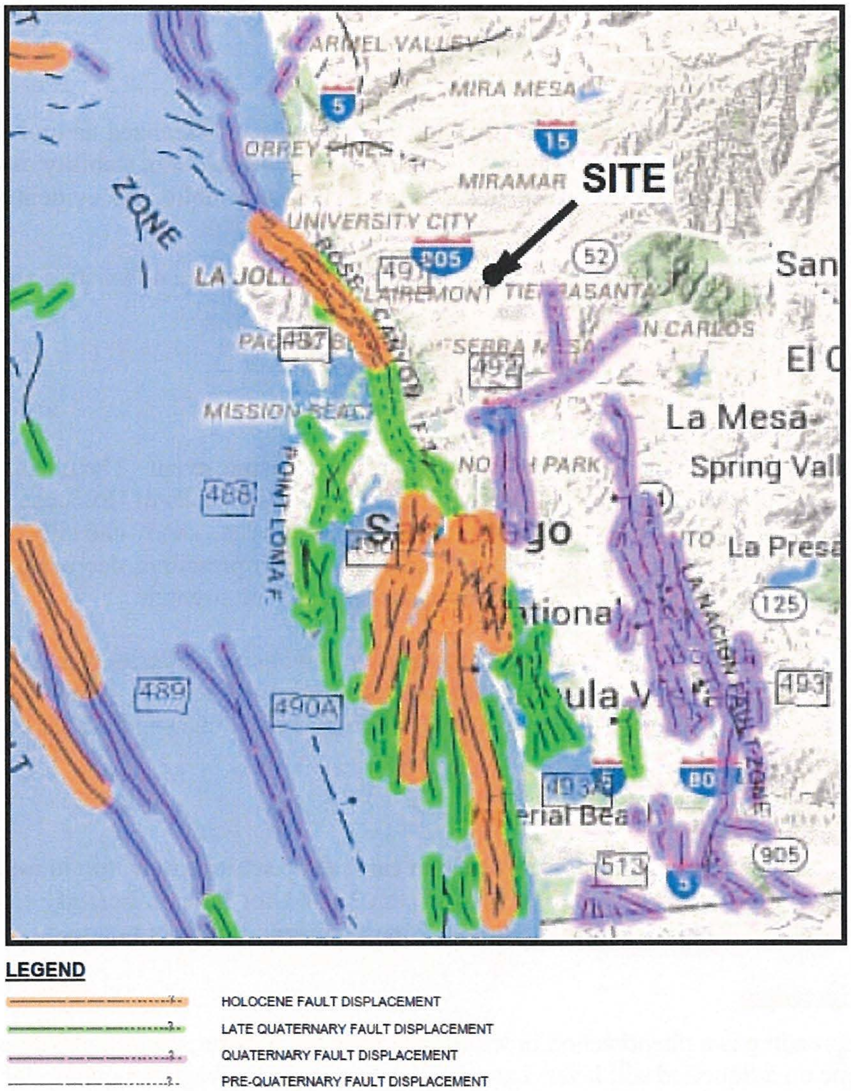


Figure 5-1. Faulting in the Site Vicinity

5.2.4 Landslide

As used herein, 'landslide' describes downslope displacement of a mass of rock, soil, and/or debris by sliding, flowing, or falling. Such mass earth movements are greater than about 10 feet thick and larger than 300 feet across. Landslides typically include cohesive block glides and disrupted slumps that are formed by translation or rotation of the slope materials along one or more slip surfaces.

The causes of classic landslides start with a preexisting condition- characteristically, a plane of weak soil or rock- inherent within the rock or soil mass. Thereafter, movement may be precipitated by earthquakes, wet weather, and changes to the structure or loading conditions on a slope (e.g., by erosion, cutting, filling, release of water from broken pipes, etc.).

In consideration of the level ground at and around the site, NOVA considers the landslide hazard at the site to be 'negligible' for the site and the surrounding area.

5.3 Soil Hazards

5.3.1 Embankment Stability

As used herein, 'embankment stability' is intended to mean the safety of localized natural or man-made embankments against failure. Unlike landslides described above, embankment stability can include smaller scale slope failures such as erosion-related washouts and more subtle, less evident processes such as soil creep.

No new slopes are planned as part of the future site development. There are no existing slopes on the site. There is no concern regarding embankment stability at this site.

5.3.2 Seismic

Liquefaction

'Liquefaction' refers to the loss of soil strength during a seismic event. The phenomenon is observed in areas that include geologically 'younger' soils (i.e., soils of Holocene age), shallow water table (less than about 60 feet depth), and cohesionless (i.e., sandy and silty) soils of looser consistency. The seismic ground motions increase soil water pressures, decreasing grain-to-grain contact among the soil particles, which causes the soils to lose strength.

Resistance of a soil mass to liquefaction increases with increasing density, plasticity (associated with clay-sized particles), geologic age, cementation, and stress history. The relatively finer grained, stiff/dense and geologically 'older' subsurface units at this site have no potential for liquefaction.

Seismically Induced Settlement

Apart from liquefaction, a strong seismic event can induce settlement within loose to moderately dense, unsaturated granular soils. The soils of Unit 2 and Unit 3 are sufficiently cemented, dense and finer grained that these soils will not be prone to seismic settlement.

Lateral Spreading

Lateral spreading is a phenomenon in which large blocks of intact, non-liquefied soil move downslope on a liquefied soil layer. Lateral spreading is often a regional event. For lateral spreading to occur, a liquefiable soil zone must be laterally continuous and unconstrained, free to move along sloping ground. Due to the absence of a potential for liquefaction and relatively flat surrounding topography, there is no potential for lateral spreading.

5.3.3 Expansive Soil

Expansive soils are characterized by their ability to undergo significant volume changes (shrinking or swelling) due to variations in moisture content, the magnitude of which is related to both clay content and plasticity index. These volume changes can be damaging to structures. Nationally, the annual value of real estate damage caused by expansive soils is exceeded only by that caused by termites.

As is discussed in Section 3, the soils have been characterized by testing to determine Expansion Index ('EI' after ASTM D 4829). Originally developed in Orange County in the 1960s, EI is a basic soil index property, comparable to indices such as the Atterberg limits of soils. The expansion index has been judged by ASTM "*... to have a greater range and better sensitivity of expansion potential than other indices...*" EI has been adopted by the 2013 California Building Code ('CBC', Section 1803.5.3) for characterization of expansive soils. The listing below tabulates the qualitative descriptors of expansion potential based upon EI.

Table 5-1. Qualitative Descriptors Of Expansion Potential Based Upon EI

Expansion Index ('EI'), ASTM D 4829	Expansion Potential, ASTM D 4829	Expansion Classification, 2013 CBC
0 to 20	Very Low	Non-Expansive
21 to 50	Low	Expansive
51 to 90	Medium	
91 to 130	High	
>130	Very high	

Geocon 2000 reports the findings of EI testing of three samples of the Unit 1 fill, determining EI= 8, EI = 0 and EI = 28 for three samples. Based upon the indications of this testing, as well as visual inspection of samples recovered by NOVA, the Unit 1 fill indicates 'very low' expansion potential.

5.3.4 Hydro-Collapsible Soils

Hydro-collapsible soils are common in the arid climates of the western United States in specific depositional environments- principally, in areas of young alluvial fans, debris flow sediments, and loess (wind-blown sediment) deposits. These soils are characterized by low *in situ* density, low moisture contents, and relatively high unwetted strength.

The soil grains of hydro-collapsible soils were initially deposited in a loose state (i.e., high initial 'void ratio') and thereafter lightly bonded by water sensitive binding agents (e.g., clay particles, low-grade cementation, etc.). While relatively strong in a dry state, the introduction of water into these soils causes the binding agents to fail. Destruction of the bonds/binding causes relatively rapid densification and volume loss (collapse) of the soil. This change is manifested at the ground surface as subsidence or settlement. Ground settlements from the wetting can be damaging to structures and civil works. Human activities that can facilitate soil collapse include irrigation, water impoundment, changes to the natural drainage, disposal of wastewater, etc.

The consistency and geologic age of the Unit 2 soils are such that these soils are not potentially hydro-collapsible.

5.3.5 Undocumented Fill

Records are not available regarding the placement of the Unit 1 fill, such that this fill is considered 'undocumented,' subject to wide variations in quality and potentially compressible.

Section 6 discusses design to adapt to the undocumented fill.

5.3.6 Corrosive Soils

Chemical testing of the near-surface soils indicates the soils contain low concentrations of soluble sulfates and chlorides. Section 6 addresses this consideration in more detail.

5.4 Other Hazards

5.4.1 Flood

The site is located within a FEMA-designated flood zone, Flood Map No. 06073C1610G dated May 16, 2012. The site area is designated "Zone X," an area of minimal flood hazard. Figure 5-2 (following page) reproduces flood mapping by FEMA of the site area.

Figure 5-2. Flood Mapping of the Site Area
(source: adapted from FEMA Flood Map 06073C1610G, Revised May 16, 2012)

5.4.2 Tsunami

Tsunami describes a series of fast-moving, long period ocean waves caused by earthquakes or volcanic eruptions. The altitude and distance of the site from the ocean preclude this threat.

5.4.3 Seiche

Seiches are standing waves that develop in an enclosed or partially enclosed body of water such as lakes or reservoirs. Harbors or inlets can also develop seiches. Most commonly caused by strong winds and rapid atmospheric pressure changes, seiches can be affected by seismic events and tsunamis.

The site is not located near a body of water that could generate a seiche.

6.0 EARTHWORK AND FOUNDATIONS

6.1 Overview

6.1.1 General

Based upon the indications of the field and laboratory data developed for this site in Geocon 2005 and NOVA 2016, it is the opinion of NOVA that the site is suitable for development of the planned structure on shallow foundations provided the geotechnical recommendations described herein are followed.

As is discussed in Section 5, the planned structures may experience strong ground motions associated with a large magnitude earthquake. This hazard is common to all civil development in this area of California. Section 6.2 addresses seismic design parameters.

The undocumented fill- referenced herein as 'Unit 1'- is considered potentially compressible. Section 6.4 provides recommendations for management of undocumented fill by remedial grading.

6.1.2 Review and Surveillance

The subsections following provide geotechnical recommendations for the planned development as it is now understood. It is intended that these recommendations provide sufficient geotechnical information to develop the project in general accordance with 2016 California Building Code (CBC) requirements.

NOVA should be given the opportunity to review the grading plan, foundation plan, and geotechnical-related specifications as they become available to confirm that the recommendations presented in this report have been incorporated into the plans prepared for the project.

All earthwork related to site and foundation preparation should be completed under the observation of NOVA.

6.2 Seismic Design Parameters

6.2.1 Site Class

The Site Class was determined using site-specific boring data and geologic knowledge, with reference to ASCE 7-10, Table 20.3-1. Based on this information, the site is classified as Site Class C per ASCE 7-10, Table 20.3-1.

6.2.2 Seismic Design Parameters

Table 6-1 (following page) provides seismic design parameters for the site in accordance with 2016 CBC and mapped spectral acceleration parameters.

Table 6-1. Seismic Design Parameters, ASCE 7-10

Parameter	Value
Site Soil Class	C
Site Latitude (decimal degrees)	32.8283
Site Longitude (decimal degrees)	-117.141608
Site Coefficient, F_a	1.000
Site Coefficient, F_v	1.415
Mapped Short Period Spectral Acceleration, S_S	1.005
Mapped One-Second Period Spectral Acceleration, S_1	0.385
Short Period Spectral Acceleration Adjusted For Site Class, S_{MS}	1.005
One-Second Period Spectral Acceleration Adjusted For Site Class, S_{M1}	0.545
Design Short Period Spectral Acceleration, S_{DS}	0.670
Design One-Second Period Spectral Acceleration, S_{D1}	0.363

Source: U.S. Seismic Design Maps, found at http://earthquake.usgs.gov/designmaps/us/application.php

6.3 Corrosivity and Sulfates

6.3.1 General

Electrical resistivity, chloride content, and pH level are all indicators of the soil's tendency to corrode ferrous metals. Chemical testing was performed for Geocon 2000 on a representative sample of the near surface soils. The results of the testing reported by Geocon 2000 are tabulated in Table 6-2.

Table 6-2. Summary of Corrosivity Testing of the Near Surface Soil

Parameter	Units	Value
pH	standard unit	10.2
Resistivity	Ohm-cm	1,000
Water Soluble Chloride	Ppm	96
Water Soluble Sulfate	Ppm	170

6.3.2 Metals

Caltrans considers a soil to be corrosive if one or more of the following conditions exist for representative soil and/or water samples taken at the site:

- chloride concentration is 500 parts per million (ppm) or greater;
- sulfate concentration is 2,000 ppm (0.2%) or greater; or,
- the pH is 5.5 or less.

Based on the Caltrans criteria, the on-site soils would not be considered 'corrosive' to buried metals.

In addition to the above parameters, the risk of soil corrosivity buried metals is considered by determination of electrical resistivity (ρ). Soil resistivity may be used to express the corrosivity of soil only in unsaturated soils. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of DC electrical current from the metal into the soil. As the resistivity of the soil decreases, the corrosivity generally increases. A common qualitative correlation (cited in Romanoff 1989, NACE 2007) between soil resistivity and corrosivity to ferrous metals is tabulated below.

Table 6-3. Soil Resistivity and Corrosion Potential

Minimum Soil Resistivity (Ω-cm)	**Qualitative Corrosion Potential**
0 to 2,000	Severe
2,000 to 10,000	Moderate
10,000 to 30,000	Mild
Over 30,000	Not Likely

Despite the relatively benign environment for corrosivity indicated by pH and water-soluble chlorides, the resistivity testing suggests that design should consider that the soils may be moderately corrosive to embedded ferrous metals.

Typical recommendations for mitigation of such corrosion potential in embedded ferrous metals include:

- a high-quality protective coating such as an 18-mil plastic tape, extruded polyethylene, coal tar enamel, or Portland cement mortar;
- electrical isolation from above grade ferrous metals and other dissimilar metals by means of dielectric fittings in utilities and exposed metal structures breaking grade; and,
- steel and wire reinforcement within concrete having contact with the site soils should have at least 2 inches of concrete cover.

If extremely sensitive ferrous metals are expected to be placed in contact with the site soils, it may be desirable to consult a corrosion specialist regarding choosing the construction materials and/or protection design for the objects of concern.

6.3.3 Sulfate Attack

As shown in Table 6-2, the soil sample tested by Geocon indicated water-soluble sulfate (SO_4) content of 170 parts per million ('ppm,' 0.017% by weight). With $SO_4 < 0.10$ percent by weight, the American Concrete Institute (ACI) 318-08 considers a soil to have no potential (S0) for sulfate attack.

Table 6-4 (following page) reproduces the Exposure Categories considered by ACI.

Table 6-4. Exposure Categories and Requirements for Water-Soluble Sulfates

Exposure Category	Class	Water-Soluble Sulfate (SO_4) In Soil (percent by weight)	Cement Type (ASTM C150)	Max Water-Cement Ratio	Min. f'$_c$ (psi)
Not	S0	$SO_4 < 0.10$	-	-	-
Moderate	S1	$0.10 \leq SO_4 < 0.20$	II	0.50	4,000
Severe	S2	$0.20 \leq SO_4 \leq 2.00$	V	0.45	4,500
Very severe	S3	$SO_4 > 2.0$	V + pozzolan	0.45	4,500

Adapted from: ACI 318-08, Building Code Requirements for Structural Concrete

6.3.4 Limitations

Testing to determine several chemical parameters that indicate a potential for soils to be corrosive to construction materials are traditionally completed by the Geotechnical Engineer, comparing test results with a variety of indices regarding corrosion potential.

Like most geotechnical consultants, NOVA does not practice in the field of corrosion protection, since this is not specifically a geotechnical issue. Should you require more information, a specialty corrosion consultant should be retained to address these issues.

6.4 Earthwork

6.4.1 General

As is noted in Section 2, no detailed structural or civil- related design information is available at this time. However, based upon the known condition of the site and the design concept that is currently considered, NOVA expects that earthwork will include (i) mass excavation for the parking garage; and, (ii) excavations for foundations and utilities.

Earthwork should be performed in accordance with Section 300 of the most recent approved edition of the "*Standard Specifications for Public Works Construction*" and "*Regional Supplement Amendments*."

6.4.2 Site Preparation

Prior to the start of earthwork, the site should be cleared of vegetation and related root systems, and existing pavement. The deleterious materials should be disposed of in approved off-site locations.

At the outset of site work, the Contractor should establish Construction Best Management Practices to prevent erosion of graded/excavated areas until such time as permanent drainage and erosion control measures have been installed. Any existing utilities which are to be abandoned should either be (i) excavated and the trenches backfilled; or, (ii) the lines completely filled with sand-cement slurry.

6.4.3 Compaction Requirements

All fill and backfill should be compacted to a minimum of 90 percent relative compaction after ASTM D1557 (the 'modified Proctor') following moisture conditioning to at least 2% above the optimum moisture content. Fill should be placed in loose lifts no thicker than the ability of the compaction equipment to thoroughly densify the lift. For most self-propelled construction equipment, this will limit loose lifts to on the order of 10-inches or less. Lift thickness for hand-operated equipment (tampers, walked behind compactors, etc.) will be limited to on the order of 4 inches or less.

6.4.4 Select Fill

Select Fill should be a mineral soil free of organics with the characteristics listed below:

- free of organics, with at least 40 percent by weight finer than ¼-inches in size and,
- maximum particle size of 3 inches; and,
- expansion index (EI) less than 50 (i.e., EI < 50, after ASTM D 4829).

Most of the Unit 1 fill that is now in place should conform to the above criteria.

6.4.5 Excavation Characteristics

The Unit 1 fill and Unit 2 Paralics will be readily excavated by earthwork equipment usual for developments of this nature. Locally, the sandstones of the Unit 3 Mission Valley Formation may require heavy ripping or special excavation techniques.

6.4.6 Remedial Grading

General

It is anticipated that most of Unit 1 undocumented fill at the site will be completely removed during excavation for the underground parking garage.

Where not removed from the foundation level in parking structure, the Unit 1 fill should be removed to contact with the level of the Unit 2 Paralics. This removal should extend at least five feet outside the building limits or to the property line, whichever is less. Thereafter, the excavated Unit 1 fill should be backfilled with either:

- Select Fill that conforms to the requirements described in Section 6.4.4; or,
- a controlled low strength material (CLSM, sometimes referenced as 'flowable fill').

Select Fill

This fill should be placed in loose lifts not to exceed 10 inches in loose thickness and compacted to at least at least 2% above optimum moisture content and 90 percent relative compaction after ASTM D 1557.

CLSM

Over excavated areas or other excavations can be backfilled up to the bottom of the design footing elevation with a CLSM that develops a minimum unconfined compressive strength of 40 psi. A two sack slurry mix should meet this criterion.

If employed, the CLSM should conform to material requirements identified in Section 19-3 of the Caltrans Standard Specifications (latest edition). The Caltrans specification for the gradation of CLSM aggregate is reproduced on below as Table 6-5 (following page).

Table 6-5. Gradation for CLSM Fill Aggregate

U.S. Standard Sieve Size (ASTM E 11)	Percent Passing by Weight, ¾ -inch Max
1½ inch	100
1 inch	80 to 100
¾ inch	60 to 100
3/8 inch	50 to 100
No. 4	40 to 80
No. 8	10 to 40

Source: Caltrans 2015, Section 19-3.02G

6.4.7 Maintenance of Moisture in Soils During Construction

The subgrade moisture condition of the building pad and foundation soils must be maintained at least 2% above optimum moisture content up to the time of concrete.

6.4.8 Trenching and Backfilling for Utilities

Excavation for utility trenches must be performed in conformance with OSHA regulations contained in 29 CFR Part 1926.

Utility trench excavations have the potential to degrade the properties of the adjacent soils. Utility trench walls that are allowed to move laterally will reduce the bearing capacity and increase settlement of adjacent footings and overlying slabs.

Backfill for utility trenches is as important as the original subgrade preparation or engineered fill placed to support either a foundation or slab. Backfill for utility trenches must be placed to meet the project specifications for the engineered fill of this project. Unless otherwise specified, the backfill for the utility trenches should be placed in 4 to 6 inch loose lifts and compacted to a minimum of 90 percent relative compaction after ASTM D 1557 (the 'modified Proctor') at soil moisture at least +2 percent of the optimum moisture content. Up to 4 inches of bedding material placed directly under the pipes or conduits placed in the utility trench can be compacted to 90 percent relative compaction with respect to the Modified Proctor.

Compaction testing should be performed for every 20 cubic yards of backfill placed or each lift within 30 linear feet of trench, whichever is less.

Backfill of utility trenches should not be placed with water standing in the trench. If granular material is used for the backfill, the material should have a gradation that will filter protect the backfill material from the adjacent soils. If this gradation is not available, a geosynthetic non-woven filter fabric should be used to reduce the potential for the migration of fines into the backfill material.

6.4.9 Flatwork

Prior to casting exterior flatwork, the upper two feet of subgrade soils should be removed and replaced with "Select" fill, moisture conditioned and recompacted, as recommended in Section 6.4.5. Concrete slabs for pedestrian traffic or landscaping should be at least four (4) inches thick.

6.5 Shallow Foundations

6.5.1 General

Shallow foundations (isolated spread or continuous) footings for support of the structure may be established following penetration of at least 12 inches into either Unit 2 or Unit 3. Foundation excavations for any at-grade portion of the structure will need to be deepened and extended at least 12 inches into either Unit 2 or Unit 3.

The following subsections detail recommendations for shallow foundations.

6.5.2 Conventionally Reinforced Concrete Slab

The ground level of the structure may employ conventional on-grade (ground-supported) slab. Conventionally reinforced on-grade concrete slabs may be designed using a modulus of subgrade reaction (k) of 140 pounds per cubic inch (i.e., k = 140 pci).

The actual slab thickness and reinforcement should be designed by the Structural Engineer. NOVA recommends the slab be a minimum 5 inches thick, reinforced by at least #3 bars placed at 16 inches on center each way within the middle third of the slabs by supporting the steel on chairs or concrete blocks ("dobies").

Minor cracking of concrete after curing due to drying and shrinkage is normal. Cracking is aggravated by a variety of factors, including high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due during curing. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking.

To reduce the potential for excessive cracking, concrete slabs-on-grade should be provided with construction or 'weakened plane' joints at frequent intervals. Joints should be laid out to form approximately square panels.

6.5.3 Conventional Foundations

Conventional foundations, consisting of isolated and continuous footings, may be employed as described below.

<u>Isolated Foundations</u>

Isolated foundations for interior columns may be designed for an allowable contact stress of 6,000 psf. This value may be increased by one-third for transient loads such as wind and seismic. These foundation units should have a minimum width of 30 inches, embedded a minimum of 24 inches below lowest adjacent grade, including a minimum embedment of 12 inches into either Unit 2 or Unit 3.

<u>Continuous Foundations</u>

Continuous foundations may be designed for an allowable contact stress of 6,000 psf, for footings with a minimum of 18 inches in width and embedded 24 inches below lowest adjacent grade with an overall minimum embedment of 12 inches into either the Unit 2 or Unit 3 soils. This bearing value may be increased by one-third for transient loads such as wind and seismic.

