APPENDIX I
PRELIMINARY BASIN SIZING MEMORANDUM

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TECHNICAL MEMORANDUM

DATE: March 31, 2022

Project No.: 937-60-20-01
SENT VIA: EMAIL

TO: Michael Robertson, Baker-Williams Engineering Group

FROM: Michele Miller, PE, RCE #88437

REVIEWED BY: Mark Kubik, PE, RCE #50963

SUBJECT: Robla Estates Preliminary Basin Sizing

West Yost has conducted a preliminary study to size the proposed detention basin and pump station at Robla Estates which are intended to provide flood control and stormwater quality treatment for the 177-unit development. This draft Technical Memorandum (TM) summarizes the hydrologic and hydraulic (H&H) model creation, study assumptions, and preliminary sizing of the proposed detention basin, and the associated pump station. The sections of this TM include:

- Background Information
- Site Visit
- Hydrologic and Hydraulic Model Creation
- Study Assumptions
- Existing Watershed Characteristics
- Proposed Watershed Characteristics
- Preliminary Basin and Pump Station Sizing Process
- Detention Basin Sizing
- Flood Control Benefit
- Draft Conditions of Approval
- Low Impact Development and Water Quality
- Hydromodification and Outlet Configuration
- Preliminary Pipe Sizing

BACKGROUND INFORMATION

A residential development project is proposed at 5330 and 5240 Rio Linda Boulevard in the City of Sacramento (City). The project is located east of Rio Linda Boulevard, west of the Bike Trail, and south of Robla Creek as shown on Figure 1. A federally certified levee separates Robla Estate from Robla Creek. Robla Estates is within an existing Federal Emergency Management Agency (FEMA) floodplain at the site. Currently, several offsite watersheds flow into the Robla Estate site and are drained to Robla Creek via an existing 48-inch culvert.

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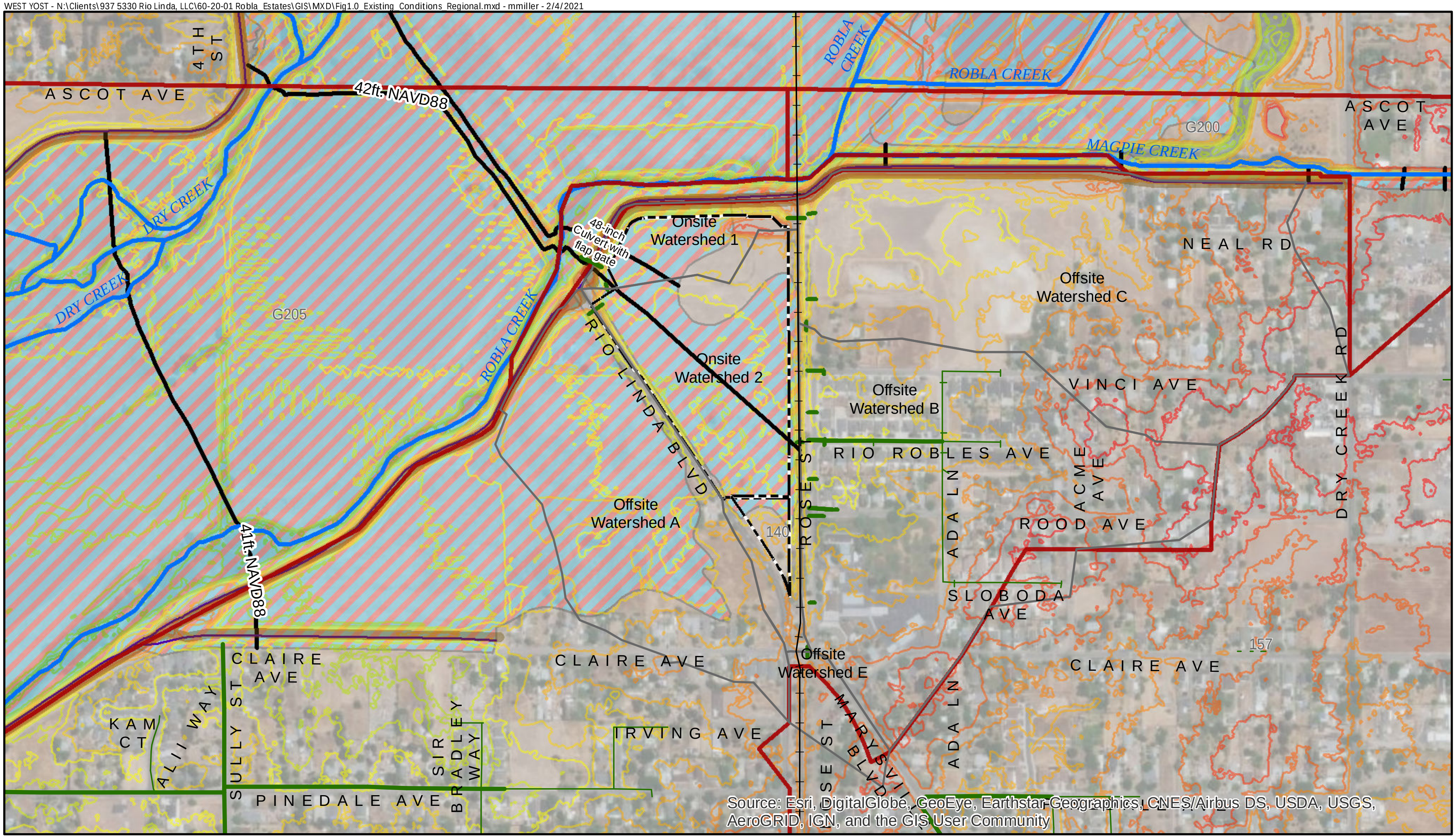


Ground Elevation ft. NAVD88

- 26
- 28
- 30
- 32
- 34
- 36
- 38
- 40
- 42
- 44
- 46
- 48
- 50

- Bike Trail
- Federal Levee
- FEMA Base Flood Elevation
- FEMA Flood Zone A
- FEMA Flood Zone AE
- City Drainage Basins
- Creeks
- Existing Storm Pipe
- Robla Estates Boundary
- Existing Watershed

N

0 250 500
Scale in Feet

WEST YOST

Figure 1

Regional Site Map
Stormwater Drainage

Robla Estates
5330 Rio Linda, LLC

SITE VISIT

A site visit was conducted on October 29, 2020 to document the culvert locations and existing offsite and onsite flow patterns. Flap gates were noted on all eastern pipe connections to Robla Estates. The flap gate on the northern pipe outfall is currently missing and will be replaced by the City. The following flow paths and infrastructure were observed on the site and listed by watershed:

- Offsite Watershed A drains northeast to a 30-inch reinforced concrete pipe (RCP) culvert where it enters the Robla Estates site and is discharged through a 48-inch RCP culvert under the levee to Robla Creek.
- Offsite Watershed B drains to the west through the City storm drain system and is discharged to the East Channel. The East Channel is relatively flat, with a slight slope north to a 48-inch RCP culvert where flow enters the Robla Estates Site. The 48-inch RCP culvert flows to the Northern Channel for discharge to Robla Creek through a 48-inch RCP culvert with flap gate. Flow can also exit the East Channel through a 36-inch RCP culvert with flap gate west of Rio Robles Avenue, which discharges to Onsite Watershed 2.
- Offsite Watershed C drains to the northwest and enters the Robla Estates site by a 48-inch RCP culvert under the Bike Trail.
- Offsite Watershed D was delineated west of Offsite Watershed A, but was found not to contribute to flows at Robla Estate. Offiste Watershed D is omitted from discussion and figures.
- Offsite Watershed E drains north to a 12-inch RCP culvert then flows north in the East Channel.
- Onsite Watershed 1 flows northwest to the Northern Channel where it is discharged through a 48-inch RCP culvert through the levee to Robla Creek.
- Onsite Watershed 2 flows northwest through a series of shallow depressions to a 48-inch RCPculvert through the levee and discharges to Robla Creek. This is the same 48-inch culvert as mentioned in Watershed 1

HYDROLOGIC AND HYDRAULIC MODEL CREATION

A local hydrologic and hydraulic model was created encompassing offsite and onsite watersheds that flow to the 48-inch culvert discharging to Robla Creek. The Horton infiltration and SWMM routing parameters were input to match the City of Sacramento Section 11 Stormwater Collection System Standards (Section 11). Impervious percentages and watershed widths reflect the guidance of the Section 11 standards. The XPSWMM software was used to simulate runoff, calculate water surface elevations, and size the proposed detention basin. Robla Estates was modeled for existing and proposed conditions to illustrate the increase in runoff associated with development. Offsite sheds were assumed to remain consistent in land use, with no additional development or increase in runoff.

STUDY ASSUMPTIONS

Through this effort, both the 100-year, 24-hour and the 100-year, 10-day design storms were simulated in accordance with the City standards for volume sizing of a detention basin. Using a long duration storm is particularly important, as there are no overland releases for Robla Estates. The 10-year, 24-hour storm was also simulated to show the detention basin functionality in a smaller storm and to demonstrate the pipe system hydraulic grade line meets City criteria. The downstream boundary condition of 42-feet (ft) North American Vertical Datum 88 (NAVD88) is from the 100-year static tailwater from the SAFCA Robla Creek HEC-RAS model. The 10-year tailwater water surface elevation (WSEL) was determined from the Robla Creek FEMA Flood Profile to be elevation 38-ft NAVD88. Currently, the City and County have no available data sources to define a dynamic tailwater stagegraph. Because of this, the detention basin and pump station sizes in this study are considered conservatively large. It is possible that size these facilities could be reduced if a dynamic tailwater was used in the analysis.

The following roughness and depressions storages have been used throughout the existing and proposed conditions model:

- Impervious Area Depression Storage: 0.1-inch
- Impervious Area Manning's "n": 0.02
- Pervious Area Depression Storage: 0.35-inch
- Pervious Area Manning's "n": 0.25

EXISTING WATERSHED CHARACTERISTICS

City Basin #140 was delineated into five watersheds to account for flow patterns within Robla Estates. Flows from the five watersheds travel north, through the Robla Estates site to be discharged to Robla Creek. The existing land use is primarily low density residential and open space. A composite infiltration rate was created to reflect the blend of land uses, which correspond to City zoning data. Refer to Figure 2 and Table 1 for existing watershed land use and hydrologic characteristics.

