Drainage Study
For
Ridgeway Apartments
2542 Ridgeway Drive
(PDS2020-LDGRMJ-30273)

Prepared: November 7, 2022

2542 Ridgeway Drive
National City, CA 91950
APN: 564-040-02, 21, 23 & 563-184-44

PREPARED FOR
BC Euclid, LLC
8445 Camino Santa Fe, Suite 102
San Diego, California 92121
(858) 427-1450

PREPARED BY
William Lundstrom, R.C.E.
Lundstrom Engineering & Surveying
5333 Mission Center Road, Suite 115
San Diego, California 92108
(619) 814-1220

Lundstrom
Engineering and Surveying, Inc.

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in Section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

11-07-2022

William Lundstrom
Registered Civil Engineer 61630
Exp. Date: 06/30/23

Date

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Introduction

Purpose and Scope

The County's application process requires a hydrology/ drainage study on all development projects at the time of application. This study provides the needed information to ensure that the proposed drainage facilities are sized and located appropriately.

The study compares storm runoff under existing conditions versus proposed conditions (100 year event) and identifies existing drainage problems that may be caused, or aggravated, by project development. The study is further used to determine impacts that might be caused downstream (erosion) and to identify proposed mitigation measures.

Section 1. Project Information

1.1.Project Description

1.1.1 Project Location

The project is located in the City of National City, at 2542 Ridgeway Drive, National City, CA 91950. **Exhibit A** provides a location map for the site.

1.1.2 Project Activities Description

The 2.7 acre site is a rectangular shaped lot located at 2542 Ridgeway Drive in the city of National City. The site is currently occupied by two single family homes and paved driveways. Runoff generated on-site travels via overland flow in a southerly direction to a natural drainage course. The natural drainage course flows westerly through the site at the south end of the property.

The proposed redevelopment will consist of three multi-family buildings with paved private driveways. A proposed private drainage system will convey storm water runoff generated on-site to a proprietary biofiltration basin for water quality treatment and underground storm drain detention storage for hydromodification flow requirements. The proposed storm drain system will convey storm water to the natural drainage course along the south end of the site.

1.2.Hydrologic Setting

This section summarizes the project's size and location in the context of the larger watershed perspective, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.

1.2.1 Watershed

The project site is located in Lower Sweetwater River HSA 903.11. Runoff from the site is conveyed through a natural drainage course to an existing public concrete box culvert approximately 100-feet downstream of the site. The public storm drain system drains directly into the Sweetwater River.

1.2.2 Topography

The 2.7 acre site is a rectangular shaped lot located at 2542 Ridgeway Drive in the city of National City. The site is currently occupied by two single family homes and paved driveways. Runoff generated on-site travels via overland flow in a southerly direction to a natural drainage course. The natural drainage course flows westerly through the site at the south end of the property.

1.2.3 FEMA Flood Insurance Rate Map

The project site is located in Zone X of the Flood Insurance Rate Map (FIRM) Panel 06073C1912G. Zone X is designated to be areas determined to be outside the 500-year floodplain. **Exhibit B** illustrates the project site within Flood Zone X.

1.2.4 Current and Adjacent Land Use

The site is currently occupied by two single family homes and paved driveways.

1.2.5 Soil and Vegetation Conditions

The project site consists of SCS Hydrologic Soil Type D. There is a mixture of urban landscaping and natural vegetation on-site.

1.2.6 Existing Drainage Patterns and Facilities (Narrative)

Runoff generated onsite sheet flows from northeast to southwest into a natural drainage course. Offsite run-on occurs in three locations. A curb inlet at the corner of Ridgeway and Euclid Drive currently outlets into the property. Offsite flow from the adjacent property to the east surface flows onto the site. These two offsite flows will be routed separately thru the improved portion of the site as discussed in section 1.4. The natural drainage course along the southern portion of the site flows from the east. This flow remains untouched in design as the portion of the property remains unimproved.

1.2.7 Impervious Cover

The proposed redevelopment will consist of three multi-family buildings with paved private driveways. The total impervious area for the project is approximately 59,300 sf.

1.3.Hydromodification

A proposed private drainage system will convey storm water runoff generated on-site to a proprietary biofiltration system for water quality treatment and into modular stormwater detention system for hydromodification flow control. The proposed storm drain system will convey storm water to the natural drainage course along the south end of the site. Runoff from the site is conveyed through a natural drainage course to an existing public concrete box culvert approximately 100-feet downstream of the site. The public storm drain system drains directly into the Sweetwater River.

1.4.Proposed Runoff Management Facilities

The proposed facilities managing runoff from the site include:

- Appropriate grading of pads to direct runoff away from structures on the site.
- Proposed street section and storm drain system to convey runoff to the existing storm drain system.
- Filterra Bioscape biofiltration basin for storm water quality treatment.
- Underground detention system for HMP flow control.
- Run-on will be bypassed in the following ways:
    - The existing curb inlet in Euclid Avenue, that currently outlets in the property will capture existing off-site run-on. The existing headwall outlet will be removed and a new 18”-24” private storm drain system will route flow through the property to outlet at a proposed headwall downstream of the site improvements, at the natural drainage course along the southern portion of the site, where existing flow patterns would lead. A proposed secondary overflow catch basin will be located on-site to capture off-site run-on that overruns the existing curb inlet in Euclid Avenue.
    - The run-on from the adjacent easterly property will be picked up by a gutter along the property line and directed to a riprap protected spillway into the natural drainage course.

Section 2. Design Criteria and Methodology

This section summarizes the design criteria and methodology applied during drainage analysis of the project site. The design criteria and methodology follow the County of San Diego County Hydrology Manual (June 2003), San Diego County Hydraulic Drainage Design Manual (September 2014), and Storm Water Standards as appropriate for the project site.

2.1.Hydrologic Design Methodology

2.1.1 Rational Method: Peak Flow

Runoff calculations for this study were accomplished using the Rational Method. The Rational Method is a physically-based numerical method where runoff is assumed to be directly proportional to rainfall and area, less losses for infiltration and depression storage. Flows were computed based on the Rational formula:

$$Q = C\,i\,A$$

where ...
- Q = Peak discharge (cfs);
- C = runoff coefficient, based on land use and soil type;
- i = rainfall intensity (in/hr);
- A = watershed area (acre)

The runoff coefficient represents the ratio of rainfall that runs off the watershed versus the portion that infiltrates to the soil or is held in depression storage. The runoff coefficient is dependent on the land use coverage and soil type.

For a typical drainage study, rainfall intensity varies with the watershed time of concentration. The watershed time of concentration at any given point is defined as the time it would theoretically take runoff to travel from the most upstream point in the watershed to a concentration point, as calculated by equations in the San Diego County Hydrology Manual.

Table 2-1 Rational Method Runoff Coefficients.

		RUNOFF COEFFICIENT			
	(%)	**Hydrologic Soil Type**			
LAND USE (County Elements)	**Imperv.**	**A**	**B**	**C**	**D**
Permanent Open Space		0.20	0.25	0.30	0.35
Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Neighborhood Commercial	80	0.76	0.77	0.78	0.79
General Commercial	85	0.80	0.80	0.81	0.82
Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Limited Industrial	90	0.83	0.84	0.84	0.85
General Industrial	95	0.87	0.87	0.87	0.87

Rational Method calculations were accomplished using the CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1. Peak discharges were computed for 100-year and 50-year storm return frequencies.

2.1.2 Time of Concentration

The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The T_c is composed of two components: initial time of concentration (T_i) and the travel time (T_t). The T_i is the time required for runoff to travel across the surface of the most remote subarea in the study, or "initial subarea". Guidelines for designation the initial subarea are provided within the discussion of computation of T_i. The T_i is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the point of interest. For the Rational Method, the T_c at any point within the drainage area is given by:

$$T_c = T_i + T_t$$

Methods of calculation differ for natural watersheds (nonurbanized) and for urban drainage systems. When analyzing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for T_c and runoff calculations, and can be determined from the local Community General Plan.

2.1.3 Initial Time of Concentration

The initial time of concentration is typically based on sheet flow at the upstream end of a drainage basin. The Overland Time of Flow is approximated by an equation developed by the Federal Aviation Agency (FAA) for analyzing flow on runways (FAA, 1970). The usual runway configuration consists of a crown, like most freeways, with sloping pavement that directs flow to either side of the runway. This type of flow is uniform in the direction perpendicular to the velocity and is very shallow. Since these depths are ¼ of an inch in magnitude, the relative roughness is high. Some higher relative roughness values for overland flow are presented in the *HEC-1 Flood Hydrograph Package User's Manual* (USACE, 1990).

The sheet flow that is predicted by the FAA equation is limited to conditions that are similar to runway topography. Some considerations that limit the extent to which the FAA equation applies are identified below:

- Urban Areas – This "runway type" runoff includes:
    - Flat roofs, sloping at 1% +/-
    - Parking lots at the extreme upstream drainage basin boundary (at the "ridge" of a catchment area.) Even a parking lot is limited in the amounts of sheet flow. Parked or moving vehicles would "break-up" the sheet flow, concentrating runoff into streams that are not characteristic of sheet flow.
    - Driveways are constructed at the upstream end of catchment areas in some developments. However, if flow from a roof is directed to a driveway through a downspout or other conveyance mechanism, flow would be concentrated.
    - Flat slopes are prone to meandering flow that tends to be disrupted by minor irregularities and obstructions. Maximum Overland Flow lengths are shorter for the flatter slopes.
- Rural or Natural Areas –The FAA equation is applicable to these conditions since (0.5% to 10%) slopes that are uniform in width of flow have slow velocities consistent with the equation. Irregularities in terrain limit the length of application.
    - Most hills and ridge lines have a relatively flat area near the drainage divide. However, with flat slopes of 0.5% +/-, minor irregularities would cause flow to concentrate into streams.
    - Parks, lawns and other vegetated areas would have slow velocities that are consistent with the FAA Equation.

The Initial Time of Concentration is reflective of the general land-use at the upstream end of a drainage basin.

2.1.4 Travel Time

The T_t is the time required for the runoff to flow in a watercourse or series of watercourses from the initial subarea to the point of interest. The T_t is computed by dividing the length of the flow path by the computed flow velocity. Since the velocity normally changes as a result of each change in flow rate or slope, such as at an inlet or grade break, the total T_t must be computed as the sum of the T_t's for each section of the flow path.

2.1.5 Rational Method: Runoff Volume

For designs that are dependent on the total storm volume, a hydrograph must be generated to account for the entire volume of runoff from the 6-hour storm event. The hydrograph for the entire 6-hour storm event is generated by creating a rainfall distribution consisting of blocks of rain, creating an incremental hydrograph for each block of rain, and adding the hydrographs from each block of rain. This process creates a hydrograph that contains runoff from all the blocks of rain and accounts for the entire volume of runoff from the 6-hour storm event. The total volume under the resulting hydrograph is equal to the following equation:

$$VOL = CP_6A$$

Where: VOL = volume of runoff (acres-inches)

P_6 = 6-hour rainfall (inches)

C = runoff coefficient

A = area of the watershed (acres)

Section 3. Characterization of Project Runoff

3.1.Hydrologic Effects of Project

The proposed project will not significantly alter drainage patterns on the site. **Exhibit D** illustrates the proposed condition hydrology map. Table 3-1 summarizes the hydrologic effects of the project. Table for reference. Q, TC, and Rainfall intensity per AES.

Table 3-1 Summary of Hydrology Analysis.

EXISTING

NODE	TC (MIN.)	AREA (ACRES)	C	I100 (in/hr)	Q100 RUN-OFF (CFS)
3	15.5	3.5	0.71	3.3	8.2
5	10.5	42.9	0.71	3.0	115.4

PROPOSED

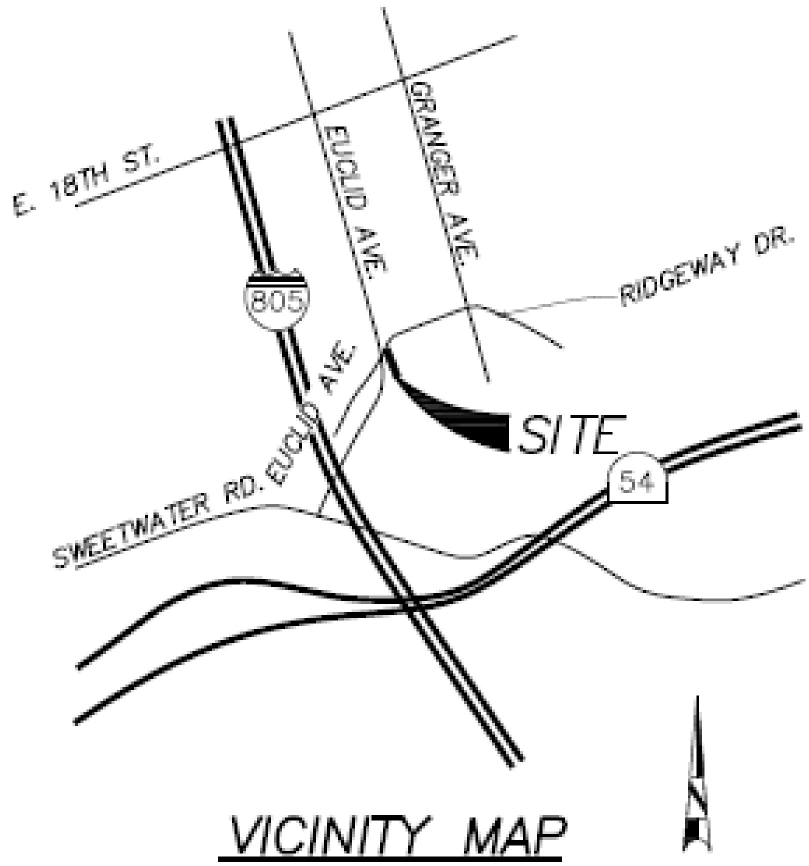
NODE	TC (MIN.)	AREA (ACRES)	C	I100 (in/hr)	Q100 RUN-OFF (CFS)
3	15.5	3.5	0.71	3.3	8.2
5	10.5	42.9	0.71	3.0	114.8

Section 4. Summary and Conclusions

This hydrology and hydraulic study have evaluated the potential effects of runoff on the proposed project. In addition, the report has addressed the methodology used to analyze the pre- and post-construction condition, which was based on the San Diego County Hydrology and Design Manual. This section provides a summary discussion that evaluates the potential effects of the proposed project.

- The proposed project will not substantially alter the existing drainage patterns on the site.
- The proposed project does not place housing or structures within 100-year flood area in which would impede or redirect flows.
- The proposed storm drain detention system will mitigate peak flows below pre-project conditions.
- In my professional opinion, the proposed work and improvements, as they relate to this project, will not increase the flow rates or velocity of surface flows to the detriment of downstream landowners and/or facilities.

E X H I B I T S



VICINITY MAP
NOT TO SCALE
T.B. 1310 C2

Exhibit A

Exhibit B

National Flood Hazard Layer FIRMette

FEMA

117°4'49"W 32°40'10"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

117°4'12"W 32°39'40"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/6/2021 at 1:23 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Exhibit C

LEGEND

DMA NUMBER	DMA #
DMA LIMITS	
FLOW PATH	
AES DRAINAGE NODE	1

100 50 0 100 200 300

SCALE: 1"=100'

Lundstrom
Engineering and Surveying, Inc.
5333 Mission Center Road, #115 • San Diego, CA 92108
Phone (619) 814-1220 • Fax (619) 641-5910

EXISTING DRAINAGE CONDITION

2542 RIDGEWAY DRIVE,
NATIONAL CITY

ENGINEER'S NAME: LUNDSTROM ENGINEERING & SURVEYING, INC.
PHONE NO. (619) 814-1220

Drawing: c:\work\l209-04\dwg\water resourses\l209-04 existing condition 06-29-2022.dwg Plot Date: 8/22/2022 9:55 AM

EXISTING DRAINAGE CONDITION

2542 RIDGEWAY DRIVE,
NATIONAL CITY

Lundstrom
Engineering and Surveying, Inc.
5333 Mission Center Road, #115 • San Diego, CA 92108
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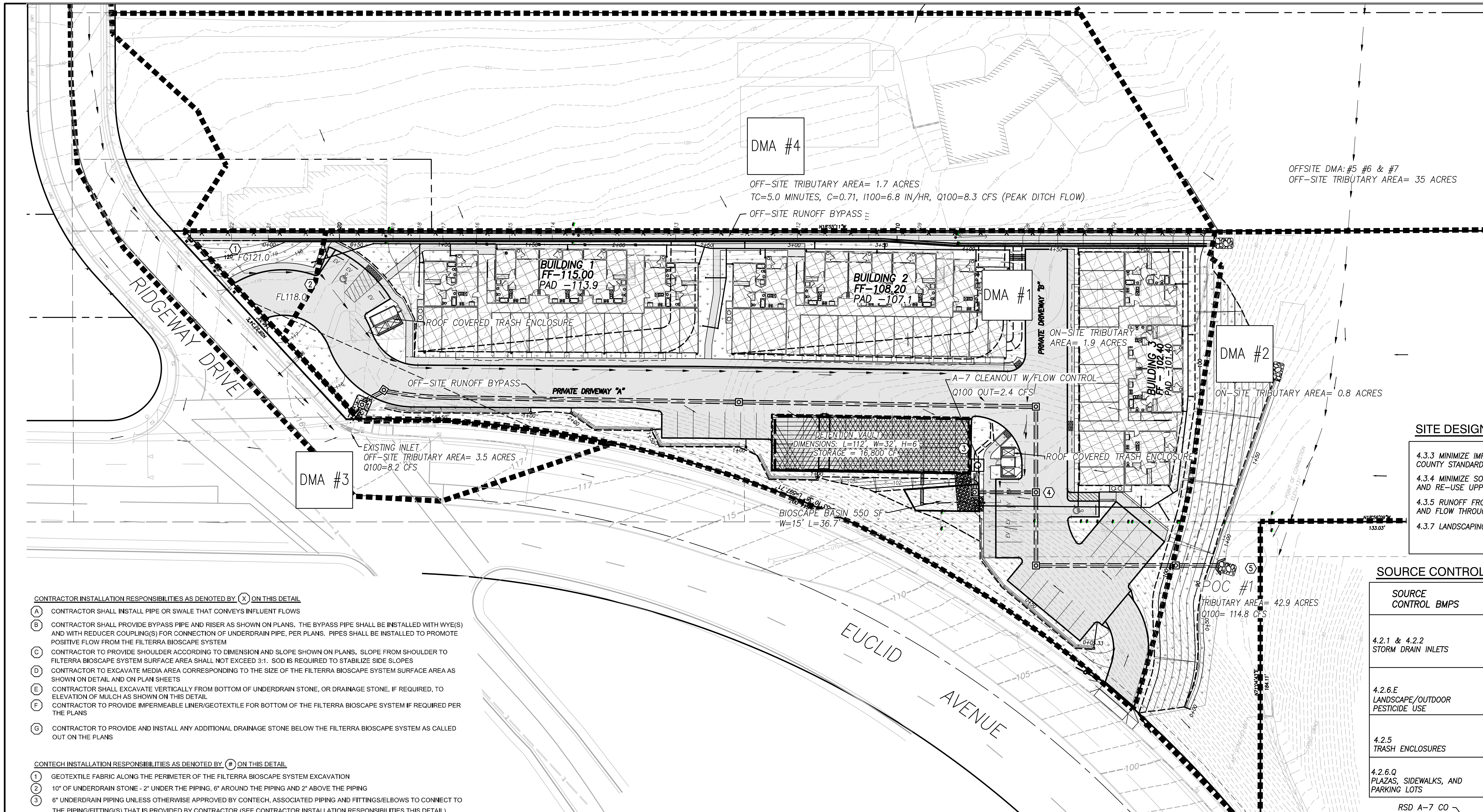
ENGINEER'S NAME: LUNDSTROM ENGINEERING & SURVEYING, INC.
PHONE NO. (619) 814-1220

Drawing: c:\work\l209-04\dwg\water resourses\l209-04 existing condition 06-29-2022.dwg Plot Date: 8/22/2022 10:20 AM

<u>Exhibit D</u>



LEGEND

- DRAINAGE MANAGEMENT AREA (DMA)
- DMA 1 PROPOSED IMPERVIOUS PAVEMENT = 33,450 SF
- DMA 1 PROPOSED ROOF AREA = 25,850 S.F.
- DMA 1 PROPOSED LANDSCAPE AREA = 24,500 S.F.
- PROPOSED BIOFILTRATION BASIN = 550 S.F.
- PROPOSED DETENTION STORAGE = 16,800 C.F. CONCRETE VAULT

DMA #1 AREA = 83,800 S.F.
DMA #2 AREA = 34,850 S.F. (SELF MITIGATING)
HYDROLOGIC SOIL GROUP D
DEPTH TO GROUNDWATER > 20 FEET
NO EXISTING NATURAL HYDROLOGIC FEATURES
NO CRITICAL COARSE SEDIMENT YIELD AREAS EXISTS ON SITE.

SITE DESIGN BMPS

4.3.3 MINIMIZE IMPERVIOUS AREA: RESIDENTIAL STREETS ARE AT THE MINIMUM REQUIRED WIDTH PER COUNTY STANDARDS.

4.3.4 MINIMIZE SOIL COMPACTION: RE-TILL SOILS COMPACTED BY CONSTRUCTION VEHICLES. COLLECT AND RE-USE UPPER SOIL LAYERS DEVELOPMENT SITE CONTAINING ORGANIC MATERIALS.

4.3.5 RUNOFF FROM WALKS AND ROOF DRAIN DOWNSPOUTS SHALL DISCHARGE ONTO SPLASH BLOCKS AND FLOW THROUGH ADJACENT LANDSCAPE AREA BEFORE ENTERING BIORETENTION BASINS

4.3.7 LANDSCAPING WITH DROUGHT TOLERANT SPECIES

SOURCE CONTROL BMPs

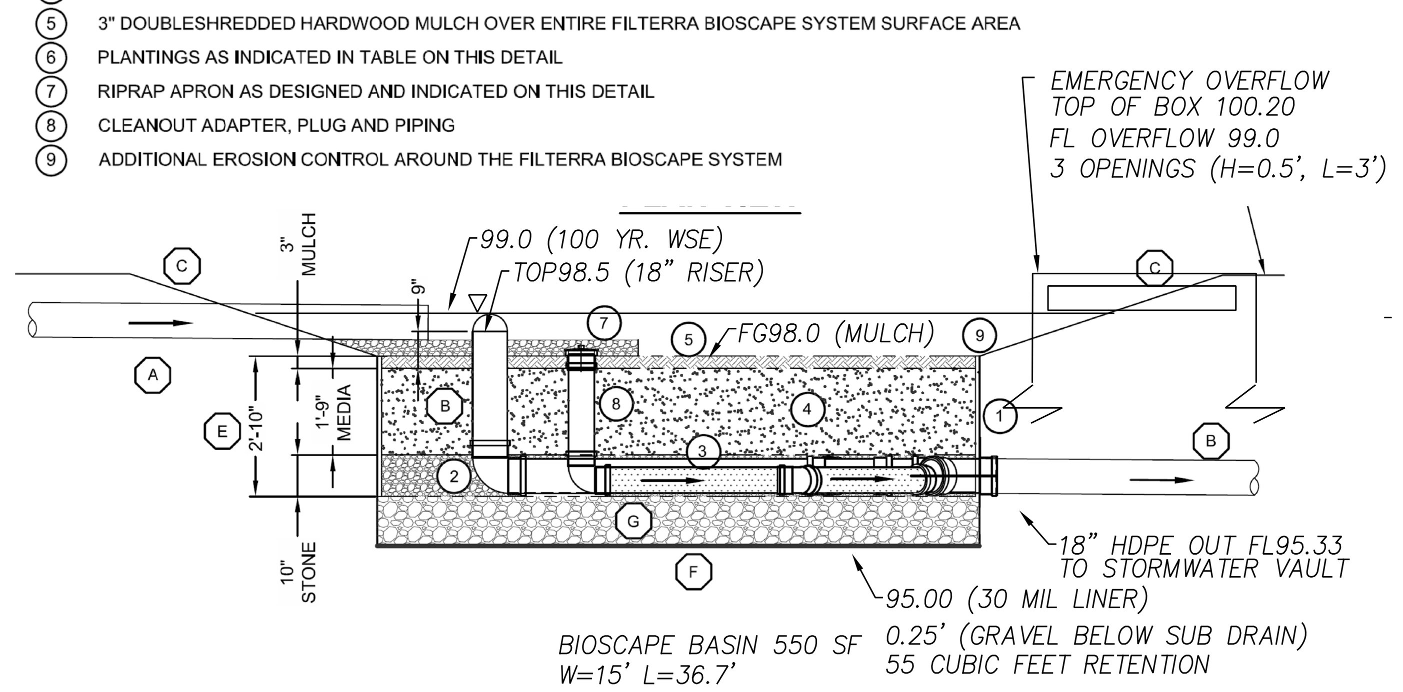
SOURCE CONTROL BMPS	PROJECT IMPLEMENTATION
4.2.1 & 4.2.2 STORM DRAIN INLETS	MARK ALL INLETS WITH THE WORDS "NO DUMPING! DRAINS TO WATERWAYS" IN ENGLISH AND "NO CONTAMINE" IN SPANISH. MAINTAIN AND PERIODICALLY REPLACE INLET MARKINGS. SEE APPLICABLE OPERATIONAL BMPS IN CASQA FACT SHEET SC-44, "DRAINAGE SYSTEM MAINTENANCE."
4.2.6.E LANDSCAPE/OUTDOOR PESTICIDE USE	LANDSCAPE HAS BEEN DESIGNED PER CITY OF SAN SAN DIEGO LANDSCAPE STANDARDS TO MINIMIZE IRRIGATION AND RUNOFF, AND TO MINIMIZE THE USE OF FERTILIZERS AND PESTICIDES THAT CAN CONTRIBUTE TO STORMWATER POLLUTION. SEE APPLICABLE BMPS IN CASQA FACT SHEETS SC-41, "BUILDING AND GROUNDS MAINTENANCE."
4.2.5 TRASH ENCLOSURES	STORAGE AREA IS PAVED WITH CONCRETE AND DESIGN NOT TO ALLOW RUN-ON FROM ADJOINING AREAS, WALLED AND CONTAINS A ROOF. SIGNS ON DUMPSTER WITH THE WORDS "DO NOT DUMP HAZARDOUS MATERIAL HERE" OR SIMILAR APPROVED BY CITY. SEE CASQA FACT SHEET SC-34, "WASTE HANDLING AND DISPOSAL."
4.2.6.Q PLAZAS, SIDEWALKS, AND PARKING LOTS	PLAZAS, SIDEWALKS, AND PARKING LOTS SHALL BE SWEPT REGULARLY AND ONCE PRIOR TO OCTOBER 1ST TO PREVENT THE ACCUMULATION OF LITTER AND DEBRIS. SEE CASQA FACT SHEET SC-41, "BUILDING AND GROUNDS MAINTENANCE."

CONTRACTOR INSTALLATION RESPONSIBILITIES AS DENOTED BY (X) ON THIS DETAIL

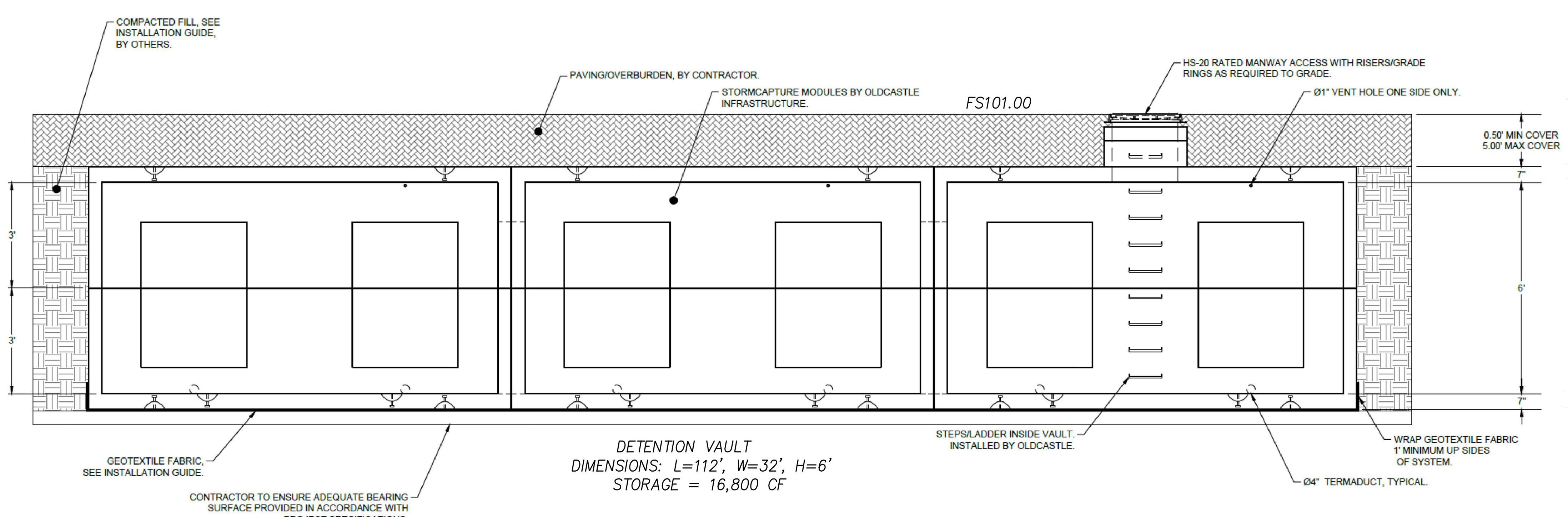
- (A) CONTRACTOR SHALL INSTALL PIPE OR SWALE THAT CONVEYS INFLUENT FLOWS
- (B) CONTRACTOR SHALL PROVIDE BYPASS PIPE AND RISER AS SHOWN ON PLANS. THE BYPASS PIPE SHALL BE INSTALLED WITH WYE(S) AND WITH REDUCER COUPLING(S) FOR CONNECTION OF UNDERDRAIN PIPE, PER PLANS. PIPES SHALL BE INSTALLED TO PROMOTE POSITIVE FLOW FROM THE FILTERRA BIOSCAPE SYSTEM
- (C) CONTRACTOR TO PROVIDE SHOULDER ACCORDING TO DIMENSION AND SLOPE SHOWN ON PLANS. SLOPE FROM SHOULDER TO FILTERRA BIOSCAPE SYSTEM SURFACE AREA SHALL NOT EXCEED 3:1. SOD IS REQUIRED TO STABILIZE SIDE SLOPES
- (D) CONTRACTOR TO EXCAVATE MEDIA AREA CORRESPONDING TO THE SIZE OF THE FILTERRA BIOSCAPE SYSTEM SURFACE AREA AS SHOWN ON DETAIL AND ON PLAN SHEETS
- (E) CONTRACTOR SHALL EXCAVATE VERTICALLY FROM BOTTOM OF UNDERDRAIN STONE, OR DRAINAGE STONE, IF REQUIRED, TO ELEVATION OF MULCH AS SHOWN ON THIS DETAIL
- (F) CONTRACTOR TO PROVIDE IMPERMEABLE LINER/GEOTEXTILE FOR BOTTOM OF THE FILTERRA BIOSCAPE SYSTEM IF REQUIRED PER THE PLANS
- (G) CONTRACTOR TO PROVIDE AND INSTALL ANY ADDITIONAL DRAINAGE STONE BELOW THE FILTERRA BIOSCAPE SYSTEM AS CALLED OUT ON THE PLANS

CONTECH INSTALLATION RESPONSIBILITIES AS DENOTED BY (#) ON THIS DETAIL

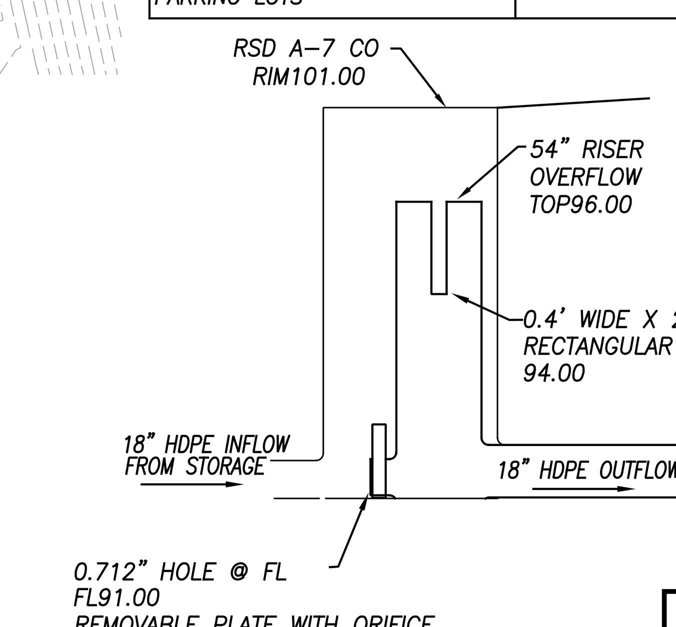
1. GEOTEXTILE FABRIC ALONG THE PERIMETER OF THE FILTERRA BIOSCAPE SYSTEM EXCAVATION
2. 10" OF UNDERDRAIN STONE - 2" UNDER THE PIPING, 6" AROUND THE PIPING AND 2" ABOVE THE PIPING
3. 6" UNDERDRAIN PIPING UNLESS OTHERWISE APPROVED BY CONTECH, ASSOCIATED PIPING AND FITTINGS/ELBOWS TO CONNECT TO THE PIPING/FITTING(S) THAT IS PROVIDED BY CONTRACTOR (SEE CONTRACTOR INSTALLATION RESPONSIBILITIES THIS DETAIL)
4. 21" ENGINEERED MEDIA
5. 3" DOUBLESHREDDED HARDWOOD MULCH OVER ENTIRE FILTERRA BIOSCAPE SYSTEM SURFACE AREA
6. PLANTINGS AS INDICATED IN TABLE ON THIS DETAIL
7. RIPRAP APRON AS DESIGNED AND INDICATED ON THIS DETAIL
8. CLEANOUT ADAPTER, PLUG AND PIPING
9. ADDITIONAL EROSION CONTROL AROUND THE FILTERRA BIOSCAPE SYSTEM



SECTION A-A VIEW



TYPICAL ELEVATION
NTS
STORMCAPTURE ® DETENTION SYSTEM



OUTLET CONTROL STRUCTURE
N.T.S.

SCALE: 1"=30'

COUNTY APPROVED CHANGES			
NO.	DESCRIPTION	APPROVED BY	DATE

BENCHMARK

DESCRIPTION: CITY OF SAN DIEGO BENCHMARK NO. 16070
LOCATION: BRASS PLUG IN TOP OF NORTHEAST CURB RETURN AT INTERSECTION OF RACHEL AVE. AND ROANOKE ST.
RECORD FROM: CITY OF SAN DIEGO
ELEVATION: 167.361 DATUM: NGVD-29

PRIVATE CONTRACT

SHEET 13	COUNTY OF SAN DIEGO DEPARTMENT OF PUBLIC WORKS	18 SHEET

POST CONSTRUCTION BMP PLAN

2542 RIDGEWAY DRIVE NATIONAL CITY, CA 91950

CALIFORNIA COORDINATE INDEX 182-1743

APPROVED FOR: WILLIAM P. MORGAN
COUNTY ENGINEER
BY:
DATE:

ENGINEER OF WORK: WILLIAM LUNDSTROM
EXP. 6-30-23 R.C.E. 61630
GRADING PERMIT NO. PDS2020-LDGRMJ-30273

Lundstrom
Engineering and Surveying, Inc.
3333 Camino del Rio South, #330 • San Diego, CA 92108
Phone (619) 814-1220 • Fax (619) 641-5910

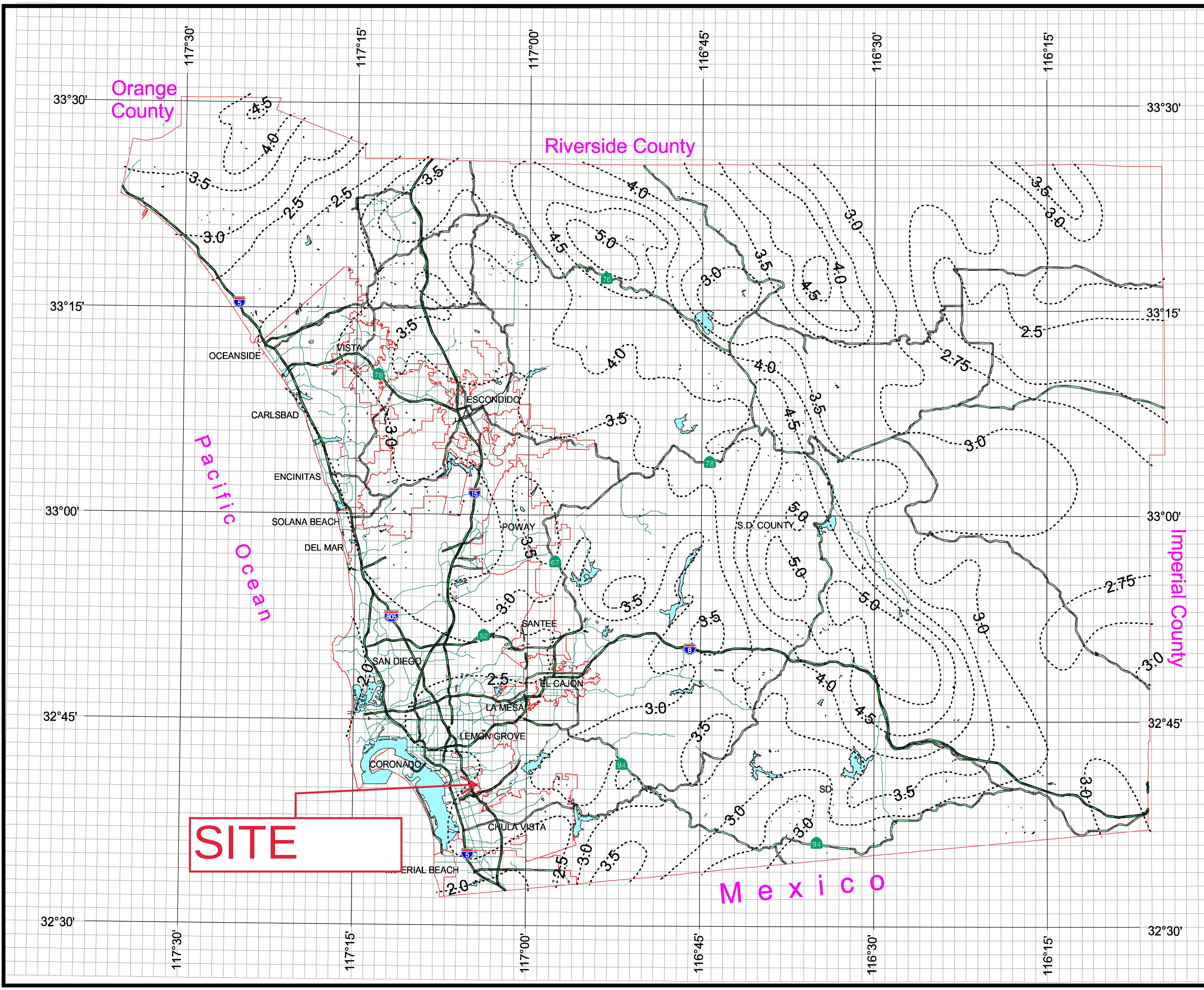
ENGINEER'S NAME: LUNDSTROM ENGINEERING & SURVEYING
PHONE NO. (619) 814-1220

APPENDIX A
Hydrologic Information

This Section Contains:

- Precipitation Analysis

Precipitation Analysis



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Department of Public Works Geographic Information Services

We Have San Diego Covered!