Resistance to Lateral Loads

Lateral loads to shallow foundations cast neatly against Unit 2 or Unit 3 sandstones may be resisted by passive earth pressure against the face of the footing, calculated as a fluid density of 400 psf per foot of depth, neglecting the upper 1 foot of soil below surrounding grade in this calculation. Additionally, a coefficient of friction of 0.35 between soil and the concrete base of the footing may be used with dead loads.

Settlement

If the building is supported as recommended above, it will settle on the order of 0.5 inch to 1 inch. This movement will occur elastically, as dead load (DL) and permanent live loads (LL) are applied. In usual circumstance, about 80% of this settlement will occur during the construction period. Angular distortion due to differential settlement of adjacent, unevenly loaded footings should be less than 1 inch in 40 feet (i.e., Δ./L less than 1:480).

6.5.4 Moisture Barrier

Capillary Break

NOVA recommends that the requirements for a capillary break ('sand layer') be determined in accordance with ACI Publication 302 "*Guide for Concrete Floor and Slab Construction.*" A "capillary break" may consist of a 4-inch thick layer of compacted, well-graded sand should be placed below the floor slab. This porous fill should be clean coarse sand or sound, durable gravel with not more than 5 percent coarser than the 1-inch sieve or more than 10 percent finer than the No. 4 sieve, such as AASHTO Coarse Aggregate No. 57.

Vapor Barrier

Membranes set below floor slabs should be rugged enough to withstand construction. If a vapor barrier is desired, a minimum 15-mil polyethylene membrane should be placed over the porous fill to preclude floor dampness.

NOVA recommends that a minimum 15-mil low permeance vapor membrane be used. For example, Carlisle-CCW produces the Blackline 400® underslab, vapor and air barrier, a 15-mil low-density polyethylene (LDPE) rated at 0.012 perms after ASTM E 96.

Limitations of This Recommendation

Recommendation for moisture barriers are traditionally included with geotechnical foundation recommendations, though these requirements are primarily the responsibility of the Structural Engineer or Architect.

If there is particular concern regarding moisture sensitive materials or equipment to be placed above the slab-on-grade, a qualified person (for example, such as the flooring subcontractor and/or Structural Engineer) should be consulted to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. NOVA does not practice in the field of moisture vapor transmission evaluation since this is not specifically a geotechnical issue.

6.6 Deep Foundations

6.6.1 General

In the event foundations for Centrum 6 are located adjacent to and above the base of the existing subterranean garage, the potential for these loads to affect the garage walls must be considered. The existing garage extends 3-levels below surrounding grade. Additionally, NOVA anticipates that there could be as much as 40 feet of backfill behind the subterranean retaining walls.

In the event it is considered that new foundations will overload the garage walls or in concern for compressible backfill, alternatives for design will include either (i) deepening foundations in order to not surcharge the walls of the existing parking structure; or, (ii) transferring column loads to depth by use of deep foundations.

6.6.2 Drilled Piles

Drilled piles (also referenced as 'cast-in-drilled-hole' piles, or 'CIDH piles') should be extended through the fill/backfill and be embedded at least five pile diameters into Unit 2 or Unit 3 below the base of the garage.

NOVA estimates that 24-inch diameter; 40-foot long drilled piles founded in formational soils will develop allowable axial capacities on the order of 200 kips at that level. Tensile capacities will be on the order of 60 kips per pile. The allowable lateral resistance will be on the order of 15 kips/pile, assuming fixed head design conditions and that piles within groups are spaced a minimum of three pile diameters (3D) center to center.

The foregoing is provided as general guidance for consideration of drilled piles. NOVA should provide specific design analyses in the event drilled piles are employed.

6.7 Control of Moisture Around Foundations

6.7.1 General

Design for the structure should include care to control accumulations of moisture around and below foundations. Such design will require coordination from among the Design Team; at a minimum to include the Architect, the Civil Engineer, and the Landscape Architect.

6.7.2 Erosion and Moisture Control During Construction

Surface water should be controlled during construction, via berms, gravel/sandbags, silt fences, straw wattles, siltation basins, positive surface grades, or other methods to avoid damage to the finish work or adjoining properties. The Contractor should take measures to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed. After grading, all excavated surfaces should exhibit positive drainage and eliminate areas where water might pond.

6.7.3 Design

General

Civil, structural, architectural and landscaping design for the areas around foundations should be undertaken with a view to the maintenance of an environment that encourages constant moisture conditions in the foundation soils following construction. Roof and surface drainage, landscaping, and utility connections should be designed to limit the potential for infiltration and/or releases of moisture beneath structures. This care should, at a minimum, include the actions described below.

Drainage

Rainfall to roofs should be collected in gutters and discharged in a controlled manner through downspouts designed to drain away from foundations. Downspouts, roof drains or scuppers should discharge into splash blocks to slabs or paving sloped away from buildings.

Surface Grades

Proper surface drainage will be required to minimize the potential of water seeking the level of the bearing soils under foundations and pavements. In areas where sidewalks or paving do not immediately adjoin the structure, protective slopes should be provided with a minimum grade (away from the structure) of approximately 3 percent for at least 5 feet from perimeter walls. A minimum gradient of 1 percent is recommended in hardscape areas. Drainage should be directed to approved drainage facilities.

6.7.4 Utilities

Design for Differential Movement

Underground piping within or near structures should be designed with flexible couplings to accommodate both ground and slab movement so that minor deviations in alignment do not result in breakage or distress. Utility knockouts should be oversized to accommodate the potential for differential movement between foundations and the surrounding soil.

Backfill Above Utilities.

Excavations for utility lines, which extend under or near structural areas should be properly backfilled and compacted. Utilities should be bedded and backfilled with approved granular soil to a depth of at least one foot over the pipe. This backfill should be uniformly watered and compacted to a firm condition for pipe support. Backfill above the pipe zone should meet the requirements for Select Fill, placed to at least 90% relative compaction at 2% above optimum.

6.8 Retaining Walls

6.8.1 General

As is discussed in Section 2, only conceptual design information is currently available. The following subsections provide guidance for design of cantilevered retaining walls should planning change and such retaining structures be employed.

6.8.2 Shallow Foundations

Retaining walls should be developed on ground prepared in accordance with the criteria provided in Section 6.4. Continuous shallow foundations may be designed in accordance with the criteria provided in Section 6.5.

6.8.3 Lateral Earth Pressures

Static

Design may include smaller conventionally reinforced concrete retaining walls. Lateral earth pressures for wall design are provided on Table 6-6 as equivalent fluid weights, in psf/foot of wall height or pounds per cubic foot (pcf).

Table 6-6. Lateral Earth Pressures

Loading Condition	Equivalent Fluid Density (pcf) for Approved Backfill[A, B]
Active (wall movement allowed)	35
"At Rest" (no wall movement)	60
'Passive" (wall movement toward the soils)	250

Note A: 'approved' means Select Fill with EI < 50 after ASTM D4829 and approved by the Geotechnical Engineer.
Note B: assumes wall includes appropriate drainage.

Vehicle Surcharge Loads

Where the retaining walls are subject to vehicle surcharge load an additional 30 pcf should be added to the lateral earth pressures.

Seismic

The lateral seismic pressure acting on a cantilevered retaining wall should be applied as an inverted triangle with a magnitude of 19H, where H is the free height of the wall. The resultant dynamic thrust acts at a distance of 0.6H above the base of the wall. This equation applies to level backfill and walls that retain no more than 15 feet of soil.

6.8.4 Foundation Uplift

A soil unit weight of 125 pcf may be assumed for calculating the weight of soil over the wall footing.

6.8.5 Resistance to Lateral Loads

Lateral loads to wall foundations will be resisted by a combination of frictional and passive resistance as described below.

- Frictional Resistance. A coefficient of friction of 0.35 between the soil and base of the footing.

- Passive Resistance. Passive soil pressure against the face of footings or shear keys cast neat against Unit 2 or Unit 3 will accumulate at an equivalent fluid weight of 350 pounds per cubic foot (pcf). The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in calculations of passive resistance.

6.8.6 Wall Drainage

The recommended equivalent fluid pressures provided in the preceding subsection assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the uncontrolled buildup of hydrostatic pressures and lateral stresses in excess of those stated.

Design for wall drainage may include the use of pre-engineered wall drainage panels or a properly compacted granular free-draining backfill material (EI <50). The use of drainage openings through the base of the wall (weep holes) is not recommended where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall.

Figure 6-1 provides a conceptual design for wall drainage. Numerous alternatives are available for collection of water behind retaining walls. The intent of this Figure 6-1 is to depict the concepts described in the preceding paragraph.

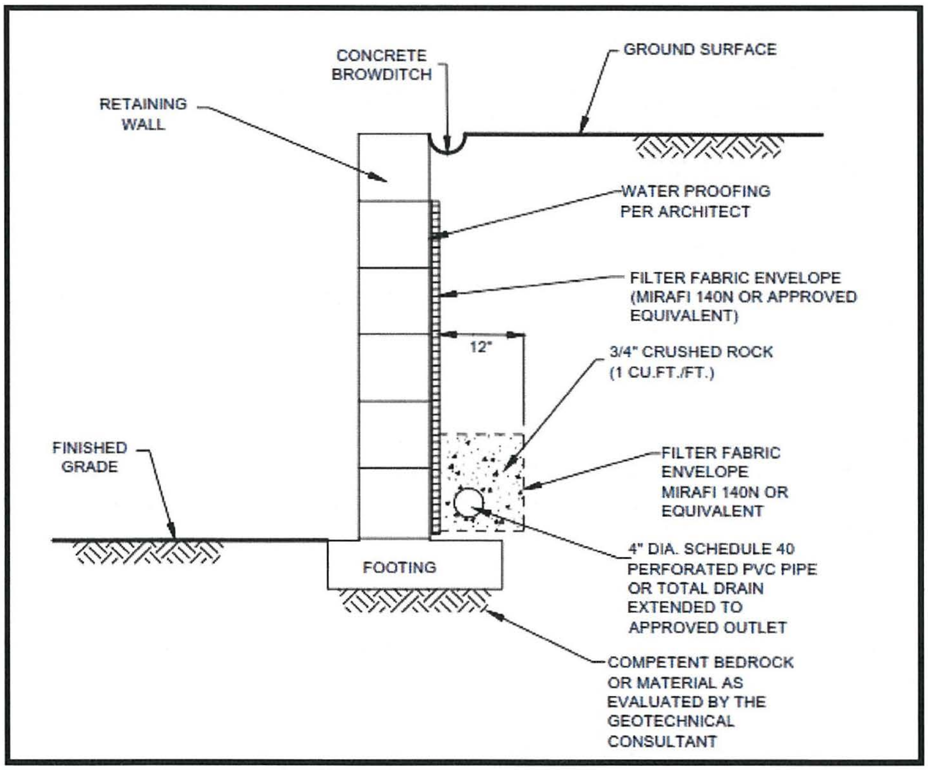


Figure 6-1. Conceptual Design for Wall Drainage

6.9 Wall Surcharge by Biofiltration Basins

Design for stormwater infiltration BMPs may employ the use of the biofiltration basins- ground supported and embedded structures that exfiltrate through a base. The design is not yet finalized. However, in the north and west of the structure, these basins may be sited adjacent to walls for the subterranean level, founded at about elevation +408 feet msl and rising to the ground surface at about El +416 feet msl. Figure 6-1 (following page) depicts preliminary planning for alignment of the structures.

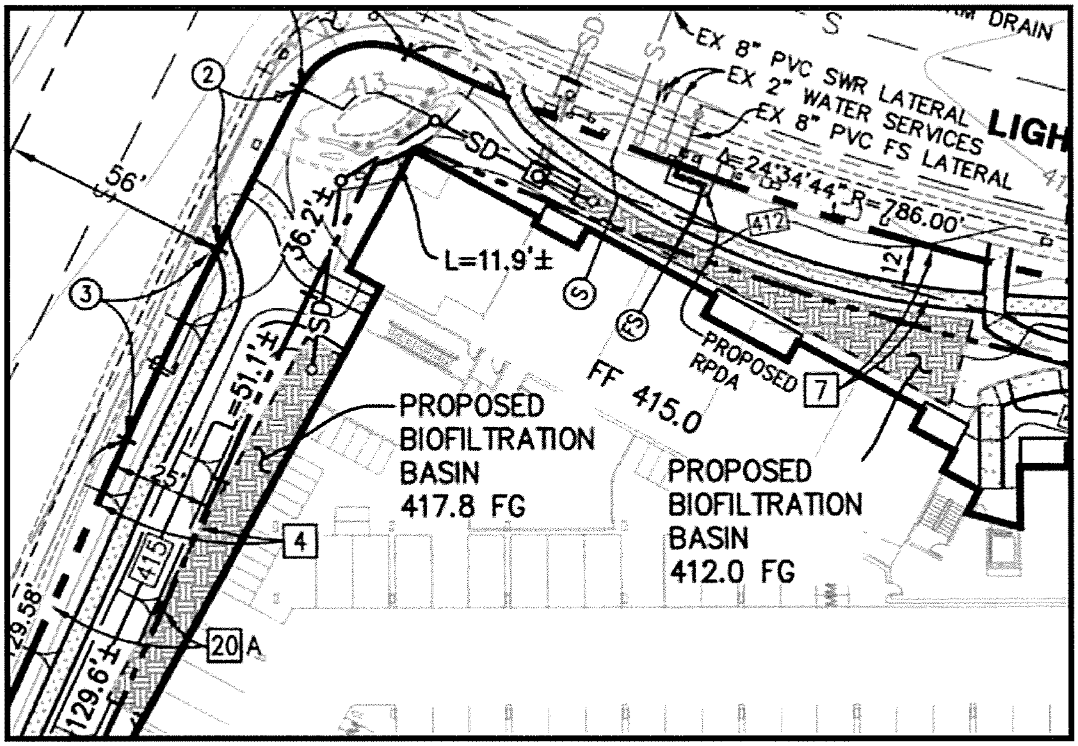


Figure 6-2. Preliminary Planning for Alignment of Biofiltration Basins

The biofiltration structures will retain both soil and water. Retained water may rise to at or near the top of the biofiltration basin. Additionally, exfiltration may saturate the ground beneath the basins. In consideration of this potential, design for subterranean walls in the vicinity of the biofiltration basins should include allowance for full hydrostatic pressure from the top of the biofiltration basin to the base of the wall. No new soil loads will be applied. Soil pressures should be considered as described in Section 6.8

6.10 Elevator Pits

Though retaining walls are not planned, it is possible that an elevator pit may be necessary.

Walls for an elevator pit should be designed in accordance with the recommendations provided in Section 6.7 for retaining walls. The elevator slab and related retaining wall footings will derive support from the Unit 2 soils that will be exposed in an excavation for the elevator pit.

Design for the elevator pit walls should add care that considers the circumstances and conditions described below.

1. Wall Yield. NOVA expects that proper function of the elevator pit should not allow yielding of the elevator pit walls. As such, walls should be designed to resist 'at rest' lateral soil pressures plus the surcharge of any structures or foundations surrounding the elevator pit.

2. Construction. By virtue of a usual location near the center of the structure, the need for special equipment, and the likelihood that elevator pit construction will precede much of the construction around it, design of elevator pit walls should include consideration for surcharge conditions that will occur during construction. Such conditions may include, but not be limited to, surcharges

from vehicle traffic and sloping ground above and around the walls.

3. Moisture. NOVA recommends that consideration be given to passive side waterproofing to prevent moisture accumulation inside the elevator pit.

4. Piston. If the elevator pit includes a plunger-type elevator piston, a deeper drilled excavation may be required. NOVA should be consulted regarding recommendations for development of a plunger-type elevator piston.

6.11 Temporary Slopes

Temporary slopes may be required for excavations during grading. All temporary excavations should comply with local safety ordinances. The safety of all excavations is solely the responsibility of the Contractor and should be evaluated during construction as the excavation progresses.

Based on the data interpreted from the borings, the design of temporary slopes may assume California Occupational Safety and Health Administration (Cal/OSHA) Soil Type A for planning purposes.

Temporary slopes in the Unit 2 and Unit 3 formational soils may be excavated no steeper than ¾: 1 (horizontal: vertical). Temporary slopes in the Unit 1 undocumented fill may be excavated no steeper than 1.2: 1 (horizontal: vertical).

7.0 TEMPORARY SHORING

7.1 General

7.1.1 Need for Temporary Shoring

Development of the below grade level of parking will require temporary shoring to maintain vertical sides of the excavation. The recommendations provided in this section are intended to provide guidance for design of temporarily retained excavations.

7.1.2 Responsibilities

It is the responsibility of the Contractor to provide an excavation that is safe, with deflections that do not damage nearby structures or utilities. Design of temporary shoring should be performed by a qualified Shoring Engineer. The Shoring Engineer should be solely responsible for the design, utilizing the indications of subsurface conditions provided in this report.

7.2 Planned Excavation

7.2.1 Limits of the Excavation

Though design to this point is only conceptual, it is expected that the excavation will be largely be bounded by streets and adjacent properties. The excavation will likely extend to within about 10 feet of both streets and properties that adjoin the site.

7.2.2 Subsurface Conditions

Design should consider that the alignment of temporary walls is underlain by the sequence of soil units described in Section 4.3.

7.2.3 Groundwater

<u>Measured Groundwater Level</u>

Based upon the indications of the engineering borings, groundwater is expected to occur at least 20 feet below the base of excavations for the parking structure.

<u>Potential for Perched Groundwater</u>

As is discussed in Section 3, periods of wet weather can develop conditions of perched water. NOVA was involved with sites complicated by perched water during the months following the heavy rains of Winter/Spring 2-16-2017.

The potential for perched water is such that design and construction-related planning should consider potential for near-surface groundwater levels to affect below grade construction. The Contractor should be prepared to address perched groundwater if encountered during the grading operations. In addition, wet soils may be encountered at the bottom of the removals.

7.3 Potential Approaches to Temporary Shoring

The excavation for the below-grade garage may extend to about 15 feet below existing ground surface, requiring temporary shoring for stability. Design of temporary shoring is principally governed by soil and groundwater conditions, as well as by the depth and width of the excavated area. As such, support of the excavation face can be provided by a variety of means.

In consideration of the excavation required in this instance, NOVA expects that a cantilevered system of 'soldier piles and wood lagging' will likely provide the most cost-effective system, drilling soldier beams into the Unit 1 and Unit 2 soils.

The soldier beam and lagging retaining wall may be supported by either

- cantilever, retaining the excavation by the stiffness of the soldier beams; or,
- external bracing, adding resistance to lateral loads by the use of tiebacks.

7.4 Design Conditions for Wall Loading

7.4.1 General

Design for braced/retained excavation should consider conditions of wall loading as described below.

1. Condition 1, 'At Rest.' Design for the retaining wall should consider the use of 'at-rest' soil pressures at locations where wall deflections may effect potentially damaging settlement.

2. Condition 2, 'Active.' Design for temporary walls that are not located near sensitive structures or utilities should consider 'active' earth pressures.

7.4.2 Design for Condition 1 ('At Rest') Wall Soil Loads

Walls developed near existing, settlement sensitive structures may be designed to resist 'at rest' (i.e., 'K_o') earth pressures, using a conventional 'equivalent fluid' wall pressure distribution for cantilevered walls. The magnitude of the maximum equivalent fluid pressure (P) may be calculated as:

$P\ (\text{psf}) = (K_o)\ (\gamma)\ (H)$ where,

$K_o = 1 - \sin\phi \quad \phi = 34°, \text{ and } K_o = (1 - 0.56) = 0.44$

$\gamma = 125\ \text{lb/ft}^3$

$H = \text{wall height}$

$P = 0.44 \times 125 \times H = 55H$

7.4.3 Design for Condition 2 ('Active') Wall Soil Loads

Wall pressures in areas where wall deflections will not immediately threaten structures or utilities may be completed using a conventional 'equivalent fluid wall pressure' distribution.

The magnitude of the maximum equivalent fluid pressure (P) may be calculated as:

$P\ (\text{psf}) = (K_a)\ (\gamma)\ (H)$ where,

$K_a = (1 - \sin\phi) / (1 + \sin\phi)$ $\phi = 34°$, $K_a = 0.31$

$\gamma = 125\ \text{lb/ft}^3$

$H = \text{wall height}$

$P = 0.31 \times 125 \times H = 39H$

7.4.4 Passive Resistance

It is assumed that soldier beams will be set in pre-drilled holes and backfilled with lean concrete or a sand cement slurry with a compressive strength of at least 700 psf.

Passive soil resistance for embedded portions of soldier piles can be calculated using an equivalent passive soil fluid weight of 400 lb/ft^3, ignoring the first foot of penetration. The passive resistance can be assumed to act over a width of 2.5 pile diameters. The means and methods of placement of this slurry mix will be the responsibility of the Shoring Contractor.

7.5 Tie-Back Anchor Design

7.5.1 General

It is not is expected that external bracing by use of tiebacks will be required to support even the taller areas of temporary excavation. The following subsections address implementation of tiebacks in the event such support is desirable.

7.5.2 Rankine Failure Wedge

Design should assume that the failure wedge adjacent to the shoring is defined by a plane drawn at 29° from the vertical from the toe of the wall. Figure 7-1 (following page) depicts this wedge graphically.

Tieback anchors should extend at least 20 feet beyond the failure wedge (i.e., the "bonded "zone) depicted in Figure 7-1. The intent of this provision is to provide global stability for the shored wall. The bonded length should commence at least 5 feet beyond the failure wedge.

7.5.3 Bond Stresses and Anchor Spacing

The Shoring Engineer should be solely responsible for determination of allowable bond stresses on pressure-concreted ('post-grouted') anchors. NOVA expects that an allowable bond stress of 3,500 psf or more should be readily achievable. Only the resistance developed beyond the failure wedge should be used in resisting lateral loads. If the anchors are spaced at least 6 feet on center, no reduction in the capacity of the anchors need be considered due to group action. In no event should the anchors extend less than the minimum length beyond the potential failure wedge as given above.

As a tie-back anchor system is intended for temporary use, provisions should be made in the design to de-tension and abandon the tie-backs when the basement walls are able to support the lateral loads.

