Drainage Study

For

Elevation of the Holy Cross Orthodox Church

Level 3 Analysis

Planning Application Number: PLNP2022-00291

Watershed: Morrison Creek

January 15, 2024



Prepared by:

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Job No.: 2022-154

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1. Introduction:

Elevation of the Holy Cross Orthodox Church is a proposed project at 9155 Jackson Road (project site), which is located on the south side of Jackson Road, between South Watt Avenue and Hedge Avenue in Sacramento, California, as shown on **Exhibit A**.

The purpose of this study is to present a preliminary analysis of the existing and proposed hydrologic and hydraulic conditions of the project site, as well as evaluate required storm water quality design measures. JTS Engineering Consultants Inc. (JTS) has prepared this study for review and approval from Sacramento County Department of Water Resources (SCDWR) during the entitlement phase of the project. A design-level drainage study will be completed prior to acceptance of improvement plans for the project.

a. Existing Conditions

The 2.97-acre project site is partially developed with six structures currently used by the Elevation of the Holy Cross Orthodox Church organization. Surrounding parcels to the east, west, and south of the subject parcel are used for as gravel mining pits. Parcels to the north of Jackson Road are primarily used for single-family residences.

b. Project Description

Proposed development of the project site includes a new church building, new storage building, a new drive aisle, and parking lot. Three of the existing buildings shall be demolished. Class A improvements will be constructed along the frontage of the project site.

c. Applicable Standards

Standard criteria followed for the proposed development includes the following standards:

i. Sacramento County Drainage Study Requirements
ii. Sacramento County Floodplain Management Ordinance
iii. Sacramento City/County Drainage Manual Volume 2: Hydrology Standards
iv. Sacramento County Improvement Standards
v. Stormwater Quality Design Manual for the Sacramento Region

d. Previous Studies: No previous drainage studies were referenced to complete this report.

e. Objectives of Analysis

The purpose of this study is to address the following items:

1. Develop and evaluate a hydrologic model for the watersheds affecting the project site. The 100-year storm shall be analyzed in existing and with-project conditions as well as mitigation measures for the project.

2. Complete a hydraulic analysis of the 100-year storm event to ensure proper flood protection of the proposed building.

3. Evaluate the preliminary grading plan and develop a schematic storm drain plan for the project site, including storm water quality requirements.

2. Baseline (Existing Conditions):

a. Historical Land-use: The parcel is developed with multiple buildings used for religious practice. Buildings were constructed in approximately 1960.

b. Topographic Sources: Topographic data of the project site was obtained from a field survey performed by Conti & Associates based on the North American Vertical Datum of 1988 (NAVD88). Elevations outside the limit of the survey were obtained from 2-foot light detecting and ranging (LiDAR) generated contours from the Sacramento County Open Data website based on the NAVD88 datum. All elevations within this report reference the NAVD88.

c. Off-site Drainage

The boundary between the Morrison Creek watershed and the Manlove watershed is located along the berm of existing mining pit to the south of Jackson Road. Assuming there are no drainage facilities to allow runoff to the pits, the berms would force runoff towards the public highway.

Per the Sacramento County Watershed Management Plan of 2021, the Morrison Creek watershed is 34,592-acres and the Jackson Highway Master Plan area, where the project site is located, is currently being prepared by Wood Rodgers, Inc. and is not available during the time of preparing this report. The drainage pattern of the adjacent east, west, and southerly parcels generally flow in a westerly direction with no clear outfall location.

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Study (FIS) Flood Insurance Rate Map (FIRM) encompassing the project site was observed, which analyzes said creek. The project site is within FIRM 06067C0215H, dated August 16, 2012, which indicates that the project site is located within Zone X or an unaffected area of the 100-year floodplain, as shown on **Exhibit B**.

The frontage of the project site contains a westerly flowing roadside ditch, which appears to be a part of the Manlove watershed. There is a 54-inch storm drain pipe along Jackson Road fronting the project site, which drains in a westerly direction until discharging to an outfall at the northwest corner of the South Watt Avenue and Jackson Road intersection.

d. On-site Drainage

No existing drainage facilities are within the project site, aside from roadside culverts along Jackson Road as well as a culvert within the easterly berm near the southeast corner of the project site, which routes to the adjacent parcel. Per discussion with SCDWR, use of the existing culvert shall not supported for the proposed project, thus, the facility was largely neglected within this study.

e. Hydrologic Modeling Assumptions

Sacramento County Hydrologic Calculator version 1.1.0.25 (SacCalc) was used to complete a hydrologic model of all contributing watersheds. The Sacramento Method was used to analyze the 100-year, 24-hour design storm. All runoff is generated within hydrologic zone 2 of Sacramento County per the hydrology standards.

As shown on the Existing Watershed Map (**Exhibit C**), the subject parcel as well as the upstream watershed draining to the frontage of the project site were delineated.

Per the National Resources Conservation Service (NRCS) Web Soil Survey website, soil within the project site is categorized as San Joaquin silt loam, leveled, 0 to 1 percent slopes with a hydrologic soil group of C per the United States Department of Agriculture (USDA) hydrologic soil group classification. Soil data for the upstream watershed indicates several underlain soil types, all of which are classified with a hydrologic soil group of C, as shown on the Hydrologic Soil Group Map (**Exhibit D**).

Aside from the project site, which accounts for surveyed impervious surfaces, impervious percentage of each watershed was delineated based on the most recent satellite imagery of the area.

The basin 'n' method was used to compute the lag transformation for each sub-shed. SacCalc input parameters, such as the longest water course or channel length, distance to centroid and land use be seen on **Table 1** below. For conservative results, and aligned with SCDWR standards, the longest water course was reduced to 90% of the measured values.

Table 1 – Existing Watershed Parameters

Watershed Name	Watershed Area (acres)	Mean Elev. (ft)	Lag Method	Longest Water Course (ft)	90% of Longest Water Course (ft)	Longest Water Course to Centroid (ft)	U/S Elev.	D/S Elev.	Slope (ft/ft)	Impervious %
WS001	51.23	60	Basin n	5565	5009	3110	66	54	0.0022	65%
WS002	3.44	57	Basin n	876	788	396	58	56	0.0023	26%

As shown on **Table 3** below, the peak runoff at the junction denoted 'JNC001', of the two watersheds was computed to 49 cubic-feet per second.