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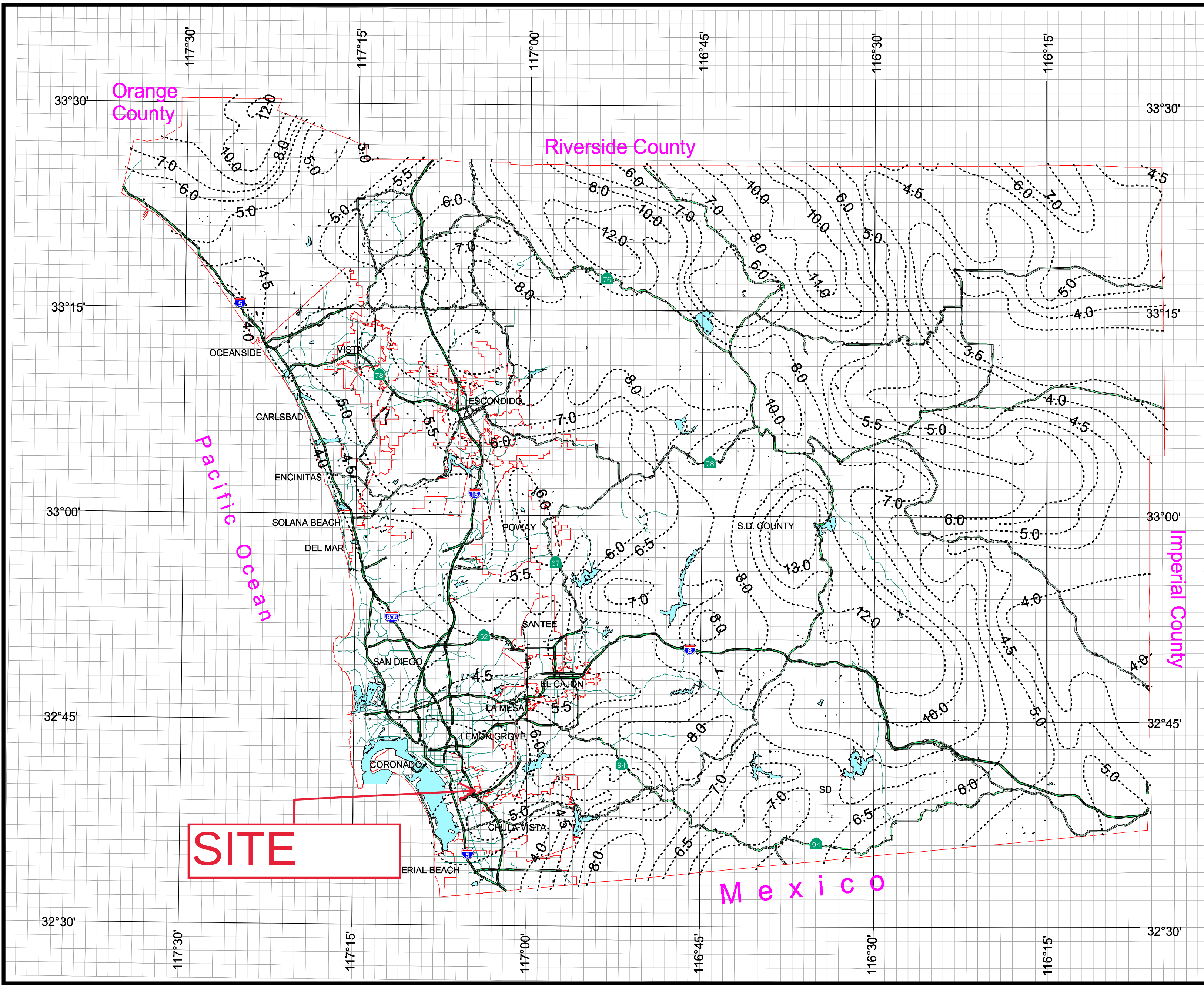
N S W E

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

- - - - - Isopluvial (inches)

DPW GIS
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N W E S

3 0 3 Miles

Soils Information

UPDATED GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2542 RIDGEWAY DRIVE
NATIONAL CITY, CALIFORNIA

PROJECT NO. 112-20017
FEBRUARY 24, 2020

PREPARED FOR:

BLUE CENTURION HOMES
9265 ACTIVITY ROAD, SUITE 112
SAN DIEGO, CALIFORNIA 92126

ATTENTION: MR. ABRAHAM EDID

PREPARED BY:

KRAZAN & ASSOCIATES, INC.
1100 OLYMPIC DRIVE, SUITE 103
CORONA, CALIFORNIA 92881
(951) 273-1011

Offices Serving the Western United States

UPDATED GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2542 RIDGEWAY DRIVE
NATIONAL CITY, CALIFORNIA

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February 24, 2020 KA Project No. 112-20017

UPDATED GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
2542 RIDGEWAY DRIVE
NATIONAL CITY, CALIFORNIA

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed development that will include construction of a 25-unit multi-family residential development. It is understood that the proposed construction will include structures utilizing conventional shallow foundation systems and concrete slab-on-grade floors, underground utilities, paved parking and drive areas, and localized landscaped areas. Discussions regarding site conditions are presented herein, together with conclusions and recommendations pertaining to site preparation, grading, utility trench backfill, drainage and landscaping, foundations, concrete floor slabs and exterior concrete flatwork, retaining walls, and pavement design.

A Vicinity Map showing the location of the site is presented on Figure 1. A Site Plan showing the approximate boring and bulk sample locations is presented on Figure 2. Descriptions of the field and laboratory investigations, boring log legend and boring logs are presented in Appendix A. Appendix A also contains a description of the laboratory-testing phase of this study, along with the laboratory test results. Appendices B and C contain guide specifications for earthwork and flexible pavements, respectively. If conflicts in the text of the report occur with the general specifications in the appendices, the recommendations in the text of the report have precedence.

PURPOSE AND SCOPE OF SERVICES

This geotechnical investigation was conducted to evaluate subsurface soil and groundwater conditions at the project site. Engineering analysis of the field and laboratory data was performed for the purpose of developing and providing geotechnical recommendations for use in the design and construction of the earthwork, foundation and pavement aspects of the project.

Our scope of services was outlined in our proposal dated January 23, 2020 (KA Proposal No. G20010CAC) and included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site.
- Review of selected published geologic maps, reports and literature pertinent to the site and surrounding area.

- A field investigation consisting of drilling three (3) borings to a depth of approximately 20 feet below the existing ground surface for evaluation of the subsurface conditions at the project site.

- Performance of two (2) infiltration tests at the subject site in order to determine an estimated infiltration rate for the near surface soil conditions.

- Performance of laboratory tests on representative soil samples obtained from the borings to evaluate the physical and index properties of the subsurface soils.

- Evaluation of the data obtained from the investigation, previous investigations and engineering analyses of the data with respect to the geotechnical aspects of structural design, site grading and paving.

- Preparation of this report summarizing the findings, results, conclusions and recommendations of our investigation.

Environmental services, such as a chemical analysis of soil and groundwater for possible environmental contaminates, were not in our scope of services.

PROPOSED CONSTRUCTION

Based on our review of the site plan and our discussions with the project representative, we understand that the proposed development will include construction of a 25-unit multi-family residential development. It is understood that the proposed construction will include structures utilizing conventional shallow foundation systems and concrete slab-on-grade floors. The proposed structures are understood to be three-stories in height. No subterranean construction is anticipated as part of the proposed development. It is anticipated that the proposed development will include underground utilities, paved parking and drive areas, and localized landscaped areas. The majority of the site is flat and level, except for the slopes along the western perimeter of the parcel. Slopes appear to range from 5:1 to 2:1. It is anticipated that cuts and fills may be up to 4 to 5 feet.

In the event these structural or grading details are inconsistent with the final design criteria, we should be notified so that we can evaluate the potential impacts of the changes on the recommendations presented in this report and provide an updated report as necessary.

SITE LOCATION AND SITE DESCRIPTION

The site is accessible from a driveway that is located on Ridgeway Drive near Euclid Avenue. The subject site is a roughly trapezoidal shape corner lot. The overall site occupies approximately 2.1 acres. The site is located east of Euclid Avenue and south of Ridgeway Drive, in the city of National City, California (see Vicinity Map, Figure 1). The site is bound to the north, west & east by residential developments, and to the south by undeveloped land. The majority of the site is flat and level except for slopes situated along the western portion of the perimeter of the parcel. Slopes appear to range from 5:1 to 2:1 (H:V). It is anticipated that cuts and fills will vary from approximately 4 to 5 feet. Elevations at the subject site range from approximately 75.0 to 105.0 above mean sea level. The site is currently occupied by a single-family residential structure located in the front of the site and a second single-family residential structure located at the rear of the site. A localized crib style landscape wall is located along the property line at the rear of the property. Ground cover in the remaining portions of the site consist of localized asphaltic concrete pavement, landscaping, and weed and tree growth.

PREVIOUS STUDIES

The site was previously investigated by our firm. Krazan and Associates, Inc. performed a Geotechnical Site Investigation in October 16, 2017 for the Ridgeway Residential Development, which includes the subject site. The area investigated by our firm consisted of approximately 2.1 acres, which include the subject site being addressed by this report. As part of the previous Geotechnical Engineering Investigation Report, six (6) boring were drilled to depths ranging from 20 to 50 feet below existing site grades. Conditions encountered during the most recent subsurface investigation were found to be similar to those discussed in the previous Geotechnical Engineering Investigation Report. As part of the current investigation performed by our firm, three additional borings were drilled on the subject site and two shallow infiltration tests were conducted in the area of the proposed infiltration system.

GEOLOGIC SETTING

The subject site is located in the San Diego region within the Peninsular Range Geomorphic Province. The Peninsular Range Geomorphic Province is characterized by northwest trending mountain ranges, separated by subparallel fault zones. The mountain ranges are underlain by basement rocks, consisting of Jurassic metavolcanic and metasedimentary rocks and Cretaceous igneous rocks of the southern California batholith. Late Cretaceous, Tertiary, and Quaternary sediments flank the mountain ranges to the northeast and southwest. Subsurface lithologies at the subject site are generally composed of artificial fill, alluvium, and formational materials. The project site is not located within a State of California Earthquake Fault Zone.

Deposits encountered on the subject site during exploratory drilling are consistent with those mapped in the area and are discussed in detail in this report. The site is located in a seismically active area of Southern California. The area in consideration shows no mapped faults on-site according to maps prepared by the California Geologic Survey and published by the International Conference of Building Officials (ICBO).

FAULT RUPTURE HAZARD ZONES

The Alquist-Priolo Geologic Hazards Zones Act went into effect in March, 1973. Since that time, the Act has been amended 11 times (Hart, 2007). The purpose of the Act, as provided in California Geologic Survey (CGS) Special Publication 42 (SP 42), is to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture". The Act was renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994, and at that time, the originally designated "Special Studies Zones" was renamed the "Earthquake Fault Zones."

The area of the subject site is not included on an Earthquake Fault Zones Map prepared by the CGS. The site is not within a Fault-Rupture Hazard Zone. The Rose Canyon and Palos Verdes Fault Zones are the nearest active fault zones to the site and are each located approximately 5.3 miles from the site.

SEISMIC HAZARDS ZONES

In 1990, the California State Legislature passed the Seismic Hazard Mapping Act to protect public safety from the effects of strong shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The Act requires that the State Geologist delineate various seismic hazards zones on Seismic Hazards Zones Maps. Specifically, the maps identify areas where soil liquefaction and earthquake-induced landslides are most likely to occur. A site-specific geotechnical evaluation is required prior to permitting most urban developments within the mapped zones. The Act also requires sellers of real property within the zones to disclose this fact to potential buyers. A State of California, Special Studies Zone Map has not been prepared for the subject site. As such, the subject site is not located in an area designated as a Liquefaction Hazard Zone by the State of California.

OTHER HAZARDS

Rockfall, Landslide, Slope Instability, Debris Flow: The majority of the subject site is relatively flat and level, except for the slopes along the western perimeter of the parcel. It is our understanding that there are no significant slopes proposed as part of the proposed development. Provided the recommendations presented in this report are implemented into the design and construction of the anticipated development, rockfalls, landslides, slope instability, and debris flows are not anticipated to pose a hazard to the subject site.

Seiches: Seiches are large waves generated within enclosed bodies of water. The site is not located in close proximity to any lakes or reservoirs. As such, seiches are not anticipated to pose a hazard to the subject site.

Hydroconsolidation: The near surface soils encountered at the subject site were found to be loose to medium dense. Provided remedial grading recommendations presented in this report are incorporated in the design and construction, hydroconsolidation is not anticipated to be a significant concern for the subject site.

SITE COEFFICIENT

The site class, per Table 1613.5.2, 2019 CBC, is based upon the site soil conditions. It is our opinion that a Site Class D is appropriate for building design at this site. For seismic design of the structures, in accordance with the seismic provisions of the 2019 CBC, we recommend the following parameters with the assumption that Equivalent Lateral Force Method would be used for calculating the seismic forces by the Structural Engineer. If other method is prefer over the ELF, a Site Specific study would be required:

2019 CALIFORNIA BUILDING CODE		
Seismic Item	**Value**	**CBC Reference**
Site Class	D	Table 1613.5.2
Fa	1.077	Table 1613.5.3 (1)
Ss	1.058	Figure 1613.5 (3)
SMS	1.139	Section 1613.5.3
SDS	0.759	Section 1613.5.4
Fv	1.939	Table 1613.5.3 (2)
S1	0.361	Figure 1613.5 (4)
SM1	0.700	Section 1613.5.3
SD1	0.467	Section 1613.5.4
Peak Horizontal Acceleration	0.531 g	
Ts	0.615	

FIELD AND LABORATORY INVESTIGATIONS

As previously noted, six (6) borings were drilled at the subject site as part of a previous Geotechnical Engineering Investigation Report. These boring were drilled to depths ranging from 20 to 50 feet below existing site grades. As part of this investigation, subsurface soil conditions were explored by drilling three (3) additional borings using a truck-mounted drill rig to a depth of approximately 20 feet below existing site grade. The borings were drilled using hollow stem augering equipment. In addition, bulk subgrade soil samples were also obtained for laboratory testing. The approximate boring and bulk sample locations are shown on the Site Plan, Figure 2. These approximate boring and sample locations were estimated in the field based on pacing and measuring from the limits of existing site features. During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsurface soils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System. A more detailed description of the field investigation is presented in Appendix A.

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory-testing program was formulated with emphasis on the evaluation of natural in-situ moisture and density, gradation, R-Value, maximum dry density, resistivity, pH value, sulfate and chloride contents of the materials encountered. Details of the laboratory-testing program are discussed in Appendix A. The results of the laboratory tests are presented on the boring logs or on the test reports, which are also included in Appendix A. This information, along with the field observations, was used to prepare the final boring logs in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

Based on the previous studies conducted on the subject site as well as conditions encountered during the recent site investigation, the subsurface soil conditions encountered at the boring locations consisted of interbeded layers of medium dense to very dense silty sand with varying gravel content to depths of up to 47 feet below existing site grades. Very dense gravelly sand was encountered from a depth of approximately 47 feet to the maximum depth explored, 50 feet below existing site grade. Field and laboratory tests suggest that these soils are moderately strong and slightly compressible. Penetration resistance, measured by the number of blows required to drive a Modified California sampler or a Standard Penetration Test (SPT) sampler, ranged from 13 blows per foot to greater than 50 blows per foot. Dry densities ranged from approximately 116 to 127 pcf. Representative samples of the near surface soil were tested and found to have angles of internal friction of 30 and 31 degrees.

The above is a general description of soil conditions encountered at the site in the borings drilled for this investigation. For a more detailed description of the soil conditions encountered, please refer to the boring logs in Appendix A.

GROUNDWATER

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Free groundwater was not encountered in any of the borings drilled as part of this investigation. Groundwater is anticipated to exist at depths in excess of 50 feet below site grades.

It should be recognized that water table elevation might fluctuate with time. The depth to groundwater can be expected to fluctuate both seasonally and from year to year. Fluctuations in the groundwater level may occur due to variations in precipitation, irrigation practices at the site and in the surrounding areas, climatic conditions, flow in adjacent or nearby canals, pumping from wells and possibly as the result of other factors that were not evident at the time of our investigation. Therefore, water level observations at the time of our field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report. Long-term monitoring in observation wells, sealed from the influence of surface water, is often required to more accurately define the potential range of groundwater conditions on a site.

SOIL CORROSIVITY

Corrosion tests were performed to evaluate the soil corrosivity to the buried structures. The test results consisted of qualified very corrosive soil with minimum sulfate and chloride contents. A qualified corrosion engineer should review the results. The results are provided below:

Parameter	Results	Test Method
pH Value	7.0	EPA 9045C
Resistivity	960 ohm-cm	CA 643

Sulfate	103 ppm	CA 417
Chloride	307 ppm	CA 422

INFILTRATION TESTING

Estimated infiltration rates were determined using the results of open borehole percolation testing performed at the subject site. The percolation testing indicated that the near surface soils were found to have infiltration rates of approximately 0.30 and 0.51 inch per hour. The infiltration rates have been calculated to reflect vertical infiltration only.

In order to perform the infiltration tests, two borings were drilled to approximately five feet below existing site grades. Infiltration testing was performed at each of the two boring locations. Prior to infiltration testing, approximately four inches of gravel was placed at the bottom of each borehole. The boreholes were pre-soaked prior to testing using clean water. The depth of each borehole was measured at each reading to verify the overall depth. The depth of water in the borehole was measured using a water level indicator or well sounder. Infiltration rates have been calculated using the Inverse Borehole procedures.

Detailed results of the percolation test and resulting infiltration rate are attached in tabular format. The soil infiltration rate is based on tests conducted with clean water. The infiltration rates may vary with time as a result of soil clogging from water impurities.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our field and laboratory investigations, along with previous geotechnical experience in the project area, the following is a summary of our evaluations, conclusions, and recommendations.

ADMINISTRATIVE SUMMARY

Based on the data collected during this investigation, and from a geologic and geotechnical engineering standpoint, it is our opinion that the proposed improvements may be made as anticipated provided that the recommendations presented in this report are considered in the design and construction of the project.

In brief, the subject site and soil conditions appear to be conducive to the development of the project.

The subsurface soil conditions encountered at the boring locations consisted of interbeded layers of medium dense to very dense silty sand with varying gravel content to depths of up to 47 feet below existing site grades. Very dense gravelly sand was encountered from a depth of approximately 47 feet to the maximum depth explored, 50 feet below existing site grade. Groundwater was not encountered in any of the borings drilled as part of this investigation.

To minimize post-construction soil movement and provide uniform support for the buildings, overexcavation and recompaction within the proposed building footprint areas should be performed to a minimum depth of three (3) feet below existing grades or one (1) foot below the bottom of any proposed foundation bearing grades. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The exposed subgrade at the base of the overexcavation should then be scarified, moisture-conditioned as necessary, and compacted. The overexcavation and recompaction should also extend laterally five feet (5') beyond edges of the proposed footings or building limits. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

The limit of grading and the proposed building footprint should be established in the field prior to construction. Additional remedial grading will be required if the building edges exceed the grading limit. The grading envelope should extend to at least five feet beyond the outer edges of the building footprint.

The exterior slabs should be at least 5 inches thick and reinforced with No. 3 rebars at 18 inches on-center, each way. The actual slab on foundation design should be determined by the project structural engineer.

GROUNDWATER INFLUENCE ON STRUCTURES/CONSTRUCTION

Based on our findings and historical records, it is not anticipated that groundwater will rise within the zone of structural influence or affect the construction of foundations and pavements for the project. However, if earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated, "pump," or not respond to densification techniques. Typical remedial measures include: discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

SEISMIC CONSIDERATIONS

Ground Shaking

Although ground rupture is not considered to be a major concern at the subject site, the site will likely be subject to at least one moderate to severe earthquake and associated seismic shaking during its lifetime, as well as periodic slight to moderate earthquakes. Some degree of structural damage due to stronger seismic shaking should be expected at the site, but the risk can be reduced through adherence to seismic design codes.

Soil Liquefaction

Soil liquefaction is a state of soil particle suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events. To evaluate the liquefaction potential of the site, the following items were evaluated:

1) Soil type
2) Groundwater depth
3) Relative density
4) Initial confining pressure
5) Intensity and duration of ground shaking

The site is not located in a liquefaction hazard zone as defined by the State of California. The subsurface conditions encountered at the site consisted of medium dense to very dense silty sand. In addition, groundwater was not encountered to depths of up to 50 feet below the existing site grades. Based on the encountered conditions, liquefaction is not considered to be a concern at the subject site.

One of the most common phenomena during seismic shaking accompanying any earthquake is the induced settlement of loose unconsolidated soils. Based on site subsurface conditions and the moderate to high seismicity of the region, any loose fill materials at the site could be vulnerable to this potential hazard. However, this hazard can be mitigated by following the design and construction recommendations of our Geotechnical Engineering Investigation (over-excavation and rework of the loose soils and/or fill). Based on the moderate penetration resistance measured, the native deposits underlying the surface materials do not appear to be subject to significant seismic settlement.

EARTHWORK

Site Preparation – Clearing and Stripping

General site clearing should include removal of vegetation and existing utilities, structures (footings and slabs); trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. Site stripping should extend to a minimum depth of 2 to 4 inches, or until all organics in excess of 3 percent by volume are removed. Deeper stripping may be required in localized areas. These materials will not be suitable for reuse as Engineered Fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Any excavations that result from clearing operations should be backfilled with Engineered Fill. Krazan & Associates' field staff should be present during site clearing operations to enable us to locate areas where depressions or disturbed soils are present and to allow our staff to observe and test the backfill as it is placed. If site clearing and backfilling operations occur without appropriate observation and testing by a qualified geotechnical consultant, there may be the need to over-excavate the building area to identify uncontrolled fills prior to mass grading of the building pad.

As with site clearing operations, any buried structures encountered during construction should be properly removed and backfilled. The resulting excavations should be backfilled with Engineered Fill.

Overexcavation and Recompaction

To reduce post-construction soil movement and provide uniform support for the proposed buildings, overexcavation and recompaction within the proposed building footprint area and any other shallow foundation bearing areas should be performed to a minimum depth of three (3) feet below existing grades or one (1) foot below the bottom of any proposed foundation bearing grades, whichever is deeper.

Overexcavation should be performed to remove and re-compact the existing fill soils present in the building area. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The exposed subgrade at the base of the overexcavation should then be scarified, moisture-conditioned as necessary, and compacted. The overexcavation and recompaction should also extend laterally five feet (5') beyond edges of the proposed footings or building limits. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

Within the proposed exterior flatwork and pavement areas, the overexcavation and recompaction should be performed to a depth of at least 12 inches below existing grade or finished subgrade, whichever is deeper. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation.

It is our understanding based on discussions with the project representatives, the landscape wall located at the rear of the site may be left in place and covered as part of the rough grading activities proposed at the subject site. In the event that the existing wall is left in place, near improvements should be set back from the zone of influence impacted be the existing wall. Based on review of the proposed conceptual site plans, however, it appears as though the existing wall could be removed as part of the rough grading activities.

Fill Placement

Prior to placement of fill soils, the upper 8 inches of native subgrade soils should be scarified, moisture-conditioned to slightly above optimum moisture-content, and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM D1557 Test Method. Fill material should be compacted to a minimum of 95 percent of the maximum dry density based on ASTM D1557 Test Method.

The over-excavated native silty sand soils are generally suitable for use as Engineered Fill provided that they are free of organic material, debris and cobbles over 4 inches. Fill material should be compacted to a minimum of 95 percent of maximum dry density based on ASTM D1557 Test Method.

The upper soils, during wet winter months, may become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

ENGINEERED FILL

The organic-free, on-site, native soils are predominately silty sands. These soils will be suitable for reuse as Engineered Fill, provided they are cleared of excessive organics and debris.

The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the contractor, since he has complete control of the project site at that time.

Imported Fill material should be predominately non-expansive granular material. This material should be approved by the Geotechnical Engineer prior to use and should typically possess the following characteristics:

NON-EXPANSIVE FILL PROPERTIES	
Percent Passing No. 200 Sieve	10 to 50
Plasticity Index (PI)	12 maximum
Liquid Limit	35 maximum
UBC Standard 29-2 Expansion Index	20 maximum

Imported Fill should be free from rocks and clods greater than 4 inches in diameter. All Imported Fill material should be submitted to the Soils Engineer for approval at least 48 hours prior to delivery at the site. Fill soils should be placed in lifts approximately 6 inches thick, moisture-conditioned to near optimum moisture-content, and compacted to achieve at least 95 percent of maximum dry density as determined by ASTM D1557 Test Method. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

FOUNDATION

The proposed structures may be supported on a shallow foundation system bearing on a minimum of one (1) foot of newly placed Engineered Fill. Spread and continuous footings can be designed for the following maximum allowable soil bearing pressures:

Load	Allowable Loading
Dead Load Only	1,750 psf
Dead-Plus-Live Load	2,300 psf
Total Load, including wind or seismic loads	3,000 psf

The footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is deeper. Minimum footing widths should be 15 inches for continuous footings and 24 inches for isolated footings. The footing excavations should not be allowed to dry out any time prior to pouring concrete.

It is recommended that the foundation for the proposed structure should be entirely within compacted fill materials or entirely within alluvium or bedrock. Footings shall not transition from one bearing material to another. It is recommended that all footings should be cleared of all loose soil and construction debris prior to pouring concrete.

It is recommended that all foundations should contain steel reinforcement of at least two (2) number four (#4) bars, one (1) top and one (1) bottom.

It is recommended that all foundations should be set back a minimum of five (5) feet from the top of all and all adjacent slopes or deepened to maintain at least five (5) feet between the bottom of the footing and the slope face. Additionally, all footing set back criteria, except for the minimum set back prescribed above, should conform to 2019 CBC Section 1805.3.2 and Figure 1805.3.1.

SETTLEMENT

Provided the site is prepared as recommended and that the foundations are designed and constructed in accordance with our recommendations, the static settlement due to foundation loads is not expected to exceed 1 inch. The differential settlement is anticipated to be less than ½ inch in 30 feet. Most of the settlement is expected to occur during construction as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated.

LATERAL LOAD RESISTANCE

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.30 acting between the base of foundations and the supporting subgrade. Where a vapor barrier material is used below concrete slabs-on-grade, a coefficient of friction should be provided by the vapor barrier manufacturer. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot acting against the appropriate vertical footing faces. Where equivalent fluid pressure against the sides of the footings or embedded slab edge are to be used, the footing or slab edge must be cast directly against undisturbed soils or the soils surrounding the structure must be recompacted to the requirements for Engineered Fill presented above. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A one-third increase in the value above may be used for short duration, wind, or seismic loads.

FLOOR SLABS AND EXTERIOR FLATWORK

The interior slabs on grade minimum should be designed at least five inches (5") in thickness. It is recommended that the slabs should be reinforced with number three (#3) bars, eighteen inches (18") on center in both directions.

The exterior slabs on grade should be designed at least five inches (5") in thickness. It is recommended that the slabs should be reinforced with number three (#3) bars, eighteen inches (18") on center in both directions.

The exterior floors should be poured separately in order to act independently of the walls and foundation system. All fills required to bring the building pads to grade should be Engineered Fills.

It is recommended that the slabs should be underlain by a minimum of two inches (2") of clean sand on top of a minimum 15 mil polyolefin membrane vapor barrier (i.e. Stego Wrap or equivalent). The vapor barrier and sand should be placed on top of a minimum of six inches (6") of compacted aggregate base.

Moisture within the structure may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor can travel through the vapor membrane and penetrate the slab-on-grade. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structure. To minimize moisture vapor intrusion, it is recommended that a vapor retarder be installed in accordance with ASTM guidelines. It is recommended that the utility trenches within the structure be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed. In addition, ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

RETAINING WALLS

For retaining walls with level ground surface behind the walls, we recommend that retaining walls capable of deflecting a minimum of 0.1 percent of its height at the top be designed using an equivalent fluid active pressure of 40 pounds per square foot per foot of depth. Walls that are incapable of this deflection or walls that are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure of 60 pounds per square foot per foot of depth. A passive lateral pressure of 240 pounds per square foot may be used to calculate sliding resistance. If walls are to be constructed above descending slopes, our office should be contacted to discuss further reduction in allowable passive pressures for resistance of lateral forces, and for overall retaining wall foundation design.

It is our understanding based on discussions with the project representatives, the landscape wall located at the rear of the site may be left in place and covered as part of the rough grading activities proposed at the subject site. In the event that the existing wall is left in place, near improvements should be set back from the zone of influence impacted be the existing wall. Proposed foundations should be set back at a projection of 1:1 from the proposed foundation to the existing wall left in place. In the event that improvement s are left in place, structural elements should not be planned above the improvements left in place. Based on review of the proposed conceptual site plans, however, it appears as though the existing wall could be removed as part of the rough grading activities.

The surcharge effect from loads adjacent to walls should be included in the wall design. The surcharge load for walls capable of deflecting (cantilever walls), we recommend applying a uniform surcharge pressure equal to one-third of the applied load over the full height of the wall. Where walls are restrained the surcharge load should be based on one-half of the applied load above the wall, also distributed over the full height of the wall. For other surcharges, such as from adjacent foundations, point loads or line loads, Krazan & Associates should be consulted.

A traffic surcharge of 250 psf is recommended for construction traffic adjacent to retaining structures. For the surcharge load for walls capable of deflecting (cantilever walls), we recommend applying a uniform surcharge pressure over the full height of the wall.

To simulate the effect of earthquake loading on retaining walls, the walls may be evaluated based on an active lateral soil pressure calculated using an equivalent fluid weight of 42 pounds per cubic foot plus a horizontal seismic surcharge line force of 36H pounds per square foot of wall. The resultant of the lateral soil pressure should be applied at H/3 above the wall base and the resultant of the seismic surcharge force should be applied at a height of 0.6H above the wall base. For the purpose of this report, "H" is defined as the vertical height from the base of the wall to the ground surface above.

Expansive soils should not be used for backfill against walls. The zone of non-expansive backfill material should extend from the bottom of each retaining wall laterally back a distance equal to the height of the wall, to a maximum of five (5) feet.

The active and at-rest earth pressures do not include hydrostatic pressures. To reduce the build-up of hydrostatic pressures, drainage should be provided behind the retaining walls. Wall drains should consist of a minimum 12-inch wide zone of drainage material, such as ¾-inch by ½-inch drain rock wrapped in a non-woven polypropylene geotextile filter fabric such as Mirafi 140N or equivalent. Alternatively, drainage may be provided by the placement of a commercially produced composite drainage blanket, such as Miradrain, extending continuously up from the base of the wall. The drainage material should extend from the base of the wall to finished subgrade in paved areas and to within about 12 inches below the top of the wall in landscape areas. In landscape areas the top 12 inches should be backfilled with compacted native soil. A 4-inch minimum diameter, perforated, Schedule 40 PVC drain pipe should be placed with holes facing down in the lower portion of the wall drainage material, surrounded with drain rock wrapped in filter fabric. A solid drainpipe leading to a suitable discharge point should provide drainage outlet. As an alternative, weep holes may be used to provide drainage. If weep holes are used, the weep holes should be 3 inches in diameter and spaced about 8 feet on centers. The backside of the weep holes should be covered with a corrosion-resistant mesh to prevent loss of backfill and/or drainage material.

TEMPORARY EXCAVATION STABILITY

All excavations should comply with the current requirements of Occupational Safety and Health Administration (OSHA). All cuts greater than 5 feet in depth should be sloped or shored. Temporary excavations should be sloped at 1:1 (horizontal to vertical) or flatter, up to a maximum depth of 10 feet, and at 2:1 (horizontal to vertical) for depths greater than 10 feet. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within five feet of the top (edge) of the excavation. Where sloped excavations are not feasible due to site constraints, the excavations may require shoring. The design of the shoring system is normally the responsibility of the contractor or shoring designer, and therefore, is outside the scope of this report. The design of the temporary shoring should take into account lateral pressures exerted by the adjacent soil, and, where anticipated, surcharge loads due to adjacent buildings and any construction equipment or traffic expected to operate alongside the excavation.

The excavation/shoring recommendations provided herein are based on soil characteristics derived from our test borings within the area. Variations in soil conditions will likely be encountered during the excavations. Krazan & Associates, Inc. should be afforded the opportunity to provide field review to evaluate the actual conditions and account for field condition variations, not otherwise anticipated in the preparation of this recommendation.

UTILITY TRENCH LOCATION, CONSTRUCTION AND BACKFILL

To maintain the desired support for existing or new foundations, new utility trenches should be located such that the base of the trench excavation is located above an imaginary plane having an inclination of 1.0 horizontal to 1.0 vertical, extending downward from the bottom edge of the adjacent footing.

Utility trenches should be excavated according to accepted engineering practices following OSHA standards by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be kept to a minimum; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation. For purposes of this section of the report, backfill is defined as material placed in a trench starting one foot above the pipe; bedding and shading (also referred to as initial backfill) is all material placed in a trench below the backfill. With the exception of specific requirements of the local utility companies or building department, pipe bedding and shading should consist of clean medium-grained sand. The sand should be placed in a damp state and should be compacted by mechanical means prior to the placement of backfill soils. Above the pipe zone, underground utility trenches may be backfilled with either free-draining sand, on-site soil or imported soil. The trench backfill should be compacted to at least 95 percent relative compaction.

COMPACTED MATERIAL ACCEPTANCE

Compaction specifications are not the only criteria for acceptance of the site grading or other such activities. However, the compaction test is the most universally recognized test method for assessing the performance of the Grading Contractor. The numerical test results from the compaction test cannot be solely used to predict the engineering performance of the compacted material. Therefore, the acceptance of compacted materials will also be dependent upon the moisture-content and the stability of that material. The Geotechnical Engineer has the option of rejecting any compacted material regardless of the degree of compaction if that material is considered to be too dry or excessively wet, unstable or if future instability is suspected. A specific example of rejection of fill material passing the required percent compaction is a fill which has been compacted with in-situ moisture-content significantly less than optimum moisture. Where expansive soils are present, heaving of the soils may occur with the introduction of water. Where the material is a lean clay or silt, this type of dry fill (brittle fill) is susceptible to future settlement if it becomes saturated or flooded.

SURFACE DRAINAGE AND LANDSCAPING

The ground surface should slope away from building pad and pavement areas toward appropriate drop inlets or other surface drainage devices. In accordance with Section 1804 of the 2019 California Building Code, it is recommended that the ground surface adjacent to foundations be sloped a minimum of 5 percent for a minimum distance of 10 feet away from structures, or to an approved alternative means of drainage conveyance. Swales used for conveyance of drainage and located within 10 feet of foundations should be sloped a minimum of 2 percent. Impervious surfaces, such as pavement and exterior concrete flatwork, within 10 feet of building foundations should be sloped a minimum of 2 percent away from the structure. Drainage gradients should be maintained to carry all surface water to collection facilities and off-site. These grades should be maintained for the life of the project.

PAVEMENT DESIGN

Based on the established standard practice of designing flexible pavements in accordance with State of California Department of Transportation (Caltrans) for projects within California, we have developed pavement sections in accordance with the procedure presented in Caltrans Standard Test Method 301. This pavement design procedure is based on the volume of traffic (Traffic Index) and the soil resistance "R" Value (R-Value).

Asphalt Concrete (Flexible) Pavements

One (1) near-surface soil sample was obtained from the soil borings at the project site for laboratory R-Value testing. The sample was tested in accordance with California Test 301. Results of the test are as follows:

R-VALUE TEST RESULTS			
Sample Number	**Sample Depth (ft)**	**Description**	**R-Value at Equilibrium**
RV #1(B-1)	0' – 5'	Silty Sand	30

Based on a review of the boring logs and the R-Value data presented above, the near surface soil of the site consists of mostly dense to very dense, medium to fine grained, silty sand. Based on the variability of the soil encountered, an R-Value of 30 has been used for flexible pavement design. If site grading exposes soil other than that assumed, we should perform additional tests to confirm or revise the recommended pavement sections for actual field conditions. Various alternative pavement sections based on the Caltrans Flexible Pavement Design Method are presented below:

ASPHALT CONCRETE (FLEXIBLE) PAVEMENTS Subgrade R-Value = 30			
Traffic Index	**Asphalt Concrete (inches)**	**Class 2 Aggregate Base (inches)**	**Depth of Compacted Subgrade (in)**
4.0	2.0	6.0	12.0
4.5	2.5	6.0	12.0
5.0	2.5	7.0	12.0
5.5	3.0	7.0	12.0
6.0	3.0	9.0	12.0
6.5	3.5	9.0	12.0
7.0	4.0	10.0	12.0
7.5	4.0	11.0	12.0
8.0	4.5	12.0	12.0

We recommend that the subgrade soil be prepared as discussed in this report. The compacted subgrade should be non-yielding when proof-rolled with a loaded ten-wheel truck, such as a water truck or dump truck, prior to pavement construction. Subgrade preparation should extend a minimum of 2 feet laterally behind the edge of pavement or back of curbs.

Pavement areas should be sloped and drainage gradients maintained to carry all surface water off the site. A cross slope of 2 percent is recommended in asphalt concrete pavement areas to provide good surface drainage and to reduce the potential for water to penetrate into the pavement structure.

Unless otherwise required by local jurisdictions, paving materials should comply with the materials specifications presented in the Caltrans Standard Specifications Section. Class 2 Aggregate should comply with the materials requirements for Class 2 Base found in Section 26.

The mineral aggregate shall be Type B, ½-inch or ¾-inch maximum, medium grading, for the wearing course and ¾-inch maximum, medium grading for the base course, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The asphalt concrete materials should comply with and be placed in accordance with the specifications presented in Section 39 of the Caltrans Standard Specifications, latest edition. Asphalt concrete should be compacted to a minimum of 95 percent of the maximum laboratory compacted (kneading compactor) unit weight.

ASTM Test procedures and should be used to assess the percent relative compaction of soils, aggregate base and asphalt concrete. Aggregate base and sub-base, and the upper 12 inches of subgrade should be compacted to at least 95 percent based on the Modified Proctor maximum compacted unit weight obtained in accordance with ASTM Test Method D1557. Compacted aggregate base should also be stable and unyielding when proof-rolled with a loaded ten-wheel water truck or dump truck.

Portland Cement Concrete (Rigid) Pavement

A five-inch layer of compacted Class 2 Aggregate Base should be placed over the prepared subgrade prior to placement of the concrete. With the addition of the aggregate base material, we recommend that in the rigid pavement is to be designed by a Structural Engineer.