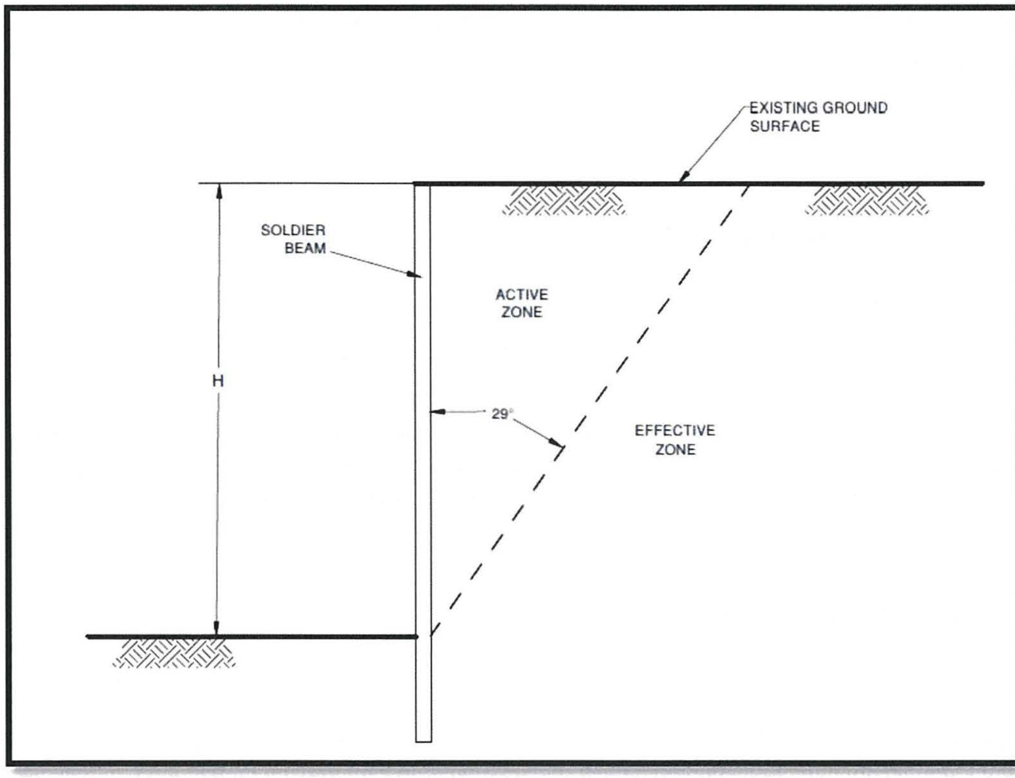


Figure 7-1. Recommended Effective Zone for Tieback Anchors

7.5.4 Anchor Testing

Wall design should provide for (i) performance testing; (ii) proof testing; and, (iii) creep testing of wall anchors. In this regard, it is recommended that guidance provided in FHWA 1999 be utilized. Guidance for proof testing for all anchors provides for loading to a single cycle and load hold at the test load. The guidance provides that loading be applied pre-provided in load increments of 0.25DL, 0.50DL, 1.00DL, 1.20DL and 1.30DL (the 'test load').

All of the production anchors should be tested to at least 130% of the design load; the total deflection during the tests should not exceed 1.5 inches. The rate of creep under the 130% test should not exceed 0.1 inch over a 15-minute period for the anchor to be approved for the design loading.

7.5.5 Anchor Installation

The anchors may be installed at angles of 15 to 35 degrees below the horizontal. The Unit 2 and Unit 3 soils are cemented such that limited caving should be anticipated in drilling the anchors.

The anchors should be filled with concrete placed by pumping from the tip of the anchor to the failure wedge (i.e., over the bonded zone). The portion of the anchor tendons outside of the bonded length should be sleeved in plastic (i.e., over the unbonded zone). If the anchor tendons are sleeved, it is acceptable to concrete the entire length of the anchor.

7.6 Miscellaneous Wall Design Considerations

Soldier piles set in drilled holes will require bearing. Bearing should not be considered. The soil-pile bond will be on the order of 600 psf or greater.

The coefficient of friction (μ) between the wall and retained soils will be about $\mu = 0.35$.

7.7 Wall Construction

Walls will be constructed by first setting the soldier beams. Thereafter, the pace of the excavation will be limited by the establishment of lagging, as described below.

Excavation should not be advanced the deeper than about 4 feet below the bottom of the lagging at any time. These gaps of up to 4 feet should only be allowed to stand for short periods of time in order to decrease the potential for sloughing/caving. Backfilling should be conducted when necessary between the back of the lagging and excavation sidewalls to reduce any sloughing in this zone.

7.8 Expected Wall Movements

7.8.1 General

Design should endeavor to limit deflection at the top of temporary walls to on the order of 1" along the deeper portion of the wall. Actual wall movement and related ground settlement are related to a variety of factors, most significantly (i) the stiffness and spacing of the soldier piles; and, (ii) workmanship in wall construction.

The high-quality sands and sandstones of Unit 2 and Unit 3 are favorable for sound wall construction. NOVA expects that the combination of workmanship and a relatively stiff cantilevered wall will result in good wall performance. Additionally, ground and wall movement monitoring described in the following subsections should be sufficient to detect any unusual behavior (e.g., larger than anticipated wall movement or ground settlement) before the condition becomes problematic.

NOVA does not provide shoring design services. However, in a check the feasibility of constructing a cantilevered wall, NOVA has completed preliminary numerical evaluations. Utilizing relatively stiff soldier piles ($I > 6{,}000\ in^4$) embedded a minimum of 15 feet below the base of the excavation, top deflection can be limited to on the order of 0.7 inch.

7.8.2 Excavation Planning and Monitoring

<u>Excavation Planning</u>

Sequencing of shoring installation, excavation and required groundwater or perched water control dewatering will be critical to control of deflections and settlement. The minimum amount of allowable deflection of the soldier pile wall should be determined by a Structural Engineer in consultation with the Geotechnical Engineer.

NOVA recommends that prior to initiating construction a detailed excavation phasing plan be submitted by the Shoring Contractor and reviewed by the Shoring Engineer and Geotechnical Engineer.

Excavation Monitoring

Systematic settlement monitoring of adjacent ground and structures/pavements should be performed to evaluate the performance of the shoring. Shoring and the conformance of related monitoring with the 2016 CBC (specifically, Section J106.2) is the responsibility of the Shoring Contractor. Caution should be used to minimize damage to existing pavement, utilities, and/or structures caused by settlement or reduction of lateral support.

At a minimum, monitoring prior to, during after construction should address the actions listed below.

1. Pre-Construction Building Condition Survey. The condition of the parking garage to the immediate south should be documented prior to wall construction. In usual case, this includes a careful walk-through by experienced structural and geotechnical engineers.

2. Soldier Beam Monitoring. Prior to construction, select soldier beams should be marked and surveyed, establishing a basis for a long-term plot of soldier pile movement with time.

3. Ground Monitoring. The ground surrounding the excavation, to a distance (where accessible) of at least 20 feet from the walls, should be periodically surveyed for evidence of settlement. Such monitoring will require a preconstruction ground survey.

4. Post-Construction Building Condition Survey. The pre-construction survey should be reproduced at the end of construction, establishing the condition of the structure at that time.

8.0 PAVEMENT DESIGN

8.1 General

The structural design of pavement sections depends primarily on anticipated traffic conditions, subgrade soils, and construction materials. For the purposes of the preliminary evaluation provided in this section, NOVA has assumed a Traffic Index (TI) of 5.0 for passenger car parking, and 6.0 for the driveways. These traffic indices should be confirmed by the project civil engineer prior to final design.

8.2 Drainage

Control of surface drainage is important to the design and construction of pavements. Standing water that develops either on the pavement surface or within the base course can soften the subgrade and create other problems related to the deterioration of the pavement. Good drainage should minimize the risk of the subgrade materials becoming saturated and weakened over a long period of time.

The following recommendations should be considered to limit the amount of excess moisture, which can reach the subgrade soils:

- maintain surface gradients at a minimum 2% grade away from the pavements;
- compact utility trenches for landscaped areas to the same criteria as the pavement subgrade;
- seal all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils;
- planters should not be located next to pavements (otherwise, subdrains should be used to drain the planter to appropriate outlets);
- place compacted backfill against the exterior side of curb and gutter; and,
- concrete curbs bordering landscaped areas should have a deepened edge to provide a cutoff for moisture flow beneath pavements (generally, the edge of the curb can be extended an additional twelve inches below the base of the curb).

Preventative maintenance should be planned and provided for in the ownership of all pavements. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

8.3 Subgrade Preparation

Remedial grading for paved areas should include removing the upper 2 feet of the Unit 1 undocumented fill, compacting the bottom of the removals to at least 90% relative compaction after ASTM D 1557 (the 'modified Proctor'). The removed soils should be replaced with "Select" fill and densified to at least 95% relative compaction after ASTM D 1557 (the 'modified Proctor').

After the completion of compaction/densification, areas to receive pavements should be proof-rolled. A loaded dump truck or similar should be used to aid in identifying localized soft or unsuitable material. Any soft or unsuitable materials encountered during this proof-rolling should be removed, replaced with an approved backfill, and compacted. The Geotechnical Engineer can provide alternative options such as using geogrid and/or geotextile to stabilize the subgrade at the time of construction, if necessary.

Construction should be managed such that preparation of the subgrade immediately precedes placement of the base course. Proper drainage of the paved areas should be provided to reduce moisture infiltration to the subgrade.

The preparation of roadway and parking area subgrades should be observed on a full-time basis by a representative of NOVA to confirm that any unsuitable materials have been removed and that the subgrade is suitable for support of the proposed driveways and parking areas after ASTM D1557.

8.4 Flexible Pavements

Provided the subgrade in paved areas is prepared per the recommendations in Section 8.3, an R-value of 30 can be assumed. Table 8-1 provides recommended sections for flexible pavements. The recommended pavement sections are for planning purposes only. Additional R-value testing should be performed on actual soils at the design subgrade levels to confirm the pavement design.

Table 8-1. Preliminary Recommendations for Flexible Pavements

Area	Estimated Subgrade R-Value	Traffic Index	Asphalt Thickness (in)	Base Course Thickness (in)
Parking Stalls	30	5.0	3.0	6.0
Auto Driveways/Roadways	30	6.0	4.0	7.0

The above sections assume properly prepared subgrade consisting of at least 24 inches of select soil compacted to a minimum of 95% relative compaction. The aggregate base materials should also be placed at a minimum relative compaction of 95%. Construction materials (asphalt and aggregate base) should conform to the current Standard Specifications for Public Works Construction (Green Book).

8.5 Rigid Pavements

The flexible pavement specifications used in driveways and parking stalls may not be adequate for truck loading and turnaround areas. In this event, NOVA recommends that a rigid concrete pavement section be provided. The pavement section should consist of 6 inches of concrete over a 6-inch base course. The aggregate base materials should also be placed at a minimum relative compaction of 95%. The concrete should be obtained from a mix design that conforms with the minimum properties shown in Table 8-2 (following page).

Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/ contraction and isolation. Sawed joints should be cut within 24-hours of concrete placement, and should be a minimum of 25% of slab thickness plus 1/4 inch. All joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. Where dowels cannot be used at joints accessible to wheel loads, pavement thickness should be increased by 25 percent at the joints and tapered to regular thickness in 5 feet.

Table 8-2. Recommendations for Concrete Pavements

Property	Recommended Requirement
Compressive Strength @ 28 days	3,250 psi minimum
Strength Requirements	ASTM C94
Minimum Cement Content	5.5 sacks/cu. yd.
Cement Type	Type V Portland
Concrete Aggregate	ASTM C33
Aggregate Size	1-inch maximum
Maximum Water Content	0.5 lb/lb of cement
Maximum Allowable Slump	4 inches

9.0 STORMWATER INFILTRATION

9.1 Overview

Based upon the indications of the field exploration and laboratory testing reported herein, NOVA has evaluated the site as abstracted below after guidance contained in the *City of San Diego BMP Design Manual* (hereafter, 'the BMP Manual'). Section 3.3 provides a description of the field work undertaken to complete percolation testing. Figure 3-2 depicts the location of the testing. Plate 2, provided following the text of this report locates the testing in larger scale. This section addresses design infiltration rates.

It should be noted that the locations of the proposed BMPs have changed over time with the changes in planning for construction. It remains NOVA's judgment that the infiltration rate will be similar across the site as it underlain by very dense Very Old Parlics in the near surface.

As is well-established by the BMP Manual, the feasibility of stormwater infiltration is principally dependent on geotechnical and hydrogeologic conditions at the project site. In consideration of the low measured infiltration rates at this site, NOVA concludes that the site is not feasible for development of permanent stormwater infiltration BMPs.

This section provides an assessment of the feasibility of stormwater infiltration utilizing the information developed by the field exploration, as well as other elements of the site assessment.

9.2 Infiltration Rates

9.2.1 General

The percolation rate of a soil profile is not the same as its infiltration rate ('I'). Therefore, the measured/calculated field percolation rate was converted to an estimated infiltration rate utilizing the Porchet Method in accordance with guidance contained in the BMP Manual. Table 9-1 provides infiltration rates determined by the percolation testing by testing in 2016 and 2017.

Table 9-1. Infiltration Rates Determined by Percolation Testing

Year	Boring	Approximate Ground Elevation (feet, msl)	Depth of Test (feet)	Approximate Test Elevation (feet, msl)	Infiltration Rate (inches/hour)	Design Infiltration Rate (in/hour, F=2*)
2016	P-1	+416	6	+410	0.01	0.00
2016	P-2	+416	6.3	+409.7	0.01	0.00
2016	P-3	+415.5	5.5	+410	0.05	0.03
2017	P-4	+413	5	+408	0.01	0.00
2017	P-5	+415	5	+410	0.03	0.01
2017	P-6	+415	5	+410	0.01	0.00
2017	P-7	+413	5	+408	0.01	0.00

Notes: (1) 'F' indicates 'Factor of Safety' (2) elevations are approximate and should be reviewed

9.2.2 Design Infiltration Rate

In consideration of the nature and variability of subsurface materials, as well as the natural tendency of infiltration structures to become less efficient with time, the calculated infiltration rates should be modified to use at least a factor of safety (F) of F=2 for preliminary design purposes. The factor of safety can potentially increase after the design considerations are evaluated and selected at the discretion of the design engineer. The design factor of safety Worksheet D.5-1 is presented in the attached Appendix C.

The 2017 percolation testing at locations P-4 through P-7 was conducted at locations of currently planned stormwater infiltration BMPs. As may be seen by review of Table 9-1, the design basis infiltration rate ranges from I = 0.00 to I = 0.03, heavily weighted by this testing and the indications of the 2016 testing to I = 0.00 inches per hour (using a preliminary F = 2).

9.3 Review of Geotechnical Feasibility Criteria

9.3.1 Overview

Section C.2 of Appendix C of the BMP Manual provides seven factors that should be considered by the project geotechnical professional while assessing the feasibility of infiltration related to geotechnical conditions. These factors are listed below

- C.2.1 Soil and Geologic Conditions
- C.2.2 Settlement and Volume Change
- C.2.3 Slope Stability
- C.2.4 Utility Considerations
- C.2.5 Groundwater Mounding
- C.2.6 Retaining Walls and Foundations
- C.2.7 Other Factors

The above geotechnical feasibility criteria are reviewed in the following subsections.

9.3.2 Soil and Geologic Conditions

The soil borings and percolation tests borings completed for this assessment disclose the sequence of soil units described below.

1. Unit 1, Undocumented Fill (Qafu). A thin veneer of undocumented fill covers the site. The fill is a silty and clayey sand (derived from the Unit 2 Paralics) of typically less than 3 feet thickness.

2. Unit 2, Paralics ($Qvop_8$). This unit was encountered immediately beneath the Unit 1 fill at all borings on the site. Formerly referenced as the Lindavista Formation, the Very Old Paralics include very dense silty sand with varying amounts of gravel and cobbles. Testing of uncemented/disturbed portions of the formation characterizes these materials as silty fine to medium sands, 'SM' after ASTM D2487. This unit is the likely source of the Unit 1 fill.

3. Unit 3, Mission Valley Formation (Tmv). The Mission Valley Formation is expected to underlie the Very Old Paralics at depths ranging from 17 to 21 feet below existing ground surface. Soils of this unit are similar in nature to the soils of Unit 2- very dense silty and clayey sands with gravel and cobbles- but also includes interbeds of cemented materials (siltstone and sandstone).

9.3.3 Settlement and Volume Change

Unit 2 and Unit 3 materials do not have expansion potential, such that these soils will not be prone to swelling upon wetting or shrinkage on drying. The soils will not be prone to hydro-collapse on wetting.

9.3.4 Slope Stability

There are no slopes on-site, nor are any material soil embankments planned for the new development. As a consequence, embankment stability is not a constraint to BMPs.

9.3.5 Utilities

Stormwater infiltration BMPs should not be sited within 10 feet of underground utilities.

9.3.6 Groundwater Mounding

In consideration of the low measured percolation/infiltration rates, it is likely that groundwater mounding will occur if stormwater infiltration is attempted in any scale. Groundwater mounding can result in damaging groundwater mounding during wet periods, affecting utilities, pavements, flat work, and foundations.

9.3.7 Retaining Walls and Foundations

Permanent stormwater infiltration BMPs should not be sited within 25 feet of foundations for structures, including any retaining walls.

9.3.8 Other Factors

Biofiltration-2 (BF-2), is located in an area with over 15 feet of fill. This was found in the exploratory boring B-1 (NOVA 2017) and the percolation rate was tested at P-5 (NOVA 2017). Due to the considerable fill depth in this area, the extension of the BMP down to natural soil is infeasible and the results from this percolation test boring should be voided.

9.4 Suitability of the Site for Stormwater Infiltration

The locations of the proposed BMPs have changed over time with the change in the proposed construction. However, in consideration of the homogeneity of the subsurface that is well demonstrated by borings completed across the limits of the planned Centrum 6 development, it is NOVA's judgment that the infiltration rate will be similar across the site as it underlain by the same very dense Very Old Parlics. This was confirmed by the percolation testing results performed November 9, 2017, at the currently planned locations of stormwater infiltration BMPs.

As a consequence of the widespread occurrence across the San Diego area of the various facies of the Paralics, the infiltration characteristics of the geologic materials are well understood. Where the Paralics occur in dense, often cemented form as is the case at this site, infiltration rates are commonly those measured and reported in NOVA 2016. The results from the testing performed November 9, 2017, at the currently planned BMP locations were consistent with these low rates- rates that suggest I = 0.00.

NOVA does not recommend infiltration of stormwater at the site by permanent stormwater BMPs. This opinion is based upon consideration of the variety of factors detailed above- most significantly, (i) the low measured infiltration rates, (ii) the related potential for groundwater mounding, and (iii) limited space for siting such structures away from walls, utilities, and foundations.

10.0 REFERENCES

10.1 Site Specific

10.1.1 Architectural

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10.1.3 Civil

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PLATES

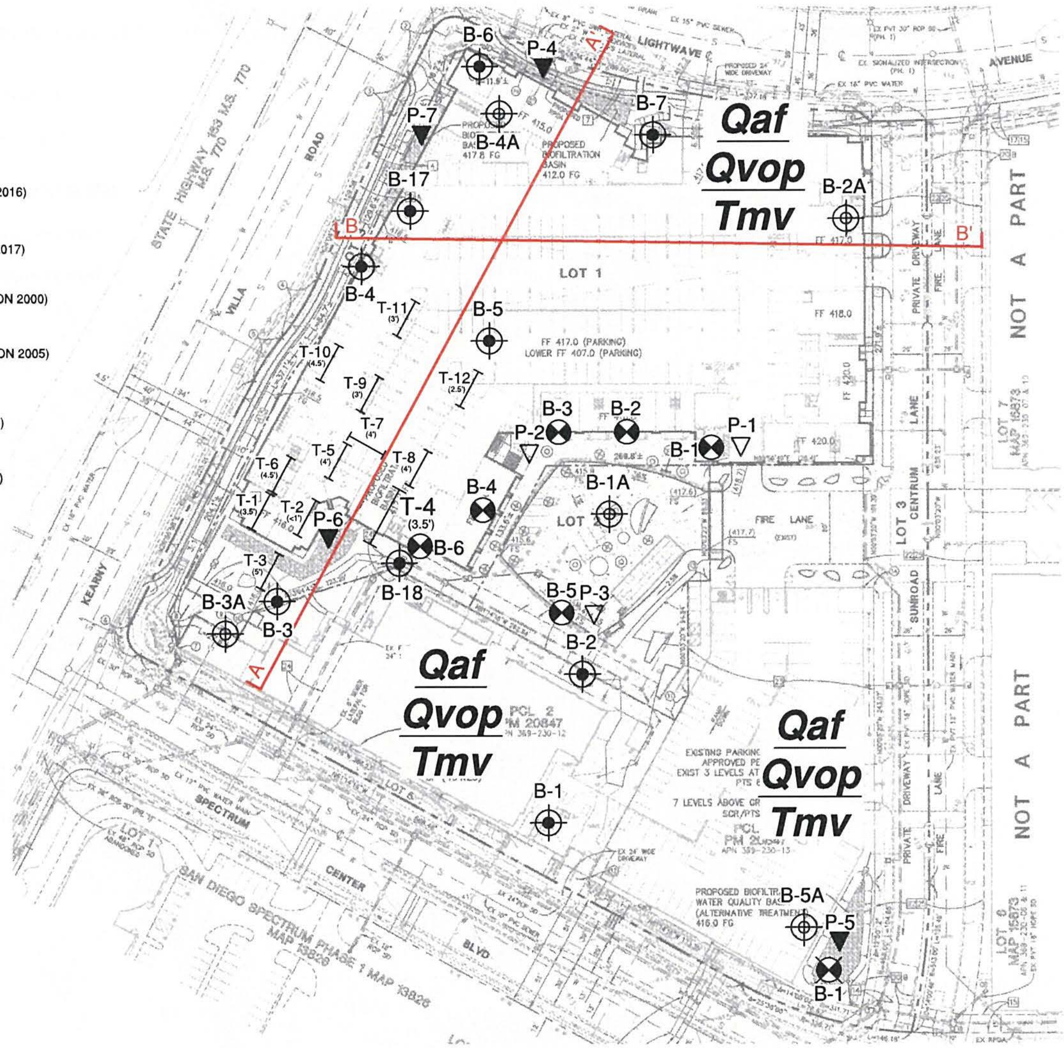
Plate 1: Subsurface Exploration Map

Plate 2: Map of Percolation Testing

Plate 3: Cross Sections

KEY TO SYMBOLS

Symbol	Description
Qaf	FILL
Qvop	VERY OLD PARALIC DEPOSITS
Tmv	MISSION VALLEY FORMATION
B-6	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (NOVA 2016)
B-1	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (NOVA 2017)
B-18	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (GEOCON 2000)
B-5A	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (GEOCON 2005)
P-7	APPROXIMATE LOCATION OF PERCOLATION TEST (NOVA 2017)
P-3	APPROXIMATE LOCATION OF PERCOLATION TEST (NOVA 2016)
T-12 (2.5')	TRENCH LOCATIONS (GEOCON 2010)
B B'	GEOLOGIC CROSS SECTION



CENTRUM

SUNROAD ENTERPRISES

Sunroad Enterprises
4445 Eastgate Mall Suite 400
San Diego, CA 92121

WERMERS PROPERTIES

Wermers Properties
2120 Shoreham Place, #150
San Diego, CA 92122

SUNROAD CENTRUM 6
SAN DIEGO, CA

VESTING TENTATIVE MAP NO. ________
PLANNED DEVELOPMENT PERMIT
AUGUST 1, 2017

CONCEPT GRADING & UTILITY PLAN

STEVENS-CRESTO ENGINEERING, INC.

