2615 Q ST

COUNTY OF SACRAMENTO, CA

HYDROLOGIC AND HYDRAULIC STUDY

VERTICAL DATUM: NAVD88

Original Submittal: May 26, 2023
Revised:

Prepared For:

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TABLE OF CONTENTS

I. INTRODUCTION

This report presents the hydrologic, hydraulic and stormwater quality analyses for 2615 Q St (Project) by Thomas Peterson Trust, located in the Rio Linda, Sacramento County, California (See Appendix A – Vicinity Map). This report estimates storm flow hydrology as outlined in the *County of Sacramento Improvement Standards – Section 9* and the *City and County of Sacramento Drainage Manual – Volume 2 Hydrology Standards* (Reference 1, hereinafter referred to as the *Manual*. Additionally, this report presents Storm Water Quality measures prescribed in the *Stormwater Quality Design Manual for the Sacramento Region* (Reference 2, hereinafter referred to as the *SQDM*).

This report analyzes the Project's proposed hydrology, overland release routing, and stormwater quality characteristics including Low Impact Development (LID) requirements and hydromodification.

II. PROJECT LOCATION AND DESCRIPTION

The Project encompasses 14.40± acres of mostly undeveloped land in Rio Linda, unincorporated Sacramento County. The site is located on the northwest corner of Q Street and 28th Street. An existing boat and RV storage borders the Project along the western boundary. Two existing single-family residences border the Project along the northern boundary. The eastern boundary of the Project is the centerline of 28th St. An existing single-family residence and open space, zoned for light industrial use, are located adjacent to the 28th St along the Project boundary. The southern boundary of the Project is the centerline of Q St. An existing self-storage is located immediately south of Q St, adjacent to the project.

See Appendix A – Vicinity Map

The development is proposed as parking for boats and RV storage. The Project will construct paved parking and a bioretention basin for water quality. The Project's proposed improvements generally consist of the following:

- Paved driveway, drive aisles, and parking stalls (8.0± acres)
- Concrete curbs
- Chain-link fencing and gate
- Roadside ditch & culvert
- Bioretention Basin (31,600 SF)
- Storm drain inlet & pipe outfall
- Landscaping (36,911 SF)

III. HYDROLOGY

METHODS

The methodology contained in this study is in compliance with the procedures presented in the *Manual*. A hydrologic analysis was completed to estimate storm runoff from the proposed Project. The flow patterns for the undeveloped and developed conditions were determined from existing topography and the proposed grading plans. Both the Existing Shed Map and Developed Shed Map can be seen in Appendix D. An Offsite Shed Map has also been provided to identify the offsite sheds that are routed through the Project.

Existing and developed condition peak flow runoff for the Project site were estimated using the Sacramento Method, as prescribed by the *Manual*. The *Manual's* rainfall zone chart, Figure 2-11 show that the Project lies within Zone 2. This method was exercised using Sacramento County's Hydrologic Calculator (Sac-Calc).

EXISTING SITE CONDITIONS AND HYDROLOGY

Previously stated, the Project site encompasses 14.40± acres of undeveloped land and adjacent existing roadway improvements on Q Street and 28th Street (See Appendix C – Survey Map & Appendix D – Existing Shed Map). Native grasses on gently sloped terrain comprise the majority of the site's existing ground cover. Existing Conditions FEMA designation and Soil Group Classification are identified, as follows:

- FEMA National Flood Hazard Layer FIRMette Map, included in Appendix B, shows *The Project* is located within Non-Shaded Flood Zone "X" (Areas of Minimal Flood Hazard). There are no proposed building sites within a FEMA-designated Flood Zone or Special Flood Hazard Area (see Appendix B – FEMA Map).

- Onsite soils belong to the Hydrologic Soil Group "C" (Appendix C – Soil Survey Map). An infiltration rate of 0.10 inches per hour for Open Space, Grassland, Ag (per Table 5-2 of the *Manual*) has been assumed for the site under existing conditions.

Existing drainage patterns are shown on the Existing Shed Map and Offsite Shed Map (Appendix D). Based on existing topography, three offsite sheds are routed through the Project Site which primarily sheet drains from south to north, to two points at the northern boundary. Runoff from the Project ultimately converges and discharges to a tributary of Dry Creek, near the north end of 26th Street, northwest from the Project Site. The existing sheds are more specifically described as follows:

SHED X1-1	Approximately one third of the existing undeveloped Site at 5.00± acres. Sheet drains from south toward the northern boundary. Runoff from Shed X1-1 contributes to generated flow at Design Point #1.

SHED O1-1	Approximately 5.96± acres of offsite, existing paved boat and RV storage west of the Project. Sheet drains from southwest to northeast toward the western boundary of the Project. Runoff from Shed O1-1 converges with Shed X1-1 and contributes to generated flow at Design Point #1.
SHED X1-2	The majority of the undeveloped project site at approximately 9.40 acres. Also includes the northern half and western half of the existing Q Street and 28th Street, respectively. Ruoff from 28th Street is collected in a roadside ditch that widens out to a larger swale through the property to the northern boundary. Shed X1-2 contributes to generated flow at Design Point #2.
SHED O1-2	Approximately 31.31± acre offsite shed south of the Project Site. Mostly commercial/industrial uses (i.e. self-storage, boat & RV storage). Drains from south to north toward the southeast corner of the Project where it discharges to the upstream end of the roadside ditch along 28th Street, converging with Shed X1-2. Shed O1-2 contributes to generated flow at Design Point #2.
SHED O2-2	Approximately 2.82± acre offsite shed east of the Project Site. Mostly undeveloped open space with a single-family residence at the northeast corner of Q Street and 28th Street. Drains west along Q Street and north along 28th Street where it discharges to the tail end of the roadside ditch on the west side of 28th Street, converging with Shed X1-2. Shed O2-2 contributes to generated flow at Design Point #2.
SHED O3-2	Approximately 0.52± acre offsite shed northeast of the Project Site. Entirely undeveloped open space draining west where it converges with Shed X1-2. Shed O3-2 contributes to generated flow at Design Point #2.

Runoff estimates for the Project's existing conditions, Sacramento Method 10-yr and 100-yr storm events are provided in the Sac-Calc Sacramento Method Results (Existing Condition) in Appendix E. Table 1 below summarizes the Sac-Calc results for the existing condition runoff estimates.

TABLE 1 **EXISTING PEAK FLOW CHARACTERISTICS** **(Sacramento Method – 10 & 100-YEAR)**		
Location	Q_{10} (cfs)	Q_{100} (cfs)
Design Point #1 [SHED X1-1 & O1-1]	17.5	32
Design Point #2 [SHEDS X1-2, O1-2, O2-2, O3-2]	77.4	137.9

DEVELOPED SITE CONDITIONS & HYDROLOGY

Under Developed Site Conditions, the Project will maintain the existing drainage patterns (See Appendix D – Developed Shed Map). The offsite sheds will continue to be routed through the site and the Project will continue to drain from south to north to the same two Design Points along the northern boundary. Beyond the project, drainage will continue on the same course to the Dry Creek Tributary as in existing condition.

The proposed site layout and finish grading were used to define the Developed Drainage Sheds. The Project site was divided into four onsite sheds (A-1, A-2, B-2, & C-2). As a result of the proposed improvements, a portion of the area draining to Design Point #1 in existing condition is shifted and contributes to flows at Design Point #2. This is due to the paved surface that is directed to the bioretention basin for treatment, which discharges to Shed C-2. The Developed Sheds are more specifically described as follows:

SHED A-1	Reduction of Shed X1-1 to 1.84± acres for the paving in the developed condition. Runoff from Shed A-1 contributes to generated flow at Design Point #1.
SHED A-2	0.29± acres including a portion of existing Q Street improvements. Drainage is collected in a ditch and routed to Shed C-2. Runoff from Shed A-2 contributes to generated flow at Design Point #2.
SHED B-2	The largest onsite shed (9.08± acres) in the developed condition. Consists of the entire new paved surface and the bioretention basin. Runoff from the paved surface sheet flows south to north and is conveyed to the bioretention basin by concrete curbs as the northern end of the paved surface. An underdrain in the bioretention basin conveys flow to the drain inlet and outfall pipe out to Shed C-2. Runoff from Shed B-2 contributes to generated flow at Design Point #2.
SHED C-2	3.18± acres including a portion of Q Street and 28th Street existing road improvements. Runoff is collected in roadside ditch and conveyed to the existing onsite swale adjacent to the proposed bioretention basin. Runoff from Shed C-2 contributes to generated flow at Design Point #2.
SHEDS O1-1, O1-2, O2-2, & 03-2	Same as existing offsite sheds. Shed O1-1 converges with Shed A-1 and contributes to generated flow at Design Point #1. Sheds O1-2, O2-2, & O3-2 converge with Shed C-2 and contribute to generated flow at Design Point #2.

Sac-Calc was also used to estimate runoff for the Developed Condition, Sacramento 10-yr and 100-yr storm events for the purposes of comparing to flows in the Existing Condition. The flow estimates are provided in the Sac-Calc Sacramento Method Results (Developed Condition) Appendix E. Table 2 below also summarizes the developed condition runoff estimates.

TABLE 2 PROPOSED PEAK FLOW CHARACTERISTICS (Sacramento Method – 10 & 100-YEAR)		
Location	Q_{10} (cfs)	Q_{100} (cfs)
Design Point #1 [SHEDS A-1 & O1-1]	14.3	25.7
Design Point #2 [SHEDS A-2, B-2, C-2, O1-2, O2-2, O3-2]	91.4	158.8

With respect to the proposed peak flow runoff rates, shown in Table 2, above, please note the following:

1. The above listed peak flow rates represent estimated unmitigated runoff based on proposed developed conditions.
2. Mitigation of peak flow rates (detention) is not proposed at this time.
    a. Onsite flows are quite low relative to the offsite flows directed through the site (approximately 16% of total in existing condition, approximately 25% of total in developed condition).
    b. Drainage leaving the Project discharges directly to a tributary of Dry Creek approximately 1,500 ft away. From that point, Dry Creek is approximately 2,000 ft away.
    c. Some attenuation is provided with the proposed bioretention basin and the design to meet hydromodification requirement (See Section V below).

IV. OVERLAND RELEASE ROUTES

As outlined in Sections 9-1 and 9-15 of the *Sacramento County Improvement Standards,* the 100-yr water surface elevation must allow for 1.2-ft of freeboard to the existing building pad elevations. For underground storm drain not designed to convey the 100-year runoff or in the event the storm drain system is inoperable, the streets are to safely route stormwater. To confirm that these requirements are met throughout, a ponding exhibit was prepared to model critical points where localized ponding might occur during the 100-yr storm event. The overland release routes have been analyzed and the results are compiled in Appendix F – Overland Release Exhibit.