RIGID PAVEMENT			
Traffic Index	**Portland Cement Concrete (inches)**	**Class 2 Aggregate Base (inches)**	**Compacted Subgrade (inches)**
5.0	5.0	6.0	12.0
7.0	6.0	6.0	12.0

The concrete pavements should be designed with both longitudinal and transverse joints. The saw-cut or formed joints should extend to a minimum depth on one-fourth of the pavement thickness plus ¼ inch. Joint spacing should not exceed 15 feet. Steel reinforcement of all rigid pavements is recommended to keep the joints tight and to control temperature cracking.

Keyed joints are recommended at all construction joints to transfer loads across the joints. Joints should be reinforced with a minimum of ½ inch diameter by 48-inch long deformed reinforcing steel placed at mid-slab depth on 18-inch center-to-center spacing to keep the joints tight for load transfer. The joints should be filled with a flexible sealer. Expansion joints should be constructed only where the pavements abut structures or fixed objects.

Smooth bar dowels, with a diameter of d/8, where d equals the thickness of the concrete, at least 14 inches in length, placed at a spacing of 12 inches on centers, may also be considered for construction joints to transfer loads across the joints. The dowels should be centered across the joints with one side of the dowel lubricated to reduce the bond strength between the dowel and the concrete and fitted with a plastic cap to allow for bar expansion.

SOIL CORROSIVITY

Corrosion tests were performed to evaluate the soil corrosivity to the buried structures. Excessive sulfate or chloride in either the soil or native water may result in an adverse reaction between the cement in concrete and the soil. California Building Code has developed criteria for evaluation of sulfate and chloride levels and how they relate to cement reactivity with soil and/or water. Based on these test results no specific recommendations are considered warranted in order to compensate for sulfate reactivity with the cement. A qualified corrosion engineer should be consulted regarding the corrosion effects of the onsite soils on underground metal utilities.

INFILTRATION TESTING

Infiltration testing was performed at two (2) locations within the proposed infiltration areas located at the subject site. The approximate test locations are identified on the attached site plan. In order to perform these tests, two (2) borings were drilled to a depth of approximately five (5) feet below existing site grades. Infiltration testing has been performed at each of the boring locations. Infiltration testing has been performed using open borehole percolation testing. The infiltration rates have been calculated using the Inverse Borehole procedures.

Prior to infiltration testing, approximately four inches of gravel was placed at the bottom of each borehole. The borehole was pre-soaked prior to testing using clean water. The depth of the borehole was measured at each reading to verify the overall depth. The depth of water in the borehole was measured using a water level indicator or well sounder.

The estimated infiltration rates were determined using the results of open borehole percolation testing at two (2) locations at the subject site. In accordance with the County of San Diego, Infiltration Rate Assessment Methods, infiltration rates have been calculated using the Inverse Borehole procedures. The infiltration rates have been adjusted to reflect vertical flow.

The infiltration testing performed in the near surfaces silty sands of the site indicate infiltration rates of approximately 0.30 and 0.51 inch per hour at a depth of approximately five (5) feet below site grades.

Detailed results of the infiltration testing are included as an attachment to this report. The soil infiltration rates are based on tests conducted with clean water. The infiltration rates may vary with time as a result of soil clogging from water impurities. A factor of safety should be incorporated into the design of the infiltration system to compensate for these factors as determined appropriate by the designer. In addition, routine maintenance consisting of clearing the system of clogged soils and debris should be expected.

ADDITIONAL SERVICES

Krazan & Associates should be retained to review your final foundation and grading plans, and specifications. It has been our experience that this review provides an opportunity to detect misinterpretation or misunderstandings with respect to the recommendations presented in this report prior to the start of construction.

Variations in soil types and conditions are possible and may be encountered during construction. In order to permit correlation between the soil data obtained during this investigation and the actual soil conditions encountered during construction, a representative of Krazan & Associates, Inc. should be present at the site during the earthwork and foundation construction activities to confirm that actual subsurface conditions are consistent with those contemplated in our development of this report. This will allow us the opportunity to compare actual conditions exposed during construction with those encountered in our investigation and to expedite supplemental recommendations if warranted by the exposed conditions. This activity is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

All earthworks should be performed in accordance with the recommendations presented in this report, or as recommended by Krazan & Associates during construction. Krazan & Associates should be notified at least five working days prior to the start of construction and at least two days prior to when observation and testing services are needed. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

The review of plans and specifications, and the observation and testing of earthwork related construction activities by Krazan & Associates are important elements of our services if we are to remain in the role of Geotechnical Engineer-Of-Record. If Krazan & Associates is not retained for these services, the client and the consultants providing these services will be assuming our responsibility for any potential claims that may arise during or after construction.

LIMITATIONS

Geotechnical Engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences advance. Although your site was analyzed using appropriate and current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to advancements in the field of Geotechnical Engineering, physical changes in the site due to site clearing or grading activities, new agency regulations, or possible changes in the proposed structure or development after issuance of this report will result in the need for professional review of this report. Updating or revisions to the recommendations report, and possibly additional study of the site may be required at that time. In light of this, the Owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The logs of the exploratory borings do not provide a warranty as to the conditions that may exist beneath the entire site. The extent and nature of subsurface soil and groundwater variations may not become evident until construction begins. It is possible that variations in soil conditions and depth to groundwater could exist beyond the points of exploration that may require additional studies, consultation, and possible design revisions. If conditions are encountered in the field during construction, which differ from those described in this report, our firm should be contacted immediately to provide any necessary revisions to these recommendations.

This report presents the results of our Geotechnical Engineering Investigation, which was conducted for the purpose of evaluating the soil conditions in terms of foundation and retaining wall design, and grading and paving of the site. This report does not include reporting of any services related to environmental studies conducted to assessment the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere, or the presence of wetlands. Any statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey professional judgment regarding the presence of potentially hazardous or toxic substances. Conversely, the absence of statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, does not constitute our rendering professional judgment regarding the absence of potentially hazardous or toxic substances.

The conclusions of this report are based on the information provided regarding the proposed construction. We emphasize that this report is valid for the project as described in the text of this report and it should not be used for any other sites or projects. The geotechnical engineering information presented herein is based upon our understanding of the proposed project and professional interpretation of the data obtained in our studies of the site. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. The Geotechnical Engineer should be notified of any changes to the proposed project so the recommendations may be reviewed and re-evaluated. The work conducted through the course of this investigation, including the preparation of this report, has been performed in accordance with the generally accepted standards of geotechnical engineering practice, which existed in geographic area of the project at the time the report was written. No other warranty, express or implied, is made. This report is issued with the understanding that the owner chooses the risk they wish to bear by the expenditures involved with the construction alternatives and scheduling that are chosen.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (951) 273-1011.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

James M. Kellogg, PE, GE
Managing Engineer
RCE No. 65092 / GE No. 2902

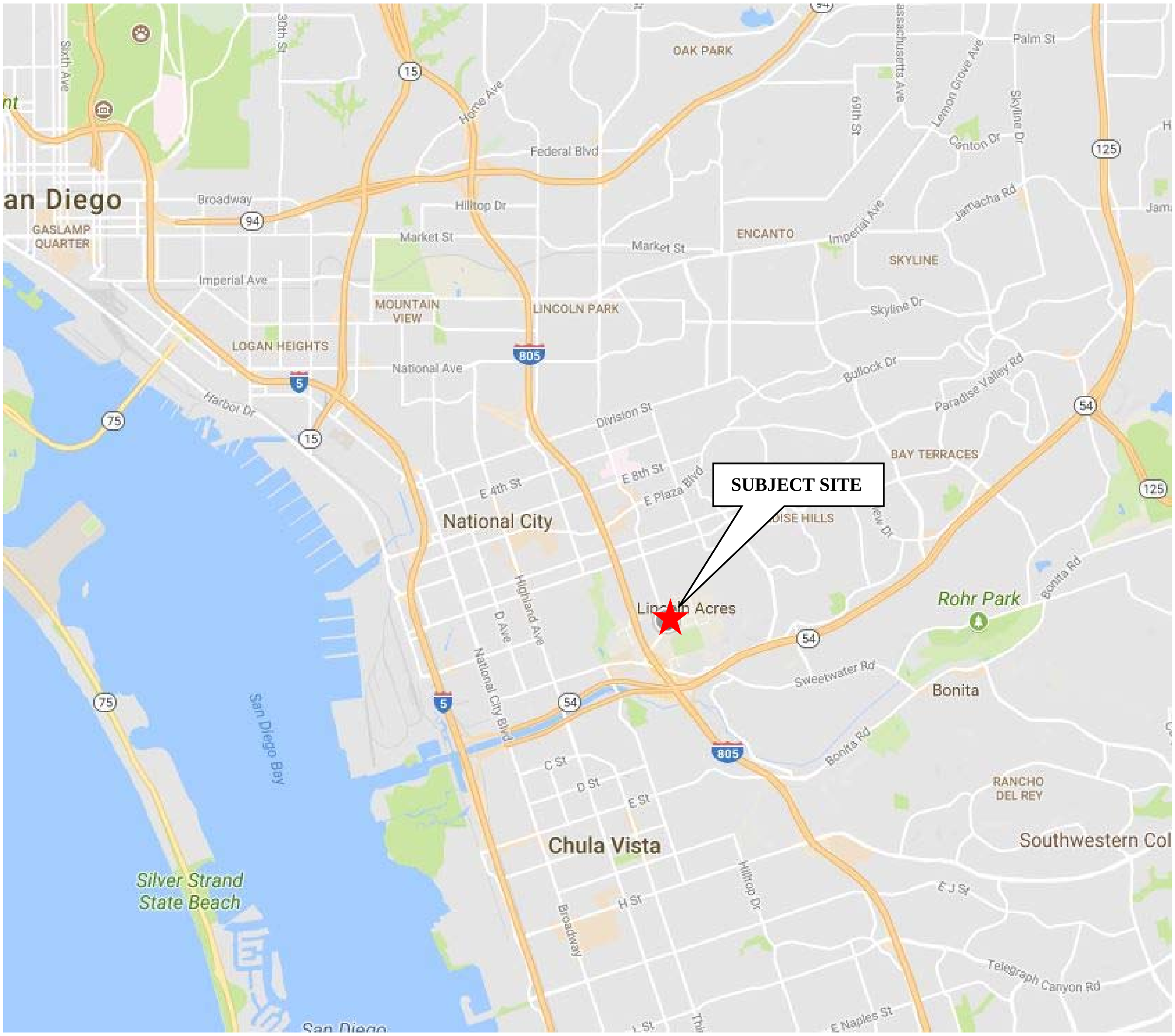
REGISTERED PROFESSIONAL ENGINEER JAMES M. KELLOGG 65092 CIVIL STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER JAMES M. KELLOGG 2902 GEOTECHNICAL STATE OF CALIFORNIA

Jorge A. Pelayo, PE
Project Engineer
RCE No. 91269

REGISTERED PROFESSIONAL ENGINEER JORGE A. PELAYO 91269 CIVIL STATE OF CALIFORNIA

Figures



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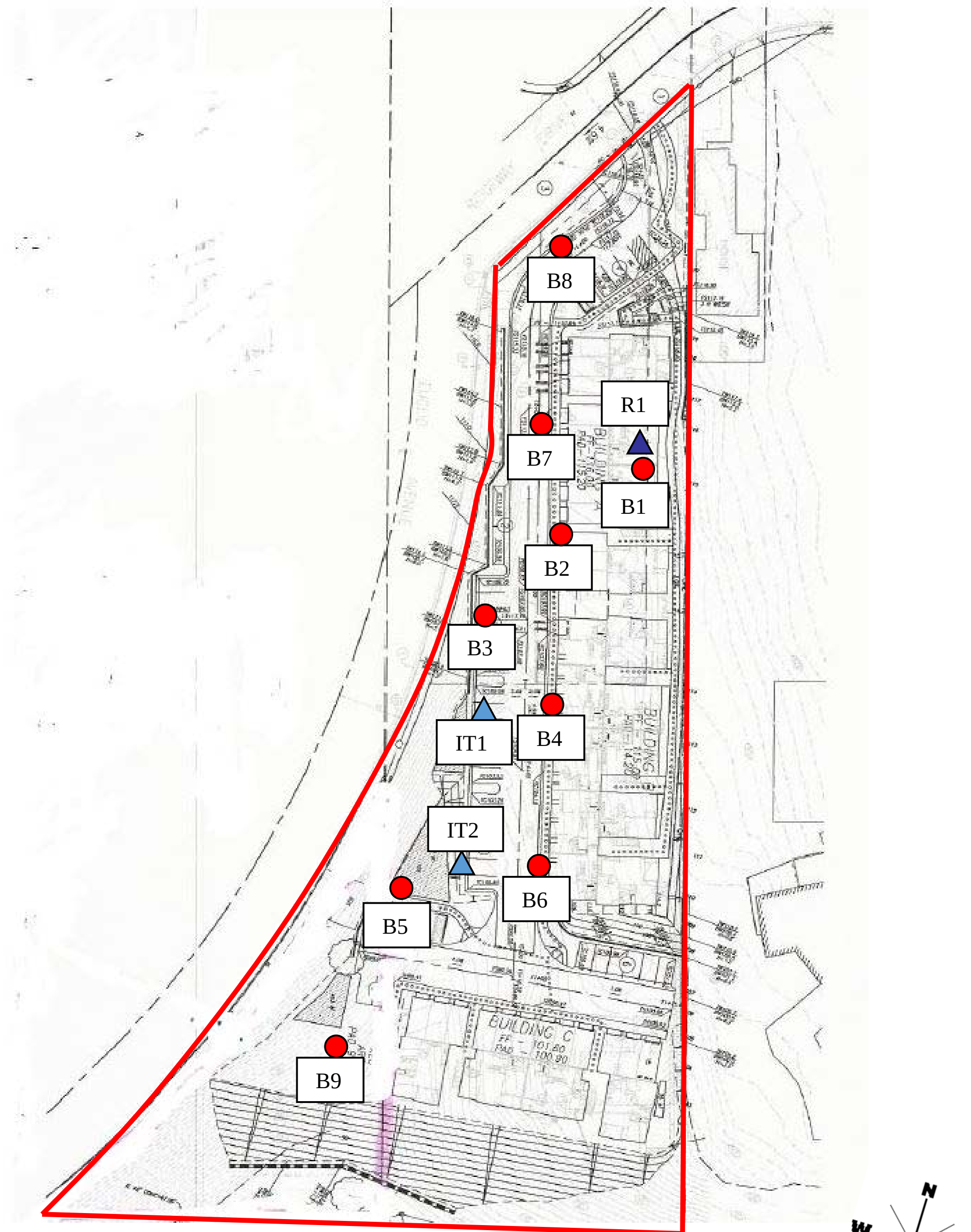
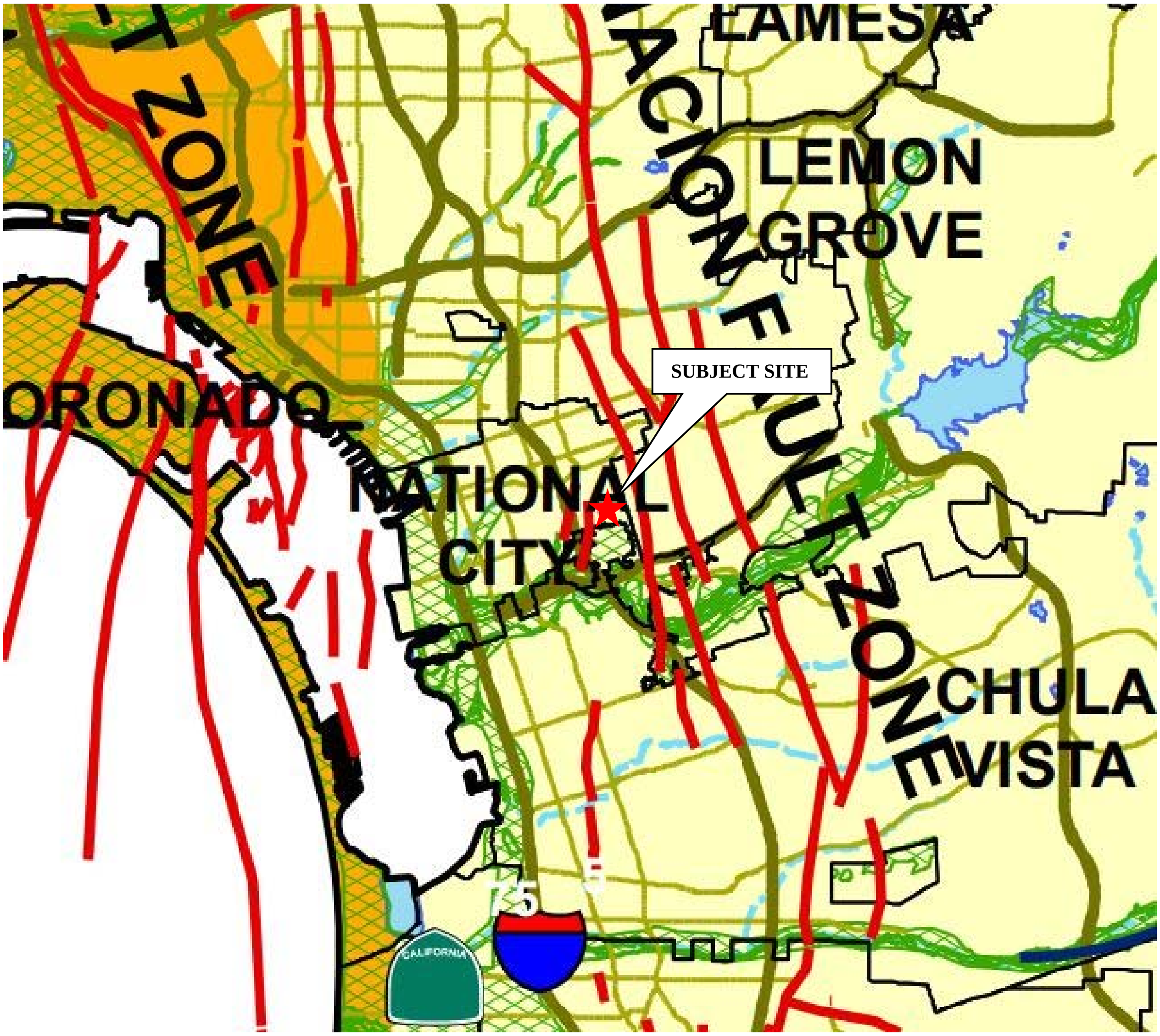
VICINITY MAP	Scale: NTS	Date: February, 2020	Krazan GEOTECHNICAL ENGINEERING
PROPOSED RESIDENTIAL DEVELOPMENT 2542 RIDGEWAY DRIVE NATIONAL CITY, CALIFORNIA	Drawn by: JP	Approved by: JK	
	Project No. 112-20017	Figure No. 1	



- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION LOCATION
- APPROXIMATE R-VALUE LOCATION

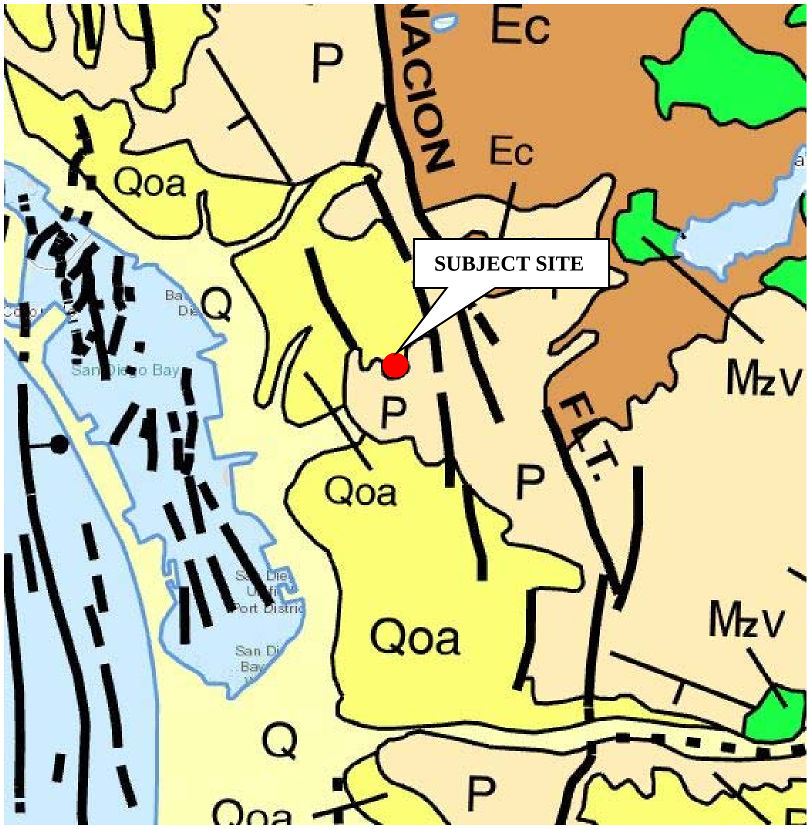
SITE MAP	**Scale:** NTS	**Date:** February, 2020	Krazan GEOTECHNICAL ENGINEERING
PROPOSED RESIDENTIAL DEVELOPMENT 2542 RIDGEWAY DRIVE NATIONAL CITY, CALIFORNIA	**Drawn by:** JP	**Approved by:** JK	
	Project No. 112-20017	**Figure No.** 2	

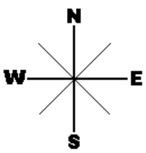


Peak Ground Acceleration (2% in 50 yrs)

- 0.18 - 0.5 (Low Liquefaction Risk)
- 0.51 - 1.60 (High Liquefaction Risk)

LIQUEFACTION: COUNTY OF SAN DIEGO MAP	**Scale:** NTS	**Date:** February, 2020	**Krazan** GEOTECHNICAL ENGINEERING
PROPOSED RESIDENTIAL DEVELOPMENT 2542 RIDGEWAY DRIVE NATIONAL CITY, CALIFORNIA	**Drawn by:** JP	**Approved by:** JK	
	Project No. 112-20017	**Figure No.** 3	





DESCRIPTION OF MAP UNITS

QUATERNARY DEPOSITS

Qs	Extensive marine and nonmarine sand deposits, generally near the coast or desert playas
Q	Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated
Qls	Selected large landslides
Qg	Glacial till and moraines. Found at high elevations mostly in the Sierra Nevada and Klamath Mountains
Qoa	Older alluvium, lake, playa, and terrace deposits
QPc	Pleistocene and/or Pliocene sandstone, shale, and gravels deposits; mostly loosely consolidated

QUATERNARY VOLCANIC ROCKS

Qrv	Recent (Holocene) volcanic flow rocks; minor pyroclastic deposits
Qrv^p	Recent (Holocene) pyroclastic and volcanic mudflow deposits
Qv	Quaternary volcanic flow rocks; minor pyroclastic deposits
Qv^p	Quaternary pyroclastic and volcanic mudflow deposits

PALEOZOIC MIXED ROCKS

m	Undivided pre-Cenozoic metasedimentary and metavolcanic rocks of great variety. Mostly slate, quartzite, hornfels, chert, phyllite, mylonite, schist, gneiss, and minor marble

PALEOZOIC METAVOLCANIC ROCKS

Pzv	Undivided Paleozoic metavolcanic rocks. Mostly flows, breccia, and tuff; includes greenstone, diabase, and pillow lavas; minor interbedded sedimentary rocks

PALEOZOIC PLUTONIC ROCKS

gr^Pz	Paleozoic and Permo-Triassic granitic rocks in the San Gabriel and Klamath Mountains

PRECAMBRIAN ROCKS

p€	Conglomerate, shale, sandstone, limestone, dolomite, marble, gneiss, hornfels, and quartzite; may be Paleozoic in part
p€c	Complex of Pre-cambrian igneous and metamorphic rocks. Mostly gneiss and schist intruded by igneous rocks; may be Mesozoic in part
gr^p€	Precambrian granite, syenite, anorthosite, and gabbroic rocks in the San Gabriel Mountains; also various Precambrian plutonic rocks elsewhere in southeastern California

Source: Department of Conservation: Geologic Map of California, 2010

GEOLOGIC MAP	**Scale:** NTS	**Date:** February, 2020	Krazan GEOTECHNICAL ENGINEERING
PROPOSED RESIDENTIAL DEVELOPMENT 2542 RIDGEWAY DRIVE NATIONAL CITY, CALIFORNIA	**Drawn by:** JP	**Approved by:** JK	
	Project No. 112-20017	**Figure No.** 4	

Log of Borings
&
Laboratory Testing

Appendix A

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

Our field investigation consisted of a surface reconnaissance and a subsurface exploration program consisted of drilling, logging and sampling a total of nine (9) borings. The depths of exploration ranged from approximately 20 feet below the existing site surface.

A member of our staff visually classified the soils in the field as the drilling progressed and recorded a continuous log of each boring. Visual classification of the soils encountered in our exploratory borings was made in general accordance with the Unified Soil Classification System (ASTM D2487). A key for the classification of the soil and the boring logs are presented in this Appendix.

During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsoils. Samples were obtained from the borings by driving either a 2.5-inch inside diameter Modified California tube sampler fitted with brass sleeves or a 2-inch outside diameter, 1-3/8-inch inside diameter Standard Penetration ("split-spoon") test (SPT) sampler without sleeves. Soil samples were retained for possible laboratory testing. The samplers were driven up to a depth of 18 inches into the underlying soil using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler was recorded for each 6-inch penetration interval and the number of blows required to drive the sampler the last 12 inches are shown as blows per foot on the boring logs.

The approximate locations of our borings and bulk samples are shown on the Site Plan, Figure 2. These approximate locations were estimated in the field based on pacing and measuring from the limits of existing site features.

Laboratory Investigation

The laboratory investigation was programmed to determine the physical and mechanical properties of the soil underlying the site. The laboratory-testing program was formulated with emphasis on the evaluation of in-situ moisture, density, gradation, shear strength, consolidation potential, and R-Value of the materials encountered. In addition, chemical tests were performed to evaluate the soil/cement reactivity and corrosivity. Test results were used in our engineering analysis with respect to site and building pad preparation through mass grading activities, foundation and retaining wall design recommendations, pavement section design, evaluation of the materials as possible fill materials and for possible exclusion of some soils from use at the structures as fill or backfill.

Select laboratory test results are presented on the boring logs, with graphic or tabulated results of selected tests included in this Appendix. The laboratory test data, along with the field observations, was used to prepare the final boring logs presented in the Appendix.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
	Clean Gravels (Less than 5% fines)	
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
	Clean Sands (Less than 5% fines)	
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

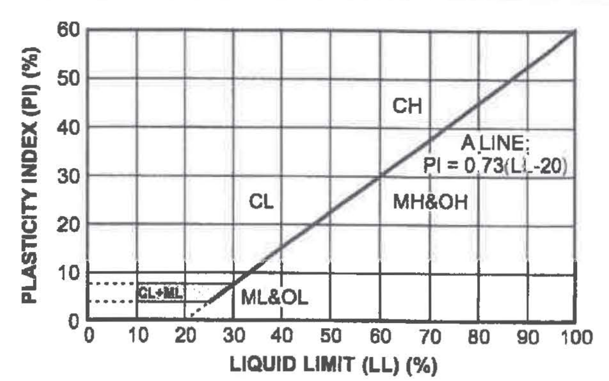
CONSISTENCY CLASSIFICATION

Description	Blows per Foot
Granular Soils	
Very Loose	< 5
Loose	5 – 15
Medium Dense	16 – 40
Dense	41 – 65
Very Dense	> 65
Cohesive Soils	
Very Soft	< 3
Soft	3 – 5
Firm	6 – 10
Stiff	11 – 20
Very Stiff	21 – 40
Hard	> 40

GRAIN SIZE CLASSIFICATION

Grain Type	*Standard Sieve Size*	*Grain Size in Millimeters*
Boulders	Above 12 inches	Above 305
Cobbles	12 to 13 inches	305 to 76.2
Gravel	3 inches to No. 4	76.2 to 4.76
Coarse-grained	3 to ¾ inches	76.2 to 19.1
Fine-grained	¾ inches to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
Coarse-grained	No. 4 to No. 10	4.76 to 2.00
Medium-grained	No. 10 to No. 40	2.00 to 0.042
Fine-grained	No. 40 to No. 200	0.042 to 0.074
Silt and Clay	Below No. 200	Below 0.074

PLASTICITY CHART



■ Standard Penetration Split Spoon Sampler

◪ California Modified Split Spoon Sampler

Log of Boring B1

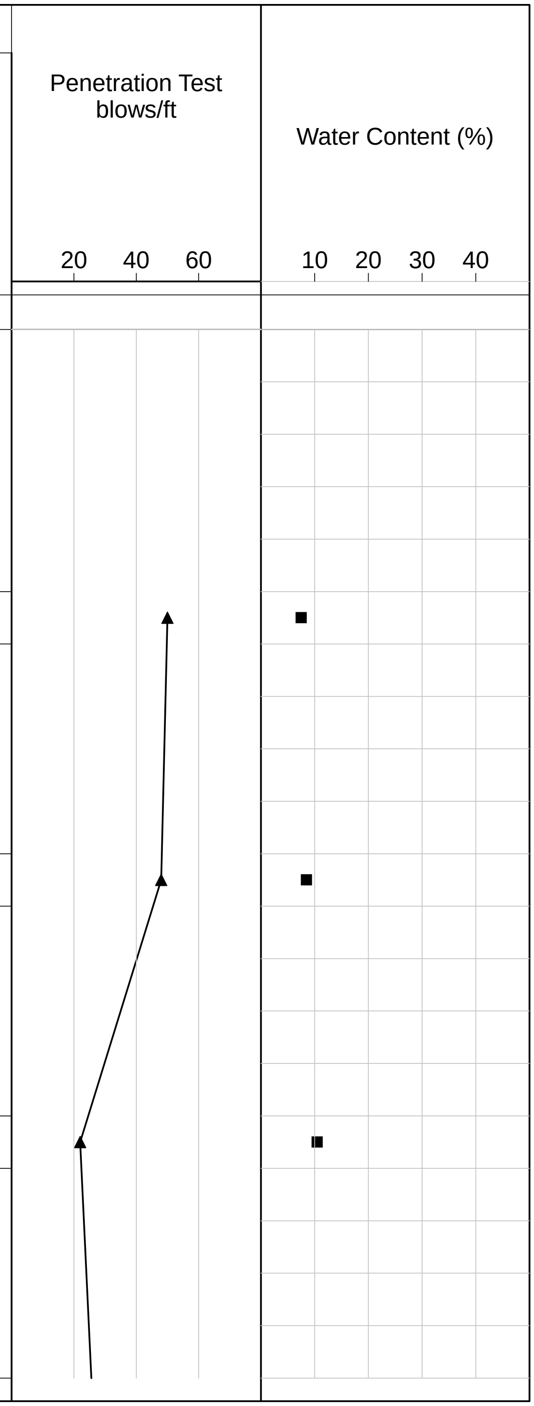
Project: Ridgeway Residential Development
Project No: 112-16114

Client: Blue Centurion Homes, LLC
Figure No.: A-1

Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo

Depth to Water> Not Encountered
Initial: N/A
At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** Very dense, medium- to fine-grained; reddish-brown, damp				
5.5			120.7	7.5		50+
8		***SILTY SAND (SM)*** Medium dense to dense, fine-grained; brown, damp				
10.5			123.7	8.5		48
15.5				10.5		22



Drill Method: Hollow Stem
Drill Date: 10-5-16

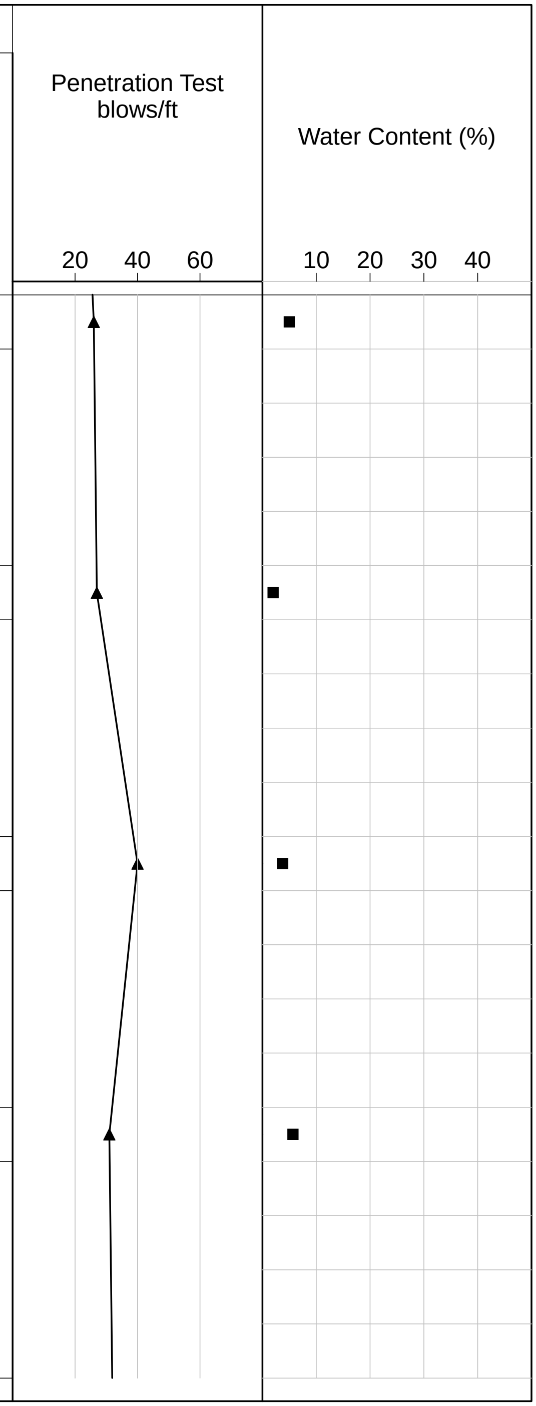
Drill Rig: CME 75
Krazan and Associates
Hole Size: 5½ Inches

Driller: Baja Exploration
Elevation: 50 Feet

Log of Boring B1

Project: Ridgeway Residential Development
Project No: 112-16114
Client: Blue Centurion Homes, LLC
Figure No.: A-1
Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo
Depth to Water> Not Encountered **Initial:** N/A **At Completion:** N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
				5.0		26
22						
24		***SILTY SAND (SM)*** Dense, coarse- to fine-grained with GRAVEL; light brown, dry				
				2.0		27
26						
28						
30				3.8		40
32						
34						
				5.7		31
36						
38						
40						



Drill Method: Hollow Stem
Drill Date: 10-5-16
Drill Rig: CME 75
Krazan and Associates
Hole Size: 5½ Inches
Driller: Baja Exploration
Elevation: 50 Feet

Log of Boring B1

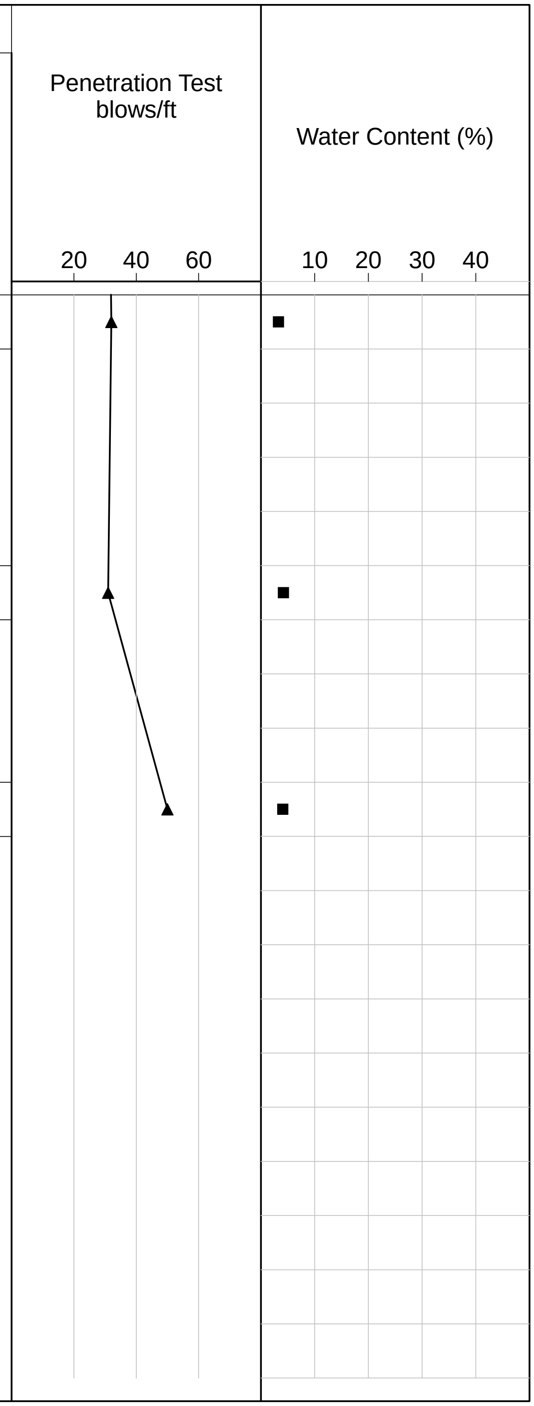
Project: Ridgeway Residential Development
Project No: 112-16114

Client: Blue Centurion Homes, LLC
Figure No.: A-1

Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo

Depth to Water> Not Encountered
Initial: N/A
At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
40–44.5		***SILTY SAND (SM)*** Dense, coarse- to fine-grained; light brown, damp		3.3		32
44.5–47.5		***SILTY SAND (SM)*** Dense, fine-grained; brown, damp		4.2		31
47.5–50		***GRAVELLY SAND (SP)*** Very dense, coarse- to fine-grained with trace CLAY; light brown, damp		4.1		50+
50–60		End of Borehole No water encountered Boring backfilled with soil cuttings				