C3.0

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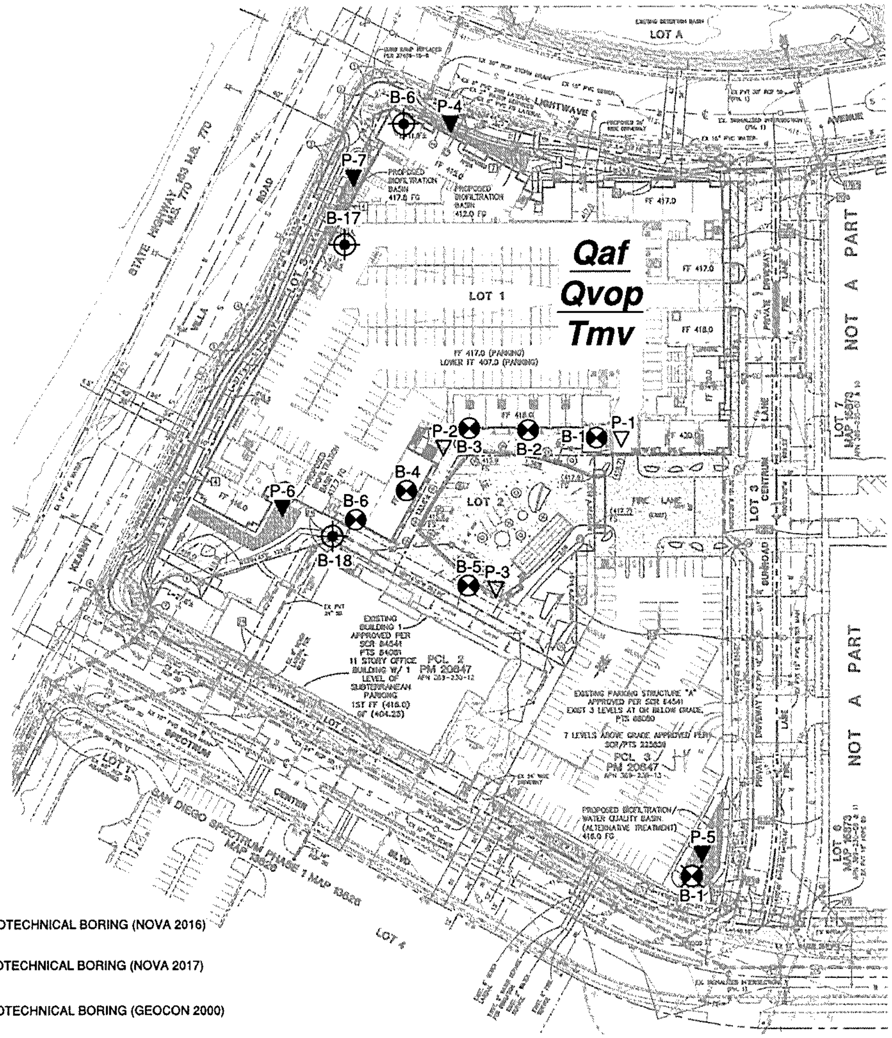
SUNROAD CENTRUM SIX
4445 EASTGATE MALL
SAN DIEGO, CALIFORNIA

PROJECT NO:	1015310
DATE:	NOV 2017
DRAWN BY:	DTW
REVIEWED BY:	JDB

SUBSURFACE INVESTIGATION MAP

0 100' 200'

PLATE: 1



KEY TO SYMBOLS

Qaf	FILL
Qvop	VERY OLD PARALIC DEPOSITS
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B-1	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (NOVA 2017)
B-18	APPROXIMATE LOCATION OF GEOTECHNICAL BORING (GEOCON 2000)
P-3	APPROXIMATE LOCATION OF PERCOLATION TEST (NOVA 2016)
P-7	APPROXIMATE LOCATION OF PERCOLATION TEST (NOVA 2017)

SUNROAD CENTRUM 6
SAN DIEGO, CA

VESTING TENTATIVE MAP NO. ______
PLANNED DEVELOPMENT PERMIT
AUGUST 1, 2017

CONCEPT GRADING & UTILITY PLAN

C3.0

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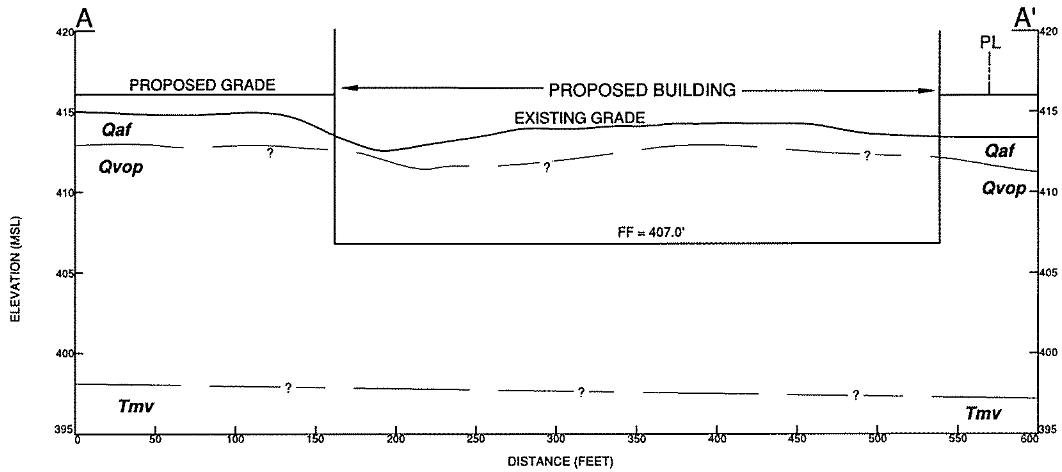
PROJECT NO:	1015310
DATE:	NOV 2017
DRAWN BY:	DTW
REVIEWED BY:	JDB

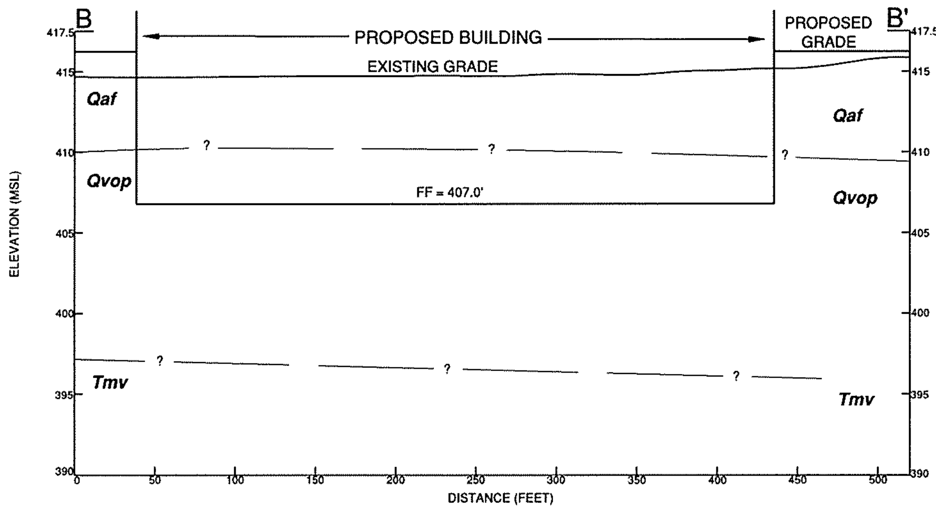
PERCOLATION TESTING MAP

0 120' 240'

PLATE: 2



GEOLOGIC CROSS-SECTION AA'
HORIZONTAL SCALE:1" = 75'
VERTICAL SCALE: 1" = 15'



GEOLOGIC CROSS-SECTION BB'
HORIZONTAL SCALE:1" = 75'
VERTICAL SCALE: 1" = 15'

KEY TO SYMBOLS

Qaf	FILL
Qvop	VERY OLD PARALIC DEPOSITS
Tmv	MISSION VALLEY FORMATION
?	GEOLOGIC CONTACT, QUERIED WHERE INFERRED

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PROJECT NO:	1015310
DATE:	NOV 2017
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REVIEWED BY:	JDB

GEOLOGIC CROSS SECTION AA' & BB'

0 1" 2"

PLATE: 3

APPENDIX A

USE OF THE GEOTECHNICAL REPORT

NOVA

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Telephone: 301/565-2733 Facsimile: 301/589-2017
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APPENDIX B

Logs of Borings by NOVA

NOVA

BORING LOG

NOVA Services

BORING NO.: B-1/P-1

PROJECT: Sunroad Centrumplace
BORING LOCATION: Spectrum Center Boulevard
DRILLING CONTRACTOR: Cal Pac Drilling
DRILLING METHOD: 6" Diameter Hollow Stem Auger
DRILLING EQUIPMENT: Mobile B-61
SAMPLING METHOD: Drive Sampler- SPT
HAMMER WT.: 140 **DROP:** 30"

PROJECT NO.: 1015310
ELEVATION AND DATUM: 416 feet ± (MSL)
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
TOTAL BORING DEPTH: 6.5 feet
DEPTH TO WATER START: N/A **FINISH:** N/A
LOGGED BY: HE
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0					3" AC OVER 4" BASE MATERIAL			
			SM			ARTIFICIAL FILL(Qaf): RED-BROWN; LOOSE; MOIST; GRAVELLY SILTY SAND; FINE TO MEDIUM GRAINED (SM)			
	2		SM			OLD PARALIC DEPOSITS UNIT 8 (Qop8): REDDISH BROWN; MEDIUM DENSE; MOIST; GRAVELY SILTY SANDSTONE; FINE TO MEDIUM GRAINED (SM)			
	4								
410	6			SPT	27				
	8					Boring Terminated at 6.5FT. No Groundwater Encountered. No Caving			
	10								
	12								
	14								
400	16								
	18								
	20								
	22								
	24								
390	26								

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

BORING LOG B-1

DATE EXCAVATED: NOVEMBER 8, 2017 **EQUIPMENT:** TRIPOD RID

EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING **GPS COORD.:** N/A

GROUNDWATER DEPTH: GROUNDWATER NOT ENCOUNTERED **ELEVATION:** 415 FT

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0				SC		**ARTIFICIAL FILL(Qafu):** *CLAYEY SAND; DARK BROWN, WET, LOOSE, FINE TO MEDIUM GRAINED, SOME COBBLE≤ 6", SOME GRAVEL≤ 3", ORGANIC ODOR*		
						MOTTLED DARK BROWN AND RED BROWN		
			CAL		43 #			*ERRONEOUS BLOWCOUNT DUE TO COBBLE*
5			CAL		28	*MEDIUM DENSE*		
			SPT		10	*LOOSE*		
10			SPT		16	*MEDIUM DENSE*		
15			SPT		7	*LOOSE*		
						BORING TERMINATED AT 16.5 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING		
20								
25								
30								

KEY TO SYMBOLS

	GROUNDWATER	#	ERRONEOUS BLOWCOUNT
	BULK SAMPLE	*	NO SAMPLE RECOVERY
	SPT SAMPLE (ASTM D1586)	——	GEOLOGIC CONTACT
	CAL. MOD. SAMPLE (ASTM D3550)	– – –	SOIL TYPE CHANGE

SUNROAD CENTRUM 6
SPECTRUM CENTER BLVD AND LIGHTWAVE AVE
SAN DIEGO, CALIFORNIA

LOGGED BY:	DM	DATE:	NOV 2017
REVIEWED BY:	HP	PROJECT NO.: 1015310	APPENDIX B-1

NOVA

BORING LOG

NOVA Services

BORING NO.: B-2

PROJECT: Sunroad Centrumplace
PROJECT NO.: 1015310
BORING LOCATION: Spectrum Center Boulevard
ELEVATION AND DATUM: 416 feet ± (MSL)
DRILLING CONTRACTOR: Cal Pac Drilling
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
DRILLING METHOD: 6" Diameter Hollow Stem Auger
TOTAL BORING DEPTH: 16 feet
DRILLING EQUIPMENT: Mobile B-61
DEPTH TO WATER START: N/A **FINISH:** N/A
SAMPLING METHOD: Drive Sampler- SPT
LOGGED BY: HE
HAMMER WT.: 140 **DROP:** 30"
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0					3" AC OVER 2" BASE MATERIAL			
			SM			ARTIFICIAL FILL(Qaf): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; SILTY SAND; FINE TO MEDIUM GRAINED (SM)			
	2		SC/ SM			OLD PARALIC DEPOSITS UNIT 8 (Qop8): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; CLAYEY SANDSTONE; FINE TO MEDIUM GRAINED (SC-SM)			
	4								
410	6			SPT	14				
			SM	SPT	10	DARK RED-BROWN; MEDIUM DENSE; MOIST; SILTY SANDSTONE; FINE TO MEDIUM GRAINED (SM)			
	8			SPT	50/6	BECOMES REDDISH BROWN; VERY DENSE			
	10			SPT	50/6	BECOMES WELL TO MODERATE-WELL CEMENTED; OCCASIONAL GRAVEL SIZE ROCK			
	12								
	14								
400	16			SPT	50/6				
						BORING TERMINATED AT 16.0FT. NO GROUNDWATER ENCOUNTERED. NO CAVING.			
	18								
	20								
	22								
	24								
390	26								

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

BORING LOG

NOVA Services

BORING NO.: B-3/P2

PROJECT: Sunroad Centrumplace
BORING LOCATION: Spectrum Center Boulevard
DRILLING CONTRACTOR: CALPAC
DRILLING METHOD: 6" Hollow Stem Auger
DRILLING EQUIPMENT: Mobile B-61
SAMPLING METHOD: Drive Sampler- SPT
HAMMER WT.: 140 **DROP:** 30"

PROJECT NO.: 1015310
ELEVATION AND DATUM: 416 feet ± (MSL)
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
TOTAL BORING DEPTH: 6.5 feet
DEPTH TO WATER START: N/A **FINISH:** N/A
LOGGED BY: HE
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0					3" AC OVER 3" BASE			
			SM			ARTIFICIAL FILL(Qaf): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; SILTY SAND; FINE TO MEDIUM GRAINED (SM)			
	2		SM			OLD PARALIC DEPOSITS UNIT 8(Qop8): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; SILTY SANDSTONE; FINE TO MEDIUM GRAINED (SM)			
	4					BECOMES LIGHT REDDISH BROWN			
410	6			SPT	72				
						BORING TERMINATED AT 6.5FT. NO GROUNDWATER ENCOUNTERED. NO CAVING.			
	8								
	10								
	12								
	14								
400	16								
	18								
	20								
	22								
	24								
390	26								

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

BORING LOG

NOVA Services

BORING NO.: B-4

PROJECT: Sunroad Centrumplace
BORING LOCATION: Spectrum Center Boulevard
DRILLING CONTRACTOR: CALPAC
DRILLING METHOD: 6" Hollow Stem Auger
DRILLING EQUIPMENT: Mobile B-61
SAMPLING METHOD: Drive Sampler- SPT
HAMMER WT.: 140 **DROP:** 30"

PROJECT NO.: 1015310
ELEVATION AND DATUM: 415.5 feet ± (MSL)
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
TOTAL BORING DEPTH: 16 feet
DEPTH TO WATER START: N/A **FINISH:** N/A
LOGGED BY: HE
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0		SM			ARTIFICIAL FILL (Qaf): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; SILTY SAND; FINE TO MEDIUM GRAINED (SM)			
			SM			OLD PARALIC DEPOSITS UNIT 8 (Qop8): DARK RED-BROWN; MEDIUM DENSE; VERY MOIST; SILTY SANDSTONE; FINE TO MEDIUM GRAINED (SM)			
	2								
	4					BECOMES LIGHT REDDISH BROWN (RUST COLOR); MEDIUM DENSE; DAMPT TO MOIST			
410	6			SPT	51 77	BECOMES VERY DENSE			
	8			SPT	46				
	10			SPT	30	OCCASIONAL GRAVEL ROCK			
	12			SPT	80	BECOMES SLIGHTLY GRAVELLY			
				SPT	68	BECOMES DARK BROWN; VERY DENSE; VERY MOIST;SOME CLAY; FINE TO COARSE GRAINED			
400	14			SPT	50/5	BECOMES LIGHT BROWN-REDDISH BROWN (RUST COLOR); VERY DENSE; DAMP; FINE TO MEDIUM GRAINED SOME COARSE			
	16					BORING TERMINATED AT 16.0FT. NO GROUNDWATER ENCOUNTERED. NO CAVING.			
	18								
	20								
	22								
	24								
390	26								

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

BORING LOG

BORING NO.: B-5/P-3

PROJECT: Sunroad Centrumplace
BORING LOCATION: Spectrum Center Boulevard
DRILLING CONTRACTOR: CALPAC
DRILLING METHOD: 6" Hollow Stem Auger
DRILLING EQUIPMENT: Mobile B-61
SAMPLING METHOD: Drive Sampler- SPT
HAMMER WT.: 140 **DROP:** 30"

PROJECT NO.: 1015310
ELEVATION AND DATUM: 415.5 feet ± (MSL)
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
TOTAL BORING DEPTH: 5.5 feet
DEPTH TO WATER START: N/A **FINISH:** N/A
LOGGED BY: HE
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0		SM			ARTIFICIAL FILL (Qaf): REDDISH BROWN-RED BROWN; MEDIUM DENSE; DAMP; SILTY SAND; FINE TO MEDIUM GRAINED (SM)			
			SM			OLD PARALIC DEPOSITS UNIT 8 (Qop8): REDDISH BROWN-RED BROWN; MEDIUM DENSE; DAMP; SILTY SANDSTONE; FINE TO MEDIUM GRAINED (SM)			
	2								
	4								
410				SPT	50/5	BECOMES GRAVELLY			
	6					BORING TERMINATED AT 5.5FT. NO GROUNDWATER ENCOUNTERED. NO CAVING.			
	8								
	10								
	12								
	14								
400	16								
	18								
	20								
	22								
	24								
390	26								

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

BORING LOG

BORING NO.: B-6

PROJECT: Sunroad Centrumplace
BORING LOCATION: Spectrum Center Boulevard
DRILLING CONTRACTOR: CALPAC
DRILLING METHOD: 6" Hollow Stem Auger
DRILLING EQUIPMENT: Mobile B-61
SAMPLING METHOD: Drive Sampler- SPT & CAL
HAMMER WT.: 140 **DROP:** 30"

PROJECT NO.: 1015310
ELEVATION AND DATUM: 415.5 feet ± (MSL)
DATE STARTED: 4/27/2016 **DATE FINISHED:** 4/27/2016
TOTAL BORING DEPTH: 6.5 feet
DEPTH TO WATER START: N/A **FINISH:** N/A
LOGGED BY: HE
REVIEWED BY: HE

ELEVATION (MSL)	DEPTH (FT.)	SOIL STRATIGRAPHY	USCS CLASSIFICATION	SAMPLER TYPE	BLOWS/FT.	GEOTECHNICAL DESCRIPTION	DRY DENSITY (pcf)	WATER CONTENT (%)	LAB TESTS
	0		SM			ARTIFICIAL FILL(Qaf): RED-BROWN; MEDIUM DENSE; MOIST; SILTY SAND W/GRAVEL; FINE TO MEDIUM GRAINED (SM)			
	1–2		SM			OLD PARALIC DEPOSITS UNIT 8(Qop8): RED-BROWN; MEDIUM DENSE; MOIST; SILTY SANDSTONE; SOME GRAVEL; FINE TO MEDIUM GRAINED (SM)			
410	5–6			SPT	50/3	BECOMES VERY DENSE AND GRAVELLY			
	6.5				50/6	BORING TERMINATED AT 6.5FT. REFUSAL DUE TO GRAVEL-COBBLE. NO GROUNDWATER ENCOUNTERED. NO CAVING.			

Elevation scale: 410, 400, 390. Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26.

SAMPLER KEY: BULK SPT MOD. CAL. NO RECOVERY

APPENDIX C

Infiltration Worksheets

NOVA

Worksheet C.4-1: Categorization of Infiltration Feasibility Condition

Categorization of Infiltration Feasibility Condition		Worksheet C.4-1	
Part 1 - Full Infiltration Feasibility Screening Criteria **Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?** Note that it is not necessary to investigate each and every criterion in the worksheet if infiltration is precluded. Instead a letter of justification from a geotechnical professional familiar with the local conditions substantiating any geotechnical issues will be required.			
Criteria	Screening Question	**Yes**	**No**
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X
Provide basis: *The infiltration rates of the existing soils for location P-1 through P-7, based on the on-site infiltration study was calculated to be less than 0.5 inches per hour (P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour) after applying a minimum factor of safety (F) of F=2.*			
2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X
Provide basis: *No. See Criterion 1.*			

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: *Water contamination was not evaluated by NOVA services.*			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: *The potential for water balance was not evaluated by NOVA services.*			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		*Proceed to Part 2*

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by County staff to substantiate findings.

Worksheet C.4-1 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X

Provide basis:

The infiltration rates of the existing soils for location P-1 through P-7, based on the on-site infiltration study was calculated to be less than 0.5 inches per hour (P-1=0.00, P-2=0.00, P-3=0.03, P-4=0.00, P-5=0.01, P-6=0.00, and P-7=0.00 inches per hour) after applying a minimum factor of safety (F) of F=2.

These widespread very low to zero permeability soil and geologic conditions do not allow for infiltration in any appreciable rate or volume.

Criteria	Screening Question	Yes	No
6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X

Provide basis:

C2.1 A geologic investigation was performed at the subject site.
C2.2 Settlement and Volume Change: The subject site is underlain by very dense formational soils, added to the very low to negligible infiltration rate of the on-site soils suggest that settlement or volume change due to water infiltration is negligible.
C2.3 BMPs are not anticipated to be located near slopes on this site. Infiltration has the potential to cause slope failures. BMPs are to be sited a minimum of 50 feet away from any slope.
C2.4 Infiltration can potentially damage subsurface and underground utilities. BMPs are to be sited a minimum of 10 feet away from all underground utilities.
C2.5 Stormwater infiltration can result in damaging ground water mounding during wet periods.
C2.6 BMPs are not anticipated to be located near foundations or retaining walls. Infiltration has the potential to increase lateral pressure and reduce soil strength which can impact foundations and retaining walls. BMPs are to be sited a minimum of 10 feet away from any foundations or retaining walls.
C2.7 Other Factors: The site is entirely underlain by the low permeable, very dense, Old Paralic Deposits which has shown to have a low infiltration rate. In consideration of these widespread, low permeability formational soils, it is NOVA's opinion that the site is not suitable for stormwater infiltration BMPs. Finally, Biofiltration-2 (BF-2), is located in an area with over 15 feet of fill. Due to the considerable fill depth in this area, the extension of the BMP down to natural soil is infeasible and the results from this percolation test boring should be voided.

<table>
<tr><th colspan="4">Worksheet C.4-1 Page 4 of 4</th></tr>
<tr><th>Criteria</th><th>Screening Question</th><th>Yes</th><th>No</th></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:
Water contamination was not evaluated by NOVA services.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:
The potential for water balance was not evaluated by NOVA services.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 5-8 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.