V. PROPOSED LID, STORMWATER QUALITY, & HYDROMODIFICATION

LID

The Project addresses Low Impact Development (LID) measures required by the County of Sacramento for commercial projects. Per the *SQDM* the goal of LID measures is "to mimic a site's predevelopment balance of runoff and infiltration by using design techniques that infiltrate, store, evaporate, and detain runoff close to its source."

To mitigate increased stormwater runoff from developed areas, the Project proposes the following LID measures:

- Common Drainage Plan Open Space (Landscaped Areas including Trees and Vegetation)
- Interceptor Trees (Proposed)
- Bio-Retention Basin

In order to determine the effectiveness of the proposed LID measures, the County's spreadsheet for Commercial Sites: Low Impact Development (LID) Credits was utilized (See Appendix G). The Project's proposed pervious and impervious surfaces were calculated for Shed B-1 as it is the only shed with an increase in impervious area. Credits for the landscaped area and interceptor trees shown on the Project's Landscape Plan have not been applied to this shed as the landscaping is within Sheds A-2 & C-2 (Appendix D – Developed Shed Map). Drainage Shed B-1 and the corresponding bioretention basin are shown on the Stormwater Management Plan in Appendix G.

Stormwater Quality Treatment

The LID Credits spreadsheet provided in Appendix G shows that the Project's proposed LID features meet the required Water Quality Treatment for the site's design runoff.

Hydromodification

The Project's proposed bioretention basin provides hydromodification under developed conditions by regulating the outflow through the outlet structure and accounting for infiltration. A perforated underdrain (4-inch dia.) is proposed beneath the basin's compost and bioretention soil mix layers that connects to the riser outlet structure. Flows larger than the underdrain capacity pond within the basin until reaching the top of the riser structure. The outlet structure is proposed as a 24-inch flat-top drain inlet.

The Sacramento Area Hydrology Model (SAHM) software was utilized to confirm the basin's adequacy in meeting hydromodification requirements per the *SQDM.* The SAHM-generated report for the Project is provided in Appendix G.

VI. CONCLUSIONS

Based on the following, the 2615 Q St Project design meets or exceeds drainage performance standards as required by the County of Sacramento.

1. The methods used to calculate storm runoff for this project are in compliance with the *Manual*.

2. The proposed Project lies outside of a FEMA-designated Flood Zone or Special Flood Hazard Area.

3. Generated storm runoff from impervious surfaces shall be routed through bioretention basins providing permanent BMP facilities, LID measures, and Hydromodifcation, prior to discharging offsite.

4. Storm flows generated from offsite sheds will be conveyed through the project site as they do in the existing condition.

5. Developed Conditions – The need to mitigate the increase in onsite Peak Runoff flows (10-yr & 100-yr) is negated by the following:

    a. The onsite peak flows are minimal in comparison to the combined flows leaving the site in both the existing and developed conditions.
    b. Flows discharge directly to a tributary of Dry Creek, with Dry Creek and the tributary both near the Project site.
    c. Some attenuation is provided by the bioretention basin (not quantified except as done so by the SAHM for hydromodification).

VII. REFERENCES

1. County of Sacramento. *County of Sacramento Improvement Standards – Section 9*. April 1, 2018

2. Sacramento Region. *Stormwater Quality Design Manual for the Sacramento Region*. July 2018.

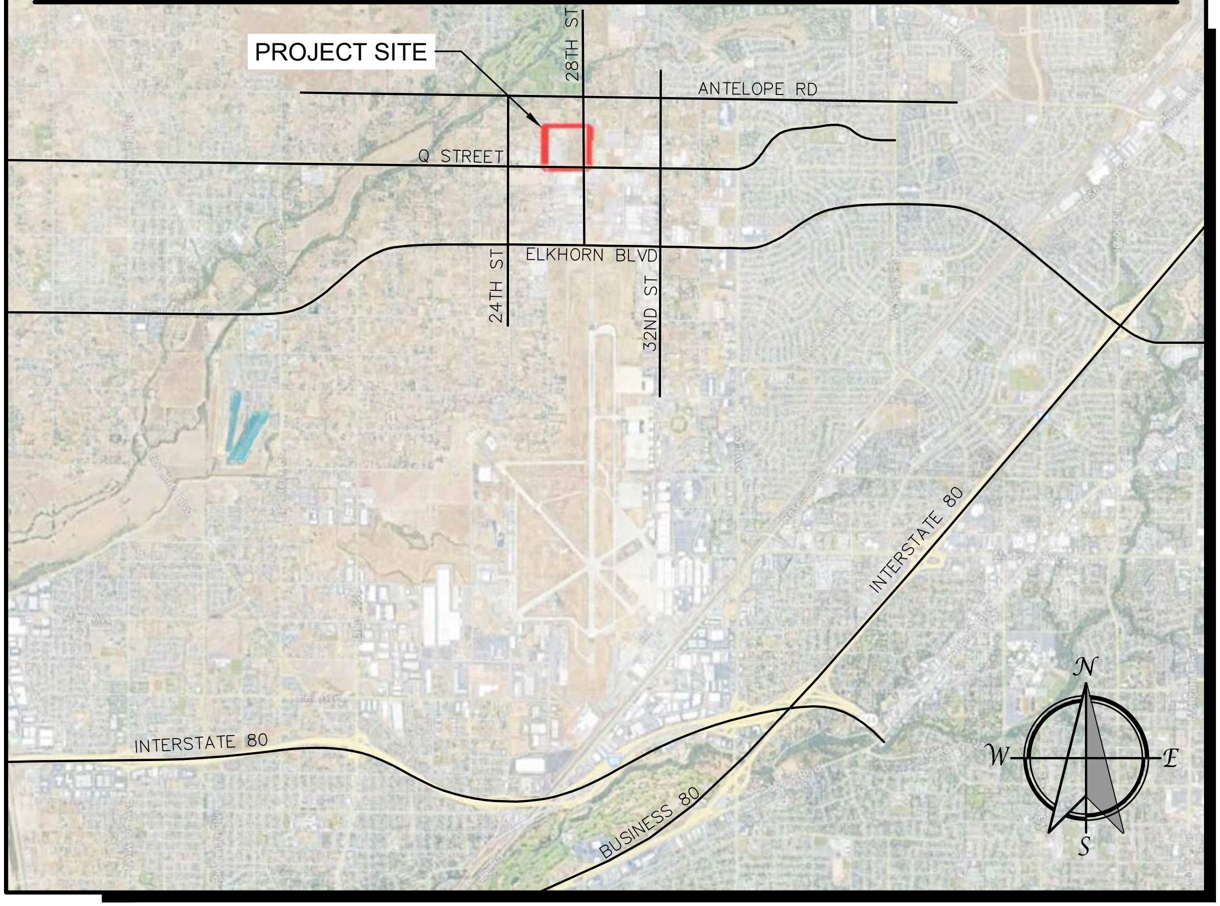
3. City/County of Sacramento. *Drainage Manual – Volume 2 Hydrology Standards*. December 1996.

APPENDIX A

VICINITY MAP

Vicinity Map

VICINITY MAP



APPENDIX B

FEMA MAP

FEMA Map

National Flood Hazard Layer FIRMette

FEMA

121°24'28"W 38°42'11"N

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

1:6,000

121°23'50"W 38°41'43"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
- B 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 4/18/2023 at 1:07 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.

APPENDIX C

EXISTING CONDITIONS

EXISTING CONDITIONS – TOPO MAP

SOIL SURVEY MAP

LEGEND	
▲	CONTROL POINT AS NOTED
◉	FOUND MONUMENT AS NOTED
CV	COMMUNICATIONS VAULT
Ⓒ	COMMUNICATIONS MANHOLE
EV	ELECTRIC VAULT
E	ELECTRIC BOX
TV	CABLE TELEVISION BOX
Ⓓ	STORM DRAIN MANHOLE
	STORM DRAIN INLET
	SEWER CLEANOUT
Ⓢ	SEWER MANHOLE
ICV	IRRIGATION CONTROL VALVE
PVC	PVC RISER
	LANDSCAPE DRAIN
	LIGHT POLE
	SIGN POST
Ⓗ	FIRE HYDRANT
W	WATER BOX
	WATER VALVE
600	ELEVATION CONTOUR
×600.0	SPOT ELEVATION
	CHAIN LINK FENCE
	TUBULAR STEEL FENCE
O.R.E.D.C.	OFFICIAL RECORDS OF EL DORADO COUNTY
8" SS	UNDERGROUND SANIARY SEWER LINE
12" SD	UNDERGROUND STORM DRAIN LINE
4" W	UNDERGROUND WATER LINE
4" W	UNDERGROUND RAW WATER LINE
C	UNDERGROUND COMMUNICATIONS LINE
G	UNDERGROUND GAS LINE
P	UNDERGROUND POWER LINE

NOTES:

1. ALL DISTANCES SHOWN HEREON ARE IN FEET AND DECIMALS THEREOF.
2. THIS SURVEY WAS PREPARED FROM INFORMATION SHOWN IN THE PRELIMINARY REPORT PREPARED BY PLACER TITLE COMPANY, ESCROW NUMBER P-541072, DATED JANUARY 27, 2022. NO LIABILITY IS ASSUMED FOR MATTERS OF RECORD NOT SHOWN THEREIN THAT MAY AFFECT THE BOUNDARY LINES, EXCEPTIONS, OR EASEMENTS AFFECTING THE PROPERTY.
3. PHYSICAL ITEMS SHOWN ON THE SURVEY ARE LIMITED TO THOSE SURFACE ITEMS VISIBLE AS OF THE DATE OF THIS SURVEY. SUBSURFACE ITEMS ARE NOT SHOWN. SAID SUBSURFACE ITEMS MAY INCLUDE, BUT ARE NOT LIMITED TO CONCRETE FOOTINGS, SLABS, SHORING, STRUCTURAL PILES, UTILITY VAULTS, PIPING, UNDERGROUND TANKS, AND ANY OTHER SUBSURFACE STRUCTURES NOT REVEALED BY SURFACE INSPECTION.

BENCHMARK: COUNTY OF SACRAMENTO BENCHMARK 212 – 2" BRASS DISC STAMPED "SACRAMENTO CO. DEPT. OF PUBLIC WORKS MTCO BM 212" LOCATED ON THE CONCRETE BASE FOR ELECTROLIER #20813 AT THE SOUTHWEST CORNER OF Q STREET AND 28TH STREET.
ELEVATION = 78.09 (NAVD88)

BASIS OF BEARINGS: PARCEL MAP FILED IN THE OFFICE OF THE RECORDER OF SACRAMENTO COUNTY IN BOOK 209 OF PARCEL MAPS, AT PAGE 6, BASED ON THE FOUND MONUMENTS SHOWN HEREON.