Table 2 – Existing Condition 100-Year, 24-Hour Peak Flow

Watershed Name	Peak Flowrate (cfs)
WS001	47.00
WS002	6.00
JNC001	49.00

See Appendix A for the attached electronic SacCalc model denoted "**Existing Condition Hydrology Model**" for reference.

f. Hydraulic Modeling Assumptions

Hydraulic calculations were completed with Hydraflow Express Extension for Autodesk Civil 3D, which follows the Federal Highway Administration (FHWA) Hydraulic Design of Highway Culverts (HDS-5). The purpose of the hydraulic calculations is to have a reference for the existing flood conditions of the roadway and identify potential local floodplains within the project site.

As seen on the **Exhibit E**, a culvert calculation was completed for the downstream driveway culvert of the project site. Sizes, shapes, and elevations of the existing culvert and driveway were obtained from field survey data.

Based on the headwater elevation on the upstream end of the culvert, during the 100-year event, the water raises to approximately 55.52-feet, which does not appear to inundate the project site, aside from the roadside ditch based on surveyed elevations.

g. Floodplain Extents

Due to the hydraulic model comprised of a single culvert calculation, the existing floodplain was not mapped at this time, however, based on said calculation minor flooding would occur along Jackson Road.

3. Mitigated Project (Proposed Condition):

a. Proposed Land Use: The proposed land-use of the project site shall be for continued use of the church organization.

b. **Grading Plan:** See **Exhibit F** for the Preliminary Grading Plan of the project site completed by Conti & Associates. All runoff generated on-site will be collected in either a single bio-retention planter in the rear of the parcel or inlet structures within the front area of the parcel.
The proposed building has been designed with main and lower finished floors. With the water surface elevation along Jackson Road computed to 55.53-feet, the lower finished floor has been elevated 57.15-feet, which allows 1.62-feet of freeboard.

Due to large berms along the east, south, and west sides of the project site, overland release was designed to allow runoff to discharge to Jackson Road through an earthen channel along the westerly property line, as shown on the cross-section of **Exhibit F**. With the westerly berm abutting the proposed channel, appropriate erosion control should be implemented in order to not compromise the stability of the berm, which will be analyzed within the design phase of the project.

c. Offsite Drainage Improvements

Off-site drainage improvements include connecting to the existing storm drain manhole along Jackson Highway with a storm drain line extending to a proposed type 'J' inlet to be placed along the proposed public curb, gutter, and sidewalk fronting the subject parcel. A culvert or inlet structure shall be placed at the upstream roadside ditch to allow runoff to enter into the proposed storm drain system. See **Exhibit G** for a schematic layout of proposed storm drain facilities.

d. Onsite Drainage Improvements

The majority of on-site runoff will route to a proposed bio-retention planter in the rear of the parcel, which will allow infiltration into native soil with an underdrain and overflow device connected to an underground storm drain network. The bio-retention planter shall be constructed to obtain low impact development (LID) control for the site as well as to provide partial treatment control. The remaining area of the parcel shall be collected within inlet structures and subsequently route to SCDWR approved proprietary treatment control devices for complete treatment control of the site.

Proposed on-site storm drain facilities shall route to the front of the parcel and connect to the proposed type 'J' drain inlet to be placed within frontage improvements. See **Exhibit G** for a schematic layout of proposed storm drain facilities.

e. **Hydrologic Model Assumptions:**

The hydrologic model from the baseline section of this report was modified for the proposed condition model, which largely remained the same aside from the proposed increase of impervious surface within watershed 'WS002' from the project site.

The basin 'n' lag transformation method was utilized within the model and follows all parameters within the existing conditions model due to drainage following the same path as the existing model during the 100-year event. See **Table 3** below for proposed watershed parameters of the modeled watersheds. As shown on said table, impervious percentage of WS002 was revised from 26% in the existing model to 60% due to the proposed development.

Table 3 – Proposed Watershed Parameters

Watershed Name	Watershed Area (acres)	Mean Elev. (ft)	Lag Method	Longest Water Course (ft)	90% of Longest Water Course (ft)	Longest Water Course to Centroid (ft)	U/S Elev.	D/S Elev.	Slope (ft/ft)	Impervious %
WS001	51.23	60	Basin n	5565	5009	3110	66	54	0.0022	65%
WS002	3.44	57	Basin n	876	788	396	58	56	0.0023	60%

As seen in **Table 4** below, watershed WS002 increased by approximately 0.7 cubic-feet per second.

Table 4 – Proposed Condition 100-Year, 24-Hour Peak Flow

Watershed Name	Peak Flowrate (cfs)
WS001	47.00
WS002	6.70
JNC001	49.00

See **Appendix A** for the electronic file of the model.

f. **Mitigation**

The volumetric difference between existing and proposed hydrographs of the project site, as shown on **Figure 1** was computed in order to determined increased runoff. The computed volume shall be detained within the bio-retention planters, above the water quality ponding depth, per SCDWR standard. As shown on **Table 5**, the volume between the existing and proposed hydrographs was computed to 9,376 cubic-feet.

