Appendix D

Drainage Analysis

PRELIMINARY

DRAINAGE STUDY

FOR

MONTANO DE EL DORADO PHASE III

1010 White Rock Road
County of El Dorado
El Dorado Hills, Ca
APN: 118-010-12

December 7, 2016

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APPENDIX

A. PROJECT LOCATION

The proposed project is located at the southeast corner of the intersection of White Rock Road and Latrobe at 1010 White Rock Road in El Dorado Hills, County of El Dorado, State of California. The approximate coordinates of the project site are latitude 38.646036° north and longitude 121.067261° west. The project site and shed areas encompasses about 14.95 acres, inclusive of APN's: 118-010-12 and a portion of APNs 118-010-14 & 15, as well as off-site street improvements along Latrobe Road. The project's location is shown on the Vicinity Map in Appendix A.

B. EXISTING SITE CONDITIONS

In its existing condition, the majority of the site is undeveloped with well-established grasses and intermittent trees. The terrain would be best described as rolling hills. The area generally is divided into three main shed areas. Shed area A-X1 (as shown on the Pre-Construction Shed Map, SM1 in Appendix B) includesapproximately 27% of the overall project site, and slopes in an easterly direction, toward an existing concrete drainage ditch along the east property line. Shed A-X2 envelopes over half of the project site (approximately 56%) and slopes in a southwesterly direction toward Latrobe Road. It is tributary to an existing 24" storm drain that passes beneath Latrobe Road, approximately 1,150 feet south of the intersection of Latrobe Road and White Rock Road. Shed A-X3 is about 13% of the project site and is located at the southern tip of the site. The shed slopes in a westerly direction toward another 24" storm drain that passes beneath Latrobe Road. Two smaller sheds (approximately 4%) to the north flow into the existing site storm drain system. The highest part of the dividing ridge is located at the southeast corner of the adjacent Pottery World property, APN 118-010-14, at an elevation of about 638 feet. The terrain slopes radially away from this area.

The east facing slope is relatively steep, with slopes up to about 3:1. There is a concrete drainage ditch located near the east property line, which runs along the back of the existing residential lots, intercepts the runoff and conveys it northerly to a drainage inlet near the far northeast corner of the property. The terrain slopes back up to the residential homes east of the concrete ditch. The west and southwest facing slopes toward Latrobe Road are also relatively steep with slopes up to about 5:1. There are rock lined drainage ditches along the east side of Latrobe Road which intercept runoff from the subject property and convey flows to two separate 24-inch culvert crossings of Latrobe Road. The majority of the east side of Latrobe Road has AC dikes, which convey the road run-off by overside drains into these respective ditches. One culvert crossing is on the west side of an existing driveway apron turnout about 790 feet north of the south property corner. The other is east of the driveway apron about 235 feet north of the south property corner. Flows from these culverts discharge on the west side of Latrobe Road and flow west into an existing channel that is tributary to Carson Creek. Cason Creek is tributary to Deer Creek, which is tributary to the Cosumnes River. Table 1 below summarizes the surrounding properties. Site conditions can be found on the Pre Construction Shed Map SM1 located in Appendix B.

TABLE 1: SITE DESCRIPTION (SURROUNDING AREAS)

North	Developed commercial shopping / retail center and White Rock Road beyond
South	Latrobe Road and Golden Foothill Pkwy intersection
East	Cresleigh El Dorado Residential Subdivision
West	Latrobe Road

The site contains two different soil types, both identified as Hydrologic Group D, which is generally characterized by low infiltration. These soils include Auburn silt loam, and Auburn very rocky silty loam. See Appendix C for soils information. In discussions with the geotechnical engineer for this project, we have assumed zero infiltration for drainage and stormwater quality calculations due to the shallow bedrock on this property and the engineered fill required for the project site.

The project site is not located within a floodplain (Zone X). See a project Firmette in Appendix F.

C. PROPOSED PROJECT DESCRIPTION

The project involves the construction of 10 new buildings. Building 1 is proposed as a two-story structure with the first floor as retail use and the second floor as office use. Buildings 2, 4, 6 and 8 are designated as single story retail. Buildings 3, 5, and 7 are proposed restaurants, with a drive-thru proposed for Building 7. Building 9 is proposed office use. Building 10 is a proposed four story hotel with the main entrance, offices, and meeting rooms on the first floor and guest rooms on floors 2 - 4. In total, approximately 127,322 square feet of new building is proposed with this project. The exact square footage of each building will be identified during the design phase of the project.

The project will also include paved driveways and parking facilities to serve all of the buildings. The driveways will connect the already developed portions of Montano de El Dorado to the north to the proposed project at three different locations and will provide good vehicular circulation for the overall site. Two new driveways along the Latrobe Road frontage are proposed as well. The middle driveway will be the main entrance off Latrobe Road with a signalized intersection. The more southern driveway is proposed as right-in right-out only. In addition to the paved driveways and parking areas, site hardscape will provide an accessible path of travel throughout the entire development. Landscaping proposed is consistent with El Dorado County standards.

Due to the substantial grade differential from Latrobe Road to the top of the site, retaining walls are proposed along the Latrobe Road frontage to match in type and kind the walls that have already been constructed. The tallest retained height of the wall along Latrobe Road is expected to be near the northwest corner of Building 8 where the wall is estimated to be about 19 feet tall. A retaining wall is also proposed along the east property line. The northern portion will retain soils from the project site, which is higher than the adjacent residential homes. Northeast of Building 2 the wall reverses and starts retaining soil from the adjacent site as the proposed project elevations are lower.

Many additional internal retaining walls are proposed on-site due to the large grade differential as stated above.

New curb, gutter, and sidewalk are also proposed as part of this project frontage improvements along the entire Latrobe Road frontage. The curb, gutter, and sidewalk will be constructed based on the existing right-of-way and a 4-Lane Divided Roadway with a 6-ft wide shoulder (includes gutter pan of curb and gutter) and a 6-foot wide sidewalk. However, the new retaining walls along Latrobe Road are proposed behind the new proposed right-of-way, which is based on an ultimate design of a 6-Lane Divided Road per El Dorado County Standard Plan RS-01. The proposed 4-lane layout provides a small strip of landscaped area between the back of the sidewalk and retaining wall which will serve as an aesthetically pleasing buffer for the sites frontage.

New storm drain, sanitary sewer, and water lines are being proposed to serve the new development, in compliance with El Dorado County Stormwater and El Dorado Irrigation District requirements, respectively. New storm drain improvements will also include both on-site and off-site drainage inlets, manholes and drain lines designed to collect and convey stormwater to one of the two 24" storm drains passing beneath Latrobre Road. On-site storm drainage will implement a series network of Low Impact Development (LID) in conjunction with underground stormwater detention piping to detain runoff and mitigate to pre-development flows prior to leaving the site. The LID measures will provide water quality as well as attenuation of the peak flows prior to entering the underground detention system. The preliminary design of the on-site storm drainage is presented in greater detail in Sections G and H of this Report.

The total area to be disturbed will be approximately 15 acres including both on-site and off-site improvements. Site improvements can be seen on the Site Plan and the Preliminary Grading, Drainage and Paving Plans C1 & C2 in Appendix A.

D. PURPOSE OF REPORT

The purpose of this report is to present the preliminary design of the storm drain system and to demonstrate that the design is in compliance with the El Dorado County Drainage Manual, dated March 14, 1995 and the Western El Dorado County Storm Water Management Plan (SWMP), dated August 2004. Per El Dorado County drainage requirements, 10-year event peak flows from the site must be detained and attenuated to match or be less than the pre-development flows. Additionally, the design must provide an overland conveyance system to accommodate the 100-year peak flow. The report demonstrates that the preliminary drainage design meets both these El Dorado County drainage requirements.

This report has also been structured to present stormwater quality measures to be implemented as Best Management Practices (BMPs) in accordance with the SWMP and CASQA Stormwater Pollution Prevention Plan. Per the SWMP, this project falls under the Project Type 5 category because more than one acre of impervious area will be created. In addition to the water quality and source control measures, Type 5 projects require hydromodification such that the 2-year, 24 hour storm does not increase from the pre development to post development condition. This report

demonstrates that the preliminary drainage design meets the Project Type 5 requirements set forth by the SWMP.

The report is divided into four (4) main parts:

A. Description of existing drainage conditions and evaluation of existing storm drain system.

B. Description and evaluation of the post-construction runoff, proposed storm drain system, and water quality treatment.

C. Conclusions.

D. Recommendations.

E. EXISTING STORM DRAINAGE CONDITIONS

As previously mentioned in Section B, the proposed project site is located on hilly terrain with the top of the hill located at the southeast corner of the adjacent Pottery World property (APN:118-010-14). The elevation at this area is about 638 feet. The elevation along Latrobe Road varies significantly along the project site frontage. At the northwestern most corner of the project site, the elevation at Latrobe Road is approximately 597 feet. Approximately 690 feet north of the south property corner, Latrobe Road dips down to an elevation of about 574 feet. Based on these values, there is a grade differential of between 41- 64 feet from the top of the existing hill to Latrobe Road. The portion of the project site that sheds toward the gravel-lined drainage ditches along the east side of Latrobe Road are designated by Sheds A-X2 and A-X3 on the Pre-Construction Shed Map - SM1. Each of these two sheds are tributary to one of two 24" storm drain pipes that convey water westerly, beneath Latrobe Road, outfalling on the west side of the road. Shed A-X1 on Shed Map SM1 delineates the shed area within the proposed project site that currently drains to the concrete drainage channel running along the east property line toward an existing drainage inlet near White Rock Road. Sheds A-X4 and A-X5 represent areas within the project area that, in the existing condition, discharge to the on-site storm drain network of the north-adjacent parcels. Sheds A-X4 and A-X5 are shown for comparison of land coverage between the pre and post construction condition.

To evaluate both pre and post-construction runoff, RFE used the USDA Urban Hydrology for Small Watersheds TR-55 Manual, an accepted method of hydrologic analysis for El Dorado County. The method outlined by the TR-55 utilizes equations based on shed area, ground cover, and ground slope to determine maximum storm flow response times and resultant peak flows. The existing land coverage within the proposed project development envelope is about 3.26% impervious. Using the values from Table 2-2a from the USDA Urban Hydrology for Small Watersheds TR-55 method, the resultant curve numbers (CN) assuming a CN of 80 for pervious areas and a CN of 98 for impervious areas. After establishing the CNs for the shed areas and the time of concentration paths for the shed areas (See Shed Map SM-1 in Appendix B), peak runoff for the 2-Yr and 10-Yr storm events were

estimated. The calculations for the determination of the estimated peak runoff flows are presented in Appendix E and applicable peak flow values also noted within this study.

Two pre-construction scenarios were evaluated for comparison in separate post-construction design calculations. The estimated 2-year 24-hour storm event peak flow was estimated for the overall site for comparison with the same post-construction storm event for post-construction to show consistency with the El Dorado County requirements. The estimated 2-year and 10-year pre-construction peak flows were also estimated for the larger southwest shed A-X2 only as the basis of comparison with the post-construction peak flows after detention that discharge into the existing 24-inch storm drain culverts crossing Latrobe Road.

F. POST-CONSTRUCTION STORM DRAINAGE CONDITIONS

As previously explained, the preliminary post-construction storm drainage system was design to satisfy requirements of the El Dorado County Drainage Manual as well as the Western El Dorado County SWMP. The key considerations for this project based on each of these two design guidelines are as follows:

El Dorado County Drainage Manual –

Safely convey the storm runoff from an event with an average recurrence interval of 10 years without the headwater depth exceeding the culvert barrel height.

The depth of flow or ponding shall not exceed a level which would cause inundation of building sites. One foot of freeboard shall be maintained between building finished floor elevation and water surface elevation resulting from a storm runoff event with an average recurrence interval of 100 years.

The post development 10-Year peak flow shall not exceed the pre development 10-Year peak flow.

Western El Dorado County SWMP -

Provide site design measures, source controls, and storm water quality treatment consistent with the SWMP. Size the stormwater quality treatment / low impact development measures to sufficiently treat the 85th percentile 24-hour storm event capture

Verify that post development flows will not exceed pre development flows for the 2-year, 24-hour storm.

In order to satisfy the requirements outlined above, the project will implement a number of LID measures in conjunction with downstream underground detention facilities. To provide water quality treatment the LID measures proposed includes rooftop and impervious area disconnection into biofiltration facilities. French drains are proposed for the standard above-ground bioretention

facilities due to the very poor infiltration rates at the site. After the water filters through the engineered soil and pollutants are removed, the water will flow into the French drains and connect into the underground storm drainage network. These biofiltration facilities are proposed within landscape areas as much as feasible.

In addition to the LID measures listed in the SWMP, this project will utilized Filterra Stormwater quality units in areas where typical bioretention/biofiltration facilities are not feasible. The Filterra units treat the stormwater in a similar fashion as bioretention/biofiltration facilities as described in the CASQA BMP TC-32 for Bioretention. Storm water is treated by flowing through a layer of engineered soil and then passes into a French drain at the bottom of the engineered soil and then is discharged into the site underground storm drain system. Additionally, the filterra includes a shrub or small tree planted within the filter soil that provides additional nutrient uptake as the water flows through the engineered soil.

For the parking area and drive aisle in front of Buildings 5 and 6, the use of bioretention/biofiltration systems and filterra inlets are not as easily applied. Therefore, for this smaller area stormfilter inlets are proposed to filter the stormwater before discharging into the on-site storm drain system.

After the stormwater has been treated via bioretention/biofiltration, filterra units, or Stormfilters, the water will be conveyed via storm drain pipes to one of two underground detention systems. The north detention system is located under the parking lot north of Building 5 and 6. This system will receive runoff from north of the main driveway entrance, including Buildings 1, 2, 3, 5, 6, and 10. The south detention system is located in the 8 driveway and will receive runoff south of the main driveway, including Buildings 4, 7, 8, and 9. For the purposes of preliminary design, the post-development condition assumes 90% impervious land coverage. See Shed Maps SM2 and SM3 in Appendix B for the post-construction shed delineations.

G. STORM DRAINAGE EVALUATION

As noted above in Section E, RFE used the USDA Urban Hydrology for Small Watersheds TR-55 Manual to estimate the pre-construction and post-construction peak flows for the project. The method outlined by the TR-55 utilizes equations based on shed area, ground cover, and ground slope to determine maximum storm flow response times and resultant peak flows.

After the shed boundaries were estimated for each of the storm drain nodes in the proposed post-construction site, the respective overall time of concentration paths of travel were determined for both the north and south detention systems. Because this report is only in the preliminary stage, individual shed analysis for time of concentration paths of travel was not conducted. This will be performed with the design drainage study as part of the improvement plans phase for this project. The final design drainage study will include the calculation of peak flows at each node with the related pipe flow hydraulics calculations. For the preliminary phase, one of the primary focus points was on the necessary detention volume required to attenuate the post-construction 2-Yr and 10-Yr peak

flows to pre-construction levels or below, comparing to the applicable pre-construction flows from shed area A-X2 only. Once the tributary sheds were established and time of concentration paths were established for each system, we estimated the resultant peak flow runoffs and then estimated the necessary detention requirements. The table below presents the pre and post development peak flows as well as the peak flows with the detention systems:

TABLE 2: PRE AND POST DEVELOPMENT PEAK FLOWS

	Area (AC)	Curve No. (CN)	Time of Conc. (min)	2-Yr Peak (cfs)	10-Yr Peak (cfs)
Pre-Development Shed A-X1	4.092	80	23.90	1.404	3.219
Pre-Development Shed A-X2	8.336	80	24.10	2.863	6.564
Pre-Development Shed A-X3	1.887	80	22	0.708	1.620
Post-Development North System	8.030	96	6.50	12.21	18.83
Post-Development South System	5.270	96	2.70	8.72	13.48
Post-Development North System (w/detention)	-	-	-	2.448	6.446
Post-Development South System (w/detention)	-	-	-	0.638	1.539

In order to attenuate and detain the post-construction stormwater runoff to the levels shown in the above table, the north system will have 5 rows of 48-inch perforated storm drain pipe side by side, 400 feet in length. The south system will have 4 rows of 48-inch perforated storm drain pipe side by side, 400 feet in length. Each system will be connected to a metering manhole which will meter the flows to pre-development conditions before leaving the site.

There are two small areas, about 0.21 acres combined, shown on Shed Map SM2 and labeled A-54 & A-57 which will not connect into either the North or South detention systems. The runoff from these area will be from a new paved parking area and a landscaped area. This new parking area will create about 4,000 square feet of new impervious area, replacing approximately 5,400 square feet of paved parking in this area that will be removed as part of this project. The runoff tributary to this parking lot will tie into the existing storm drain system to the west of the parking lot. Flows from the landscape area will flow down the loop road and into the storm. There is approximately 3,000 square feet of impervious area in Shed A-27 that, in the existing condition, discharges to the Pottery World storm drain system. With the proposed development, this area will be tributary to the North Detention System, no longer discharging into the existing development's system. Additionally, Shed Area A-33, in the existing state, discharges to the Pottery World storm drain system. This entire area will now be captured and conveyed to the North Detention System. Between the tributary areas removed from the existing development storm drain system (Sheds A-27 and A-33), the overall balance of stormwater should not increase from the Pre to Post Condition for the existing development's system. Additionally, the existing underground detention system constructed as part of the US Bank phase for the site, includes additional capacity for areas to the south of the US Bank to approximately the existing ridge area. This area now will flow into the new system as part of this project. Thus, there should be adequate capacity for the areas noted above that will flow into this existing system.

Each of the two storm drain detention systems will be connected to an outlet control metering manhole to meter the discharge to pre-development levels for the 2-year and 10-year storm events. The system has been design to keep the peak flowrates from the project site into the two 24" storm drains that pass beneath Latrobe Road at or below the pre-development flows from the site. Approximately 13.23 acres of the project site (88%) will have runoff conveyed to either the north or south detention systems, prior to being metered out to the existing 24" storm drains at or below pre-development levels for the 2-year and 10-year peak flows. The remaining 12% of the project site includes primarily off-site area along the Latrobe Road frontage, as well as the as site entry driveways and the areas described in the preceding paragraph. The metered discharge from the north system will tie into the existing 24" storm drain passing beneath Latrobe Road immediately west of proposed Building 7. The metered discharge from the south system will tie into the existing 24" storm drain passing beneath Latrobe Road immediately west of Building 9.

In the event that the underground storm drain becomes inundated or for storm events greater than a 10-Yr intensity, overland release locations are at each of the two proposed driveways. The

overland release elevation is 1.5' lower than the lowest building finished floor elevation which satisfies the El Dorado County requirement of 1.0'.

No stormwater quality calculations for the sizing of the bioretention facilities or Filterra stormwater quality units have been included with the preliminary design. The sizing calculations for each of the bioretention facilities and Filterra stormwater quality units will be part of the final design drainage report. The calculations will be in conformance to requirements outlined in section 4.5 of the Western El Dorado SWMP and per Section 5.5 of the CASQA BMP Handbook for New and Redevelopment.

H. CONCLUSIONS

- The preliminary drainage improvements were designed as per the standards of the El Dorado County Drainage Manual and the West El Dorado County SWMP. Post-Development 2-Yr and 10-Yr peak flows will be attenuated to match Pre-Development peak flows.
- Low impact development and water quality treatment BMPs used in design to treat stormwater runoff include rooftop and impervious area disconnection, bioretention facilities and Filterra stormwater quality units. Since this site has basically no infiltration due to bedrock and engineered fill over almost all of the site, the proposed LID identified appears to be the best feasible solution for the project.
- Two overland release locations will be provided with this development; one at each driveway along Latrobe Road. The elevation of the overland release is 590.50' for each of the two overland release locations, and the lowest building elevation is set at 592.00'. This will provide over 1.0' of freeboard for overland release, thereby satisfying the El Dorado County requirement.

