

Appendix H

Drainage Study



Watermark Engineering, Inc.

DATE: April 14, 2025
TO: Kier+Wright and Costco Wholesale
FROM: Patrick Stiehr, PE
RE: Drainage Study for Costco El Dorado Hills at Highway 50 and Silva Valley Parkway



OVERVIEW

The project consists of two hydraulically connected parcels covering about 45 acres that include a Costco gas station on the northeast side of Silva Valley Parkway and a Costco warehouse on the southwest side. Both are located just north of the Highway 50 interchange. See **Figure 1, Vicinity Map**.

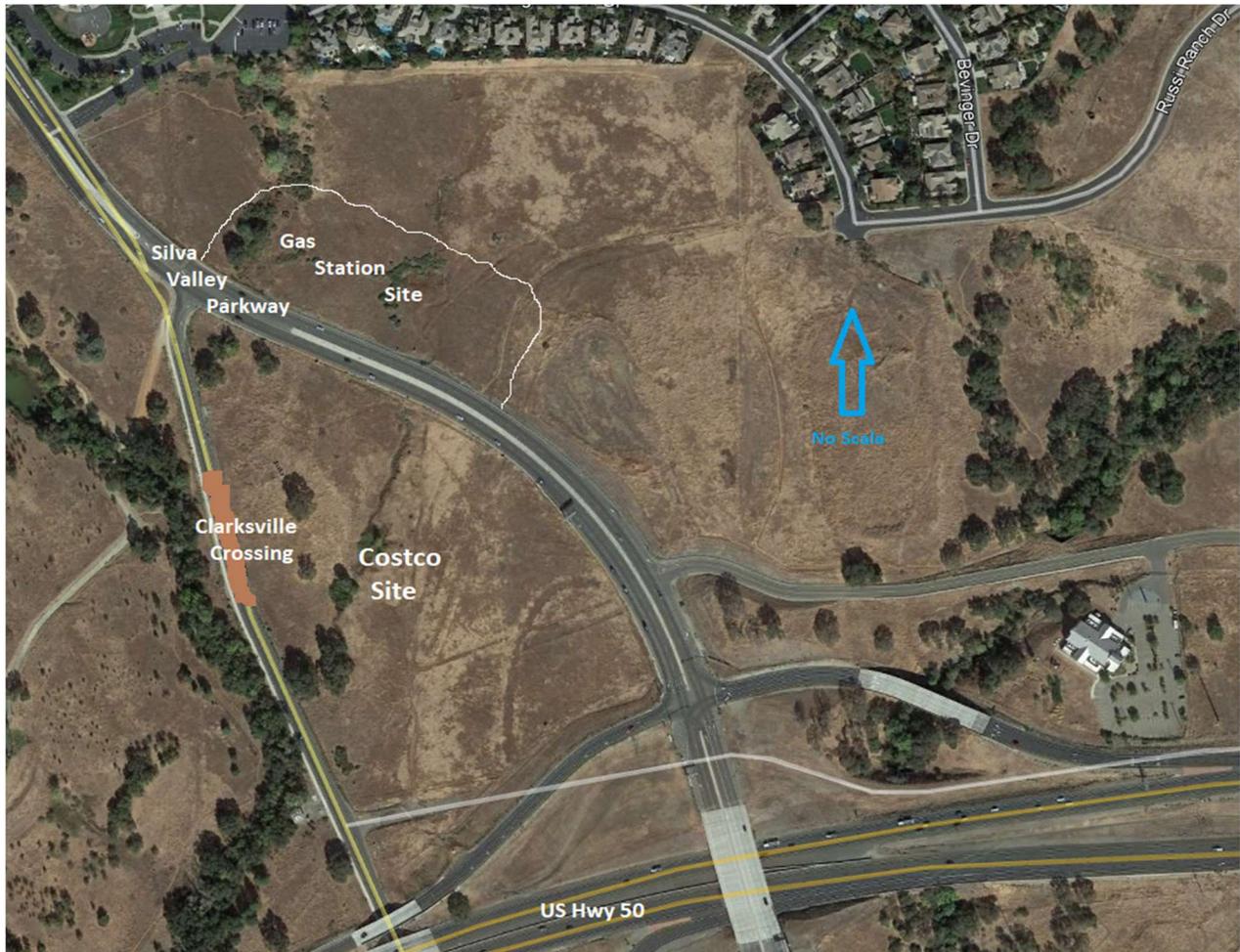


Figure 1. Vicinity Map

This study provides evaluation of the proposed onsite facilities to demonstrate adequate capacity of the proposed drainage facilities but does not address downstream conditions. A consideration is that the proposed Costco development is located at the lower end of the 763-acre watershed the passes under Highway 50. Per Caltrans requirement, the drainage facilities will include attenuation storage to reduce the estimated peak 100-year flow to existing conditions. The peak flow from this development area will enter the watercourse and pass under Highway 50 at least 15 minutes before the main stem peak arrives, meaning the likelihood of the proposed development increasing the main stem peak flow is minimal.

HYDROLOGY

The hydrology was based on the SCS methodology embedded within the XP-SWMM software.

Soils

The soils within the project area are classified by the NRCS as Auburn Silt Loam and falls within Hydrologic Group D, low infiltration. The published hydraulic conductivity for the Auburn Silt Loam is 7.09 micrometers per second, or one inch per hour in US units.

Shed Definition

The gas station was divided into five subsheds, DMAs 8-12. There are five offsite sheds, A B, C1, C2, and D. The Costco site was divided into seven sheds, DMAs 1-7. All of the site generally drains to the southwest.