If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td>No Infiltration</td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

C.5 Feasibility Screening Exhibits

Table C.5-1 lists the feasibility screening exhibits that were generated using readily available GIS data sets to assist the project applicant to screen the project site for feasibility.

Table C.5-1: Feasibility Screening Exhibits

Figures	Layer	Intent/Rationale	Data Sources
C.1 Soils	Hydrologic Soil Group – A, B, C, D	Hydrologic Soil Group will aid in determining areas of potential infiltration	SanGIS http://www.sangis.org/
	Hydric Soils	Hydric soils will indicate layers of intermittent saturation that may function like a D soil and should be avoided for infiltration	USDA Web Soil Survey. Hydric soils, (ratings of 100) were classified as hydric. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
C.2: Slopes and Geologic Hazards	Slopes >25%	BMPs are hard to construct on slopes >25% and can potentially cause slope instability	SanGIS http://www.sangis.org/
	Liquefaction Potential	BMPs (particularly infiltration BMPs) must not be sited in areas with high potential for liquefaction or landslides to minimize earthquake/landslide risks	SanGIS http://www.sangis.org/
	Landslide Potential		SanGIS Geologic Hazards layer. Subset of polygons with hazard codes related to landslides was selected. This data is limited to the City of San Diego Boundary. http://www.sangis.org/
C.3: Groundwater Table Elevations	Groundwater Depths	Infiltration BMPs will need to be sited in areas with adequate distance (>10 ft) from the groundwater table	GeoTracker. Data downloaded for San Diego county from 2014 and 2013. In cases where there were multiple measurements made at the same well, the average was taken over that year. http://geotracker.waterboards.ca.gov/data_download_by_county.asp
C.4: Contaminated Sites	Contaminated soils and/or groundwater sites	Infiltration must limited in areas of contaminated soil/groundwater	GeoTracker. Data downloaded for San Diego county and limited to active cleanup sites http://geotracker.waterboards.ca.gov/

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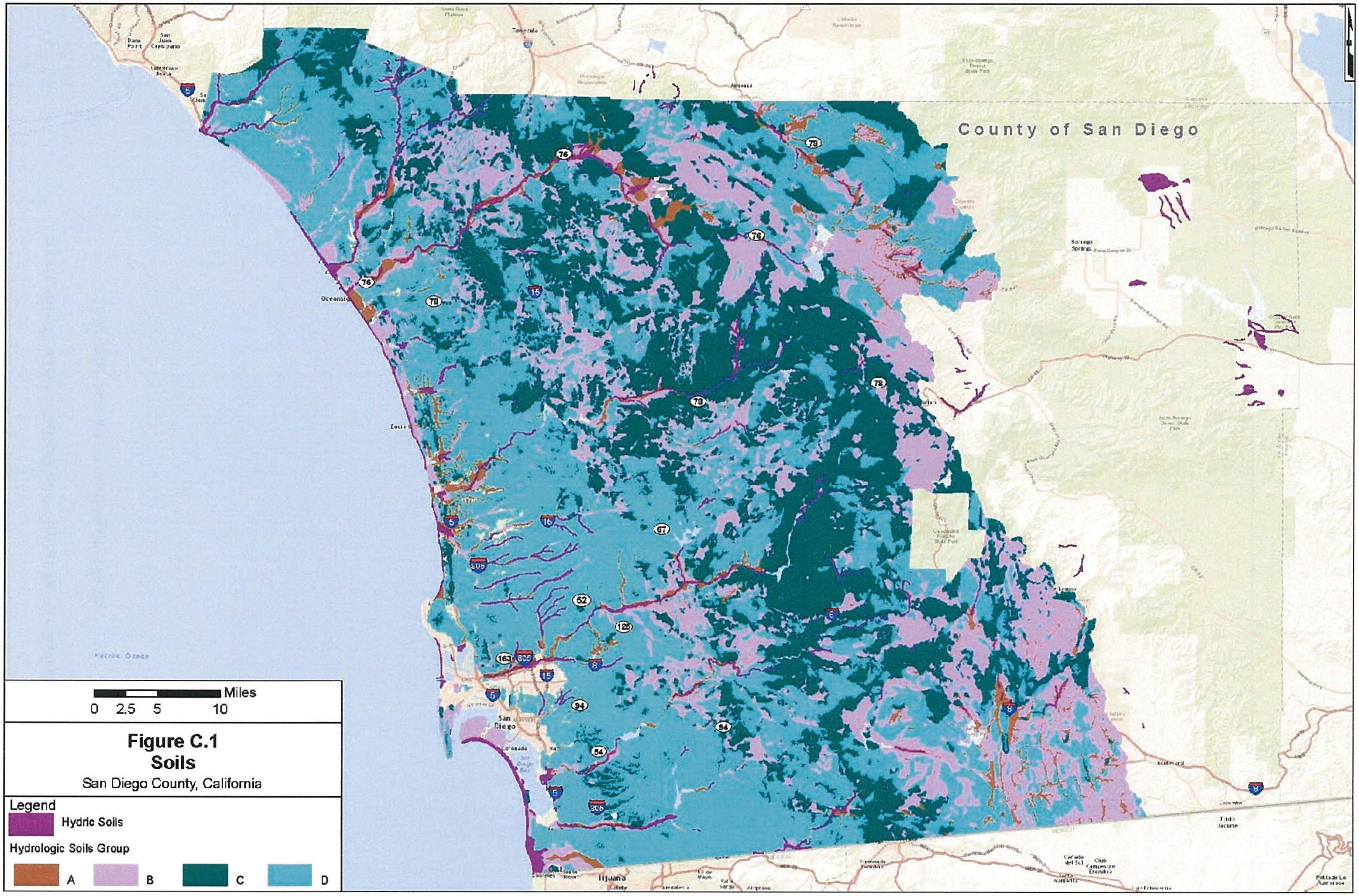


Figure C.1
Soils
San Diego County, California

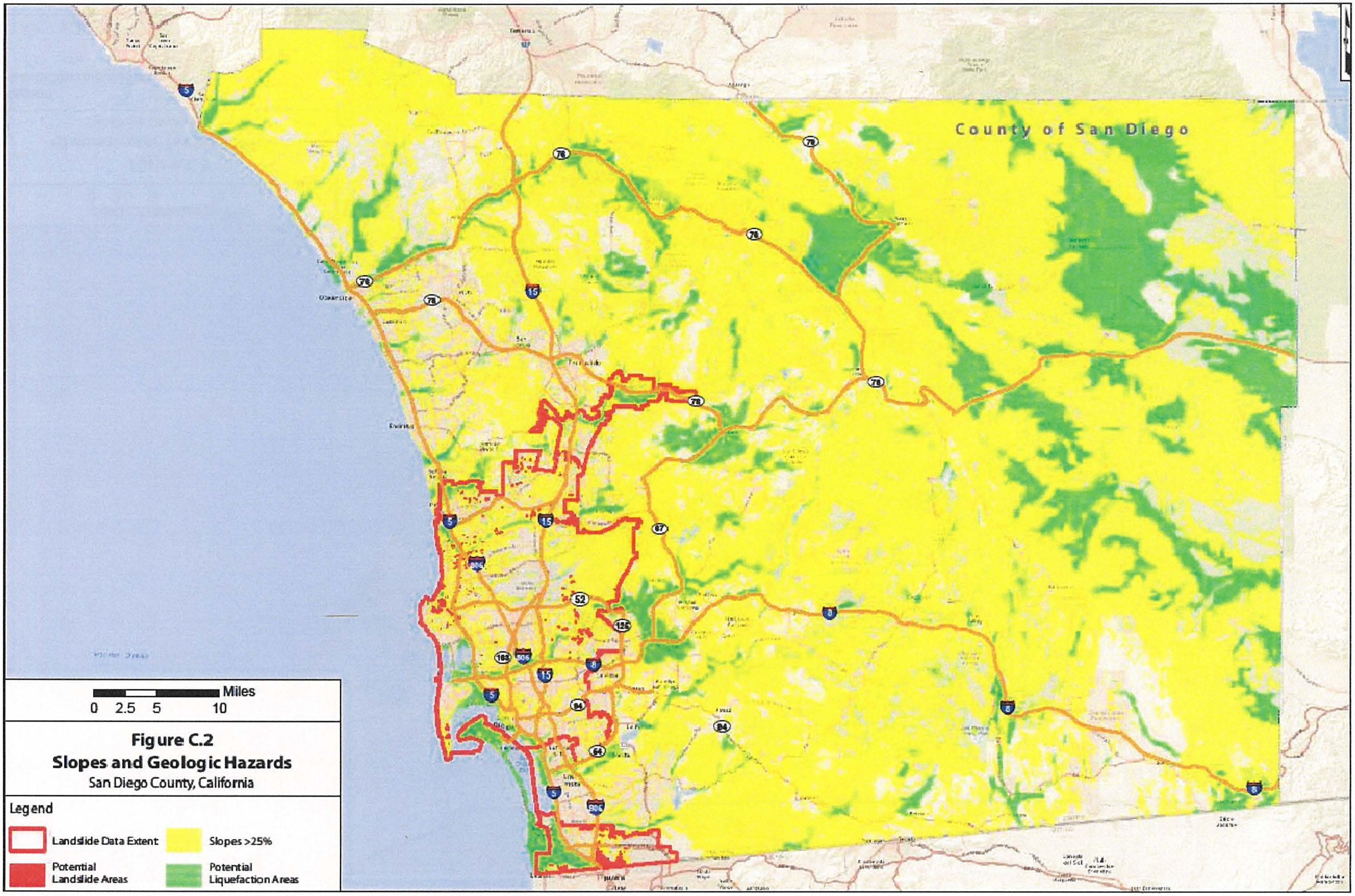


Figure C.2
Slopes and Geologic Hazards
San Diego County, California

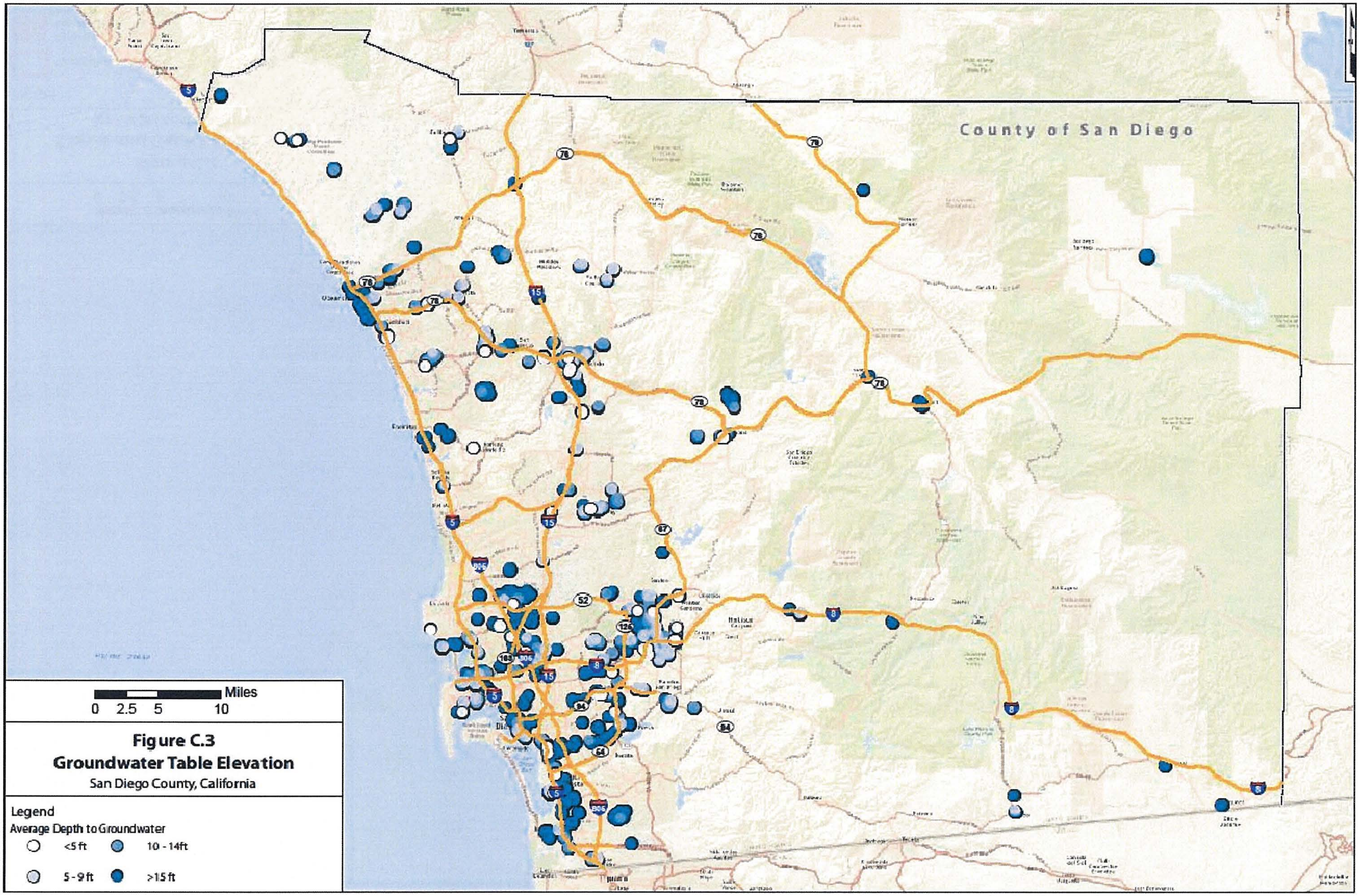


Figure C.3
Groundwater Table Elevation
San Diego County, California

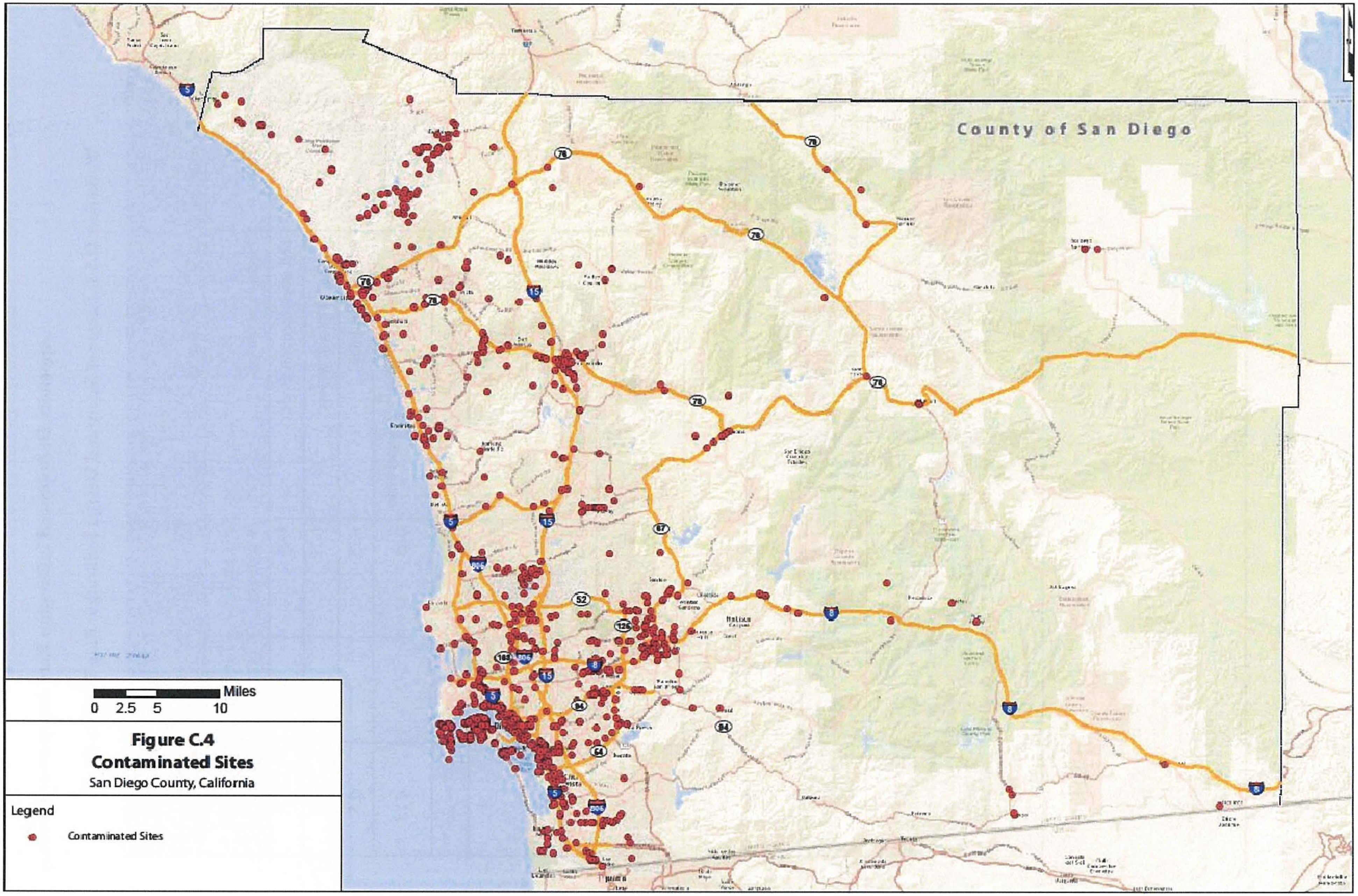


Figure C.4
Contaminated Sites
San Diego County, California

Worksheet D.5-1: Factor of Safety and Design Infiltration Rate Worksheet

Factor of Safety and Design Infiltration Rate Worksheet			Worksheet D.5-1		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	*2*	*0.5*
		Predominant soil texture	0.25	*2*	*0.5*
		Site soil variability	0.25	*2*	*0.5*
		Depth to groundwater / impervious layer	0.25	*1*	*0.25*
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			*1.75* → ***2***
B	Design	Level of pretreatment/ expected sediment loads	0.5		
		Redundancy/resiliency	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{total} = S_A \times S_B$					
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)				*0.01*	
Design Infiltration Rate, in/hr, $K_{design} = K_{observed} / S_{total}$					
Supporting Data					

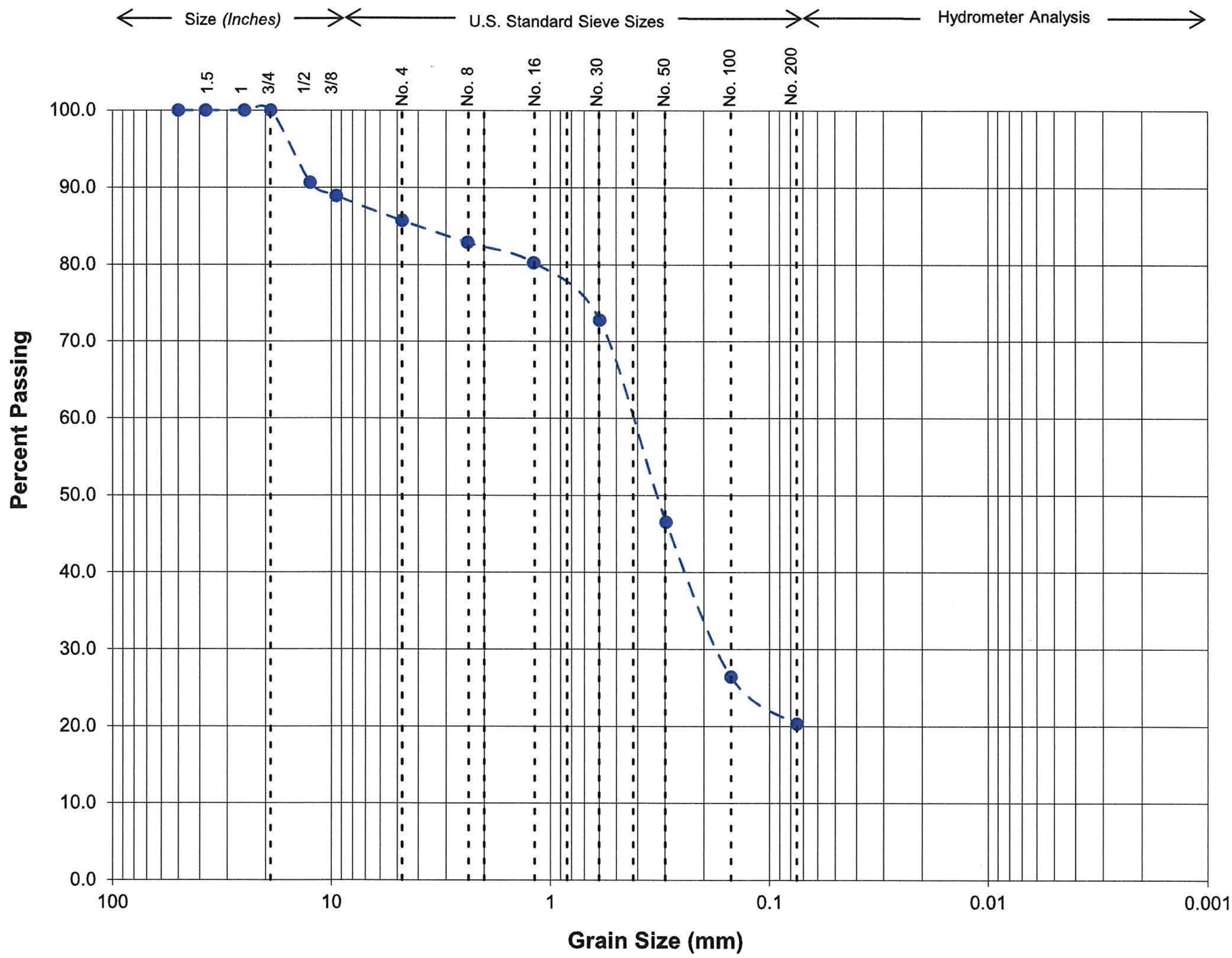
Briefly describe infiltration test and provide reference to test forms:

Borehole percolation tests were utilized for all percolation borings (P-1 through P-7) at the bottom of the prospective infiltration basins accompanied by exploratory engineering borings. The data is abstracted and detailed in the Preliminary Geotechnical Investigation (NOVA 2017). The minimum factor of safety required is F=2 per the San Diego County BMP Manual (February 2016). If the site passes the feasibility analysis at F=2, then the design considerations (B) must be evaluated and selected at the ***discretion of the design engineer****. The design factor will then be multiplied by the suitability factor (2 in this case) thus* ***potentially*** *increasing the factor of safety.*