I. RECOMMENDATIONS

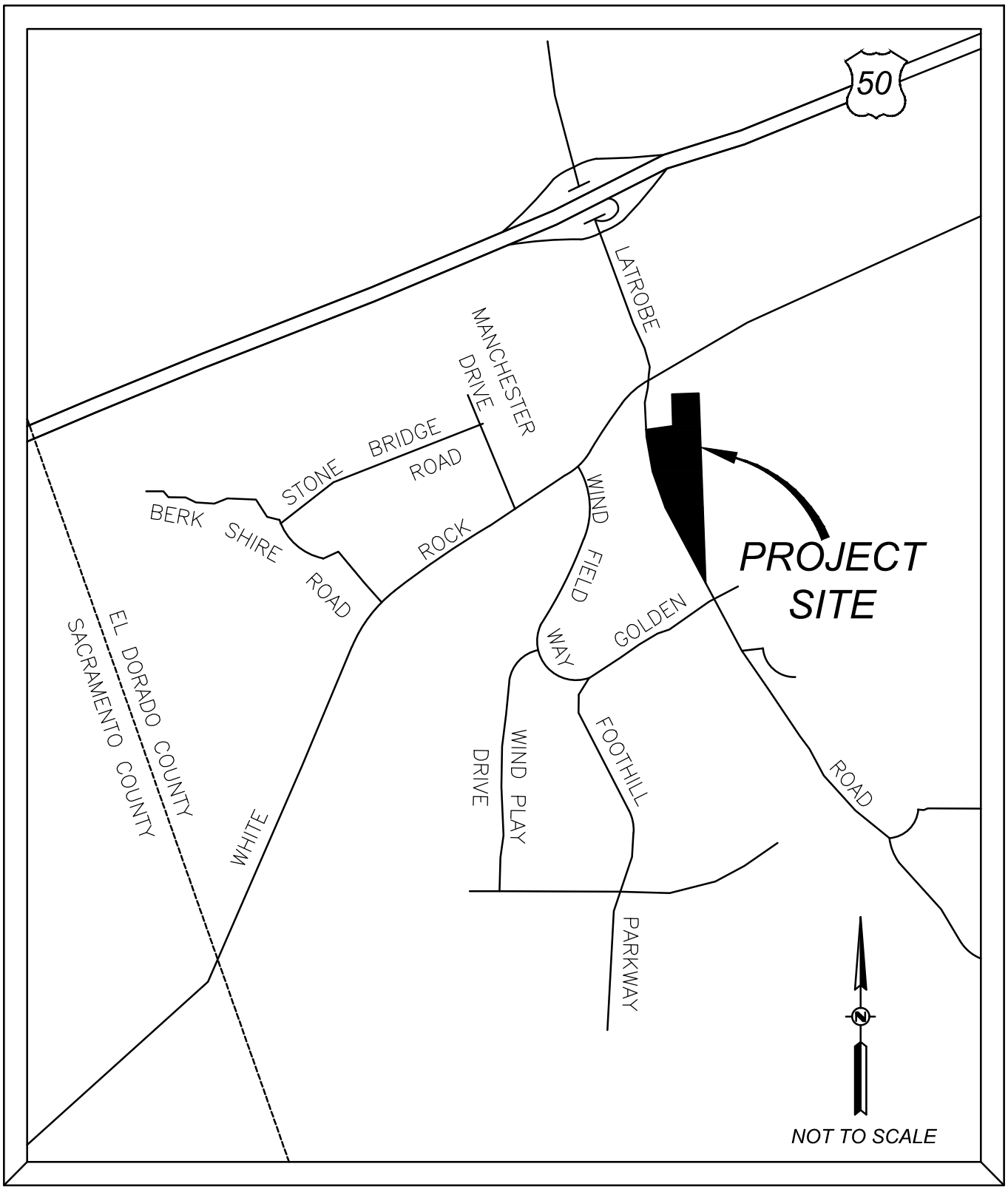
In order to accommodate the estimated future condition peak flows and existing topographic conditions, as well as to provide the best feasible water quality treatment, it is recommended that the final design and construction include grading and storm drainage improvements consistent with the Preliminary Montano De El Dorado Phase III development plans and conclusions outlined in this preliminary drainage study.

J. REFERENCES

- Autodesk Hydraflow Express Extension for AutoCAD Civil 3D 2015
- County of El Dorado Drainage Manual; Resolution No. 67-95. March 14, 1995.
- Western El Dorado County Storm Water Management Plan. August 2004
- USDA Urban Hydrology for Small Watersheds: Technical Release 55. June 1986
- USDA Natural Resources Conservation Service Web Soil Survey

APPENDIX A

VICINITY MAP AND SITE PLAN EXHIBITS



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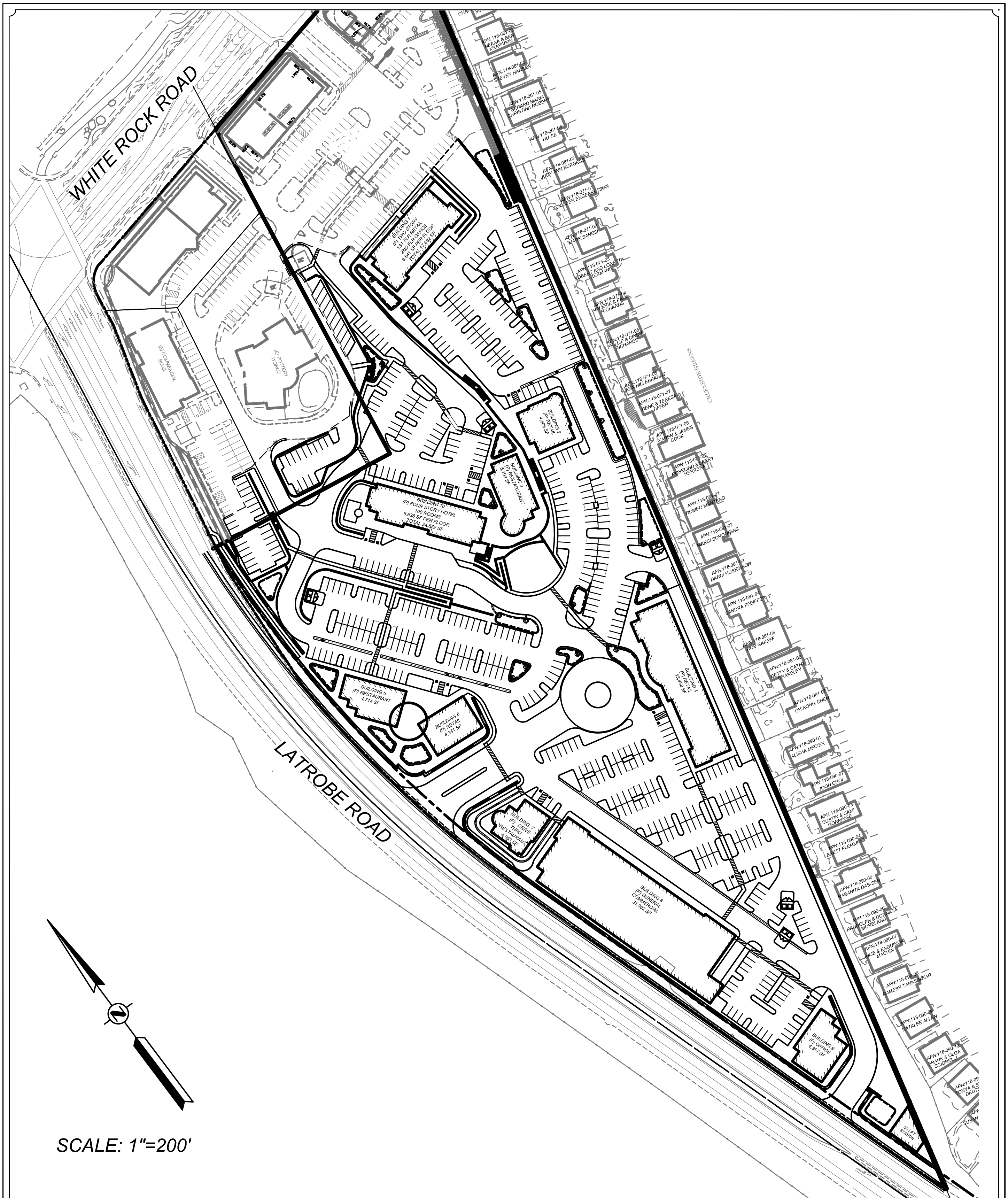
VICINITY MAP

MONTANO DE EL DORADO
APN: 118-010-12, 14, & 15
1010 WHITE ROCK ROAD
EL DORADO HILLS, CA



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SITE PLAN

MONTANO DE EL DORADO

APN: 118-010-12, 14, & 15

1010 WHITE ROCK ROAD

EL DORADO HILLS, CA

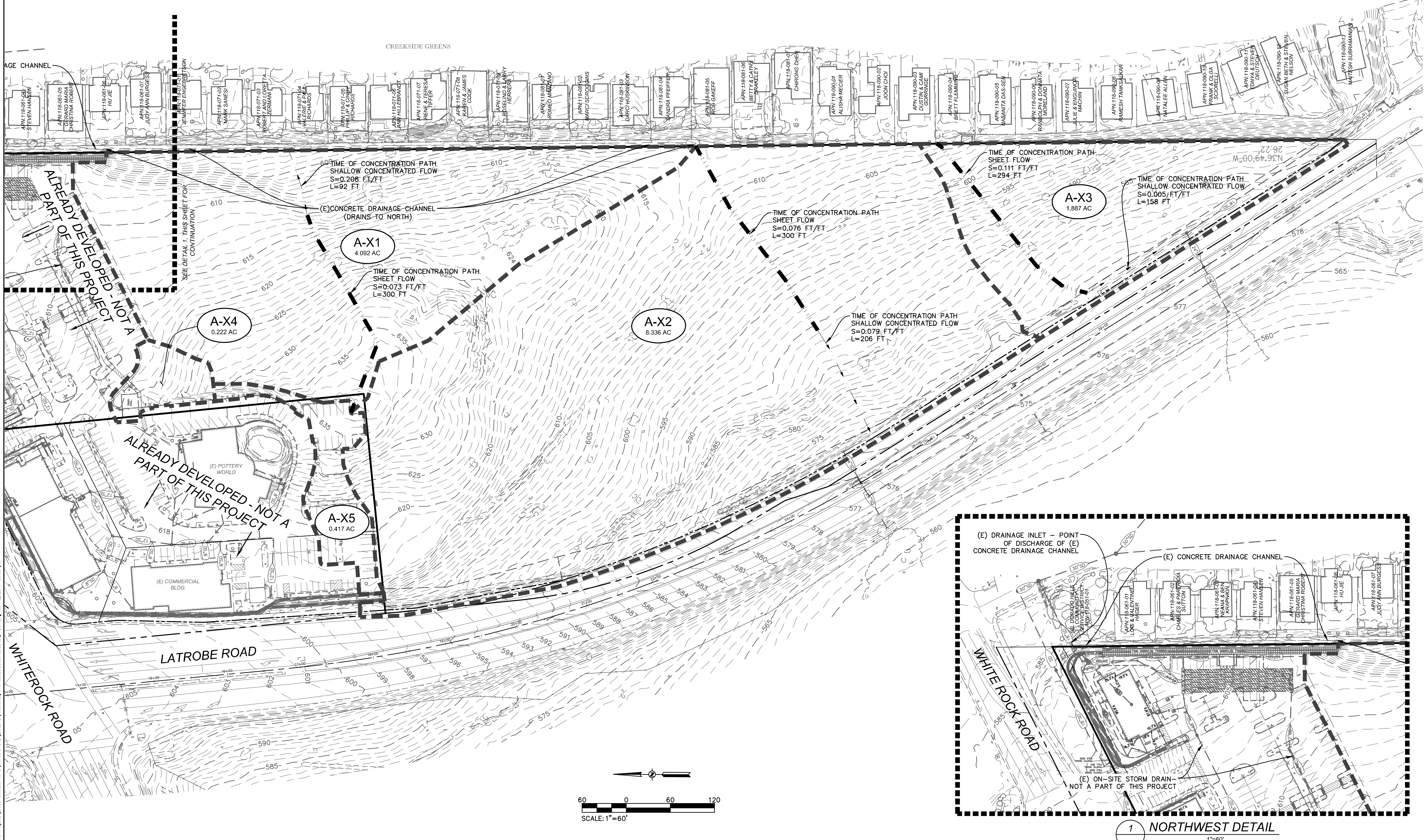
APPENDIX B

PROJECT SITE SHED MAP EXHIBITS

PRE-CONSTRUCTION SHED AREAS					
SHED	PERVIOUS (SF)	IMPERVIOUS (SF)	TOTAL (SF)	TOTAL (AC)	% IMPERVIOUS
A-X1	178,262	0	178,262	4.092	0.00
A-X2	356,073	7,031	363,104	8.336	1.94
A-X3	80,175	2,035	82,210	1.887	2.48
A-X4	8,234	1,417	9,651	0.222	14.68
A-X5	7,403	10,743	18,146	0.417	59.20
	630,147	21,226	651,373	14.953	3.26

LEGEND

- DRAINAGE AREA DESIGNATIONS AND AREA — A-X1 1.42 AC
- DRAINAGE AREA BOUNDARY
- OVERLAND RELEASE



1 NORTHWEST DETAIL 1"=60'

PRELIMINARY PLAN SET - NOT FOR CONSTRUCTION

NO.	REVISION	DATE	BY	APPR'D

	BY	CHECK
DESIGN	TSM	RPW
DRAWN	TSM	RPW
QUANT.		

ORIGINAL SCALE IS IN INCHES

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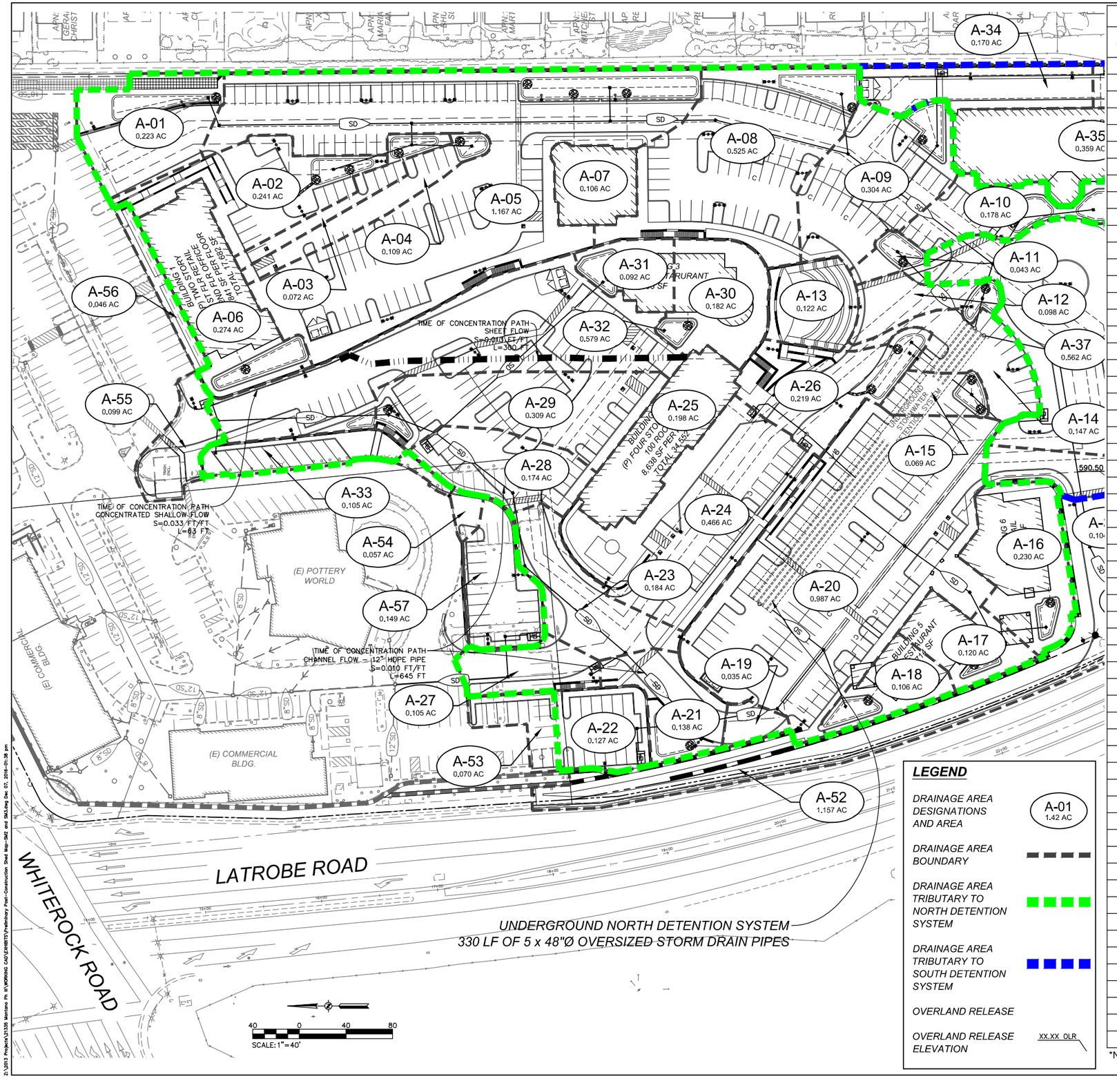
MONTANO DE EL DORADO - PHASE III
WHITEROCK ROAD
EL DORADO HILLS, CA
PRELIMINARY PRE-CONSTRUCTION SHED MAP

Drawing | Sheet
SM1
of 3 Total

11/18/2016

RFE PROJECT #21335 – MONTANO DE EL DORADO – PHASE III, EL DORADO HILLS, CA



POST-CONSTRUCTION SHED AREAS

SHED	PERVIOUS (SF)	IMPERVIOUS (SF)	TOTAL (SF)	TOTAL (AC)	% IMPERVIOUS
A-01	972	8,747	9,719	0.223	90.00
A-02	1,049	9,439	10,488	0.241	90.00
A-03	312	2,807	3,119	0.072	90.00
A-04	475	4,274	4,749	0.109	90.00
A-05	5,085	45,765	50,850	1.167	90.00
A-06	1,193	10,735	11,928	0.274	90.00
A-07	461	4,145	4,606	0.106	90.00
A-08	2,287	20,581	22,868	0.525	90.00
A-09	1,298	11,681	12,979	0.298	90.00
A-10	686	6,175	6,861	0.158	90.00
A-11	188	1,692	1,880	0.043	90.00
A-12	425	3,828	4,253	0.098	90.00
A-13	530	4,774	5,304	0.122	90.00
A-14	642	5,779	6,421	0.147	90.00
A-15	300	2,699	2,999	0.069	90.00
A-16	1,001	9,005	10,006	0.230	90.00
A-17	521	4,692	5,213	0.120	90.00
A18	462	4,155	4,617	0.106	90.00
A-19	153	1,380	1,533	0.035	90.00
A-20	4,301	38,713	43,014	0.987	90.00
A-21	599	5,393	5,992	0.138	90.00
A-22	554	4,982	5,536	0.127	90.00
A-23	802	7,220	8,022	0.184	90.00
A-24	2,029	18,263	20,292	0.466	90.00
A-25	864	7,774	8,638	0.198	90.00
A-26	954	8,582	9,535	0.219	90.00
A-27	459	4,127	4,586	0.105	90.00
A-28	757	6,812	7,569	0.174	90.00
A-29	1,346	12,117	13,463	0.309	90.00
A-30	794	7,142	7,935	0.182	90.00
A-31	402	3,620	4,022	0.092	90.00
A-32	2,523	22,710	25,233	0.579	90.00
A-33	457	4,113	4,570	0.105	90.00
A-34	742	6,676	7,418	0.170	90.00
A-35	1,563	14,064	15,627	0.359	90.00
A-36	591	5,322	5,913	0.136	90.00
A-37	2,292	20,627	22,919	0.526	90.00
A-38	3,604	32,432	36,036	0.827	90.00
A-39	454	4,085	4,539	0.104	90.00
A-40	357	3,215	3,572	0.082	90.00
A-41	406	3,657	4,063	0.093	90.00
A-42	307	2,763	3,070	0.070	90.00
A-43	3,329	29,960	33,289	0.764	90.00
A-44	245	2,209	2,454	0.056	90.00
A-45	848	7,630	8,478	0.195	90.00
A-46	3,714	33,423	37,137	0.853	90.00
A-47	313	2,818	3,131	0.072	90.00
A-48	342	3,074	3,416	0.078	90.00
A-49	1,428	12,856	14,284	0.328	90.00
A-50	927	8,347	9,274	0.213	90.00
A-51	1,736	15,626	17,362	0.399	90.00
A-52	5,215	46,938	52,153	1.197	90.00
A-53	304	2,737	3,041	0.070	90.00
A-54	247	2,219	2,466	0.057	90.00
A-55	431	3,883	4,314	0.099	90.00
A-56	201	1,808	2,009	0.046	90.00
A-57	649	5,837	6,486	0.149	90.00
	65,125	586,126	651,251	14.951	90.00

*NOTE: POST-DEVELOPED LAND COVERAGE ASSUMED TO BE 90% IMPERVIOUS

LEGEND

- DRAINAGE AREA DESIGNATIONS AND AREA — A-01, 1.42 AC
- DRAINAGE AREA BOUNDARY
- DRAINAGE AREA TRIBUTARY TO NORTH DETENTION SYSTEM
- DRAINAGE AREA TRIBUTARY TO SOUTH DETENTION SYSTEM
- OVERLAND RELEASE
- OVERLAND RELEASE ELEVATION — XX.XX OLR

NO.	REVISION	DATE	BY	APPRVD
	PRELIMINARY PLAN SET - NOT FOR CONSTRUCTION			

	BY	CHECK
DESIGN	TSM	RPW
DRAWN	TSM	RPW
QUANT.		