JOB #518-001

TOPOGRAPHIC & BOUNDARY SURVEY
2615 Q Street
APNs 208-0012-015, 016, 017, 020
& 208-0022-001 & 002

CITY OF RIO LINDA
COUNTY OF SACRAMENTO
STATE OF CALIFORNIA

Scale: 1"=10' Date: JANUARY 2019 Revised:
P:\Projects\518-001\02 DWG\A- Survey\MASTER\518-001 T.dwg, 03-31-22

TSD ENGINEERING, INC.
expect more.
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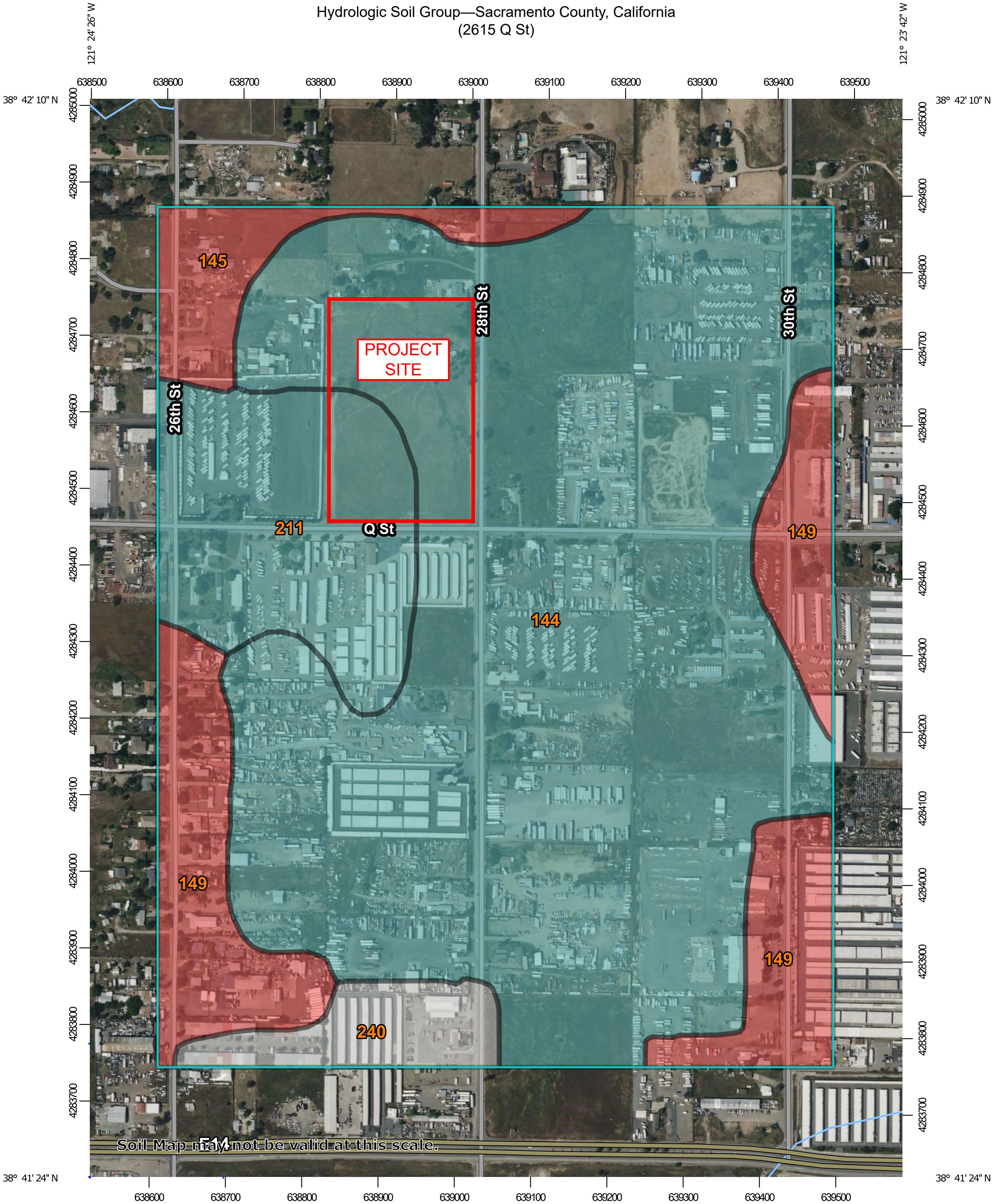
Fax: (916) 608-0701

Hydrologic Soil Group—Sacramento County, California
(2615 Q St)



Map Scale: 1:6,860 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 300, 600, 1200, 1800

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Sacramento County, California
Survey Area Data: Version 22, Sep 1, 2022

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

Date(s) aerial images were photographed: Apr 23, 2022—Apr 24, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
144	Fiddyment fine sandy loam, 0 to 1 percent slopes	C	164.9	66.8%
145	Fiddyment fine sandy loam, 1 to 8 percent slopes	D	10.0	4.1%
149	Fiddyment-Urban land complex, 1 to 8 percent slopes	D	34.5	14.0%
211	San Joaquin fine sandy loam, 0 to 3 percent slopes	C	28.8	11.7%
240	Xerarents-Urban land-San Joaquin complex, 0 to 5 percent slopes		8.4	3.4%
Totals for Area of Interest			**246.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D

SHED MAPS

EXISTING SHED MAP

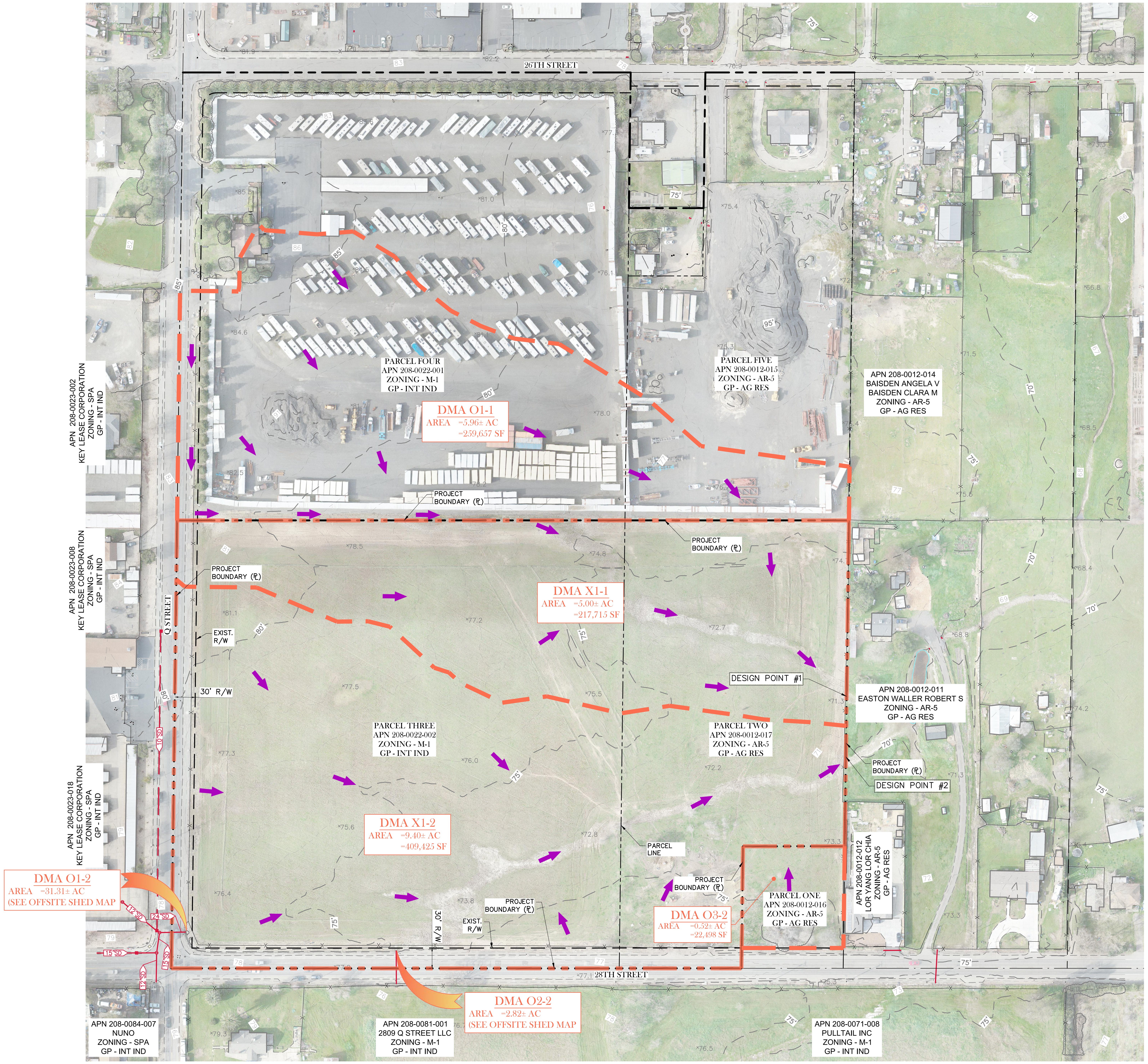
OFFSITE SHED MAP

DEVELOPED SHED MAP

EXISTING SHED MAP

KEY FEATURES LEGEND

- 5' CONTOUR [EXISTING]
- 1' CONTOUR [EXISTING]
- SHED BOUNDARY ON ℞ [EXISTING]
- SHED BOUNDARY [EXISTING]
- STORM DRAIN [EXISTING]
- STORM DRAIN INLET [EXISTING]
- STORM DRAIN MANHOLE [EXISTING]
- SURFACE FLOW DIRECTION [EXISTING]
- DESIGN POINT #_ — DESIGN POINT I.D.



scale: 1"=80'