APPENDIX D

Records of Laboratory Testing by NOVA

NOVA



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

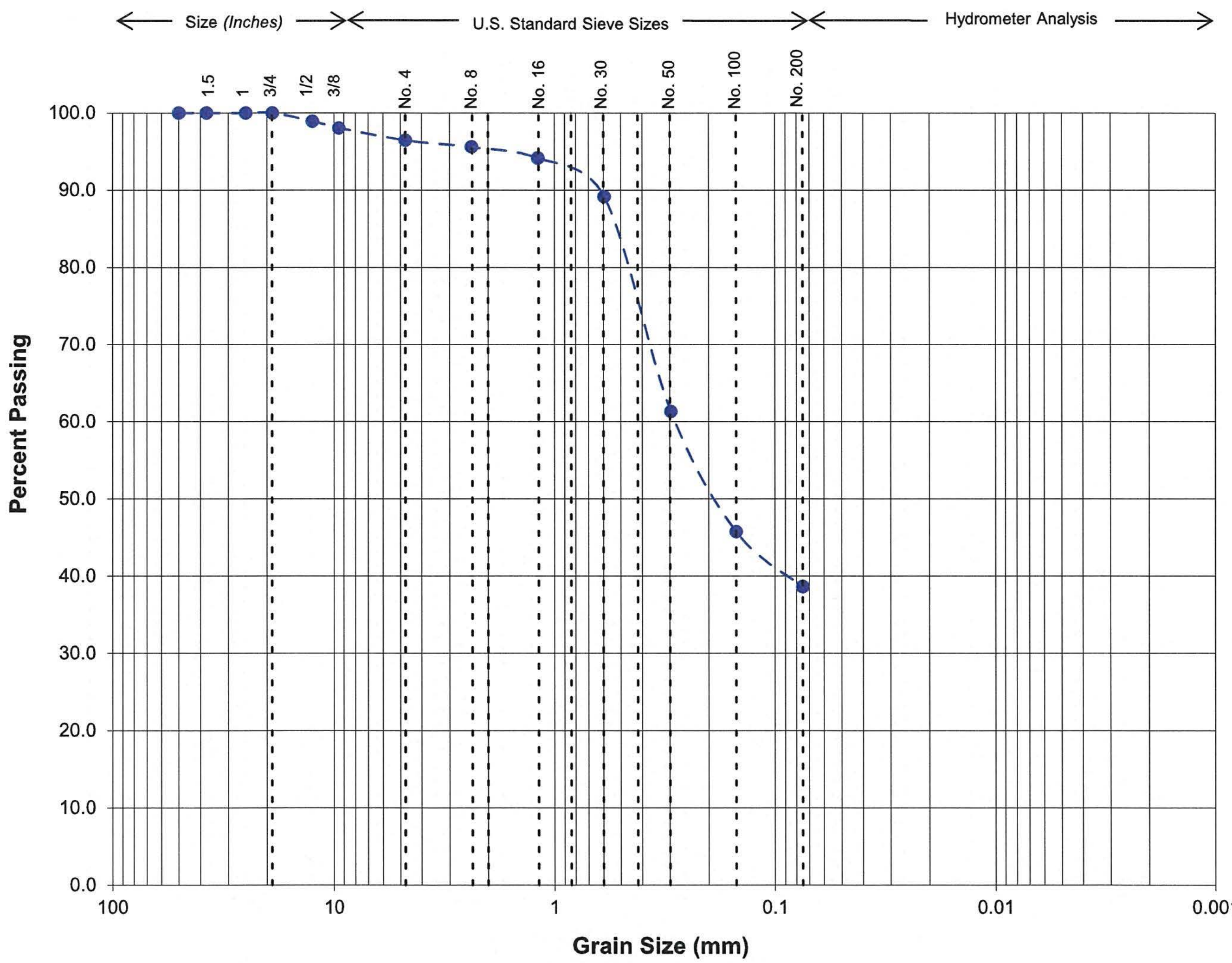
Sample Location:	B-1
Depth (ft):	5.0'
USCS Soil Type:	SM
Passing No. 200 (%):	20

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-1



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

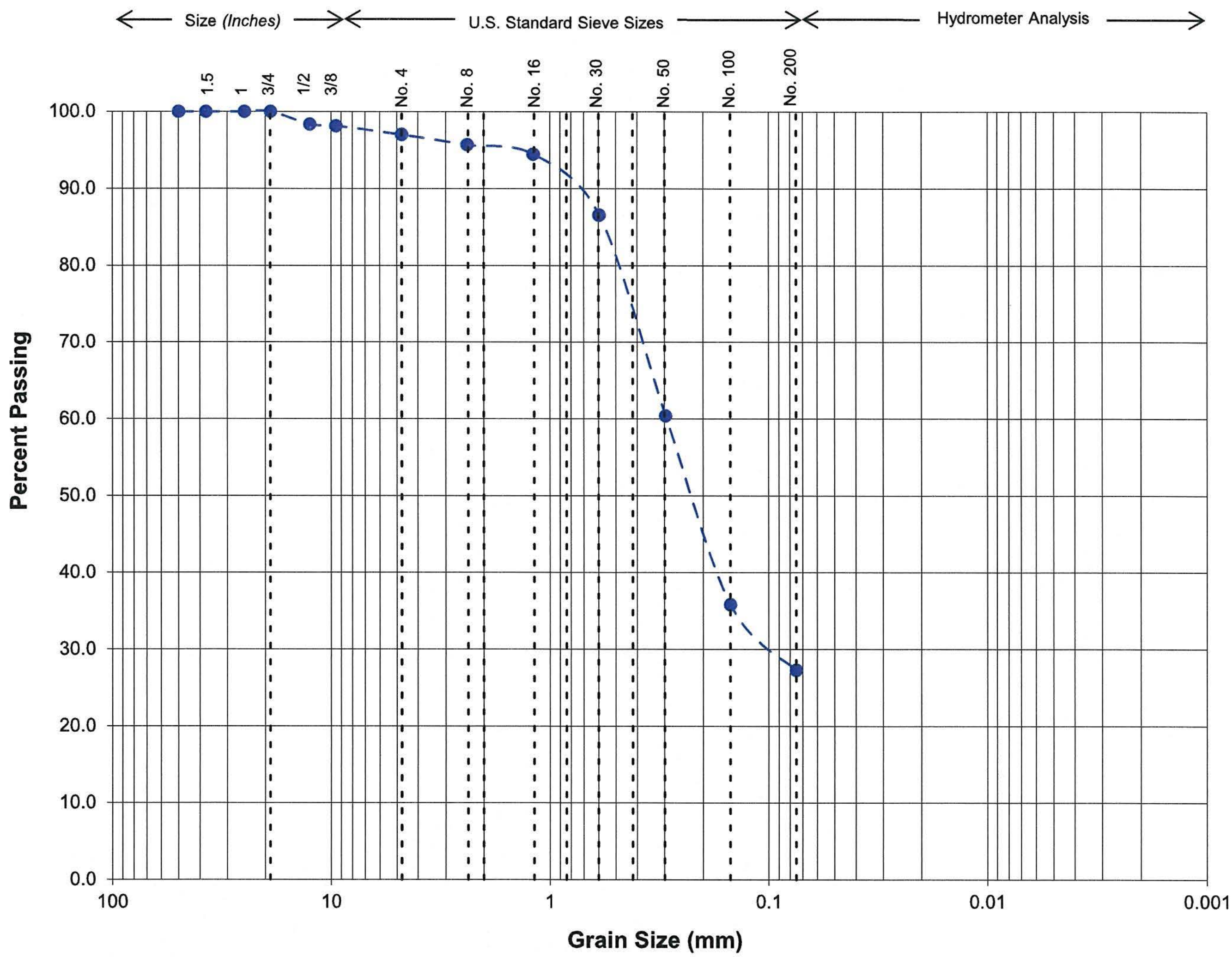
Sample Location:	B-2
Depth (ft):	5.0'
USCS Soil Type:	SM
Passing No. 200 (%):	39

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-2



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

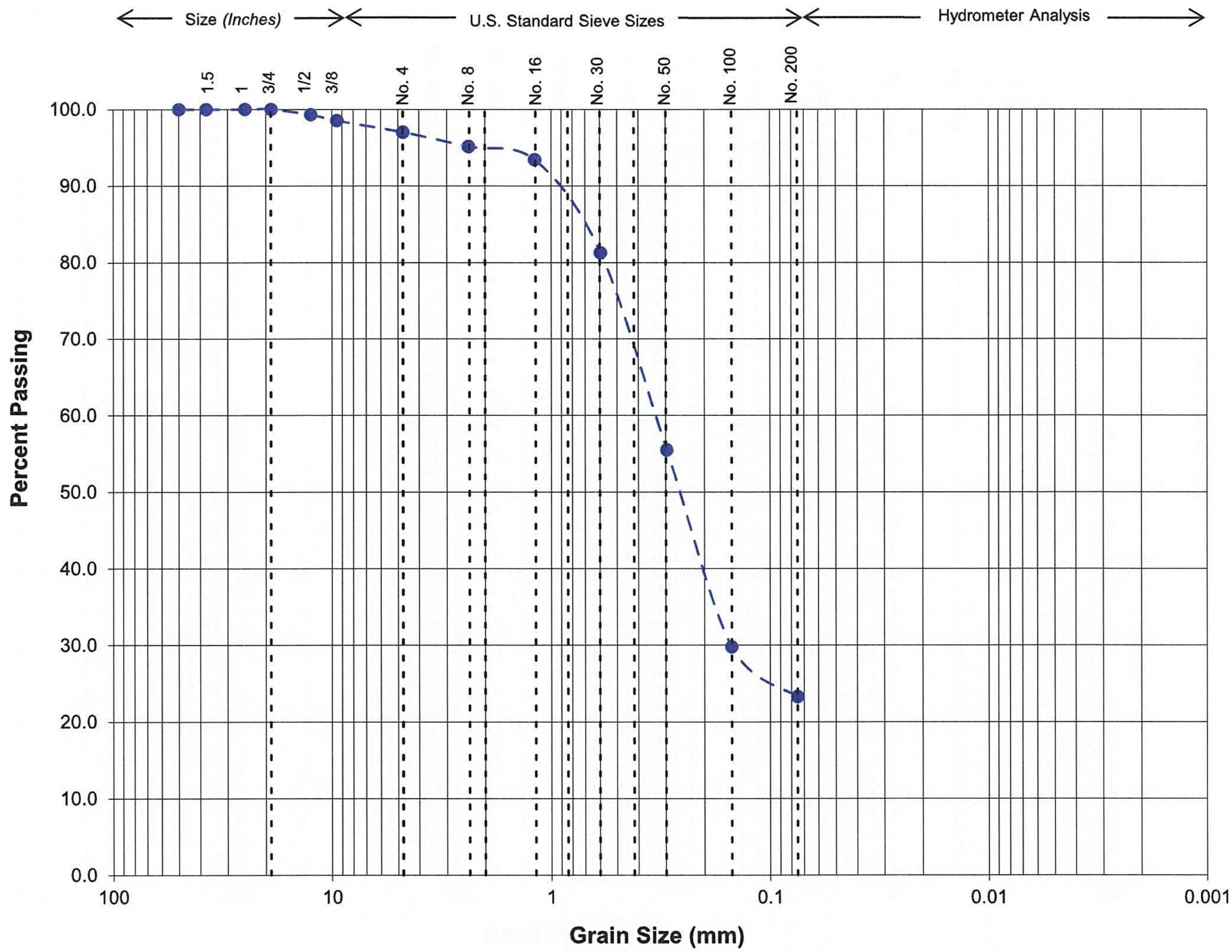
Sample Location:	B-2
Depth (ft):	6.5'
USCS Soil Type:	SM
Passing No. 200 (%):	27

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-3



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

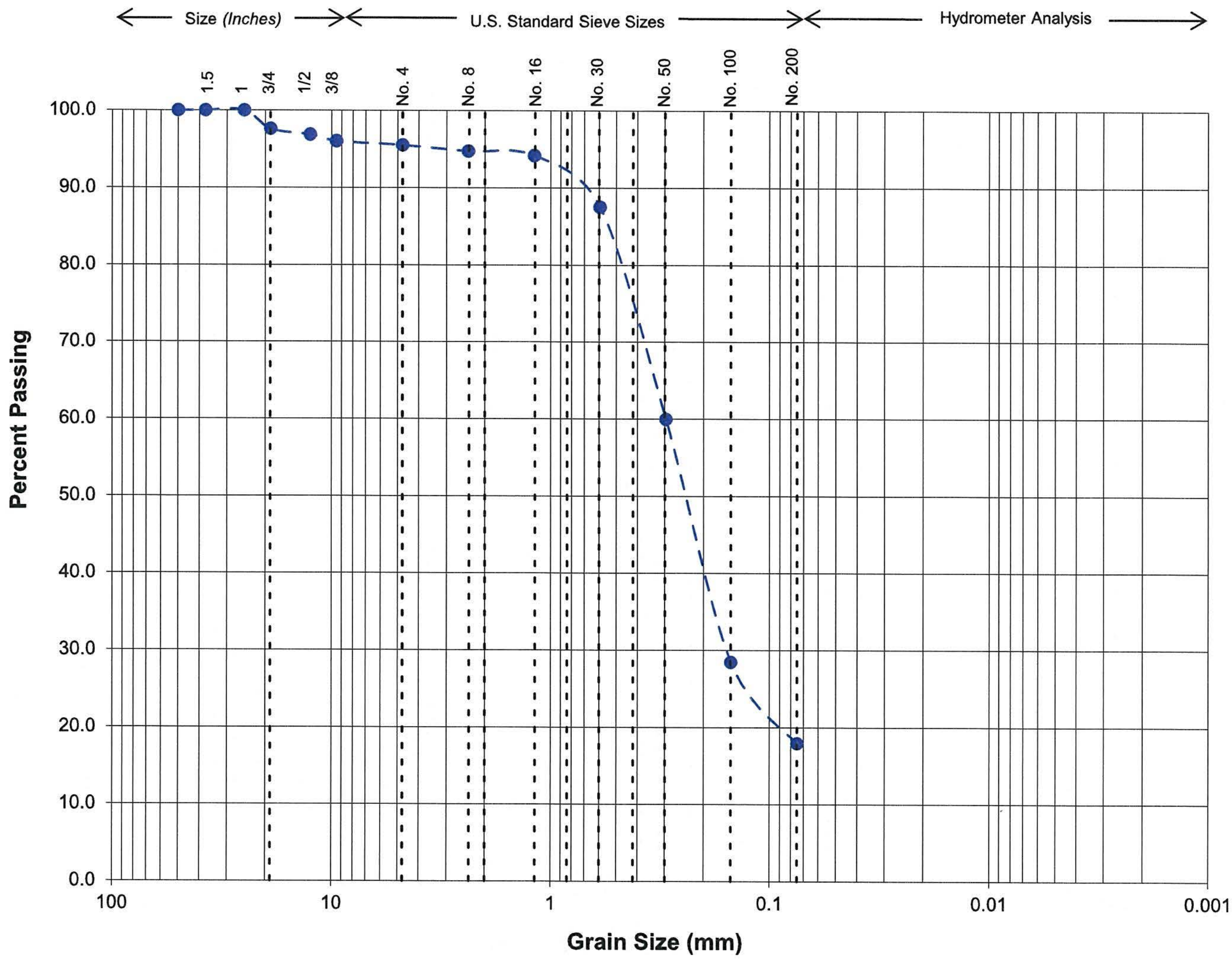
Sample Location:	B-2
Depth (ft):	8'
USCS Soil Type:	SM
Passing No. 200 (%):	23

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-4



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

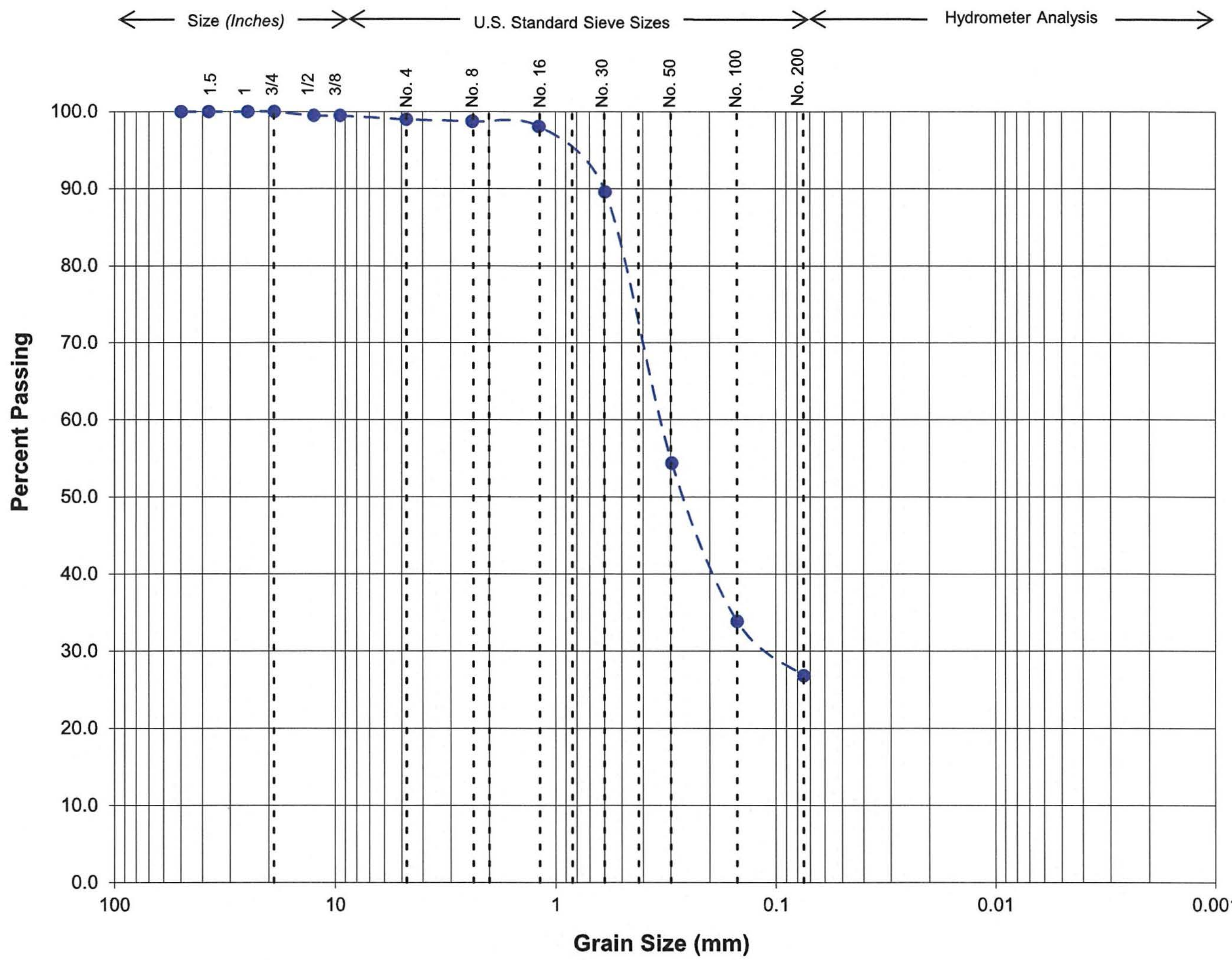
Sample Location:	B-2
Depth (ft):	9.5'
USCS Soil Type:	SM
Passing No. 200 (%):	18

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-5



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

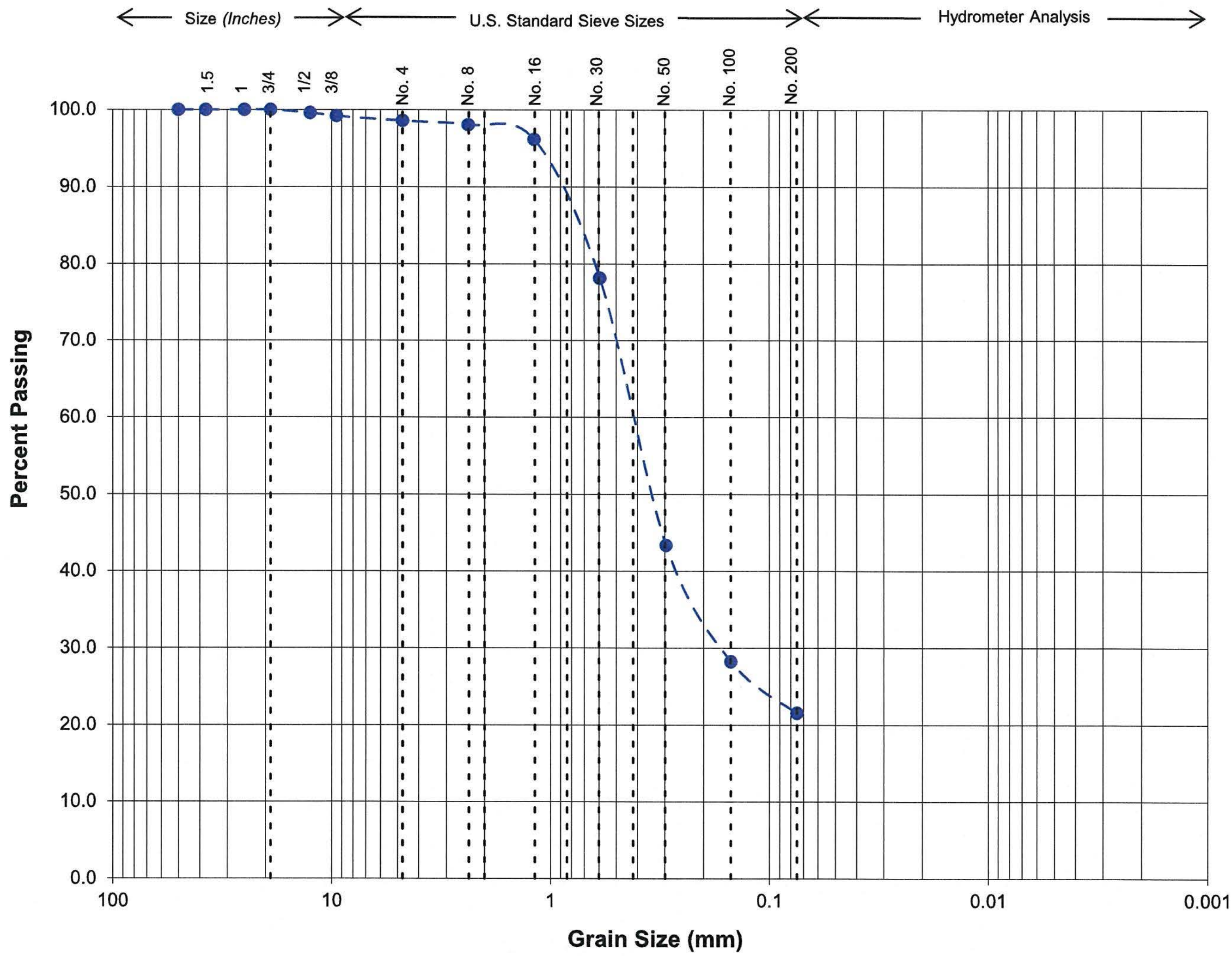
Sample Location:	B-3
Depth (ft):	5'
USCS Soil Type:	SM
Passing No. 200 (%):	27