ORIGINAL SCALE IS IN INCHES 0 1 2

PROFESSIONAL ENGINEER * CIVIL * ROBERT P. WOOD No. C048648 Exp. 6-30-18 * STATE OF CALIFORNIA *

RFE ENGINEERING, INC
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ARROWEST PROPETIES, INC. CA
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ATTN: VINAL PERKINS
TELE:916-284-2555

MONTANO DE EL DORADO - PHASE III
WHITEROCK ROAD & LATROBE ROAD
EL DORADO HILLS, CA

PRELIMINARY

POST-CONSTRUCTION SHED MAP

Drawing — of —
Sheet SM2 of Total 3

12/06/2016

RFE PROJECT #21335 – MONTANO DE EL DORADO – PHASE III, EL DORADO HILLS, CA

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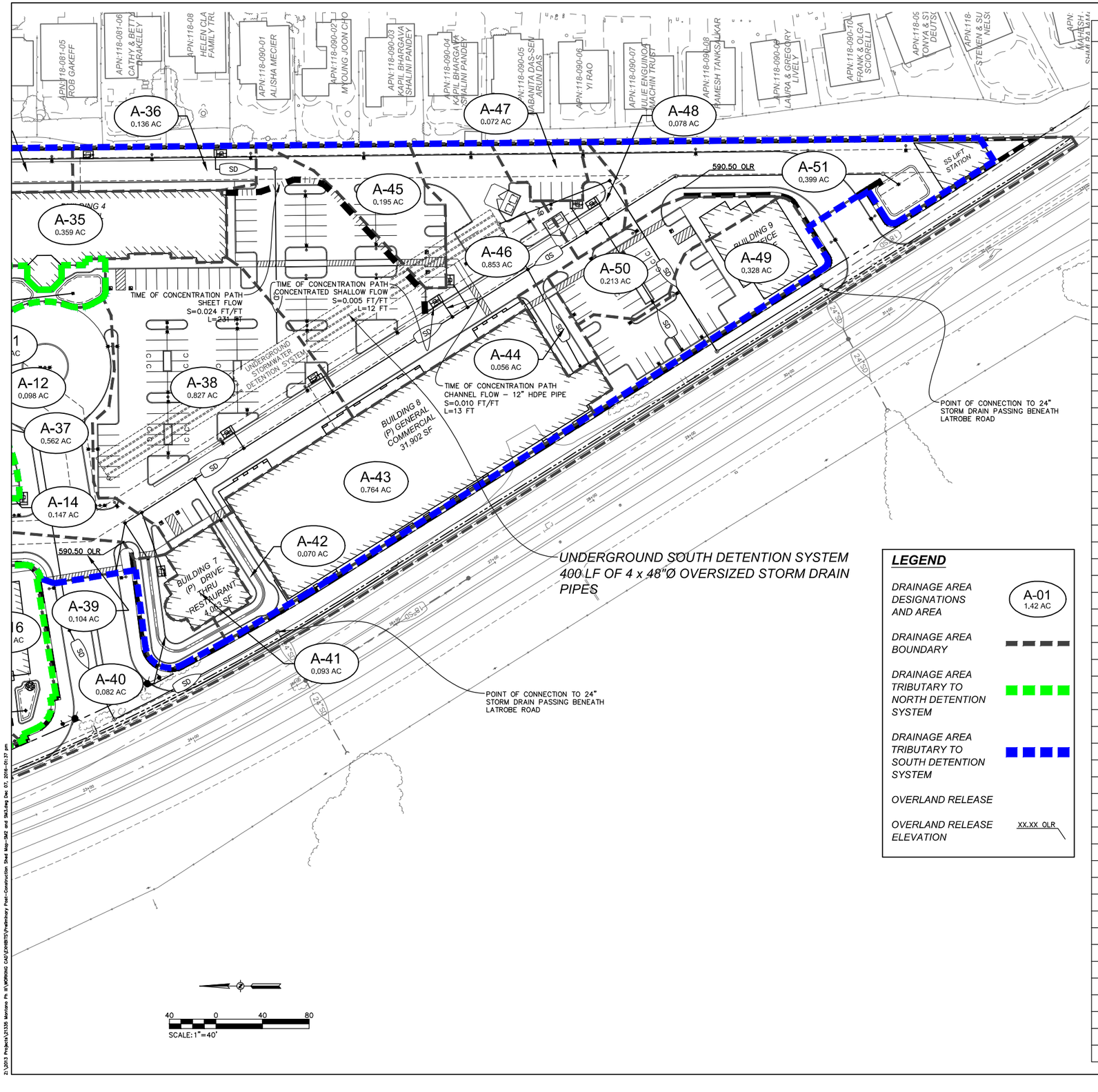

LEGEND

- DRAINAGE AREA DESIGNATIONS AND AREA — A-01, 1.42 AC
- DRAINAGE AREA BOUNDARY
- DRAINAGE AREA TRIBUTARY TO NORTH DETENTION SYSTEM
- DRAINAGE AREA TRIBUTARY TO SOUTH DETENTION SYSTEM
- OVERLAND RELEASE
- OVERLAND RELEASE ELEVATION — XX.XX OLR

POST-CONSTRUCTION SHED AREAS

SHED	PERVIOUS (SF)	IMPERVIOUS (SF)	TOTAL (SF)	TOTAL (AC)	% IMPERVIOUS
A-01	972	8,747	9,719	0.223	90.00
A-02	1,049	9,439	10,488	0.241	90.00
A-03	312	2,807	3,119	0.072	90.00
A-04	475	4,274	4,749	0.109	90.00
A-05	5,085	45,765	50,850	1.167	90.00
A-06	1,193	10,735	11,928	0.274	90.00
A-07	461	4,145	4,606	0.106	90.00
A-08	2,287	20,581	22,868	0.525	90.00
A-09	1,298	11,681	12,979	0.298	90.00
A-10	686	6,175	6,861	0.158	90.00
A-11	188	1,692	1,880	0.043	90.00
A-12	425	3,828	4,253	0.098	90.00
A-13	530	4,774	5,304	0.122	90.00
A-14	642	5,779	6,421	0.147	90.00
A-15	300	2,699	2,999	0.069	90.00
A-16	1,001	9,005	10,006	0.230	90.00
A-17	521	4,692	5,213	0.120	90.00
A18	462	4,155	4,617	0.106	90.00
A-19	153	1,380	1,533	0.035	90.00
A-20	4,301	38,713	43,014	0.987	90.00
A-21	599	5,393	5,992	0.138	90.00
A-22	554	4,982	5,536	0.127	90.00
A-23	802	7,220	8,022	0.184	90.00
A-24	2,029	18,263	20,292	0.466	90.00
A-25	864	7,774	8,638	0.198	90.00
A-26	954	8,582	9,535	0.219	90.00
A-27	459	4,127	4,586	0.105	90.00
A-28	757	6,812	7,569	0.174	90.00
A-29	1,346	12,117	13,463	0.309	90.00
A-30	794	7,142	7,935	0.182	90.00
A-31	402	3,620	4,022	0.092	90.00
A-32	2,523	22,710	25,233	0.579	90.00
A-33	457	4,113	4,570	0.105	90.00
A-34	742	6,676	7,418	0.170	90.00
A-35	1,563	14,064	15,627	0.359	90.00
A-36	591	5,322	5,913	0.136	90.00
A-37	2,292	20,627	22,919	0.526	90.00
A-38	3,604	32,432	36,036	0.827	90.00
A-39	454	4,085	4,539	0.104	90.00
A-40	357	3,215	3,572	0.082	90.00
A-41	406	3,657	4,063	0.093	90.00
A-42	307	2,763	3,070	0.070	90.00
A-43	3,329	29,960	33,289	0.764	90.00
A-44	245	2,209	2,454	0.056	90.00
A-45	848	7,630	8,478	0.195	90.00
A-46	3,714	33,423	37,137	0.853	90.00
A-47	313	2,818	3,131	0.072	90.00
A-48	342	3,074	3,416	0.078	90.00
A-49	1,428	12,856	14,284	0.328	90.00
A-50	927	8,347	9,274	0.213	90.00
A-51	1,736	15,626	17,362	0.399	90.00
A-52	5,215	46,938	52,153	1.197	90.00
A-53	304	2,737	3,041	0.070	90.00
A-54	247	2,219	2,466	0.057	90.00
A-55	431	3,883	4,314	0.099	90.00
A-56	201	1,808	2,009	0.046	90.00
A-57	649	5,837	6,486	0.149	90.00
	65,125	586,126	651,251	14.951	90.00

*NOTE: POST-DEVELOPED LAND COVERAGE ASSUMED TO BE 90% IMPERVIOUS

NO.	REVISION	DATE	BY	APPRVD
	PRELIMINARY PLAN SET - NOT FOR CONSTRUCTION			

	BY	CHECK
DESIGN	TSM	RPW
DRAWN	TSM	RPW
QUANT.		

ORIGINAL SCALE IS IN INCHES 0 1 2

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MONTANO DE EL DORADO - PHASE III
WHITEROCK ROAD & LATROBE ROAD
EL DORADO HILLS, CA

PRELIMINARY
POST-CONSTRUCTION SHED MAP

Drawing SM3 Sheet of Total 3

12/06/2016

RFE PROJECT #21335 – MONTANO DE EL DORADO – PHASE III, EL DORADO HILLS, CA

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APPENDIX C

SITE WEB SOIL SURVEY DATA

Hydrologic Soil Group—El Dorado Area, California
(Montano Ph 3)

Map Scale: 1:3,970 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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 1:20,000.

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: http://websoilsurvey.nrcs.usda.gov
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: El Dorado Area, California
Survey Area Data: Version 7, Sep 15, 2014

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

Date(s) aerial images were photographed: Aug 15, 2011—Apr 29, 2012

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

Hydrologic Soil Group— Summary by Map Unit — El Dorado Area, California (CA624)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AkC	Argonaut gravelly loam, 2 to 15 percent slopes	D	2.6	11.1%
AwD	Auburn silt loam, 2 to 30 percent slopes	D	1.4	6.0%
AxD	Auburn very rocky silt loam, 2 to 30 percent slopes	D	19.1	82.9%
Totals for Area of Interest			**23.0**	**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

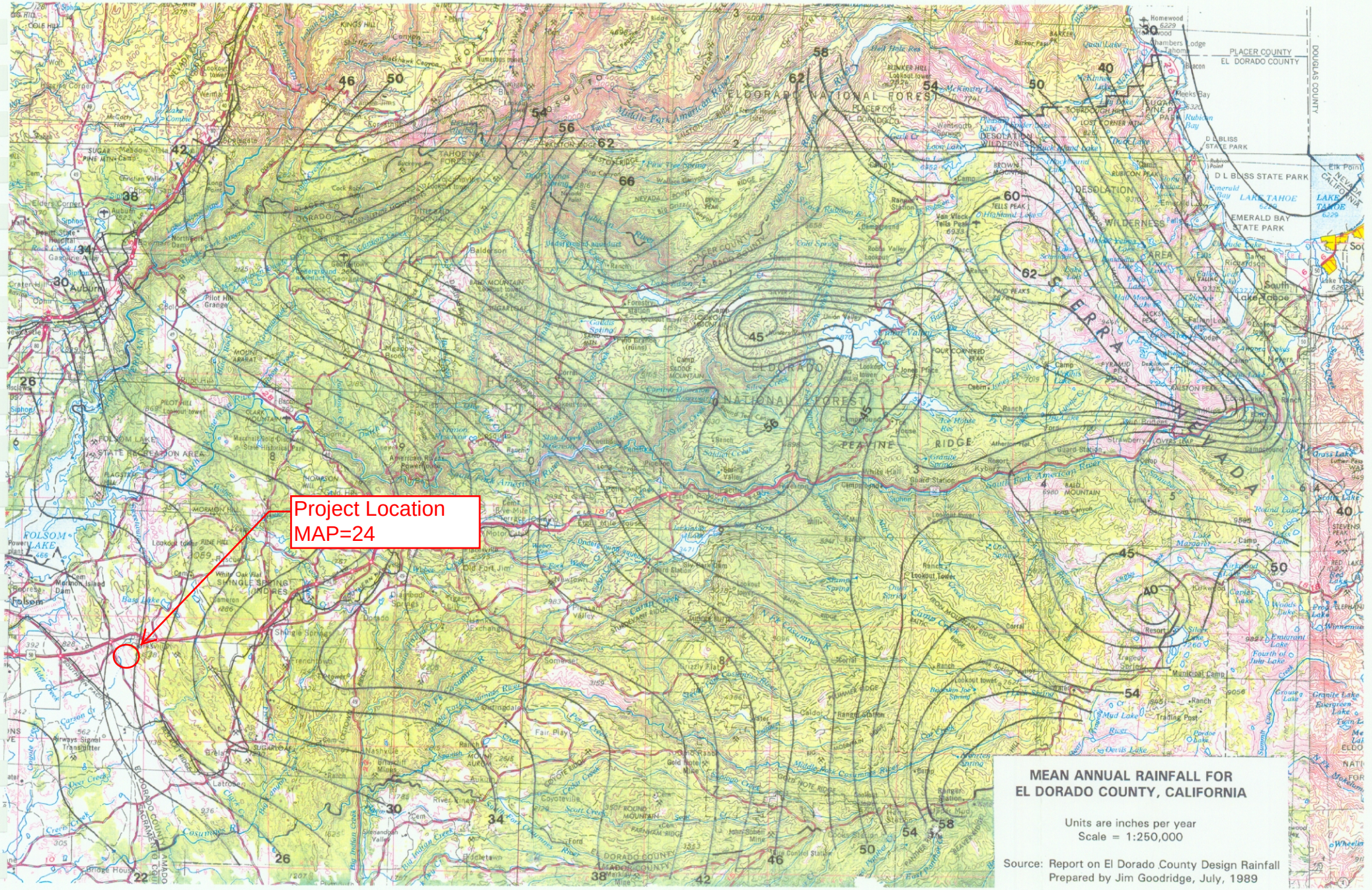
Tie-break Rule: Higher

APPENDIX D

JURISDICTIONAL DESIGN GUIDELINES

&

BMPS


Project Location
MAP=24
MEAN ANNUAL RAINFALL FOR
EL DORADO COUNTY, CALIFORNIA
Units are inches per year
Scale = 1:250,000
Source: Report on El Dorado County Design Rainfall
Prepared by Jim Goodridge, July, 1989

El Dorado Design Rainfall

Rainfall Depth in Inches for Return Period = 2.33 years

Mean Annual Precipitation	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hrs	3 Hrs	6 Hrs	12 Hrs	24 Hrs
20	0.113	0.162	0.200	0.286	0.410	0.587	0.723	1.035	1.481	2.120
22	0.120	0.172	0.212	0.304	0.435	0.623	0.768	1.099	1.572	2.249
24	0.128	0.183	0.225	0.322	0.461	0.660	0.814	1.165	1.667	2.385
26	0.135	0.193	0.238	0.341	0.488	0.698	0.860	1.231	1.762	2.521
28	0.142	0.203	0.251	0.359	0.514	0.735	0.907	1.298	1.857	2.657
30	0.149	0.214	0.264	0.377	0.540	0.773	0.953	1.364	1.952	2.793
32	0.157	0.224	0.277	0.396	0.566	0.810	1.000	1.430	2.047	2.929
34	0.164	0.235	0.289	0.414	0.593	0.848	1.046	1.497	2.142	3.065
36	0.171	0.245	0.302	0.433	0.619	0.886	1.092	1.563	2.237	3.200
38	0.179	0.256	0.315	0.451	0.645	0.923	1.139	1.629	2.332	3.336
40	0.186	0.266	0.328	0.469	0.671	0.961	1.185	1.696	2.426	3.472
42	0.193	0.276	0.341	0.488	0.698	0.998	1.231	1.762	2.521	3.608
44	0.200	0.287	0.354	0.506	0.724	1.036	1.278	1.828	2.616	3.744
46	0.208	0.297	0.366	0.524	0.750	1.074	1.324	1.895	2.711	3.880
48	0.215	0.308	0.379	0.543	0.777	1.111	1.370	1.961	2.806	4.016
50	0.222	0.318	0.392	0.561	0.803	1.149	1.417	2.027	2.901	4.152
52	0.229	0.328	0.405	0.579	0.829	1.186	1.463	2.094	2.996	4.287
54	0.237	0.339	0.418	0.598	0.855	1.224	1.510	2.160	3.091	4.423
56	0.244	0.349	0.431	0.616	0.882	1.262	1.556	2.226	3.186	4.559
58	0.251	0.360	0.443	0.634	0.908	1.299	1.602	2.293	3.281	4.695
60	0.259	0.370	0.456	0.653	0.934	1.337	1.649	2.359	3.376	4.831
62	0.266	0.380	0.469	0.671	0.960	1.374	1.695	2.425	3.471	4.967
64	0.273	0.391	0.482	0.690	0.987	1.412	1.741	2.492	3.566	5.103
66	0.280	0.401	0.495	0.708	1.013	1.450	1.788	2.558	3.661	5.238
68	0.288	0.412	0.508	0.726	1.039	1.487	1.834	2.625	3.756	5.374
70	0.295	0.422	0.520	0.745	1.066	1.525	1.880	2.691	3.851	5.510
72	0.302	0.432	0.533	0.763	1.092	1.562	1.927	2.757	3.946	5.646
74	0.309	0.443	0.546	0.781	1.118	1.600	1.973	2.824	4.040	5.782
76	0.317	0.453	0.559	0.800	1.144	1.638	2.020	2.890	4.135	5.918
78	0.324	0.464	0.572	0.818	1.171	1.675	2.066	2.956	4.230	6.054
80	0.331	0.474	0.585	0.836	1.197	1.713	2.112	3.023	4.325	6.189
82	0.339	0.484	0.597	0.855	1.223	1.750	2.159	3.089	4.420	6.325
84	0.346	0.495	0.610	0.873	1.250	1.788	2.205	3.155	4.515	6.461
86	0.353	0.505	0.623	0.892	1.276	1.826	2.251	3.222	4.610	6.597
88	0.360	0.516	0.636	0.910	1.302	1.863	2.298	3.288	4.705	6.733
90	0.368	0.526	0.649	0.928	1.328	1.901	2.344	3.354	4.800	6.869