The Drainage Management Areas (DMAs) are shown on the 'Storm Water Quality Control Plan prepared by Kier+Wright and are shown on **Figure 2**. Offsite flows from the northeast will be piped through both the gas station and warehouse sites.

SCS Parameters

The idealized rainfall distribution for the 10-year, 24-hour storm was developed from the El Dorado County Table A2.2.3, depth-duration-frequency, developed by Jim Goodridge in 2008. A screen shot of the hyetograph is shown in **Figure 3**. The mean annual rainfall was estimated at 26 inches per year.

An assumed time-of-concentration of five minutes and a Curve Number of 98 were used for all nodes within the project areas. **Table 1** provides a summary of the shed areas and peak flows from the 10-year and 100-year, 24-hour storms. The 100-year storm has the same general shape as the 10-year storm, but with greater intensities and storm volume.

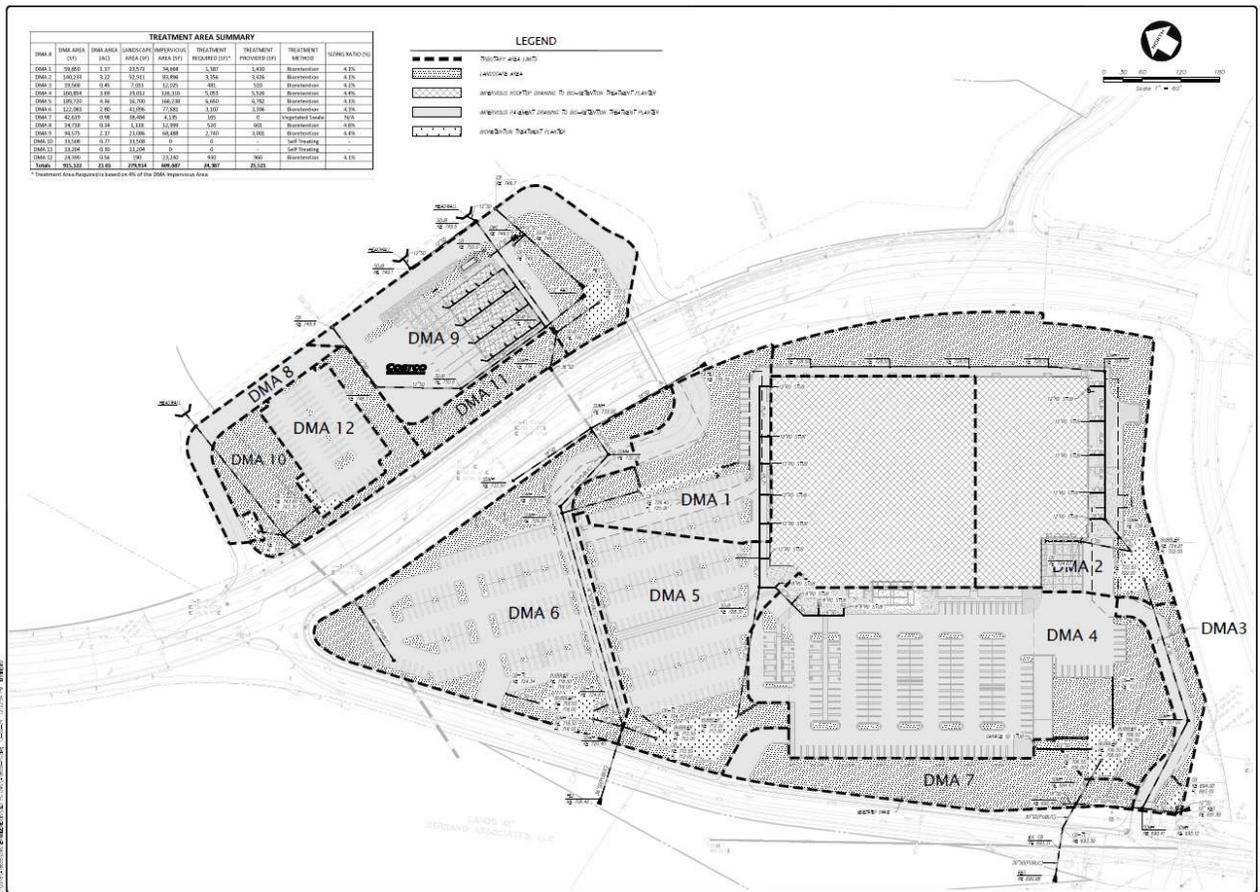


Figure 2. DMA Areas

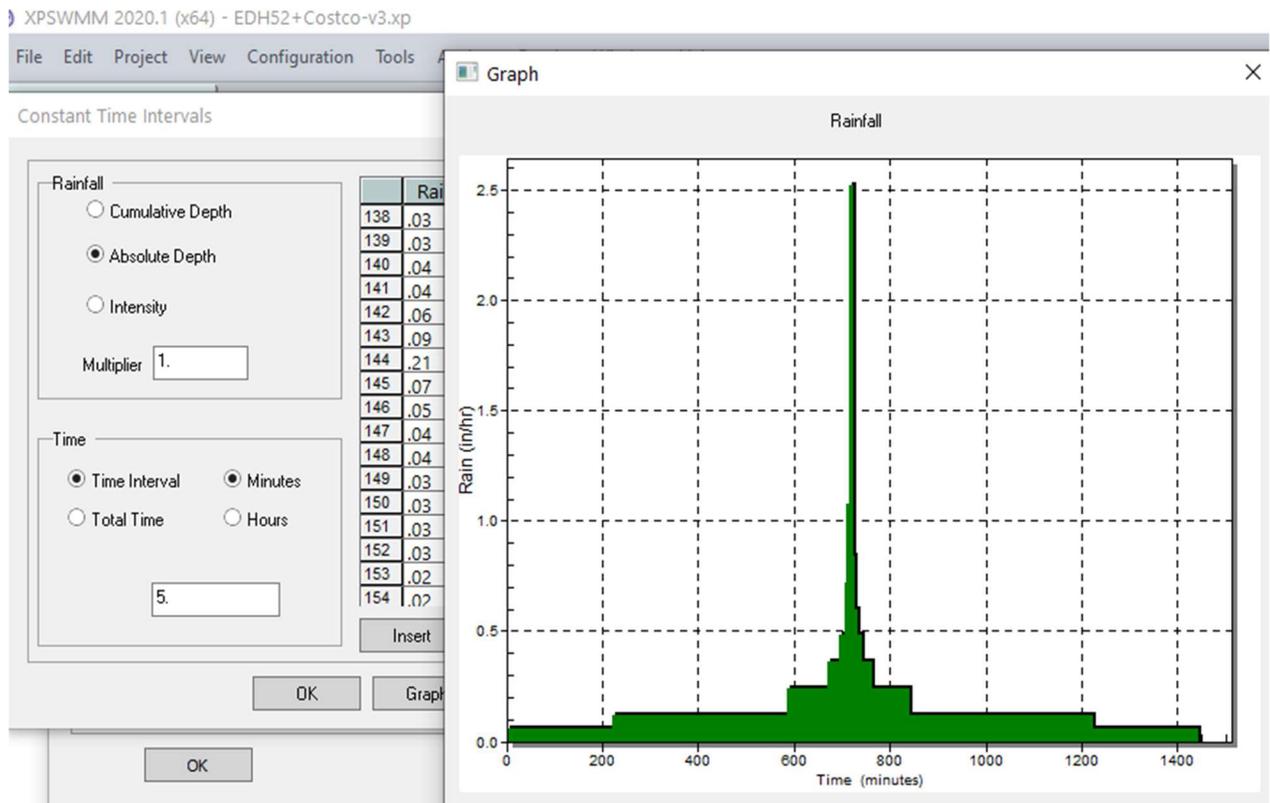


Figure 3. Plot of Rainfall Hyetograph for 10-year, 24-hour Storm

Table 1 Summary of Hydrologic Parameters and Design Flows

Node Name	Area acres	Width ft	Slope ft/ft	Pervious Area Curve Number	Impervious Percent age %	10-yr Max Flow cfs	100-yr Max Flow cfs	Initial Abstraction Fraction min	Initial Abstraction Depth in	Pervious Area Curve Number	Time of Concentration (min)
ClrkvilXinDia	0.3	30	0.02	95	98.00	0.70	1.2	0.2	0.05	95	5
ClrkvilXingDlb	0.3	30	0.02	95	95.00	0.70	1.2	0.2	0.05	95	5