Existing surface storage was added to the hydraulic model to account for stormwater that can pond up within a watershed without resulting overland spills. The existing storage areas follow contour lines below elevation 38 which corresponds to the elevation of Rio Linda Boulevard and the bike path. Figure 2 shows the delineation of the existing storage areas

Watershed widths were estimated by using the Equation 11-3 from the Section 11:

Equation 11-3 $$W = A/L$$

Where:

W = Shed Width (theoretical dimension)

L = Shed Length (feet) = overland (sheet) flow length = 150-feet for Residential, 200-feet for commercial

A = Shed Area (SF)

Table 1. Existing Watershed Characteristics

Subcatchment ID	Area, ac	Basin Length, ft	Basin Width, ft	Basin Slope, ft/ft	Composite Watershed Impervious Percent	NRCS Soil Type	10-Year, 24-Hour Peak Flow Rate, cfs	10-Year, 24-Hour Volume, ac-ft	100-Year, 24-Hour Peak Flow Rate, cfs	100-Year, 24-Hour Volume, ac-ft	100-Year, 10-Day Peak Flow Rate, cfs	100-Year, 10-Day Volume, ac-ft
Offsite Watersheds												
Offsite Watershed A	29.6	588.8	2,189.7	0.004	14.0	Type D	8.36	2.11	16.54	4.65	8.90	6.76
Offsite Watershed B	50.8	1,066.4	2,075.1	0.006	46.3	Type D	30.71	6.99	58.99	11.97	26.31	23.90
Offsite Watershed C	54.5	869.7	2,729.9	0.005	22.1	Type D	18.85	4.70	35.76	9.50	18.50	15.52
Offsite Watershed E	3.6	241.2	650.2	0.006	35.1	Type D	3.13	0.45	6.29	0.80	2.08	1.51
Subtotal	**138.5**	-	-	-	**29.6**	-	-	-	-	-	-	-
Onsite Watersheds												
Onsite Watershed 1	6.5	243.2	983.5	0.006	2.6	Type D	0.96	0.41	2.67	0.98	2.46	1.19
Onsite Watershed 2	21.7	289.3	2,091.2	0.004	11.1	Type D	5.46	1.43	11.06	3.28	6.25	4.53
Subtotal	**28.3**	-	-	-	**57.1**	-	-	-	-	-	-	-

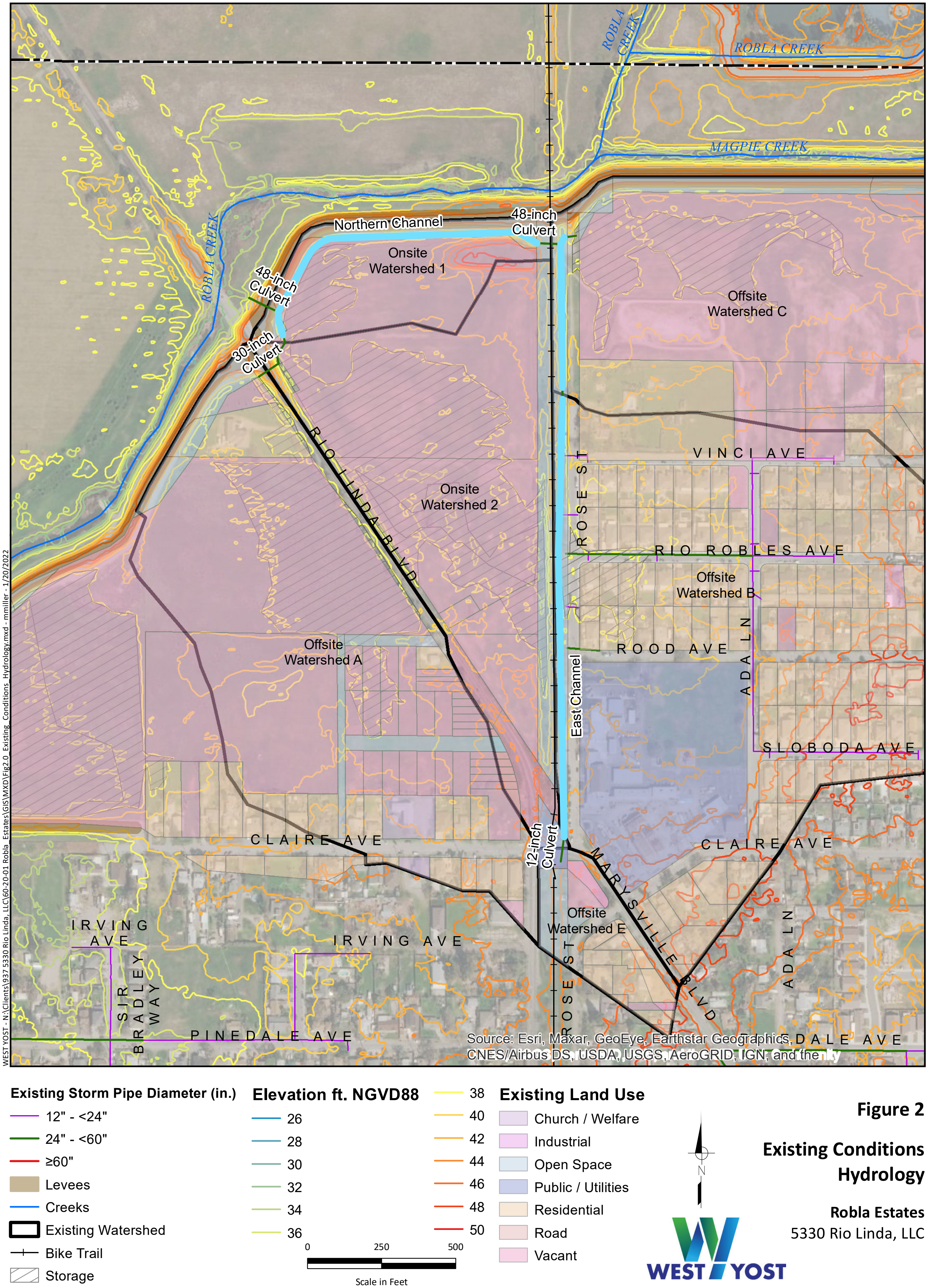


Figure 2

Existing Conditions Hydrology

Robla Estates

5330 Rio Linda, LLC

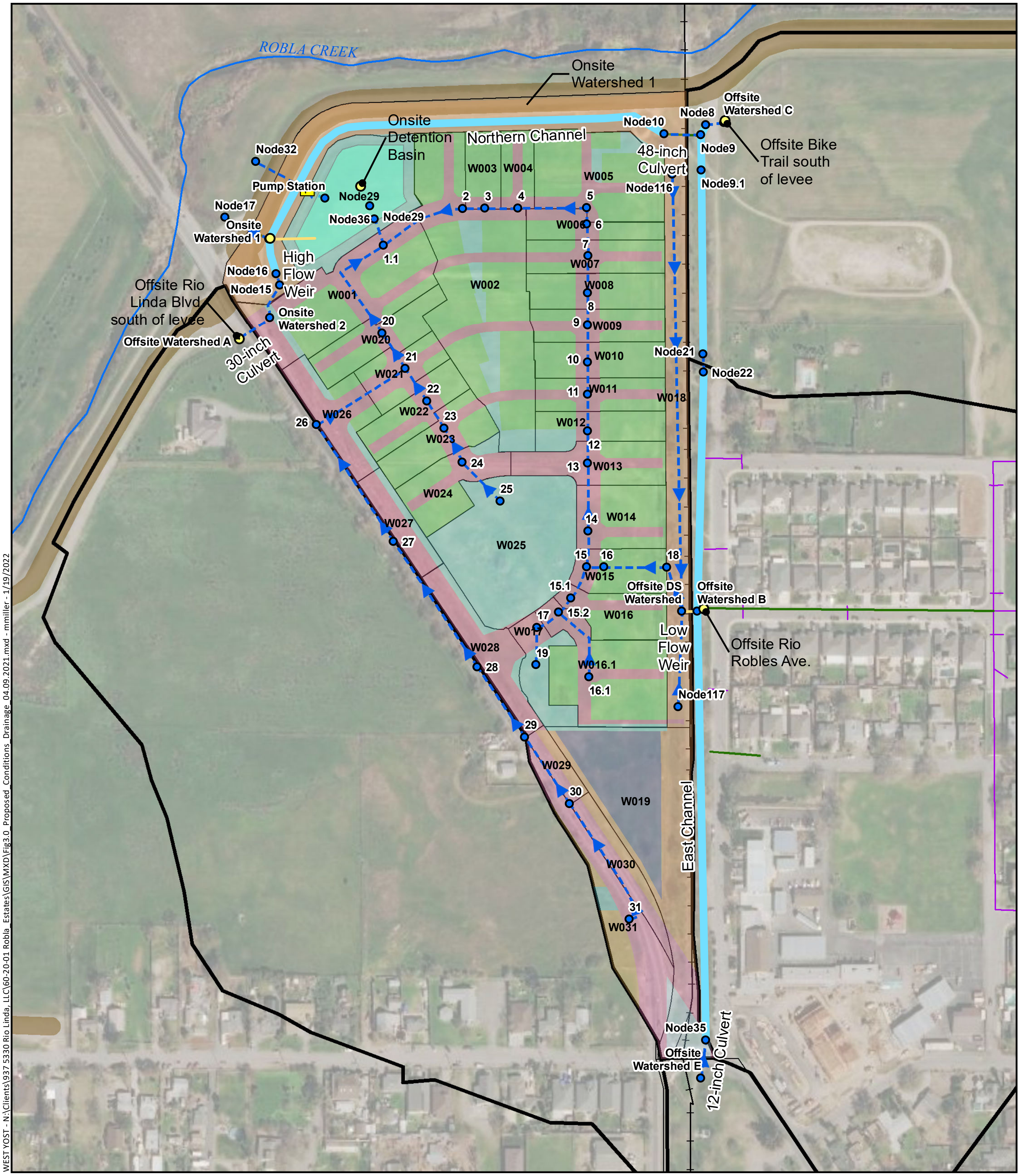
PROPOSED WATERSHED CHARACTERISTICS

Onsite Watershed 1 was modified to reflect the site improvements proposed with the Robla Estates Development. Onsite Watershed 2 was replaced with Watersheds W001 through W031 for more precise delineation and routing to the proposed storm system. The proposed land use is primarily residential, with some commercial and open spaces. A composite infiltration rate was created to reflect the blend of proposed land uses, comprised of Medium Density Residential (70% impervious), Open Space (2% impervious), Recreation (5% impervious), Roads (95% impervious), and Commercial (95% impervious). Refer to Figure 3 and Table 2 for proposed watershed land use and hydrologic characteristics. No changes are proposed to any offsite watersheds. The following changes to flow path and infrastructure are listed by onsite watershed:

- Onsite Watershed 1 flows northwest to the Northern Channel, which conveys runoff to a 48-inch culvert that conveys runoff under the levee to Robla Creek.
- Watersheds W001 through W031 flow northwest through the proposed on-site pipe system to discharge to the proposed Detention Basin, which is also a discrete watershed. A watershed length of 150-feet was used for the proposed development watersheds.