Source: Design Rainfall Tables for El Dorado County, prepared by Jim Goodridge, July 29, 1989

El Dorado Design Rainfall

Rainfall Depth in Inches for Return Period = 10 years

Mean Annual Precipitation	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hrs	3 Hrs	6 Hrs	12 Hrs	24 Hrs
20	0.167	0.239	0.295	0.422	0.603	0.863	1.065	1.524	2.180	3.120
22	0.177	0.254	0.313	0.448	0.640	0.916	1.130	1.617	2.314	3.311
24	0.188	0.269	0.332	0.475	0.679	0.972	1.198	1.715	2.454	3.511
26	0.199	0.284	0.350	0.502	0.718	1.027	1.267	1.812	2.594	3.711
28	0.209	0.300	0.369	0.529	0.756	1.082	1.335	1.910	2.733	3.911
30	0.220	0.315	0.388	0.556	0.795	1.138	1.403	2.008	2.873	4.111
32	0.231	0.330	0.407	0.583	0.834	1.193	1.471	2.105	3.013	4.311
34	0.241	0.345	0.426	0.610	0.872	1.248	1.540	2.203	3.153	4.511
36	0.252	0.361	0.445	0.637	0.911	1.304	1.608	2.301	3.292	4.711
38	0.263	0.376	0.464	0.664	0.950	1.359	1.676	2.398	3.432	4.911
40	0.274	0.391	0.483	0.691	0.988	1.414	1.744	2.496	3.572	5.111
42	0.284	0.407	0.502	0.718	1.027	1.470	1.813	2.594	3.712	5.311
44	0.295	0.422	0.520	0.745	1.066	1.525	1.881	2.691	3.851	5.511
46	0.306	0.437	0.539	0.772	1.104	1.580	1.949	2.789	3.991	5.711
48	0.316	0.453	0.558	0.799	1.143	1.636	2.017	2.887	4.131	5.911
50	0.327	0.468	0.577	0.826	1.182	1.691	2.086	2.984	4.271	6.111
52	0.338	0.483	0.596	0.853	1.221	1.747	2.154	3.082	4.410	6.311
54	0.348	0.499	0.615	0.880	1.259	1.802	2.222	3.180	4.550	6.511
56	0.359	0.514	0.634	0.907	1.298	1.857	2.290	3.277	4.690	6.711
58	0.370	0.529	0.653	0.934	1.337	1.913	2.359	3.375	4.830	6.911
60	0.381	0.545	0.672	0.961	1.375	1.968	2.427	3.473	4.969	7.111
62	0.391	0.560	0.690	0.988	1.414	2.023	2.495	3.570	5.109	7.311
64	0.402	0.575	0.709	1.015	1.453	2.079	2.563	3.668	5.249	7.511
66	0.413	0.591	0.728	1.042	1.491	2.134	2.632	3.766	5.389	7.711
68	0.423	0.606	0.747	1.069	1.530	2.189	2.700	3.863	5.528	7.911
70	0.434	0.621	0.766	1.096	1.569	2.245	2.768	3.961	5.668	8.111
72	0.445	0.636	0.785	1.123	1.607	2.300	2.836	4.059	5.808	8.311
74	0.455	0.652	0.804	1.150	1.646	2.355	2.905	4.156	5.948	8.511
76	0.466	0.667	0.823	1.177	1.685	2.411	2.973	4.254	6.087	8.711
78	0.477	0.682	0.842	1.204	1.723	2.466	3.041	4.352	6.227	8.911
80	0.488	0.698	0.860	1.231	1.762	2.521	3.109	4.449	6.367	9.111
82	0.498	0.713	0.879	1.258	1.801	2.577	3.178	4.547	6.507	9.311
84	0.509	0.728	0.898	1.285	1.839	2.632	3.246	4.645	6.646	9.511
86	0.520	0.744	0.917	1.312	1.878	2.687	3.314	4.742	6.786	9.711
88	0.530	0.759	0.936	1.339	1.917	2.743	3.382	4.840	6.926	9.911
90	0.541	0.774	0.955	1.366	1.955	2.798	3.451	4.938	7.066	10.111

Source: Design Rainfall Tables for El Dorado County, prepared by Jim Goodridge, July 29, 1989

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

Pre-Development

Post-Development

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

West Slope Development and Redevelopment Standards and Post Construction Storm Water Plan Requirements

All qualifying cities and counties in California must comply with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit administered by the State Water Resources Control Board and the nine Regional Boards beneath it. The unincorporated portion of El Dorado County's west slope is covered under a Phase II NPDES permit, which became effective on July 1, 2013. By July 1, 2015, this state mandated permit requires the County to address storm water runoff from new development and redevelopment projects, both during construction and after construction occurs. Projects subject to the requirements, as outlined below, must submit the appropriate Post Construction Storm Water Plan based on the project type. For additional El Dorado County NPDES information, please view the El Dorado County Storm Water Homepage.

Project Type 1: Exempt from Post Construction Requirements

Project Definition:

- **Projects that create or replace less than 2,500 square feet of impervious surface**
- **Linear Utility Projects that create less than 5,000 square feet of impervious surface**

Project Considerations	Your Submittal	MS4 Permit Reference
1. Limit clearing, grading and soil compaction. 2. Minimize impervious surfaces. 3. Direct runoff to landscaping and/or use porous pavements. 4. Conserve natural areas as much as possible consistent with local General Plan. 5. Comply with County slope and stream setback ordinances/requirements. 6. Comply with Chapter 15.14 El Dorado County Grading, Erosion, and Sediment Control Ordinance.	1. Refer to El Dorado County Building Services for Plan and application submittal requirements: http://www.edcgov.us/Building/.	N/A

Project Type 2: Small Projects and Single Family Homes

Project Definition: Projects that create or replace between 2,500 and 4,999 square feet of **impervious surface** . ~~Linear utility projects are exempt. Additionally, projects that have been submitted prior to July 1, 2015 are exempt.~~

Small and Single Family Home Projects do not include interior remodels, routine maintenance or repair such as: roof or exterior surface replacement, pavement resurfacing, and repaving within the existing footprint. Decks designed with spacing between boards can be excluded from the tally of impervious surface.

Project Requirements	Your Submittal	MS4 Permit Reference

1. Implement Exempt Project considerations. 2. Implement and direct water to one or more Site Design Measures. Click here for El Dorado County's Site Design Measures requirements.	1. Refer to El Dorado County Building Services for Plan and application submittal requirements: http://www.edcgov.us/Building/. 2. Complete Step 1 Table from the Site Design Measures Manual. 3. Include proposed impervious surface area and Site Design Measure(s) on your Site Plans (refer to the Site Design Measures Manual for guidance).	Section E.12.b. Site Design Measures (pages 48 and 49)

Project Type 3: Regulated Projects

Project Definition: Projects other than **single family homes** (unless they are part of a larger Common Plan of Development) that create or replace 5,000 square feet or more of **impervious surface** . **Single family homes** shall meet the above Project Type 2 requirements. Regulated projects do not include interior remodels, routine maintenance or repair such as: roof or exterior surface replacement, pavement resurfacing, and repaving within the existing footprint. Decks designed with spacing between boards can be excluded from the tally of impervious surface.

Project Requirements	Your Submittal	MS4 Permit Reference
1. Implement Exempt Project considerations. 2. Implement Site Design Measures provided above for Type 2 Projects. 3. Remaining runoff from the 85th percentile 24-hour storm event (~1 inch of water) shall be directed to one or more Storm Water Treatment and Baseline Hydromodification Measures using volumetric and/or flow-based sizing criteria. 4. Identify potential sources of pollutants and implement corresponding source control measures. Click here to access CASQA Source Control BMP Fact Sheets. 5. Provide ongoing maintenance of water retention and treatment facilities.	1. Refer to El Dorado County Building Services for plan and application submittal requirements: http://www.edcgov.us/Building/. 2. Site Plans showing Drainage Management Areas (DMAs), proposed impervious surface areas, Site Design Measures, Source Controls and Storm Water Treatment and Baseline Hydromodification Measures that are planned to be implemented on the site. 3. Calculations demonstrating 85th percentile 24-hour storm event capture and treatment for each DMA (can be included in a Drainage Report).	Section E.12.c. Regulated Projects through Section E.12.e. Low Impact Development (LID) Design Standards (pages 49 -55)

Project Type 4: Roads and Linear Underground/Overhead Projects (LUPs) (i.e., gas, water, sewer, and overhead power lines)

Project Definition: Projects that create 5,000 square feet or more of newly constructed contiguous **impervious surface** . Review MS4 Section E.12.c.(c) for specific exclusions.

Project Requirements	Your Submittal	MS4 Permit Reference

1. Implement Exempt Project considerations. 2. Implement Regulated Project requirements. Requirements for Roads and Linear Utility Projects can vary. Refer to Section E.12.c.(c) of the MS4 Permit to review variations.	1. Same as Regulated Projects. Refer to Section E.12.c.(c) of the MS4 Permit to review variations. This project	Same as Regulated Projects

Project Type 5: Hydromodifications Projects		
Project Definition: Projects that create or replace one acre or more of **impervious surface.**		
Project Requirements	**Your Submittal**	**MS4 Permit Reference**
1. Implement Exempt Project considerations. 2. Implement Regulated Project Requirements. 3. Implement Hydromodification Management Measures. Refer to Section E.12.f. of the MS4 Permit to review variations.	1. Same as Regulated Projects. 2. Verification showing post project flows will not exceed pre-project flow rate for the 2-year, 24-hour storm (can be included in a Drainage Report).	Section E.12.c. Regulated Projects through Section E.12.f. Hydromodification Management (pages 49 -57)

For questions or comments about the Storm Water Management Program or Post Construction Storm Water requirements please click here or contact:

El Dorado County Long Range Planning Division
2850 Fairlane Court, Placerville, CA 95667
(530) 573-7906 / stormwater@edcgov.us

Facebook Page: http://www.facebook.com/EDCStormwater

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

✓	Sediment	■
✓	Nutrients	▲
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■

Legend ***(Removal Effectiveness)***

- ● Low
- ▲ Medium
- ■ High

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

CASQA California Stormwater Quality Association

be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

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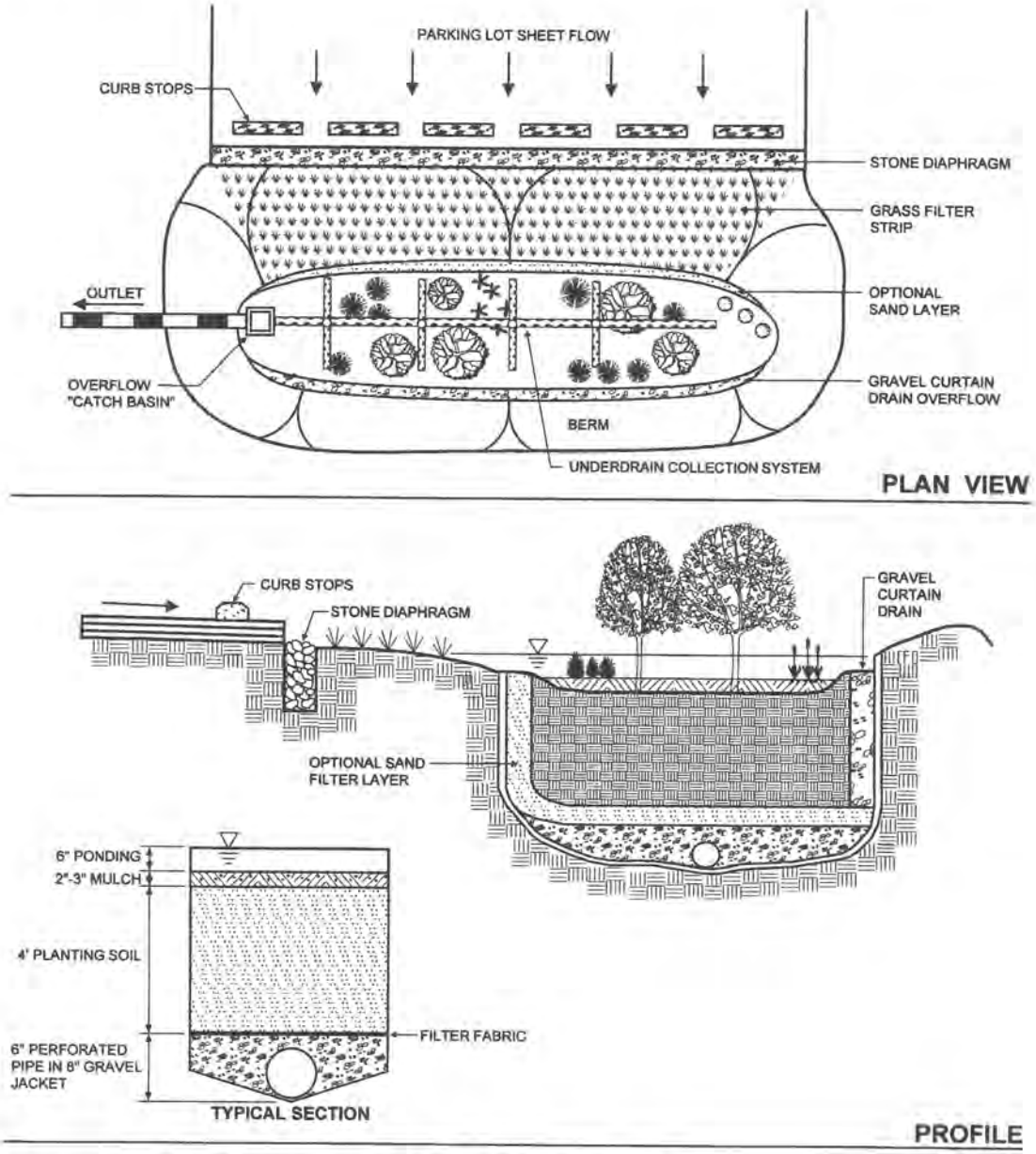


Schematic of a Bioretention Facility (MDE, 2000)



CONTECH®
ENGINEERED SOLUTIONS

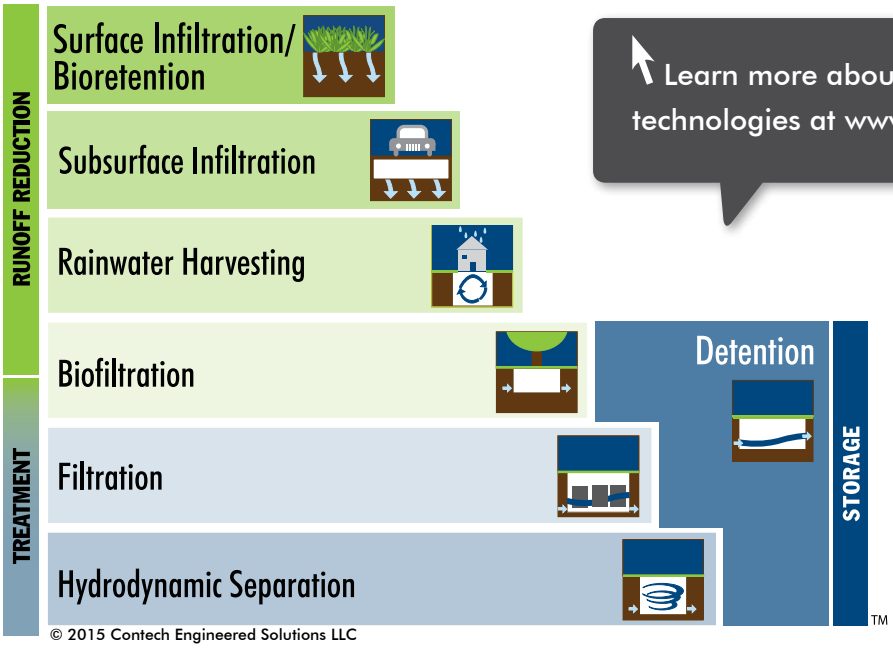
Filterra® Bioretention System

Solutions Guide

Stormwater Solutions from Contech

Selecting the Right Stormwater Solution Just Got Easier...

It's simple to choose the right stormwater solution to achieve your goals with the Contech Stormwater Solutions Staircase. First, select the runoff reduction practices that are most appropriate for your site, paying particular attention to pretreatment needs. If the entire design storm cannot be retained, select a treatment best management practice (BMP) for the balance. Finally, select a detention system to address any outstanding downstream erosion.



Learn more about all of our stormwater technologies at www.ContechES.com/stormwater

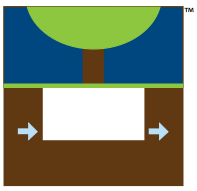
Low Impact Development Site Planner

The Low Impact Development (LID) Site Planner is a free, web-based tool intended to guide you in preliminary selection of the most effective and likely to be approved stormwater control measures that are technically feasible given known site constraints. To utilize this tool, visit www.conteches.com/lidsiteplanner

Benefits of the tool include:

- A fast, easy-to-use tool that follows a Low Impact Development design approach consistent with regulations that prioritize Green Infrastructure.
- Helps minimize the cost and delay of redesigns by prompting users to consider a wide range of common site constraints early in the design process.
- Captures specific site conditions precluding the use of infeasible BMPs.
- Allows flexibility to select flow through treatment controls where runoff reduction is not feasible.
- Provides a summary report with links to design guides, standard details, and specifications for stormwater management approaches that are likely to be feasible and approved on the project.

Bioretention as a Stormwater Management Strategy



Filtration and Biological Treatment in One System

Stormwater management regulations such as Low Impact Development (LID) and Green Infrastructure (GI) have proliferated throughout the United States.

Implementing LID and GI in urban environments is challenging, as they often require a large footprint. That doesn't mean LID/GI is not possible, it just means the solution may take a more engineered form. Contech has addressed this need by developing a unique solution – the Filterra Bioretention System.

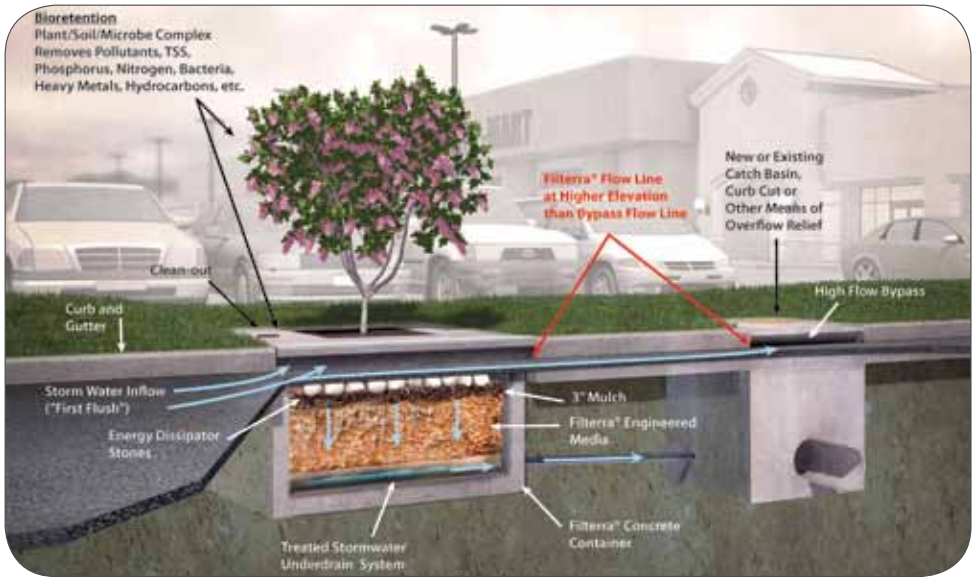
What is Filterra?