DMA 10	0.77	50	0.01	80	2.00	0.90	2.1	0.2	0.04	80	6
DMA 11	0.3	40	0.01	80	2.00	0.40	0.9	0.2	0.04	80	5
DMA 12bio	0.56	100	0.01	95	95.00	1.30	2.2	0.2	0.04	95	5
DMA 1Bio	1.37	100	0.005	95	95.00	3.10	5.5	0.2	0.05	95	5
DMA 2bio	3.22	100	0.01	95	95.00	7.30	12.9	0.2	0.05	95	5
DMA 3bio	0.45	100	0.01	95	95.00	1.00	1.8	0.2	0.05	95	5
DMA 4bio	3.69	250	0.01	95	95.00	8.40	14.8	0.2	0.05	95	5
DMA 5bio	4.36	230	0.01	95	95.00	9.90	17.5	0.2	0.05	95	5
DMA 6bio	2.8	300	0.01	95	90.00	6.30	11.2	0.2	0.05	95	5
DMA 7	0.98	50	0.01	95	95.00	2.20	3.9	0.2	0.05	95	5
DMA 8bio	0.34	100	0.01	95	95.00	0.80	1.4	0.2	0.04	95	5
DMA 9bio	2.07	200	0.01	95	95.00	4.70	8.3	0.2	0.04	95	5
Existing	44.22	1500	0.295	81	2.00	45.40	102.5	0.2	0.04	81	10
OffsiteShed A	0.92	100	0.04	80	2.00	1.20	2.8	0.2	0.04	80	5
OffsiteShed B	3.43	500	0.05	80	2.00	3.90	9.1	0.2	0.04	80	7
OffsiteShed C1	6.7	450	0.03	80	2.00	6.60	15.1	0.2	0.04	80	10
OffsiteShed C2	3.6	150	0.05	80	2.00	4.30	10	0.2	0.04	80	6
OffsiteShed D	2.18	100	0.04	80	2.00	2.60	6.1	0.2	0.04	80	6
OffsiteShed E-sw	4.55	300	0.02	80	40.00	6.30	12.2	0.2	0.05	80	10
SVPkwy a	0.5	80	0.015	98	95.00	1.10	2	0.2	0.04	98	5
SVPkwy b	0.7	80	0.02	98	95.00	1.60	2.8	0.2	0.04	98	5
SVPkwy c	0.73	80	0.02	98	95.00	1.70	2.9	0.2	0.04	98	5

HYDRAULICS

The XP-SWMM software was used for the backwater analysis. Drainage facilities information for the modeling was based on the Preliminary Grading Plan Drainage Exhibit prepared by Kier+Wright for the Costco site.