In the model for proposed conditions, the existing storage surface storage volume remains on all offsite parcels and is removed on the Robla Estates site. All future upstream projects will be required to fully mitigate impacts of increased imperviousness.

Table 2. Proposed Watershed Characteristics													
Subcatchment ID	Area, ac	Proposed Roadway Area, ac	Basin Length, ft	Basin Width, ft	Basin Slope, ft/ft	Composite Watershed Impervious Percent	NRCS Soil Type	10-Year, 24-Hour Peak Flow Rate, cfs	10-Year, 24-Hour Volume, ac-ft	100-Year, 24-Hour Peak Flow Rate, cfs	100-Year, 24-Hour Volume, ac-ft	100-Year, 10-Day Peak Flow Rate, cfs	100-Year, 10-Day Volume, ac-ft
Offsite Watersheds													
Offsite Watershed A	29.60	-	589	2,190	0.004	14.0	Type D	14.14	2.56	30.93	5.29	14.15	8.05
Offsite Watershed B	50.80	-	1,066	2,075	0.006	46.3	Type D	45.58	7.20	86.99	12.24	29.43	24.64
Offsite Watershed C	54.50	-	870	2,730	0.005	22.1	Type D	32.40	5.39	66.16	10.50	26.18	17.48
Offsite Watershed E	3.60	-	241	650	0.006	35.1	Type D	4.48	0.46	9.26	0.81	2.33	1.56
Subtotal	**138.50**	-	-	-	-	**29.6**	-	-	-	-	-	-	-
Onsite Watersheds													
Onsite Watershed 1	2.50	0.00	102	1,064	0.003	2.0	Type D	1.24	0.19	3.79	0.41	1.52	0.57
W-001	1.55	0.76	150	451	0.01	78.9	Type D	3.94	0.31	7.21	0.47	1.11	1.11
W-002	2.60	0.56	150	755	0.01	66.4	Type D	5.97	0.47	11.20	0.73	1.83	1.65
W-003	0.31	0.05	150	89	0.01	73.9	Type D	0.75	0.06	1.39	0.09	0.22	0.21
W-004	0.29	0.12	150	84	0.01	80.0	Type D	0.74	0.06	1.36	0.09	0.21	0.21
W-005	1.19	0.25	150	344	0.01	69.9	Type D	2.81	0.22	5.23	0.34	0.84	0.78
W-006	0.37	0.14	150	108	0.01	79.1	Type D	0.95	0.07	1.74	0.11	0.27	0.27
W-007	0.52	0.22	150	150	0.01	80.6	Type D	1.32	0.10	2.42	0.16	0.37	0.37
W-008	0.55	0.10	150	158	0.01	74.4	Type D	1.34	0.10	2.47	0.16	0.39	0.37
W-009	0.49	0.21	150	144	0.01	80.7	Type D	1.27	0.10	2.32	0.15	0.35	0.36
W-010	0.53	0.10	150	153	0.01	74.6	Type D	1.30	0.10	2.39	0.16	0.37	0.36
W-011	0.48	0.21	150	140	0.01	80.8	Type D	1.24	0.10	2.27	0.15	0.35	0.35
W-012	0.48	0.08	150	140	0.01	60.8	Type D	1.05	0.08	1.99	0.13	0.34	0.29
W-013	0.62	0.37	150	180	0.01	84.9	Type D	1.63	0.13	2.96	0.20	0.45	0.46
W-014	0.64	0.24	150	185	0.01	79.6	Type D	1.62	0.13	2.97	0.20	0.46	0.46
W-015	0.46	0.11	150	133	0.01	75.9	Type D	1.14	0.09	2.09	0.14	0.33	0.32
W-016	0.49	0.15	150	141	0.01	77.9	Type D	1.23	0.10	2.25	0.15	0.35	0.34
W-016.1	1.55	0.73	150	450	0.01	80.5	Type D	3.97	0.32	7.20	0.48	1.11	1.12
W-017	0.41	0.11	150	119	0.01	29.1	Type D	0.56	0.05	1.18	0.09	0.27	0.17
W-018	1.45	0.01	82	768	0.01	2.5	Type D	1.34	0.11	3.30	0.24	1.43	0.79
W-019	2.08	0.13	200	454	0.01	51.6	Type D	3.80	0.32	7.44	0.53	1.43	1.13
W-020	0.54	0.16	150	156	0.01	77.3	Type D	1.35	0.11	2.48	0.16	0.38	0.38
W-021	0.42	0.24	150	122	0.01	84.3	Type D	1.10	0.09	2.00	0.13	0.30	0.31
W-022	0.48	0.17	150	139	0.01	78.9	Type D	1.22	0.10	2.23	0.15	0.34	0.34
W-023	0.54	0.15	150	156	0.01	76.7	Type D	1.34	0.11	2.47	0.16	0.38	0.38
W-024	0.60	0.24	150	174	0.01	75.5	Type D	1.49	0.12	2.74	0.18	0.43	0.41
W-025	1.83	0.01	150	531	0.01	5.4	Type D	1.24	0.15	3.25	0.31	1.15	0.46
W-026	0.61	0.43	150	176	0.01	79.5	Type D	1.55	0.12	2.83	0.19	0.43	0.43
W-027	0.35	0.26	150	102	0.01	72.6	Type D	0.85	0.07	1.58	0.10	0.25	0.24
W-028	0.62	0.53	150	180	0.01	81.5	Type D	1.60	0.13	2.92	0.19	0.44	0.45
W-029	0.20	0.11	150	59	0.01	54.1	Type D	0.41	0.03	0.79	0.05	0.14	0.11
W-030	0.40	0.25	150	115	0.01	60.8	Type D	0.86	0.07	1.63	0.11	0.28	0.24
W-031	0.99	0.69	150	287	0.01	67.0	Type D	2.28	0.18	4.28	0.28	0.70	0.63
Detention Basin	1.36	0.00	110	538	0.01	5.5	Type D	1.14	0.11	2.84	0.23	0.87	0.35
Subtotal	**28.3**	**7.88**	-	-	-	**57.1**	-	-	-	-	-	-	-



Modeled Link

Modeled Node

Existing Storm Pipe Diameter (in.)

12" - <24"

24" - <60"

≥ 60"

Basin Extents

Levees

Offsite Watersheds

Onsite Subwatersheds

Creeks

Bike Trail

Hydraulic Results Location

Proposed Land Use

Commercial

Medium Density Residential

Open Space

Recreation

Road

0 150 300

Scale in Feet

N

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Figure 3

Proposed Conditions Hydrology

Robla Estates

5330 Rio Linda, LLC

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PRELIMINARY BASIN AND PUMP STATION SIZING PROCESS

To determine the required size and outlet configurations for the detention basin, the following steps were taken:

- Determined the total tributary area and impervious percentage to be served by the detention basin.
- Determined the stormwater quality treatment volume (SWQV) for the detention basin based on the amount of Low Impact Development (LID) achieved above the minimum requirements.
- Performed hydrologic modeling with the Sacramento Area Hydrology Model (SAHM) to determine the required volume and outlet configuration to provide hydromodification mitigation.
- Performed hydrologic and hydraulic modeling with XPSWMM to determine the required storage volumes and outlet configurations for flood control, addressing the following City requirements:
  - 0.5-foot of freeboard is required to the DI Grate in the 10-year, 24-hour storm.
  - The detention basin crest must be equal or higher to the 100-year, 24-hour storm. No freeboard is required.
  - 1.0-foot of freeboard is required to the finished floor of new structures for the 100-year, 24-hour storm.
  - There are no overland releases from the basin triggering the need for public safety hazard criteria for sizing the detention basin.
- Performed hydrologic and hydraulic modeling with XPSWMM to meet alternative City controlling Overland Release Path (ORP) criteria. See Draft Conditions of Approval for an additional discussion:
  - The justification for the variance is that ORP low elevation release path is 39.6-ft NAVD88 which exceeds the 200-yr, 24-hour HGL of 39.7-ft NAVD88 with complete pump station failure.
  - City suggested alternative ORP criterion 1 to set minimum finished floor to the 100-year, 24-hour HGL with complete pump station failure. This resulting water surface elevation for this scenario is 38.7 feet NAVD88.
  - City suggested alternative ORP criterion 2 to set minimum 10-year, 24-hour HGL with complete pump failure at or below the top of the DI grates and no more than 6 inches above the gutter flowline in low lying areas.