Filterra is an engineered biofiltration device with components that make it similar to bioretention in pollutant removal and application, but has been optimized for high volume/flow treatment in a compact system. Its small footprint allows Filterra to be used on highly developed sites such as landscaped areas, parking lots, and streetscapes. Filterra is adaptable and can be used alone or in combination with perforated pipes or chambers to optimize runoff reduction.

How The Standard Offline Filterra Systems Works

Stormwater runoff enters the Standard Offline Filterra system through a curb-inlet opening and flows through a specially designed filter media mixture contained in a landscaped modular container. The biofiltration media captures and immobilizes pollutants; some of these pollutants are then decomposed, volatilized and incorporated into the biomass of the Filterra system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. The Standard Offline Filterra system utilizes a downstream catch basin or curb inlet for bypass flows allowing for the shallowest profile and most flexible design of any of the Filterra configurations.

In areas where runoff reduction and infiltration are mandated or desirable, Filterra can be paired with other Contech products such as ChamberMaxx or an Urban Green Rainwater Harvesting system to provide even greater alignment with LID/GI goals.



Learn more at www.ContechES.com/filterra

Filterra® Features & Benefits

- **Regulatory Compliance** – Multiple third-party field tests confirmed Filterra meets regulatory requirements for pollutant removal under TAPE, TARP, and NJCAT testing.
- **Value** – Filterra offers a cost effective stormwater treatment system featuring easy installation and simple maintenance.
- **Aesthetics** – Landscaping enhances the appearance of your site making it more attractive while removing pollutants.
- **Flexible** – Multiple sizes and a variety of configurations available to meet site-specific needs.
- **Versatile** – Filterra is ideal for both new construction and urban retrofits, as well as:
  - » Streetscapes
  - » Urban settings
  - » Parking lots
  - » Roof drains
  - » Highways
- **Easy Installation** – Delivered on-site, ready to lift and place.
- **Activation** – Performed by Contech-certified providers to ensure effective performance from the start.
- **Maintenance** – Simple and safe (no confined space access), and the first year of maintenance is included with the purchase of every system.

Third-party field testing confirmed Filterra meets regulatory requirements for pollutant removal under nationally recognized TAPE, TARP, and NJCAT testing protocols.

Additional Filterra® Configurations

Filterra is offered in multiple configurations to meet site specific needs. These configurations make Filterra a versatile yet effective stormwater BMP with a low life-cycle cost.

Filterra Internal Bypass – Curb

The Filterra Internal Bypass – Curb incorporates a curb inlet treatment chamber and internal high flow bypass in a single structure. This eliminates the need for a separate bypass structure and enables placement on grade or in a "sag" or "sump" condition.

Filterra Internal Bypass – Pipe

The Filterra Internal Bypass – Pipe treats stormwater runoff from rooftops or other sub-grade sources such as area drains. Higher flows bypass the biofiltration treatment system via an overflow/bypass pipe design.

Filterra - Street Tree

The Filterra Street Tree accommodates trees larger than the standard small-medium-sized trees used in standard Filterra units. These larger trees can provide benefits to site landscape designs on canopy cover, tree count, or percentage of green area.

Filterra – Sediment Chamber

The Filterra Sediment Chamber includes a pre-treatment chamber that provides settling for debris and sediment, meeting water quality volume temporary hold requirements in some jurisdictions, and provides a treatment-train feature to a standard Filterra.

Filterra – Recessed Top

The Filterra Recessed Top allows for a seamless integration of Filterra into the landscape design with pavers, mulch, sod, or even architectural concrete.

Learn more at www.ContechES.com/filterra

Filterra® Media – Proven Pollutant Removal

At the heart of the Filterra system is Filterra engineered biofiltration media; a specified gradation of washed aggregate and organic material homogeneously blended under strict quality controlled conditions. Using data from independent, third-party studies including the University of Virginia (TARP), Herrera Environmental Consultants (TAPE), Terraphase Engineering (NJCAT), North Carolina State University (TAPE & TARP) and Geosyntec Consultants, the filter media has been optimized to operate under high flow rates while maintaining pollutant removal performance. Filterra media is tested for hydraulic functionality, fertility, and particle size distribution to ensure uniform performance.

Filterra media also supports a vegetation component consisting of grasses, shrubs, or trees that assist with the adsorption of pollutants with biological uptake/storage and pollutant consumption by microbes within the plant root zone.

Measured Pollutant Removal Performance

(Ranges varying with particle size, pollutant loading and site conditions)

TSS Removal	85%
Phosphorus Removal	70%
Nitrogen Removal	43%
Total Copper Removal	58%
Dissolved Copper Removal	46%
Total Zinc Removal	66%
Dissolved Zinc Removal	58%
Oil & Grease	93%

Information on the pollutant removal efficiency of the filter media/plant media is based on third-party lab and field studies.

Some jurisdictions recognize higher removal rates - see your Contech Stormwater Consultant for details.

Filterra media has been **optimized** to operate under high flow rates while maintaining pollutant removal performance.

Filterra® – Regulatory Approvals

Based on more than 20 years of research and development, testing and field monitoring, Filterra's performance has been recognized by some of the nation's most significant regulatory agencies, including the states of Washington, Virginia, Maryland and New Jersey, the District of Columbia, the Texas Commission on Environmental Quality and the Atlanta (GA) Regional Commission. Highlights regarding these approvals include:

- Granted ESD (Environmental Site Design) status by the state of Maryland Department of the Environment (MDE).
- GULD-approved for ALL pollutants of concern with the state of Washington Department of Ecology (WA-Ecology) with (2) TAPE field tests.
- Third-party nationally recognized field/lab tests completed: (1) TARP, (2) TAPE, (1) NJCAT and (1) NC-DENR.

Filterra® – In the Field

We make it easy! The Filterra system is delivered to the job site with all components except plant and mulch.

Filterra – Installation

- Bioretention system sealed from construction sediment.
- Contractor off-loads top and vault separately.
- Set vault to grade on 6" compacted #57, pipe up, backfill, set top.

Filterra – Activation

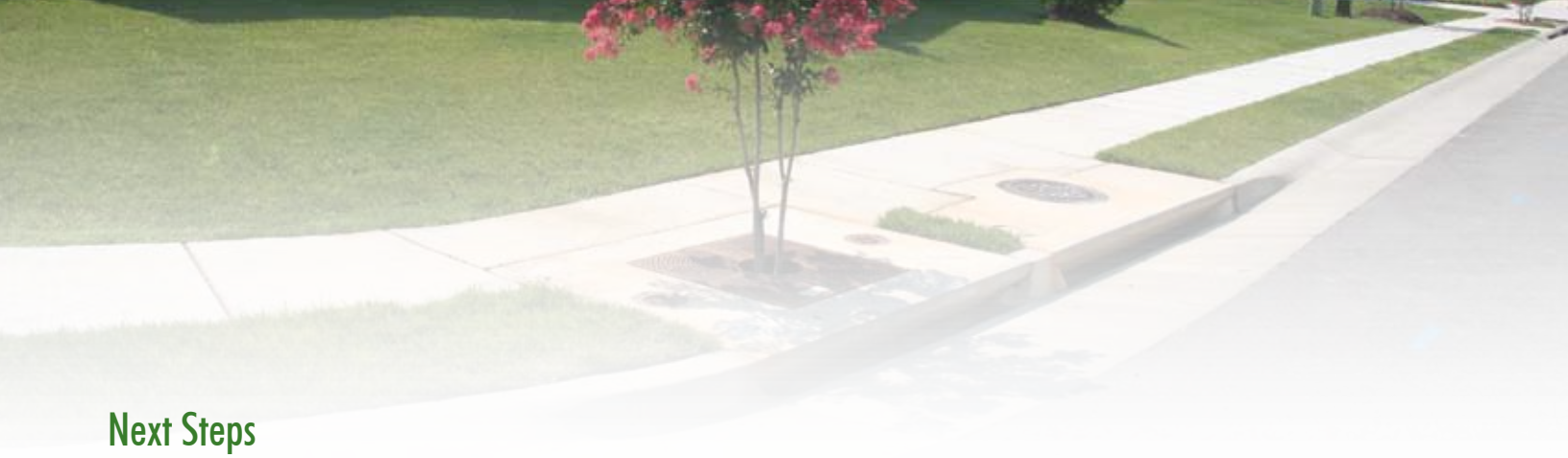
- Contractors: Do NOT remove throat plate nor tree grate covers.
- Vegetation selection guidance based on your climate zone.
- Contech-certified providers conduct on-site activation with installation of mulch and plant.

Filterra – Maintenance

- The first year of maintenance is included with every system.
- Maintenance is low-cost, low-tech and simple:
  - » Remove trash, sediment, and mulch.
  - » Replace with a fresh layer of 3" of mulch.
  - » Can be done by landscape contractor.
  - » No confined space entry.

The **first year of maintenance** is **included** with the purchase of every Filterra system.

Learn more at www.ContechES.com/filterra



Next Steps

Dig Deeper

Find all the information you need at www.ContechES.com, including field and laboratory test results, approvals, brochures, design guides, standard details and specifications within the product section of our site.

Connect with Us

We're here to make your job easier – and that includes being able to get in touch with us when you need to. www.ContechES.com/localresources.

While you're there, be sure to check out our upcoming seminar schedule or request an in-house technical presentation.

Start a Project

If you are ready to begin a project, contact your local representative to get started. Or you can check out our design toolbox for all our online resources at www.ContechES.com/startaproject.

Links to Stormwater Design Tools:

To use the Land Value Calculator, visit: www.ContechES.com/lvc

To use the Design Your Own Detention System tool, visit: www.ContechES.com/dyods

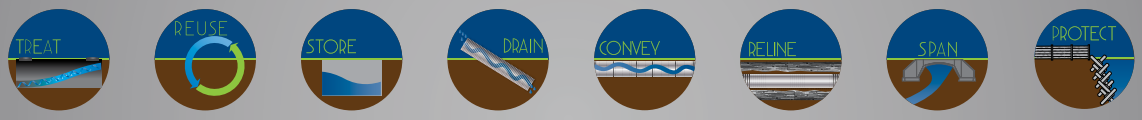
To use the Design Your Own Hydrodynamic Separator tool, visit: www.ContechES.com/dyohds

To use the Rainwater Harvesting Runoff Reduction Calculator tool, visit: www.ContechES.com/rwh-calculator

To use the Low Impact Development Site Planner tool, visit: www.ContechES.com/lidsiteplanner

CONTECH® ENGINEERED SOLUTIONS

COMPLETE SITE SOLUTIONS



STORMWATER SOLUTIONS

Helping to satisfy stormwater management requirements on land development projects

- Stormwater Treatment
- Detention/Infiltration
- Rainwater Harvesting
- Biofiltration/Bioretention

PIPE SOLUTIONS

Meeting project needs for durability, hydraulics, corrosion resistance, and stiffness

- Corrugated Metal Pipe (CMP)
- Steel Reinforced Polyethylene (SRPE)
- High Density Polyethylene (HDPE)
- Polyvinyl Chloride (PVC)

STRUCTURES SOLUTIONS

Providing innovative options and support for crossings, culverts, and bridges

- Plate, Precast & Truss bridges
- Hard Armor
- Retaining Walls
- Tunnel Liner Plate

Get Social With Us!

Filterra Brochure 3M 1/16

CONTECH® ENGINEERED SOLUTIONS

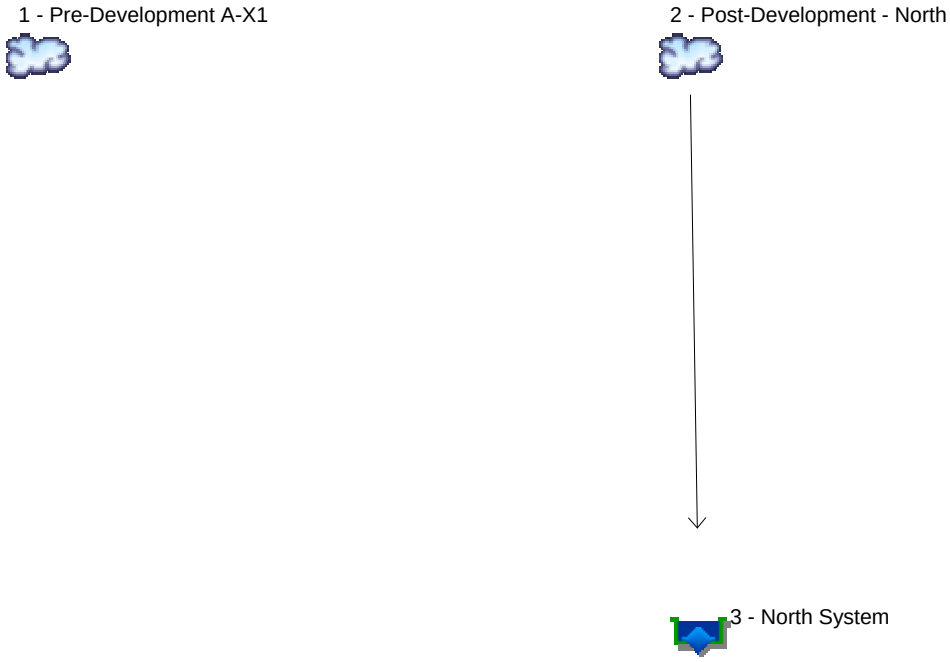
We print our brochures entirely on Forest Stewardship Council certified paper. FSC certification ensures that the paper in our brochures contain fiber from well-managed and responsibly harvested forests that meet strict environmental and socioeconomic standards.

FSC

APPENDIX E

RUNOFF CALCULATIONS

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development A-X1
2	SCS Runoff	Post-Development - North
3	Reservoir	North System

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	5.600	-------	-------	12.41	-------	-------	-------	Pre-Development A-X1
2	SCS Runoff	------	-------	12.21	-------	-------	18.83	-------	-------	-------	Post-Development - North
3	Reservoir	2	-------	2.008	-------	-------	7.098	-------	-------	-------	North System

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.600	2	610	45,765	------	------	------	Pre-Development A-X1
2	SCS Runoff	12.21	2	596	53,123	------	------	------	Post-Development - North
3	Reservoir	2.008	2	624	50,959	2	103.29	16,975	North System

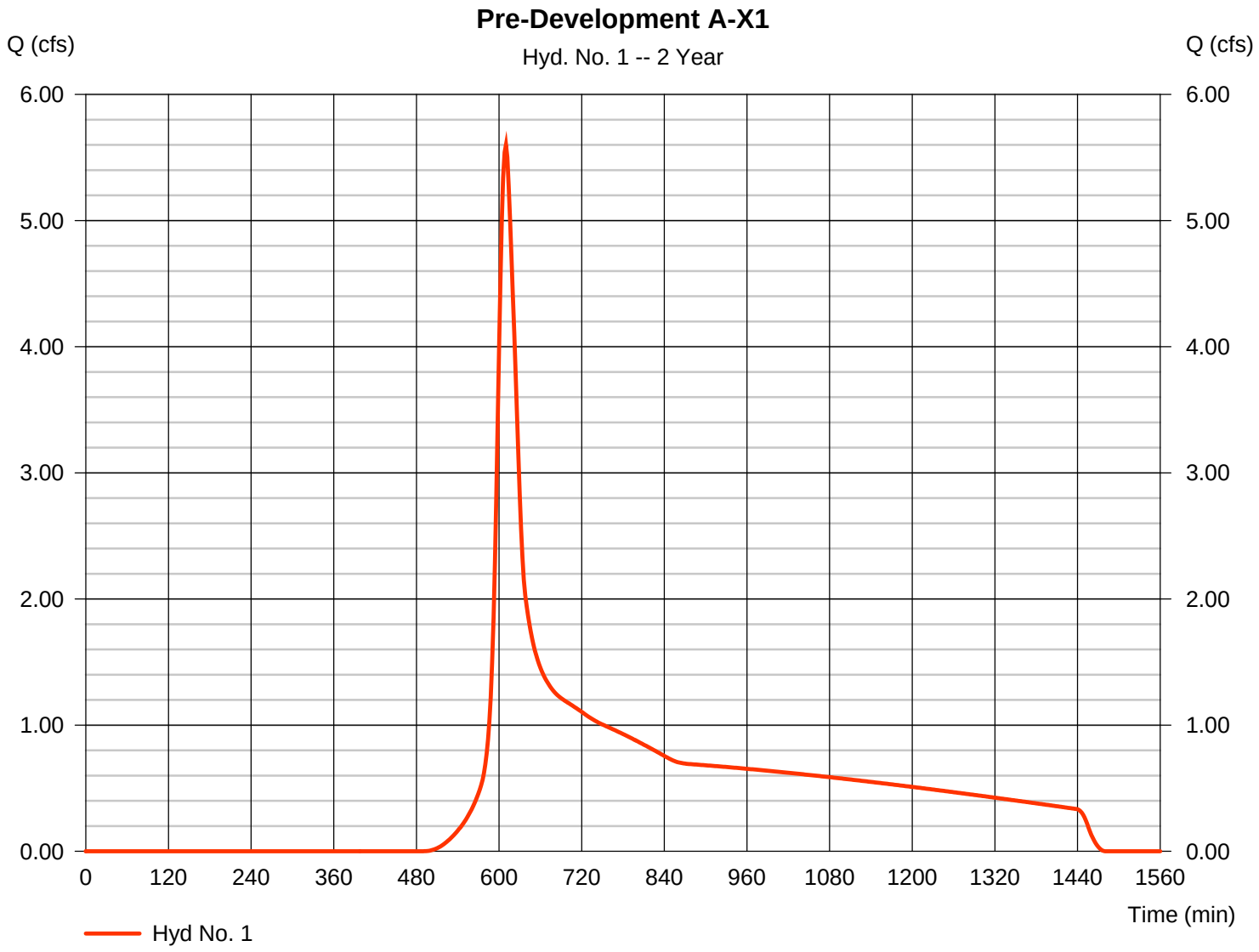
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.600 cfs
Storm frequency	=	2 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	45,765 cuft
Drainage area	=	14.930 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.446 x 80) + (0.487 x 98)] / 14.930



TR55 Tc Worksheet

Hyd. No. 1

Pre-Development A-X1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.60		0.00		0.00		
Travel Time (min)	**= 23.34**	**+**	**0.00**	**+**	**0.00**	**=**	**23.34**
Shallow Concentrated Flow							
Flow length (ft)	= 206.00		0.00		0.00		
Watercourse slope (%)	= 7.90		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.53		0.00		0.00		
Travel Time (min)	**= 0.76**	**+**	**0.00**	**+**	**0.00**	**=**	**0.76**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 24.10 min