Figure 4 provides a schematic modeling map for the two development area projects. The “Existing” node was used to generate existing conditions hydrographs for the 10- and 100-year storms without additional routing.

Table 2 provides a summary of the design flows and the hydraulic parameters and characteristics of the drainage facilities.

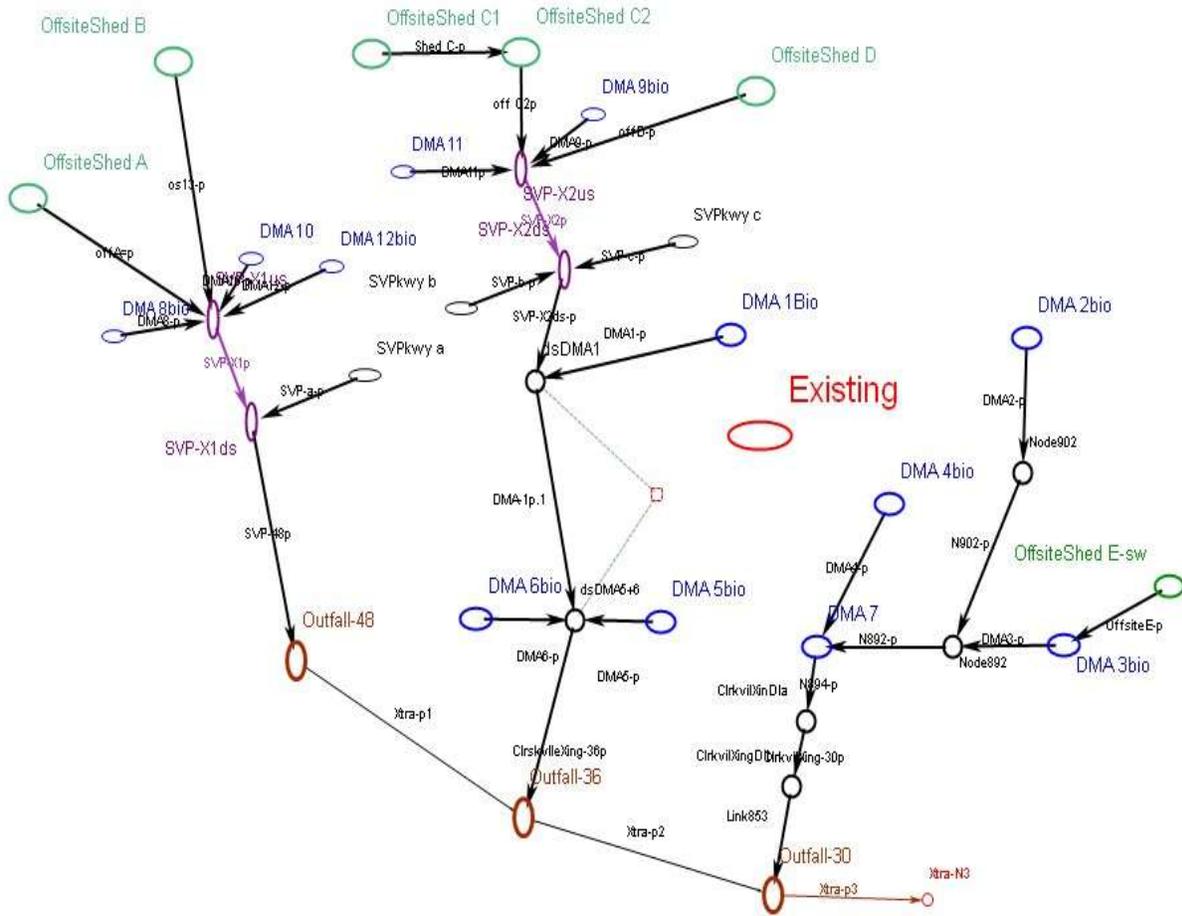


Figure 4 Modeling Map

Table 2 Summary of Flows and Hydraulic Information

Upstream Node Name	Ground Elevation (Spill Crest) ft	Upstream Invert Elevation ft	Maximum Water Elevation (US) ft	10-yr Max Flow cfs	10-yr Max Velocity ft/s	100-yr Max Flow cfs	100-yr Max Velocity ft/s	Downstream Node Name	Downstream Invert Elevation ft	Maximum Water Elevation (DS) ft	Time to Peak hr
ClrkvilXinDla	693.3	688.68	690.23	24.4	8.1	35.3	8.7	ClrkvilXingDlb	688.55	689.94	12.029
ClrkvilXingDlb	693.31	688.55	689.94	25.1	8.6	36.4	9.4	Outfall-30	688	689.51	12.029
DMA 10	744.3	735.7	736.04	0.9	3.8	2.1	4.8	SVP-X1us	735	735.34	12.031
DMA 11	732.5	730	730.27	0.4	1.9	0.9	2.5	SVP-X2us	729.5	729.72	12.036
DMA 12bio	744.3	735	735.37	1.3	4.7	2.2	5.5	SVP-X1us	734	734.37	12.024
DMA 1Bio	726.4	719.77	721.57	3.1	3.9	5.4	6.8	dsDMA1	719.16	720.67	12.022
DMA 2bio	722.5	715	715.53	7.3	13	12.9	15.1	Node902	699.59	700.12	12.022
DMA 3bio	695.12	689.6	691.05	7.3	3.9	17.1	5.3	Node892	689.33	691.01	12.056
DMA 4bio	706.5	700	700.47	8.4	11	14.8	12.4	DMA 7	688.81	690.69	12.021
DMA 5bio	712.5	707.36	708.86	9.9	5.8	17.5	9.8	dsDMA5+6	707.09	708.39	12.022
DMA 6bio	718.5	707.33	708.53	6.3	4	11.2	6.3	dsDMA5+6	707.09	708.39	12.021
DMA 7	694.43	688.81	690.69	23.7	8.3	34.1	10.8	ClrkvilXinDla	688.68	690.23	12.031
DMA 8bio	740	733.5	733.82	0.8	2.7	1.4	3.2	SVP-X1us	733	733.32	12.026
DMA 9bio	738	733.5	735.18	4.7	6.1	8.1	10.2	SVP-X2us	733	733.9	12.022
dsDMA1	729.3	719.16	722.49	16.9	4.6	39.8	4.2	Node928	718.5	722.49	12.017
dsDMA1	729.3	719.16	720.67	23.6	5.6	48.9	7	dsDMA5+6	718.5	719.93	12.044
dsDMA5+6	722.5	707.09	708.39	38.6	16	75.2	19.4	Outfall-36	703	703.9	12.029
Node892	695.41	689.33	691.01	13.9	5	21.5	6.7	DMA 7	688.81	690.69	12.043
Node902	707	699.59	700.12	7.3	6.4	12.9	10.2	Node892	689.33	691.01	12.024
Node928	725	718.5	722.49	12	11	14.8	12.3	dsDMA5+6	707.09	708.06	12.042
OffsiteShed A	735	733	733.32	1.2	2.8	2.8	4	SVP-X1us	732	732.64	12.021
OffsiteShed B	745	736.7	737.18	3.9	5.6	9	7.4	SVP-X1us	732	732.64	12.042
OffsiteShed C1	739	737	738.05	6.6	5.2	15.1	7	OffsiteShed C2	736.56	737.16	12.075
OffsiteShed C2	749	736.56	737.16	10.3	9.5	23.8	12.3	SVP-X2us	728	728.8	12.056