DETENTION BASIN SIZING

The 100-year, 24-hour design storm was used to analyze peak flow to determine required conveyance capacities. The detention basin was also simulated for the 100-year, 10-day design storm rainfall to consider volume, as there is no emergency overland flow path. The Table 3 illustrates the detention basin geometry. A 45 cubic feet per second (cfs) firm capacity pump station is required to mitigate the peak flows in the basin, maintaining freeboard requirements. If additional area can be added to the detention basin extents, the pump capacity could be decreased. A geotechnical evaluation will need to be conducted to assess the soil stability for building the detention basin adjacent the levee. The levee owner and operator will need to be notified of the detention basin and pump station construction.

Table 3 shows the detention basin and the associated pump station location. Currently, offsite flows make their way to the Northern Channel before being discharged to Robla Creek. A high flow weir was added to the Northern Channel to continue to route minor storm flows directly to the existing 48-inch culvert through the levee. Only when the water level in Robla Creek rises and the 48-inch culvert's flap gate is closed will flows overtop the weir (crest elevation 34-ft NAVD88) and spill into the detention basin. Once in the detention basin, flows will need to be pumped out. This high flow weir will minimize pumping during minor storm events when the water levels in Robla Creek are relatively low.

In addition to the high flow weir at the detention basin, a second weir is proposed at the East Channel. This low flow weir reduces pumping at the detention basin by routing minor event flows to the Northern Channel for gravity discharge to Robla Creek. In larger events, the highs flows will enter the detention basin. The East Channel bottom width will be expanded to 10-feet, with a 3-foot retaining wall running along the west side adjacent to the development. The east side of the East Channel will remain undisturbed. The Northern Channel and the Eastern Channel have a 1-foot freeboard in the 100-year storm.

Table 3. Elevation - Area-Storage Volume Data

Description	Elevation, ft, NAVD88	Depth	Area, sf	Area, ac	Volume, ac-ft
Bottom of Basin	26.0	0.0	11,485	0.26	0.00
	27.0	1.0	13,385	0.31	0.29
	28.0	2.0	15,414	0.35	0.62
WQV WSEL (29.1)	29.0	3.0	17,571	0.40	0.99
	30.0	4.0	19,856	0.46	1.42
	31.0	5.0	22,269	0.51	1.91
	32.0	6.0	24,810	0.57	2.45
	33.0	7.0	27,479	0.63	3.05
10-year, 24-hour WSEL (34.3)	34.0	8.0	30,276	0.69	3.71
100-year, 10-day WSEL (35.6)	35.0	9.0	33,201	0.76	4.44
100-year, 24-hour WSEL (36.2)	36.0	10.0	36,254	0.83	5.23
Top of Basin	36.5	10.5	37,828	0.87	5.66

ac-ft = acre-feet
sf = square feet

The following City detention basin design standards are met:

- Side slopes: 4H:1V
- Low flow channel slope at detention basin bottom: 1 percent
- Access road to bottom of pond

- Access road to the pump station

The pump station is sized for 45 cfs firm capacity and 60 cfs total capacity. The operation levels will meet the following design standards:

- Pump 1: Turns on at: Stormwater Quality WSEL (29.1-ft NAVD88)
- Pump 2: Turns on at: 1-foot Above Stormwater Quality WSEL (30.0-ft NAVD88)
- Pump 3: Turns on at: 2-feet Above Stormwater Quality WSEL (31.0-ft NAVD88)
- Pump 4: Redundant Pump

City flow meter installation standards will allow for the use of 90% of the pump curve flow rates; otherwise, the project is restricted to 75% of the pump curve flow rate. If utilizing a flow meter, further modeled pump operation (including on/off levels) will be added as an addendum.

FLOOD CONTROL BENEFIT

The Robla Estates detention basin and pump station will reduce the flood depth throughout the project site and in the offsite watersheds. Table 4 and Table 5 show the benefit of the detention basin and pump station at five locations (refer to Figure 1 for hydraulic results locations).

Table 4. 100-Year, 24-Hour Hydraulic Grade Line

Scenario	Onsite upstream of 48-inch discharge culvert, ft NAVD88	Onsite Detention Basin, ft NAVD88	Offsite Rio Linda Blvd. south of levee, ft NAVD88	Offsite Bike Trail south of levee, ft NAVD88	Offsite Rio Robles Ave., ft NAVD88
Ground Surface	38.0	36.5	38.0	41.2	41.8
Existing Condition	38.2	-	38.2	38.2	38.2
Proposed Condition	36.2	36.2	36.3	37.7	37.5

Table 5. 10-Year, 24-Hour Hydraulic Grade Line

Scenario	Onsite upstream of 48-inch discharge culvert, ft NAVD88	Onsite Detention Basin, ft NAVD88	Offsite Rio Linda Blvd. south of levee, ft NAVD88	Offsite Bike Trail south of levee, ft NAVD88	Offsite Rio Robles Ave., ft NAVD88
Ground Surface	38.0	36.5	38.0	41.2	41.8
Existing Condition	37.5	-	37.5	37.5	37.5
Proposed Condition	34.7	34.3	34.9	37.0	36.8

Consideration was given to ensuring that the pump station discharge rate have no significant impact to Robla Creek. FEMA freeboard requirements state that 3-ft of freeboard from 100-year water surface elevation to the levee crest is required. Currently there is 4-ft of freeboard in Robla Creek as indicated by the 100-year water surface elevation in the FEMA flood insurance study. The addition of 45 cfs to the 2,900 cfs contained in Robla Creek will not likely affect the water surface elevation or freeboard.

DRAFT CONDITIONS OF APPROVAL

A meeting was held with the City of Sacramento to discuss the Controlling Overland Release Path (ORP) criteria. Section 11 specifies the finished floor elevation of structures as 12-inches over the ORP, but adhering to this criteria would be infeasible at this site. The project site is the regional low point on the upstream side of the levee. The ORP of this site would be above Rio Linda Boulevard which is 39.9-ft NAVD88, higher than the 200-yr, 24-hour design storm HGL of 39.7-ft NAVD88 with complete pump station failure. The following ORP criteria has been established as a variance to Section 11 which will be incorporated into the Draft Conditions of Approval (COA):

- City suggested alternative ORP Criterion 1 to set minimum finished floor to the 100-year, 24-hour HGL with complete pump station failure 38.7 feet NAVD88. This criterion is similar to FEMA precedence.

- City suggested alternative ORP Criterion 2 to set minimum 10-year, 24-hour HGL with complete pump failure at or below the top of the DI grates and no more than 6 inches above the gutter flowline in low lying areas. At all locations the 10-year is below grade at manhole rim elevation with complete pump failure. At the lowest roadway rim elevation of 37.9-ft, the 10-year, 24-hour with complete pump failure, there is no water in the roadway (HGL is 37.8-ft NAVD88).

This additional modeling was considered when making the ORP variance:

- The FEMA/Community Rating System (CRS) finished floor requirements will be satisfied. Maximum 100-Year, 24-hour HGL of 36.2-ft NAVD88, below lowest pad of 38.7-ft NAVD88
- Dynamic analysis performed for more accurate decision-making tool:
  - 10-year, 24-hour HGL with complete station failure predicted at 37.8feet NAVD88
  - 100-year, 24-hour HGL with complete station failure predicted at 38.7 feet NAVD88
  - 200-year, 24-hour HGL with operational pump station predicted at 36.9 feet NAVD88
  - 200-year, 24-hour HGL with complete station failure predicted at 39.7 feet NAVD88

LOW IMPACT DEVELOPMENT AND WATER QUALITY

The implementation of the following low impact development (LID) features is required to manage onsite runoff and water quality. The following LID features together achieve above the 100-credit minimum, removing the need for additional water quality treatment measures.

- Natural Storage reservoirs and drainage corridors
- Buffer zones for natural water bodies
- Landscape area/park
- Flood Control/Drainage basin
- Infiltration Basin
- Disconnected Roof Drains
- Disconnected Pavement Worksheet

Attachment B details the calculations for the LID credits and refers to the SQDM to guide detailed design. Refer to Figure 4 for the potential spatial distribution of LID features that exceed the 100-credit minimum. Attachment A details the water quality volume of 1.01 acre-feet per the Stormwater Quality Design Manual (SQDM), that is planned for infiltration, as calculated by the Stormwater Quality Design Manual (SQDM). The City prefers infiltration basins over bio-retention basins, due to maintenance concerns. The detention basin's discharge structure has been designed to retain water for 48-hours.

In addition, the bottom of the detention pond (11,485 sq ft.) will be excavated and filled with a 2-foot-deep layer of gravel to promote infiltration. Using the SQDM recommendations for submerged gravel beds, an additional 0.15 acre-feet of storage will be added. The following design details from the SQDM will apply for the gravel:

- The gravel media will be 1" to 1-1/2" in size
- The bed depth is 2-feet
- The porosity of the gravel bed is 0.3

HYDROMODIFICATION AND OUTLET CONFIGURATION

Hydromodification control measures address changes to runoff characteristics from urbanization that result in the artificially altered rate of erosion or sedimentation within receiving waters. Based on the Hydromodification Mitigation Applicability Flow Chart provided in the 2018 Sacramento Region Stormwater Quality Design Manual (SQDM), the Study Area is not an exempt project and is therefore subject to hydromodification management requirements.

The detention basin was sized to provide hydromodification mitigation using the SAHM. The analysis was performed based on a pre-project and post-project evaluation of flow durations for flows ranging from 25 percent of the 2-year storm frequency to the 10-year storm frequency. Results of the hydromodification analyses are presented in Attachment A.

The detention basin outlet was configured with a riser pipe with a round orifice at the bottom for low flows. During large storm events that exceed the design event (10-year), excess flow can spill over the top of the riser. The orifice diameter and elevation were set to release 75 percent of the water quality volume in a minimum of 24 hours and the total design volume over an additional 24 hours. The water quality volume was calculated as 1.01 acre-feet. A 5mm (or smaller) screen at the orifice outlet will be added to address the State Water Resources Control Board Trash Amendments. The outlet geometry is as follows:

- Riser Diameter (in): 36
- Riser Height (ft): 6.5
- Orifice Diameter (in):4.25
- Orifice Height (in): 0.15

PRELIMINARY PIPE SIZING

Onsite storm pipes for the Robla Estates site have been sized to meet the City standards. Pipes were sized using XPSWMM. In addition to those standards mentioned in the Preliminary Basin and Pump Sizing Process section, the following standards have been addressed:

- Manning's roughness of 0.015 for concrete pipe to account for friction and minor losses.
- The minimum design velocity shall be two feet-per-second and the maximum velocity shall be 10 feet-per-second utilizing the Manning equation:
  - Assuming the pipe is flowing freely at a depth of 0.8 times the inside diameter (80% full), and
  - During a 100-year event.