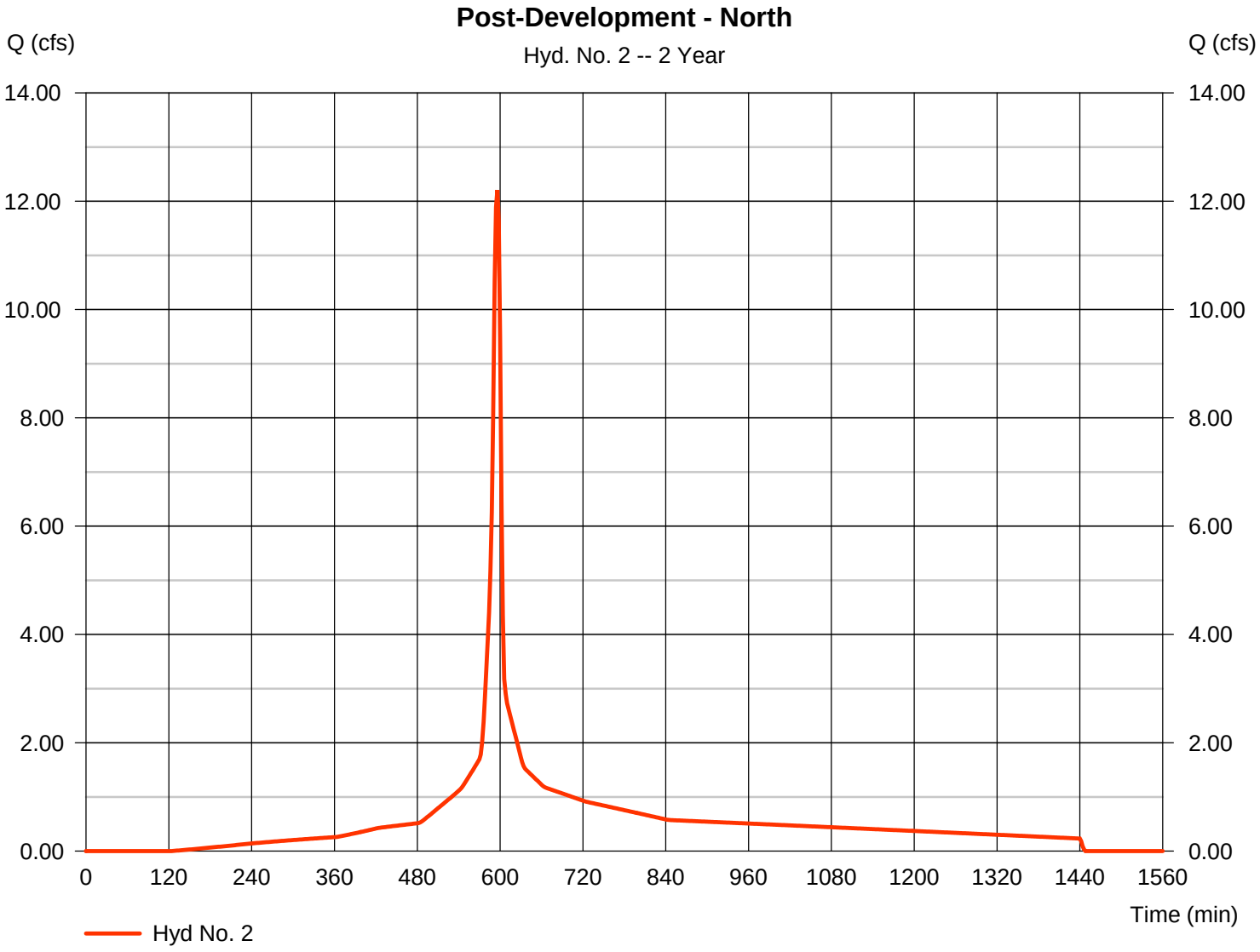
Hydrograph Report

Hyd. No. 2

Post-Development - North

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.21 cfs
Storm frequency	=	2 yrs	Time to peak	=	596 min
Time interval	=	2 min	Hyd. volume	=	53,123 cuft
Drainage area	=	8.030 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.803 x 80) + (7.231 x 98)] / 8.030



TR55 Tc Worksheet

Hyd. No. 2

Post-Development - North

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 1.30		0.00		0.00		
Travel Time (min)	**= 4.02**	**+**	**0.00**	**+**	**0.00**	**=**	**4.02**
Shallow Concentrated Flow							
Flow length (ft)	= 63.00		0.00		0.00		
Watercourse slope (%)	= 3.30		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=3.69		0.00		0.00		
Travel Time (min)	**= 0.28**	**+**	**0.00**	**+**	**0.00**	**=**	**0.28**
Channel Flow							
X sectional flow area (sqft)	= 0.79		0.00		0.00		
Wetted perimeter (ft)	= 3.14		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=4.91						
			0.00				
					0.00		
Flow length (ft)	({0})645.0		0.0		0.0		
Travel Time (min)	**= 2.19**	**+**	**0.00**	**+**	**0.00**	**=**	**2.19**

Total Travel Time, Tc ..... 6.50 min

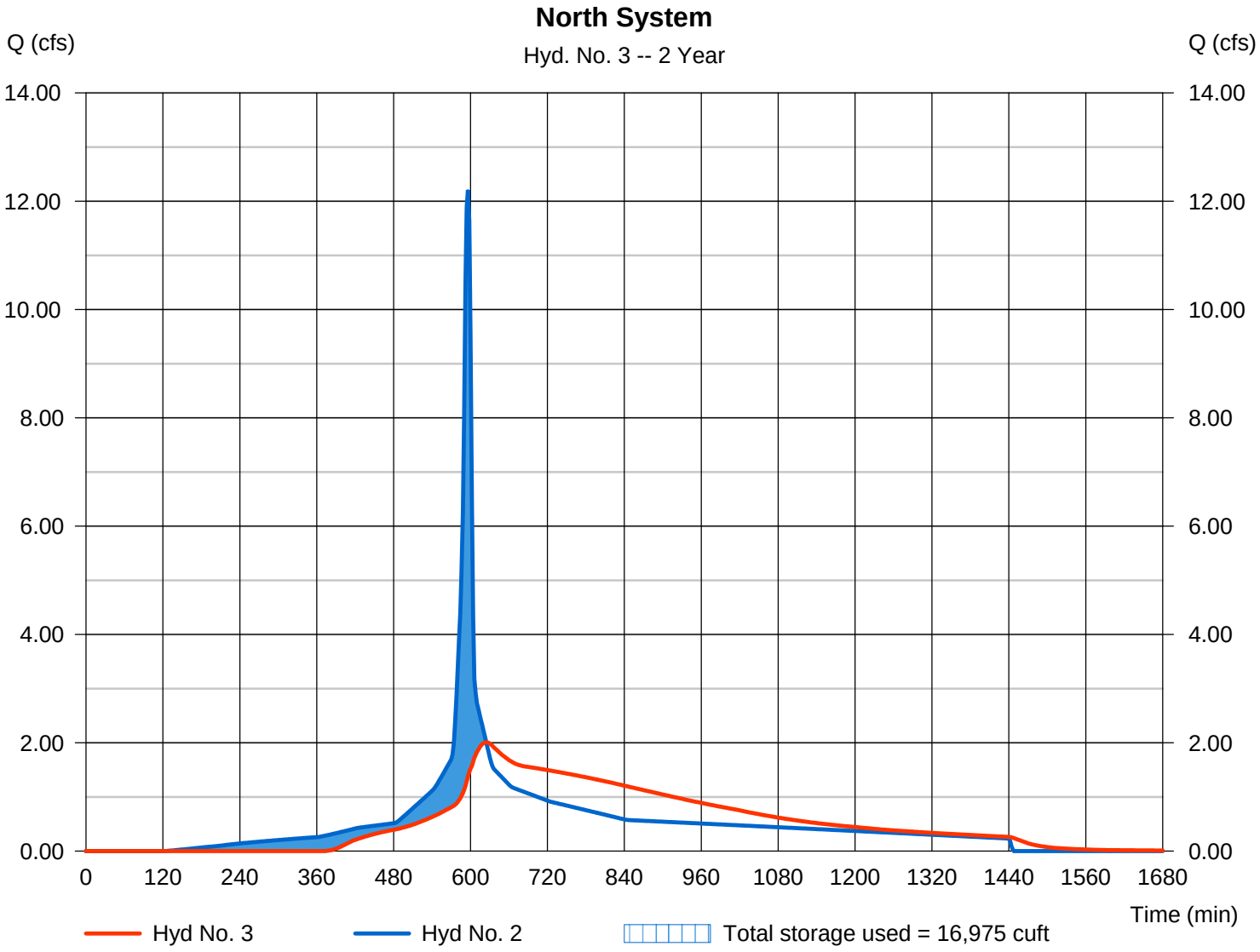
Hydrograph Report

Hyd. No. 3

North System

Hydrograph type	=	Reservoir	Peak discharge	=	2.008 cfs
Storm frequency	=	2 yrs	Time to peak	=	624 min
Time interval	=	2 min	Hyd. volume	=	50,959 cuft
Inflow hyd. No.	=	2 - Post-Development - North	Max. Elevation	=	103.29 ft
Reservoir name	=	North UG Detention	Max. Storage	=	16,975 cuft

Storage Indication method used.



Pond No. 1 - North UG Detention

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 350.00 ft, No. Barrels = 3, Slope = 0.10%, Headers = No
Encasement -Invert elev. = 99.00 ft, Width = 6.00 ft, Height = 6.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.00	n/a	0	0
0.63	99.64	n/a	1,159	1,159
1.27	100.27	n/a	1,672	2,831
1.90	100.90	n/a	2,524	5,355
2.54	101.54	n/a	2,995	8,350
3.17	102.18	n/a	3,171	11,522
3.81	102.81	n/a	3,171	14,693
4.45	103.44	n/a	2,995	17,687
5.08	104.08	n/a	2,523	20,211
5.72	104.72	n/a	1,671	21,882
6.35	105.35	n/a	1,601	23,483

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	12.00	Inactive	0.00
Span (in)	= 6.00	12.00	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	103.00	103.00	0.00
Length (ft)	= 0.00	0.00	1.00	0.00
Slope (%)	= 0.00	0.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	99.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.63	1,159	99.64	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.27	2,831	100.27	0.19 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.191
1.90	5,355	100.90	0.77 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.765
2.54	8,350	101.54	1.07 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.074
3.17	11,522	102.18	1.31 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.312
3.81	14,693	102.81	1.51 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.512
4.45	17,687	103.44	1.69 ic	0.77 ic	0.00	---	0.00	---	---	---	---	---	2.457
5.08	20,211	104.08	1.85 ic	2.88 ic	0.00	---	0.00	---	---	---	---	---	4.730
5.72	21,882	104.72	2.00 ic	4.17 ic	0.00	---	0.00	---	---	---	---	---	6.165
6.35	23,483	105.35	2.13 ic	5.14 ic	0.00	---	0.00	---	---	---	---	---	7.278

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	12.41	2	610	91,582	------	------	------	Pre-Development A-X1
2	SCS Runoff	18.83	2	596	83,489	------	------	------	Post-Development - North
3	Reservoir	7.098	2	604	81,325	2	105.25	23,204	North System

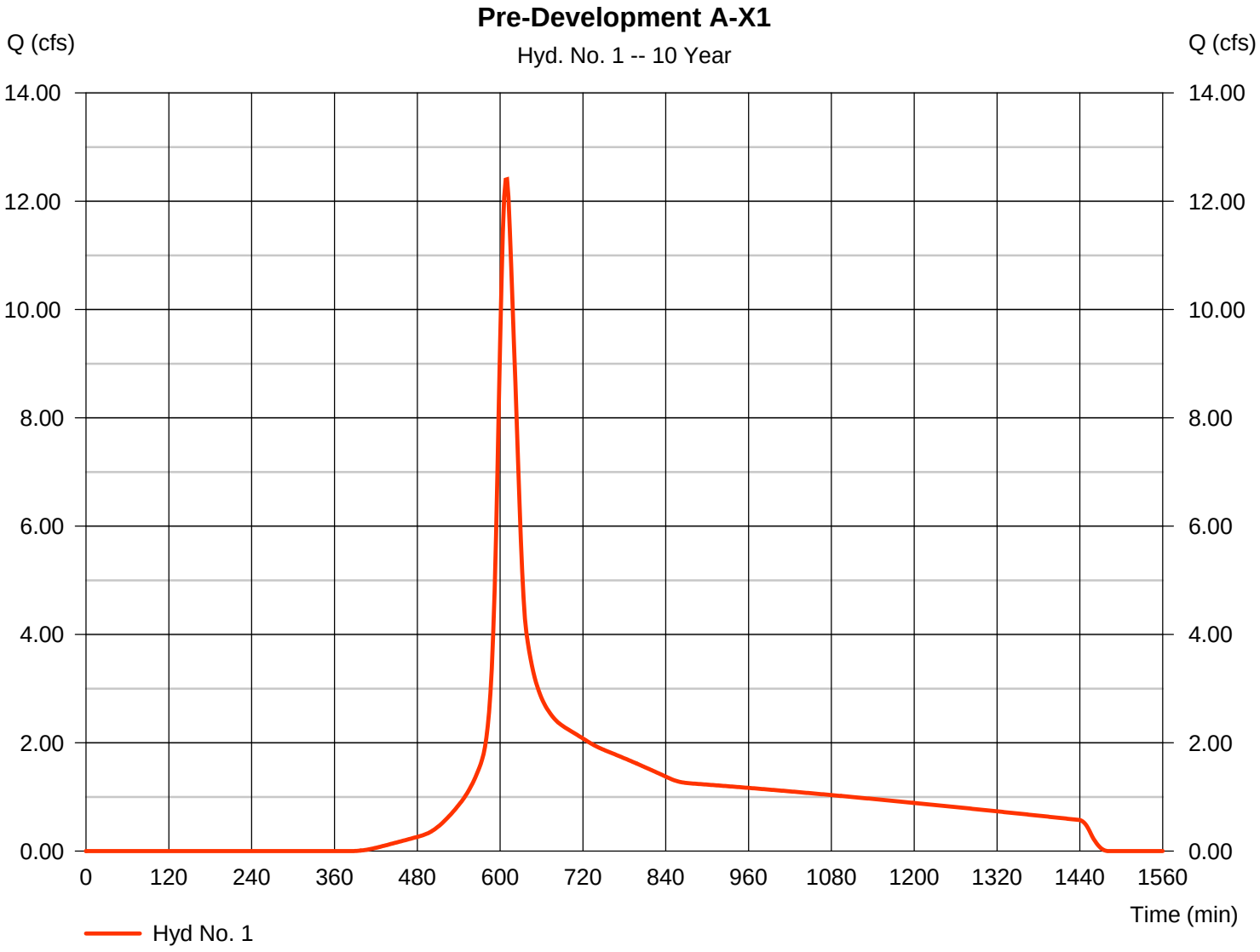
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.41 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	91,582 cuft
Drainage area	=	14.930 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.446 x 80) + (0.487 x 98)] / 14.930



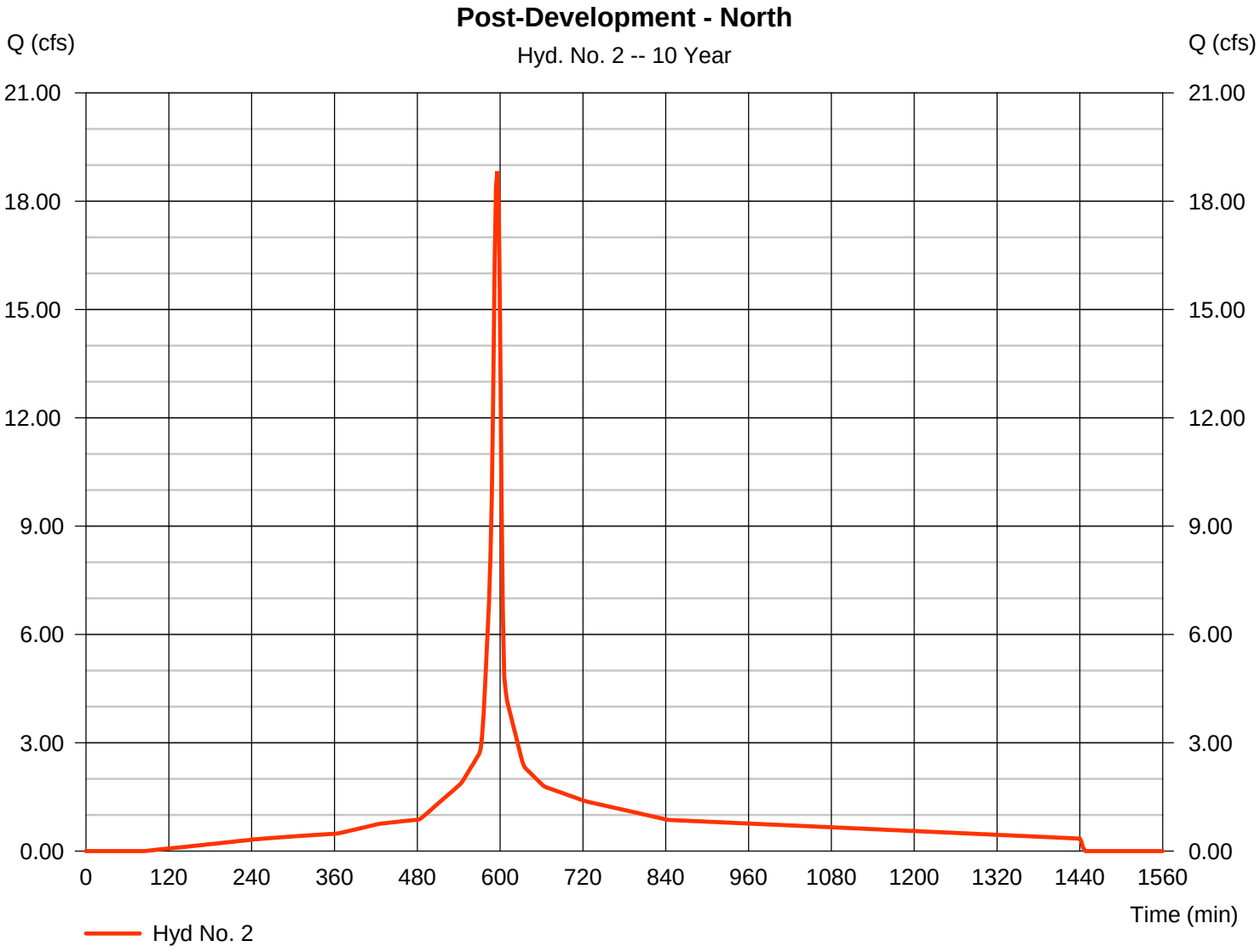
Hydrograph Report

Hyd. No. 2

Post-Development - North

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.83 cfs
Storm frequency	=	10 yrs	Time to peak	=	596 min
Time interval	=	2 min	Hyd. volume	=	83,489 cuft
Drainage area	=	8.030 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.803 x 80) + (7.231 x 98)] / 8.030