Drill Method: Hollow Stem
Drill Date: 10-5-16

Drill Rig: CME 75
Krazan and Associates
Hole Size: 5½ Inches

Driller: Baja Exploration
Elevation: 50 Feet

Log of Boring B2

Project: Ridgeway Residential Development
Project No: 112-16114

Client: Blue Centurion Homes, LLC
Figure No.: A-2

Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo

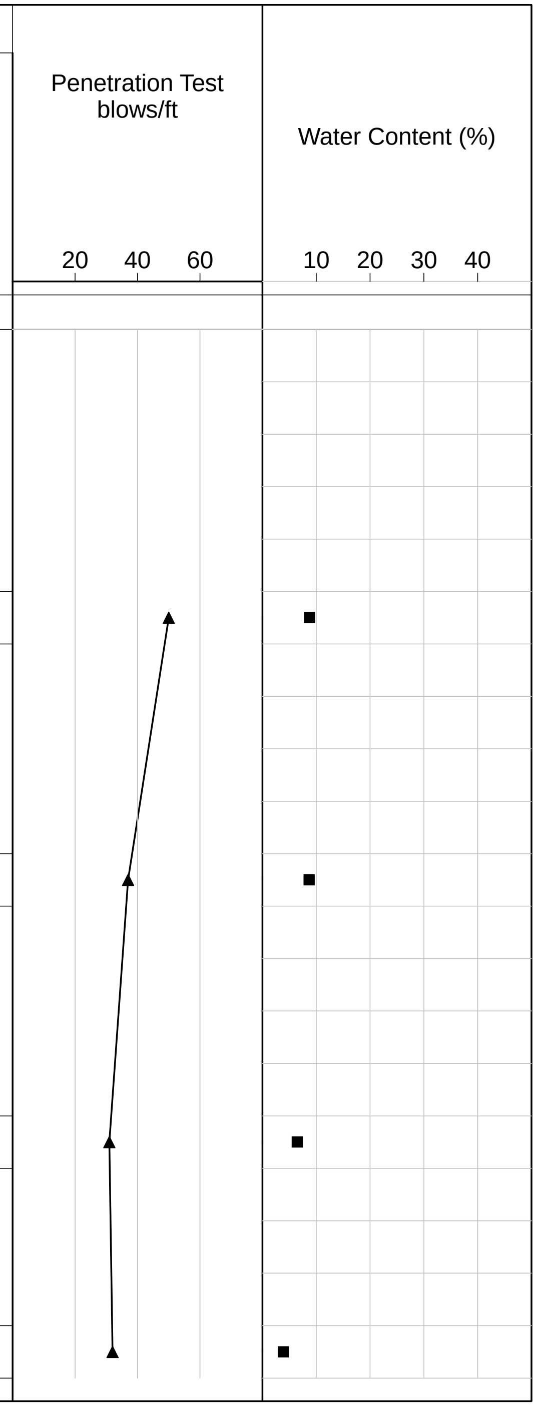
Depth to Water> Not Encountered
Initial: N/A
At Completion: N/A

SUBSURFACE PROFILE

Depth (ft)	Description
0	Ground Surface
0–9.5	***SILTY SAND (SM)*** Very dense, medium- to fine-grained; reddish-brown, moist
9.5–20	***SILTY SAND (SM)*** Dense, fine-grained; brown, moist to damp
	No water encountered Boring backfilled with soil cuttings

SAMPLE

Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
116.3	8.8		50+
119.9	8.7		37
	6.5		31
	3.9		32



Drill Method: Hollow Stem
Drill Date: 10-5-16

Drill Rig: CME 75
Hole Size: 5½ Inches

Krazan and Associates

Driller: Baja Exploration
Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B3

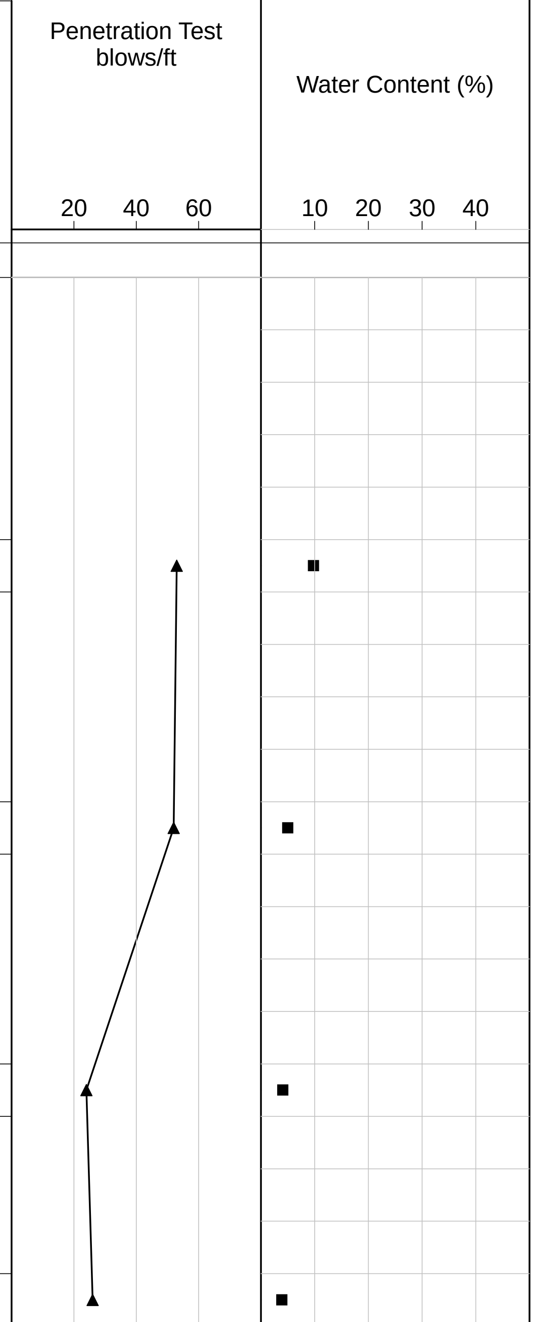
Project: Ridgeway Residential Development | **Project No:** 112-16114

Client: Blue Centurion Homes, LLC | **Figure No.:** A-3

Location: 2542 Ridgeway Drive, National City, CA | **Logged By:** Jorge Pelayo

Depth to Water> Not Encountered | **Initial:** N/A | **At Completion:** N/A

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–7.5		***SILTY SAND (SM)*** Dense, medium- to fine-grained; reddish-brown, moist				
5–6			116.5	9.8		53
7.5–20		***SILTY SAND (SM)*** Meduim dense to dense, fine-grained; brown, moist to damp				
10–11			124.2	5.0		52
15–16				4.1		24
19–20		No water encountered Boring backfilled with soil cuttings		3.9		26



Drill Method: Hollow Stem | **Drill Date:** 10-5-16

Drill Rig: CME 75 | **Hole Size:** 5½ Inches

Driller: Baja Exploration | **Elevation:** 20 Feet

Krazan and Associates

Sheet: 1 of 1

Log of Boring B4

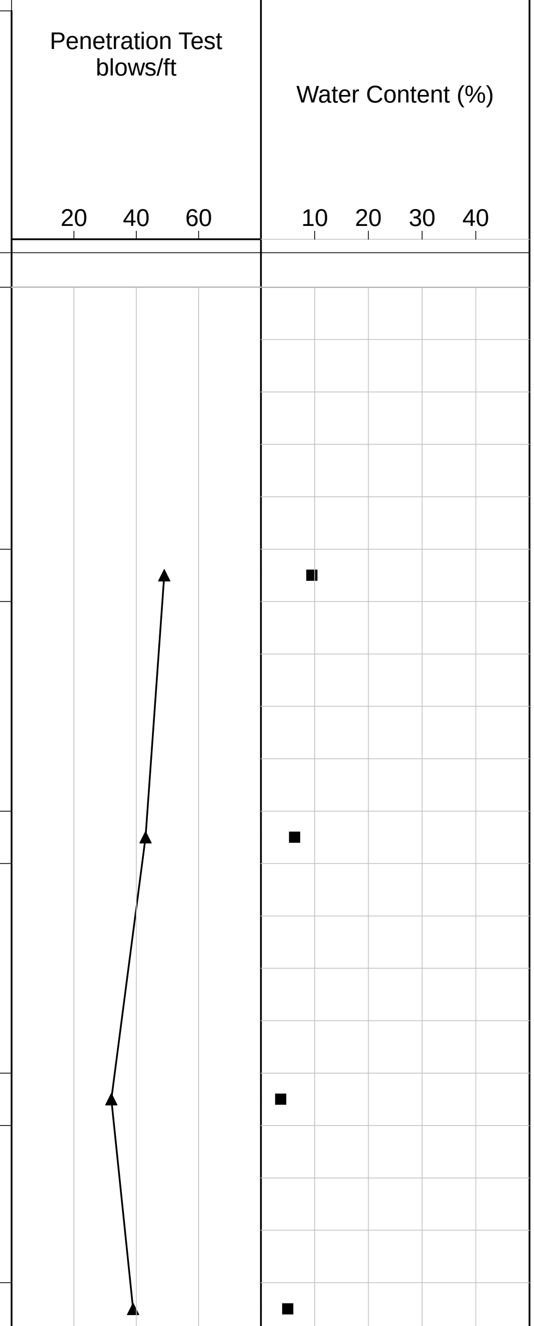
Project: Ridgeway Residential Development | **Project No:** 112-16114

Client: Blue Centurion Homes, LLC | **Figure No.:** A-4

Location: 2542 Ridgeway Drive, National City, CA | **Logged By:** Jorge Pelayo

Depth to Water> Not Encountered | **Initial:** N/A | **At Completion:** N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** Dense, medium- to fine-grained; reddish-brown, moist				
5			121.6	9.5		49
8		***SILTY SAND (SM)*** Dense, fine-grained; brown, moist to damp				
10			126.5	6.3		53
15				3.7		32
19–20		No water encountered Boring backfilled with soil cuttings		5.0		39



Drill Method: Hollow Stem | **Drill Date:** 10-5-16

Drill Rig: CME 75 | **Hole Size:** 5½ Inches

Krazan and Associates

Driller: Baja Exploration | **Elevation:** 20 Feet

Sheet: 1 of 1

Log of Boring B5

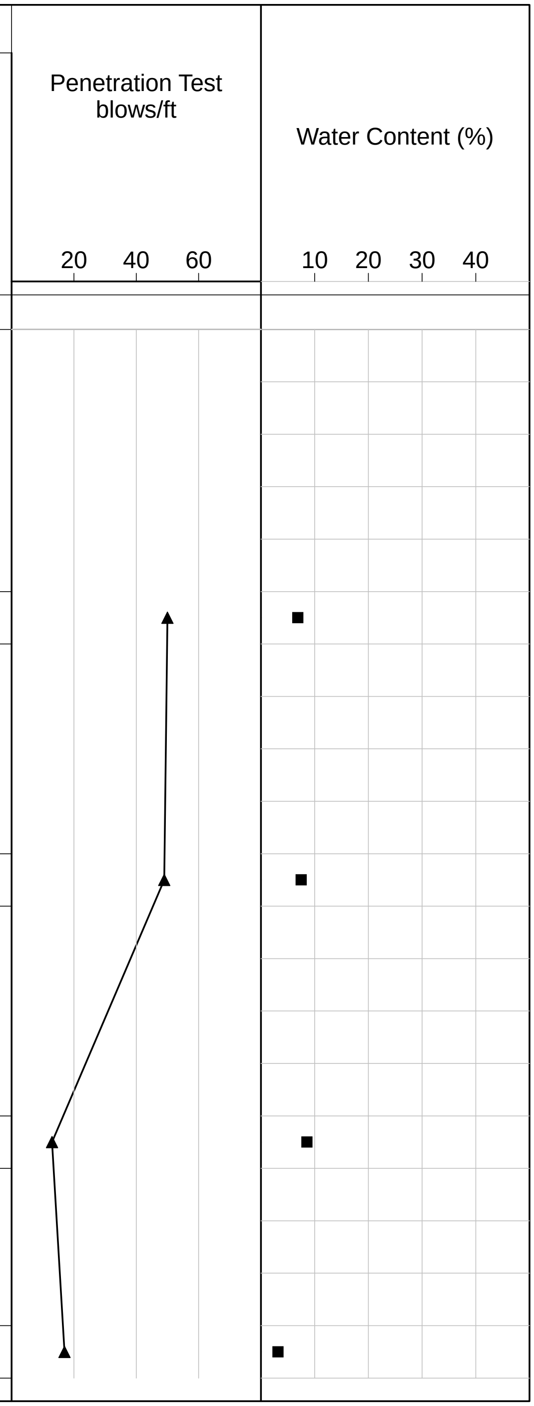
Project: Ridgeway Residential Development
Project No: 112-16114

Client: Blue Centurion Homes, LLC
Figure No.: A-5

Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo

Depth to Water> Not Encountered **Initial:** N/A **At Completion:** N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** Very dense, medium- to fine-grained; reddish-brown, moist				
5.5			121.3	6.9		50+
7.5		***SILTY SAND (SM)*** Dense, fine-grained; brown, moist to damp				
10.5			127.3	7.5		49
15.5				8.6		13
19.5		No water encountered Boring backfilled with soil cuttings		3.2		17
20						



Drill Method: Hollow Stem
Drill Date: 10-5-16

Drill Rig: CME 75
Hole Size: 5½ Inches

Krazan and Associates

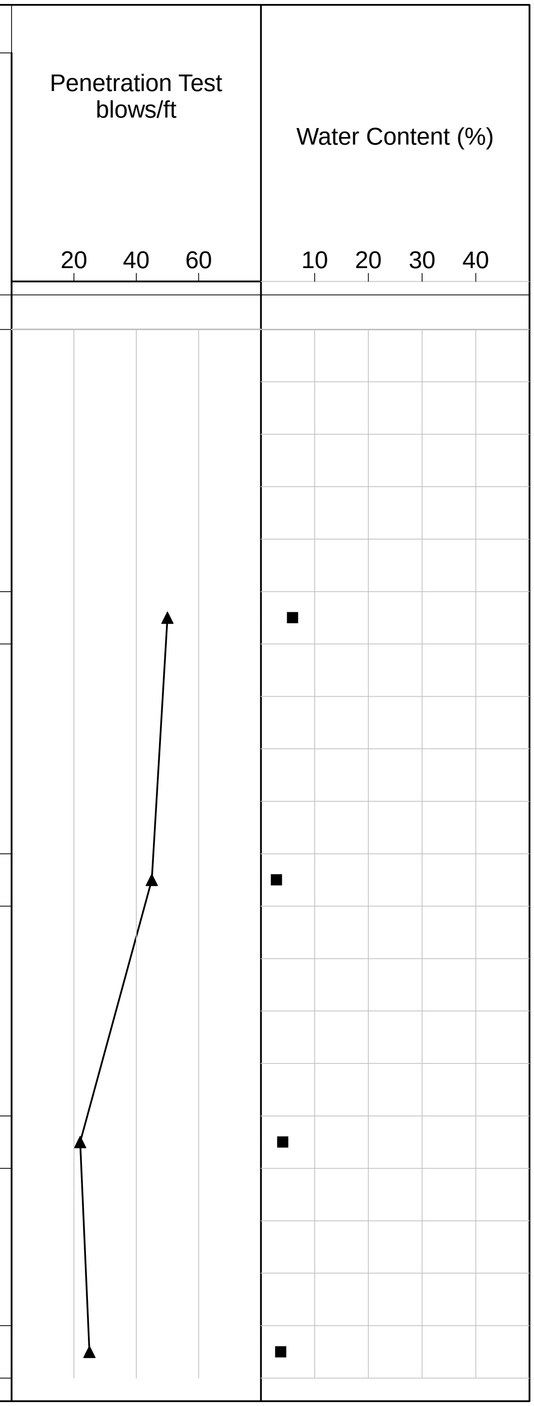
Driller: Baja Exploration
Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B6

Project: Ridgeway Residential Development	**Project No:** 112-16114
Client: Blue Centurion Homes, LLC	**Figure No.:** A-6
Location: 2542 Ridgeway Drive, National City, CA	**Logged By:** Jorge Pelayo
Depth to Water> Not Encountered **Initial:** N/A	**At Completion:** N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** Very dense, medium- to fine-grained; reddish-brown, damp				
~5.5			115.4	5.7		50+
~8.5		***SILTY SAND (SM)*** Dense, fine-grained; brown, moist to damp				
~10.5			126.4	2.7		45
~15.5				4.5		22
~19.5		No water encountered Boring backfilled with soil cuttings		3.0		25
20						



Drill Method: Hollow Stem	**Krazan and Associates**	**Drill Date:** 10-5-16
Drill Rig: CME 75		**Hole Size:** 5½ Inches
Driller: Baja Exploration		**Elevation:** 20 Feet
		Sheet: 1 of 1

Log of Boring B7

Project: Ridgeway Residential Development
Project No: 112-20017

Client: Blue Centurion Homes, LLC
Figure No.: A-7

Location: 2542 Ridgeway Drive, National City, CA
Logged By: Jorge Pelayo

Depth to Water> Not Encountered
Initial: N/A
At Completion: N/A

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	Penetration Test blows/ft (20, 40, 60)	Water Content (%) (10, 20, 30, 40)
		Ground Surface						
0		***SILTY SAND (SM)*** Medium dense to very dense, medium- to fine-grained; reddish-brown, damp to moist						
2								
4								
6			117.9	7.4		50+		
8								
10			123.0	3.4		40		
12								
14								
16				3.6		25		
18		No water encountered Boring backfilled with soil cuttings						
20				3.7		20		

Drill Method: Hollow Stem
Drill Date: 2-14-20

Drill Rig: CME 75
Krazan and Associates
Hole Size: 7½ Inches

Driller: Baja Exploration
Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B8

Project: Ridgeway Residential Development

Project No: 112-20017

Client: Blue Centurion Homes, LLC

Figure No.: A-8

Location: 2542 Ridgeway Drive, National City, CA

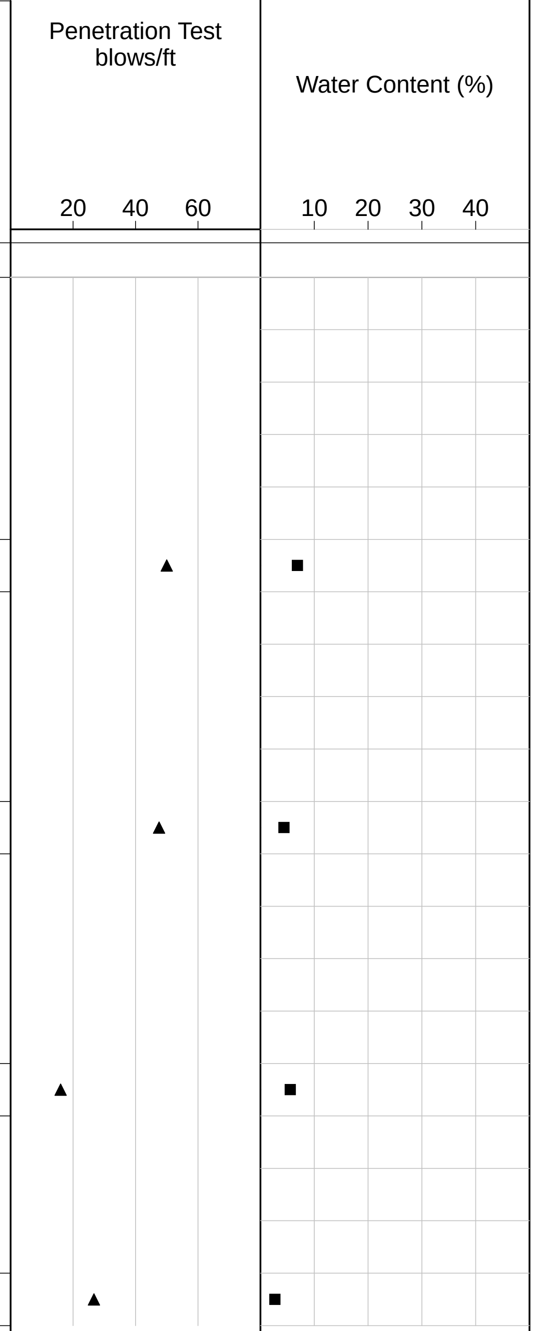
Logged By: Jorge Pelayo

Depth to Water> Not Encountered

Initial: N/A

At Completion: N/A

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** Medium dense to very dense, medium- to fine-grained; reddish-brown, damp to moist				
5–6			120.4	8.4		50+
10–11			126.1	4.6		47
15–16				6.4		16
19–20		No water encountered Boring backfilled with soil cuttings		2.2		27



Drill Method: Hollow Stem

Drill Date: 2-14-20

Drill Rig: CME 75

Krazan and Associates

Hole Size: 7½ Inches

Driller: Baja Exploration

Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B9

Project: Ridgeway Residential Development | **Project No:** 112-20017

Client: Blue Centurion Homes, LLC | **Figure No.:** A-9

Location: 2542 Ridgeway Drive, National City, CA | **Logged By:** Jorge Pelayo

Depth to Water> Not Encountered | **Initial:** N/A | **At Completion:** N/A

SUBSURFACE PROFILE			SAMPLE				Penetration Test blows/ft (20, 40, 60)	Water Content (%) (10, 20, 30, 40)
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.		
		Ground Surface						
0		***SILTY SAND (SM)*** Dense to very dense, medium- to fine-grained; reddish-brown, damp to moist						
~5.5			113.4	7.3		50+	▲	■
~10.5			124.6	6.4		50+	▲	■
~15.5				3.1		33	▲	■
~19.5		No water encountered Boring backfilled with soil cuttings		3.0		38	▲	■
20								

Drill Method: Hollow Stem | **Drill Date:** 2-14-20

Drill Rig: CME 75 | **Krazan and Associates** | **Hole Size:** 7½ Inches

Driller: Baja Exploration | **Elevation:** 20 Feet

Sheet: 1 of 1

Sieve Analysis

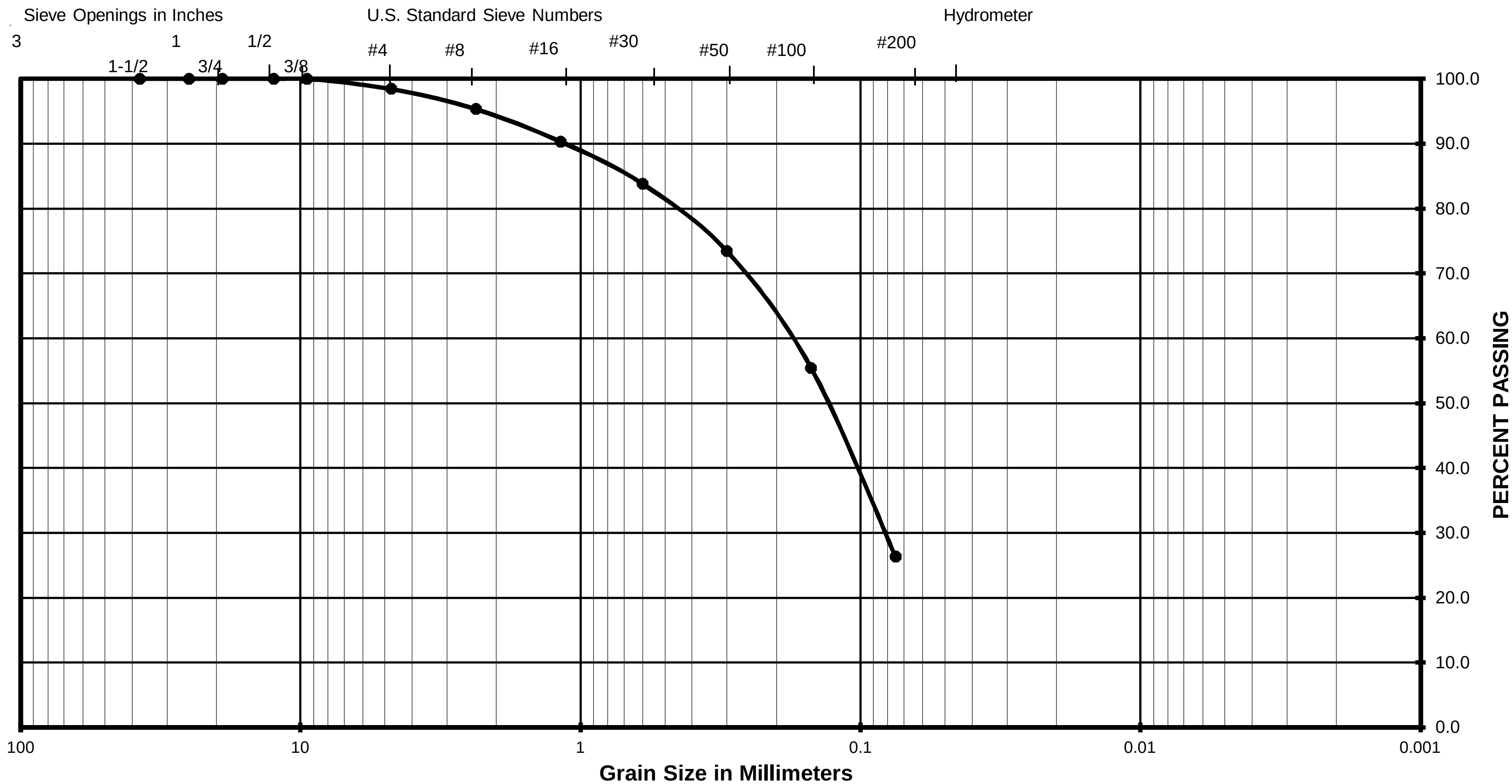
Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : ########
Sample Location : B-1 @ 5'
Soil Classification : SM

Wet Weight	:	531.00
Dry Weight	:	494.10
Moisture Content	:	7%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	7.8	1.6	1.6	98.4
#8	2.36	15.4	3.1	4.7	95.3
#16	1.18	24.6	5.0	9.7	90.3
#30	0.60	32.4	6.6	16.2	83.8
#50	0.30	51.2	10.4	26.6	73.4
#100	0.15	89.0	18.0	44.6	55.4
#200	0.08	143.6	29.1	73.7	26.3

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 5'

Krazan Testing Laboratory

Sieve Analysis

Project Number	:	11216114
Project Name	:	2542 Ridgeway Drive
Date	:	########
Sample Location	:	B-1 @ 10'
Soil Classification	:	SM

Wet Weight	:	546.00
Dry Weight	:	503.40
Moisture Content	:	8%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	5.4	1.1	1.1	98.9
#8	2.36	14.2	2.8	3.9	96.1
#16	1.18	10.0	2.0	5.9	94.1
#30	0.60	19.6	3.9	9.8	90.2
#50	0.30	58.4	11.6	21.4	78.6
#100	0.15	59.6	11.8	33.2	66.8
#200	0.08	145.6	28.9	62.1	37.9

Krazan Testing Laboratory

Grain Size Analysis

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 10'

Krazan Testing Laboratory

Sieve Analysis

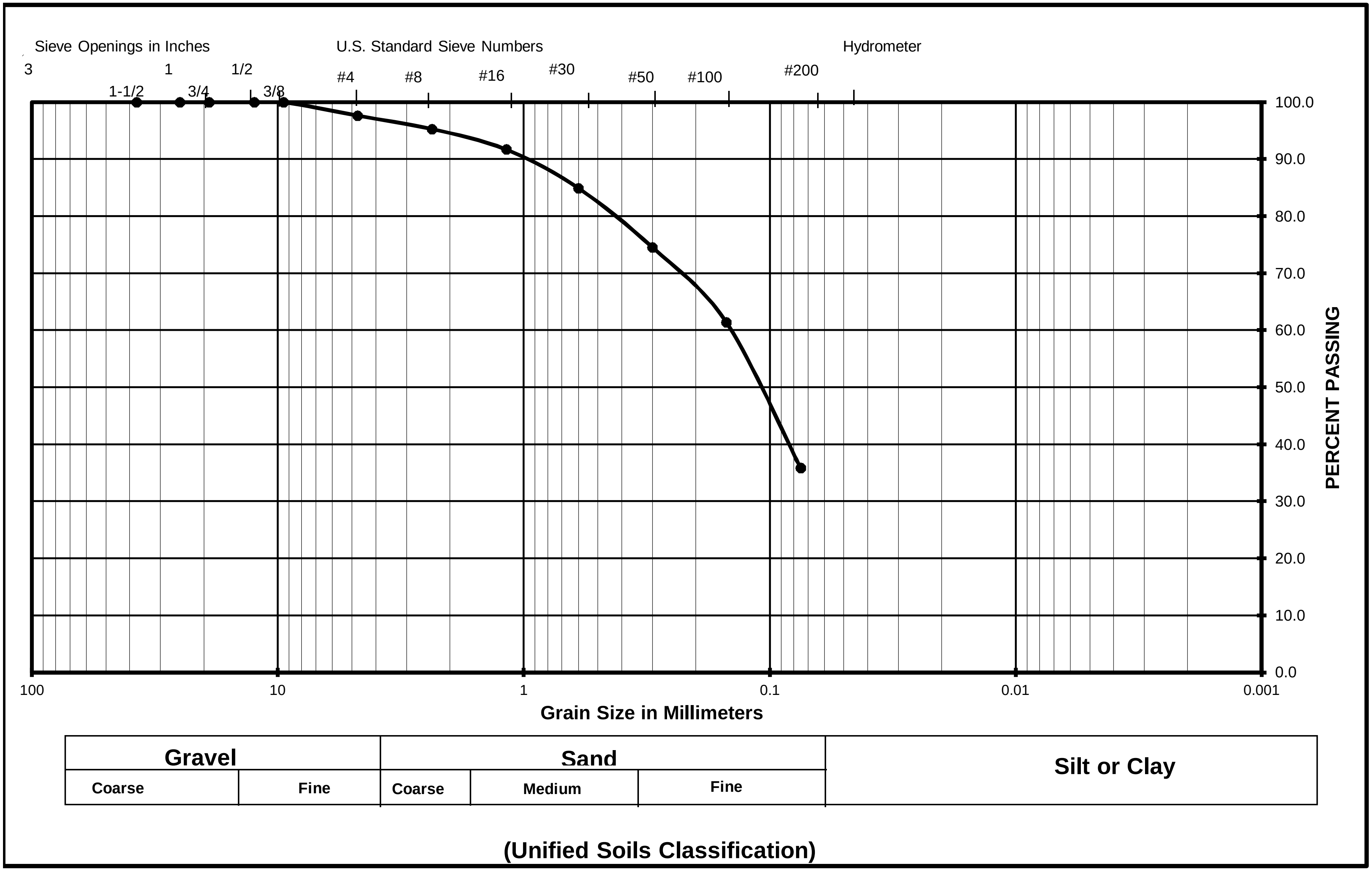
Project Number	:	11216114
Project Name	:	2542 Ridgeway Drive
Date	:	########
Sample Location	:	B-1 @ 15'
Soil Classification	:	SM

Wet Weight	:	577.40
Dry Weight	:	522.30
Moisture Content	:	11%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	12.4	2.4	2.4	97.6
#8	2.36	12.3	2.4	4.7	95.3
#16	1.18	18.7	3.6	8.3	91.7
#30	0.60	35.4	6.8	15.1	84.9
#50	0.30	54.2	10.4	25.5	74.5
#100	0.15	68.9	13.2	38.7	61.3
#200	0.08	133.2	25.5	64.2	35.8

Krazan Testing Laboratory

Grain Size Analysis



Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 15'

Krazan Testing Laboratory

Sieve Analysis

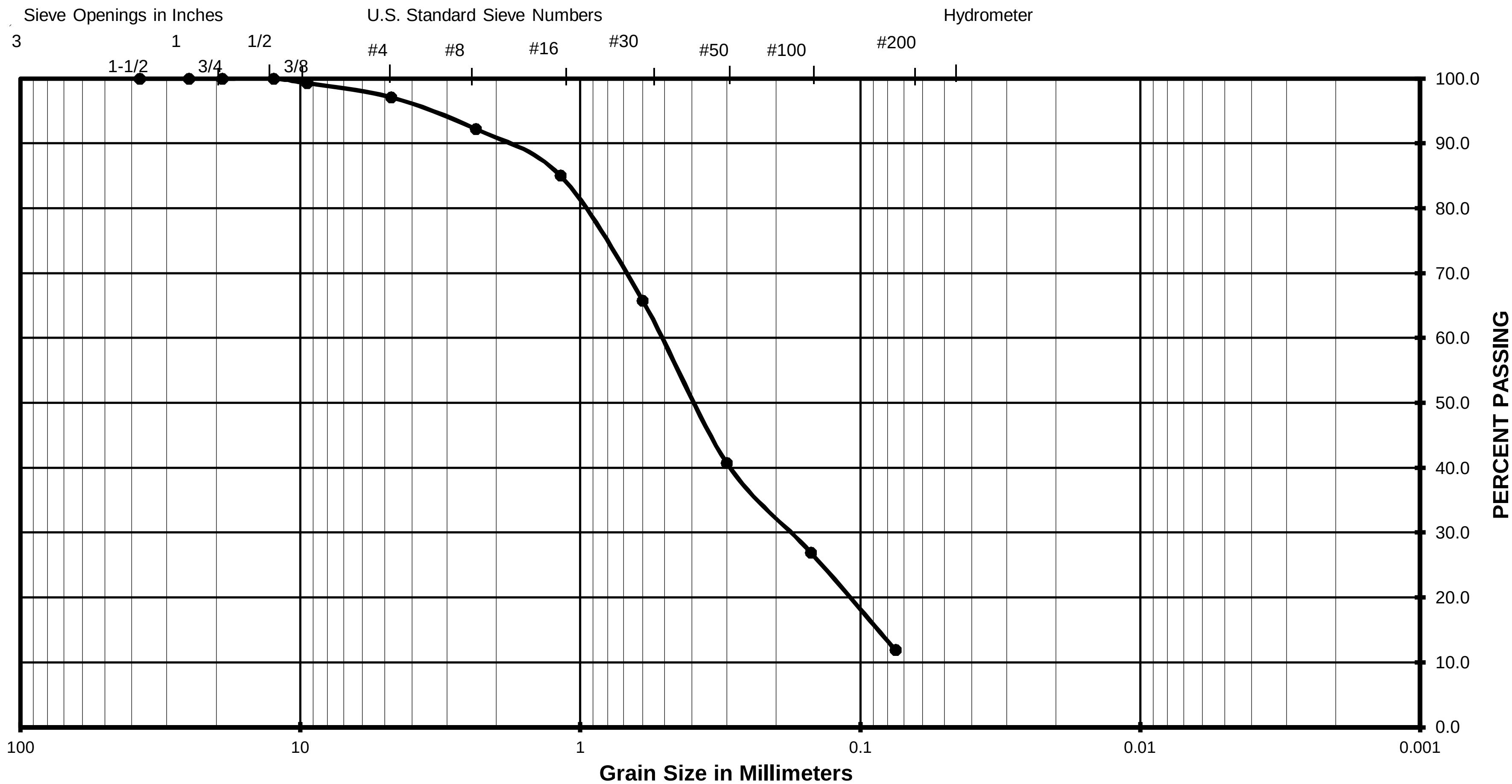
Project Number	: 11216114
Project Name	: 2542 Ridgeway Drive
Date	: ########
Sample Location	: B-1 @ 20'
Soil Classification	: SM

Wet Weight	:	522.10
Dry Weight	:	497.10
Moisture Content	:	5%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50	3.5	0.7	0.7	99.3
#4	4.75	10.8	2.2	2.9	97.1
#8	2.36	24.5	4.9	7.8	92.2
#16	1.18	35.6	7.2	15.0	85.0
#30	0.60	95.6	19.2	34.2	65.8
#50	0.30	124.5	25.0	59.2	40.8
#100	0.15	68.9	13.9	73.1	26.9
#200	0.08	74.5	15.0	88.1	11.9

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 20'

Krazan Testing Laboratory

Sieve Analysis

Project Number	: 11216114
Project Name	: 2542 Ridgeway Drive
Date	: ########
Sample Location	: B-1 @ 25'
Soil Classification	: SM w/gravel

Wet Weight	:	525.50
Dry Weight	:	514.90
Moisture Content	:	2%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50	24.6	4.8	4.8	95.2
#4	4.75	25.8	5.0	9.8	90.2
#8	2.36	24.6	4.8	14.6	85.4
#16	1.18	68.4	13.3	27.9	72.1
#30	0.60	94.2	18.3	46.1	53.9
#50	0.30	84.6	16.4	62.6	37.4
#100	0.15	52.0	10.1	72.7	27.3
#200	0.08	62.3	12.1	84.8	15.2

Krazan Testing Laboratory

Grain Size Analysis

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM w/gravel
Sample Number	B-1 @ 25'

Krazan Testing Laboratory

Sieve Analysis

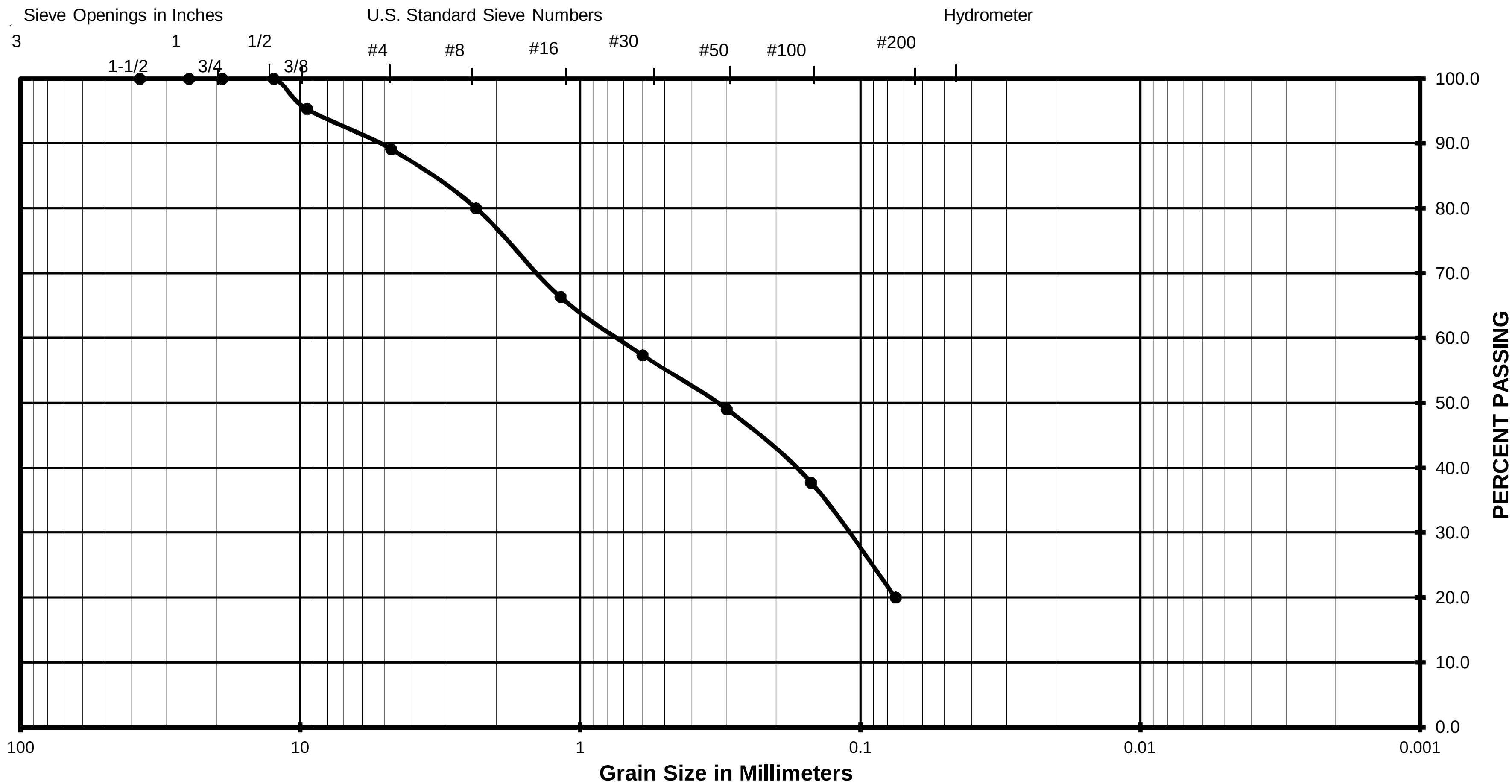
Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : ########
Sample Location : B-1 @ 30'
Soil Classification : SM w/gravel