OffsiteShed D	734	730	730.54	2.6	4.5	6.1	5.6	SVP-X2us	728.5	729.04	12.04
OffsiteShed E-sw	692	689.66	691.08	6.4	3.8	16.5	5.2	DMA 3bio	689.6	691.05	12.071
Outfall-30	693.3	688	689.51	72.6	14.6	130.1	17.1	Xtra-N3	686	687.5	12.032
Outfall-36	710.01	703	703.9	47.4	14.2	94.2	18.1	Outfall-30	688	689.51	12.037
Outfall-48	720	710	710.5	8.9	6.2	19.1	8	Outfall-36	703	703.9	12.043
SVP-X1ds	739	730	730.47	9	10.9	19.1	13.6	Outfall-48	710.2	710.67	12.04
SVP-X1us	737.8	732	732.64	7.9	8.5	17.2	10.8	SVP-X1ds	730	730.47	12.031
SVP-X2ds	733	723.38	724.18	20.5	8.4	43.5	10.8	dsDMA1	719.16	720.67	12.04
SVP-X2us	734.1	728	728.8	17.5	11.5	38.2	14.4	SVP-X2ds	723.38	724.18	12.042
SVPkwy a	737.5	733	733.37	1.1	3.4	2	3.9	SVP-X1ds	732	732.37	12.028
SVPkwy b	732.5	729	729.43	1.6	3.7	2.8	4.4	SVP-X2ds	728	728.43	12.026
SVPkwy c	735.79	730	730.31	1.6	6.4	2.9	7	SVP-X2ds	724	724.3	12.025

The modeling results indicate that the proposed storm drain pipes have adequate capacity to convey the 10-year, 24-hour storm. Note that the bio-retention areas were not modeled as storage areas. If the bio-retention areas were added, there may be a decreased peak flow because of the attenuation throughout the development. They were not added because it seemed unnecessary.

Attachments 1, 2 and 3 provide screen shots of a highlighted reach of storm drain pipe within the project with the 10-year, 24-hr storm water surface profiles. This information is available in Table 2 but is also provided graphically to aid the reader.

ATTENUATION OF 100-YR FLOW

The facilities to attenuate the 100-year flow down to existing conditions are preliminary at this time but consist of an oversized pipe within the middle storm drain within the parking lot. An orifice or smaller pipe will then be used to meter the flow as necessary.

The preliminary design includes 220 linear feet of 48-inch storm drain with a downstream 15-inch storm drain. The XP model was then configured to compare the flow along the normal 36-inch storm drain to the attenuated flow within the combined large and small pipes.

The bottom part of the model map shows that all the flows were combined as part of this evaluation. Note that the three outfalls are not and will not be connected and the configuration is for modeling and comparison purposes only.

Figure 5 shows the 100-year runoff hydrograph for existing conditions (102 cfs). Figure 6 shows the computed flows for the 10-yr, 100-yr and 100-yr attenuated flow (99) cfs for developed conditions. The red value in Figure 6 is the 100-year flow without attenuation.