80 0 40 80 160

2615 Q ST - COUNTY OF SACRAMENTO, CA

NW CORNER OF Q ST & 28TH ST
RIO LINDA, CA

Proposed By:
THOMAS PETERSON TRUST
PO BOX 454
NORTH HIGHLANDS, CA 95660

MAY 24, 2023
INITIAL SUBMITTAL

TSD ENGINEERING, INC.
expect more.
785 Orchard Drive, Suite #110
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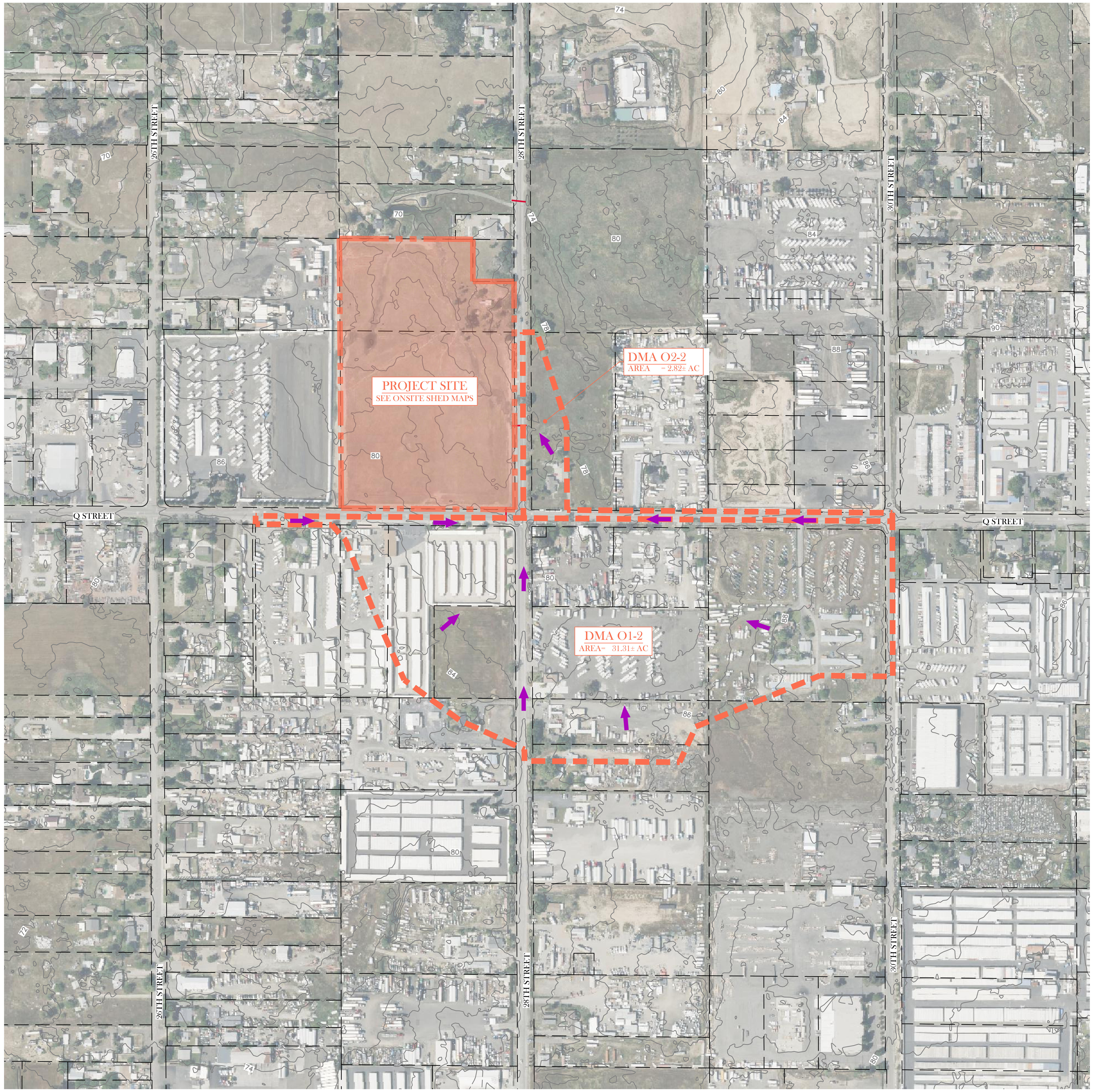
Phone: (916) 608-0707
Fax: (916) 608-0701

OFFSITE SHED MAP



KEY FEATURES LEGEND

- 2' CONTOUR [EXISTING]
- PROJECT BOUNDARY
- SHED BOUNDARY [EXISTING]
- STORM DRAIN [EXISTING]
- SURFACE FLOW DIRECTION [EXISTING]

N W E S

scale: 1"=200'

200 0 100 200 400

2615 Q ST - COUNTY OF SACRAMENTO, CA

NW CORNER OF Q ST & 28TH ST
RIO LINDA, CA

Proposed By: **THOMAS PETERSON TRUST**
PO BOX 454
NORTH HIGHLANDS, CA 95660

MAY 24, 2023
INITIAL SUBMITTAL

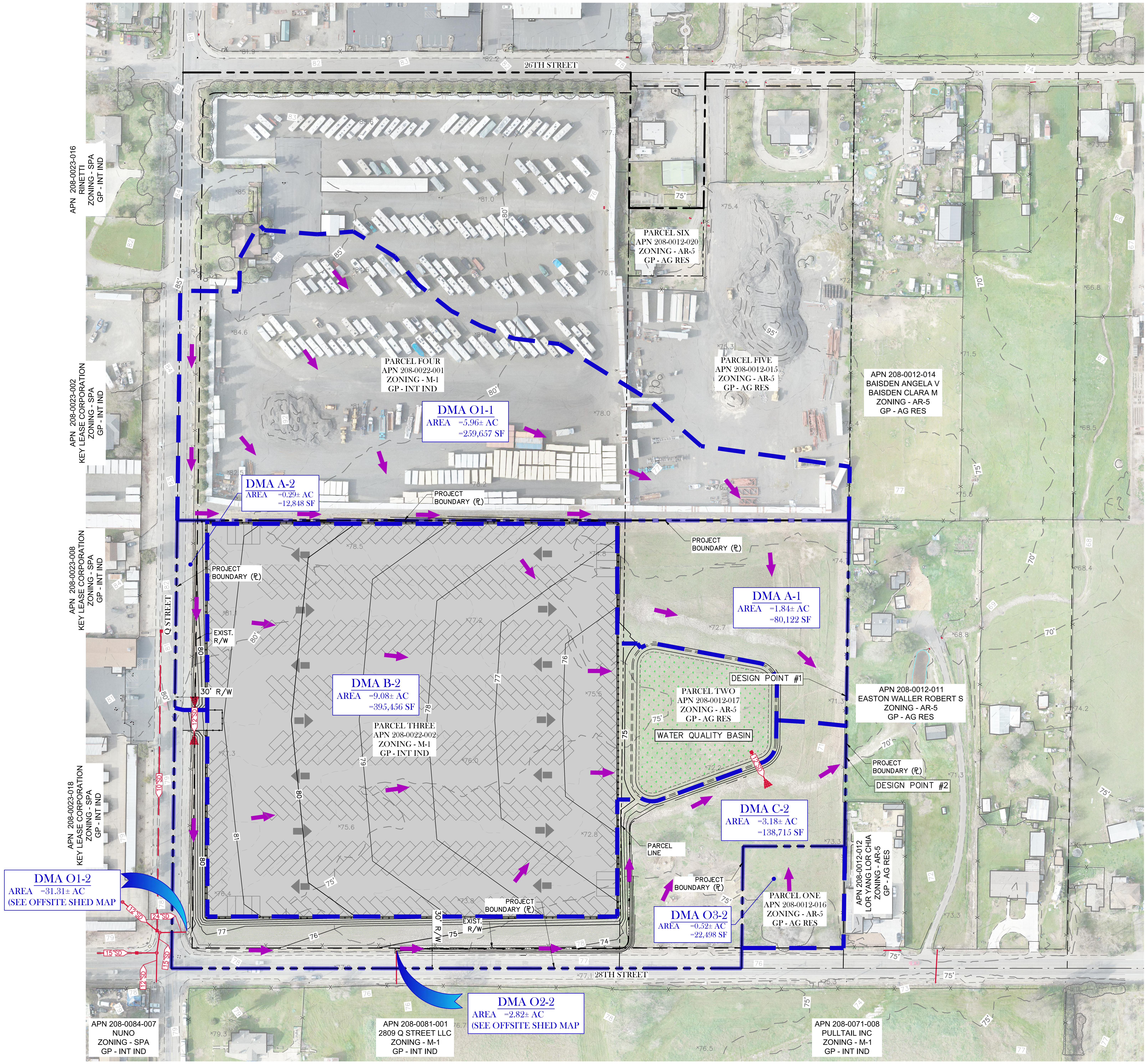
TSD ENGINEERING, INC.
expect more.
785 Orchard Drive, Suite #110
Folsom, CA 95630
Phone: (916) 608-0707
Fax: (916) 608-0701

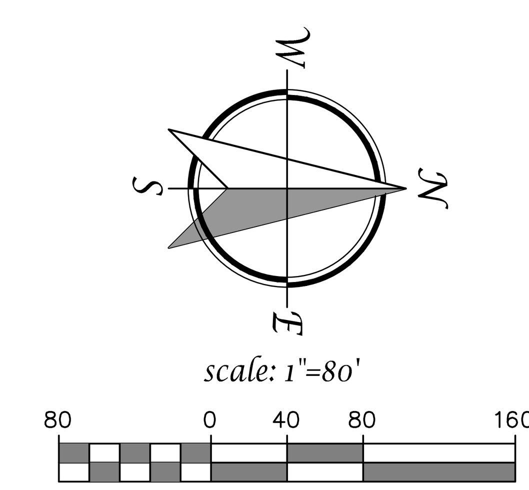
P:\Projects\518-001\03 REPORTS\HYDROLOGY AND HYDRAULICS\Appendix D - Site Plan\518-001_Offsite Shed Map.dwg, Jonathan, 15:00:09, 05-25-23

DEVELOPED SHED MAP

KEY FEATURES LEGEND

100	5' CONTOUR [EXISTING]
99	1' CONTOUR [EXISTING]
100	5' CONTOUR [PROPOSED]
99	1' CONTOUR [PROPOSED]
	SHED BOUNDARY ON ℄ [EXISTING]
	SHED BOUNDARY [EXISTING]
	STORM DRAIN [EXISTING]
	STORM DRAIN [PROPOSED]
	STORM DRAIN INLET [EXISTING]
	STORM DRAIN MANHOLE [EXISTING]
	STORM DRAIN INLET [PROPOSED]
	SURFACE FLOW DIRECTION [EXISTING]
DESIGN POINT #_	DESIGN POINT I.D.