Wet Weight	:	522.20
Dry Weight	:	503.20
Moisture Content	:	4%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50	23.5	4.7	4.7	95.3
#4	4.75	31.2	6.2	10.9	89.1
#8	2.36	45.8	9.1	20.0	80.0
#16	1.18	68.9	13.7	33.7	66.3
#30	0.60	45.1	9.0	42.6	57.4
#50	0.30	42.0	8.3	51.0	49.0
#100	0.15	56.8	11.3	62.3	37.7
#200	0.08	89.4	17.8	80.0	20.0

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM w/gravel
Sample Number	B-1 @ 30'

Krazan Testing Laboratory

Sieve Analysis

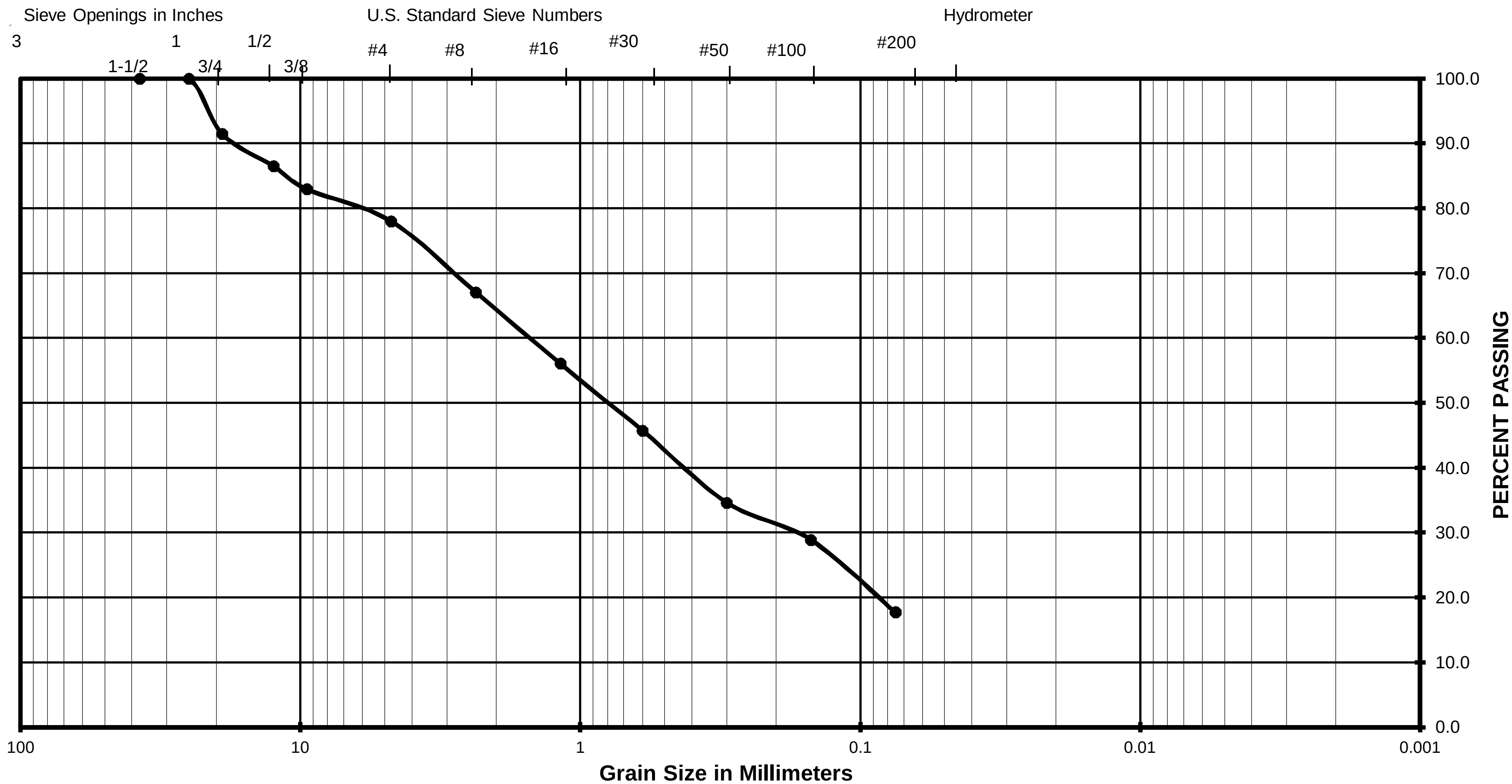
Project Number	: 11216114
Project Name	: 2542 Ridgeway Drive
Date	: ########
Sample Location	: B-1 @ 35'
Soil Classification	: SM w/gravel

Wet Weight	:	525.40
Dry Weight	:	496.40
Moisture Content	:	6%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00	42.5	8.6	8.6	91.4
1/2"	12.50	24.5	4.9	13.5	86.5
3/8"	9.50	17.6	3.5	17.0	83.0
#4	4.75	24.6	5.0	22.0	78.0
#8	2.36	54.4	11.0	33.0	67.0
#16	1.18	54.6	11.0	44.0	56.0
#30	0.60	51.3	10.3	54.3	45.7
#50	0.30	55.0	11.1	65.4	34.6
#100	0.15	28.6	5.8	71.1	28.9
#200	0.08	55.4	11.2	82.3	17.7

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM w/gravel
Sample Number	B-1 @ 35'

Krazan Testing Laboratory

Sieve Analysis

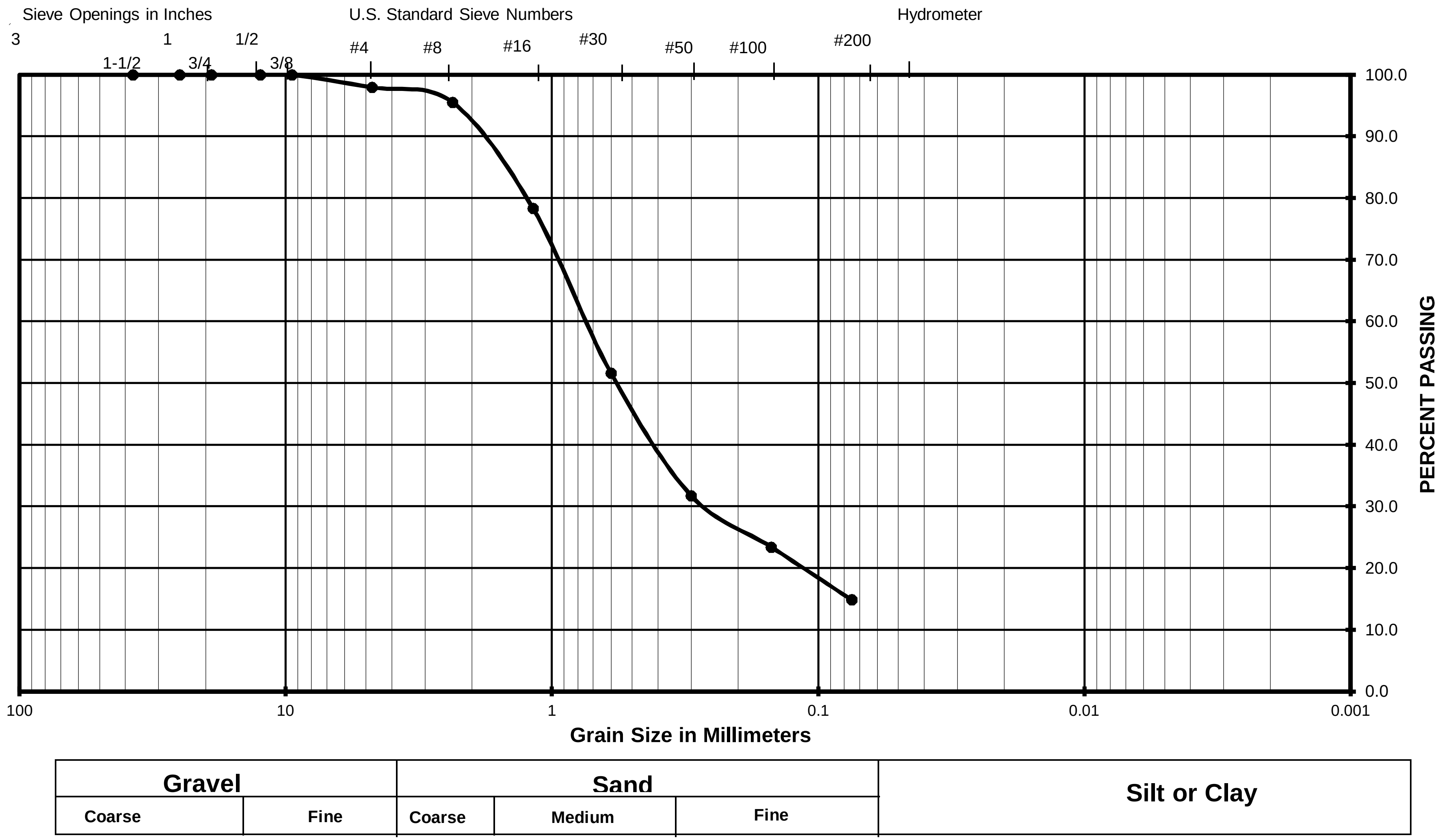
Project Number	:	11216114
Project Name	:	2542 Ridgeway Drive
Date	:	########
Sample Location	:	B-1 @ 40'
Soil Classification	:	SM

Wet Weight	:	521.10
Dry Weight	:	504.10
Moisture Content	:	3%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	10.4	2.1	2.1	97.9
#8	2.36	12.4	2.5	4.5	95.5
#16	1.18	86.3	17.1	21.6	78.4
#30	0.60	135.0	26.8	48.4	51.6
#50	0.30	100.0	19.8	68.3	31.7
#100	0.15	42.0	8.3	76.6	23.4
#200	0.08	43.1	8.5	85.1	14.9

Krazan Testing Laboratory

Grain Size Analysis



(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 40'

Krazan Testing Laboratory

Sieve Analysis

Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : ########
Sample Location : B-1 @ 45'
Soil Classification : SM

Wet Weight	:	527.70
Dry Weight	:	505.40
Moisture Content	:	4%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	8.9	1.8	1.8	98.2
#8	2.36	11.2	2.2	4.0	96.0
#16	1.18	14.6	2.9	6.9	93.1
#30	0.60	20.4	4.0	10.9	89.1
#50	0.30	21.4	4.2	15.1	84.9
#100	0.15	30.1	6.0	21.1	78.9
#200	0.08	198.6	39.3	60.4	39.6

Krazan Testing Laboratory

Grain Size Analysis

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM
Sample Number	B-1 @ 45'

Krazan Testing Laboratory

Sieve Analysis

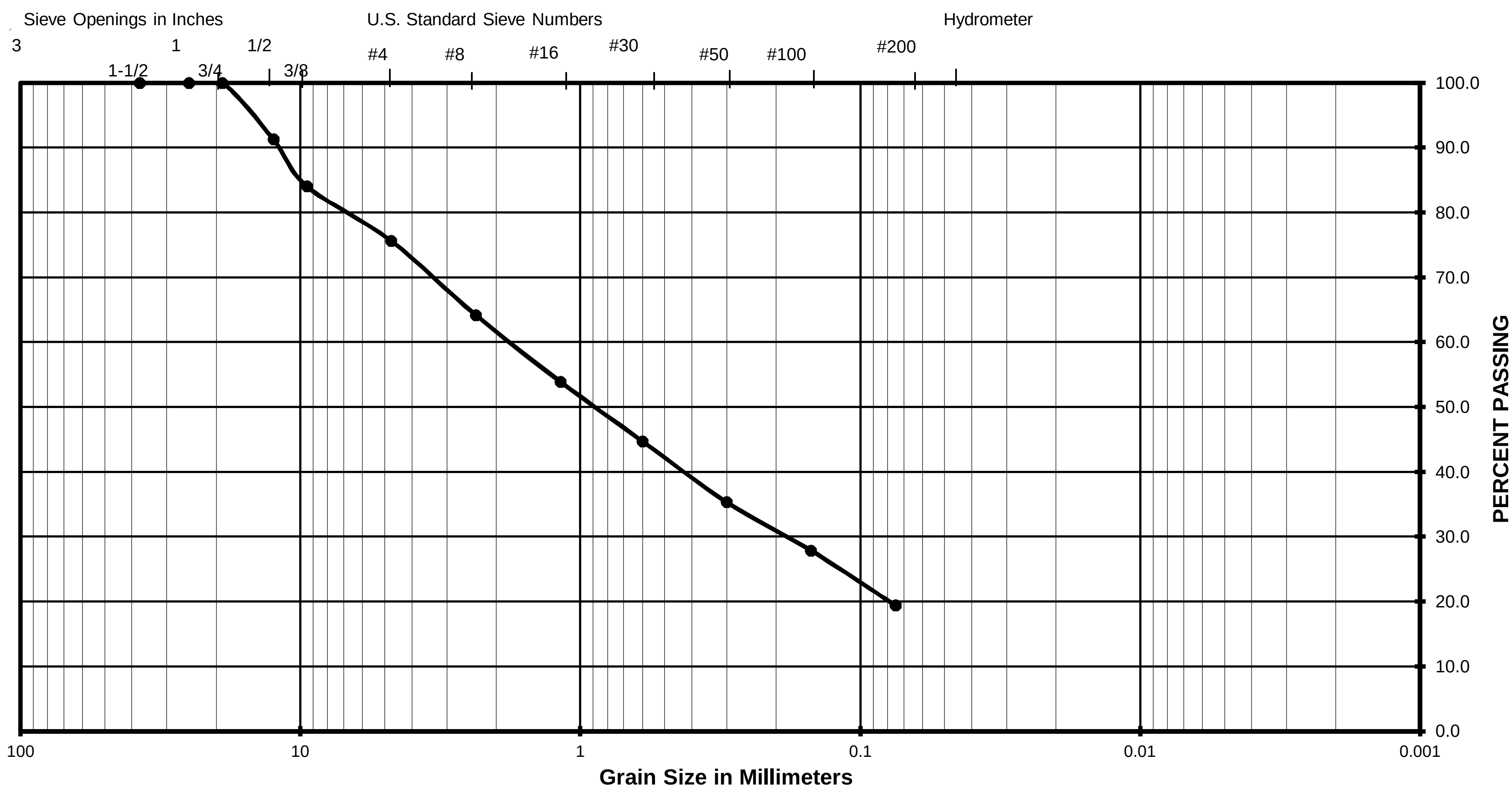
Project Number	: 11216114
Project Name	: 2542 Ridgeway Drive
Date	: ########
Sample Location	: B-1 @ 50'
Soil Classification	: SM w/gravel

Wet Weight	:	509.90
Dry Weight	:	489.20
Moisture Content	:	4%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50	42.6	8.7	8.7	91.3
3/8"	9.50	35.4	7.2	15.9	84.1
#4	4.75	41.2	8.4	24.4	75.6
#8	2.36	56.2	11.5	35.9	64.1
#16	1.18	50.0	10.2	46.1	53.9
#30	0.60	45.1	9.2	55.3	44.7
#50	0.30	45.9	9.4	64.7	35.3
#100	0.15	36.4	7.4	72.1	27.9
#200	0.08	41.5	8.5	80.6	19.4

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	2542 Ridgeway Drive
Project Number	11216114
Soil Classification	SM w/gravel
Sample Number	B-1 @ 50'

Krazan Testing Laboratory

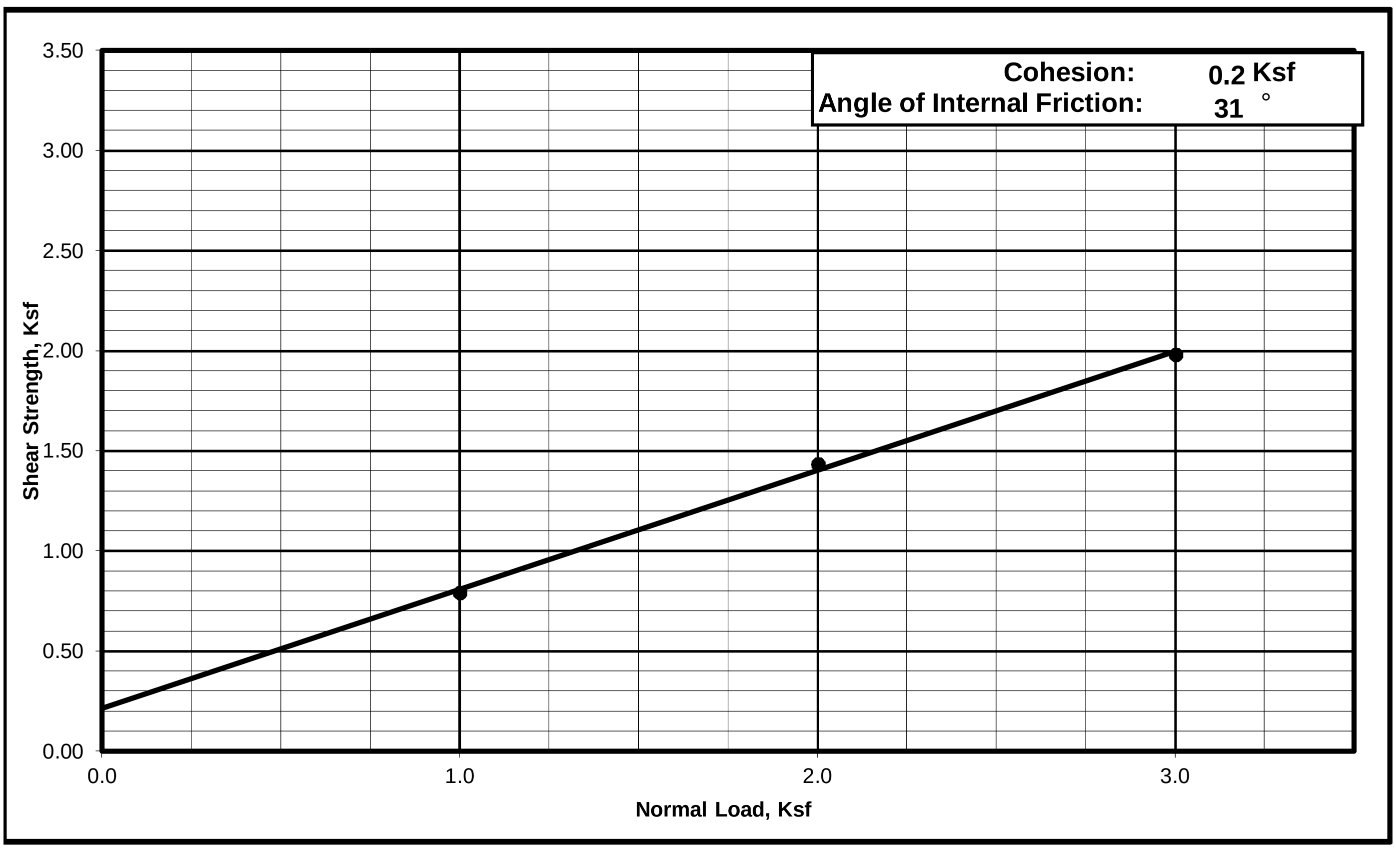
Direct Shear of Consolidated, Drained Soils
ASTM D - 3080 / AASHTO T - 236

Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : 10/17/2016
Sample Location : B-3 @ 5'
Soil Classification : SM
Sample Surface Area : 0.0289

STRESS DISPLACEMENT DATA

Lat. Disp. (in.)	Normal Load		
	1000	2000	3000
0	0	0	0
0.030	30	38.2	41.3
0.060	44.4	60	68.8
0.090	55.4	78.4	84.6
0.120	61.4	92.4	102.4
0.150	63.8	101.6	124.6
0.180	68	118.6	147.6
0.210	69.4	125.6	164.7
0.240	67	128.4	174.6
0.270		125.4	178.6
0.300			174.6
0.330			
0.360			

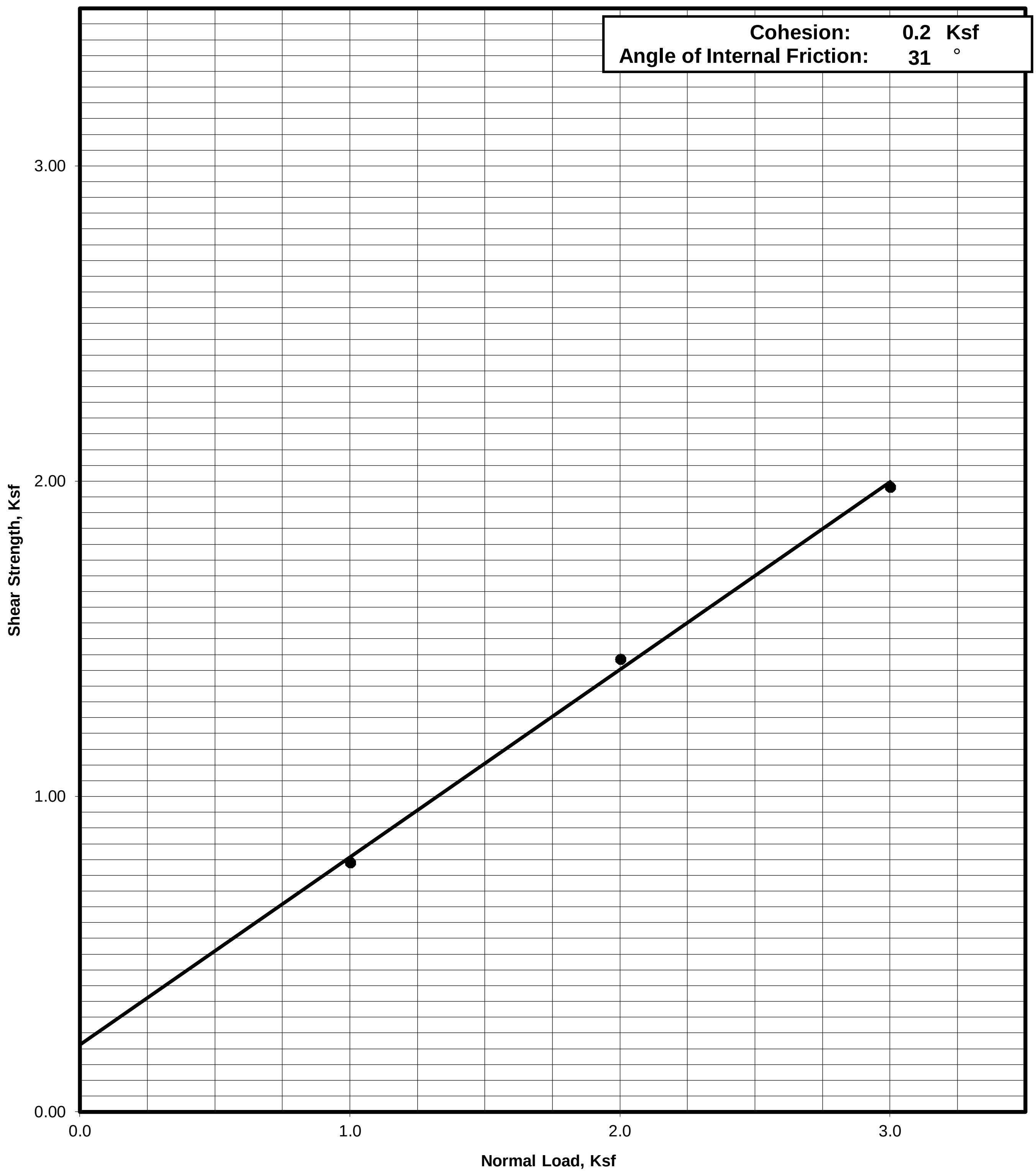
Normal Load psf	Shear force lbs	Shear Stress psf
1000	22.9	792
2000	41.5	1436
3000	57.3	1982



Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
11216114	B-3 @ 5'	SM	10/17/2016



Krazan Testing Laboratory

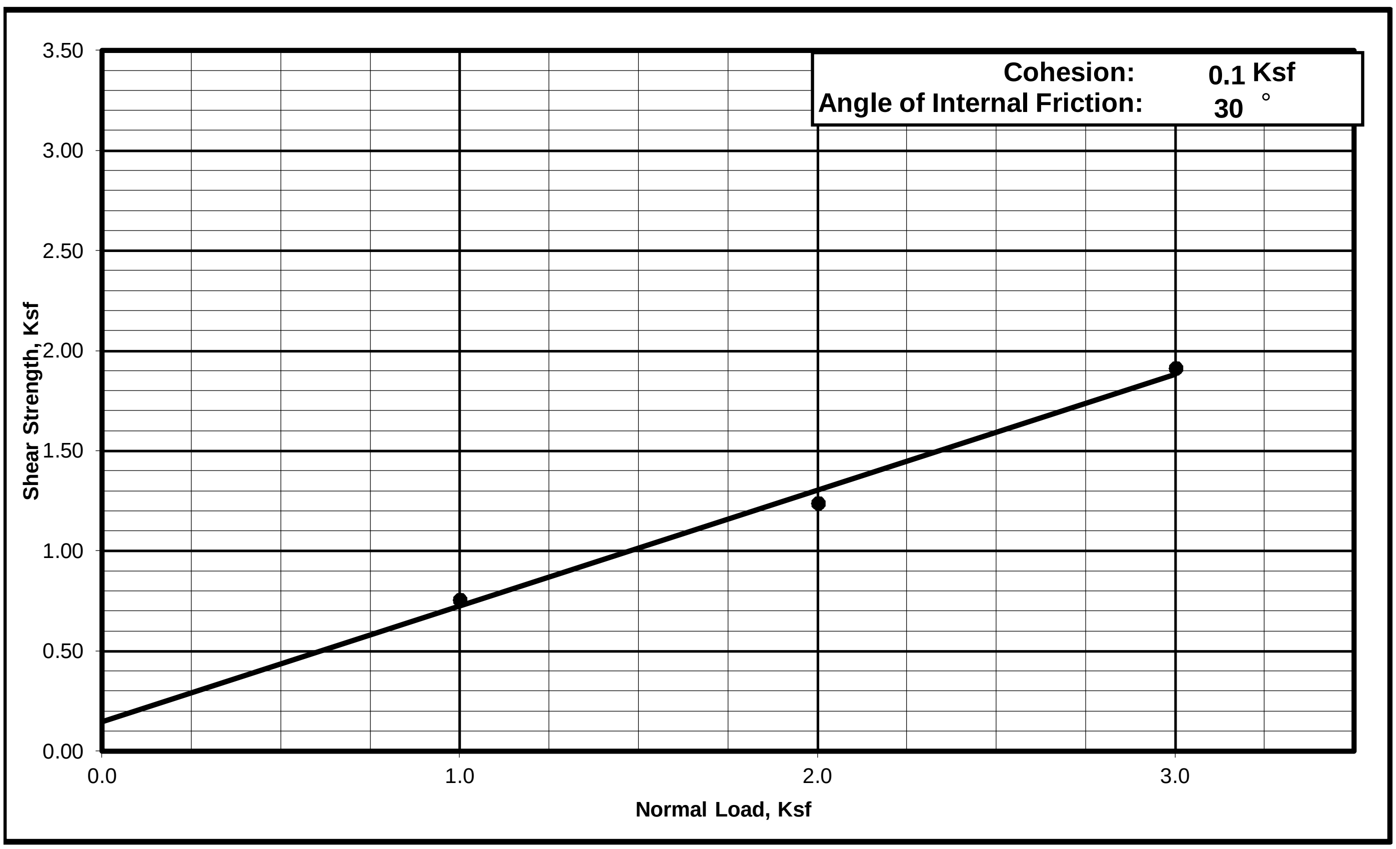
Direct Shear of Consolidated, Drained Soils
ASTM D - 3080 / AASHTO T - 236

Project Number	: 11216114
Project Name	: 2542 Ridgeway Drive
Date	: 10/17/2016
Sample Location	: B-5 @ 5'
Soil Classification	: SM
Sample Surface Area	: 0.0289

STRESS DISPLACEMENT DATA

Lat. Disp.	Normal Load		
(in.)	1000	2000	3000
0	0	0	0
0.030	28.6	38.4	54.6
0.060	42.4	61.4	78.4
0.090	58.4	78.6	92.4
0.120	62	88.2	114.6
0.150	66.8	96	124.8
0.180	64.8	105.4	136.4
0.210		110.6	148.2
0.240		107.6	157.6
0.270			167
0.300			172.4
0.330			168.2
0.360			

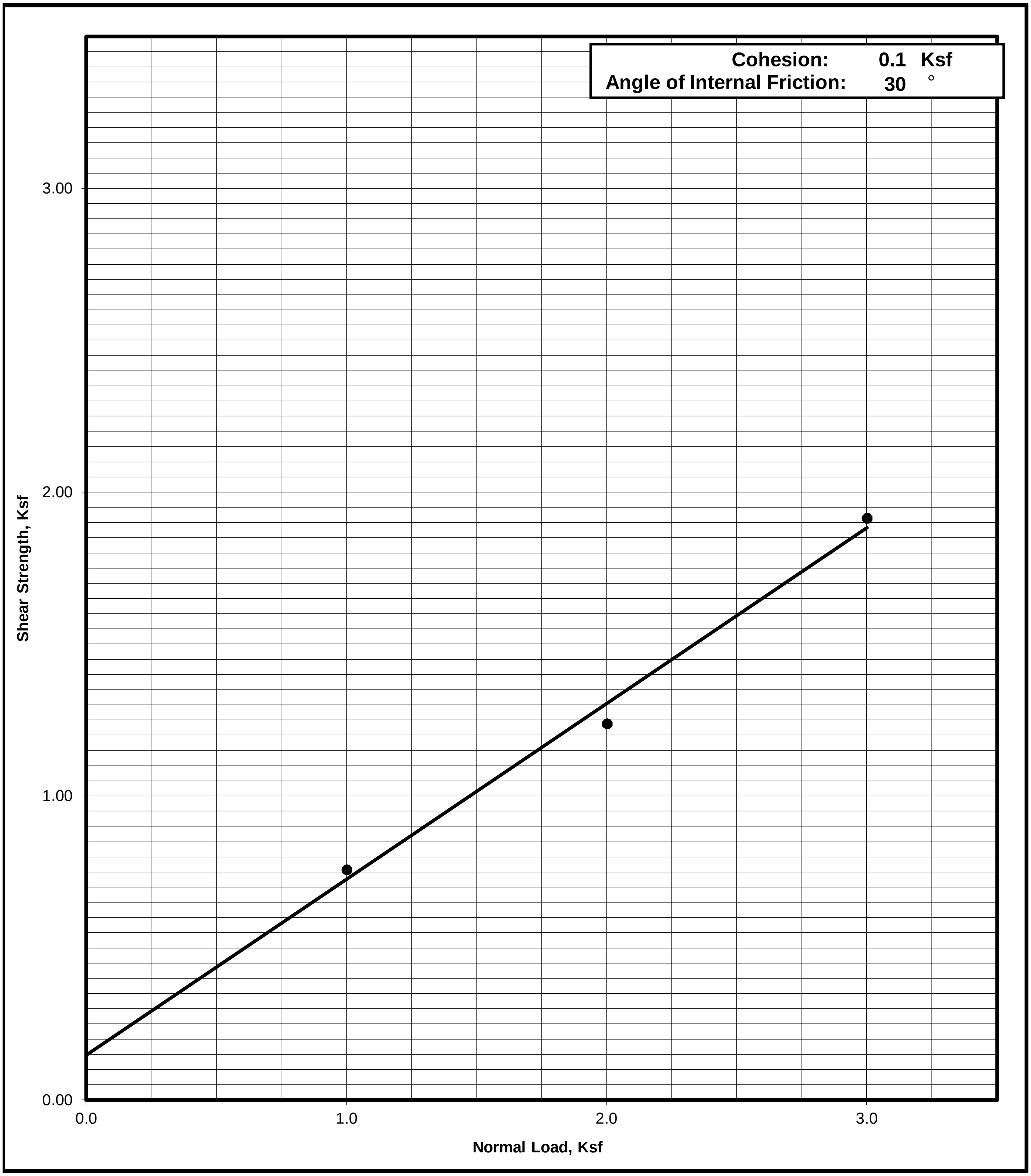
Normal Load psf	Shear force lbs	Shear Stress psf
1000	22.0	760
2000	35.8	1240
3000	55.4	1917



Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
11216114	B-5 @ 5'	SM	10/17/2016

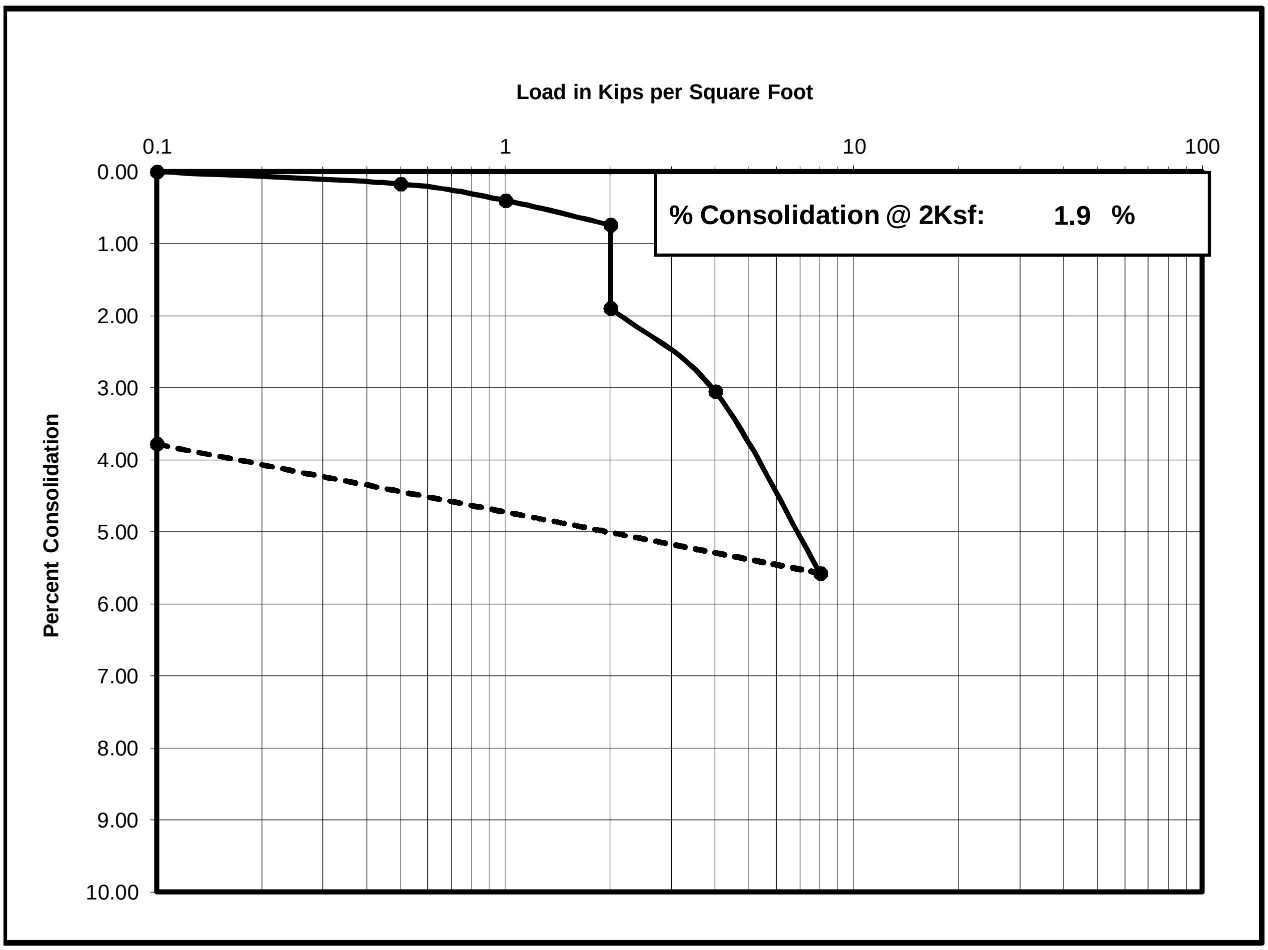


Krazan Testing Laboratory

One Dimensional Consolidation Properties of Soil
ASTM D - 2435 / AASHTO T - 216

Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : 10/11/2016
Sample Location : B-2 @ 5'
Soil Classification : SM
Sample Condition : Undisturbed

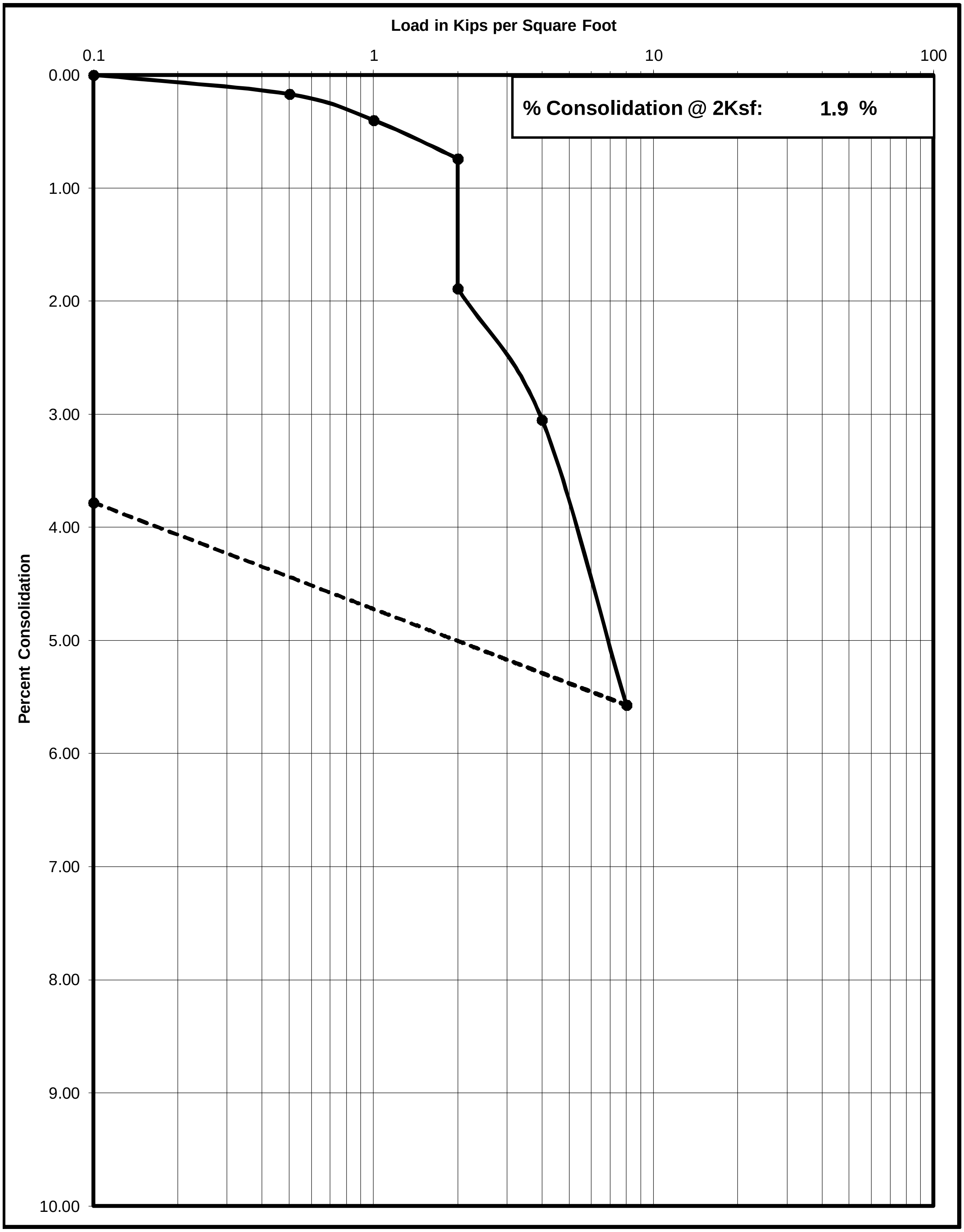
LOAD (ksf)	Reading	% Consolidation
0.1	0	--
0.5	0.0017	0.17
1	0.004	0.40
2	0.0074	0.74
Satur.	0.0189	1.89
4	0.0305	3.05
8	0.0557	5.57
0.1	0.0378	3.78