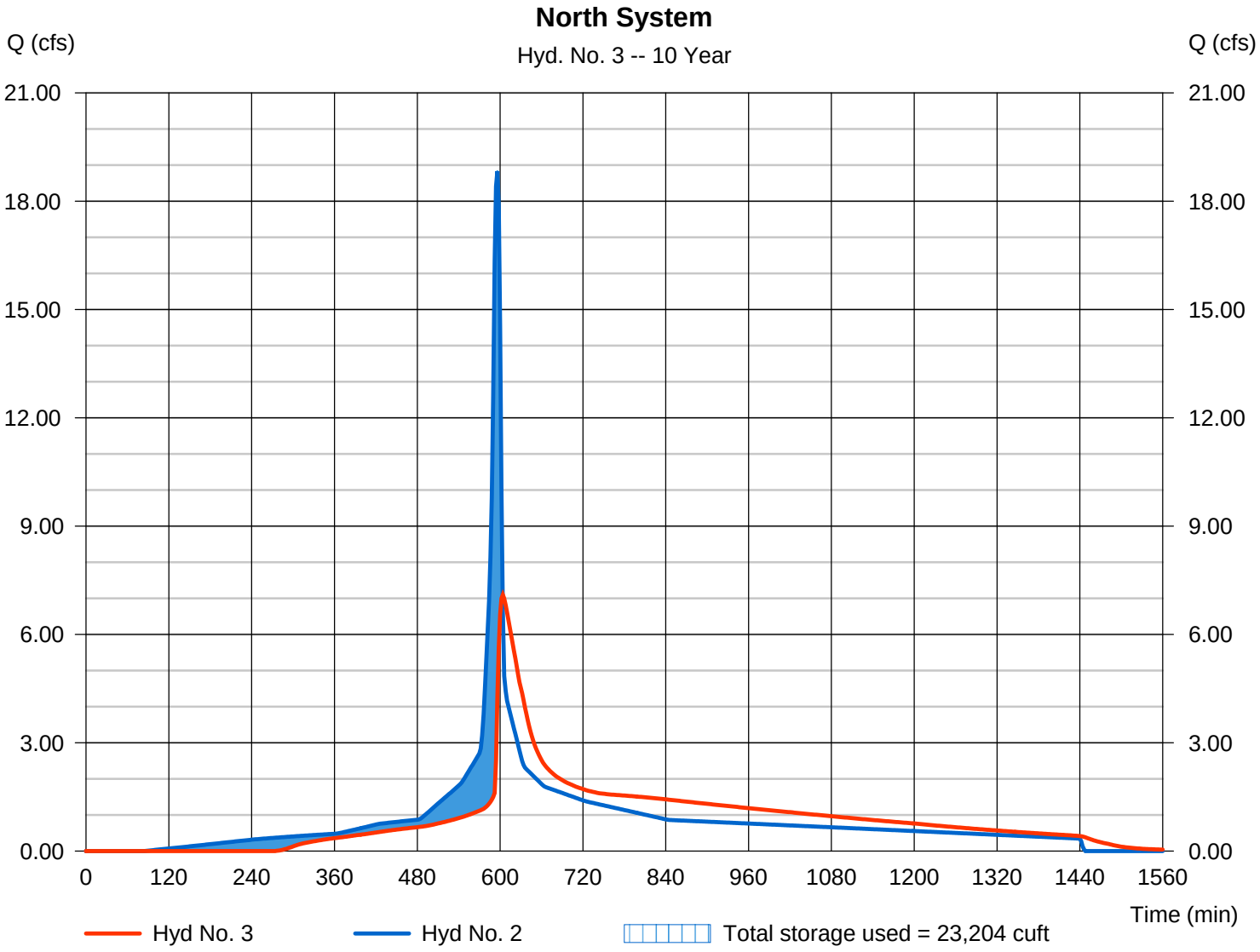
Hydrograph Report

Hyd. No. 3

North System

Hydrograph type	=	Reservoir	Peak discharge	=	7.098 cfs
Storm frequency	=	10 yrs	Time to peak	=	604 min
Time interval	=	2 min	Hyd. volume	=	81,325 cuft
Inflow hyd. No.	=	2 - Post-Development - North	Max. Elevation	=	105.25 ft
Reservoir name	=	North UG Detention	Max. Storage	=	23,204 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	3.3705	0.1000	0.4857	--------
3	0.0000	0.0000	0.0000	--------
5	0.0000	0.0000	0.0000	--------
10	4.9332	0.1000	0.4842	--------
25	0.0000	0.0000	0.0000	--------
50	0.0000	0.0000	0.0000	--------
100	6.9679	0.1000	0.4832	--------

File name: Montano MAP 24 IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.53	1.10	0.90	0.78	0.70	0.65	0.60	0.56	0.53	0.50	0.48	0.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.24	1.61	1.33	1.15	1.04	0.95	0.88	0.83	0.78	0.74	0.71	0.68
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	3.17	2.28	1.88	1.63	1.47	1.35	1.25	1.17	1.11	1.05	1.00	0.96

Tc = time in minutes. Values may exceed 60.

ip. file name: Z:\2013 Projects\21335 Montano Ph III\Admin\Calcs\Prelim Drainage Study\Montano MAP 24 Depths.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.38	0.00	3.30	3.51	5.77	6.80	4.98
SCS 6-Hr	0.00	1.16	0.00	0.00	1.72	0.00	0.00	2.43
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

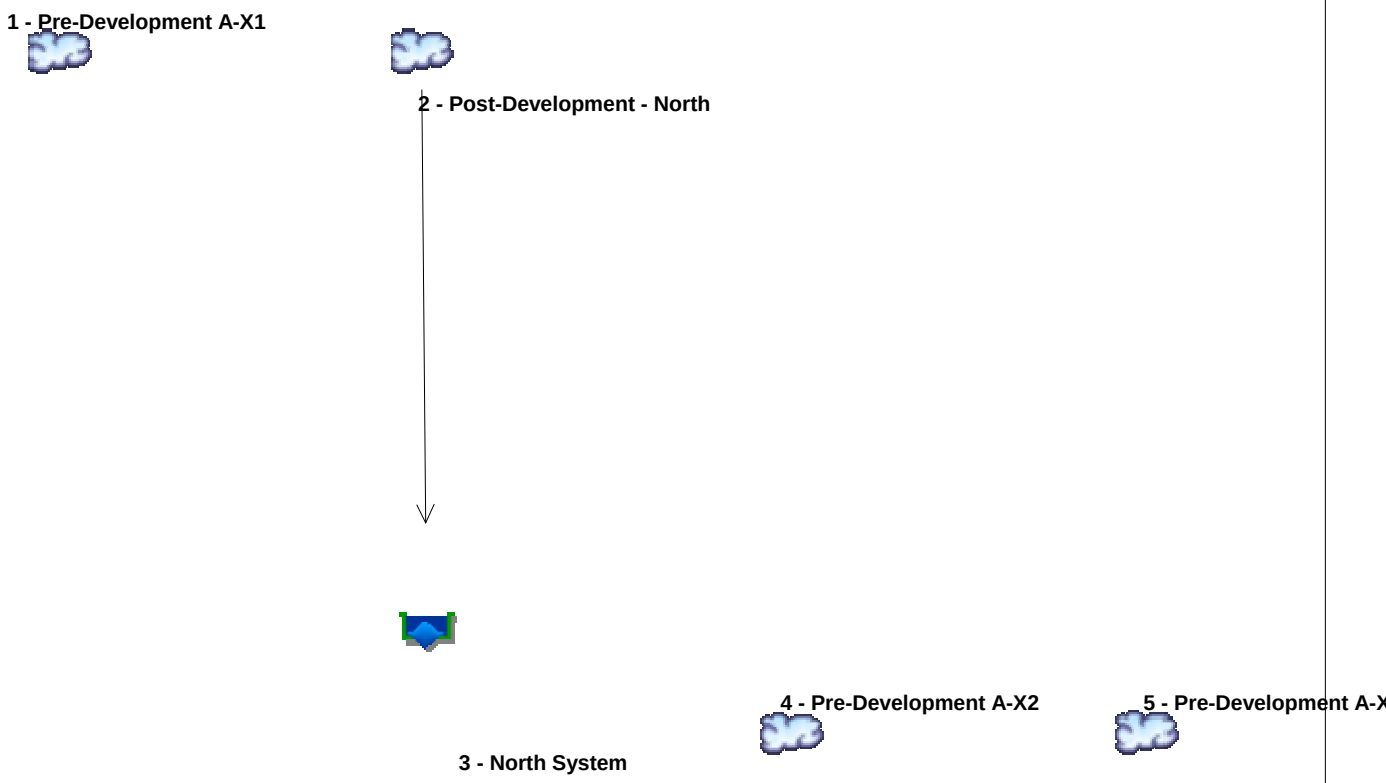
Hydraflow Table of Contents

Montano Prelim.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5 Wednesday, 10 / 19 / 2016

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development A-X1
2	SCS Runoff	Post-Development - North
3	Reservoir	North System
4	SCS Runoff	Pre-Development A-X2
5	SCS Runoff	Pre-Development A-X3

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	1.404	-------	-------	3.219	-------	-------	-------	Pre-Development A-X1
2	SCS Runoff	------	-------	12.21	-------	-------	18.83	-------	-------	-------	Post-Development - North
3	Reservoir	2	-------	2.448	-------	-------	6.446	-------	-------	-------	North System
4	SCS Runoff	------	-------	2.863	-------	-------	6.564	-------	-------	-------	Pre-Development A-X2
5	SCS Runoff	------	-------	0.708	-------	-------	1.620	-------	-------	-------	Pre-Development A-X3

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.404	2	610	11,793	------	------	------	Pre-Development A-X1
2	SCS Runoff	12.21	2	596	53,123	------	------	------	Post-Development - North
3	Reservoir	2.448	2	616	53,107	2	102.46	12,134	North System
4	SCS Runoff	2.863	2	610	24,048	------	------	------	Pre-Development A-X2
5	SCS Runoff	0.708	2	608	5,635	------	------	------	Pre-Development A-X3

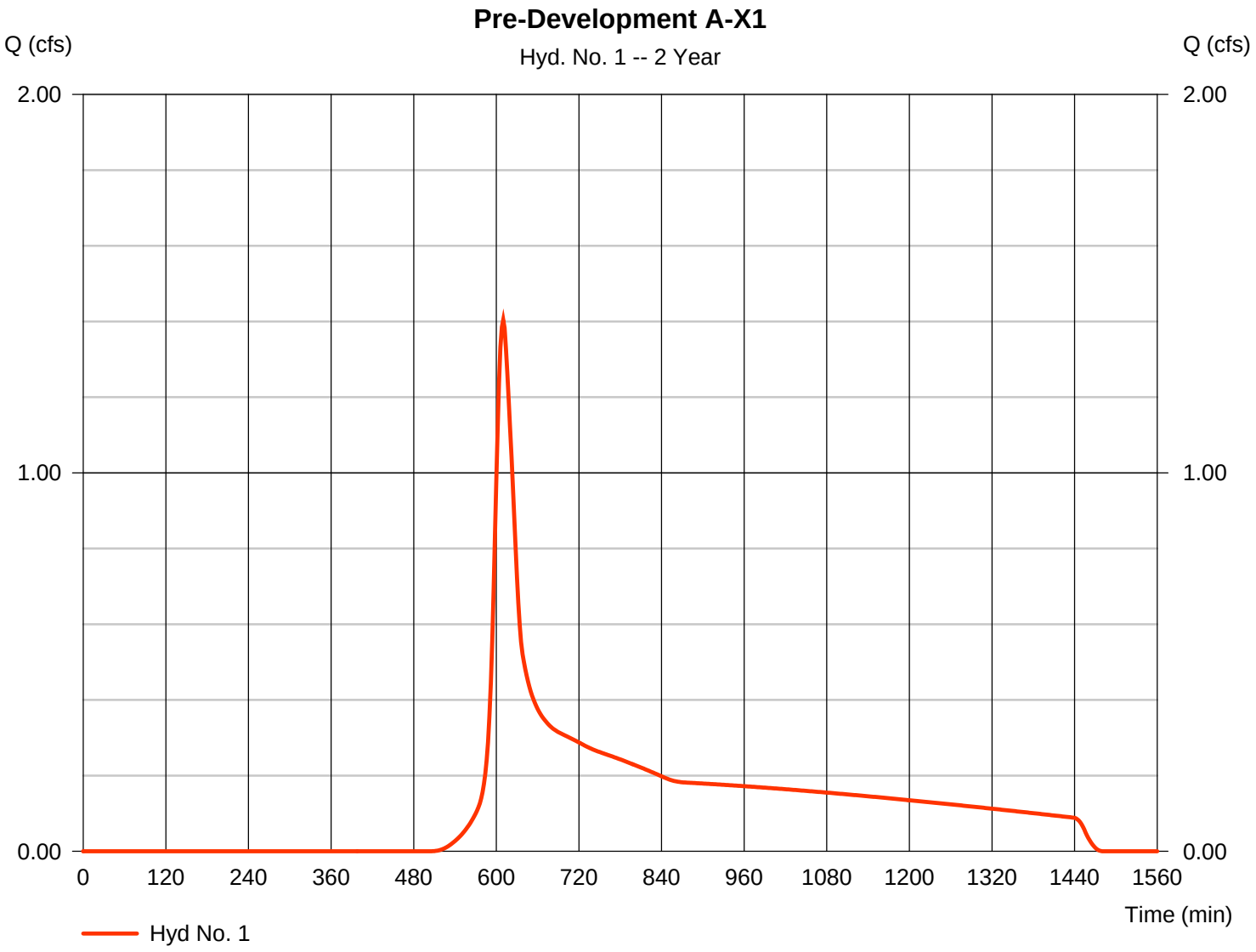
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.404 cfs
Storm frequency	= 2 yrs	Time to peak	= 610 min
Time interval	= 2 min	Hyd. volume	= 11,793 cuft
Drainage area	= 4.090 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.90 min
Total precip.	= 2.38 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.092 x 80)] / 4.090



TR55 Tc Worksheet

Hyd. No. 1

Pre-Development A-X1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.30		0.00		0.00		
Travel Time (min)	**= 23.72**	**+**	**0.00**	**+**	**0.00**	**=**	**23.72**
Shallow Concentrated Flow							
Flow length (ft)	= 92.00		0.00		0.00		
Watercourse slope (%)	= 20.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=7.36		0.00		0.00		
Travel Time (min)	**= 0.21**	**+**	**0.00**	**+**	**0.00**	**=**	**0.21**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 23.90 min

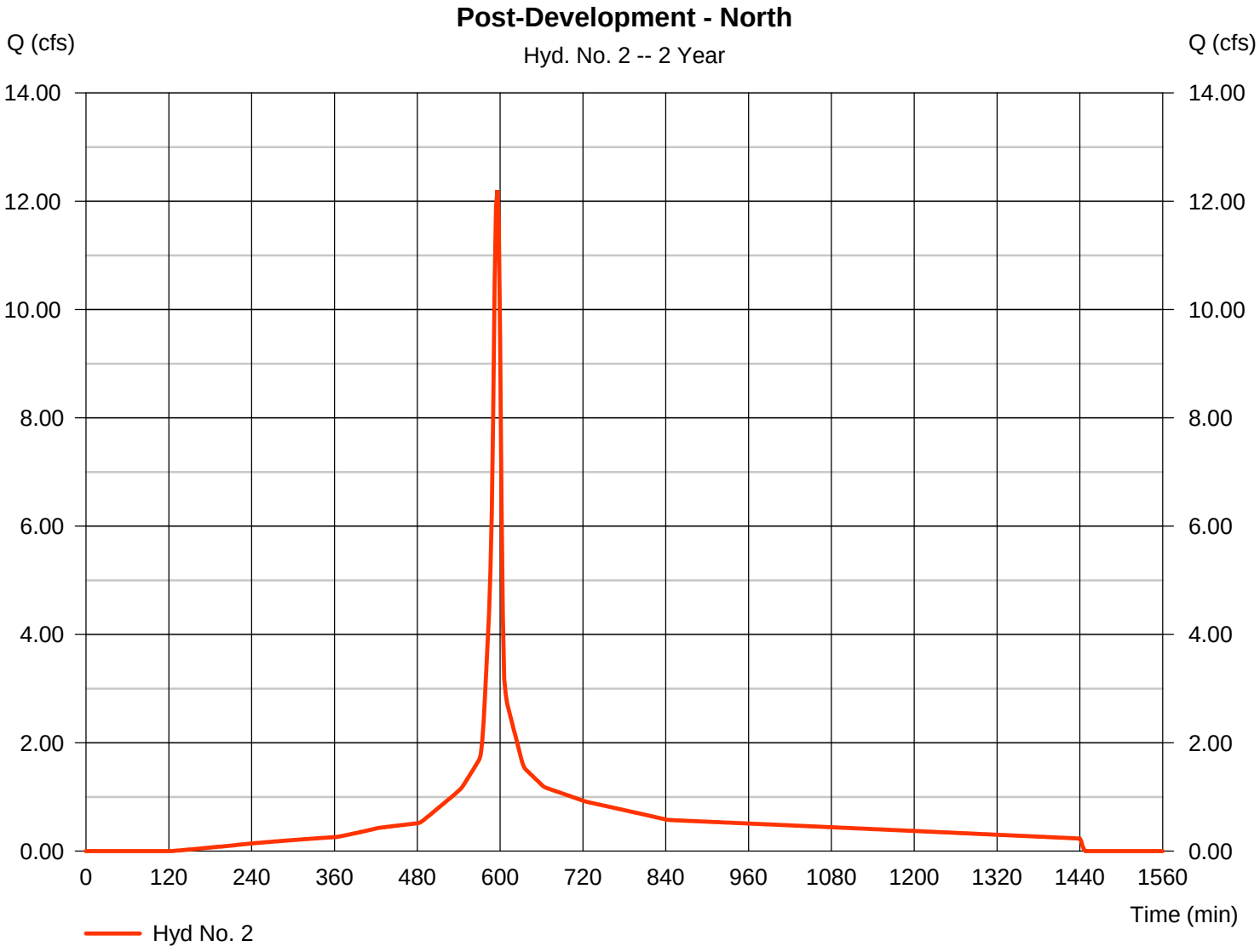
Hydrograph Report

Hyd. No. 2

Post-Development - North

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.21 cfs
Storm frequency	=	2 yrs	Time to peak	=	596 min
Time interval	=	2 min	Hyd. volume	=	53,123 cuft
Drainage area	=	8.030 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.803 x 80) + (7.231 x 98)] / 8.030



TR55 Tc Worksheet

Hyd. No. 2

Post-Development - North

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 1.30		0.00		0.00		
Travel Time (min)	**= 4.02**	**+**	**0.00**	**+**	**0.00**	**=**	**4.02**
Shallow Concentrated Flow							
Flow length (ft)	= 63.00		0.00		0.00		
Watercourse slope (%)	= 3.30		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=3.69		0.00		0.00		
Travel Time (min)	**= 0.28**	**+**	**0.00**	**+**	**0.00**	**=**	**0.28**
Channel Flow							
X sectional flow area (sqft)	= 0.79		0.00		0.00		
Wetted perimeter (ft)	= 3.14		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=4.91						
			0.00				
					0.00		
Flow length (ft)	({0})645.0		0.0		0.0		
Travel Time (min)	**= 2.19**	**+**	**0.00**	**+**	**0.00**	**=**	**2.19**

Total Travel Time, Tc ..... 6.50 min

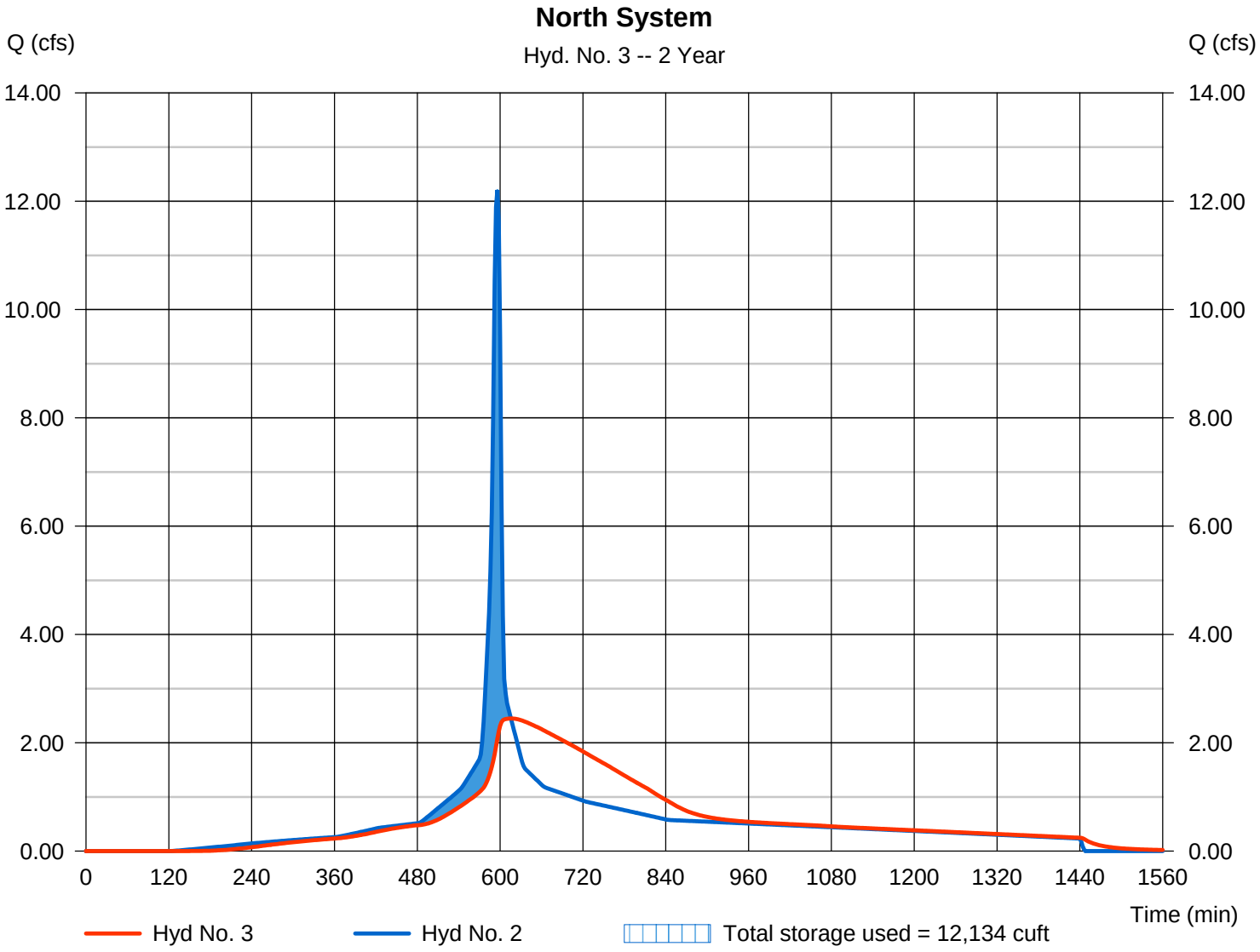
Hydrograph Report

Hyd. No. 3

North System

Hydrograph type	=	Reservoir	Peak discharge	=	2.448 cfs
Storm frequency	=	2 yrs	Time to peak	=	616 min
Time interval	=	2 min	Hyd. volume	=	53,107 cuft
Inflow hyd. No.	=	2 - Post-Development - North	Max. Elevation	=	102.46 ft
Reservoir name	=	North UG Detention	Max. Storage	=	12,134 cuft

Storage Indication method used.