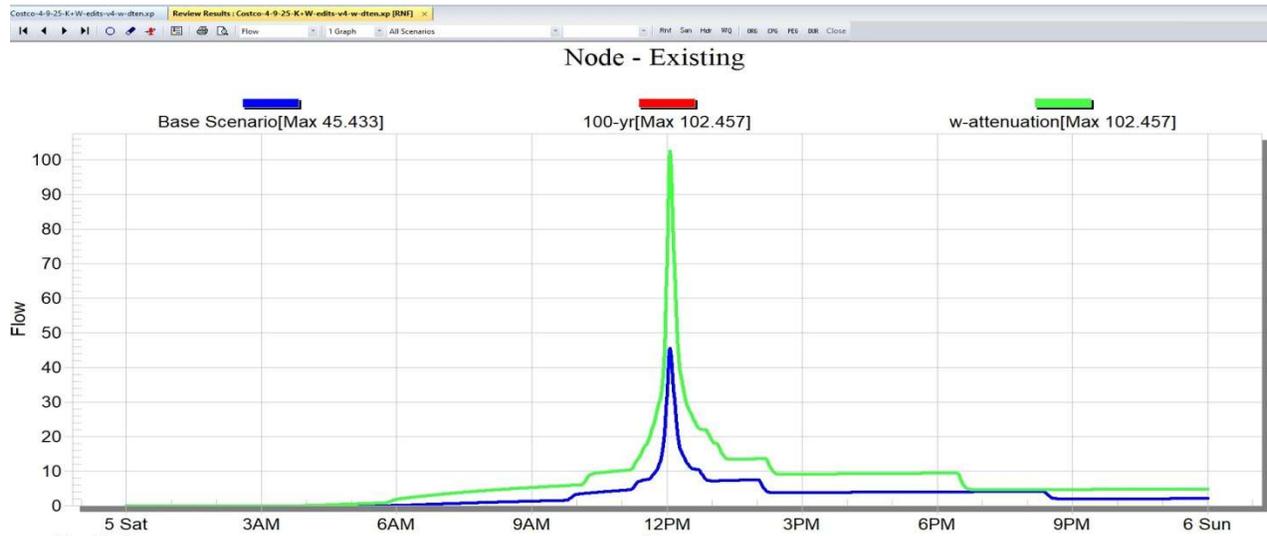


FIGURE 5. PLOT OF EXISTING CONDITIONS HYDROGRAPHS

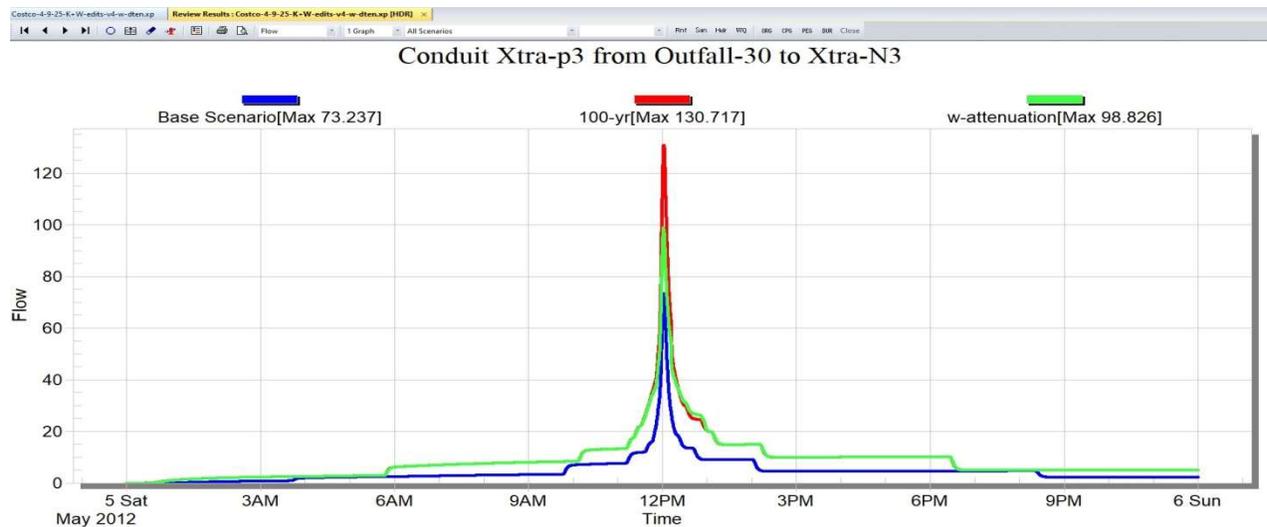


FIGURE 6. PLOT OF OUTFLOWS FROM DEVELOPMENT SITE

SUMMARY AND COMMENTS

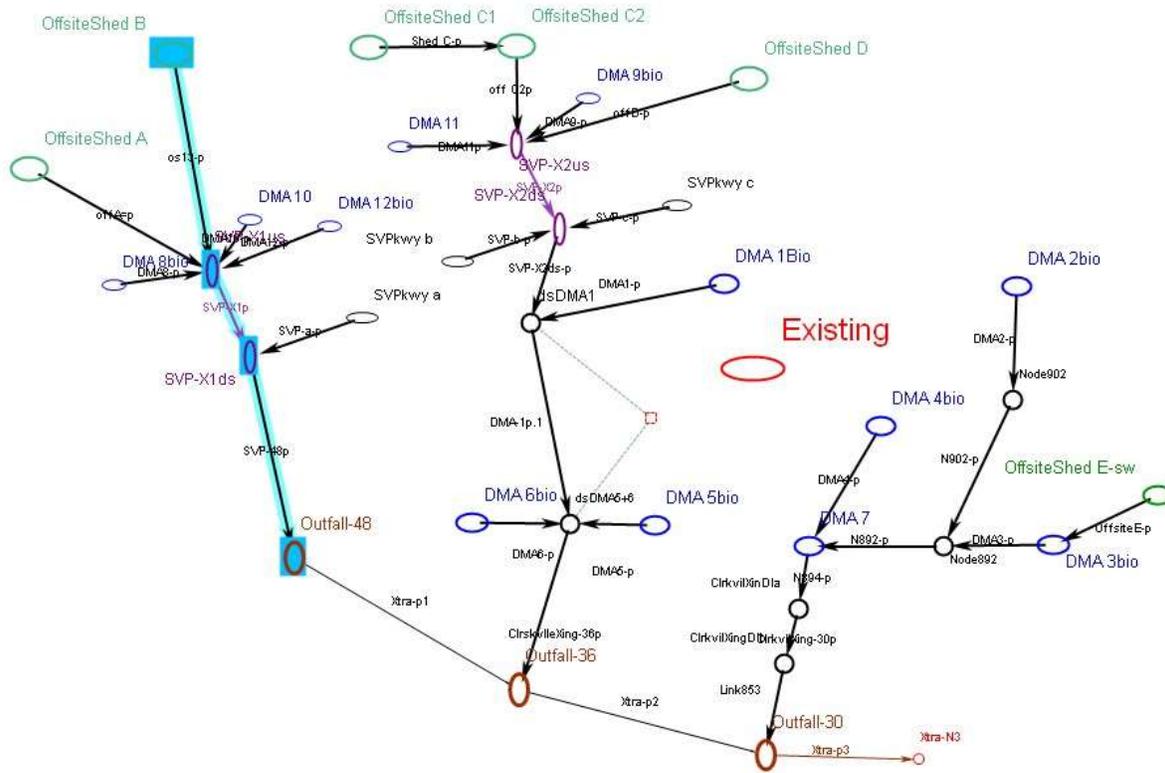
The modeling shows that the proposed piping network for the two projects has adequate capacity to convey the 10-year storm.

The modeling also shows that the 100-year peak flow can be attenuated on-site with a