2615 Q ST - COUNTY OF SACRAMENTO, CA

NW CORNER OF Q ST & 28TH ST
RIO LINDA, CA

Proposed By:

THOMAS PETERSON TRUST
PO BOX 454
NORTH HIGHLANDS, CA 95660

MAY 24, 2023
INITIAL SUBMITTAL

TSD ENGINEERING, INC.
expect more.
785 Orchard Drive, Suite #110
Folsom, CA 95630
Phone: (916) 608-0707
Fax: (916) 608-0701

APPENDIX E

HYDROLOGY

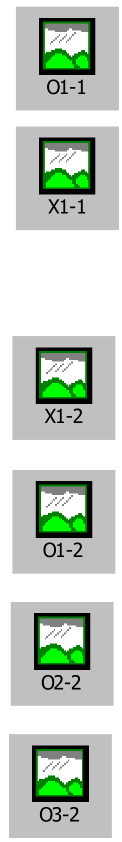
<u>SacCalc – Sacramento Method</u>

Shed Layout – Existing Condition

Peak Flow Results – Existing Condition

Shed Layout – Developed Condition

Peak Flow Results – Developed Condition


O1-1
X1-1
X1-2
O1-2
O2-2
O3-2

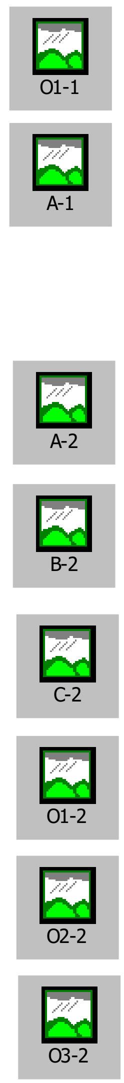
View HEC-1 output

Sacramento method results
(Project: 2615 Q St (Existing Condition))
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
O1-1	21.	12:02	.01			
X1-1	11.	12:09	.01			
X1-2	20.	12:10	.01			
O3-2	1.2	12:08	.00			
O1-2	111.	12:02	.05			
O2-2	5.7	12:12	.00			

(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
O1-1	12.	12:02	.01			
X1-1	5.5	12:12	.01			
X1-2	9.9	12:14	.01			
O3-2	.6	12:11	.00			
O1-2	64.	12:02	.05			
O2-2	2.9	12:16	.00			


O1-1
A-1
A-2
B-2
C-2
O1-2
O2-2
O3-2

View HEC-1 output

Sacramento method results
(Project: 2615 Q St (Developed Condition))
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
O1-1	21.	12:02	.01			
A-1	4.7	12:06	.00			
A-2	.7	12:07	.00			
O3-2	1.2	12:08	.00			
O1-2	111.	12:02	.05			
O2-2	5.7	12:12	.00			
B-2	32.	12:02	.01			
C-2	8.2	12:06	.00			

(10-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
O1-1	12.	12:02	.01			
A-1	2.3	12:09	.00			
A-2	.4	12:10	.00			
O3-2	.6	12:11	.00			
O1-2	64.	12:02	.05			
O2-2	2.9	12:16	.00			
B-2	19.	12:02	.01			
C-2	4.5	12:07	.00			

APPENDIX F

OVERLAND RELEASE

Overland Release Exhibit

OVERLAND RELEASE EXHIBIT

2615 Q ST - COUNTY OF SACRAMENTO, CA

NW CORNER OF Q ST & 28TH ST
RIO LINDA, CA

Proposed By:
THOMAS PETERSON TRUST
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Appendix G

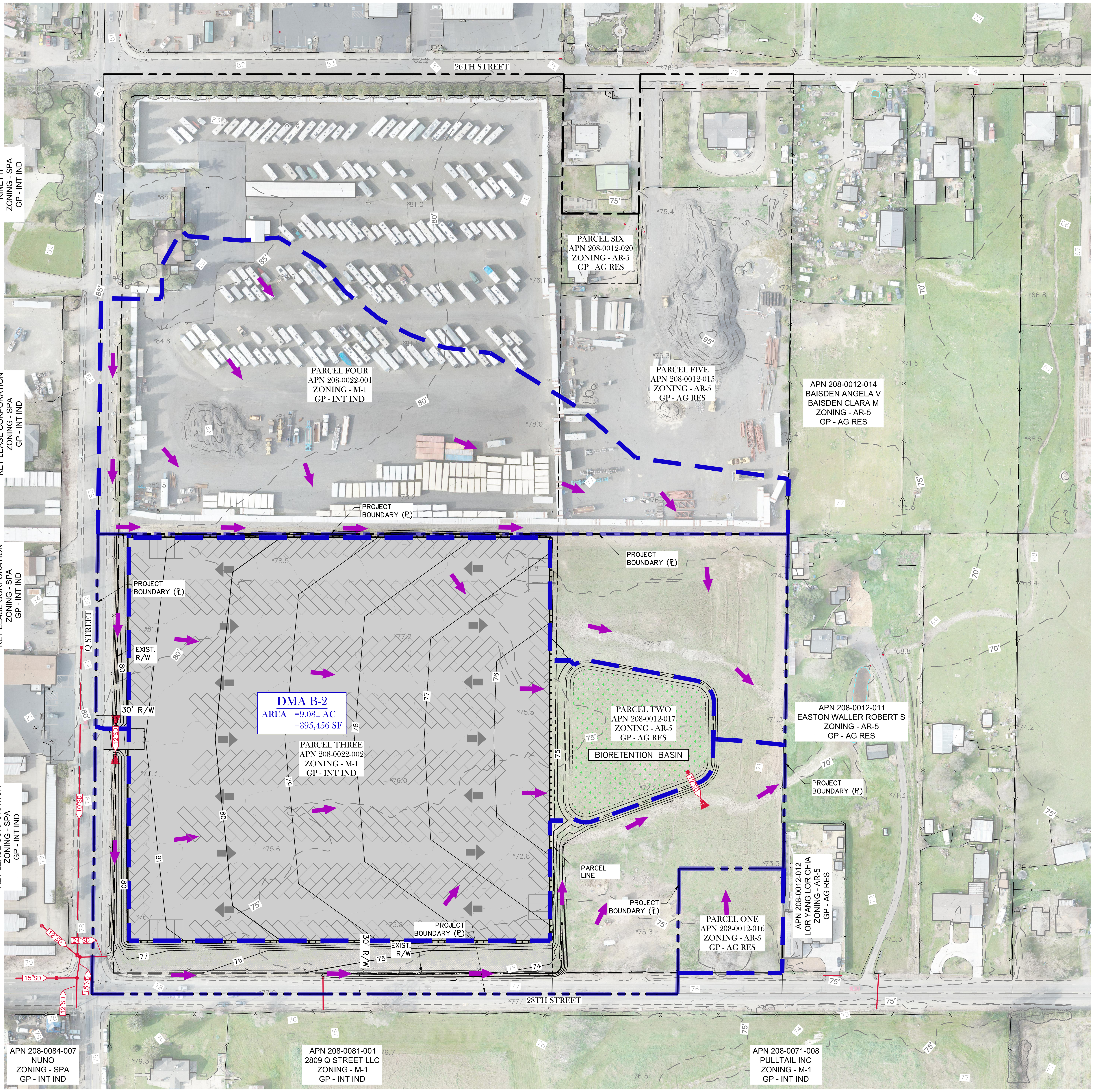
LID, Stormwater Quality Treatment, & Hydromodification

Stormwater Management Plan (Exhibit)

Commercial Sites LID Credits and Treatment BMP Sizing Worksheet

SAHM Project Report

STORMWATER MANAGEMENT PLAN



DMA SUMMARY									
DMA I.D.	TOTAL AREA (SF)	TOTAL AREA (AC)	% IMPERVIOUS	AREA IMPERVIOUS (SF)	AREA PERVIOUS (SF)	AREA PERVIOUS (AC)	INTERCEPTOR TREES (EVERGREEN)	INTERCEPTOR TREES (DECIDUOUS)	BIO-RETENTION FEATURE AREA (SF)
B-2	395,456	9.08	89	350,045	45,411	1.04	0	0	31,600

KEY FEATURES LEGEND

- 5' CONTOUR [EXISTING]
- 1' CONTOUR [EXISTING]
- 5' CONTOUR [PROPOSED]
- 1' CONTOUR [PROPOSED]
- SHED BOUNDARY ON ℞ [EXISTING]
- SHED BOUNDARY [EXISTING]
- STORM DRAIN [EXISTING]
- STORM DRAIN [PROPOSED]
- STORM DRAIN INLET [EXISTING]
- STORM DRAIN MANHOLE [EXISTING]
- STORM DRAIN INLET [PROPOSED]
- SURFACE FLOW DIRECTION [EXISTING]

scale: 1"=80'

80 0 40 80 160

2615 Q ST - COUNTY OF SACRAMENTO, CA

NW CORNER OF Q ST & 28TH ST
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Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: DMA B-2

Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	15	acres	A_{CDP}
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}
a. Natural storage reservoirs and drainage corridors	0	acres	
b. Buffer zones for natural water bodies	0	acres	
c. Natural areas including existing trees, other vegetation, and soil	0	acres	
d. Common landscape area/park	0	acres	
e. Regional Flood Control/Drainage basins	0	acres	

see area example below

1 b. Project Drainage Shed Area (Total)	9.08	acres	A
Project-Specific Open Space (In-project, communal)**	1.04	acres	A_{PSOS}
a. Natural storage reservoirs and drainage corridors	0.00	acres	
b. Buffer zones for natural water bodies	0.00	acres	
c. Natural areas including existing trees, other vegetation, and soil	0.31	acres	
d. Landscape area/park	0.00	acres	
e. Flood Control/Drainage basins	0.73	acres	

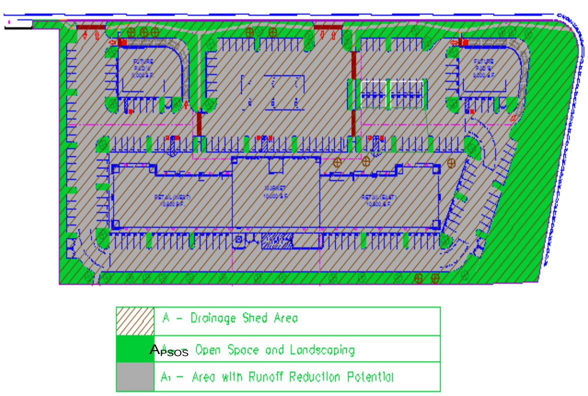
see area example below

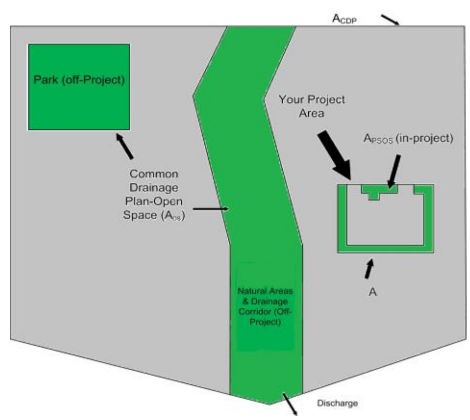
** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS} =$	8.04	acres	A_T
Assumed Initial Impervious Fraction	$A_T / A =$	0.89		I