A list of pipe characteristics and hydraulic results are listed in Table 6.

Offsite Watersheds
Bike Trail

LID Features

Buildings/Parking
WQ/Infiltration
Natural Sotrage Reservoirs or Drainage Corridor
Buffer Zones for Natural Water Bodies
Flood Control/Drainage Basin
Landscape Area/Park
Streets and Driveways
Buildings (Disconnected)

N

0 150 300
Scale in Feet

WEST YOST

Figure 4

Reommended LID Features

Robla Estates
5330 Rio Linda, LLC
January 2022

Table 6. Hydraulic Results

Conduit Data									10-year, 24-hour Flows			100-year, 24-hour Flows				
Link Name	Upstream Node	Downstream Node	Upstream Rim Elevation	Downstream Rim Elevation	Upstream Invert	Downstream Invert	Diameter, ft	Roughness Manning's "n"	Upstream WSEL	Downstream WSEL	Maximum Flow, cfs	Upstream WSEL	Downstream WSEL	Maximum Flow, cfs	Maximum Velocity, ft/sec	Comment
253.1	1.1	Detention Basin	38.47	40.50	28.04	28.00	3.5	0.015	34.27	34.18	56.14	36.23	36.20	79.73	8.2	Proposed Pipe
299.1	2	1.1	38.87	38.47	28.17	28.04	3.5	0.015	34.45	34.31	38.19	36.31	36.23	48.73	5.0	Proposed Pipe
302.1	5	4	39.07	38.77	28.42	28.30	3.5	0.015	34.71	34.58	30.85	36.45	36.38	35.06	3.6	Proposed Pipe
305.1	14	13	39.37	39.07	29.28	29.10	3	0.015	35.88	35.59	25.62	37.16	36.95	25.82	3.6	Proposed Pipe
311.1	26	21	39.87	39.17	28.52	28.34	2.5	0.015	34.55	34.45	6.71	36.31	36.24	11.37	2.3	Proposed Pipe
313.1	27	26	39.67	39.87	28.90	28.52	2	0.015	34.83	34.55	5.23	36.92	36.31	8.62	2.7	Proposed Pipe
316.1	24	23	39.07	38.77	28.85	28.69	1.5	0.015	34.94	34.85	2.58	37.06	36.94	5.33	2.9	Proposed Pipe
322.1	25	24	37.00	39.07	29.13	28.85	1.5	0.015	34.96	34.94	1.17	37.07	37.06	3.85	2.1	Proposed Pipe
327.1	28	27	40.37	39.67	29.42	28.90	1.5	0.015	35.70	34.83	4.46	38.80	36.92	7.10	3.9	Proposed Pipe
330.1	29	28	41.07	40.37	29.71	29.42	1.5	0.015	35.94	35.70	2.98	39.19	38.80	4.82	2.6	Proposed Pipe
336.1	17	15.2	38.87	38.97	29.66	29.66	1.5	0.015	36.05	36.04	4.25	37.47	37.29	8.30	4.6	Proposed Pipe
341.1	23	22	38.77	38.97	28.69	28.58	1.5	0.015	34.85	34.71	3.84	36.94	36.67	6.67	3.7	Proposed Pipe
343.1	20	1.1	38.77	38.47	28.27	28.04	2.5	0.015	34.32	34.31	14.04	36.23	36.23	23.85	4.8	Proposed Pipe
345.1	21	20	39.17	38.77	28.34	28.27	2.5	0.015	34.45	34.32	12.74	36.24	36.23	21.45	4.3	Proposed Pipe
346.1	22	21	38.97	39.17	28.58	28.34	1.5	0.015	34.71	34.45	4.99	36.67	36.24	8.17	4.5	Proposed Pipe
349.1	3	2	38.57	38.87	28.24	28.17	3.5	0.015	34.52	34.45	32.25	36.35	36.31	37.60	3.9	Proposed Pipe
350.1	4	3	38.77	38.57	28.30	28.24	3.5	0.015	34.58	34.52	31.55	36.38	36.35	36.34	3.8	Proposed Pipe
352.1	6	5	38.67	39.07	28.47	28.42	3.5	0.015	34.74	34.71	28.09	36.47	36.45	30.57	3.2	Proposed Pipe
354.1	7	6	38.87	38.67	28.55	28.47	3.5	0.015	34.80	34.74	27.57	36.50	36.47	29.61	3.1	Proposed Pipe
356.1	8	7	38.72	38.87	28.65	28.55	3.5	0.015	34.86	34.80	27.29	36.53	36.50	28.84	3.0	Proposed Pipe
358.1	9	8	38.97	38.72	28.74	28.65	3	0.015	34.99	34.86	27.00	36.60	36.53	28.26	4.0	Proposed Pipe
360.1	10	9	39.27	38.97	28.83	28.74	3	0.015	35.15	34.99	26.74	36.68	36.60	27.80	3.9	Proposed Pipe
362.1	11	10	39.07	39.27	28.92	28.83	3	0.015	35.29	35.15	26.45	36.76	36.68	27.31	3.8	Proposed Pipe
364.1	12	11	38.67	39.07	29.02	28.92	3	0.015	35.45	35.29	26.20	36.86	36.76	26.87	3.8	Proposed Pipe
365.1	13	12	39.07	38.67	29.10	29.02	3	0.015	35.59	35.45	25.93	36.95	36.86	26.38	3.7	Proposed Pipe
368.1	15	14	38.87	39.37	29.38	29.28	3	0.015	36.03	35.88	25.30	37.29	37.16	25.30	3.5	Proposed Pipe
370.1	15.1	15	39.07	38.87	29.48	29.38	2	0.015	36.04	36.03	8.08	37.29	37.29	15.18	4.8	Proposed Pipe
394.1	15.2	15.1	38.97	39.07	29.66	29.48	2	0.015	36.04	36.04	8.13	37.29	37.29	15.29	4.8	Proposed Pipe
L18.1	Node116.1.1	16	38.35	38.74	29.57	29.43	3	0.015	36.28	36.09	23.40	37.48	37.33	21.66	3.0	Proposed Pipe
L19	19	17	38.00	38.87	30.15	29.66	1.5	0.015	36.06	36.05	3.74	37.97	37.47	7.27	4.0	Proposed Pipe
L30	30	29	41.20	41.07	30.00	29.71	1	0.015	37.40	35.94	2.70	41.23	39.19	4.30	5.2	Proposed Pipe
L31	31	30	43.50	41.20	30.75	30.00	1	0.015	38.64	37.40	2.03	43.54	41.23	2.95	3.5	Proposed Pipe
L32	16.1	15.2	38.00	38.97	30.20	29.66	2	0.015	36.04	36.04	3.93	37.30	37.29	7.15	2.2	Proposed Pipe
Link0	Offsite Watershed C	Node8	40.00	38.00	35.82	35.67	2	0.015	37.01	36.74	10.47	37.68	37.41	18.19	6.1	Proposed Pipe
Link1	Node9	Node10	41.80	39.28	35.65	35.28	4	0.015	36.73	36.19	9.87	37.41	36.88	22.65	4.4	Proposed Pipe
Link10	Node22	Offsite Watershed B	40.00	41.80	35.39	35.51	Channel	0.040	36.77	36.79	-6.12	37.46	37.51	-12.14	-0.7	Existing Channel
Link13	Onsite Watershed 2	Node15	39.00	38.00	33.24	33.12	3	0.015	34.75	34.73	5.94	36.28	36.27	11.64	2.5	Existing Culvert
Link14	Node8	Node9	38.00	41.80	35.67	35.65	Channel	0.040	36.74	36.73	10.48	37.41	37.41	18.10	0.9	Existing Channel
Link2	Offsite Watershed B	Offsite DS Watershed	41.80	38.18	36.00	35.68	2	0.015	36.79	36.46	28.64	37.51	37.53	50.06	8.7	Proposed Pipe
Link27	Offsite Watershed E	Node35	44.00	44.00	41.44	40.94	1	0.015	42.99	41.58	4.38	44.11	41.89	6.38	8.2	Existing Culvert
Link28	Node35	Offsite Watershed B	44.00	41.80	40.94	35.51	Channel	0.060	41.58	36.79	2.61	41.89	37.51	5.79	1.1	Existing Channel
Link3	Offsite Watershed A	Onsite Watershed 2	39.00	39.00	34.14	33.24	2.5	0.015	34.89	34.75	5.94	36.29	36.28	11.61	5.1	Existing Culvert
Link4	Node15	Node16	38.00	38.00	33.12	33.04	2.5	0.015	34.73	34.72	5.95	36.27	36.27	11.65	2.8	Existing Culvert
Link5	Onsite Watershed 1	Node17	39.28	46.00	32.84	31.23	4	0.015	34.72	38.00	0.00	36.27	42.00	0.00	0.0	No Discharge with flap gate
Link6	Node10	Onsite Watershed 1	39.28	39.28	35.28	32.84	Channel	0.035	36.19	34.72	9.66	36.88	36.27	22.26	1.6	Existing Channel
Link65	Node116	Offsite DS Watershed	38.68	38.18	35.68	34.40	Channel	0.035	36.38	36.37	-3.03	37.52	37.53	-14.44	-0.4	Existing Channel
Link66	Node117	Offsite DS Watershed	38.68	38.18	35.68	34.88	Channel	0.035	36.41	36.41	-1.23	37.53	37.53	-4.25	-0.3	Existing Channel
Link7	Node16	Onsite Watershed 1	38.00	39.28	33.04	32.84	Channel	0.035	34.72	34.72	6.02	36.27	36.27	12.43	-0.2	Existing Channel
Link8	Node9	Node9.1	41.80	37.64	35.65	35.64	Channel	0.040	36.73	36.73	-2.73	37.41	37.41	-9.73	-0.5	Existing Channel
Link8.1	Node9.1	Node21	37.64	40.00	35.64	35.58	Channel	0.040	36.73	36.76	-3.37	37.41	37.45	-10.33	-0.5	Existing Channel
Link9	Node21	Node22	40.00	40.00	35.58	35.39	4	0.015	36.76	36.77	-4.48	37.45	37.46	-10.75	-1.9	Existing Culvert