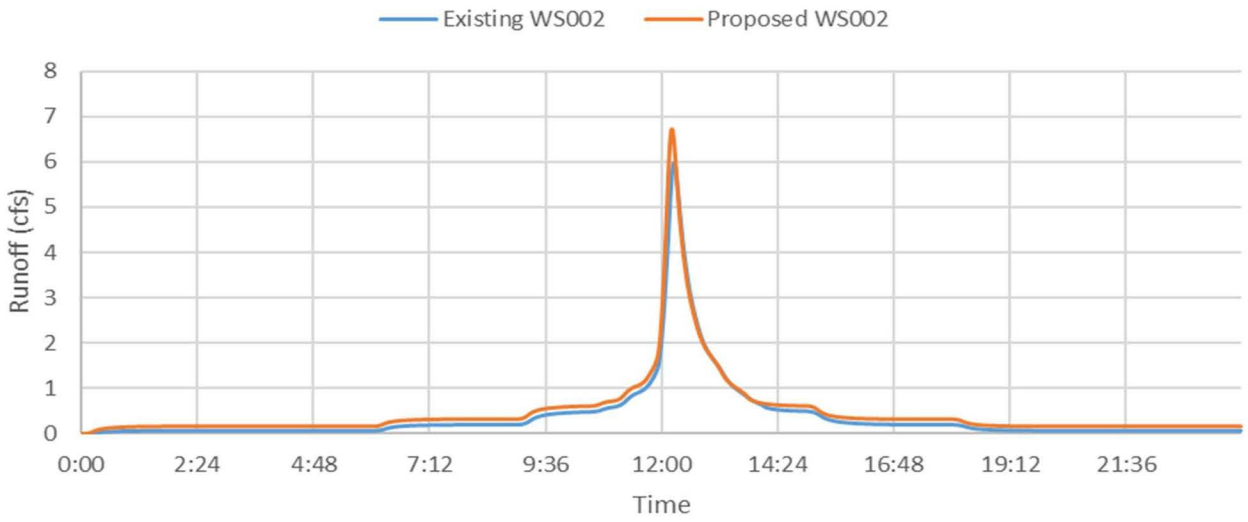


Figure 1 – Existing and Proposed Runoff Hydrographs of Project Site Watershed

Table 5 – 100-Year, 24-Hour Runoff Volume for Project Site Watershed (WS002)

Existing Volume (ft^3)	Proposed Volume (ft^3)	Difference (ft^3)
32,923	42,299	9,376

g. Hydraulic Model Assumptions

Based on results of the existing and proposed hydrologic models, the peak runoff along the project site frontage shall remain the same in both conditions, thus, it is assumed that the water surface elevation along the frontage shall remain the same in existing and proposed conditions with the implemented mitigation.

The overland release channel through the project site to Jackson Road was analyzed to ensure that the building is properly elevated. As shown on **Exhibit H**, a triangular channel with 2-foot horizontal to 1-foot vertical side slopes was analyzed with the proposed peak runoff flowrate of the project site watershed (WS002). The Manning's roughness value was set to 0.06, which correlates to a natural channel per County improvement standards.

h. Floodplain Extents

A proposed flood map of the project site and Jackson Road was not completed for this study. Based on the existing and proposed hydrology results at Jackson Road, it is anticipated that the proposed flood inundation surrounding the area shall have negligible differences.

i. Public Storm Drainage Design

As previously stated, a proposed type 'J' drain inlet will be placed along the project frontage on Jackson Road, which will connect to the existing underground 54-inch storm drain line within the roadway right-of-way and the project site storm drain system will connect to said inlet structure.

The Sacramento County public storm drain system is sized to capture and convey the Nolte storm event, which will be completed in the design-level drainage study for the project site in order to ensure that the proposed type 'J' inlet and connection pipe to the existing system is properly sized.

j. Stormwater Quality

Requirements

The Stormwater Quality Design Manual for the Sacramento Region (SQDMSR) was used as a reference for all stormwater quality design measures. Based on delineations of existing and proposed impervious areas, as well as impervious surfaces to be replaced, it appears the project site shall be implementing more than one acre of hardscape surfaces.

Considering the proposed project site as a commercial/industrial development, per Table 3-2 of the SQDMSR, commercial/industrial development implementing one or more acres of impervious area are subject to source control, hydro-modification control, low impact development control, and treatment control. Full Capture Trash control is not anticipated to be required based on the proposed use of the parcel.

DWR simply checked for the required 100 points and reviewed the site plan for presence of SWQ/LID measures but no detailed review will be conducted. A detailed review will be completed at the Level 4 study.

LID and Treatment Control

Low impact development and treatment control were assessed using the spreadsheet entitled 'Appendix D-2 Commercial Sites Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations' obtained from the Sacramento Stormwater Quality Partnership website for each sub-shed denoted on **Exhibit G**.

As seen on the table on **Exhibit G** and the LID compliance spreadsheets **(Appendix B)**, the weighted average of LID points of the project site was computed as 155.51, which meets the 100-point minimum requirement for LID control.

The bio-retention planter in watershed WS00A was upsized to incorporate complete treatment control for the sub-shed. The remaining water quality flow of 0.09 cubic-feet per second will be treated through a Contech Stormfilter prior to discharging into the public system.

Hydromodification Control

Under SCDWR direction, due to the project site runoff routed to the Manlove watershed, which is largely developed, hydromodification control will not be required.

4. Summary of Findings:

Existing and proposed hydrologic models were created to analyze the 100-year, 24-hour design storm event. Analyzing these models, it appears that the peak flowrate increases for the project site watershed by approximately 0.7 cubic-feet per second, however, the peak flowrate at Jackson Road fronting the project site shall remain at 49 cubic-feet per second.

Analyzing the volumetric increase of runoff generated from the proposed 100-year design storm event, approximately 9,376 cubic-feet of additional runoff volume is generated. This volume should be detained within the proposed bio-retention planter and calculated above the water quality volume as to not overlap the two volumes, per SCDWR standard.

The hydraulic analysis presented in this report included a culvert calculation of the existing driveway culvert, which computed a headwater elevation of 55.52-feet for the existing storm event. Due to the proposed hydrology model indicating equal peak runoff from the existing model, it is assumed that the water surface elevation will remain the same as the existing condition. However, based on the anticipation of Class A frontage improvements, further analysis should be completed within the design-level drainage study to properly size the proposed system within the roadway. Proposed building pads and finished floors shall be set a minimum of 1.2-feet and 1.5-feet, respectively above the water surface elevation calculated along Jackson Road, as well as the overland release pathway.

Storm water quality facilities were analyzed to adhere to LID control, treatment control, and hydro-modification control per the SQDMSR. All control requirements are met with the implementation of the proposed bio-retention planters.

5. Conclusion:

This study is intended to provide a preliminary drainage analysis and anticipated mitigation measures to be implanted with the proposed project. Prior to construction permits, a design-level drainage study shall be submitted to SCDWR for review and approval.