Krazan Testing Laboratory

Consolidation Test

Project No	Boring No. & Depth	Date	Soil Classification
11216114	B-2 @ 5'	########	SM



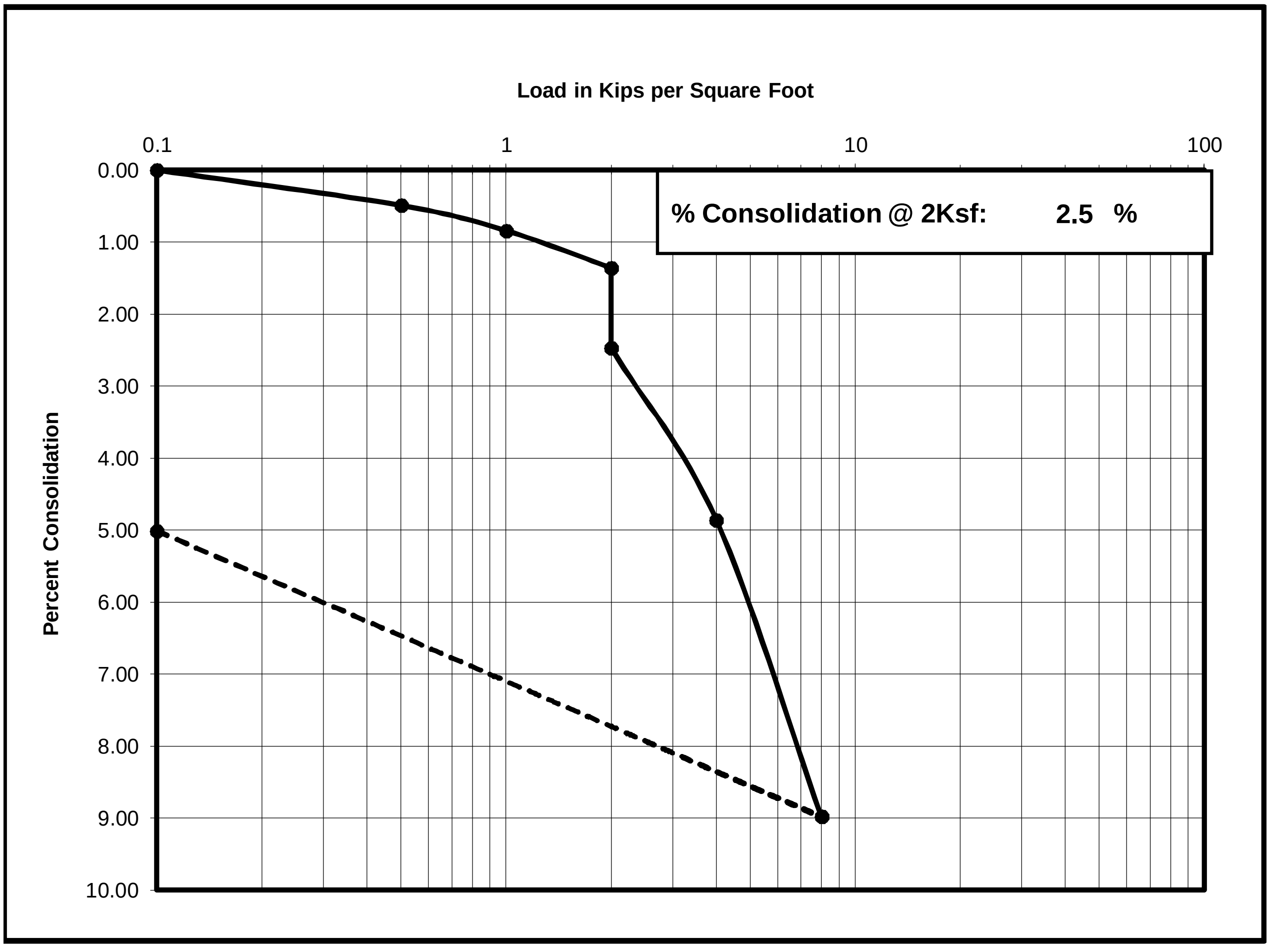
Krazan Testing Laboratory

One Dimensional Consolidation Properties of Soil

ASTM D - 2435 / AASHTO T - 216

Project Number : 11216114
Project Name : 2542 Ridgeway Drive
Date : 10/11/2016
Sample Location : B-6 @ 5'
Soil Classification : SM
Sample Condition : Undisturbed

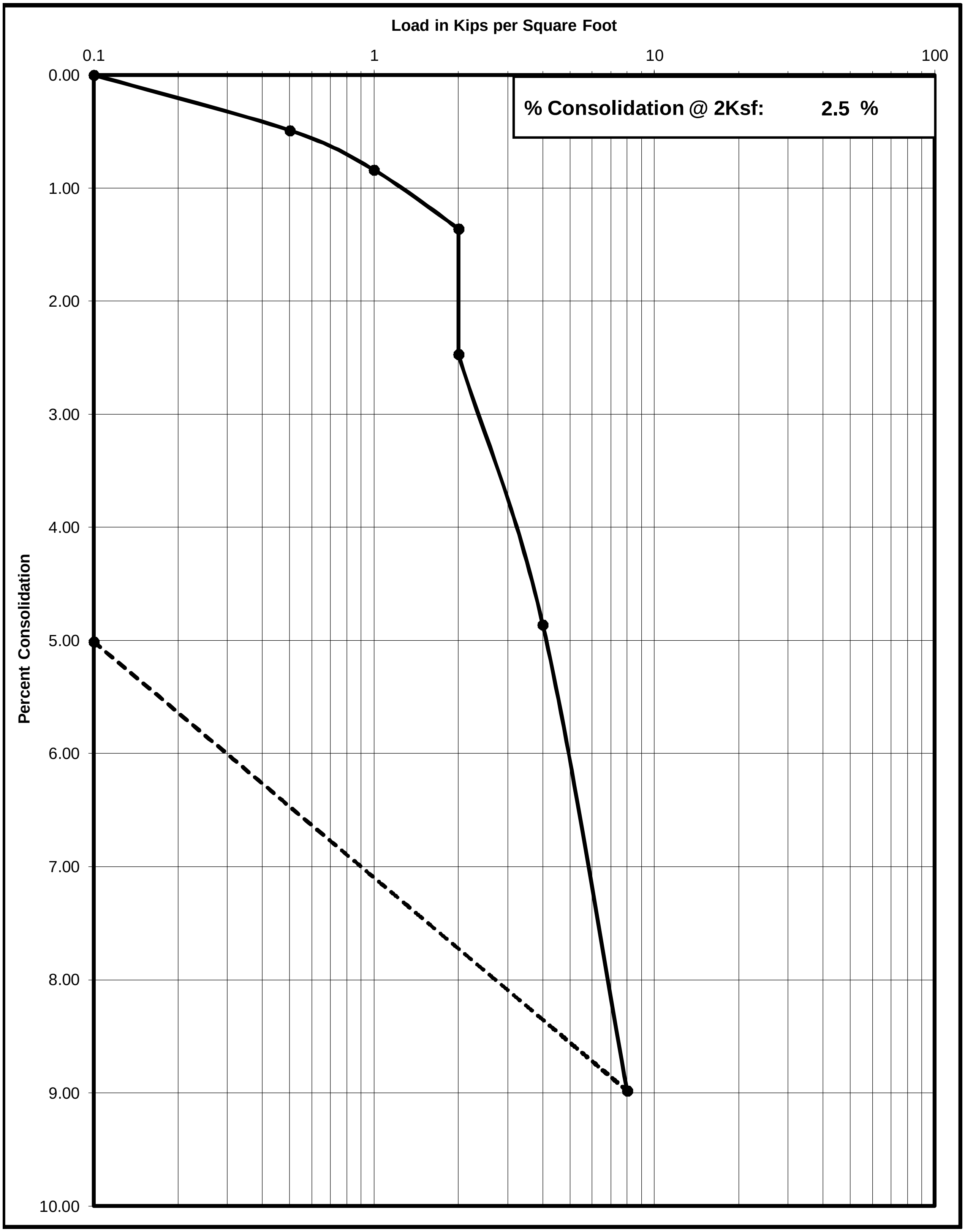
LOAD (ksf)	Reading	% Consolidation
0.1	0.0001	--
0.5	0.0049	0.49
1	0.0084	0.84
2	0.0136	1.36
Satur.	0.0247	2.47
4	0.0486	4.86
8	0.0898	8.98
0.1	0.0501	5.01



Krazan Testing Laboratory

Consolidation Test

Project No	Boring No. & Depth	Date	Soil Classification
11216114	B-6 @ 5'	########	SM



Krazan Testing Laboratory

ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

Krazan & Associates, Inc
1100 Olympic Drive, Ste. 103
Corona, CA 92881

DATE: 10/13/16

P.O. NO: Verbal

LAB NO: B-9834

SPECIFICATION: 417/422/643

MATERIAL: Soil

Project No: 11216114
2542 Ridgeway
National City

ANALYTICAL REPORT

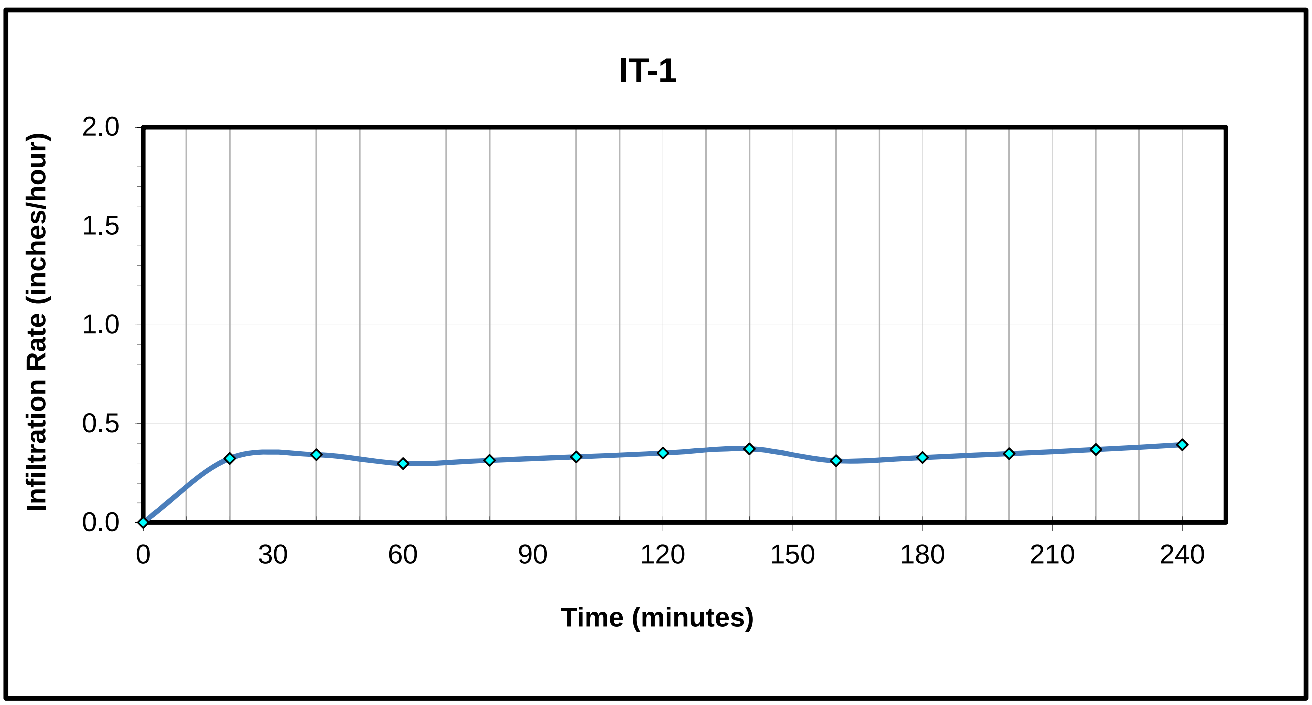
CORROSION SERIES
SUMMARY OF DATA

	pH	SOLUBLE SULFATES per CA. 417 ppm	SOLUBLE CHLORIDES per CA. 422 ppm	MIN. RESISTIVITY per CA. 643 ohm-cm
B-1 @ 0-5’	7.0	103	307	960

RESPECTFULLY SUBMITTED

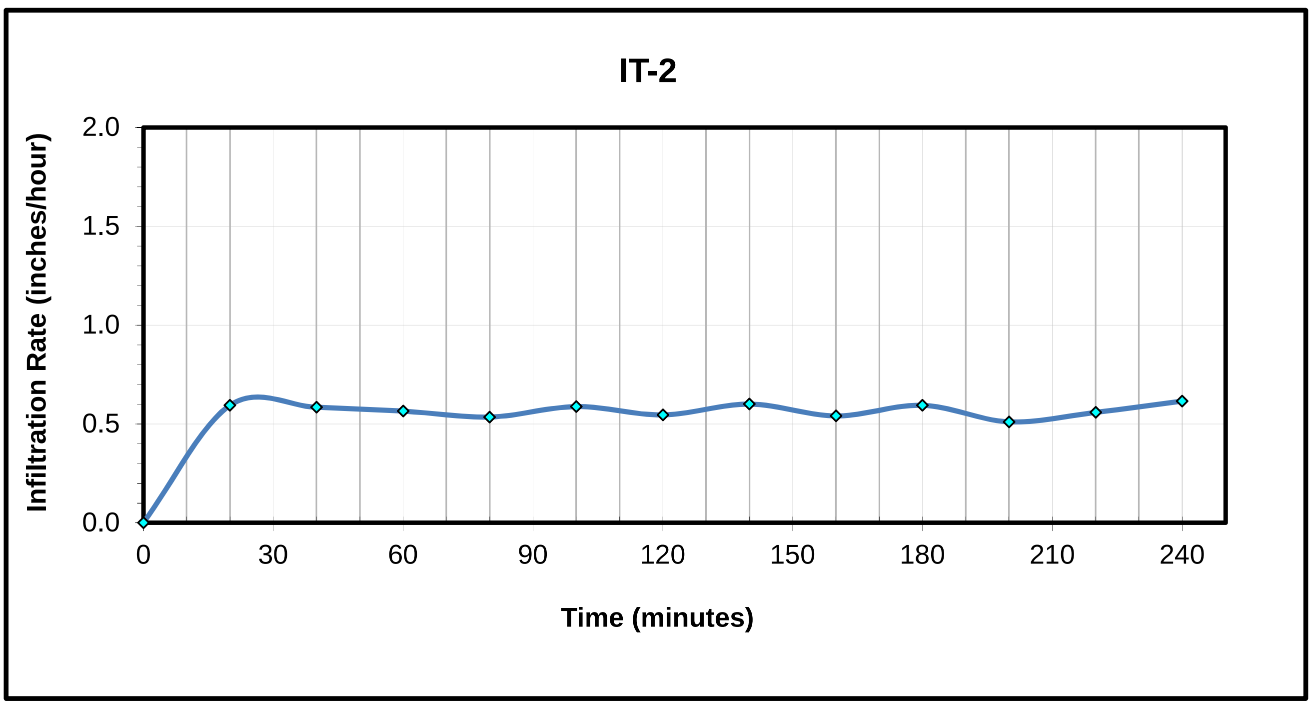
WES BRIDGER CHEMIST

RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11220017**				**Date**	**2/14/2020**
Project Name	Ridgeway Development					
Project Address	National City, CA					
Test No:	IT-1	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	>50'	**Soil Classification**		SM		
Reading	**Elasped Time(min.)**	**Incremental Time (min.)**	**Initial Depth To Water(in.)**	**Final Depth To Water(in.)**	**Incremental Fall of Water(in.)**	**Incremental Infiltration Rate (in/hr)**
Start	0	0.00		2.0	--	--
1	20.00	20.00	2.0	5.0	3.00	0.32
2	40.00	20.00	5.0	8.0	3.00	0.34
3	60.00	20.00	8.0	10.5	2.50	0.30
4	80.00	20.00	10.5	13.0	2.50	0.31
5	100.00	20.00	13.0	15.5	2.50	0.33
6	120.00	20.00	15.5	18.0	2.50	0.35
7	140.00	20.00	18.0	20.5	2.50	0.37
8	160.00	20.00	20.5	22.5	2.00	0.31
9	180.00	20.00	22.5	24.5	2.00	0.33
10	200.00	20.00	24.5	26.5	2.00	0.35
11	220.00	20.00	26.5	28.5	2.00	0.37
12	240.00	20.00	28.5	30.5	2.00	0.39
	Infiltration Rate in Inches per Hour					**0.30**



RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE						
Project #	**11220017**				**Date**	**2/19/2020**
Project Name	Ridgeway Development					
Project Address	National City, CA					
Test No:	IT-2	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	>50'	**Soil Classification**		SM		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		4.0	--	--
1	20.00	20.00	4.0	9.0	5.00	0.59
2	40.00	20.00	9.0	13.5	4.50	0.58
3	60.00	20.00	13.5	17.5	4.00	0.56
4	80.00	20.00	17.5	21.0	3.50	0.54
5	100.00	20.00	21.0	24.5	3.50	0.59
6	120.00	20.00	24.5	27.5	3.00	0.55
7	140.00	20.00	27.5	30.5	3.00	0.60
8	160.00	20.00	30.5	33.0	2.50	0.54
9	180.00	20.00	33.0	35.5	2.50	0.59
10	200.00	20.00	35.5	37.5	2.00	0.51
11	220.00	20.00	37.5	39.5	2.00	0.56
12	240.00	20.00	39.5	41.5	2.00	0.62
	Infiltration Rate in Inches per Hour					**0.51**



General Earthwork Specifications

Appendix B

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including, but not limited to, the furnishing of all labor, tools and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthworks in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Incorporated, hereinafter referred to as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades, when achieved, shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary adjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to the minimum relative compaction of 95 percent. Soil moisture-content requirements presented in the Geotechnical Engineer’s report shall also be complied with. The maximum laboratory compacted dry unit weight of each soil placed as fill shall be determined in accordance with ASTM Test Method D1557-00 (Modified Proctor). The optimum moisture-content shall also be determined in accordance with this test method. The terms “relative compaction” and “compaction” are defined as the in-place dry density of the compacted soil divided by the laboratory compacted maximum dry density as determined by ASTM Test Method D1557-00, expressed as a percentage as specified in the technical portion of the Geotechnical Engineer's report. The location and frequency of field density tests shall be as determined by the Geotechnical Engineer. The results of these tests and compliance with these specifications shall be the basis upon which the Geotechnical Engineer will judge satisfactory completion of work.

SOILS AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the Geotechnical Engineering Investigation report.

The Contractor shall make his own interpretation of the data contained in the Geotechnical Engineering Investigation report and the Contractor shall not be relieved of liability under the Contract for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or wind-blown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing, over-excavation of the proposed building pad areas, preparation of foundation materials for receiving fill, construction of Engineered Fill including the placement of non-expansive fill where recommended by the Geotechnical Engineer.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter and all other matter determined by the Geotechnical Engineer to be deleterious. Site stripping to remove organic materials and organic-laden soils in landscaped areas shall extend to a minimum depth of 2 inches or until all organic-laden soil with organic matter in excess of 3 percent of the soils by volume are removed. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent that would permit removal of all roots greater than 1 inch in diameter. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavation should not be permitted until all exposed surfaces have been inspected and the Geotechnical Engineer is present for the proper control of backfill placement and compaction. Burning in areas that are to receive fill materials shall not be permitted.

Excavations required to achieve design grades, depressions, soft or pliant areas, or areas disturbed by demolition activities extending below planned finished subgrade levels should be excavated down to firm, undisturbed soil and backfilled with Engineered Fill. The resulting excavations should be backfilled with Engineered Fill.

EXCAVATION: Following clearing and grubbing operations, the proposed building pad area shall be over-excavated to a depth of at least five feet below existing grades or two feet below the deepest existing structure foundation within the limits of each of the building pads. The remaining areas of the building and adjoining exterior concrete flatwork or pavements at the building perimeter shall be over-excavated to a depth of at least one foot below existing grade. The areas of over-excavation and recompaction beneath footings and slabs shall extend out laterally a minimum of five feet beyond the perimeter of these elements.

All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable **TECHNICAL REQUIREMENTS**.

SUBGRADE PREPARATION: Surfaces to receive Engineered Fill or to support structures directly, shall be scarified to a depth of 8 inches, moisture-conditioned as necessary and compacted in accordance with the **TECHNICAL REQUIREMENTS**, above.

Loose soil areas and/or areas of disturbed soil shall be should be excavated down to firm, undisturbed soil, moisture-conditioned as necessary and backfilled with Engineered Fill. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas that are to receive fill materials shall be approved by the Geotechnical Engineer prior to the placement of any of the fill material.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction of site fills, with the limitations of their use presented in the Geotechnical Engineer's report, provided the Geotechnical Engineer gives prior approval. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Geotechnical Engineer, and shall comply with the requirements for non-expansive fill, aggregate base or aggregate subbase as applicable for its proposed used on the site as presented in the Geotechnical Engineer's report.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. Fill materials should be placed and compacted in horizontal lifts, each not exceeding 8 inches in uncompacted thickness. Due to equipment limitations, thinner lifts may be necessary to achieve the recommended level of compaction. Compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer. Additional lifts should not be placed if the previous lift did not meet the required dry density (relative compaction) or if soil conditions are not stable. The compacted subgrade in pavement areas should be non-yielding when proof-rolled with a loaded ten-wheel truck, such as a water truck or dump truck, prior to pavement construction.

Both cut and fill shall be surface-compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture-content and density of previously placed fill is as specified.

General Paving Specifications

Appendix C

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS - The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

The term "Standard Specifications": hereinafter referred to as the January 1999 Standard Specifications of the State of California, Department of Transportation, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures, State of California, Department of Public Works, Division of Highways. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as defined in the ASTM D1557-00.

2. SCOPE OF WORK - This portion of the work shall include all labor, materials, tools, and equipment necessary for, and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. PREPARATION OF THE SUBGRADE - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 95 percent. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement courses.

4. UNTREATED AGGREGATE BASE - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class 2 material, ¾-inches maximum size. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent. The aggregate base material shall be spread and compacted in accordance with Section 26 of the Standard Specifications. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. AGGREGATE SUBBASE - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class II material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent, and it shall be spread and compacted in accordance with Section 25 of the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

6. ASPHALT CONCRETE SURFACING - Asphalt concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The viscosity grade of the asphalt shall be AR-8000. The mineral aggregate shall be Type B, ½-inch or ¾-inch maximum, medium grading, for the wearing course and ¾-inch maximum, medium grading for the base course, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The drying, proportioning, and mixing of the materials shall conform to Section 39.

The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to the applicable chapters of Section 39, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with a combination steel-wheel and pneumatic rollers, as described in Section 39-6. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

7. FOG SEAL COAT - The fog seal (mixing type asphalt emulsion) shall conform to and be applied in accordance with the requirements of Section 37.

APPENDIX B
Hydrologic Calculations

This Section Contains:

- Existing Condition Analysis
- Proposed Condition Analysis

```
                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
        Rational Hydrology Study        Date: 08/24/22
------------------------------------------------------------------------
EXISTING 100 YEAR




------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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Program License Serial Number 6540

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.600
24 hour precipitation(inches) =  5.500
P6/P24 =    47.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  129.000(Ft.)
Lowest elevation =  127.500(Ft.)
Elevation difference =    1.500(Ft.) Slope =  2.000 %
```

```
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.83 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7100)*(  75.000^.5)/(   2.000^(1/3)]=   4.83
Calculated TC of    4.825 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.850(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.710
Subarea runoff =      0.486(CFS)
Total initial stream area =       0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   127.500(Ft.)
End of street segment elevation =   115.000(Ft.)
Length of street segment  =  1525.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      4.374(CFS)
Depth of flow =   0.388(Ft.), Average velocity =   2.377(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  13.090(Ft.)
Flow velocity =   2.38(Ft/s)
Travel time =   10.69 min.     TC =   15.52  min.
 Adding area flow to street
Rainfall intensity (I) =      3.300(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
```

```
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      3.300(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      2.485
Subarea runoff =      7.713(CFS) for      3.400(Ac.)
Total runoff =      8.199(CFS)  Total area =       3.500(Ac.)
Street flow at end of street =      8.199(CFS)
Half street flow at end of street =      8.199(CFS)
Depth of flow =   0.464(Ft.), Average velocity =   2.765(Ft/s)
Flow width (from curb towards crown)=  16.848(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   113.500(Ft.)
Downstream point/station elevation =   113.100(Ft.)
Pipe length  =    30.00(Ft.) Slope =   0.0133  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.199(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     8.199(CFS)
Normal flow depth in pipe =   10.84(In.)
Flow top width inside pipe =   17.62(In.)
Critical Depth =   13.32(In.)
Pipe flow velocity =      7.37(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =    15.59 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     12.585(CFS)
Depth of flow =   0.270(Ft.), Average velocity =   4.517(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1             0.00             9.00
        2            10.00             0.00
        3            20.00             0.00
        4            30.00             9.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     12.586(CFS)
  '     '        flow top width =     10.601(Ft.)
  '     '    velocity=    4.517(Ft/s)
```

```
  '     '        area =      2.786(Sq.Ft)
  '     '        Froude number =     1.553

Upstream point elevation =   113.100(Ft.)
Downstream point elevation =    71.000(Ft.)
Flow length =   610.000(Ft.)
Travel time  =    2.25 min.
Time of concentration =   17.84 min.
Depth of flow =   0.270(Ft.)
Average velocity =   4.517(Ft/s)
Total irregular channel flow =    12.585(CFS)
Irregular channel normal depth above invert elev. =   0.270(Ft.)
Average velocity of channel(s) =   4.517(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.016(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      3.016(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      5.609
Subarea runoff =      8.718(CFS) for      4.400(Ac.)
Total runoff =     16.918(CFS)  Total area =       7.900(Ac.)
Depth of flow =   0.323(Ft.), Average velocity =   5.056(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      7.900(Ac.)
Runoff from this stream =     16.918(CFS)
Time of concentration =   17.84 min.
Rainfall intensity =     3.016(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       6.000 to Point/Station       7.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  180.000(Ft.)
Lowest elevation =  178.500(Ft.)
Elevation difference =    1.500(Ft.) Slope =  2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.83 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7100)*(  75.000^.5)/(   2.000^(1/3)]=   4.83
Calculated TC of    4.825 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.850(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.710
Subarea runoff =      0.486(CFS)
Total initial stream area =       0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       7.000 to Point/Station       8.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   178.500(Ft.)
End of street segment elevation =   173.000(Ft.)
Length of street segment  =   450.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  25.000(Ft.)
Distance from crown to crossfall grade break  =   5.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.000
Slope from grade break to crown (v/hz)  =   0.000
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   1.000
Gutter width =   1.500(Ft.)
Gutter hike from flowline = -0.130(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      7.842(CFS)
Depth of flow =   0.119(Ft.), Average velocity =   2.640(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
```

```
Halfstreet flow width =  25.000(Ft.)
Flow velocity =   2.64(Ft/s)
Travel time =    2.84 min.     TC =    7.67  min.
 Adding area flow to street
Rainfall intensity (I) =      5.200(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      5.200(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      2.911
Subarea runoff =     14.650(CFS) for      4.000(Ac.)
Total runoff =     15.136(CFS)  Total area =       4.100(Ac.)
Street flow at end of street =     15.136(CFS)
Half street flow at end of street =     15.136(CFS)
Depth of flow =   0.177(Ft.), Average velocity =   3.431(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  25.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       8.000 to Point/Station       5.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     60.345(CFS)
Depth of flow =   0.681(Ft.), Average velocity =   8.233(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1             0.00             9.00
        2            10.00             0.00
        3            20.00             0.00
        4            30.00             9.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     60.345(CFS)
  '     '        flow top width =     11.514(Ft.)
  '     '    velocity=    8.233(Ft/s)
  '     '        area =      7.330(Sq.Ft)
  '     '        Froude number =     1.818

Upstream point elevation =   173.000(Ft.)
Downstream point elevation =    71.000(Ft.)
Flow length =  1400.000(Ft.)
```

```
Travel time  =    2.83 min.
Time of concentration =   10.50 min.
Depth of flow =   0.681(Ft.)
Average velocity =   8.233(Ft/s)
Total irregular channel flow =    60.345(CFS)
Irregular channel normal depth above invert elev. =   0.681(Ft.)
Average velocity of channel(s) =   8.233(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      4.245(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      4.245(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =     24.850
Subarea runoff =     90.348(CFS) for     30.900(Ac.)
Total runoff =    105.484(CFS)  Total area =      35.000(Ac.)
Depth of flow =   0.951(Ft.), Average velocity =  10.030(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     35.000(Ac.)
Runoff from this stream =    105.484(CFS)
Time of concentration =   10.50 min.
Rainfall intensity =     4.245(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       16.918     17.84                3.016
2      105.484     10.50                4.245
Qmax(1) =
           1.000 *    1.000 *    16.918) +
           0.711 *    1.000 *   105.484) + =      91.868
Qmax(2) =
           1.000 *    0.589 *    16.918) +
           1.000 *    1.000 *   105.484) + =     115.444
```

```
Total of 2 main streams to confluence:
Flow rates before confluence point:
      16.918     105.484
Maximum flow rates at confluence using above data:
       91.868      115.444
Area of streams before confluence:
        7.900       35.000


Results of confluence:
Total flow rate =    115.444(CFS)
Time of concentration =    10.501 min.
Effective stream area after confluence  =     42.900(Ac.)
End of computations, total study area =          42.900 (Ac.)
```

Proposed Condition Analysis

```
                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
        Rational Hydrology Study        Date: 08/23/22
------------------------------------------------------------------------
PROPOSED 100 YEAR




------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6540

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.600
24 hour precipitation(inches) =  5.500
P6/P24 =    47.3%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(4.3 DU/A or Less       )
Impervious value, Ai = 0.300
Sub-Area C Value = 0.520
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  121.000(Ft.)
Lowest elevation =  118.000(Ft.)
Elevation difference =    3.000(Ft.) Slope =  4.000 %
Top of Initial Area Slope adjusted by User to  2.000 %
```

```
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 80.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 4.3 DU/A or Less
In Accordance With Table 3-2
Initial Area Time of Concentration =   8.10 minutes
 (for slope value of   2.00 %)
Rainfall intensity (I) =      5.018(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.520
Subarea runoff =      0.261(CFS)
Total initial stream area =       0.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   118.000(Ft.)
End of street segment elevation =    99.000(Ft.)
Length of street segment  =   530.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.922(CFS)
Depth of flow =   0.286(Ft.), Average velocity =   3.829(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.977(Ft.)
Flow velocity =   3.83(Ft/s)
Travel time =    2.31 min.     TC =   10.41  min.
 Adding area flow to street
Rainfall intensity (I) =      4.270(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      4.270(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.700  CA =      1.330
Subarea runoff =      5.417(CFS) for      1.800(Ac.)
Total runoff =      5.678(CFS)  Total area =       1.900(Ac.)
Street flow at end of street =      5.678(CFS)
Half street flow at end of street =      5.678(CFS)
Depth of flow =   0.341(Ft.), Average velocity =   4.444(Ft/s)
Flow width (from curb towards crown)=  10.729(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       3.000
**** 6 HOUR HYDROGRAPH ****
______________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =  10.41
Basin Area =     1.90 Acres
6 Hour Rainfall =  2.600 Inches
Runoff Coefficient =  0.700
Peak Discharge =     5.68 CFS
     Time (Min)     Discharge (CFS)
       0              0.000
       10              0.207
       20              0.211
       30              0.219
       40              0.223
       50              0.233
       60              0.238
       70              0.250
       80              0.256
       90              0.270
       100              0.278
       110              0.295
       120              0.305
       130              0.327
       140              0.339
       150              0.369
       160              0.386
       170              0.428
       180              0.454
       190              0.520
       200              0.564
       210              0.690
       220              0.786
       230              1.154
       240              1.625
       250              5.678
```

```
              260                 0.925
              270                 0.619
              280                 0.484
              290                 0.406
              300                 0.353
              310                 0.315
              320                 0.286
              330                 0.263
              340                 0.244
              350                 0.228
              360                 0.215
              370                 0.203
       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                           6 - H O U R    S T O R M
                      R u n o f f     H y d r o g r a p h
       ---------------------------------------------------------------------
                   Hydrograph in   1   Minute intervals ((CFS))

       ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        1.4       2.8       4.3       5.7
 -----------------------------------------------------------------------
   0+ 0       0.0000      0.00  Q          |         |         |         |
   0+ 1       0.0000      0.02  Q          |         |         |         |
   0+ 2       0.0001      0.04  Q          |         |         |         |
   0+ 3       0.0002      0.06  Q          |         |         |         |
   0+ 4       0.0003      0.08  Q          |         |         |         |
   0+ 5       0.0004      0.10  Q          |         |         |         |
   0+ 6       0.0006      0.12  Q          |         |         |         |
   0+ 7       0.0008      0.14  VQ         |         |         |         |
   0+ 8       0.0010      0.17  VQ         |         |         |         |
   0+ 9       0.0013      0.19  VQ         |         |         |         |
   0+10       0.0016      0.21  VQ         |         |         |         |
   0+11       0.0019      0.21  VQ         |         |         |         |
   0+12       0.0021      0.21  VQ         |         |         |         |
   0+13       0.0024      0.21  VQ         |         |         |         |
   0+14       0.0027      0.21  VQ         |         |         |         |
   0+15       0.0030      0.21  VQ         |         |         |         |
   0+16       0.0033      0.21  VQ         |         |         |         |
   0+17       0.0036      0.21  VQ         |         |         |         |
   0+18       0.0039      0.21  VQ         |         |         |         |
   0+19       0.0042      0.21  VQ         |         |         |         |
   0+20       0.0044      0.21  VQ         |         |         |         |
   0+21       0.0047      0.21  VQ         |         |         |         |
   0+22       0.0050      0.21  VQ         |         |         |         |
   0+23       0.0053      0.21  VQ         |         |         |         |
   0+24       0.0056      0.21  VQ         |         |         |         |
   0+25       0.0059      0.21  VQ         |         |         |         |
   0+26       0.0062      0.22  VQ         |         |         |         |
   0+27       0.0065      0.22  VQ         |         |         |         |
   0+28       0.0068      0.22  VQ         |         |         |         |
```