Attachment A

Hydromodification Analyses Results

Stormwater Quality Volume Calculation

Roblas Estates

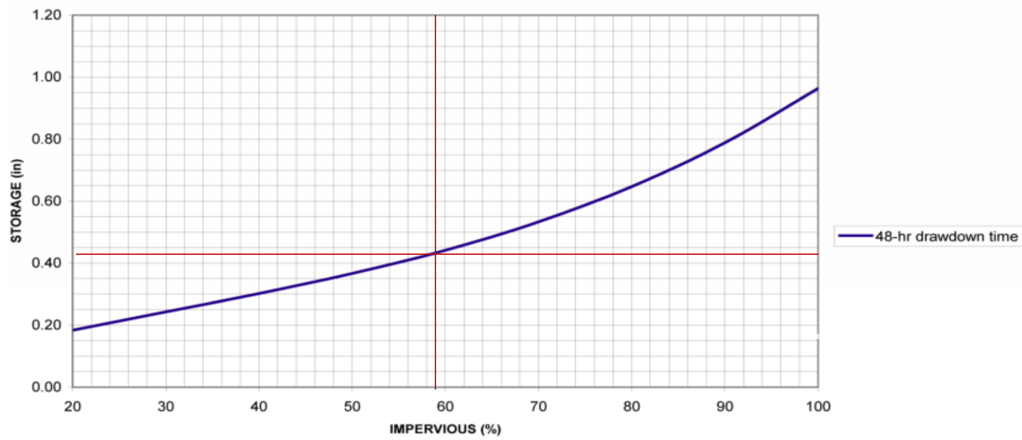
Water Quality Volume Calculation

Equation:

$WQV(ac\text{-}ft) = P_0 * A/12$

Variables:

54.6	%	Drainage shed impervious area
28.3	A	Drainage shed area in acres that drains to the proposed control measure
0.43	P_0	Maximized Detention Volume in watershed inches (From Graph)
1.01	WQV	Water Quality Volume in acre-feet



Source: URBAN RUNOFF QUALITY MANAGEMENT: WEF Manual of Practice No. 23 and Report on Engineering Practice No. 87.

Curve for Maximized Detention Volume P_0	Date: August 2006
	Figure: E-3

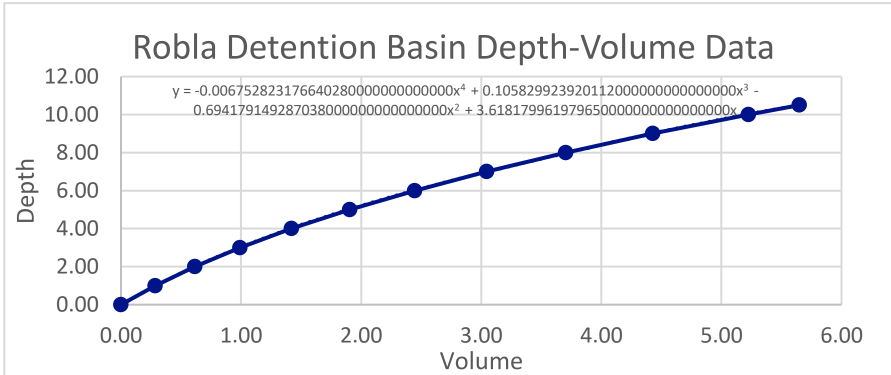
Orifice Design for Risers

Roblas Estates

Water Quality Volume Calculation

Key:
WQCV
Manually input
Design Criteria

Orifice Coeff	0.61
Orifice Elev.* (ft)	0.15
Orifice Dia (in)	4.25
Orifice Dia (ft)	0.35
Orifice Area (sf)	0.099



Time (hr)	Volume of water (ac-ft)	Water Elevation (ft)	Orifice Equ Flow (cfs)
0.00	1.01	3.06	0.82
1.00	0.95	1.02	0.45
2.00	0.91	0.92	0.42
3.00	0.87	0.88	0.41
4.00	0.84	0.85	0.40
5.00	0.81	0.82	0.39
6.00	0.77	0.79	0.38
7.00	0.74	0.75	0.37
8.00	0.71	0.72	0.37
9.00	0.68	0.69	0.36
10.00	0.65	0.66	0.35
11.00	0.62	0.64	0.34
12.00	0.59	0.61	0.33
13.00	0.57	0.58	0.32
14.00	0.54	0.56	0.31
15.00	0.52	0.53	0.30
16.00	0.49	0.51	0.29
17.00	0.47	0.48	0.28
18.00	0.44	0.46	0.27
19.00	0.42	0.44	0.26
20.00	0.40	0.41	0.25
21.00	0.38	0.39	0.24
22.00	0.36	0.37	0.23
23.00	0.34	0.35	0.22
24.00	0.32	0.34	0.21
25.00	0.31	0.32	0.20
26.00	0.29	0.30	0.19
27.00	0.27	0.29	0.18

- For single orifice outlet control or single row of orifices at the permanent pool elevation (WS Elevpp) (see Figure CWB-1), use the orifice equation based on the WQV (ft3) and depth of water above orifice centerline D (ft) to determine orifice area (ft2):
  Orifice Equation

  $Q = C \times A \times (2gD)^{1/2}$

  Where:

  Q = Flow rate, (cfs)

  C = Orifice coefficient (use 0.61)

  A = Area of orifice, (ft^2)

  g = Acceleration due to gravity (32.2 ft/sec^2)

  D = Depth of water above orifice centerline (D_{WQV})

28.00	0.26	0.27	0.17
29.00	0.25	0.26	0.16
30.00	0.23	0.24	0.15
31.00	0.22	0.23	0.14
32.00	0.21	0.22	0.13
33.00	0.20	0.21	0.12
34.00	0.19	0.20	0.11
35.00	0.18	0.19	0.10
36.00	0.17	0.18	0.08
37.00	0.17	0.17	0.07
38.00	0.16	0.17	0.06
39.00	0.15	0.16	0.05
40.00	0.15	0.16	0.04
41.00	0.15	0.15	0.03
42.00	0.14	0.15	0.02
43.00	0.14	0.15	#NUM!
44.00	#NUM!	#NUM!	#NUM!
45.00	#NUM!	#NUM!	#NUM!
46.00	#NUM!	#NUM!	#NUM!
47.00	#NUM!	#NUM!	#NUM!
48.00	#NUM!	#NUM!	#NUM!

SAHM

PROJECT REPORT

General Model Information

Project Name:	SAHM_Robla Estates_Hydro
Site Name:	Robla Estates
Site Address:	Rio Linda Blvd.
City:	Sacramento
Report Date:	1/21/2022
Gage:	RANCHO C
Data Start:	1961/10/01
Data End:	2004/09/30
Timestep:	Hourly
Precip Scale:	0.94
Version Date:	2016/03/29

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

Onsite Watersheds

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Grass,Flat(0-1%)	25.64
Pervious Total	25.64
Impervious Land Use	acre
Imperv,Flat(0-1%)	2.58
Impervious Total	2.58
Basin Total	28.22

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Proposed Watersheds

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
D,Urban,Flat(0-1%)	12.13
Pervious Total	12.13
Impervious Land Use	acre
Imperv,Flat(0-1%)	16.15
Impervious Total	16.15
Basin Total	28.28

Element Flows To:

Surface	Interflow	Groundwater
SSD Table 1	SSD Table 1	

Routing Elements

Pre-Project Routing

Mitigated Routing

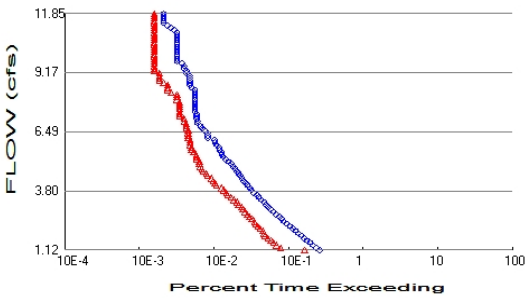
SSD Table 1

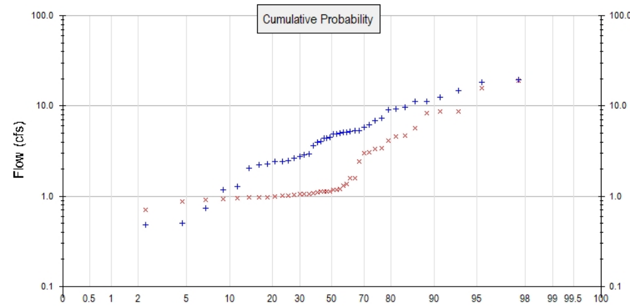
Depth: 11 ft.
Element Flows To:
Outlet 1 Outlet 2

SSD Table Hydraulic Table

Stage (feet)	**Area (ac.)**	**Volume (ac-ft.)**	**Outlet Struct**	**NotUsed**	**NotUsed**	**NotUsed**	**NotUsed**
0.000	0.260	0.000	0.000	0.000	0.000	0.000	0.000
1.000	0.310	0.290	0.452	0.000	0.000	0.000	0.000
2.000	0.350	0.620	0.667	0.000	0.000	0.000	0.000
3.000	0.400	0.990	0.827	0.000	0.000	0.000	0.000
4.000	0.460	1.420	0.962	0.000	0.000	0.000	0.000
5.000	0.510	1.910	1.079	0.000	0.000	0.000	0.000
6.000	0.570	2.450	1.186	0.000	0.000	0.000	0.000
7.000	0.630	3.050	5.247	0.000	0.000	0.000	0.000
8.000	0.690	3.710	32.75	0.000	0.000	0.000	0.000
9.000	0.760	4.430	43.98	0.000	0.000	0.000	0.000
10.000	0.830	5.230	52.64	0.000	0.000	0.000	0.000
11.00	0.870	5.650	60.05	0.000	0.000	0.000	0.000