Open Space & Pervious Area LID Credit (Step 1)

$(A_{OS}/A_{CDP}+A_{PSOS}/A)\times100 =$ 11 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits	→				0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits	→				0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100 =$ 0 pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement & Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

Box K4: 1

6. Enter Efficiency of Porous Pavement (see table below) — Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7

9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8 — 0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.	0	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.	0	trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area	31,600	sq ft		
Subdrain Elevation	24	inches		
Ponding Depth, inches	12	inches	10.82	acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs		drawdown_hrs_inf		
Soil Infiltration Rate, in/hr		soil_inf_rate		
Sizing Option 1: Capture Volume, acre-ft	0.00	capture_vol_inf	0.00	acres
Sizing Option 2: Infiltration BMP surface area, sq ft	0	soil_surface_area	0.00	acres

Basin or trench? ______ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft ______ mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 10.82 | A_{LIDc}

Runoff Management Credit (Step 3) $A_{LIDC}/A_T*200 =$ 269.1 pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 280.6

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC} =$ -2.78 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment $A_{AT} / A =$ -0.31 I_A

STOP: No additional treatment needed

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity)	0.18	i
Obtain A_{AT} from Step 3	-2.78	A_{AT}
Use C = 0.95	0.95	C
Flow = 0.95 * i * A_{AT}	-0.48	cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1	9.08	A
Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.	0.00	P_0
Calculate treatment volume (acre-ft): **Treatment volume = A x (P_0 / 12)**	0.00	Acre-Feet

______ hrs Specified Draw Down time

v06232012

SAHM

PROJECT REPORT

General Model Information

Project Name:	518-001_SAHM
Site Name:	PETERSON STORAGE
Site Address:	2615 Q ST
City:	RIO LINDA
Report Date:	5/25/2023
Gage:	RANCHO C
Data Start:	1961/10/01
Data End:	2004/09/30
Timestep:	Hourly
Precip Scale:	0.944
Version Date:	2019/12/01

POC Thresholds

Low Flow Threshold for POC1:	25 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year

Landuse Basin Data
Pre-Project Land Use

DMA B-2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C,Grass,Flat(0-1%)	9.08
Pervious Total	9.08
Impervious Land Use	acre
Impervious Total	0
Basin Total	9.08

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

DMA B-2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C,Grass,Flat(0-1%)	8.04
Pervious Total	8.04
Impervious Land Use	acre
Imperv,Flat(0-1%)	1.04
Impervious Total	1.04
Basin Total	9.08

Element Flows To:

Surface	Interflow	Groundwater
BIORETENTION BASIN	BIORETENTION BASIN	

Routing Elements
Pre-Project Routing

Mitigated Routing

BIORETENTION BASIN

Bottom Length: 190.00 ft.
Bottom Width: 166.32 ft.
Depth: 1.5 ft.
Volume at riser head: 0.7503 acre-feet.
Infiltration On
Infiltration rate: 0.1
Infiltration safety factor: 0.333
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 134.146
Total Volume Through Riser (ac-ft.): 45.544
Total Volume Through Facility (ac-ft.): 179.69
Percent Infiltrated: 74.65
Total Precip Applied to Facility: 43.644
Total Evap From Facility: 8.877
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 27.1 in.
Element Flows To:
Outlet 1 Outlet 2

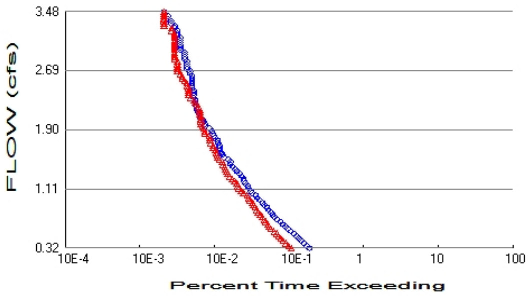
Pond Hydraulic Table

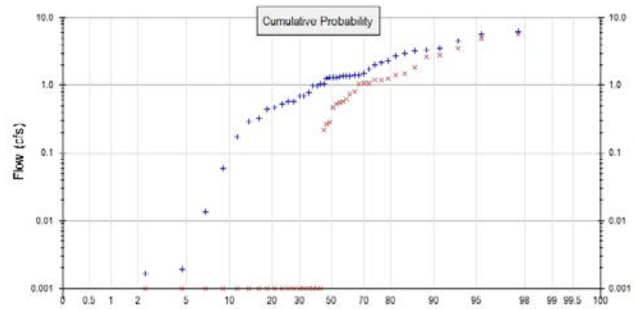
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
73.330	0.725	0.000	0.000	0.000
73.347	0.726	0.012	0.000	0.024
73.363	0.727	0.024	0.000	0.024
73.380	0.727	0.036	0.000	0.024
73.397	0.728	0.048	0.000	0.024
73.413	0.729	0.060	0.000	0.024
73.430	0.730	0.072	0.000	0.024
73.447	0.731	0.085	0.000	0.024
73.463	0.732	0.097	0.000	0.024
73.480	0.732	0.109	0.000	0.024
73.497	0.733	0.121	0.000	0.024
73.513	0.734	0.133	0.000	0.024
73.530	0.735	0.146	0.000	0.024
73.547	0.736	0.158	0.000	0.024
73.563	0.737	0.170	0.000	0.024
73.580	0.737	0.182	0.000	0.024
73.597	0.738	0.195	0.000	0.024
73.613	0.739	0.207	0.000	0.024
73.630	0.740	0.219	0.000	0.024
73.647	0.741	0.232	0.000	0.024
73.663	0.741	0.244	0.000	0.024
73.680	0.742	0.256	0.000	0.024
73.697	0.743	0.269	0.000	0.025
73.713	0.744	0.281	0.000	0.025
73.730	0.745	0.294	0.000	0.025
73.747	0.746	0.306	0.000	0.025

73.763	0.746	0.319	0.000	0.025
73.780	0.747	0.331	0.000	0.025
73.797	0.748	0.343	0.000	0.025
73.813	0.749	0.356	0.000	0.025
73.830	0.750	0.368	0.000	0.025
73.847	0.751	0.381	0.000	0.025
73.863	0.751	0.393	0.000	0.025
73.880	0.752	0.406	0.000	0.025
73.897	0.753	0.419	0.000	0.025
73.913	0.754	0.431	0.000	0.025
73.930	0.755	0.444	0.000	0.025
73.947	0.756	0.456	0.000	0.025
73.963	0.756	0.469	0.000	0.025
73.980	0.757	0.482	0.000	0.025
73.997	0.758	0.494	0.000	0.025
74.013	0.759	0.507	0.000	0.025
74.030	0.760	0.519	0.000	0.025
74.047	0.761	0.532	0.000	0.025
74.063	0.761	0.545	0.000	0.025
74.080	0.762	0.558	0.000	0.025
74.097	0.763	0.570	0.000	0.025
74.113	0.764	0.583	0.000	0.025
74.130	0.765	0.596	0.000	0.025
74.147	0.766	0.609	0.000	0.025
74.163	0.766	0.621	0.000	0.025
74.180	0.767	0.634	0.000	0.025
74.197	0.768	0.647	0.000	0.025
74.213	0.769	0.660	0.000	0.025
74.230	0.770	0.673	0.000	0.025
74.247	0.771	0.685	0.000	0.025
74.263	0.772	0.698	0.000	0.025
74.280	0.772	0.711	0.000	0.025
74.297	0.773	0.724	0.000	0.026
74.313	0.774	0.737	0.000	0.026
74.330	0.775	0.750	0.000	0.026
74.347	0.776	0.763	0.051	0.026
74.363	0.777	0.776	0.145	0.026
74.380	0.777	0.789	0.267	0.026
74.397	0.778	0.802	0.412	0.026
74.413	0.779	0.815	0.576	0.026
74.430	0.780	0.828	0.757	0.026
74.447	0.781	0.841	0.953	0.026
74.463	0.782	0.854	1.164	0.026
74.480	0.783	0.867	1.389	0.026
74.497	0.783	0.880	1.625	0.026
74.513	0.784	0.893	1.874	0.026
74.530	0.785	0.906	2.133	0.026
74.547	0.786	0.919	2.403	0.026
74.563	0.787	0.932	2.683	0.026
74.580	0.788	0.945	2.971	0.026
74.597	0.788	0.958	3.268	0.026
74.613	0.789	0.972	3.573	0.026
74.630	0.790	0.985	3.885	0.026
74.647	0.791	0.998	4.203	0.026
74.663	0.792	1.011	4.528	0.026
74.680	0.793	1.024	4.858	0.026
74.697	0.794	1.038	5.193	0.026
74.713	0.794	1.051	5.533	0.026

74.730	0.795	1.064	5.876	0.026
74.747	0.796	1.077	6.222	0.026
74.763	0.797	1.091	6.571	0.026
74.780	0.798	1.104	6.921	0.026
74.797	0.799	1.117	7.273	0.026
74.813	0.800	1.131	7.625	0.026
74.830	0.800	1.144	7.977	0.026
74.847	0.801	1.157	8.329	0.026

Analysis Results
POC 1





+ Pre-Project x Mitigated

Pre-Project Landuse Totals for POC #1
Total Pervious Area: 9.08
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 8.04
Total Impervious Area: 1.04

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Pre-Project. POC #1

Return Period	Flow(cfs)
2 year	1.2955
5 year	2.396651
10 year	3.480856
25 year	5.806757

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.278756
5 year	1.296939
10 year	2.747945
25 year	4.994666

Annual Peaks

Annual Peaks for Pre-Project and Mitigated. POC #1

Year	Pre-Project	Mitigated
1962	1.313	0.618
1963	0.697	0.000
1964	0.059	0.000
1965	1.260	0.550
1966	0.014	0.000
1967	1.397	1.085
1968	0.288	0.000
1969	1.321	1.058
1970	1.041	0.466
1971	1.435	0.565
1972	0.002	0.000
1973	3.249	1.207
1974	0.990	0.000
1975	1.339	0.000

1976	0.002	0.000
1977	0.002	0.000
1978	1.375	0.264
1979	0.519	0.000
1980	2.331	0.521
1981	0.176	0.000
1982	2.694	1.846
1983	3.374	2.651
1984	1.296	0.814
1985	0.702	0.000
1986	5.752	4.880
1987	0.450	0.000
1988	0.982	0.000
1989	1.728	1.272
1990	1.404	0.000
1991	1.039	0.279
1992	1.983	1.184
1993	1.373	1.409
1994	0.581	0.000
1995	6.152	5.724
1996	3.570	0.749
1997	4.598	3.507
1998	2.944	2.828
1999	0.788	0.219
2000	2.162	1.516
2001	0.567	0.000
2002	0.471	0.000
2003	0.323	0.000
2004	1.519	1.039