length of over-sized pipe connected to a smaller pipe, or with an orifice to reduce peak flow.

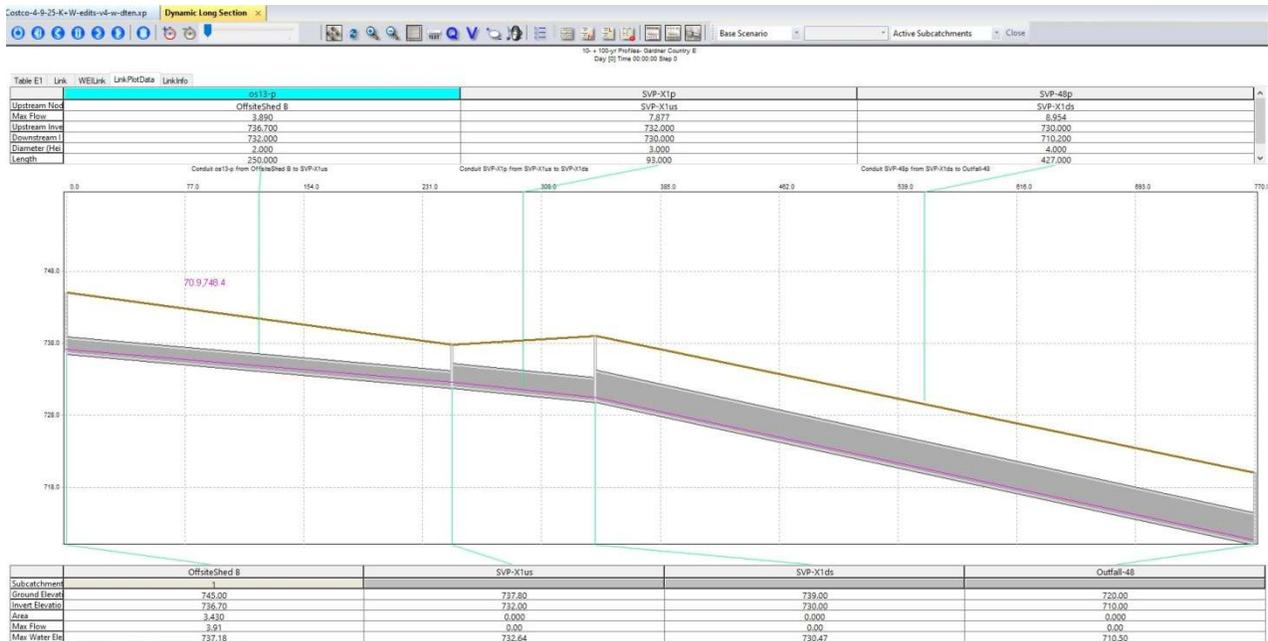
Additional information is available upon request including the XP-SWMM model and the rainfall 5-minute distribution depicted in Figure 2.

Water quality for the two projects is accomplished via the bio-retention area planters scattered within the project. No additional information has been provided within this document.