Analysis Results
POC 1





+ Pre-Project x Mitigated

Pre-Project Landuse Totals for POC #1
Total Pervious Area: 25.64
Total Impervious Area: 2.58

Mitigated Landuse Totals for POC #1
Total Pervious Area: 12.13
Total Impervious Area: 16.15

Flow Frequency Method: Log Pearson Type III 17B

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

Return Period	Flow(cfs)
2 year	4.46704
5 year	9.136381
10 year	11.8537
25 year	18.592377

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.1374
5 year	4.19996
10 year	8.497806
25 year	16.116023

Annual Peaks

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

Year	Pre-Project	Mitigated
1962	5.074	3.411
1963	2.638	1.125
1964	1.289	0.957
1965	4.885	1.582
1966	0.740	0.933
1967	5.007	4.588
1968	2.065	0.914
1969	4.467	1.179
1970	3.643	1.208
1971	5.367	4.114
1972	0.482	0.873
1973	11.196	1.183
1974	3.918	1.083
1975	5.231	1.047

1976	0.412	0.702
1977	0.505	0.566
1978	5.847	1.132
1979	2.224	1.001
1980	9.312	1.137
1981	1.185	1.062
1982	9.097	5.639
1983	11.242	8.779
1984	4.422	3.071
1985	2.771	1.306
1986	18.428	15.629
1987	2.426	1.005
1988	4.067	0.961
1989	6.174	1.124
1990	5.099	1.110
1991	4.380	1.582
1992	6.819	2.980
1993	4.915	1.375
1994	2.445	1.008
1995	19.631	19.201
1996	12.364	3.322
1997	14.857	8.309
1998	9.669	8.655
1999	2.949	1.042
2000	7.299	4.712
2001	2.470	0.977
2002	2.262	0.979
2003	2.852	1.060
2004	5.287	2.425

Ranked Annual Peaks

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

Rank	Pre-Project	Mitigated
1	19.6309	19.2005
2	18.4284	15.6290
3	14.8565	8.7791
4	12.3637	8.6550
5	11.2417	8.3092
6	11.1964	5.6388
7	9.6690	4.7118
8	9.3122	4.5881
9	9.0973	4.1137
10	7.2986	3.4113
11	6.8194	3.3219
12	6.1740	3.0712
13	5.8469	2.9804
14	5.3672	2.4249
15	5.2868	1.5823
16	5.2312	1.5822
17	5.0994	1.3750
18	5.0736	1.3059
19	5.0071	1.2079
20	4.9147	1.1830
21	4.8852	1.1787
22	4.4670	1.1374
23	4.4220	1.1325
24	4.3802	1.1252
25	4.0675	1.1240

26	3.9176	1.1096
27	3.6434	1.0829
28	2.9495	1.0615
29	2.8519	1.0598
30	2.7710	1.0469
31	2.6375	1.0421
32	2.4697	1.0076
33	2.4446	1.0045
34	2.4256	1.0007
35	2.2620	0.9788
36	2.2237	0.9768
37	2.0653	0.9613
38	1.2892	0.9572
39	1.1848	0.9326
40	0.7397	0.9145
41	0.5048	0.8728
42	0.4822	0.7023
43	0.4123	0.5664

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.1168	987	619	62	Pass
1.2252	885	297	33	Pass
1.3337	795	262	32	Pass
1.4421	732	237	32	Pass
1.5506	664	220	33	Pass
1.6590	610	200	32	Pass
1.7675	568	184	32	Pass
1.8759	516	177	34	Pass
1.9844	471	170	36	Pass
2.0928	434	158	36	Pass
2.2013	393	146	37	Pass
2.3098	356	137	38	Pass
2.4182	330	132	40	Pass
2.5267	308	122	39	Pass
2.6351	282	112	39	Pass
2.7436	254	105	41	Pass
2.8520	237	98	41	Pass
2.9605	215	93	43	Pass
3.0689	200	88	44	Pass
3.1774	189	80	42	Pass
3.2858	179	78	43	Pass
3.3943	163	69	42	Pass
3.5027	150	64	42	Pass
3.6112	142	58	40	Pass
3.7197	129	56	43	Pass
3.8281	121	51	42	Pass
3.9366	115	48	41	Pass
4.0450	106	41	38	Pass
4.1535	100	39	39	Pass
4.2619	94	37	39	Pass
4.3704	89	35	39	Pass
4.4788	85	31	36	Pass
4.5873	81	30	37	Pass
4.6957	76	27	35	Pass
4.8042	73	26	35	Pass
4.9126	68	25	36	Pass
5.0211	65	24	36	Pass
5.1296	59	24	40	Pass
5.2380	54	22	40	Pass
5.3465	50	22	44	Pass
5.4549	48	22	45	Pass
5.5634	47	20	42	Pass
5.6718	45	19	42	Pass
5.7803	44	19	43	Pass
5.8887	41	18	43	Pass
5.9972	39	18	46	Pass
6.1056	38	18	47	Pass
6.2141	31	17	54	Pass
6.3225	31	17	54	Pass
6.4310	31	17	54	Pass
6.5395	28	17	60	Pass
6.6479	26	16	61	Pass
6.7564	25	16	64	Pass

6.8648	23	16	69	Pass
6.9733	23	15	65	Pass
7.0817	22	15	68	Pass
7.1902	22	13	59	Pass
7.2986	22	13	59	Pass
7.4071	21	13	61	Pass
7.5155	21	13	61	Pass
7.6240	21	13	61	Pass
7.7325	21	13	61	Pass
7.8409	21	13	61	Pass
7.9494	21	12	57	Pass
8.0578	21	12	57	Pass
8.1663	21	12	57	Pass
8.2747	21	10	47	Pass
8.3832	21	9	42	Pass
8.4916	19	9	47	Pass
8.6001	18	9	50	Pass
8.7085	18	8	44	Pass
8.8170	18	7	38	Pass
8.9254	18	7	38	Pass
9.0339	18	7	38	Pass
9.1424	16	7	43	Pass
9.2508	16	6	37	Pass
9.3593	15	6	40	Pass
9.4677	15	6	40	Pass
9.5762	14	6	42	Pass
9.6846	12	6	50	Pass
9.7931	12	6	50	Pass
9.9015	12	6	50	Pass
10.0100	12	6	50	Pass
10.1184	12	6	50	Pass
10.2269	12	6	50	Pass
10.3353	12	6	50	Pass
10.4438	12	6	50	Pass
10.5523	12	6	50	Pass
10.6607	12	6	50	Pass
10.7692	12	6	50	Pass
10.8776	12	6	50	Pass
10.9861	12	6	50	Pass
11.0945	11	6	54	Pass
11.2030	10	6	60	Pass
11.3114	9	6	66	Pass
11.4199	8	6	75	Pass
11.5283	8	6	75	Pass
11.6368	8	6	75	Pass
11.7452	8	6	75	Pass
11.8537	8	6	75	Pass

Water Quality

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

POC 3

POC #3 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

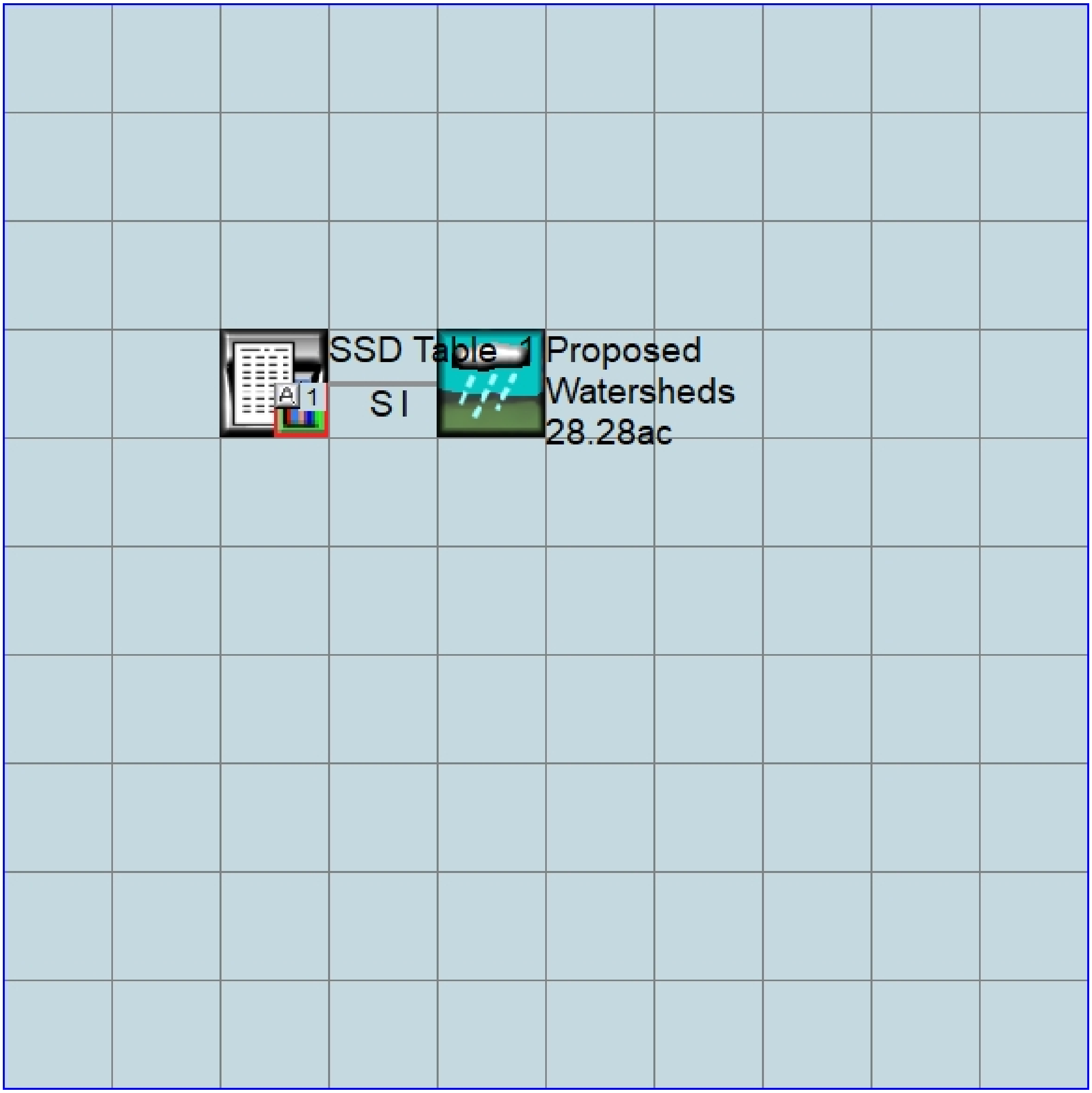
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Pre-Project Schematic