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0+29      0.0071      0.22  VQ        |         |         |         |
0+30      0.0074      0.22   |Q       |         |         |         |
0+31      0.0077      0.22   |Q       |         |         |         |
0+32      0.0080      0.22   |Q       |         |         |         |
0+33      0.0083      0.22   |Q       |         |         |         |
0+34      0.0086      0.22   |Q       |         |         |         |
0+35      0.0089      0.22   |Q       |         |         |         |
0+36      0.0092      0.22   |Q       |         |         |         |
0+37      0.0095      0.22   |Q       |         |         |         |
0+38      0.0098      0.22   |Q       |         |         |         |
0+39      0.0102      0.22   |Q       |         |         |         |
0+40      0.0105      0.22   |Q       |         |         |         |
0+41      0.0108      0.22   |Q       |         |         |         |
0+42      0.0111      0.23   |Q       |         |         |         |
0+43      0.0114      0.23   |Q       |         |         |         |
0+44      0.0117      0.23   |Q       |         |         |         |
0+45      0.0120      0.23   |Q       |         |         |         |
0+46      0.0123      0.23   |Q       |         |         |         |
0+47      0.0127      0.23   |Q       |         |         |         |
0+48      0.0130      0.23   |Q       |         |         |         |
0+49      0.0133      0.23   |Q       |         |         |         |
0+50      0.0136      0.23   |Q       |         |         |         |
0+51      0.0139      0.23   |Q       |         |         |         |
0+52      0.0143      0.23   |Q       |         |         |         |
0+53      0.0146      0.23   |QV      |         |         |         |
0+54      0.0149      0.24   |QV      |         |         |         |
0+55      0.0152      0.24   |QV      |         |         |         |
0+56      0.0156      0.24   |QV      |         |         |         |
0+57      0.0159      0.24   |QV      |         |         |         |
0+58      0.0162      0.24   |QV      |         |         |         |
0+59      0.0165      0.24   |QV      |         |         |         |
1+ 0      0.0169      0.24   |QV      |         |         |         |
1+ 1      0.0172      0.24   |QV      |         |         |         |
1+ 2      0.0175      0.24   |QV      |         |         |         |
1+ 3      0.0179      0.24   |QV      |         |         |         |
1+ 4      0.0182      0.24   |QV      |         |         |         |
1+ 5      0.0185      0.24   |QV      |         |         |         |
1+ 6      0.0189      0.25   |QV      |         |         |         |
1+ 7      0.0192      0.25   |QV      |         |         |         |
1+ 8      0.0195      0.25   |QV      |         |         |         |
1+ 9      0.0199      0.25   |QV      |         |         |         |
1+10      0.0202      0.25   |QV      |         |         |         |
1+11      0.0206      0.25   |QV      |         |         |         |
1+12      0.0209      0.25   |QV      |         |         |         |
1+13      0.0213      0.25   |QV      |         |         |         |
1+14      0.0216      0.25   |Q V     |         |         |         |
1+15      0.0220      0.25   |Q V     |         |         |         |
1+16      0.0223      0.25   |Q V     |         |         |         |
1+17      0.0227      0.25   |Q V     |         |         |         |
1+18      0.0230      0.25   |Q V     |         |         |         |
```

1+19	0.0234	0.26	Q V				
1+20	0.0237	0.26	Q V				
1+21	0.0241	0.26	Q V				
1+22	0.0244	0.26	Q V				
1+23	0.0248	0.26	Q V				
1+24	0.0252	0.26	Q V				
1+25	0.0255	0.26	Q V				
1+26	0.0259	0.26	Q V				
1+27	0.0262	0.27	Q V				
1+28	0.0266	0.27	Q V				
1+29	0.0270	0.27	Q V				
1+30	0.0274	0.27	Q V				
1+31	0.0277	0.27	Q V				
1+32	0.0281	0.27	Q V				
1+33	0.0285	0.27	Q V				
1+34	0.0289	0.27	Q V				
1+35	0.0292	0.27	Q V				
1+36	0.0296	0.27	Q V				
1+37	0.0300	0.28	Q V				
1+38	0.0304	0.28	Q V				
1+39	0.0308	0.28	Q V				
1+40	0.0311	0.28	Q V				
1+41	0.0315	0.28	Q V				
1+42	0.0319	0.28	Q V				
1+43	0.0323	0.28	Q V				
1+44	0.0327	0.28	Q V				
1+45	0.0331	0.29	Q V				
1+46	0.0335	0.29	Q V				
1+47	0.0339	0.29	Q V				
1+48	0.0343	0.29	Q V				
1+49	0.0347	0.29	Q V				
1+50	0.0351	0.29	Q V				
1+51	0.0355	0.30	Q V				
1+52	0.0359	0.30	Q V				
1+53	0.0363	0.30	Q V				
1+54	0.0367	0.30	Q V				
1+55	0.0371	0.30	Q V				
1+56	0.0376	0.30	Q V				
1+57	0.0380	0.30	Q V				
1+58	0.0384	0.30	Q V				
1+59	0.0388	0.30	Q V				
2+ 0	0.0392	0.30	Q V				
2+ 1	0.0396	0.31	Q V				
2+ 2	0.0401	0.31	Q V				
2+ 3	0.0405	0.31	Q V				
2+ 4	0.0409	0.31	Q V				
2+ 5	0.0414	0.32	Q V				
2+ 6	0.0418	0.32	Q V				
2+ 7	0.0422	0.32	Q V				
2+ 8	0.0427	0.32	Q V				

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2+ 9       0.0431      0.32  | Q   V   |         |         |         |
2+10       0.0436      0.33  | Q   V   |         |         |         |
2+11       0.0440      0.33  | Q   V   |         |         |         |
2+12       0.0445      0.33  | Q   V   |         |         |         |
2+13       0.0449      0.33  | Q   V   |         |         |         |
2+14       0.0454      0.33  | Q   V   |         |         |         |
2+15       0.0459      0.33  | Q   V   |         |         |         |
2+16       0.0463      0.33  | Q   V   |         |         |         |
2+17       0.0468      0.34  | Q   V   |         |         |         |
2+18       0.0472      0.34  | Q   V   |         |         |         |
2+19       0.0477      0.34  | Q   V   |         |         |         |
2+20       0.0482      0.34  | Q   V   |         |         |         |
2+21       0.0486      0.34  | Q   V   |         |         |         |
2+22       0.0491      0.35  | Q   V   |         |         |         |
2+23       0.0496      0.35  | Q   V   |         |         |         |
2+24       0.0501      0.35  | Q    V  |         |         |         |
2+25       0.0506      0.35  | Q    V  |         |         |         |
2+26       0.0511      0.36  | Q    V  |         |         |         |
2+27       0.0516      0.36  | Q    V  |         |         |         |
2+28       0.0521      0.36  | Q    V  |         |         |         |
2+29       0.0526      0.37  | Q    V  |         |         |         |
2+30       0.0531      0.37  | Q    V  |         |         |         |
2+31       0.0536      0.37  | Q    V  |         |         |         |
2+32       0.0541      0.37  | Q    V  |         |         |         |
2+33       0.0546      0.37  | Q    V  |         |         |         |
2+34       0.0551      0.38  | Q    V  |         |         |         |
2+35       0.0556      0.38  | Q    V  |         |         |         |
2+36       0.0562      0.38  | Q    V  |         |         |         |
2+37       0.0567      0.38  | Q    V  |         |         |         |
2+38       0.0572      0.38  | Q     V |         |         |         |
2+39       0.0578      0.38  | Q     V |         |         |         |
2+40       0.0583      0.39  | Q     V |         |         |         |
2+41       0.0588      0.39  | Q     V |         |         |         |
2+42       0.0594      0.39  | Q     V |         |         |         |
2+43       0.0599      0.40  | Q     V |         |         |         |
2+44       0.0605      0.40  | Q     V |         |         |         |
2+45       0.0610      0.41  | Q     V |         |         |         |
2+46       0.0616      0.41  | Q     V |         |         |         |
2+47       0.0622      0.42  | Q     V |         |         |         |
2+48       0.0627      0.42  | Q     V |         |         |         |
2+49       0.0633      0.42  | Q     V |         |         |         |
2+50       0.0639      0.43  |  Q    V |         |         |         |
2+51       0.0645      0.43  |  Q     V|         |         |         |
2+52       0.0651      0.43  |  Q     V|         |         |         |
2+53       0.0657      0.44  |  Q     V|         |         |         |
2+54       0.0663      0.44  |  Q     V|         |         |         |
2+55       0.0669      0.44  |  Q     V|         |         |         |
2+56       0.0675      0.44  |  Q     V|         |         |         |
2+57       0.0681      0.45  |  Q     V|         |         |         |
2+58       0.0688      0.45  |  Q     V|         |         |         |
```

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2+59       0.0694      0.45  |  Q     V|         |         |         |
3+ 0       0.0700      0.45  |  Q     V|         |         |         |
3+ 1       0.0706      0.46  |  Q     V|         |         |         |
3+ 2       0.0713      0.47  |  Q     V|         |         |         |
3+ 3       0.0719      0.47  |  Q      V         |         |         |
3+ 4       0.0726      0.48  |  Q      V         |         |         |
3+ 5       0.0733      0.49  |  Q      V         |         |         |
3+ 6       0.0740      0.49  |  Q      V         |         |         |
3+ 7       0.0746      0.50  |  Q      V         |         |         |
3+ 8       0.0753      0.51  |  Q      V         |         |         |
3+ 9       0.0761      0.51  |  Q      V         |         |         |
3+10       0.0768      0.52  |  Q      V         |         |         |
3+11       0.0775      0.52  |  Q      V         |         |         |
3+12       0.0782      0.53  |  Q      V         |         |         |
3+13       0.0790      0.53  |  Q      |V        |         |         |
3+14       0.0797      0.54  |  Q      |V        |         |         |
3+15       0.0804      0.54  |  Q      |V        |         |         |
3+16       0.0812      0.55  |  Q      |V        |         |         |
3+17       0.0820      0.55  |  Q      |V        |         |         |
3+18       0.0827      0.56  |  Q      |V        |         |         |
3+19       0.0835      0.56  |  Q      |V        |         |         |
3+20       0.0843      0.56  |  Q      |V        |         |         |
3+21       0.0851      0.58  |   Q     |V        |         |         |
3+22       0.0859      0.59  |   Q     | V       |         |         |
3+23       0.0867      0.60  |   Q     | V       |         |         |
3+24       0.0876      0.61  |   Q     | V       |         |         |
3+25       0.0884      0.63  |   Q     | V       |         |         |
3+26       0.0893      0.64  |   Q     | V       |         |         |
3+27       0.0902      0.65  |   Q     | V       |         |         |
3+28       0.0911      0.66  |   Q     | V       |         |         |
3+29       0.0920      0.68  |   Q     | V       |         |         |
3+30       0.0930      0.69  |   Q     |  V      |         |         |
3+31       0.0940      0.70  |   Q     |  V      |         |         |
3+32       0.0949      0.71  |   Q     |  V      |         |         |
3+33       0.0959      0.72  |    Q    |  V      |         |         |
3+34       0.0969      0.73  |    Q    |  V      |         |         |
3+35       0.0979      0.74  |    Q    |  V      |         |         |
3+36       0.0990      0.75  |    Q    |  V      |         |         |
3+37       0.1000      0.76  |    Q    |  V      |         |         |
3+38       0.1011      0.77  |    Q    |   V     |         |         |
3+39       0.1021      0.78  |    Q    |   V     |         |         |
3+40       0.1032      0.79  |    Q    |   V     |         |         |
3+41       0.1044      0.82  |    Q    |   V     |         |         |
3+42       0.1055      0.86  |     Q   |   V     |         |         |
3+43       0.1068      0.90  |     Q   |   V     |         |         |
3+44       0.1081      0.93  |     Q   |    V    |         |         |
3+45       0.1094      0.97  |     Q   |    V    |         |         |
3+46       0.1108      1.01  |      Q  |    V    |         |         |
3+47       0.1122      1.04  |      Q  |    V    |         |         |
3+48       0.1137      1.08  |      Q  |    V    |         |         |
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3+49       0.1152      1.12  |      Q  |     V   |         |         |
3+50       0.1168      1.15  |       Q |     V   |         |         |
3+51       0.1185      1.20  |       Q |     V   |         |         |
3+52       0.1202      1.25  |       Q |     V   |         |         |
3+53       0.1220      1.30  |        Q|      V  |         |         |
3+54       0.1238      1.34  |        Q|      V  |         |         |
3+55       0.1258      1.39  |        Q|      V  |         |         |
3+56       0.1277      1.44  |         Q      V  |         |         |
3+57       0.1298      1.48  |         Q       V |         |         |
3+58       0.1319      1.53  |         Q       V |         |         |
3+59       0.1341      1.58  |         |Q      V |         |         |
4+ 0       0.1363      1.63  |         |Q       V|         |         |
4+ 1       0.1391      2.03  |         |   Q    V|         |         |
4+ 2       0.1425      2.44  |         |      Q V|         |         |
4+ 3       0.1464      2.84  |         |         Q         |         |
4+ 4       0.1508      3.25  |         |         |VQ       |         |
4+ 5       0.1559      3.65  |         |         |V   Q    |         |
4+ 6       0.1615      4.06  |         |         | V     Q |         |
4+ 7       0.1676      4.46  |         |         |  V      |Q        |
4+ 8       0.1743      4.87  |         |         |   V     |   Q     |
4+ 9       0.1816      5.27  |         |         |    V    |      Q  |
4+10       0.1894      5.68  |         |         |     V   |        Q|
4+11       0.1966      5.20  |         |         |      V  |     Q   |
4+12       0.2031      4.73  |         |         |       V |  Q      |
4+13       0.2089      4.25  |         |         |        Q|         |
4+14       0.2141      3.78  |         |         |     Q  V|         |
4+15       0.2187      3.30  |         |         |  Q      V         |
4+16       0.2226      2.83  |         |        Q|         |V        |
4+17       0.2258      2.35  |         |     Q   |         |V        |
4+18       0.2284      1.88  |         |  Q      |         |V        |
4+19       0.2303      1.40  |        Q|         |         | V       |
4+20       0.2316      0.93  |     Q   |         |         | V       |
4+21       0.2328      0.89  |     Q   |         |         | V       |
4+22       0.2340      0.86  |     Q   |         |         | V       |
4+23       0.2352      0.83  |    Q    |         |         | V       |
4+24       0.2363      0.80  |    Q    |         |         |  V      |
4+25       0.2373      0.77  |    Q    |         |         |  V      |
4+26       0.2384      0.74  |    Q    |         |         |  V      |
4+27       0.2393      0.71  |    Q    |         |         |  V      |
4+28       0.2403      0.68  |   Q     |         |         |  V      |
4+29       0.2412      0.65  |   Q     |         |         |  V      |
4+30       0.2420      0.62  |   Q     |         |         |  V      |
4+31       0.2429      0.61  |   Q     |         |         |  V      |
4+32       0.2437      0.59  |   Q     |         |         |   V     |
4+33       0.2445      0.58  |   Q     |         |         |   V     |
4+34       0.2453      0.57  |  Q      |         |         |   V     |
4+35       0.2460      0.55  |  Q      |         |         |   V     |
4+36       0.2468      0.54  |  Q      |         |         |   V     |
4+37       0.2475      0.52  |  Q      |         |         |   V     |
4+38       0.2482      0.51  |  Q      |         |         |   V     |
```

4+39	0.2489	0.50	Q			V
4+40	0.2495	0.48	Q			V
4+41	0.2502	0.48	Q			V
4+42	0.2508	0.47	Q			V
4+43	0.2515	0.46	Q			V
4+44	0.2521	0.45	Q			V
4+45	0.2527	0.45	Q			V
4+46	0.2533	0.44	Q			V
4+47	0.2539	0.43	Q			V
4+48	0.2545	0.42	Q			V
4+49	0.2550	0.41	Q			V
4+50	0.2556	0.41	Q			V
4+51	0.2562	0.40	Q			V
4+52	0.2567	0.40	Q			V
4+53	0.2572	0.39	Q			V
4+54	0.2578	0.38	Q			V
4+55	0.2583	0.38	Q			V
4+56	0.2588	0.37	Q			V
4+57	0.2593	0.37	Q			V
4+58	0.2598	0.36	Q			V
4+59	0.2603	0.36	Q			V
5+ 0	0.2608	0.35	Q			V
5+ 1	0.2613	0.35	Q			V
5+ 2	0.2618	0.35	Q			V
5+ 3	0.2622	0.34	Q			V
5+ 4	0.2627	0.34	Q			V
5+ 5	0.2632	0.33	Q			V
5+ 6	0.2636	0.33	Q			V
5+ 7	0.2641	0.33	Q			V
5+ 8	0.2645	0.32	Q			V
5+ 9	0.2649	0.32	Q			V
5+10	0.2654	0.32	Q			V
5+11	0.2658	0.31	Q			V
5+12	0.2662	0.31	Q			V
5+13	0.2667	0.31	Q			V
5+14	0.2671	0.30	Q			V
5+15	0.2675	0.30	Q			V
5+16	0.2679	0.30	Q			V
5+17	0.2683	0.29	Q			V
5+18	0.2687	0.29	Q			V
5+19	0.2691	0.29	Q			V
5+20	0.2695	0.29	Q			V
5+21	0.2699	0.28	Q			V
5+22	0.2703	0.28	Q			V
5+23	0.2707	0.28	Q			V
5+24	0.2710	0.28	Q			V
5+25	0.2714	0.27	Q			V
5+26	0.2718	0.27	Q			V
5+27	0.2722	0.27	Q			V
5+28	0.2725	0.27	Q			V

5+29	0.2729	0.27	Q				V
5+30	0.2733	0.26	Q				V
5+31	0.2736	0.26	Q				V
5+32	0.2740	0.26	Q				V
5+33	0.2743	0.26	Q				V
5+34	0.2747	0.26	Q				V
5+35	0.2750	0.25	Q				V
5+36	0.2754	0.25	Q				V
5+37	0.2757	0.25	Q				V
5+38	0.2761	0.25	Q				V
5+39	0.2764	0.25	Q				V
5+40	0.2767	0.24	Q				V
5+41	0.2771	0.24	Q				V
5+42	0.2774	0.24	Q				V
5+43	0.2777	0.24	Q				V
5+44	0.2781	0.24	Q				V
5+45	0.2784	0.24	Q				V
5+46	0.2787	0.23	Q				V
5+47	0.2790	0.23	Q				V
5+48	0.2793	0.23	Q				V
5+49	0.2797	0.23	Q				V
5+50	0.2800	0.23	Q				V
5+51	0.2803	0.23	Q				V
5+52	0.2806	0.23	Q				V
5+53	0.2809	0.22	Q				V
5+54	0.2812	0.22	Q				V
5+55	0.2815	0.22	Q				V
5+56	0.2818	0.22	Q				V
5+57	0.2821	0.22	Q				V
5+58	0.2824	0.22	Q				V
5+59	0.2827	0.22	Q				V
6+ 0	0.2830	0.21	Q				V
6+ 1	0.2833	0.21	Q				V
6+ 2	0.2836	0.21	Q				V
6+ 3	0.2839	0.21	Q				V
6+ 4	0.2842	0.21	Q				V
6+ 5	0.2845	0.21	Q				V
6+ 6	0.2848	0.21	Q				V
6+ 7	0.2850	0.21	Q				V
6+ 8	0.2853	0.21	Q				V
6+ 9	0.2856	0.20	Q				V
6+10	0.2859	0.20	Q				V

++

```
Process from Point/Station       3.000 to Point/Station       3.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity (I) =      3.016(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  17.84 min.  Rain intensity =       3.02(In/Hr)
Total area =        1.900(Ac.)  Total runoff =     2.440(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       4.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    91.000(Ft.)
Downstream point/station elevation =    88.000(Ft.)
Pipe length  =    50.00(Ft.) Slope =   0.0600  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.440(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.440(CFS)
Normal flow depth in pipe =    3.74(In.)
Flow top width inside pipe =   14.61(In.)
Critical Depth =    7.09(In.)
Pipe flow velocity =      9.17(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =    17.93 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity (I) =      3.016(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  17.84 min.  Rain intensity =       3.02(In/Hr)
```

```
Total area =        5.400(Ac.)  Total runoff =    10.600(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       4.000 to Point/Station       5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    88.000(Ft.)
Downstream point/station elevation =    72.000(Ft.)
Pipe length  =   150.00(Ft.) Slope =   0.1067  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.600(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    10.600(CFS)
Normal flow depth in pipe =    6.14(In.)
Flow top width inside pipe =   20.94(In.)
Critical Depth =   14.01(In.)
Pipe flow velocity =     16.70(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    17.99 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Rainfall intensity (I) =      3.000(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Time of concentration =    17.99 min.
Rainfall intensity =      3.000(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      5.041
Subarea runoff =      4.521(CFS) for      1.700(Ac.)
Total runoff =     15.121(CFS)  Total area =      7.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Rainfall intensity (I) =      3.000(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Time of concentration =    17.99 min.
Rainfall intensity =      3.000(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.674  CA =      5.321
Subarea runoff =      0.840(CFS) for      0.800(Ac.)
Total runoff =     15.961(CFS)  Total area =       7.900(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.900(Ac.)
Runoff from this stream =     15.961(CFS)
Time of concentration =   17.99 min.
Rainfall intensity =     3.000(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity (I) =      4.245(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.50 min.  Rain intensity =       4.25(In/Hr)
Total area =       35.000(Ac.)  Total runoff =   105.500(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       5.000 to Point/Station       5.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     35.000(Ac.)
Runoff from this stream =    105.500(CFS)
Time of concentration =   10.50 min.
```

```
Rainfall intensity =     4.245(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       15.961     17.99                3.000
2      105.500     10.50                4.245
Qmax(1) =
           1.000 *    1.000 *    15.961) +
           0.707 *    1.000 *   105.500) + =      90.507
Qmax(2) =
           1.000 *    0.584 *    15.961) +
           1.000 *    1.000 *   105.500) + =     114.816