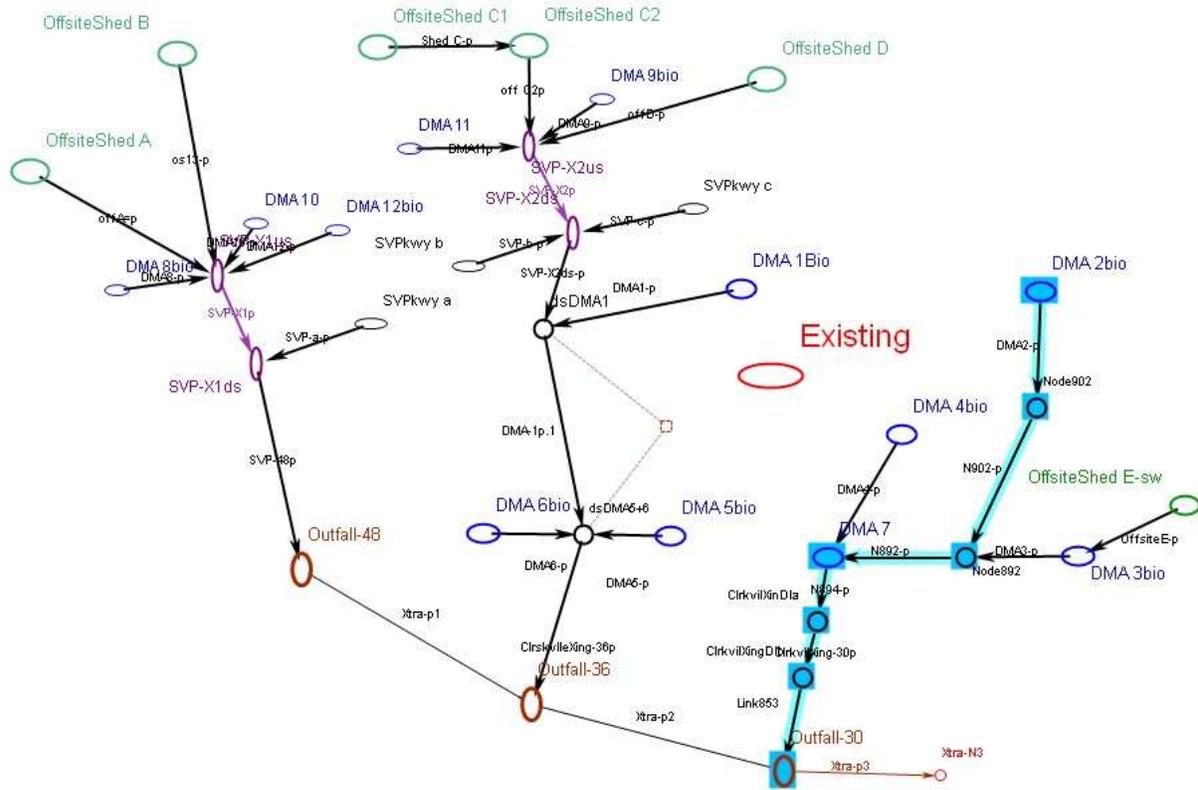
The offsite drainage northwest of the gas station is included in the analysis, but is considered as pass-through flow.



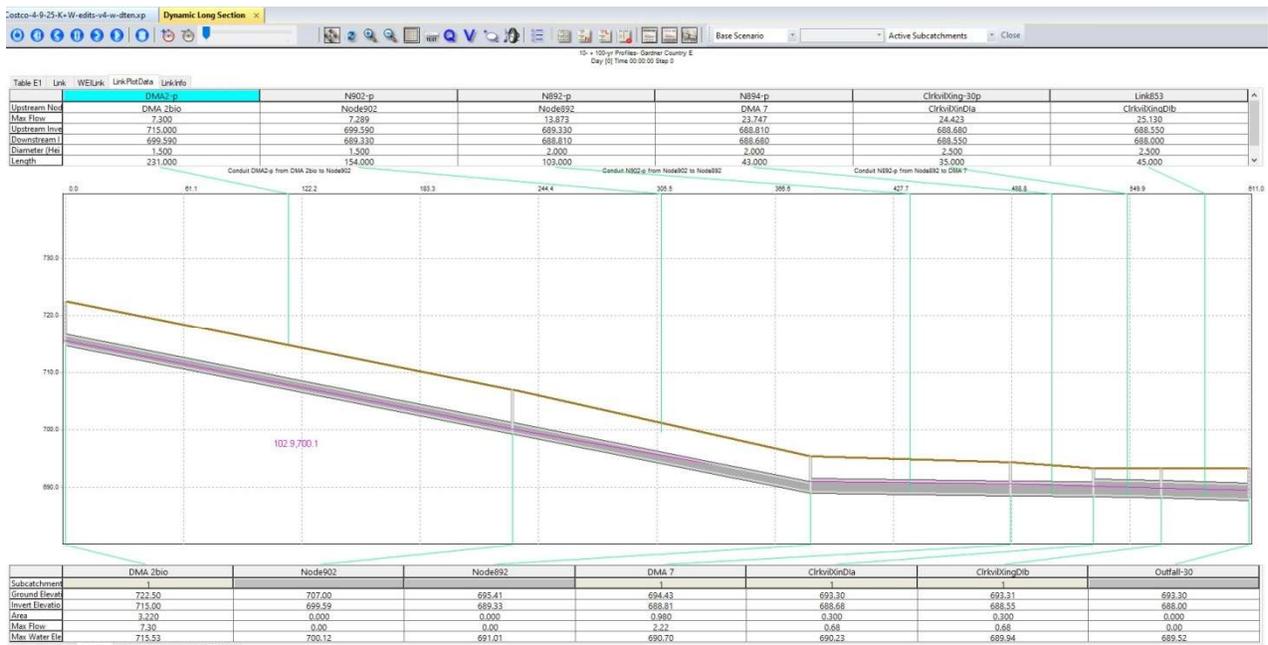
Attachment 1a. Modeling Map with Highlighted Reach 1



Attachment 1b. 10-yr Water Surface Profile along Reach 1



Attachment 3a. Modeling Map with Highlighted Reach 3.



Attachment 3b. 10-yr Water Surface Profile along Reach 3