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	**B-6**



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

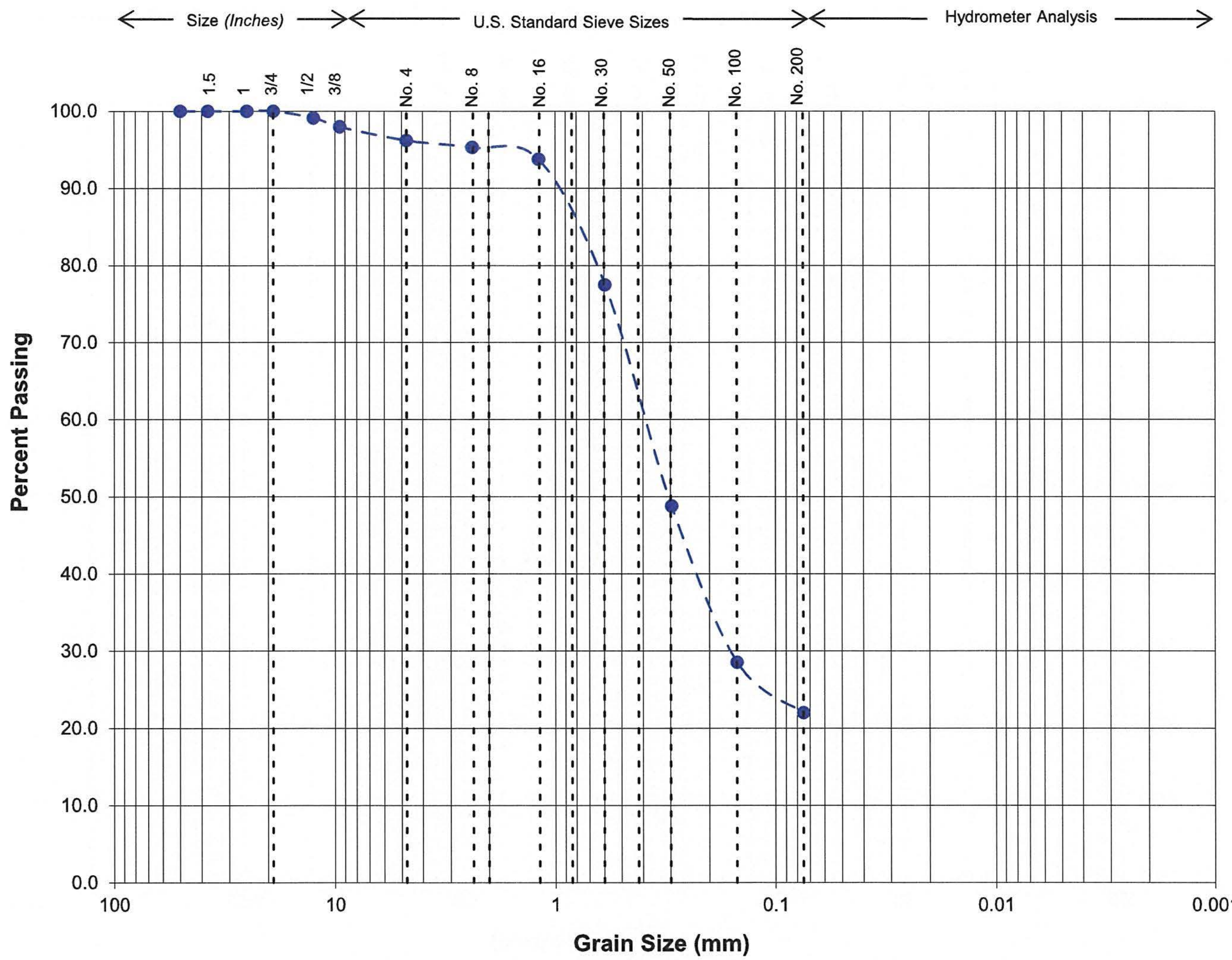
Sample Location:	B-4
Depth (ft):	5'
USCS Soil Type:	SM
Passing No. 200 (%):	22

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-7



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

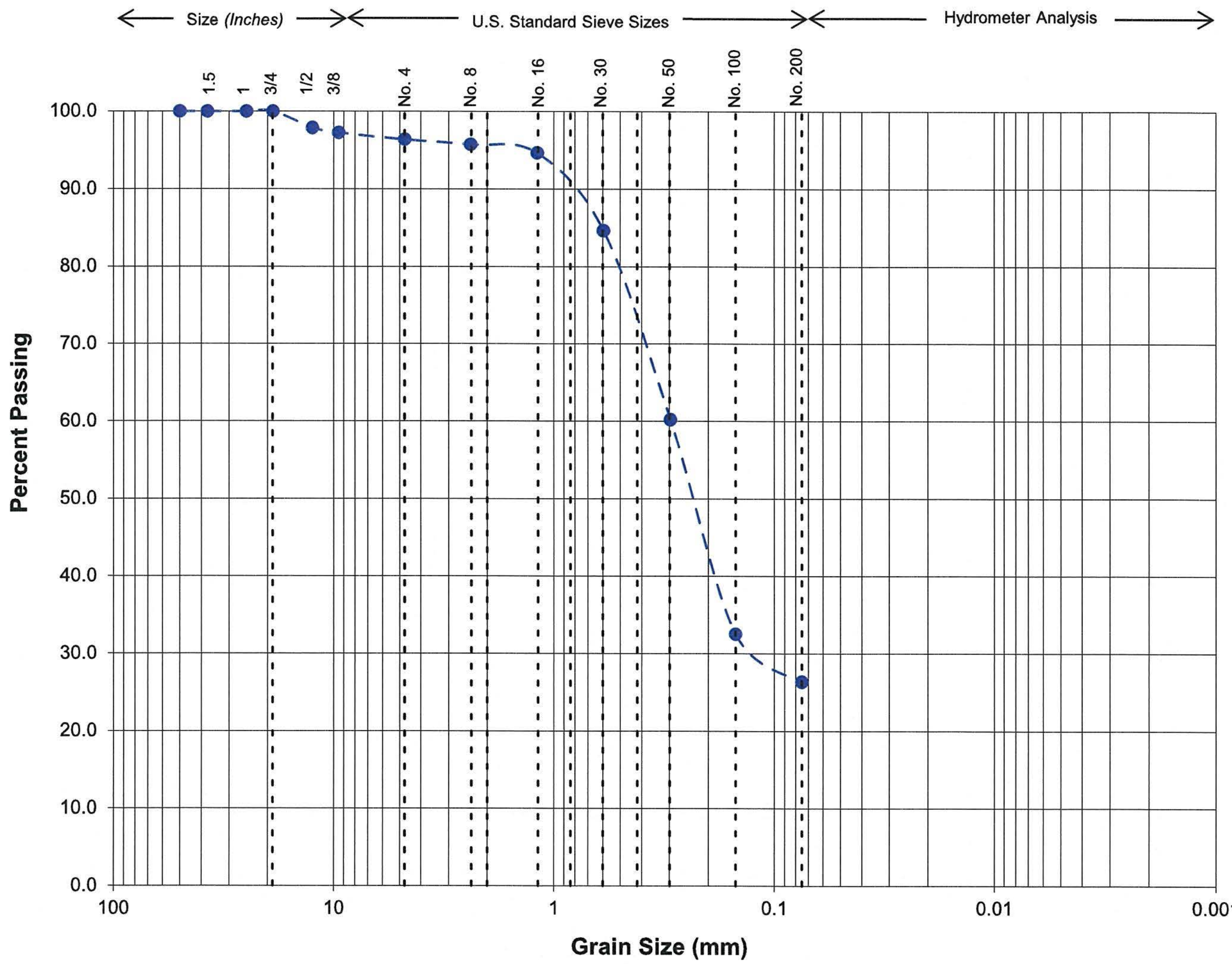
Sample Location:	B-4
Depth (ft):	6.5'
USCS Soil Type:	SM
Passing No. 200 (%):	22

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-8



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

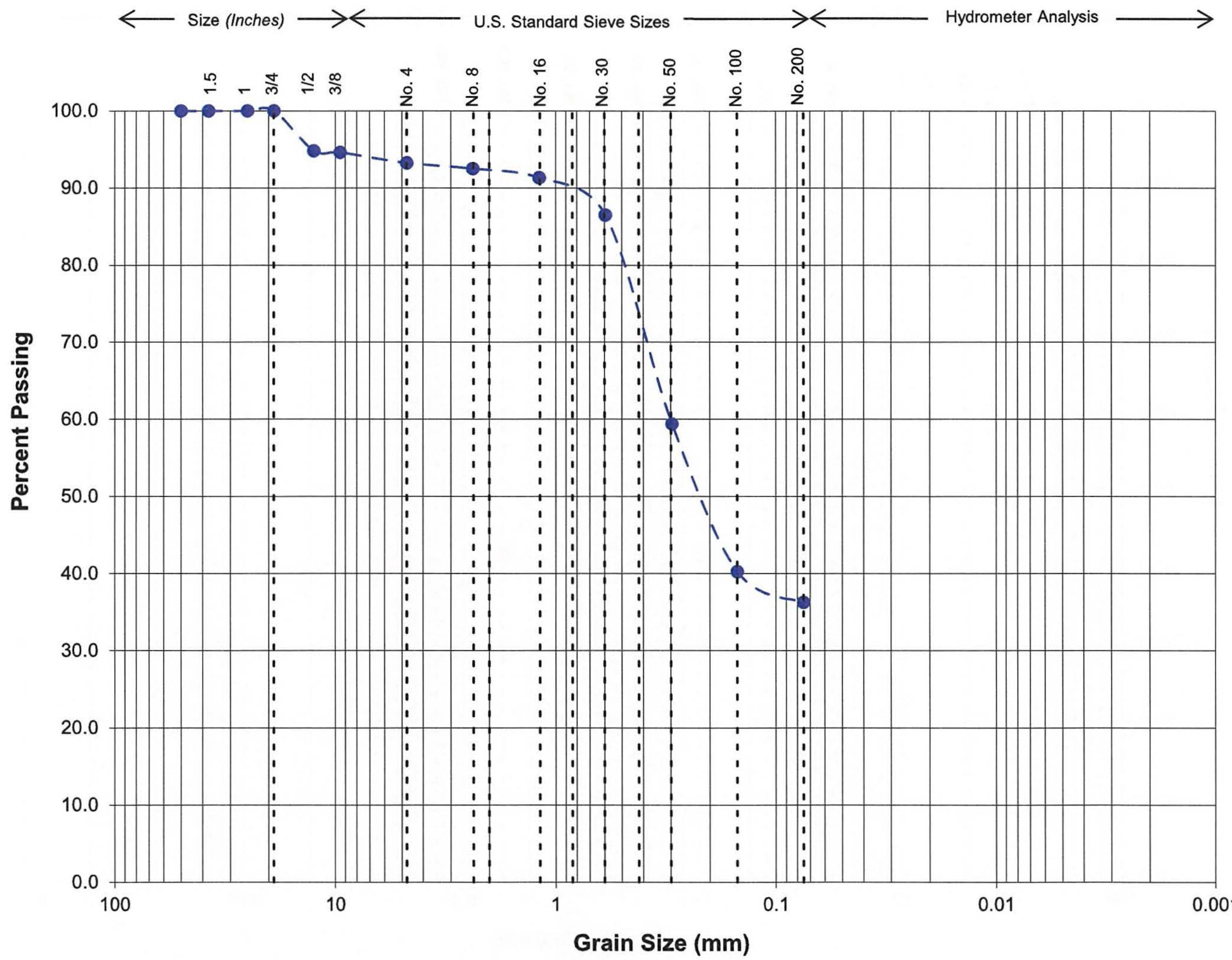
Sample Location:	B-4
Depth (ft):	8'
USCS Soil Type:	SM
Passing No. 200 (%):	26

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-9



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

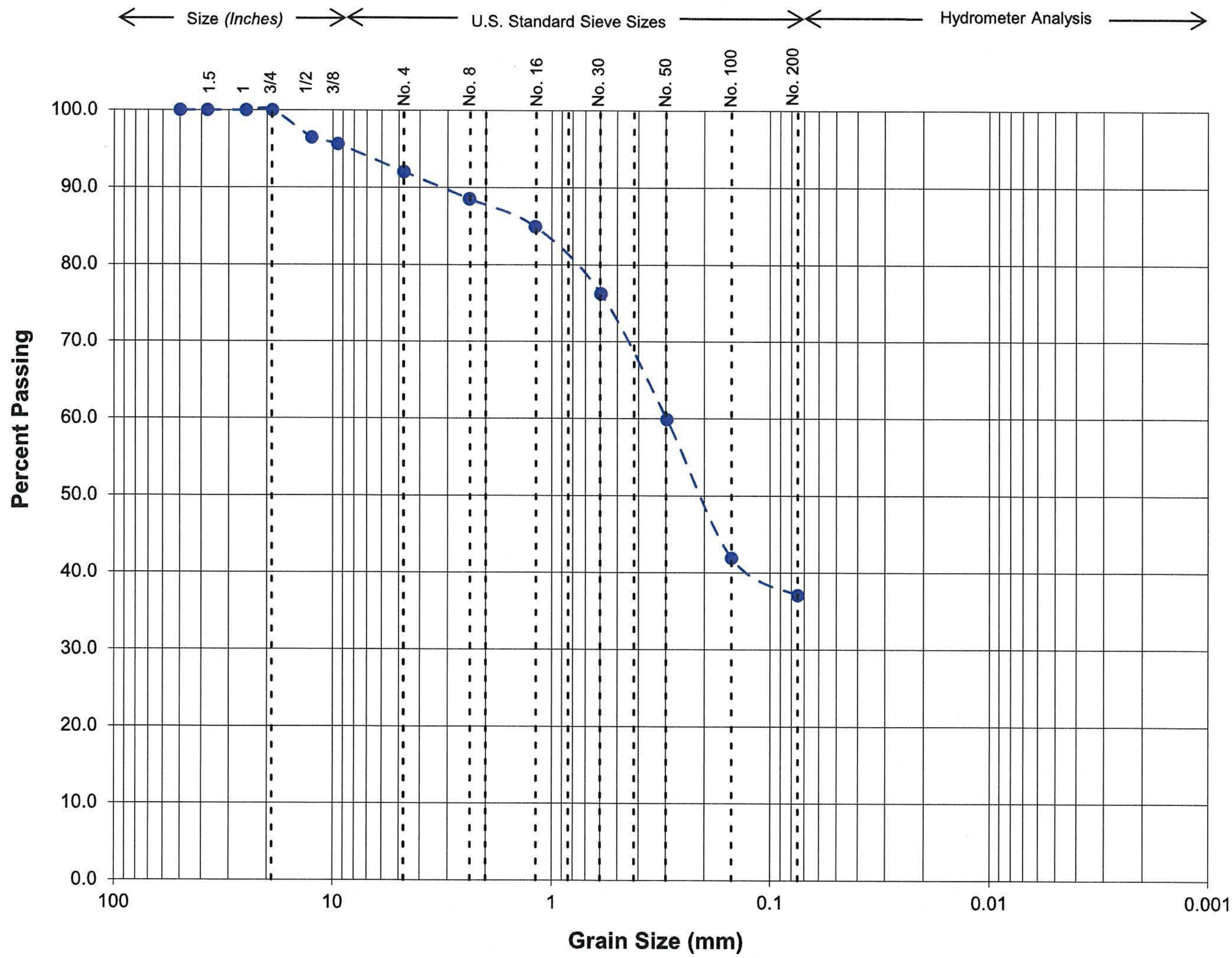
Sample Location:	B-4
Depth (ft):	9.5'
USCS Soil Type:	SM
Passing No. 200 (%):	36

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-10



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

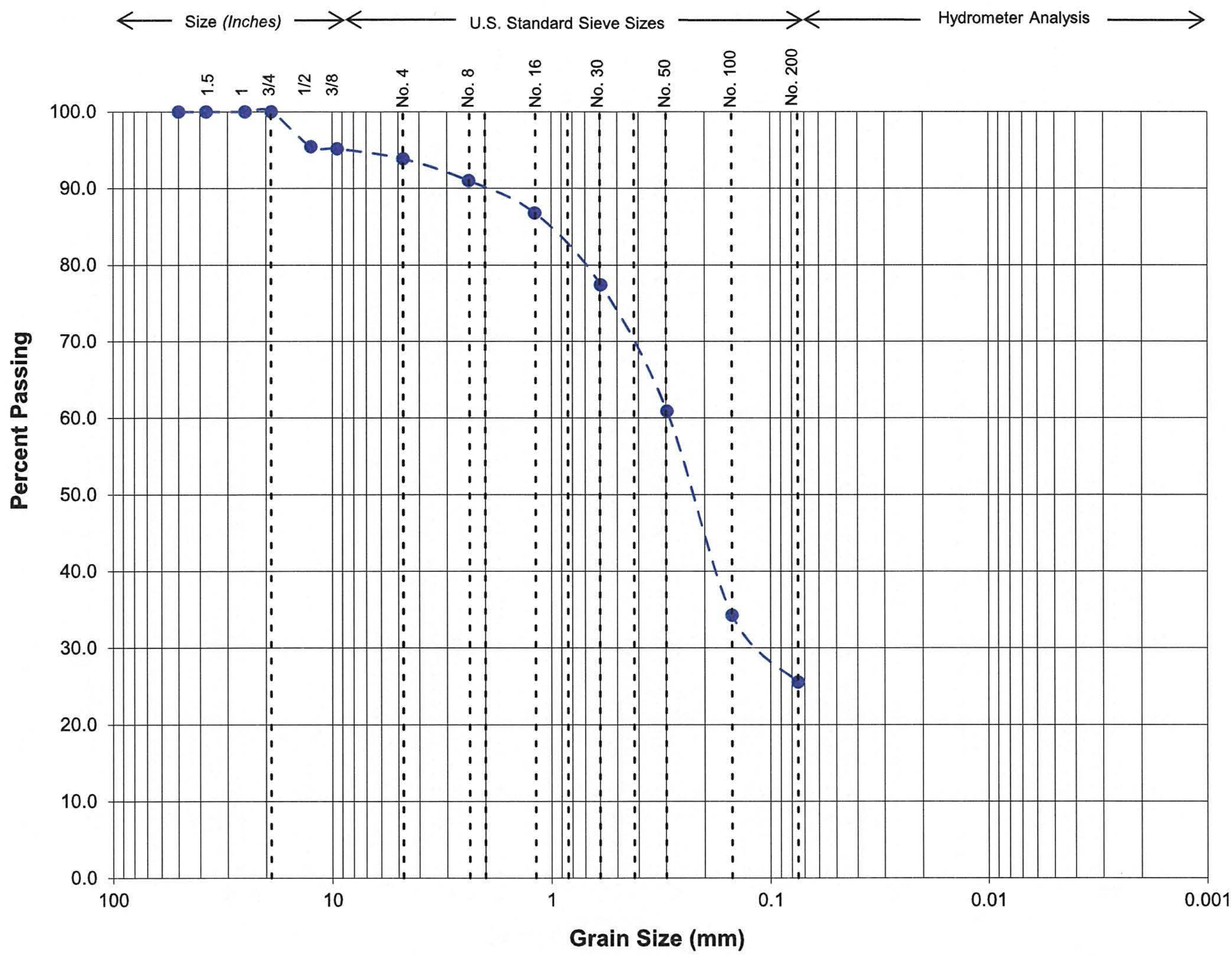
Sample Location:	B-4
Depth (ft):	11'
USCS Soil Type:	SM
Passing No. 200 (%):	37

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-11



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

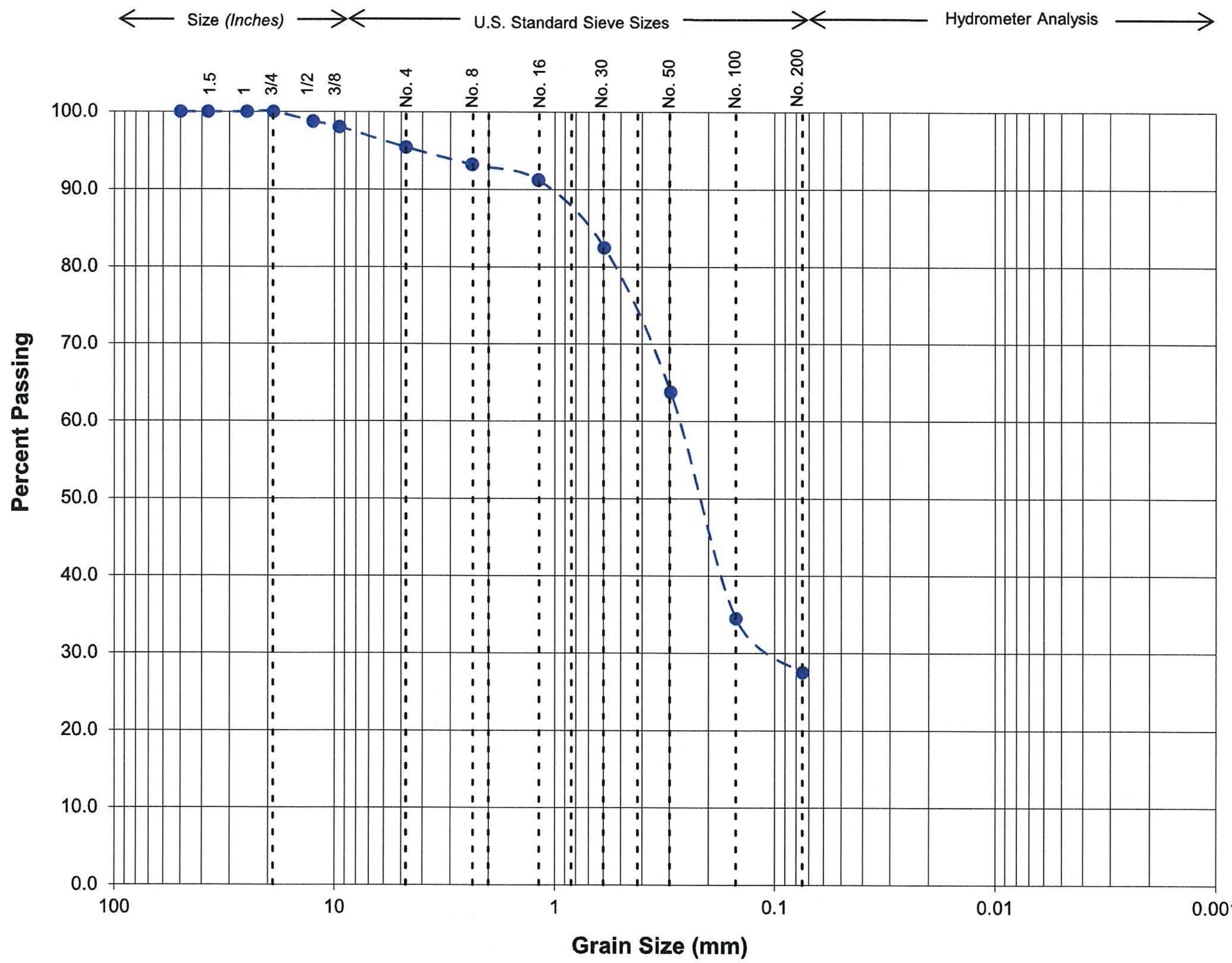
Sample Location:	B-4
Depth (ft):	12.5'
USCS Soil Type:	SM
Passing No. 200 (%):	26