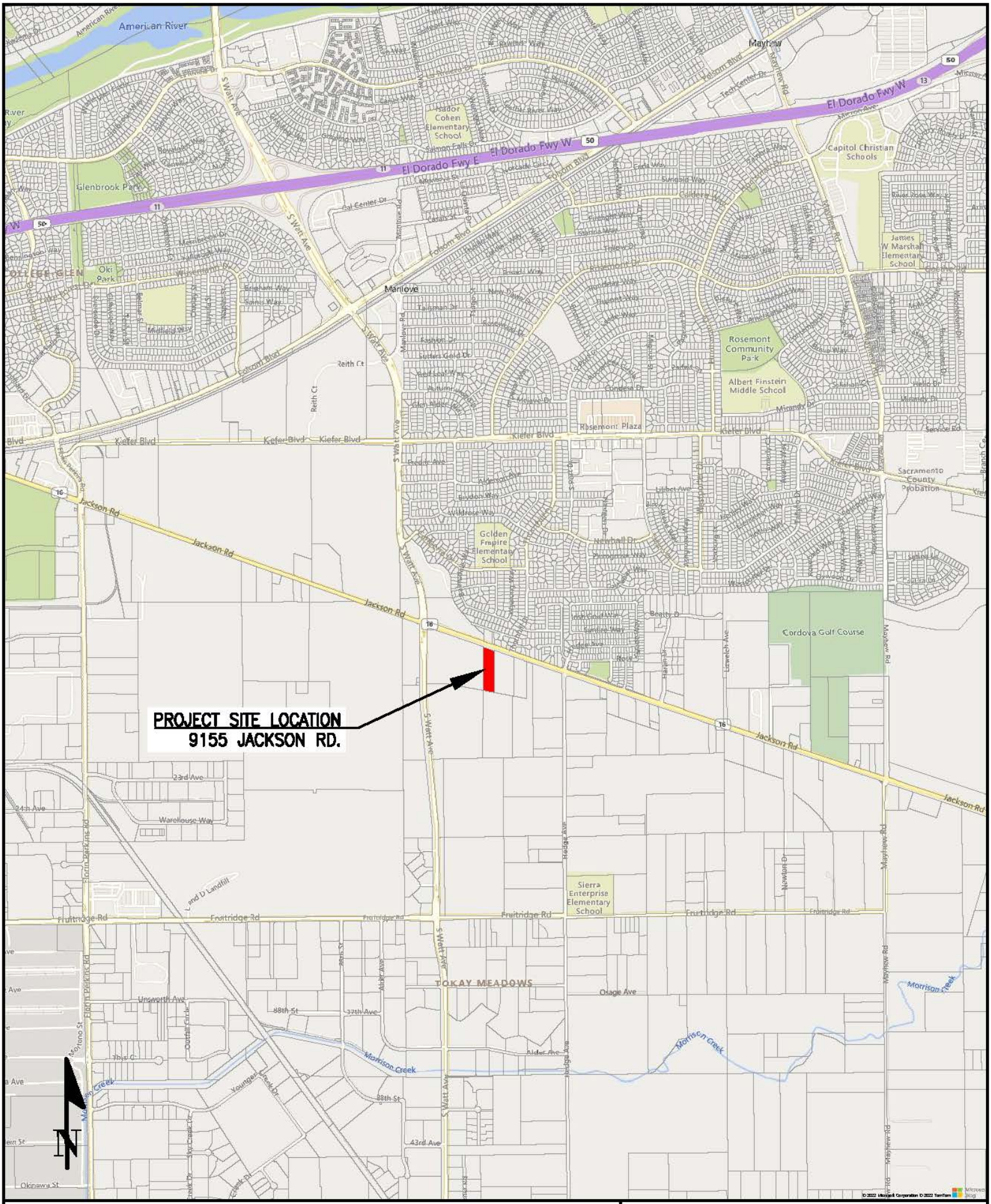


EXHIBIT A
VICINITY MAP
HOLY CROSS CHURCH

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EXHIBIT B
FEMA FLOOD MAP

ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9155 JACKSON RD.
SACRAMENTO, CA

JANUARY 2024

LEGEND

- Project Site Boundary
- Cross-Section

FEMA Flood Zone

- A
- A99
- AE
- AH
- AO
- X

NOTES:

1. FLOOD DATA OBTAINED FROM FEMA FLOOD MAP SERVICE CENTER.
2. PROJECT SITE LOCATED WITHIN FEMA FIRM 06067C0215H, DATED AUGUST 16, 2012.

0 1,000 2,000 ft

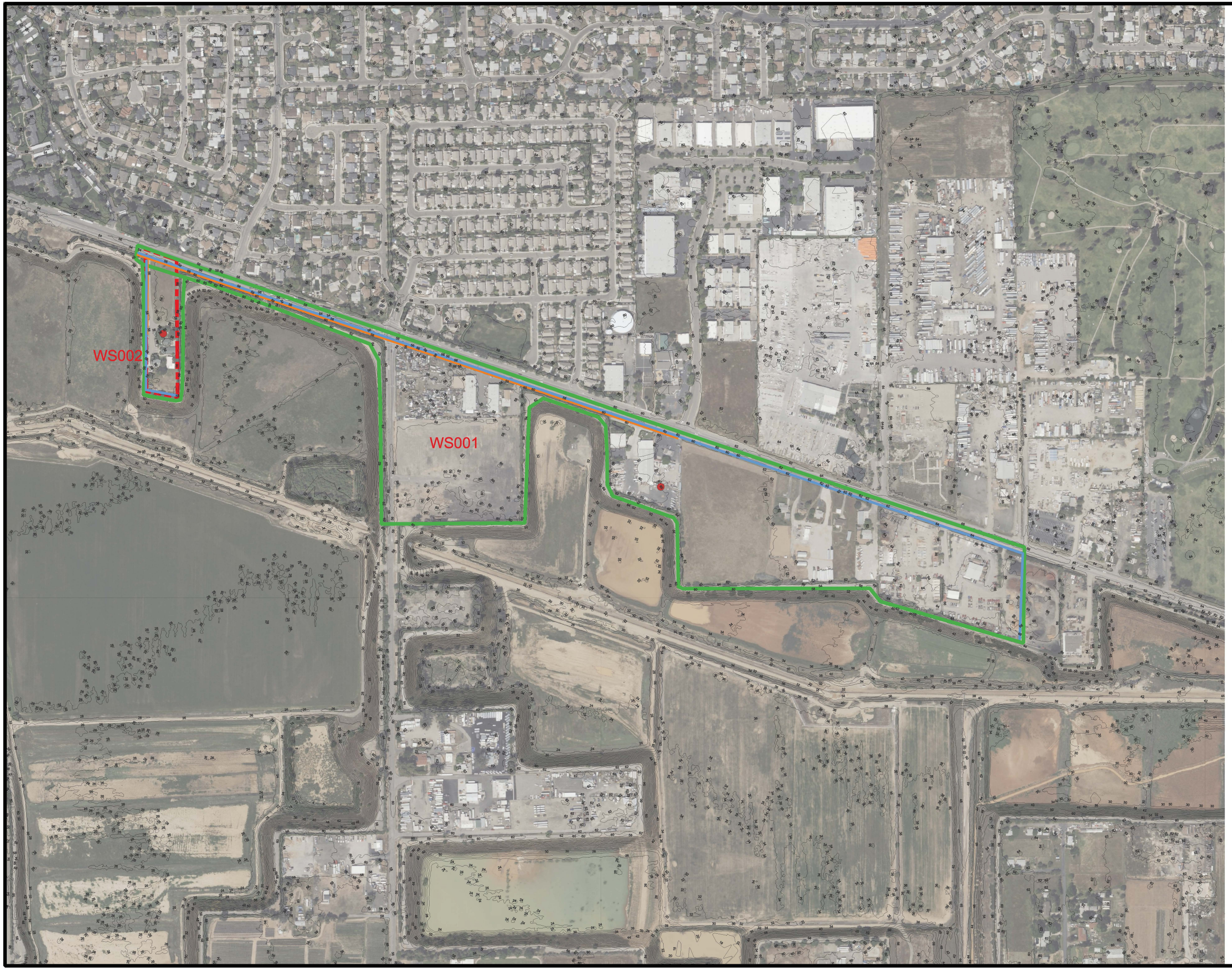
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EXHIBIT C
EXISTING WATERSHED MAP

ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9155 JACKSON RD.
SACRAMENTO, CA

JANUARY 2024



LEGEND

- Project Site Boundary
- Watershed Boundary
- Longest Watercourse to Centroid
- Longest Watercourse
- Centroid
- Elevation Contours - NAVD88

0 500 1,000 ft

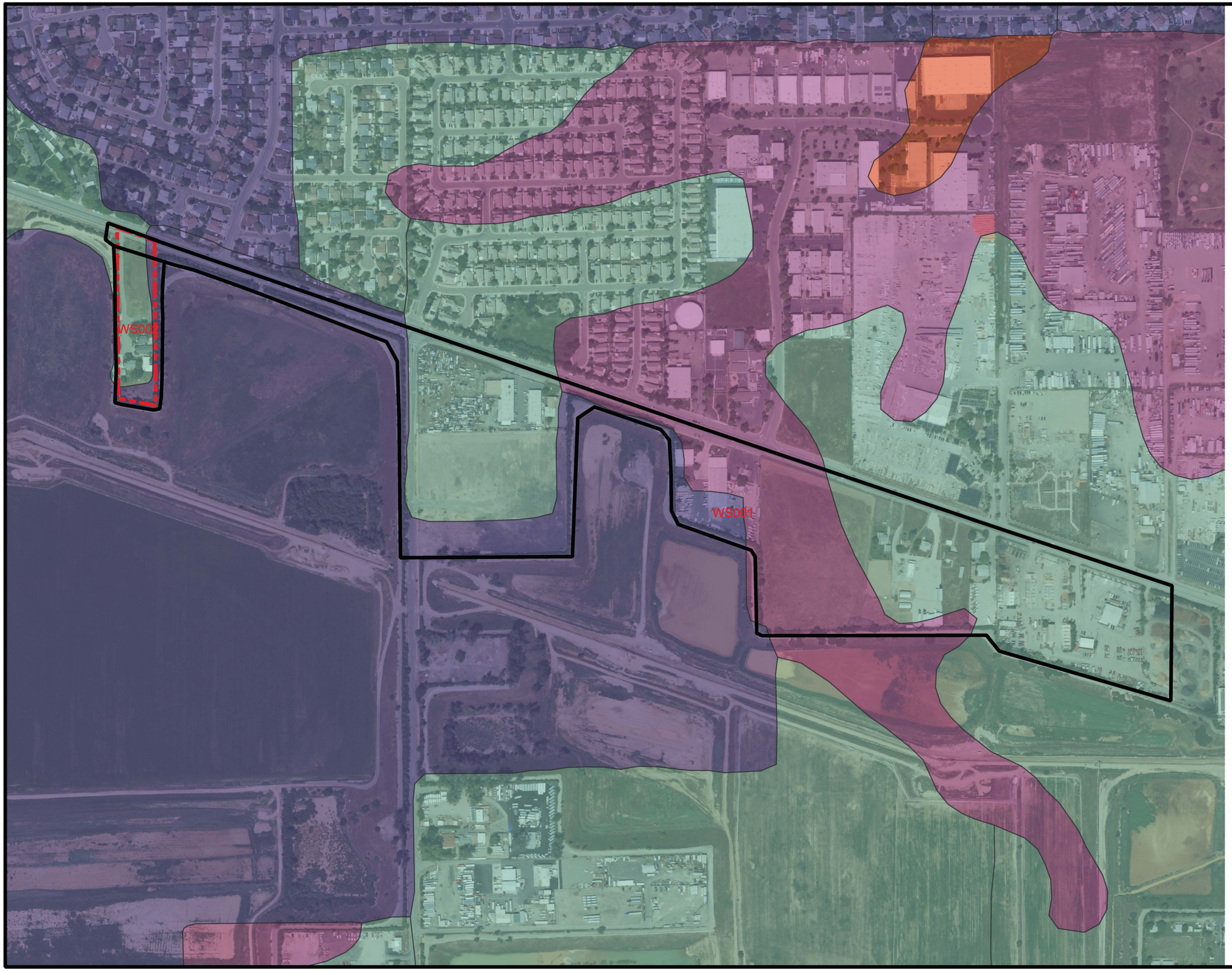
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EXHIBIT D
HYDROLOGIC SOIL GROUP MAP

ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9155 JACKSON RD.
SACRAMENTO, CA

JANUARY 2024



LEGEND

- Watershed Boundary
- Project Site Boundary

Hydrologic Soil Group

- A
- A/D
- B
- B/D
- C
- C/D
- D
- UNCLASSIFIED IN DATABASE INTERPRETED AS HSG 'C'

NOTES:

1. SOIL DATA OBTAINED FROM USDA NRCS WEB SOIL SURVEY WEBSITE (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

0 400 800 ft

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Culvert Report

Exhibit E

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 13 2023

Existing Project Site Driveway Culvert

Invert Elev Dn (ft)	= 52.82
Pipe Length (ft)	= 40.00
Slope (%)	= 0.70
Invert Elev Up (ft)	= 53.10
Rise (in)	= 25.0
Shape	= Arch
Span (in)	= 50.0
No. Barrels	= 1
n-Value	= 0.024
Culvert Type	= Arch Corrugated Metal
Culvert Entrance	= Thin wall projecting (A)
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0496, 0.57, 0.9