Mitigated Schematic



Pre-Project UCI File

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   SAHM_Robla Estates_Hydro.wdm
MESSU      25   MitSAHM_Robla Estates_Hydro.MES
           27   MitSAHM_Robla Estates_Hydro.L61
           28   MitSAHM_Robla Estates_Hydro.L62
           30   POCSAHM_Robla Estates_Hydro1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      57
      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        SSD Table  1                MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                           User  t-series Engl Metr ***
                                           in  out           ***
   57      D,Urban,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 ***
   57         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  *********
```

```
   57         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 ***
   57         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
   57              0      4.45      0.02       400      0.01         3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3        ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   57             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 ***
   57              0       0.3      0.25       0.5       0.4         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3        ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   57       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3        ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   57      0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11
  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
   57              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#   ***
Proposed Watersheds***
PERLND  57                       12.13     RCHRES   1      2
PERLND  57                       12.13     RCHRES   1      3
IMPLND   1                       16.15     RCHRES   1      5

******Routing******
PERLND  57                       12.13     COPY     1     12
IMPLND   1                       16.15     COPY     1     15
PERLND  57                       12.13     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

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



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

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

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

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

  HYDR-PARM1
```

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   12    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)  (ft/sec)    (Minutes)***
  0.000000  0.260000  0.000000  0.000000
  1.000000  0.310000  0.290000  0.451904
  2.000000  0.350000  0.620000  0.666688
  3.000000  0.400000  0.990000  0.827483
  4.000000  0.460000  1.420000  0.961761
  5.000000  0.510000  1.910000  1.079462
  6.000000  0.570000  2.450000  1.185535
  7.000000  0.630000  3.050000  5.246885
  8.000000  0.690000  3.710000  32.75419
  9.000000  0.760000  4.430000  43.97818
  10.00000  0.830000  5.230000  52.64104
  11.00000  0.870000  5.650000  60.05271
  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     22 IRRG      ENGL    0.7       SAME PERLND  57      EXTNL  SURLI

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO      1 1          1     WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1          1     WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1       12.1     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1       12.1     WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

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

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

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

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

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

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

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

END MASS-LINK

END RUN
```

Pre-Project HSPF Message File

Mitigated HSPF Message File

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Attachment B

Low Impact Development Credits and Treatment BMP Sizing Calculations for Residential Sites

Appendix D-1: Residential Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Robla Estates

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		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)	28.30	acres	A
Project-Specific Open Space (In-project, communal)**	9.49	acres	A_{PSOS}
a. Natural storage reservoirs and drainage corridors	2.39	acres	
b. Buffer zones for natural water bodies	2.24	acres	
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres	
d. Landscape area/park	4.00	acres	
e. Flood Control/Drainage basins	0.86	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	$A - A_{PSOS}$ =	18.81	acres	A_T
Number of Units in A_T		177		
Number of units per acre in A_T	DU/A_T =	10		DUA
Assumed Initial Impervious Fraction of A_T (determined using Table D-1a)		0.6		I

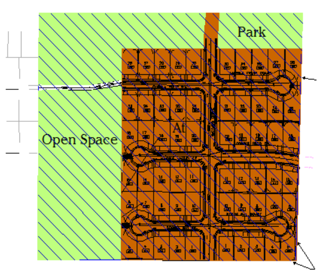
Open Space & Pervious Area LID Credit (Step 1)

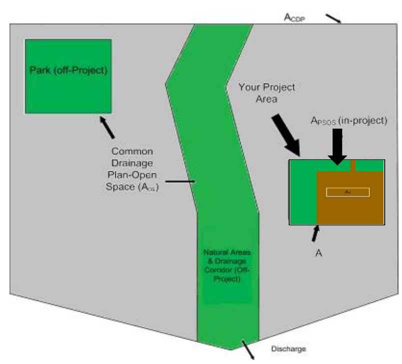
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 34 pts

Table D-1a

Dwelling units per acre	Imperviousness
1	0.17
2	0.25
3,4	0.35
5,6	0.40
7	0.50
8,9	0.55
10-14	0.60
15-20	0.70

Legend
A - Drainage Shed Area
A_{PSOS} Parks and Open Space
A_T - Area with Runoff Reduction Potential





Step 2 - Runoff Reduction Credits

Runoff Reduction Measures		Effective Area Managed (A_C)	
Disconnected Roof Drains (see Fact Sheet)	use Form D-1a for credits	1.04	acres
Disconnected Pavement (see Fact Sheet)	use Form D-1b for credits	0.11	acres
Interceptor Trees (see Fact Sheet)	use Form D-1c for credits	0.00	acres
Alternative Driveway Design (see Fact Sheet)	use Form D-1d for credits	0.00	acres
Total Effective Area Managed (Credit Area)	A_C	1.15	acres EAM

Runoff Reduction Credit (Step 2) $(A_C / A_T)*100$ = 6 pts

Form D-1a: Disconnected Roof Drains Worksheet

See Fact Sheet for more information regarding Disconnected Roof Drain credit guidelines

Effective Area Managed (A_C)

1. Determine efficiency Multiplier

Runoff is directed to a dispersal trench or dry well (Type A and B soils only) 1.00

Runoff is directed across landscaping, determine setback

25 ft +	Use multiplier of	1.00
$\geq$ 20 and < 25 ft	Use multiplier of	0.90
$\geq$ 15 and < 20 ft	Use multiplier of	0.70
$\geq$ 10 and < 15 ft	Use multiplier of	0.45
$\geq$ 5 and < 10 ft	Use multiplier of	0.25

Efficiency Multiplier → 1.00 Box J1

2. Determine percentage of roof drains disconnected → 25.0% Box J2

3. Select project density in dwelling units per acre:

1	Use reduction factor of	0.08
2	Use reduction factor of	0.13
3,4	Use reduction factor of	0.19
5,6	Use reduction factor of	0.23
7	Use reduction factor of	0.29
8,9	Use reduction factor of	0.33
10-14	Use reduction factor of	0.37
15-20	Use reduction factor of	0.44

Reduction Factor → 0.37 Box J3

4. Determine Area Managed

Multiply Box J3 by A_T, and enter the result in Box J4 — 6.9 acres Box J4

5. Multiply Boxes J1, J2 and J4, and enter 60% of the Result in Box J — 1.0 acres Box J

This is the amount of area credit to enter into the "Disconnected Roof Drains" Box of Form D-1

Form D-1b: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding NDC Pavement credit guidelines

Effective Area Managed (A_C)

Divided Sidewalks

1. Determine percentage of units with divided Sidewalks — 25.0% Box K1

Multiply Box K1, A_T, and 0.04 and enter 60% of the result in Box K — 0.11 acres Box K

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-1

Form D-1c: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

Effective Area Managed (A_C)

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1. — 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. — 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. — 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 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 the 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-1

Form D-1d: Alternative Driveway Design

See Fact Sheet for more information regarding Alternative Driveway Design credit guidelines

1. Select type of driveway

Pervious Driveway:	Multiplier:
Cobblestone Block P	0.40
Pervious Concrete/A	0.60
Modular Block Porous Pavement Porous Gravel	0.75
Not Directly-connected I	1.00

Box M1

2. Determine percentage of units with Alternative Driveways: — Box M2

4. Multiply Boxes M1, M2, A_T and 0.04, and enter the result in Box M — 0.00 acres

This is the amount of area credit to enter into the "Alternative Driveway Design" Box of Form D-1

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 ______ sq ft (Private Maintenance)
Subdrain Elevation ______ inches
Ponding Depth, inches ______ inches | 0.00 | acres

Impervious Area Managed by Infiltration BMPs (see Fact Sheet)

Drawdown Time, hrs 48 drawdown_hrs_inf
Soil Infiltration Rate, in/hr 0.50 soil_inf_rate
Sizing Option 1: Capture Volume, acre-ft 1.01 capture_vol_inf | 12.59 | acres
Sizing Option 2: Infiltration BMP surface area, sq ft ______ soil_surface_area | 0.00 | acres
Basin or trench? ______ approximate BMP depth 2.00 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 12.59 A_{LIDc}

Runoff Management Credit (Step 3) $A_{LIDC}/A_T*200 =$ 133.8 pts

Total LID Credits (Step 1+2+3)

LID compliant, check for treatment sizing in Step 4 173.5

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

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC} =$ 5.07 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment $(A_T*I-A_C-A_{LIDC}) / A =$ 0.000 I_A

STOP: No additional treatment needed

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

Form D-1e

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

Determine C Factor using Table D-1b ______ C

Determine i using Table D-1c (Rainfall Intensity) 0.18 i

A_{AT} from Step 2 5.07 A_{AT}

Flow = C * i * A_{AT} 0.00 cfs

TABLE D-1b

Development Type	Runoff Coefficient (Rational), C
Single-family areas	0.50
Multi-units, detached	0.60
Apartment dwelling areas	0.70
Multi-units, attached	0.75
User Specified	0.00

Table D-1c

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 28.30 A ______ hrs Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to 4 in Appendix E of this manual using I_A from Step 2. E- 0.00 P_0

Calculate treatment volume (acre-ft):
Treatment volume = A x (P_0 / 12) 0.00 Acre-Feet

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