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-12



GRAVEL		SAND			SILT OR CLAY
Coarse	Fine	Coarse	Medium	Fine	

Sample Location:	B-4
Depth (ft):	14'
USCS Soil Type:	SM
Passing No. 200 (%):	28

NOVA

GRADATION ANALYSIS TEST RESULTS

CENTRUMPLACE INFILTRATION STUDY
5247-5289 KEARNY VILLA ROAD
SAN DIEGO.CA

DATE	PROJECT NO.	FIGURE
5/6/2016	1015310.1	B-13

APPENDIX E

Records of Borings and Trenches by Geocon

NOVA

PROJECT NO. 06505-52-04

TRENCH T 1

ELEV. (MSL.) 413 DATE COMPLETED 11-03-2010

EQUIPMENT JD 510 BACKHOE BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown, Silty, fine to coarse SAND; few gravel and cobble			
2	T1-1			SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		111.6	8.6
				CL	Stiff, moist, reddish brown to yellowish brown, Sandy CLAY; trace gravel			
4	T1-2			SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Very dense, damp, reddish brown, Silty, fine to coarse SANDSTONE; little gravel and cobble; weakly cemented; micaceous		127.9	6.6

TRENCH TERMINATED AT 4 FEET
NO GROUNDWATER ENCOUNTERED

Figure A-1,
Log of Trench T 1, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 2 ELEV. (MSL.) 413 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, moist, reddish brown and dark reddish brown, Silty, fine to medium SAND; few gravel and cobble			
2				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense, damp, reddish brown, Silty, fine- to coarse-grained SANDSTONE; little gravel and cobble; weakly cemented; some mica flakes			
					TRENCH TERMINATED AT 2.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-2,
Log of Trench T 2, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 3** ELEV. (MSL.) **413** DATE COMPLETED **11-03-2010** EQUIPMENT **JD 510 BACKHOE** BY: **N. BORJA**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, moist, reddish brown and light gray, Silty, fine to medium SAND; little gravel and cobble			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes -Excavates with trace gravel and cobble		111.5	14.0
4				SM-SC	Medium dense, moist, reddish brown to yellowish brown and gray, Silty to Clayey, fine to medium SAND; few gravel and cobble			
6				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Very dense, damp to moist, reddish brown, Silty, fine- to coarse-grained SANDSTONE; some gravel and cobble; weakly cemented			
					TRENCH TERMINATED AT 6.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-3,
Log of Trench T 3, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

PROJECT NO. 06505-52-04

TRENCH T 4

ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010

EQUIPMENT JD 510 BACKHOE BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown, Silty, fine to medium SAND; little gravel and cobble; trace asphalt concrete			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		110.2	10.6
4				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, damp, reddish brown, Silty, fine- to coarse-grained SANDSTONE; little gravel and cobble; weakly cemented			
					TRENCH TERMINATED AT 4.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-4,
Log of Trench T 4, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 5 ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown, Silty, fine to medium SAND; few gravel and cobble; trace asphalt concrete			
2	T5-1			SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes -Becomes reddish brown to dark reddish brown; few gravel and cobble			
4				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, damp, reddish brown to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; some gravel and cobble; uncemented			
					TRENCH TERMINATED AT 5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-5,
Log of Trench T 5, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 6** ELEV. (MSL.) 413 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown, Silty, fine to medium SAND; little gravel and cobble; trace asphalt concrete			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		108.9	8.9
4				SC	Medium dense, moist, yellowish brown and reddish brown, Clayey, fine to medium SAND; few gravel and cobble			
				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, moist, reddish brown to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; some gravel and cobble; uncemented			
					TRENCH TERMINATED AT 5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-6,
Log of Trench T 6, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

TRENCH T 7

ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010

EQUIPMENT JD 510 BACKHOE BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T7-1			SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown to brown, Silty, fine to medium SAND; few gravel and cobble; trace asphalt concrete			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		112.0	10.4
							101.5	12.9
				SC	Stiff, moist, reddish brown and gray, Sandy CLAY			
4	T7-2			SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, damp, reddish brown to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; few gravel and cobble; weakly cemented		125.5	6.6

TRENCH TERMINATED AT 4.5 FEET
NO GROUNDWATER ENCOUNTERED

Figure A-7,
Log of Trench T 7, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 8 ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose, moist to wet, brown to reddish brown, Silty, fine to medium SAND; little gravel and cobble			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes			
	T8-1			SC	Stiff, moist, mottled reddish brown to yellowish brown and gray, Sandy CLAY; trace gravel and cobble		116.6	15.0
4				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, damp, reddish brown to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; some gravel and cobble; weakly cemented			
					TRENCH TERMINATED AT 4.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-8,
Log of Trench T 8, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 9 ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, brown to reddish brown, Silty, fine to medium SAND; little gravel and cobble			
2				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		113.9	8.7
				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Very dense, damp, reddish brown, Silty, fine- to medium-grained SANDSTONE; little gravel and cobble; weakly cemented; some mica flakes			
					TRENCH TERMINATED AT 3.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-9,
Log of Trench T 9, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 10 ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown to brown, Silty, fine to medium SAND; few gravel and cobble			
2								
				SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes			
4				SC	Medium dense, moist, reddish brown, Clayey, fine to medium SAND; trace gravel			
				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Dense to very dense, damp, reddish brown to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; little gravel and cobble; weakly cemented			
					TRENCH TERMINATED AT 5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-10,
Log of Trench T 10, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. 06505-52-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 414 DATE COMPLETED 11-03-2010 EQUIPMENT JD 510 BACKHOE BY: N. BORJA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist, reddish brown to brown, Silty, fine to medium SAND; few gravel and cobble			
2	T11-1			SM	**WEATHERED TERRACE DEPOSITS (Qt)** Medium dense, moist, dark reddish brown, Silty, fine to medium SAND; trace charcoal flakes		118.8 128.2	6.9 3.9
				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Very dense, damp, reddish brown, Silty, fine- to medium-grained SANDSTONE; little gravel; weakly cemented			
					TRENCH TERMINATED AT 3.5 FEET NO GROUNDWATER ENCOUNTERED			

Figure A-11,
Log of Trench T 11, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-52-04

TRENCH T 12

ELEV. (MSL.) 415 DATE COMPLETED 11-03-2010

EQUIPMENT JD 510 BACKHOE BY: N. BORJA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**UNDOCUMENTED FILL (Qudf)** Loose to medium dense, moist to wet, brown to reddish brown, Silty, fine to medium SAND; few gravel and cobble			
2	T12-1			CH	**WEATHERED TERRACE DEPOSITS (Qt)** Stiff, moist, dark reddish brown, Sandy FAT CLAY; high plasticity		96.3 106.5	26.0 20.5
				SM	**VERY OLD PARALIC DEPOSITS (Qvop)** Very dense, damp, reddish brown, Silty, fine- to medium-grained SANDSTONE; little gravel and cobble; weakly cemented			

TRENCH TERMINATED AT 3 FEET
NO GROUNDWATER ENCOUNTERED

Figure A-12,
Log of Trench T 12, Page 1 of 1

06505-52-04.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. 06505-22-02

BORING B 1A

ELEV. (MSL.) ______ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**PREVIOUSLY PLACED FILL** Soft, moist, dark brown, Sandy CLAY			
				SM	**LINDAVISTA FORMATION** Dense to very dense, moist, red, mottled light brown, Silty, fine to medium SAND			
2	B1A-1							
4								
	B1A-2					50/5"	98.4	11.7
6								
8								
10	B1A-3					[illegible]	106.0	7.1
12								
14								
	B1A-4				-Pyrite flecks, no apparent mottling	50/5"	[illegible]	10.2
16								
18					-Difficult drilling, gravel-cobble lense at ~8 feet			
20					-No recovery, gravel in sampler	50/3"		
22				SM	**MISSION VALLEY FORMATION** Very dense, damp, light gray with reddish brown mottling, Silty, fine to medium SANDSTONE, weakly cemented			
24					-Thin gravel lense at 23 feet			

06505-22-02.GPJ

Log of Boring B 1A, Page 1 of 3

SAMPLE SYMBOLS			
	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06505-22-02

BORING B 1A

ELEV. (MSL.) ________ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
	B1A-5				**MISSION VALLEY FORMATION** Very dense, damp, light gray with reddish brown mottling. Silty, fine to medium SANDSTONE, weakly cemented	50/6"	108.1	11.8
26								
28								
30	B1A-6				-Less mottling	50/6"	110.6	14.3
32								
34								
	B1A-7					50/6"	109.6	16.8
36				SM				
38								
40	B1A-8					50/5"	100.0	[illegible]
42								
44								
	B1A-9					50/6"	111.3	13.8
46								
48								

06505-22-02.GPJ

Log of Boring B 1A, Page 2 of 3

SAMPLE SYMBOLS			
	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 1A

ELEV. (MSL.) ______ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
50	B1A-10				**MISSION VALLEY FORMATION** Very dense, damp, light gray with reddish brown mottling, Silty fine to medium SANDSTONE with fine to coarse angular gravel	50/6"	98.8	15.1
52								
54				SM				
56								
58								
60	B1A-11				-No gravel	50/6"	116.6	13.9

BORING TERMINATED AT 60 FEET 6 INCHES
No groundwater encountered
Backfilled with 16 ft of hydrated bentonite grout and chips

06505-22-02.GPJ

SAMPLE SYMBOLS	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

PROJECT NO. 06505-22-02

BORING B 2A

ELEV. (MSL.) ________ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL-SC	**PREVIOUSLY PLACED FILL** Hard/dense, moist, dark reddish brown, Sandy CLAY to Clayey SAND with coarse rounded gravel			
5	B2A-1					50/6"		6.6
10	B2A-2				-Poor recovery, gravel/cobble	50/3"		6.0
11				SM	**LINDAVISTA FORMATION** Dense to very dense, moist, red, Silty, fine to medium SAND			
15					-No recovery, cobble in sampler	50/1"		
18					-Difficult drilling, gravel/cobble			
19				SM	**MISSION VALLEY FORMATION** Very dense, damp, light gray, Silty, fine to medium SANDSTONE, weakly cemented -No recovery, gravel/cobble	50/3"		

06505-22-02.GPJ

Log of Boring B 2A, Page 1 of 3

SAMPLE SYMBOLS	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO 06505-22-02

BORING B 2A

ELEV. (MSL) ________ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
	B2A-3				**MISSION VALLEY FORMATION** Very dense, damp, light gray with reddish brown mottling, Silty, fine to medium SANDSTONE, weakly cemented	50/6"	108.6	13.2
26								
28								
30	B2A-4				-With fine sub-rounded gravel	50/3"	95.2	12.3
32								
34								
	B2A-5				-Increased fine sand	50/6"	108.7	12.9
36				SM				
38								
40	B2A-6				-Siltstone interbeds	50/4"	[illegible]	17.3
42								
44								
	B2A-7				-Laminated with light brown silt	50/4"	106.5	11.0
46								
48								

06505-22-02.GPJ

Log of Boring B 2A, Page 2 of 3

SAMPLE SYMBOLS			
	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 2A

ELEV. (MSL.) ______ DATE COMPLETED 03-02-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
50	B2A-8				**MISSION VALLEY FORMATION** Very dense, damp, light gray with reddish brown mottling. Silty, fine to medium SANDSTONE, weakly cemented	50/6"	111.8	15.0
52								
54				SM				
	B2A-9					50/4"	[illegible]	[illegible]
56								
58								
60	B2A-10					50/4"	113.0	13.0

BORING TERMINATED AT 60 FEET 6 INCHES
No groundwater encountered
Backfilled with 16 ft³ of hydrated bentonite grout and chips

0650S-22-02.GPJ

Log of Boring B 2A, Page 3 of 3

SAMPLE SYMBOLS: SAMPLING UNSUCCESSFUL; STANDARD PENETRATION TEST; DRIVE SAMPLE (UNDISTURBED); DISTURBED OR BAG SAMPLE; CHUNK SAMPLE; WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 3A

ELEV. (MSL.) ________ DATE COMPLETED 03-03-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**PREVIOUSLY PLACED FILL** Soft, moist, dark brown, Sandy CLAY			
2								
				SM	**LINDAVISTA FORMATION** Dense to very dense, moist, red, Silty, fine to medium SAND			
4								
	B3A-1				-With fine to coarse subangular gravel and cobbles	50/5"	91.6	7.6
6	B3A-2							
8								
10	B3A-3				-Cobble in sampler	50/5"		6.4
12	B3A-4			SM/SC	Dense to very dense, moist, dark reddish brown to grayish tan, Silty to Clayey, fine to medium SAND with gravel and cobbles			
14								
					-Refusal at 15 feet, moved location 20 feet east and continued drilling -Difficult drilling, cobble lense 14 to 16 feet	50/[illegible]"		
16								
				SC	**MISSION VALLEY FORMATION** Very dense, moist, light brownish gray with grayish tan mottling, Clayey, fine to medium SAND			
18								
20	B3A-5				-Ring sample disturbed	50/3"		
22								
24				SM/SC	Very dense, damp, brownish gray with grayish tan mottling, Clayey to Silty, fine to medium SAND			

06505-22-02 GPJ

Log of Boring B 3A, Page 1 of 2

SAMPLE SYMBOLS		
SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 3A

ELEV. (MSL.) ________ DATE COMPLETED 03-03-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
	B3A-6				**MISSION VALLEY FORMATION** Very dense, damp, brownish gray with grayish tan mottling, Clayey to Silty, fine to medium SAND	50/4"	94.4	12.9
26								
28				SM/SC				
30					-Sample disturbed	50/4"		
32					Very dense, damp, light gray, Silty, fine- to medium-grained SANDSTONE, weakly cemented			
34								
						50/4"		
36								
38				SM				
40	B3A-7				-Interbedded with moist, grayish tan, clayey, fine sand	50/5"	106.3	14.2
42								
44								
	B3A-8					50/4"	107.8	13.8

BORING TERMINATED AT 45 FEET 4 INCHES
No groundwater encountered
Backfilled with 12 ft³ of hydrated bentonite grout and chips

06505-22-02.GPJ

Log of Boring B 3A, Page 2 of 2

SAMPLE SYMBOLS		
... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 4A

ELEV. (MSL.) ____________ DATE COMPLETED 03-03-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**PREVIOUSLY PLACED FILL** Loose, moist, dark brown, Silty SAND			
				SP-SM	**LINDAVISTA FORMATION** Medium dense to dense, damp, red, fine to medium SAND with Silt			
2								
4								
	B4A-1				-Becomes very dense below 5 feet	50/5"	[illegible]	8.3
6								
8								
10	B4A-2				-Pale reddish brown, silty, fine SANDSTONE, moderately cemented	50/6"	[illegible]	[illegible]
12					-Cobble lenses between 13 and 15 feet			
14								
					-Cobble or boulder	50/5"		
16								
18				SC	**MISSION VALLEY FORMATION** Very dense, moist, brownish gray with grayish tan and pinkish tan mottling, Clayey, fine to medium SAND			
20	B4A-3					50/5"	92.7	10.0
22								
24				SM	Very dense, damp, gray, Silty, fine to medium SANDSTONE, weakly cemented			

06505-22-02.GPJ

Log of Boring B 4A, Page 1 of 2

SAMPLE SYMBOLS		
SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 4A

ELEV. (MSL.) ________ DATE COMPLETED 03-03-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
	B4A-4				**MISSION VALLEY FORMATION**	50/4"	98.2	11.5
26	B4A-5				Very dense, damp, gray, Silty, fine to medium SANDSTONE, weakly cemented			
28								
30	B4A-6				-Laminated with moist, dark brown silt interbeds	50/5"	91.1	12.9
32								
				SM				
34								
	B4A-7					50/5"	98.2	11.4
36								
38								
40	B4A-8				-Laminated with dull pink, clayey fine sand interbeds	50/5"	104.5	14.1
42								
44								
	B4A-9					50/4"	113.8	13.5

BORING TERMINATED AT 45 FEET 4 INCHES

No groundwater encountered

Backfilled with 12 ft³ of hydrated bentonite grout and chips

06505-22-02.GPJ

Log of Boring B 4A, Page 2 of 2

SAMPLE SYMBOLS		
SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-22-02

BORING B 5A

ELEV. (MSL.) ________ DATE COMPLETED 03-03-2005

EQUIPMENT CME 85 W/8" HSA

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3.5				CL/SC	**PREVIOUSLY PLACED FILL** Hard and dense, moist, grayish brown and orange-brown, fine to medium SAND and CLAY with gravel and cobbles			
3.5 – 8	B5A-1			SW-SM/ SW-SC	Dense to very dense, damp, grayish orange-brown to reddish brown, fine to medium SAND with Silt and Clay, scattered gravel and cobbles	67/11"	90.9	10.1
8 – 21				SM	**LINDAVISTA FORMATION** Dense, damp, dark reddish brown, Silty, fine SAND with gravel and cobble lenses	50/1"		
	B5A-2					50/3"		
						50/2"		
21 – 25				SM/SC	**MISSION VALLEY FORMATION** Very dense, damp, brownish gray, Silty to Clayey, fine to medium SANDSTONE, weakly cemented			

06505-22-02.GPJ

Log of Boring B 5A, Page 1 of 2

SAMPLE SYMBOLS		
SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06505-22-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 5A ELEV. (MSL.) ______ DATE COMPLETED 03-03-2005 EQUIPMENT CME 85 W/8" HSA	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
					MISSION VALLEY FORMATION Very dense, damp, light gray, Silty, fine to medium SANDSTONE, becomes moderately cemented with depth	50/1"		
26								
28								
30	B5A-3				-No recovery using California Modified sampler; drove SPT sample	50/2"		
32								
				SM				
34								
	B5A-4					50/5"		
36								
38								
40	B5A-5				-Laminated with gray, poorly to moderately indurated siltstone interbeds and cobbles	50/5"		
42								
44								
	B5A-6					50/3"		
					BORING TERMINATED AT 45 FEET 3 INCHES No groundwater encountered Backfilled with 12 ft^3 of hydrated bentonite grout and chips			

06505-22-02.GPJ

Log of Boring B 5A, Page 2 of 2

SAMPLE SYMBOLS			
	SAMPLING UNSUCCESSFUL	STANDARD PENETRATION TEST	DRIVE SAMPLE (UNDISTURBED)
	DISTURBED OR BAG SAMPLE	CHUNK SAMPLE	WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 1

ELEV. (MSL.) ______ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B1-1			SC	PREVIOUSLY PLACED FILL Dense, moist, brown, Clayey SAND with gravel/cobbles			
2	B1-2					50/5"	113.9	11.2
4				SM	LINDAVISTA FORMATION Moist, light reddish-brown, Silty SANDSTONE			
6	B1-3					50/4.5"	111.3	8.3
					BORING TERMINATED AT 6 FEET			

Figure A-1, Log of Boring B 1

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 2

ELEV. (MSL.) ________ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B2-1			SM	PREVIOUSLY PLACED FILL Dense, moist, reddish-brown, Silty SAND with gravel			
2	B2-2				LINDAVISTA FORMATION Very dense, moist, light reddish-brown, Silty SANDSTONE with gravel	50/5"		
4				SM				
	B2-3					50/6"	97.9	7.4
6					BORING TERMINATED AT 6 FEET			

Figure A-2, Log of Boring B 2

SUNSP

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 3

ELEV. (MSL.) __________ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B3-1				PREVIOUSLY PLACED FILL Very dense, damp, light brown, Silty SAND with gravel/cobbles			
2	B3-2					50/4"		8.6
4				SM				
6								
	B3-3					50/5"	110.8	9.2
8				SM	LINDAVISTA FORMATION Very dense, moist, tan/reddish-brown, Silty SANDSTONE with trace gravel			
10				SM	Very dense, moist, reddish-brown, Silty SANDSTONE with cobbles			

BORING TERMINATED AT 10.5 FEET

Figure A-3, Log of Boring B 3

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 4 ELEV. (MSL.) ______ DATE COMPLETED 10/19/00 EQUIPMENT IR A300 MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B4-1			SM	**PREVIOUSLY PLACED FILL** Moderately dense, moist, light brown, Silty SAND with gravel			
2	B4-2			SM	Moderately dense, moist, dark red, Silty SAND with gravel	19	117.3	9.6
4	B4-3			SM	**LINDAVISTA FORMATION** Very dense, moist, reddish-brown, Silty SAND with gravel and cobbles	50/3"	109.5	10.3
6								
8								
10	B4-4			SM	Very dense, moist, light reddish-brown, Silty SANDSTONE with gravel	18/3"		
12								
14					BORING TERMINATED AT 14 FEET			

Figure A-4, Log of Boring B 4

SUNSP

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 5

ELEV. (MSL.) ______ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B5-1				**PREVIOUSLY PLACED FILL** Very dense, moist, brown, Silty SAND			
2	B5-2					50/6"		5.4
4					**LINDAVISTA FORMATION** Very dense, moist, reddish-brown, Silty SANDSTONE			
	B5-3					50/6"	112.4	9.3
6								
8								
10					BORING TERMINATED AT 10 FEET			

Figure A-5, Log of Boring B 5

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 6

ELEV. (MSL.) ______ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B6-1				**PREVIOUSLY PLACED FILL** Moderately dense, moist, light brown, Silty SAND with gravel			
2	B6-2				**LINDAVISTA FORMATION** Very dense, moist, light reddish-brown, Silty SANDSTONE	50/5"	107.6	6.9
	B6-1							
4								
	B6-3					50/6"		
6								
8								
10	B6-4					50/5"	101.6	7.1
					BORING TERMINATED AT 10.5 FEET			

Figure A-6, Log of Boring B 6

SUNSP

SAMPLE SYMBOLS ☐ ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 7

ELEV. (MSL.) ______ DATE COMPLETED 10/19/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B7-1				**PREVIOUSLY PLACED FILL** Moderately dense, moist, dark brown, Silty SAND with gravel			
2	B7-2					27		
4				SM				
6	B7-3					22	119.8	11.1
8				SM	**LINDAVISTA FORMATION** Very dense, moist, light reddish-brown, Silty SANDSTONE			
10					BORING TERMINATED AT 10 FEET			

Figure A-7, Log of Boring B 7

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 17

ELEV. (MSL.) ________ DATE COMPLETED 10/23/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B17-1			GP	**PREVIOUSLY PLACED FILL** Very dense, brown, Silty SAND/poorly graded gravel			
2								
4	B17-2				**LINDAVISTA FORMATION** Very dense, moist, reddish-brown, Silty SANDSTONE	50/4"		7.3
6	B17-3					50/5"	109.5	6.9
8								
10					BORING TERMINATED AT 10 FEET			

Figure A-17, Log of Boring B 17

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06505-02-01

BORING B 18

ELEV. (MSL.) ____________ DATE COMPLETED 10/23/00

EQUIPMENT IR A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B18-1				**PREVIOUSLY PLACED FILL** Very dense, moist, brown, Clayey SAND/Silty SAND with gravel			
2	B18-2					50/5"	100.8	9.2
4				SM				
6					**LINDAVISTA FORMATION** Very dense, moist, reddish-brown, Silty SANDSTONE with gravel/cobbles			
8								
10					BORING TERMINATED AT 10 FEET			

Figure A-18, Log of Boring B 18

SUNSP

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.