Ranked Annual Peaks

Ranked Annual Peaks for Pre-Project and Mitigated. POC #1

Rank	Pre-Project	Mitigated
1	6.1518	5.7237
2	5.7523	4.8796
3	4.5978	3.5071
4	3.5701	2.8284
5	3.3738	2.6514
6	3.2494	1.8463
7	2.9437	1.5165
8	2.6939	1.4089
9	2.3306	1.2721
10	2.1625	1.2071
11	1.9827	1.1845
12	1.7282	1.0848
13	1.5188	1.0583
14	1.4350	1.0393
15	1.4044	0.8140
16	1.3965	0.7487
17	1.3752	0.6180
18	1.3733	0.5654
19	1.3392	0.5499
20	1.3214	0.5206
21	1.3131	0.4655
22	1.2955	0.2788
23	1.2601	0.2638
24	1.0412	0.2187
25	1.0385	0.0000

26	0.9896	0.0000
27	0.9817	0.0000
28	0.7884	0.0000
29	0.7024	0.0000
30	0.6972	0.0000
31	0.5809	0.0000
32	0.5666	0.0000
33	0.5192	0.0000
34	0.4706	0.0000
35	0.4499	0.0000
36	0.3234	0.0000
37	0.2876	0.0000
38	0.1761	0.0000
39	0.0588	0.0000
40	0.0137	0.0000
41	0.0019	0.0000
42	0.0017	0.0000
43	0.0016	0.0000

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3239	714	403	56	Pass
0.3558	650	373	57	Pass
0.3877	596	340	57	Pass
0.4195	554	313	56	Pass
0.4514	511	294	57	Pass
0.4833	475	274	57	Pass
0.5152	439	259	58	Pass
0.5471	397	239	60	Pass
0.5790	366	215	58	Pass
0.6109	338	202	59	Pass
0.6428	311	195	62	Pass
0.6747	290	185	63	Pass
0.7065	261	174	66	Pass
0.7384	240	164	68	Pass
0.7703	227	156	68	Pass
0.8022	214	145	67	Pass
0.8341	203	138	67	Pass
0.8660	192	132	68	Pass
0.8979	177	126	71	Pass
0.9298	166	122	73	Pass
0.9616	154	114	74	Pass
0.9935	143	108	75	Pass
1.0254	135	104	77	Pass
1.0573	121	93	76	Pass
1.0892	117	86	73	Pass
1.1211	109	81	74	Pass
1.1530	106	77	72	Pass
1.1849	98	75	76	Pass
1.2168	95	70	73	Pass
1.2486	93	65	69	Pass
1.2805	87	60	68	Pass
1.3124	82	57	69	Pass
1.3443	75	55	73	Pass
1.3762	71	53	74	Pass
1.4081	66	52	78	Pass
1.4400	62	49	79	Pass
1.4719	62	48	77	Pass
1.5038	58	44	75	Pass
1.5356	50	42	84	Pass
1.5675	49	41	83	Pass
1.5994	47	40	85	Pass
1.6313	45	39	86	Pass
1.6632	44	36	81	Pass
1.6951	44	36	81	Pass
1.7270	43	34	79	Pass
1.7589	42	33	78	Pass
1.7908	38	33	86	Pass
1.8226	37	32	86	Pass
1.8545	36	28	77	Pass
1.8864	35	28	80	Pass
1.9183	32	27	84	Pass
1.9502	28	26	92	Pass
1.9821	28	25	89	Pass

2.0140	27	25	92	Pass
2.0459	26	25	96	Pass
2.0778	24	25	104	Pass
2.1096	24	24	100	Pass
2.1415	23	24	104	Pass
2.1734	22	24	109	Pass
2.2053	22	23	104	Pass
2.2372	21	22	104	Pass
2.2691	21	21	100	Pass
2.3010	21	20	95	Pass
2.3329	20	18	90	Pass
2.3648	20	17	85	Pass
2.3966	20	17	85	Pass
2.4285	20	17	85	Pass
2.4604	19	17	89	Pass
2.4923	19	16	84	Pass
2.5242	19	16	84	Pass
2.5561	19	15	78	Pass
2.5880	19	14	73	Pass
2.6199	19	14	73	Pass
2.6517	18	13	72	Pass
2.6836	18	12	66	Pass
2.7155	16	12	75	Pass
2.7474	16	12	75	Pass
2.7793	16	12	75	Pass
2.8112	16	12	75	Pass
2.8431	15	11	73	Pass
2.8750	15	11	73	Pass
2.9069	15	11	73	Pass
2.9387	15	11	73	Pass
2.9706	13	11	84	Pass
3.0025	13	11	84	Pass
3.0344	13	11	84	Pass
3.0663	13	11	84	Pass
3.0982	13	11	84	Pass
3.1301	13	11	84	Pass
3.1620	12	11	91	Pass
3.1939	12	11	91	Pass
3.2257	12	10	83	Pass
3.2576	11	10	90	Pass
3.2895	11	8	72	Pass
3.3214	10	8	80	Pass
3.3533	10	8	80	Pass
3.3852	9	8	88	Pass
3.4171	9	8	88	Pass
3.4490	8	8	100	Pass
3.4809	8	8	100	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

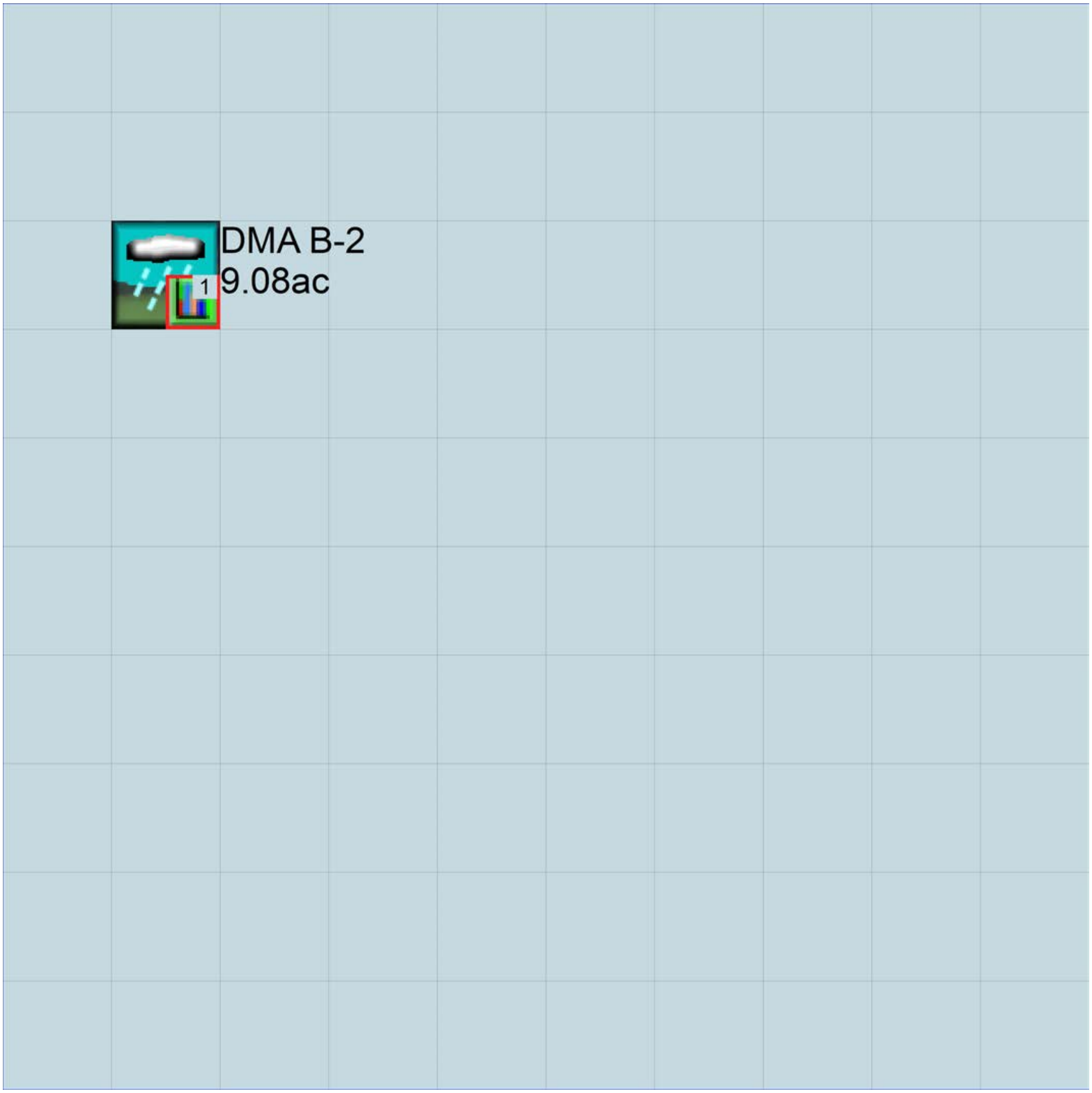
PERLND Changes

No PERLND changes have been made.