Embankment

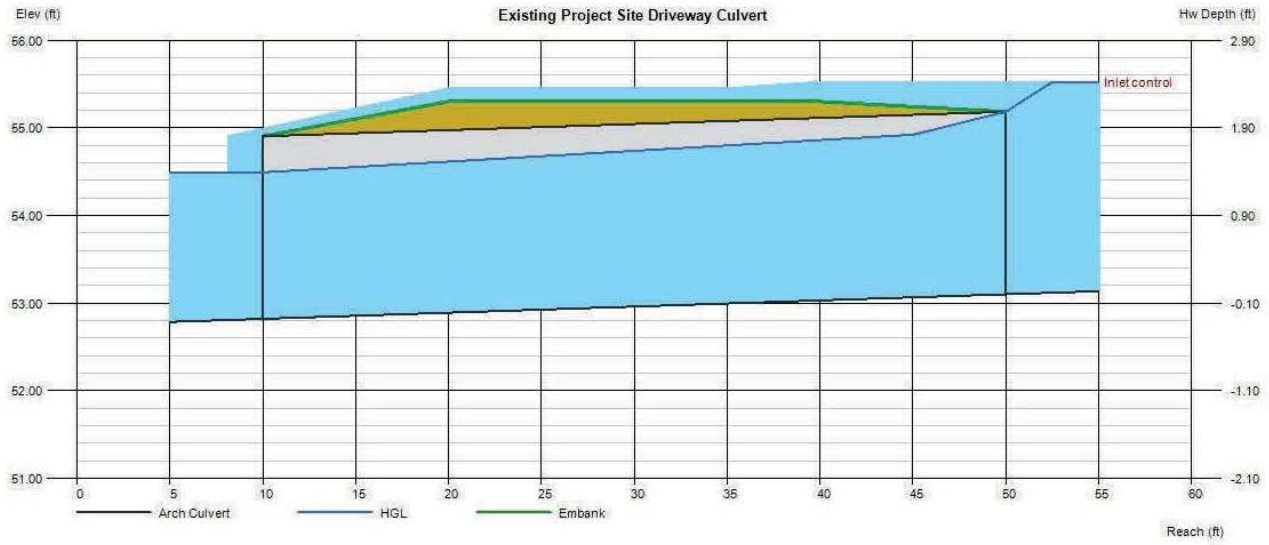
Top Elevation (ft)	= 55.30
Top Width (ft)	= 20.00
Crest Width (ft)	= 50.00

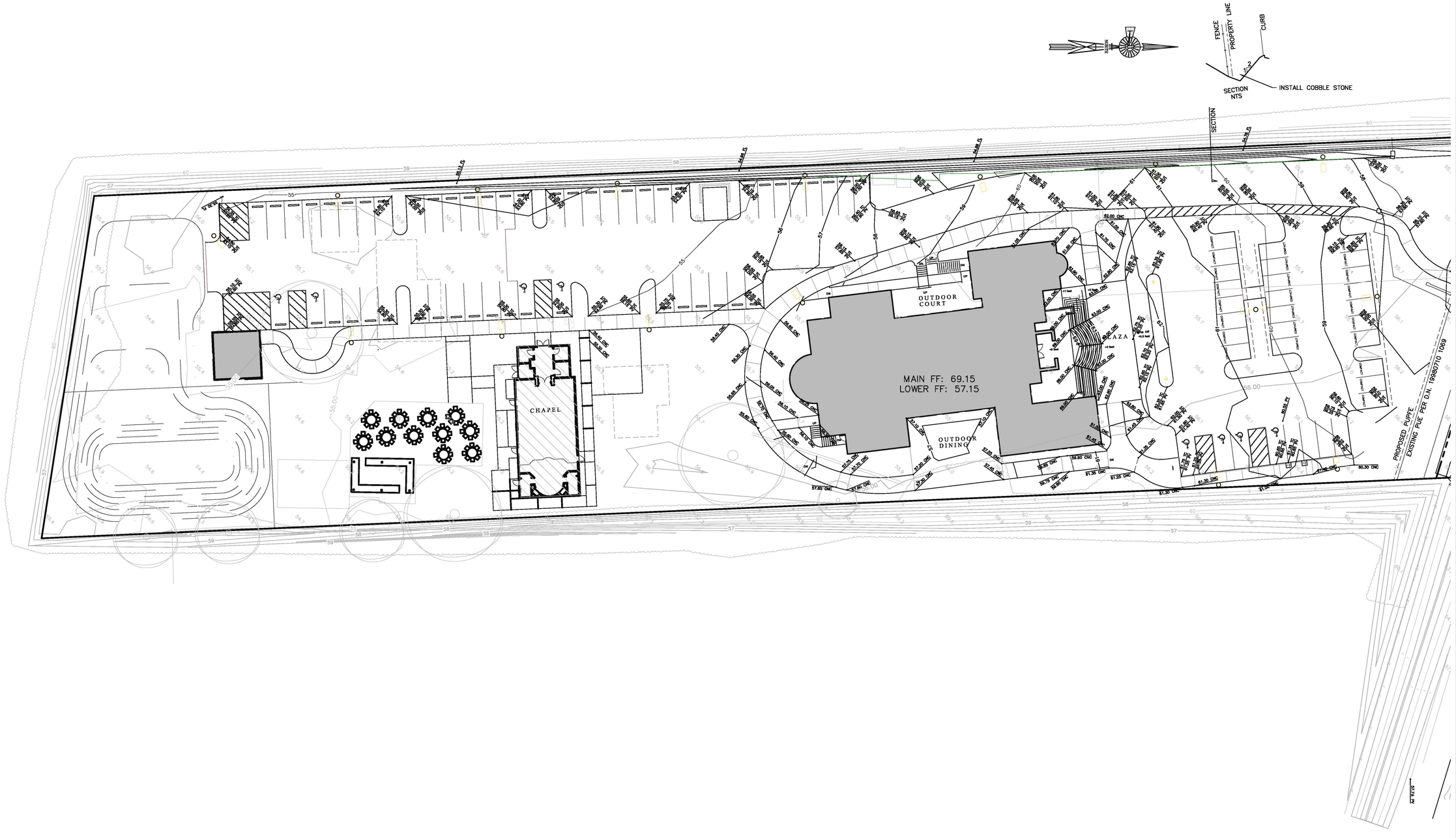
Calculations

Qmin (cfs)	= 49.00
Qmax (cfs)	= 49.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 49.00
Qpipe (cfs)	= 33.52
Qovertop (cfs)	= 15.48
Veloc Dn (ft/s)	= 5.48
Veloc Up (ft/s)	= 5.10
HGL Dn (ft)	= 54.49
HGL Up (ft)	= 54.98
Hw Elev (ft)	= 55.52
Hw/D (ft)	= 1.16
Flow Regime	= Inlet Control