Total of 2 streams to confluence:
Flow rates before confluence point:
      15.961     105.500
Maximum flow rates at confluence using above data:
       90.507      114.816
Area of streams before confluence:
        7.900       35.000
Results of confluence:
Total flow rate =    114.816(CFS)
Time of concentration =    10.500 min.
Effective stream area after confluence =     42.900(Ac.)
End of computations, total study area =          46.700 (Ac.)
```

EXISTING GRATED INLET IN EUCLID AVE → NODE #2

Q_{100} = 8.2 cfs

SAG CONDITION → $Q_{IN} = C \times A \times (2 g d)^{1/2}$
(0.5' PONDING)

$= 0.67 \times 4.7 (32.2)^{1/2}$

$Q_{IN} = 17.9$ cfs $> Q_{100}$

PROPOSED TYPE A-4 CLEANOUT W/ 3 OPENINGS (L = 4', H > 0.5')
(EMERGENCY OVERFLOW)

$Q_{IN} = C_w P_e d^{3/2}$

$= 3.0 \times 4 \times 0.5^{3/2}$

$Q_{IN} = 14.7$ cfs $> Q_{100}$

X3 $= 44.1$ cfs $> Q_{100}$

Name:

Date:

Lundstrom +associates
PLANNING | CIVIL ENGINEERING | LAND SURVEYING

Project: RIDGEWAY A

Description: INLET CAPACITY

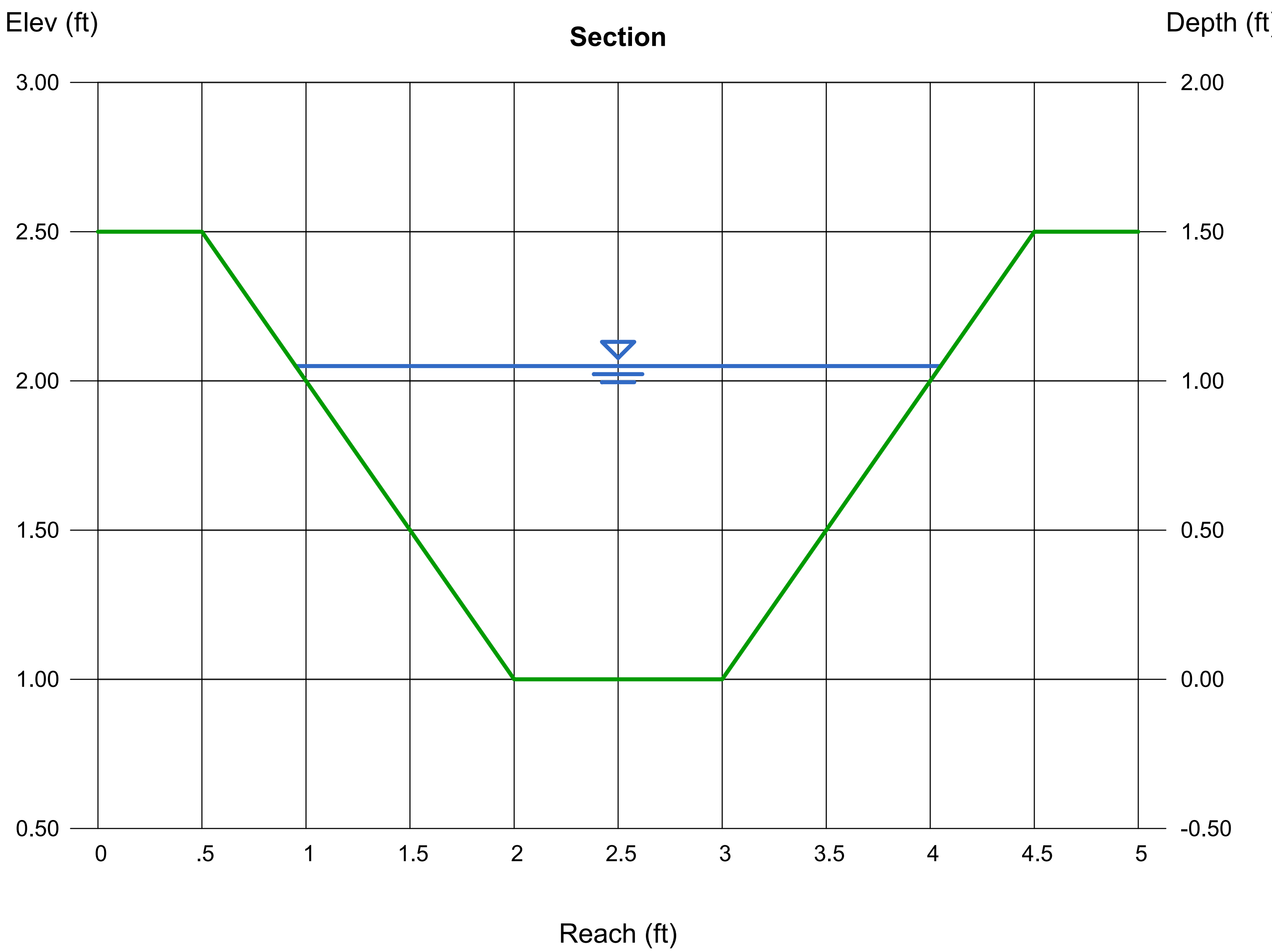
Channel Report

PROPOSED DITCH DMA#4 (OFF SITE RUN-ON)

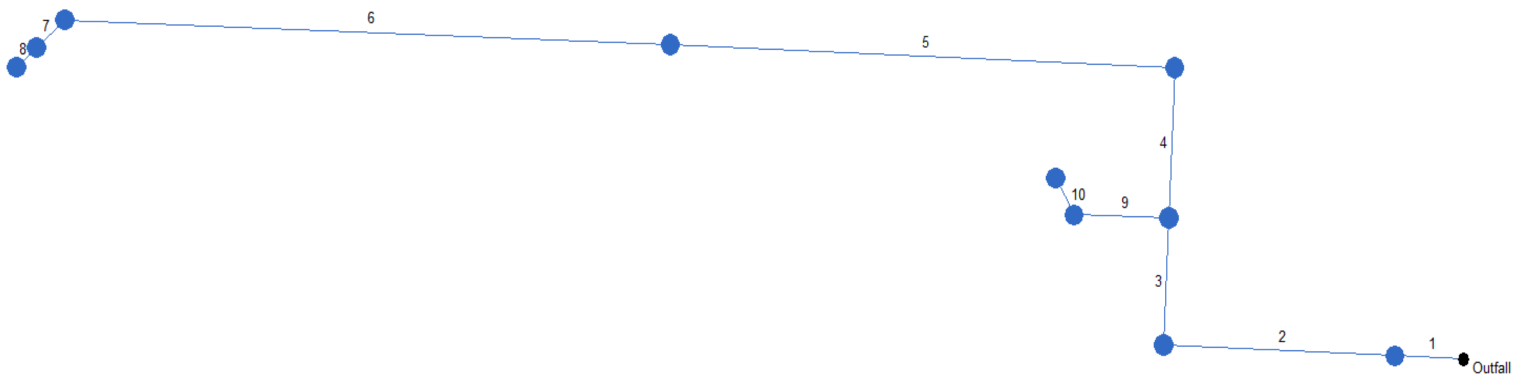
Trapezoidal	
Bottom Width (ft)	= 1.00
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 1.00
N-Value	= 0.025

Calculations	
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted	
Depth (ft)	= 1.05
Q (cfs)	= 8.506
Area (sqft)	= 2.15
Velocity (ft/s)	= 3.95
Wetted Perim (ft)	= 3.97
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 3.10
EGL (ft)	= 1.29



Hydraflow Plan View



Project File: L209-04 PIPE FLOW.stm	No. Lines: 10	09-14-2022

Hydraflow Storm Sewers 2005

Storm Sewer Tabulation

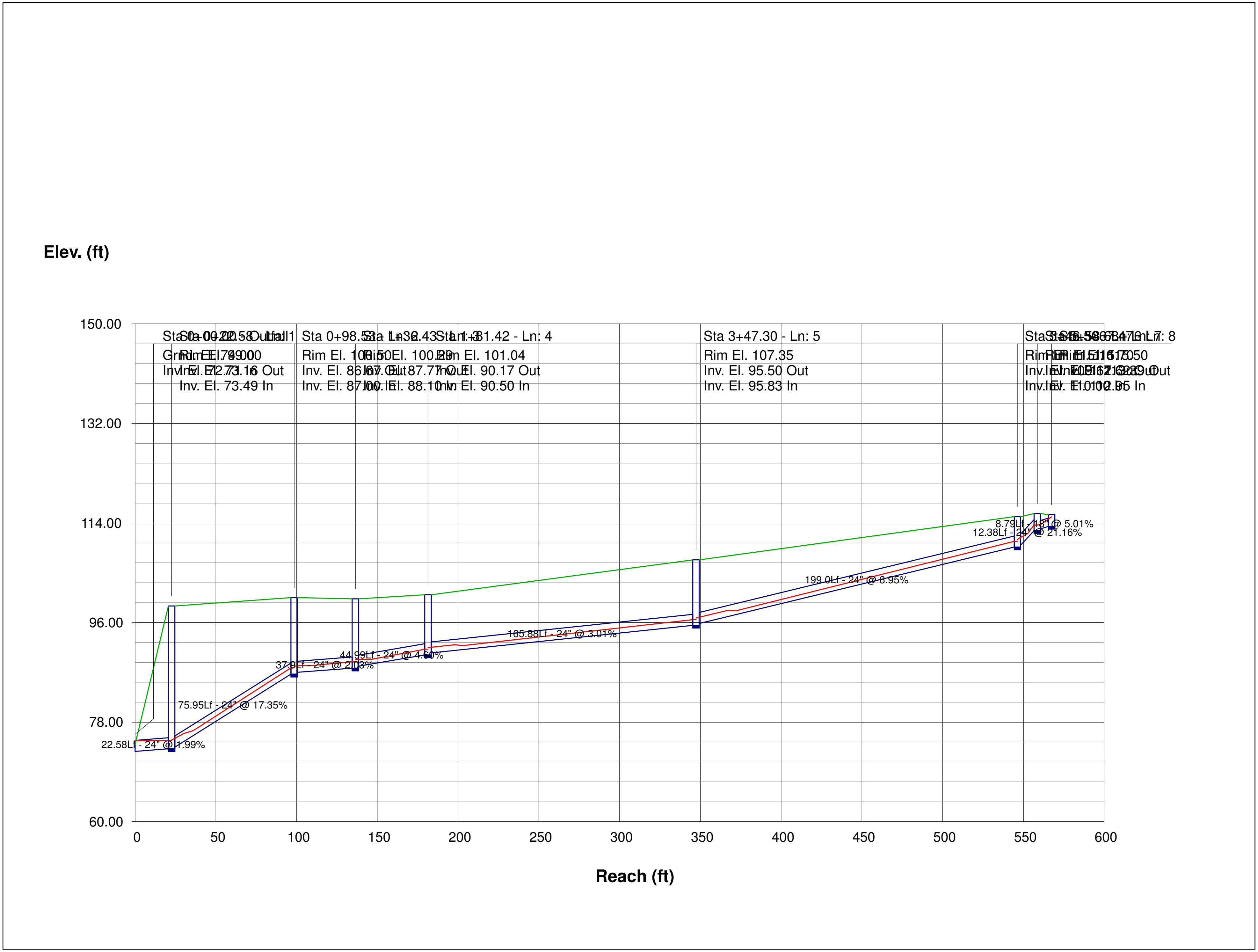
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	22.6	0.00	0.00	0.00	0.00	0.00	0.0	1.7	0.0	10.60	37.74	3.82	24	1.99	73.16	72.71	74.63	74.70	99.00	74.00	
2	1	76.0	0.00	0.00	0.00	0.00	0.00	0.0	1.5	0.0	10.60	111.4	5.29	24	17.35	86.67	73.49	87.82	74.78	100.50	99.00	
3	2	37.9	0.00	0.00	0.00	0.00	0.00	0.0	1.4	0.0	10.60	38.10	5.68	24	2.03	87.77	87.00	88.92	88.14	100.29	100.50	
4	3	45.0	0.00	0.00	0.00	0.00	0.00	0.0	1.2	0.0	8.20	57.34	4.62	24	4.60	90.17	88.10	91.18	89.31	101.04	100.29	
5	4	165.9	0.00	0.00	0.00	0.00	0.00	0.0	0.7	0.0	8.20	46.41	5.22	24	3.01	95.50	90.50	96.51	91.49	107.35	101.04	
6	5	199.0	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.0	8.20	70.49	5.22	24	6.95	109.67	95.83	110.68	96.82	115.16	107.35	
7	6	12.4	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	8.20	123.0	5.22	24	21.16	112.62	110.00	113.63	110.99	115.70	115.16	
8	7	8.8	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	8.20	27.77	7.05	18	5.01	113.39	112.95	114.72	113.71	115.50	115.70	
9	3	31.1	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.40	29.36	2.60	18	5.60	89.84	88.10	90.43	89.39	100.00	100.29	
10	9	12.6	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.40	32.85	4.20	18	7.01	91.00	90.12	91.59	90.62	101.00	100.00	

Project File: L209-04 PIPE FLOW.stm | Number of lines: 10 | Run Date: 09-14-2022

NOTES: Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82; Return period = 100 Yrs.

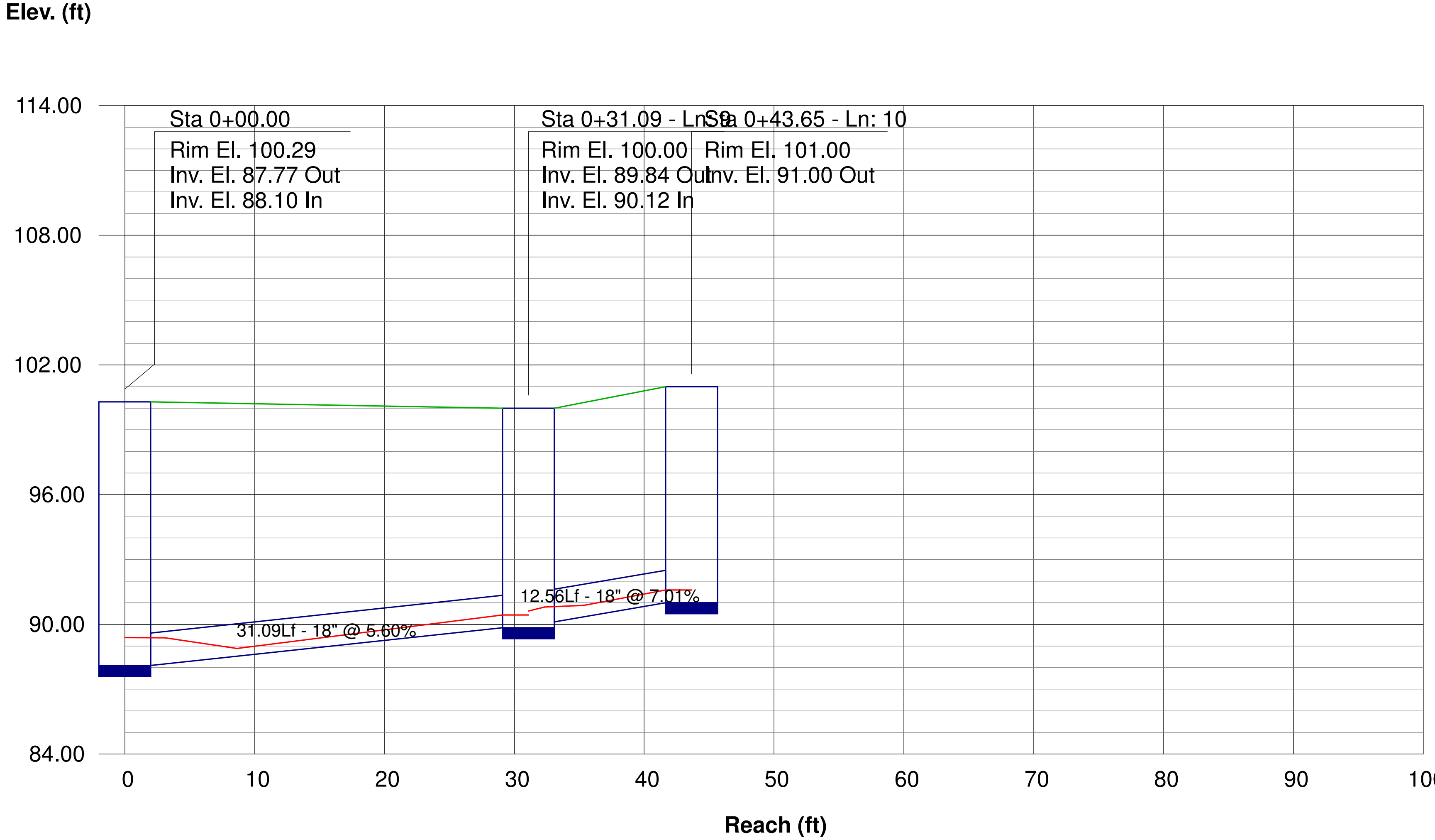
Storm Sewer Profile

Proj. file: L209-04 PIPE FLOW.stm



Storm Sewer Profile

Proj. file: L209-04 PIPE FLOW.stm



PONDPACK REPORT

Project Summary	
Title	
Engineer	
Company	
Date	12/28/2021

Notes

Table of Contents

PONDPACK REPORT

Subsection: User Notifications

User Notifications?	No user notifications generated.

PONDPACK REPORT

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
DMA 1	Base	0	12,410.00	250.000	5.68

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
OUTFALL	Base	0	13,724.00	258.000	2.30

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
DETENTION VAULT (IN)	Base	0	13,799.00	249.000	5.28	(N/A)	(N/A)
DETENTION VAULT (OUT)	Base	0	13,724.00	258.000	2.30	95.54	4,467.00

PONDPACK REPORT

Subsection: Read Hydrograph | Scenario: Base
Label: DMA 1

Peak Discharge	5.68 ft³/s
Time to Peak	250.000 min
Hydrograph Volume	12,410.00 ft³

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 10.000 min
Time on left represents time for first value in each row.

Time (min)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
0.000	0.00	0.21	0.21	0.22	0.22
50.000	0.23	0.24	0.25	0.26	0.27
100.000	0.28	0.30	0.31	0.33	0.34
150.000	0.37	0.39	0.43	0.45	0.52
200.000	0.56	0.69	0.79	1.15	1.63
250.000	5.68	0.93	0.62	0.48	0.41
300.000	0.35	0.32	0.29	0.26	0.24
350.000	0.23	0.22	0.00	(N/A)	(N/A)

PONDPACK REPORT

Subsection: Time vs. Elevation — Scenario: Base

Label: DETENTION VAULT (OUT)

Time vs. Elevation (ft)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
0.000	94.00	94.00	94.01	94.02	94.03
15.000	94.04	94.05	94.06	94.07	94.08
30.000	94.09	94.10	94.11	94.11	94.12
45.000	94.13	94.14	94.14	94.15	94.16
60.000	94.16	94.17	94.17	94.18	94.19
75.000	94.19	94.20	94.20	94.21	94.21
90.000	94.22	94.22	94.23	94.23	94.24
105.000	94.24	94.25	94.26	94.26	94.27
120.000	94.27	94.28	94.28	94.29	94.29
135.000	94.30	94.30	94.31	94.31	94.32
150.000	94.32	94.33	94.34	94.34	94.35
165.000	94.35	94.36	94.37	94.38	94.38
180.000	94.39	94.40	94.41	94.42	94.43
195.000	94.44	94.45	94.46	94.47	94.49
210.000	94.50	94.52	94.53	94.55	94.57
225.000	94.59	94.62	94.65	94.69	94.73
240.000	94.77	94.86	95.00	95.21	95.40
255.000	95.52	95.54	95.49	95.41	95.34
270.000	95.27	95.20	95.14	95.08	95.03
285.000	94.98	94.94	94.90	94.86	94.82
300.000	94.79	94.76	94.73	94.70	94.68
315.000	94.66	94.63	94.61	94.59	94.58
330.000	94.56	94.55	94.53	94.52	94.50
345.000	94.49	94.48	94.47	94.46	94.45
360.000	94.44	94.43	94.41	94.40	94.38
375.000	94.36	94.34	94.33	94.31	94.30
390.000	94.28	94.27	94.26	94.24	94.23
405.000	94.22	94.21	94.20	94.19	94.19
420.000	94.18	94.17	94.16	94.16	94.15
435.000	94.14	94.14	94.13	94.13	94.12
450.000	94.12	94.11	94.11	94.10	94.10
465.000	94.09	94.09	94.09	94.08	94.08
480.000	94.08	94.08	94.07	94.07	94.07
495.000	94.07	94.06	94.06	94.06	94.06
510.000	94.06	94.06	94.05	94.05	94.05
525.000	94.05	94.05	94.05	94.05	94.05
540.000	94.04	94.04	94.04	94.04	94.04
555.000	94.04	94.04	94.04	94.04	94.04
570.000	94.04	94.04	94.04	94.04	94.03
585.000	94.03	94.03	94.03	94.03	94.03
600.000	94.03	94.03	94.03	94.03	94.03

PONDPACK REPORT

Subsection: Time vs. Elevation | Scenario: Base

Label: DETENTION VAULT (OUT)

Time vs. Elevation (ft)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
615.000	94.03	94.03	94.03	94.03	94.03
630.000	94.03	94.03	94.03	94.03	94.03
645.000	94.03	94.03	94.03	94.03	94.03
660.000	94.03	94.03	94.03	94.03	94.03
675.000	94.03	94.03	94.03	94.03	94.03
690.000	94.03	94.03	94.03	94.03	94.03
705.000	94.03	94.03	94.03	94.03	94.03
720.000	94.03	94.03	94.03	94.03	94.03
735.000	94.03	94.03	94.03	94.03	94.03
750.000	94.03	94.03	94.03	94.03	94.03
765.000	94.03	94.03	94.03	94.03	94.03
780.000	94.03	94.03	94.03	94.03	94.03
795.000	94.03	94.03	94.03	94.03	94.03
810.000	94.03	94.03	94.03	94.03	94.03
825.000	94.03	94.03	94.03	94.03	94.03
840.000	94.03	94.03	94.03	94.03	94.03
855.000	94.03	94.03	94.03	94.03	94.03
870.000	94.03	94.03	94.03	94.03	94.03
885.000	94.03	94.03	94.03	94.03	94.03
900.000	94.03	94.03	94.03	94.03	94.03
915.000	94.03	94.03	94.03	94.03	94.03
930.000	94.03	94.03	94.03	94.03	94.03
945.000	94.03	94.03	94.03	94.03	94.03
960.000	94.03	94.03	94.03	94.03	94.03
975.000	94.03	94.03	94.03	94.03	94.03
990.000	94.03	94.03	94.03	94.03	94.03
1,005.000	94.03	94.03	94.03	94.03	94.03
1,020.000	94.03	94.03	94.03	94.03	94.03
1,035.000	94.03	94.03	94.03	94.03	94.03
1,050.000	94.03	94.03	94.03	94.03	94.03
1,065.000	94.03	94.03	94.03	94.03	94.03
1,080.000	94.03	94.03	94.03	94.03	94.03
1,095.000	94.03	94.03	94.03	94.03	94.03
1,110.000	94.03	94.03	94.03	94.03	94.03
1,125.000	94.03	94.03	94.03	94.03	94.03
1,140.000	94.03	94.03	94.03	94.03	94.03
1,155.000	94.03	94.03	94.03	94.03	94.03
1,170.000	94.03	94.03	94.03	94.03	94.03
1,185.000	94.03	94.03	94.03	94.03	94.03
1,200.000	94.03	94.03	94.03	94.03	94.03
1,215.000	94.03	94.03	94.03	94.03	94.03

PONDPACK REPORT

Subsection: Time vs. Elevation | Scenario: Base

Label: DETENTION VAULT (OUT)

Time vs. Elevation (ft)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
1,230.000	94.03	94.03	94.03	94.03	94.03
1,245.000	94.03	94.03	94.03	94.03	94.03
1,260.000	94.03	94.03	94.03	94.03	94.03
1,275.000	94.03	94.03	94.03	94.03	94.03
1,290.000	94.03	94.03	94.03	94.03	94.03
1,305.000	94.03	94.03	94.03	94.03	94.03
1,320.000	94.03	94.03	94.03	94.03	94.03
1,335.000	94.03	94.03	94.03	94.03	94.03
1,350.000	94.03	94.03	94.03	94.03	94.03
1,365.000	94.03	94.03	94.03	94.03	94.03
1,380.000	94.03	94.03	94.03	94.03	94.03
1,395.000	94.03	94.03	94.03	94.03	94.03
1,410.000	94.03	94.03	94.03	94.03	94.03
1,425.000	94.03	94.03	94.03	94.03	94.03
1,440.000	94.03	(N/A)	(N/A)	(N/A)	(N/A)

PONDPACK REPORT

Subsection: Time vs. Volume Scenario: Base
Label: DETENTION VAULT

Time vs. Volume (ft³)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Volume (ft³)	Volume (ft³)	Volume (ft³)	Volume (ft³)	Volume (ft³)
0.000	0.00	5.00	22.00	48.00	80.00
15.000	112.00	143.00	173.00	201.00	229.00
30.000	255.00	281.00	305.00	328.00	351.00
45.000	372.00	393.00	413.00	433.00	452.00
60.000	470.00	489.00	506.00	524.00	541.00
75.000	558.00	574.00	590.00	606.00	621.00
90.000	636.00	651.00	666.00	681.00	695.00
105.000	710.00	725.00	740.00	755.00	770.00
120.000	784.00	799.00	814.00	829.00	845.00
135.000	860.00	875.00	889.00	905.00	921.00
150.000	938.00	955.00	972.00	990.00	1,008.00
165.000	1,027.00	1,048.00	1,069.00	1,090.00	1,112.00
180.000	1,133.00	1,156.00	1,181.00	1,208.00	1,237.00
195.000	1,268.00	1,298.00	1,330.00	1,366.00	1,407.00
210.000	1,452.00	1,500.00	1,549.00	1,598.00	1,653.00
225.000	1,719.00	1,797.00	1,888.00	1,993.00	2,113.00
240.000	2,247.00	2,485.00	2,910.00	3,496.00	4,070.00
255.000	4,410.00	4,467.00	4,314.00	4,090.00	3,876.00
270.000	3,671.00	3,479.00	3,302.00	3,139.00	2,989.00
285.000	2,851.00	2,724.00	2,606.00	2,494.00	2,390.00
300.000	2,293.00	2,202.00	2,118.00	2,040.00	1,967.00
315.000	1,900.00	1,837.00	1,779.00	1,725.00	1,673.00
330.000	1,625.00	1,581.00	1,539.00	1,500.00	1,464.00
345.000	1,430.00	1,397.00	1,366.00	1,336.00	1,307.00
360.000	1,278.00	1,246.00	1,203.00	1,151.00	1,096.00
375.000	1,043.00	994.00	946.00	902.00	859.00
390.000	819.00	781.00	745.00	710.00	678.00
405.000	647.00	618.00	590.00	563.00	538.00
420.000	514.00	492.00	471.00	450.00	431.00
435.000	413.00	395.00	379.00	363.00	349.00
450.000	335.00	321.00	309.00	297.00	285.00
465.000	275.00	264.00	255.00	245.00	237.00
480.000	228.00	221.00	213.00	206.00	199.00
495.000	193.00	187.00	181.00	176.00	171.00
510.000	166.00	161.00	157.00	152.00	148.00
525.000	145.00	141.00	138.00	135.00	131.00
540.000	129.00	126.00	123.00	121.00	118.00
555.000	116.00	114.00	112.00	110.00	108.00
570.000	107.00	105.00	104.00	102.00	101.00
585.000	99.00	98.00	97.00	96.00	95.00
600.000	94.00	93.00	92.00	91.00	90.00

PONDPACK REPORT

Subsection: Time vs. Volume Scenario: Base
Label: DETENTION VAULT

Time vs. Volume (ft^3)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Volume (ft^3)	Volume (ft^3)	Volume (ft^3)	Volume (ft^3)	Volume (ft^3)
615.000	89.00	89.00	88.00	87.00	87.00
630.000	86.00	86.00	85.00	85.00	84.00
645.000	84.00	83.00	83.00	82.00	82.00
660.000	82.00	81.00	81.00	81.00	80.00
675.000	80.00	80.00	80.00	79.00	79.00
690.000	79.00	79.00	79.00	78.00	78.00
705.000	78.00	78.00	78.00	78.00	78.00
720.000	77.00	77.00	77.00	77.00	77.00
735.000	77.00	77.00	77.00	77.00	77.00
750.000	77.00	76.00	76.00	76.00	76.00
765.000	76.00	76.00	76.00	76.00	76.00
780.000	76.00	76.00	76.00	76.00	76.00
795.000	76.00	76.00	76.00	76.00	76.00
810.000	76.00	76.00	76.00	76.00	76.00
825.000	76.00	76.00	76.00	75.00	75.00
840.000	75.00	75.00	75.00	75.00	75.00
855.000	75.00	75.00	75.00	75.00	75.00
870.000	75.00	75.00	75.00	75.00	75.00
885.000	75.00	75.00	75.00	75.00	75.00
900.000	75.00	75.00	75.00	75.00	75.00
915.000	75.00	75.00	75.00	75.00	75.00
930.000	75.00	75.00	75.00	75.00	75.00
945.000	75.00	75.00	75.00	75.00	75.00
960.000	75.00	75.00	75.00	75.00	75.00
975.000	75.00	75.00	75.00	75.00	75.00
990.000	75.00	75.00	75.00	75.00	75.00
1,005.000	75.00	75.00	75.00	75.00	75.00
1,020.000	75.00	75.00	75.00	75.00	75.00
1,035.000	75.00	75.00	75.00	75.00	75.00
1,050.000	75.00	75.00	75.00	75.00	75.00
1,065.000	75.00	75.00	75.00	75.00	75.00
1,080.000	75.00	75.00	75.00	75.00	75.00
1,095.000	75.00	75.00	75.00	75.00	75.00
1,110.000	75.00	75.00	75.00	75.00	75.00
1,125.000	75.00	75.00	75.00	75.00	75.00
1,140.000	75.00	75.00	75.00	75.00	75.00
1,155.000	75.00	75.00	75.00	75.00	75.00
1,170.000	75.00	75.00	75.00	75.00	75.00
1,185.000	75.00	75.00	75.00	75.00	75.00
1,200.000	75.00	75.00	75.00	75.00	75.00
1,215.000	75.00	75.00	75.00	75.00	75.00

PONDPACK REPORT

Subsection: Time vs. Volume | Scenario: Base

Label: DETENTION VAULT

Time vs. Volume (ft³)

Output Time increment = 3.000 min
Time on left represents time for first value in each row.

Time (min)	Volume (ft³)	Volume (ft³)	Volume (ft³)	Volume (ft³)	Volume (ft³)
1,230.000	75.00	75.00	75.00	75.00	75.00
1,245.000	75.00	75.00	75.00	75.00	75.00
1,260.000	75.00	75.00	75.00	75.00	75.00
1,275.000	75.00	75.00	75.00	75.00	75.00
1,290.000	75.00	75.00	75.00	75.00	75.00
1,305.000	75.00	75.00	75.00	75.00	75.00
1,320.000	75.00	75.00	75.00	75.00	75.00
1,335.000	75.00	75.00	75.00	75.00	75.00
1,350.000	75.00	75.00	75.00	75.00	75.00
1,365.000	75.00	75.00	75.00	75.00	75.00
1,380.000	75.00	75.00	75.00	75.00	75.00
1,395.000	75.00	75.00	75.00	75.00	75.00
1,410.000	75.00	75.00	75.00	75.00	75.00
1,425.000	75.00	75.00	75.00	75.00	75.00
1,440.000	75.00	(N/A)	(N/A)	(N/A)	(N/A)

PONDPACK REPORT

Subsection: Outlet Input Data | Scenario: Base

Label: Composite Outlet Structure - 1

Requested Pond Water Surface Elevations	
Minimum (Headwater)	94.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	97.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 1	Forward	TW	96.00	97.00
Rectangular Weir	Weir - 1	Forward	TW	94.00	97.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

PONDPACK REPORT

Subsection: Outlet Input Data — Scenario: Base

Label: Composite Outlet Structure - 1

Structure ID: Riser - 1 Structure Type: Stand Pipe	
Number of Openings	1
Elevation	96.00 ft
Diameter	54.0 in
Orifice Area	15.9 ft²
Orifice Coefficient	0.600
Weir Length	14.14 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	True

Structure ID: Weir - 1 Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	94.00 ft
Weir Length	0.40 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

PONDPACK REPORT

Subsection: Elevation-Volume-Flow Table (Pond) Scenario: Base
Label: DETENTION VAULT

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	94.00 ft
Volume (Initial)	0.00 ft³
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	3.000 min

Elevation (ft)	Outflow (ft³/s)	Storage (ft³)	Area (ft²)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
94.00	0.00	0.00	0	0.00	0.00	0.00
94.50	0.42	1,450.00	0	0.00	0.42	16.54
95.00	1.20	2,900.00	0	0.00	1.20	33.42
95.50	2.20	4,350.00	0	0.00	2.20	50.54
96.00	3.39	5,800.00	0	0.00	3.39	67.84
96.50	19.74	7,250.00	0	0.00	19.74	100.29
97.00	48.65	8,700.00	0	0.00	48.65	145.31

PONDPACK REPORT

Subsection: Level Pool Pond Routing Summary — Scenario: Base

Label: DETENTION VAULT (IN)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	94.00 ft
Volume (Initial)	0.00 ft³
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	3.000 min

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	5.28 ft³/s	Time to Peak (Flow, In)	249.000 min
Flow (Peak Outlet)	2.30 ft³/s	Time to Peak (Flow, Outlet)	258.000 min

Elevation (Water Surface, Peak)	95.54 ft
Volume (Peak)	4,467.08 ft³

Mass Balance (ft³)	
Volume (Initial)	0.00 ft³
Volume (Total Inflow)	13,799.00 ft³
Volume (Total Infiltration)	0.00 ft³
Volume (Total Outlet Outflow)	13,724.00 ft³
Volume (Retained)	71.00 ft³
Volume (Unrouted)	-4.00 ft³
Error (Mass Balance)	0.0 %

PONDPACK REPORT

Subsection: Pond Inflow Summary Scenario: Base
Label: DETENTION VAULT (IN)

Summary for Hydrograph Addition at 'DETENTION VAULT'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	DMA 1

Node Inflows

Inflow Type	Element	Volume (ft^3)	Time to Peak (min)	Flow (Peak) (ft^3/s)
Flow (From)	DMA 1	12,410.00	250.000	5.68
Flow (In)	DETENTION VAULT	13,798.96	249.000	5.28

PONDPACK REPORT

Index

SDHM 3.1

PROJECT REPORT

General Model Information

Project Name:	ridgeway c 11-01-2022
Site Name:	Ridgeway A
Site Address:	
City:	
Report Date:	11/3/2022
Gage:	BONITA
Data Start:	10/01/1971
Data End:	09/30/2004
Timestep:	Hourly
Precip Scale:	1.000
Version Date:	2020/04/07

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,NatVeg,Moderate	1.9
Pervious Total	1.9
Impervious Land Use	acre
Impervious Total	0
Basin Total	1.9

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Moderate	0.54
Pervious Total	0.54
Impervious Land Use	acre
IMPERVIOUS-FLAT	1.36
Impervious Total	1.36
Basin Total	1.9

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

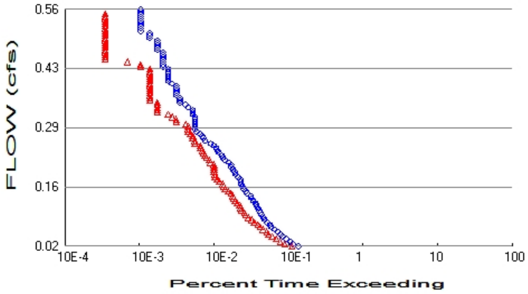
Width:	53.7834401787442 ft.
Length:	53.7834401787442 ft.
Depth:	6 ft.
Discharge Structure	
Riser Height:	5 ft.
Riser Diameter:	54 in.
Notch Type:	Rectangular
Notch Width:	0.400 ft.
Notch Height:	2.000 ft.
Orifice 1 Diameter:	0.69993 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

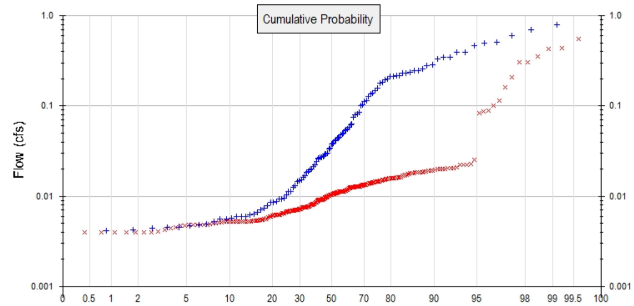
Vault Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.066	0.000	0.000	0.000
0.0667	0.066	0.004	0.003	0.000
0.1333	0.066	0.008	0.004	0.000
0.2000	0.066	0.013	0.005	0.000
0.2667	0.066	0.017	0.006	0.000
0.3333	0.066	0.022	0.007	0.000
0.4000	0.066	0.026	0.008	0.000
0.4667	0.066	0.031	0.009	0.000
0.5333	0.066	0.035	0.009	0.000
0.6000	0.066	0.039	0.010	0.000
0.6667	0.066	0.044	0.010	0.000
0.7333	0.066	0.048	0.011	0.000
0.8000	0.066	0.053	0.011	0.000
0.8667	0.066	0.057	0.012	0.000
0.9333	0.066	0.062	0.012	0.000
1.0000	0.066	0.066	0.013	0.000
1.0667	0.066	0.070	0.013	0.000
1.1333	0.066	0.075	0.014	0.000
1.2000	0.066	0.079	0.014	0.000
1.2667	0.066	0.084	0.015	0.000
1.3333	0.066	0.088	0.015	0.000
1.4000	0.066	0.093	0.015	0.000
1.4667	0.066	0.097	0.016	0.000
1.5333	0.066	0.101	0.016	0.000
1.6000	0.066	0.106	0.016	0.000
1.6667	0.066	0.110	0.017	0.000
1.7333	0.066	0.115	0.017	0.000
1.8000	0.066	0.119	0.017	0.000
1.8667	0.066	0.124	0.018	0.000
1.9333	0.066	0.128	0.018	0.000
2.0000	0.066	0.132	0.018	0.000
2.0667	0.066	0.137	0.019	0.000
2.1333	0.066	0.141	0.019	0.000
2.2000	0.066	0.146	0.019	0.000
2.2667	0.066	0.150	0.020	0.000
2.3333	0.066	0.154	0.020	0.000
2.4000	0.066	0.159	0.020	0.000

2.4667	0.066	0.163	0.020	0.000
2.5333	0.066	0.168	0.021	0.000
2.6000	0.066	0.172	0.021	0.000
2.6667	0.066	0.177	0.021	0.000
2.7333	0.066	0.181	0.022	0.000
2.8000	0.066	0.185	0.022	0.000
2.8667	0.066	0.190	0.022	0.000
2.9333	0.066	0.194	0.022	0.000
3.0000	0.066	0.199	0.023	0.000
3.0667	0.066	0.203	0.045	0.000
3.1333	0.066	0.208	0.086	0.000
3.2000	0.066	0.212	0.138	0.000
3.2667	0.066	0.216	0.197	0.000
3.3333	0.066	0.221	0.263	0.000
3.4000	0.066	0.225	0.334	0.000
3.4667	0.066	0.230	0.409	0.000
3.5333	0.066	0.234	0.488	0.000
3.6000	0.066	0.239	0.570	0.000
3.6667	0.066	0.243	0.653	0.000
3.7333	0.066	0.247	0.739	0.000
3.8000	0.066	0.252	0.826	0.000
3.8667	0.066	0.256	0.914	0.000
3.9333	0.066	0.261	1.003	0.000
4.0000	0.066	0.265	1.092	0.000
4.0667	0.066	0.270	1.200	0.000
4.1333	0.066	0.274	1.312	0.000
4.2000	0.066	0.278	1.428	0.000
4.2667	0.066	0.283	1.546	0.000
4.3333	0.066	0.287	1.668	0.000
4.4000	0.066	0.292	2.358	0.000
4.4667	0.066	0.296	2.527	0.000
4.5333	0.066	0.301	2.699	0.000
4.6000	0.066	0.305	2.875	0.000
4.6667	0.066	0.309	3.055	0.000
4.7333	0.066	0.314	3.239	0.000
4.8000	0.066	0.318	3.426	0.000
4.8667	0.066	0.323	3.617	0.000
4.9333	0.066	0.327	3.811	0.000
5.0000	0.066	0.332	4.008	0.000
5.0667	0.066	0.336	4.831	0.000
5.1333	0.066	0.340	6.333	0.000
5.2000	0.066	0.345	8.275	0.000
5.2667	0.066	0.349	10.57	0.000
5.3333	0.066	0.354	13.17	0.000
5.4000	0.066	0.358	16.03	0.000
5.4667	0.066	0.363	19.13	0.000
5.5333	0.066	0.367	22.42	0.000
5.6000	0.066	0.371	25.90	0.000
5.6667	0.066	0.376	29.52	0.000
5.7333	0.066	0.380	33.27	0.000
5.8000	0.066	0.385	37.11	0.000
5.8667	0.066	0.389	41.03	0.000
5.9333	0.066	0.394	44.98	0.000
6.0000	0.066	0.398	48.94	0.000
6.0667	0.066	0.402	52.89	0.000
6.1333	0.000	0.000	56.79	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 1.9
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.54
Total Impervious Area: 1.36

Flow Frequency Method: Cunnane

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.23855
5 year	0.406261
10 year	0.561449
25 year	0.744842

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.022328
5 year	0.226606
10 year	0.392587
25 year	0.494665

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0239	391	322	82	Pass
0.0293	332	257	77	Pass
0.0347	307	225	73	Pass
0.0401	269	197	73	Pass
0.0456	242	175	72	Pass
0.0510	227	155	68	Pass
0.0564	208	148	71	Pass
0.0619	192	132	68	Pass
0.0673	169	120	71	Pass
0.0727	163	112	68	Pass
0.0782	148	100	67	Pass
0.0836	140	94	67	Pass
0.0890	134	83	61	Pass
0.0944	126	77	61	Pass
0.0999	122	74	60	Pass
0.1053	117	67	57	Pass
0.1107	113	66	58	Pass
0.1162	108	64	59	Pass
0.1216	104	59	56	Pass
0.1270	97	55	56	Pass
0.1325	91	54	59	Pass
0.1379	90	52	57	Pass
0.1433	81	49	60	Pass
0.1488	77	45	58	Pass
0.1542	73	41	56	Pass
0.1596	69	39	56	Pass
0.1650	67	38	56	Pass
0.1705	66	34	51	Pass
0.1759	65	32	49	Pass
0.1813	61	30	49	Pass
0.1868	57	30	52	Pass
0.1922	55	29	52	Pass
0.1976	52	29	55	Pass
0.2031	49	29	59	Pass
0.2085	49	29	59	Pass
0.2139	46	26	56	Pass
0.2193	40	25	62	Pass
0.2248	38	23	60	Pass
0.2302	37	22	59	Pass
0.2356	34	21	61	Pass
0.2411	33	20	60	Pass
0.2465	31	19	61	Pass
0.2519	29	19	65	Pass
0.2574	26	16	61	Pass
0.2628	22	16	72	Pass
0.2682	21	15	71	Pass
0.2736	20	15	75	Pass
0.2791	19	14	73	Pass
0.2845	17	13	76	Pass
0.2899	16	13	81	Pass
0.2954	16	13	81	Pass
0.3008	16	12	75	Pass
0.3062	16	9	56	Pass

0.3117	16	9	56	Pass
0.3171	16	8	50	Pass
0.3225	15	7	46	Pass
0.3279	15	5	33	Pass
0.3334	15	5	33	Pass
0.3388	13	5	38	Pass
0.3442	12	5	41	Pass
0.3497	10	5	50	Pass
0.3551	10	4	40	Pass
0.3605	10	4	40	Pass
0.3660	9	4	44	Pass
0.3714	9	4	44	Pass
0.3768	9	4	44	Pass
0.3823	9	4	44	Pass
0.3877	9	4	44	Pass
0.3931	8	4	50	Pass
0.3985	7	4	57	Pass
0.4040	7	4	57	Pass
0.4094	7	4	57	Pass
0.4148	7	4	57	Pass
0.4203	7	4	57	Pass
0.4257	7	4	57	Pass
0.4311	6	3	50	Pass
0.4366	6	3	50	Pass
0.4420	6	2	33	Pass
0.4474	6	1	16	Pass
0.4528	6	1	16	Pass
0.4583	6	1	16	Pass
0.4637	6	1	16	Pass
0.4691	5	1	20	Pass
0.4746	5	1	20	Pass
0.4800	5	1	20	Pass
0.4854	5	1	20	Pass
0.4909	5	1	20	Pass
0.4963	4	1	25	Pass
0.5017	4	1	25	Pass
0.5071	4	1	25	Pass
0.5126	3	1	33	Pass
0.5180	3	1	33	Pass
0.5234	3	1	33	Pass
0.5289	3	1	33	Pass
0.5343	3	1	33	Pass
0.5397	3	1	33	Pass
0.5452	3	1	33	Pass
0.5506	3	1	33	Pass
0.5560	3	0	0	Pass
0.5614	3	0	0	Pass

Water Quality

Drawdown Time Results

Pond: Vault 1

Days	Stage(feet)	Percent of Total Run Time
1	0.439	5.0996
2	0.760	3.1963
3	1.161	1.8786
4	1.641	1.0383
5	2.199	0.5057

Maximum Stage: 5.000 Drawdown Time: 05 00:00:10

Model Default Modifications

Total of 0 changes have been made.

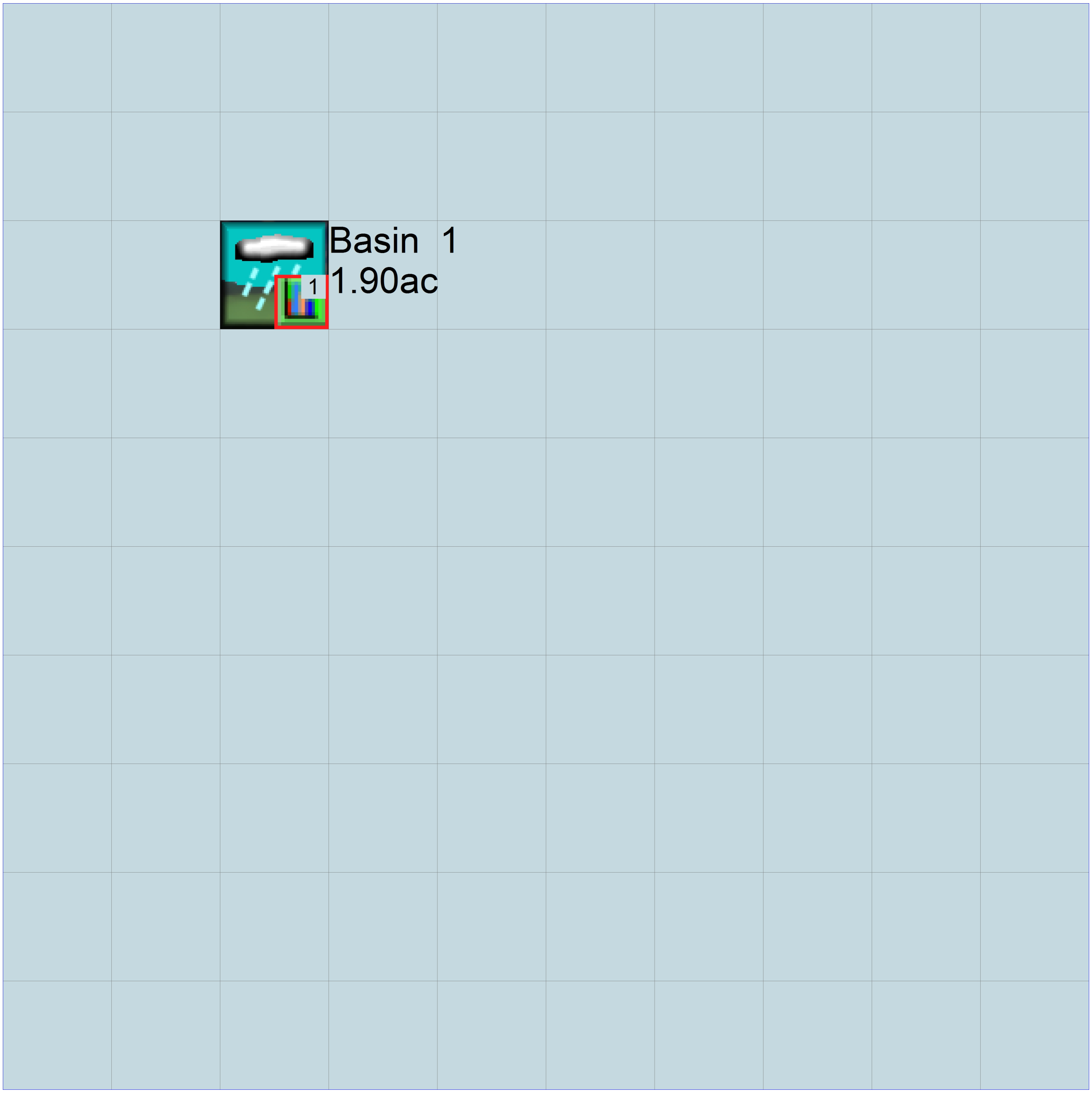
PERLND Changes

No PERLND changes have been made.

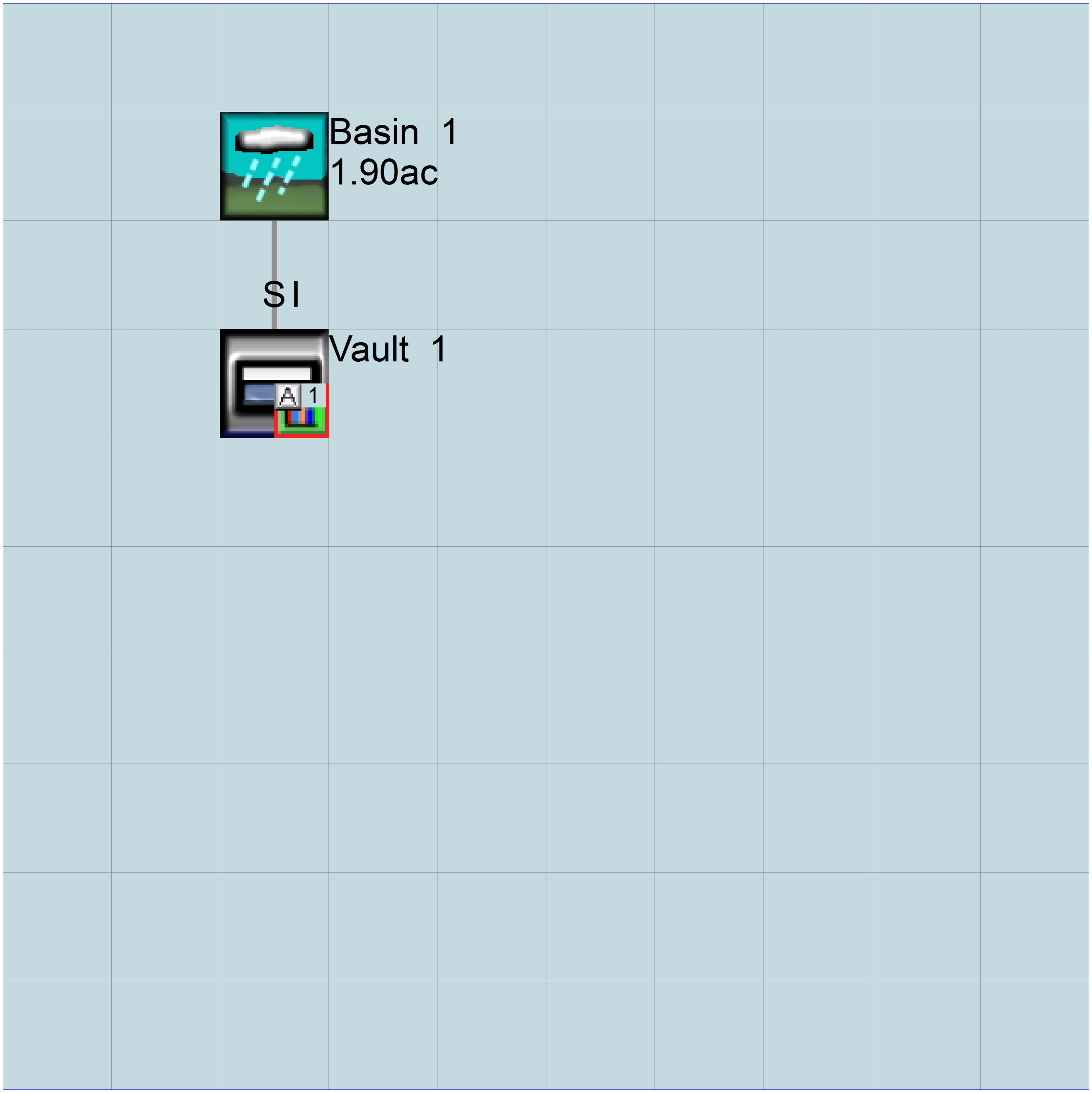
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1971 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   ridgeway c 11-01-2022.wdm
MESSU      25   Mitridgeway c 11-01-2022.MES
           27   Mitridgeway c 11-01-2022.L61
           28   Mitridgeway c 11-01-2022.L62
           30   POCridgeway c 11-01-20221.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      47
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out           ***
   47      D,Urban,Moderate       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   47         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
  47         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  47         0    1    1    1    0    0    0    0    1    1    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  47              0       3.5     0.025        50       0.1       2.5     0.915
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  47              0         0         2         2         0      0.05      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  47              0       0.6      0.03         1       0.3         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  47        0.6  0.6  0.6  0.6  0.7  0.7  0.7  0.7  0.7  0.6  0.6  0.6
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
  47        0.1  0.1  0.1  0.1  0.1  0.1  0.1  0.1  0.1  0.1  0.1  0.1
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  47              0         0      0.15         0         1      0.05         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      IMPERVIOUS-FLAT        1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    1
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.05     0.011       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  47                        0.54     RCHRES   1      2
PERLND  47                        0.54     RCHRES   1      3
IMPLND   1                        1.36     RCHRES   1      5

******Routing******
PERLND  47                        0.54     COPY     1     12
IMPLND   1                        1.36     COPY     1     15
PERLND  47                        0.54     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     Vault  1               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
```

```
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
    1             1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.066406  0.000000  0.000000
  0.066667  0.066406  0.004427  0.003433
  0.133333  0.066406  0.008854  0.004854
  0.200000  0.066406  0.013281  0.005945
  0.266667  0.066406  0.017708  0.006865
  0.333333  0.066406  0.022135  0.007676
  0.400000  0.066406  0.026563  0.008408
  0.466667  0.066406  0.030990  0.009082
  0.533333  0.066406  0.035417  0.009709
  0.600000  0.066406  0.039844  0.010298
  0.666667  0.066406  0.044271  0.010855
  0.733333  0.066406  0.048698  0.011385
  0.800000  0.066406  0.053125  0.011891
  0.866667  0.066406  0.057552  0.012376
  0.933333  0.066406  0.061979  0.012844
  1.000000  0.066406  0.066406  0.013294
  1.066667  0.066406  0.070833  0.013730
  1.133333  0.066406  0.075260  0.014153
  1.200000  0.066406  0.079688  0.014563
  1.266667  0.066406  0.084115  0.014962
  1.333333  0.066406  0.088542  0.015351
  1.400000  0.066406  0.092969  0.015730
  1.466667  0.066406  0.097396  0.016100
  1.533333  0.066406  0.101823  0.016462
  1.600000  0.066406  0.106250  0.016816
  1.666667  0.066406  0.110677  0.017163
  1.733333  0.066406  0.115104  0.017503
  1.800000  0.066406  0.119531  0.017836
  1.866667  0.066406  0.123958  0.018164
  1.933333  0.066406  0.128386  0.018485
  2.000000  0.066406  0.132813  0.018801
  2.066667  0.066406  0.137240  0.019112
  2.133333  0.066406  0.141667  0.019418
  2.200000  0.066406  0.146094  0.019719
  2.266667  0.066406  0.150521  0.020015
  2.333333  0.066406  0.154948  0.020307
  2.400000  0.066406  0.159375  0.020596
  2.466667  0.066406  0.163802  0.020880
  2.533333  0.066406  0.168229  0.021160
  2.600000  0.066406  0.172656  0.021437
  2.666667  0.066406  0.177083  0.021710
  2.733333  0.066406  0.181511  0.021979
```

```
  2.800000  0.066406  0.185938  0.022246
  2.866667  0.066406  0.190365  0.022509
  2.933333  0.066406  0.194792  0.022769
  3.000000  0.066406  0.199219  0.023027
  3.066667  0.066406  0.203646  0.045903
  3.133333  0.066406  0.208073  0.086654
  3.200000  0.066406  0.212500  0.138154
  3.266667  0.066406  0.216927  0.197670
  3.333333  0.066406  0.221354  0.263526
  3.400000  0.066406  0.225781  0.334528
  3.466667  0.066406  0.230209  0.409754
  3.533333  0.066406  0.234636  0.488453
  3.600000  0.066406  0.239063  0.569995
  3.666667  0.066406  0.243490  0.653833
  3.733333  0.066406  0.247917  0.739485
  3.800000  0.066406  0.252344  0.826521
  3.866667  0.066406  0.256771  0.914551
  3.933333  0.066406  0.261198  1.003216
  4.000000  0.066406  0.265625  1.092189
  4.066667  0.066406  0.270052  1.200726
  4.133333  0.066406  0.274479  1.312702
  4.200000  0.066406  0.278906  1.428013
  4.266667  0.066406  0.283334  1.546566
  4.333333  0.066406  0.287761  1.668273
  4.400000  0.066406  0.292188  2.358320
  4.466667  0.066406  0.296615  2.526956
  4.533333  0.066406  0.301042  2.699464
  4.600000  0.066406  0.305469  2.875757
  4.666667  0.066406  0.309896  3.055757
  4.733333  0.066406  0.314323  3.239388
  4.800000  0.066406  0.318750  3.426580
  4.866667  0.066406  0.323177  3.617266
  4.933333  0.066406  0.327604  3.811383
  5.000000  0.066406  0.332032  4.008871
  5.066667  0.066406  0.336459  4.831157
  5.133333  0.066406  0.340886  6.333040
  5.200000  0.066406  0.345313  8.275949
  5.266667  0.066406  0.349740  10.57334
  5.333333  0.066406  0.354167  13.17282
  5.400000  0.066406  0.358594  16.03599
  5.466667  0.066406  0.363021  19.13104
  5.533333  0.066406  0.367448  22.42942
  5.600000  0.066406  0.371875  25.90403
  5.666667  0.066406  0.376302  29.52824
  5.733333  0.066406  0.380729  33.27534
  5.800000  0.066406  0.385157  37.11829
  5.866667  0.066406  0.389584  41.02963
  5.933333  0.066406  0.394011  44.98148
  6.000000  0.066406  0.398438  48.94574
  6.066667  0.066406  0.402865  52.89423
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM     22 IRRG     ENGL    0.7       SAME PERLND  47     EXTNL  SURLI

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO      1 1         1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1         1      WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1      12.1      WDM    701 FLOW     ENGL      REPL
```

```
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

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Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com