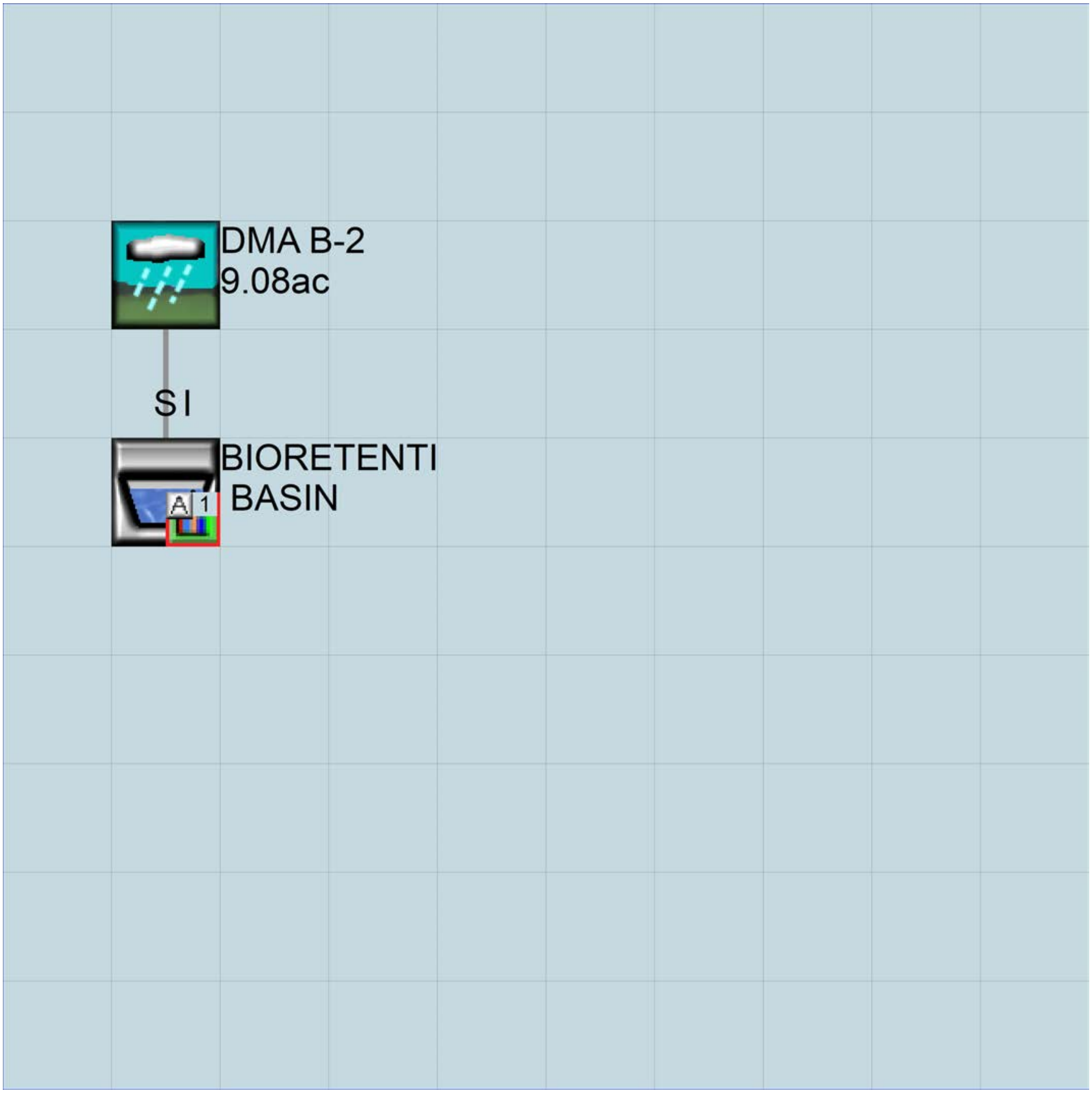
IMPLND Changes

No IMPLND changes have been made.

Appendix
Pre-Project Schematic



Mitigated Schematic



Pre-Project UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1961 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   518-001_SAHM.wdm
MESSU      25   Pre518-001_SAHM.MES
           27   Pre518-001_SAHM.L61
           28   Pre518-001_SAHM.L62
           30   POC518-001_SAHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      33
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        DMA B-2                     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           ***
   33     C,Grass,Flat(0-1%)      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 ***
   33         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  *********
   33         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 ***
   33         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   33             0       4.5     0.045       400      0.01         3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   33            40        35         2         2         0         0      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   33             0       0.3      0.25       0.7       0.5         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   33       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   33      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  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
   33             0         0      0.15         0         4      0.05         0
  END PWAT-STATE1

END PERLND

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

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

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

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

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2
```

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

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

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
DMA B-2***
PERLND  33                        9.08     COPY   501     12
PERLND  33                        9.08     COPY   501     13

******Routing******
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                           ***
  END GEN-INFO
  *** Section RCHRES***

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

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  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
             *  *  *  *     *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  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
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES
```

```
SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
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    0.944          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.944          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.85           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.85           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1961 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   518-001_SAHM.wdm
MESSU      25   Mit518-001_SAHM.MES
           27   Mit518-001_SAHM.L61
           28   Mit518-001_SAHM.L62
           30   POC518-001_SAHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      33
      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        BIORETENTION  BASIN         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           ***
   33     C,Grass,Flat(0-1%)      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 ***
   33         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  *********
```

```
   33         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 ***
   33         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   33             0       4.5     0.045       400      0.01         3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   33            40        35         2         2         0         0      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   33             0       0.3      0.25       0.7       0.5         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   33       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   33      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  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
   33             0         0      0.15         0         4      0.05         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1     Imperv,Flat(0-1%)       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    0
```

```
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100      0.01      0.05       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#   ***
DMA B-2***
PERLND  33                          8.04     RCHRES   1      2
PERLND  33                          8.04     RCHRES   1      3
IMPLND   1                          1.04     RCHRES   1      5

******Routing******
PERLND  33                          8.04     COPY     1     12
IMPLND   1                          1.04     COPY     1     15
PERLND  33                          8.04     COPY     1     13
RCHRES   1                             1     COPY   501     17
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     BIORETENTION  BA-005    2    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  5  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      0.04       0.0     73.33       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  5.0  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
   91    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)     (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.725455  0.000000  0.000000  0.000000
  0.016667  0.726273  0.012098  0.000000  0.024386
  0.033333  0.727091  0.024209  0.000000  0.024414
  0.050000  0.727911  0.036334  0.000000  0.024441
  0.066667  0.728730  0.048473  0.000000  0.024469
  0.083333  0.729550  0.060625  0.000000  0.024496
  0.100000  0.730371  0.072791  0.000000  0.024524
  0.116667  0.731192  0.084971  0.000000  0.024552
  0.133333  0.732013  0.097164  0.000000  0.024579
  0.150000  0.732835  0.109371  0.000000  0.024607
  0.166667  0.733657  0.121592  0.000000  0.024634
  0.183333  0.734480  0.133827  0.000000  0.024662
  0.200000  0.735304  0.146075  0.000000  0.024690
  0.216667  0.736127  0.158337  0.000000  0.024717
  0.233333  0.736952  0.170612  0.000000  0.024745
  0.250000  0.737776  0.182902  0.000000  0.024773
  0.266667  0.738601  0.195205  0.000000  0.024800
  0.283333  0.739427  0.207522  0.000000  0.024828
  0.300000  0.740253  0.219852  0.000000  0.024856
  0.316667  0.741079  0.232197  0.000000  0.024884
  0.333333  0.741906  0.244555  0.000000  0.024911
  0.350000  0.742734  0.256927  0.000000  0.024939
  0.366667  0.743562  0.269313  0.000000  0.024967
  0.383333  0.744390  0.281712  0.000000  0.024995
  0.400000  0.745219  0.294126  0.000000  0.025023
  0.416667  0.746048  0.306553  0.000000  0.025050
  0.433333  0.746878  0.318994  0.000000  0.025078
  0.450000  0.747708  0.331449  0.000000  0.025106
  0.466667  0.748538  0.343918  0.000000  0.025134
  0.483333  0.749370  0.356400  0.000000  0.025162
  0.500000  0.750201  0.368897  0.000000  0.025190
  0.516667  0.751033  0.381407  0.000000  0.025218
  0.533333  0.751866  0.393931  0.000000  0.025246
  0.550000  0.752698  0.406469  0.000000  0.025274
  0.566667  0.753532  0.419021  0.000000  0.025302
  0.583333  0.754366  0.431587  0.000000  0.025330
  0.600000  0.755200  0.444167  0.000000  0.025358
  0.616667  0.756035  0.456760  0.000000  0.025386
  0.633333  0.756870  0.469368  0.000000  0.025414
  0.650000  0.757706  0.481989  0.000000  0.025442
  0.666667  0.758542  0.494625  0.000000  0.025470
  0.683333  0.759378  0.507274  0.000000  0.025498
```

```
  0.700000  0.760215  0.519937  0.000000  0.025526
  0.716667  0.761053  0.532615  0.000000  0.025554
  0.733333  0.761891  0.545306  0.000000  0.025582
  0.750000  0.762729  0.558011  0.000000  0.025611
  0.766667  0.763568  0.570730  0.000000  0.025639
  0.783333  0.764408  0.583463  0.000000  0.025667
  0.800000  0.765247  0.596210  0.000000  0.025695
  0.816667  0.766088  0.608971  0.000000  0.025723
  0.833333  0.766928  0.621747  0.000000  0.025752
  0.850000  0.767770  0.634536  0.000000  0.025780
  0.866667  0.768611  0.647339  0.000000  0.025808
  0.883333  0.769453  0.660156  0.000000  0.025836
  0.900000  0.770296  0.672987  0.000000  0.025865
  0.916667  0.771139  0.685833  0.000000  0.025893
  0.933333  0.771982  0.698692  0.000000  0.025921
  0.950000  0.772826  0.711565  0.000000  0.025950
  0.966667  0.773671  0.724453  0.000000  0.025978
  0.983333  0.774516  0.737354  0.000000  0.026006
  1.000000  0.775361  0.750270  0.000000  0.026035
  1.016667  0.776207  0.763200  0.051590  0.026063
  1.033333  0.777053  0.776144  0.145865  0.026091
  1.050000  0.777900  0.789102  0.267884  0.026120
  1.066667  0.778747  0.802074  0.412312  0.026148
  1.083333  0.779594  0.815060  0.576057  0.026177
  1.100000  0.780442  0.828060  0.757015  0.026205
  1.116667  0.781291  0.841074  0.953616  0.026234
  1.133333  0.782140  0.854103  1.164619  0.026262
  1.150000  0.782989  0.867146  1.388990  0.026291
  1.166667  0.783839  0.880203  1.625839  0.026319
  1.183333  0.784690  0.893274  1.874373  0.026348
  1.200000  0.785540  0.906359  2.133870  0.026376
  1.216667  0.786392  0.919458  2.403654  0.026405
  1.233333  0.787244  0.932572  2.683085  0.026434
  1.250000  0.788096  0.945700  2.971547  0.026462
  1.266667  0.788948  0.958842  3.268438  0.026491
  1.283333  0.789802  0.971998  3.573165  0.026520
  1.300000  0.790655  0.985169  3.885141  0.026548
  1.316667  0.791509  0.998353  4.203780  0.026577
  1.333333  0.792364  1.011552  4.528495  0.026606
  1.350000  0.793219  1.024766  4.858696  0.026634
  1.366667  0.794074  1.037993  5.193790  0.026663
  1.383333  0.794930  1.051235  5.533178  0.026692
  1.400000  0.795786  1.064491  5.876256  0.026721
  1.416667  0.796643  1.077761  6.222418  0.026749
  1.433333  0.797500  1.091045  6.571051  0.026778
  1.450000  0.798358  1.104344  6.921538  0.026807
  1.466667  0.799216  1.117657  7.273260  0.026836
  1.483333  0.800075  1.130985  7.625595  0.026865
  1.500000  0.800934  1.144327  7.977923  0.026893
  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    0.944          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.944          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.85           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.85           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    0.944          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.85           RCHRES   1     EXTNL  POTEV

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   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
```

```
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 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       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Pre-Project HSPF Message File

Mitigated HSPF Message File

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