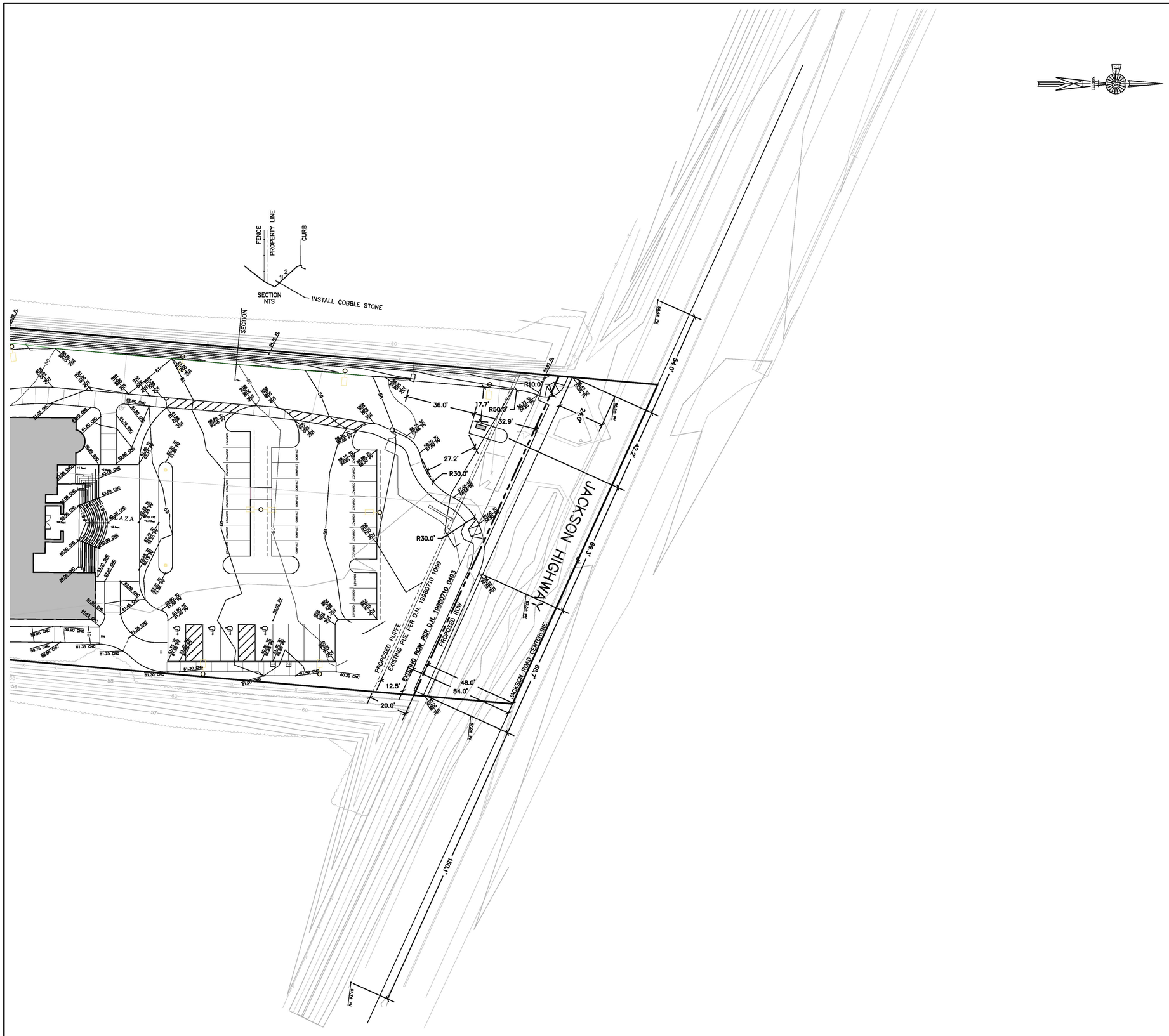
CONTI & ASSOCIATES, INC.
ENGINEERING SERVICES
979 N. COVENANT VIEW WAY, EAGLE, ID 83616
(530) 721-7911 | aconti@contieng.com

ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9000 JACKSON ROAD, SACRAMENTO ,CA

GRADING PLAN

Design	AMC
Check	RWS
Date	08/19/2023
Scale	1"= 20'
Original Drawing Scale	0 ½" 1"
Sheet Number	2 Of 4
Project File No.	21-003



CONTI & ASSOCIATES, INC.
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ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9000 JACKSON ROAD, SACRAMENTO ,CA

FRONTAGE IMPROVEMENTS

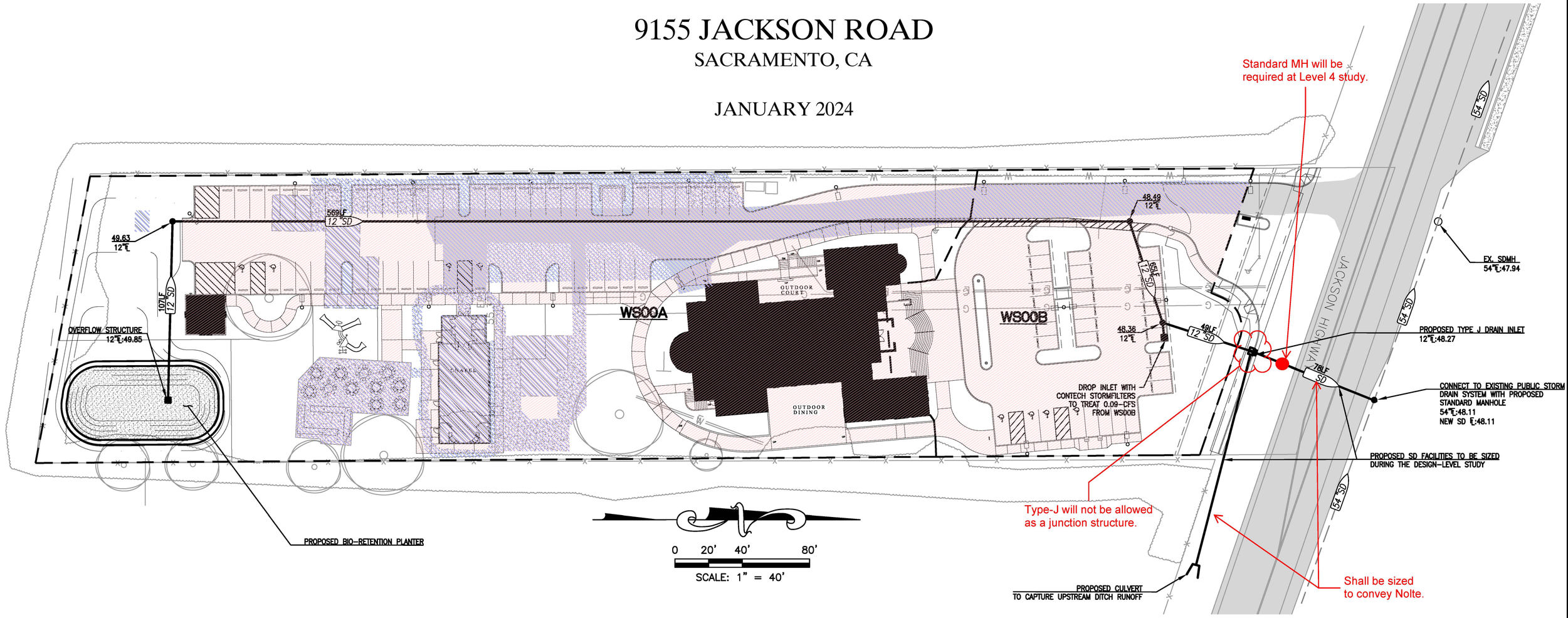
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Check	RWS
Date	08/19/2023
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Original Drawing Scale	0 ½" 1"
Sheet Number	3 Of 4
Project File No.	21-003

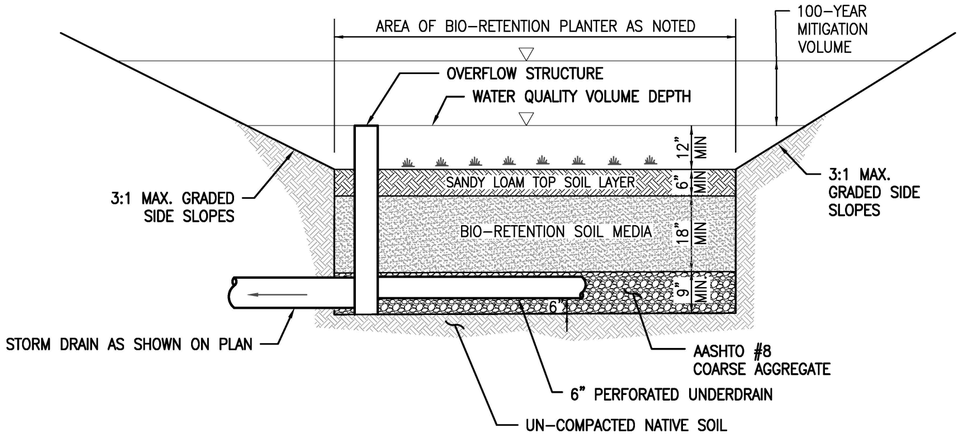
EXHIBIT G
SCHEMATIC STORM DRAIN SYSTEM LAYOUT

ELEVATION OF THE HOLY CROSS ORTHODOX CHURCH

9155 JACKSON ROAD
SACRAMENTO, CA

JANUARY 2024





TYPICAL BIO-RETENTION PLANTER AND DETENTION DETAIL
NTS

Sub-Shed	Total Area		Existing Impervious		Existing Pervious		Proposed Impervious		Proposed Landscape		% Imperv.	Bio-Retention Planter	LID Points from Spreads	WQF	% of Site	Weighted LID Points
	(ft2)	(acres)	(ft2)	(acres)	(ft2)	(acres)	(ft2)	(acres)	(ft2)	(acres)		(ft2)		(ft3/s)		
WS00A	86964.53	2.00	27442.62	0.63	59521.91	1.37	50148.85	1.15	36815.68	0.85	58%	3400.00	200.00	0.00	74%	147.79
WS00B	30724.32	0.71	3191.73	0.07	27532.60	0.63	21616.33	0.50	9107.99	0.21	70%	0.00	29.60	0.09	26%	7.73
Total	117688.86	2.70	30634.35	0.70	87054.51	2.00	71765.18	1.65	45923.67	1.05	61%	3400.00	-	0.09	100%	155.51

LEGEND

- DENOTES PROPOSED SCENARIO IMPERVIOUS AREA
- DENOTES EXISTING SCENARIO IMPERVIOUS AREA
- 12"SD — PROPOSED STORM DRAIN PIPE
- PROPOSED BIO-RETENTION PLANTER

NOTE

1. DEPICTED WATERSHEDS ANALYZE ONSITE LID AND SWQ TREATMENT. NOT ANALYZED FOR 100-YEAR HYDROLOGY AS WATERSHED DEPICTED ON EXHIBIT C.

JTS ENGINEERING CONSULTANTS, INC.
1808 J STREET SACRAMENTO, CA 95811

Channel Report

Exhibit H

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 13 2023

Overland Release Channel

Triangular

Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 54.65
Slope (%)	= 0.10
N-Value	= 0.060

Calculations

Compute by:	Known Q
Known Q (cfs)	= 6.70

Highlighted

Depth (ft)	= 2.11
Q (cfs)	= 6.700
Area (sqft)	= 8.90
Velocity (ft/s)	= 0.75
Wetted Perim (ft)	= 9.44
Crit Depth, Yc (ft)	= 0.94
Top Width (ft)	= 8.44
EGL (ft)	= 2.12