Pond No. 1 - North UG Detention

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 300.00 ft, No. Barrels = 5, Slope = 0.00%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	n/a	0	0
0.40	100.40	n/a	983	983
0.80	100.80	n/a	1,703	2,686
1.20	101.20	n/a	2,073	4,759
1.60	101.60	n/a	2,284	7,043
2.00	102.00	n/a	2,386	9,429
2.40	102.40	n/a	2,386	11,815
2.80	102.80	n/a	2,283	14,098
3.20	103.20	n/a	2,072	16,170
3.60	103.60	n/a	1,703	17,874
4.00	104.00	n/a	980	18,853

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 8.00	12.00	Inactive	0.00
Span (in)	= 8.00	12.00	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	102.75	103.00	0.00
Length (ft)	= 0.00	0.00	1.00	0.00
Slope (%)	= 0.00	0.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	100.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.04	98	100.04	0.01 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.006
0.08	197	100.08	0.02 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.023
0.12	295	100.12	0.05 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.050
0.16	393	100.16	0.09 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.088
0.20	492	100.20	0.13 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.135
0.24	590	100.24	0.19 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.189
0.28	688	100.28	0.25 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.251
0.32	787	100.32	0.32 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.319
0.36	885	100.36	0.39 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.393
0.40	983	100.40	0.47 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.471
0.44	1,154	100.44	0.55 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.552
0.48	1,324	100.48	0.64 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.635
0.52	1,494	100.52	0.72 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.718
0.56	1,664	100.56	0.80 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.798
0.60	1,835	100.60	0.87 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.873
0.64	2,005	100.64	0.94 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.938
0.68	2,175	100.68	0.99 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.989
0.72	2,345	100.72	1.05 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.045
0.76	2,516	100.76	1.10 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.098
0.80	2,686	100.80	1.15 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.148
0.84	2,893	100.84	1.20 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.196
0.88	3,101	100.88	1.24 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.243
0.92	3,308	100.92	1.29 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.287
0.96	3,515	100.96	1.33 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.330
1.00	3,723	101.00	1.37 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.372
1.04	3,930	101.04	1.41 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.413
1.08	4,137	101.08	1.45 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.452
1.12	4,345	101.12	1.49 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.491
1.16	4,552	101.16	1.53 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.528
1.20	4,759	101.20	1.56 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.564
1.24	4,988	101.24	1.60 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.600

Continues on next page...

North UG Detention

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	5,216	101.28	1.64 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.635
1.32	5,444	101.32	1.67 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.669
1.36	5,673	101.36	1.70 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.703
1.40	5,901	101.40	1.74 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.736
1.44	6,129	101.44	1.77 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.768
1.48	6,358	101.48	1.80 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.800
1.52	6,586	101.52	1.83 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.831
1.56	6,815	101.56	1.86 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.861
1.60	7,043	101.60	1.89 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.891
1.64	7,281	101.64	1.92 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.921
1.68	7,520	101.68	1.95 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.950
1.72	7,759	101.72	1.98 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.979
1.76	7,997	101.76	2.01 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.007
1.80	8,236	101.80	2.04 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.035
1.84	8,474	101.84	2.06 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.063
1.88	8,713	101.88	2.09 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.090
1.92	8,952	101.92	2.12 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.117
1.96	9,190	101.96	2.14 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.143
2.00	9,429	102.00	2.17 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.170
2.04	9,667	102.04	2.20 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.195
2.08	9,906	102.08	2.22 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.221
2.12	10,145	102.12	2.25 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.246
2.16	10,383	102.16	2.27 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.271
2.20	10,622	102.20	2.30 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.296
2.24	10,860	102.24	2.32 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.321
2.28	11,099	102.28	2.34 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.345
2.32	11,337	102.32	2.37 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.369
2.36	11,576	102.36	2.39 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.392
2.40	11,815	102.40	2.42 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.416
2.44	12,043	102.44	2.44 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.439
2.48	12,271	102.48	2.46 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.462
2.52	12,500	102.52	2.49 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.485
2.56	12,728	102.56	2.51 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.508
2.60	12,956	102.60	2.53 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.530
2.64	13,184	102.64	2.55 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.552
2.68	13,413	102.68	2.57 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.574
2.72	13,641	102.72	2.60 ic	0.00	0.00	---	0.00	---	---	---	---	---	2.596
2.76	13,869	102.76	2.62 ic	0.00 ic	0.00	---	0.00	---	---	---	---	---	2.618
2.80	14,098	102.80	2.64 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	2.651
2.84	14,305	102.84	2.66 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	2.696
2.88	14,512	102.88	2.68 ic	0.07 ic	0.00	---	0.00	---	---	---	---	---	2.756
2.92	14,719	102.92	2.70 ic	0.12 ic	0.00	---	0.00	---	---	---	---	---	2.828
2.96	14,927	102.96	2.72 ic	0.19 ic	0.00	---	0.00	---	---	---	---	---	2.911
3.00	15,134	103.00	2.74 ic	0.26 ic	0.00	---	0.00	---	---	---	---	---	3.006
3.04	15,341	103.04	2.76 ic	0.35 ic	0.00	---	0.00	---	---	---	---	---	3.113
3.08	15,548	103.08	2.79 ic	0.44 ic	0.00	---	0.00	---	---	---	---	---	3.228
3.12	15,756	103.12	2.81 ic	0.55 ic	0.00	---	0.00	---	---	---	---	---	3.353
3.16	15,963	103.16	2.83 ic	0.66 ic	0.00	---	0.00	---	---	---	---	---	3.487
3.20	16,170	103.20	2.85 ic	0.78 ic	0.00	---	0.00	---	---	---	---	---	3.630
3.24	16,340	103.24	2.87 ic	0.91 ic	0.00	---	0.00	---	---	---	---	---	3.779
3.28	16,511	103.28	2.88 ic	1.05 ic	0.00	---	0.00	---	---	---	---	---	3.934
3.32	16,681	103.32	2.90 ic	1.19 ic	0.00	---	0.00	---	---	---	---	---	4.094
3.36	16,851	103.36	2.92 ic	1.34 ic	0.00	---	0.00	---	---	---	---	---	4.260
3.40	17,022	103.40	2.94 ic	1.48 ic	0.00	---	0.00	---	---	---	---	---	4.426
3.44	17,192	103.44	2.96 ic	1.64 ic	0.00	---	0.00	---	---	---	---	---	4.598
3.48	17,362	103.48	2.98 ic	1.79 ic	0.00	---	0.00	---	---	---	---	---	4.769
3.52	17,533	103.52	3.00 ic	1.94 ic	0.00	---	0.00	---	---	---	---	---	4.940
3.56	17,703	103.56	3.02 ic	2.09 ic	0.00	---	0.00	---	---	---	---	---	5.107
3.60	17,874	103.60	3.04 ic	2.23 ic	0.00	---	0.00	---	---	---	---	---	5.271
3.64	17,971	103.64	3.06 ic	2.37 ic	0.00	---	0.00	---	---	---	---	---	5.428
3.68	18,069	103.68	3.07 ic	2.50 ic	0.00	---	0.00	---	---	---	---	---	5.574
3.72	18,167	103.72	3.09 ic	2.61 ic	0.00	---	0.00	---	---	---	---	---	5.703
3.76	18,265	103.76	3.11 ic	2.70 ic	0.00	---	0.00	---	---	---	---	---	5.811
3.80	18,363	103.80	3.13 ic	2.80 ic	0.00	---	0.00	---	---	---	---	---	5.933
3.84	18,461	103.84	3.15 ic	2.90 ic	0.00	---	0.00	---	---	---	---	---	6.051
3.88	18,559	103.88	3.16 ic	3.00 ic	0.00	---	0.00	---	---	---	---	---	6.166
3.92	18,657	103.92	3.18 ic	3.10 ic	0.00	---	0.00	---	---	---	---	---	6.278
3.96	18,755	103.96	3.20 ic	3.19 ic	0.00	---	0.00	---	---	---	---	---	6.386
4.00	18,853	104.00	3.22 ic	3.27 ic	0.00	---	0.00	---	---	---	---	---	6.493

...End

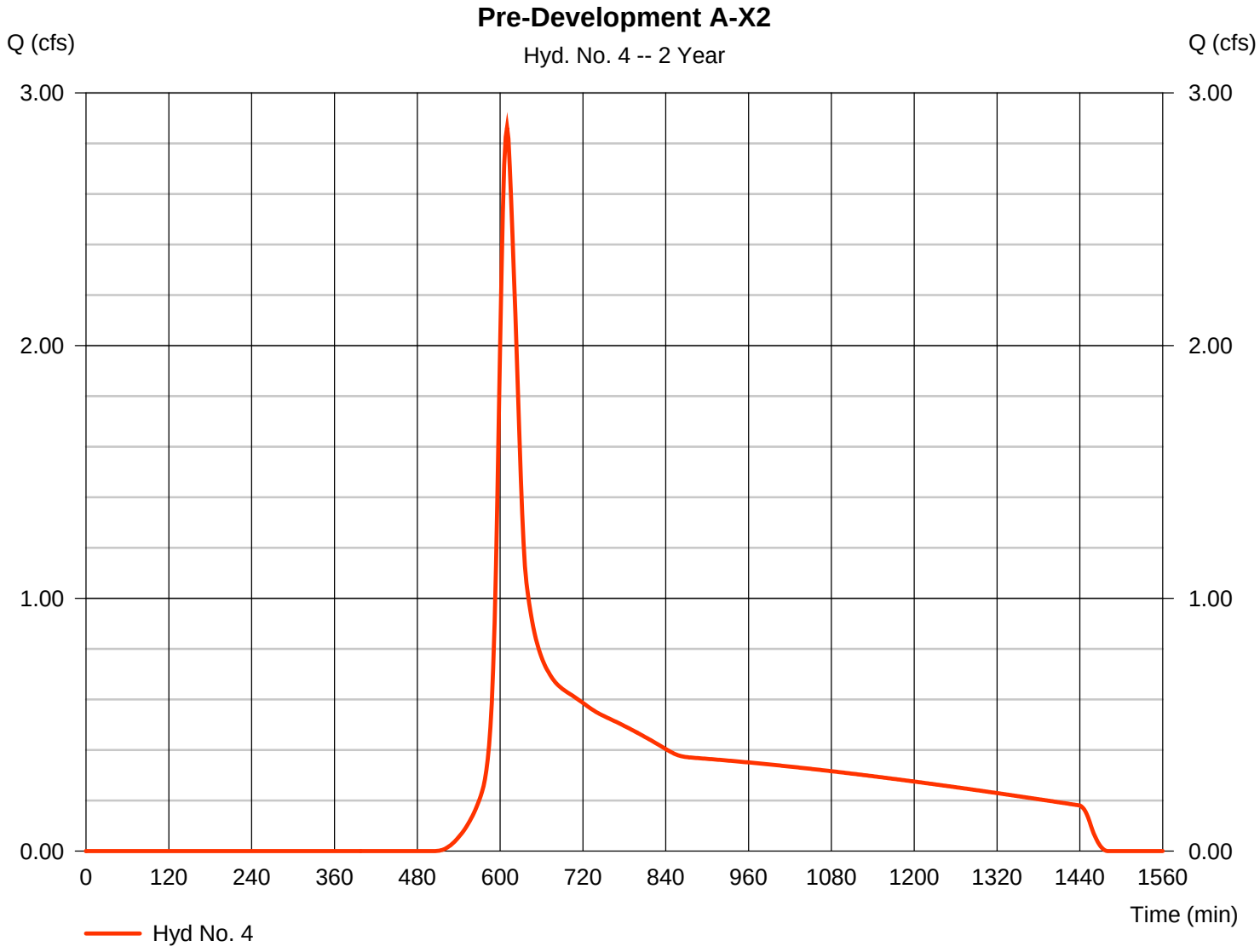
Hydrograph Report

Hyd. No. 4

Pre-Development A-X2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.863 cfs
Storm frequency	=	2 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	24,048 cuft
Drainage area	=	8.340 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.174 x 80) + (0.161 x 98)] / 8.340



TR55 Tc Worksheet

Hyd. No. 4

Pre-Development A-X2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.60		0.00		0.00		
Travel Time (min)	**= 23.34**	**+**	**0.00**	**+**	**0.00**	**=**	**23.34**
Shallow Concentrated Flow							
Flow length (ft)	= 206.00		0.00		0.00		
Watercourse slope (%)	= 7.90		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.53		0.00		0.00		
Travel Time (min)	**= 0.76**	**+**	**0.00**	**+**	**0.00**	**=**	**0.76**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 24.10 min

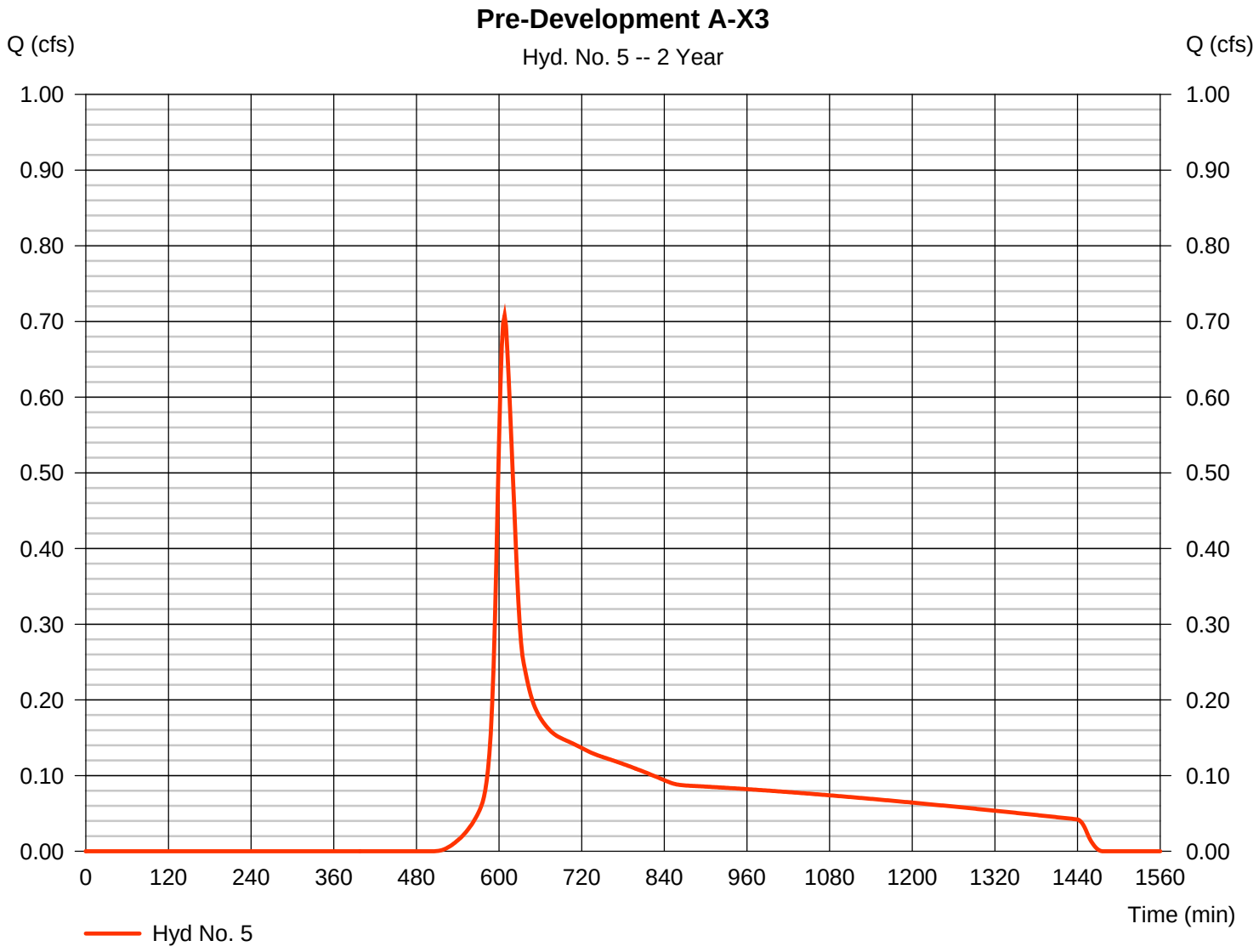
Hydrograph Report

Hyd. No. 5

Pre-Development A-X3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.708 cfs
Storm frequency	= 2 yrs	Time to peak	= 608 min
Time interval	= 2 min	Hyd. volume	= 5,635 cuft
Drainage area	= 1.890 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 22.00 min
Total precip.	= 2.38 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.840 x 80) + (0.050 x 98)] / 1.890



TR55 Tc Worksheet

Hyd. No. 5

Pre-Development A-X3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 294.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 11.10		0.00		0.00		
Travel Time (min)	**= 19.73**	**+**	**0.00**	**+**	**0.00**	**=**	**19.73**
Shallow Concentrated Flow							
Flow length (ft)	= 158.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.14		0.00		0.00		
Travel Time (min)	**= 2.31**	**+**	**0.00**	**+**	**0.00**	**=**	**2.31**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 22.00 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.219	2	610	24,031	------	------	------	Pre-Development A-X1
2	SCS Runoff	18.83	2	596	83,489	------	------	------	Post-Development - North
3	Reservoir	6.446	2	604	83,472	2	103.99	18,810	North System
4	SCS Runoff	6.564	2	610	49,002	------	------	------	Pre-Development A-X2
5	SCS Runoff	1.620	2	608	11,482	------	------	------	Pre-Development A-X3

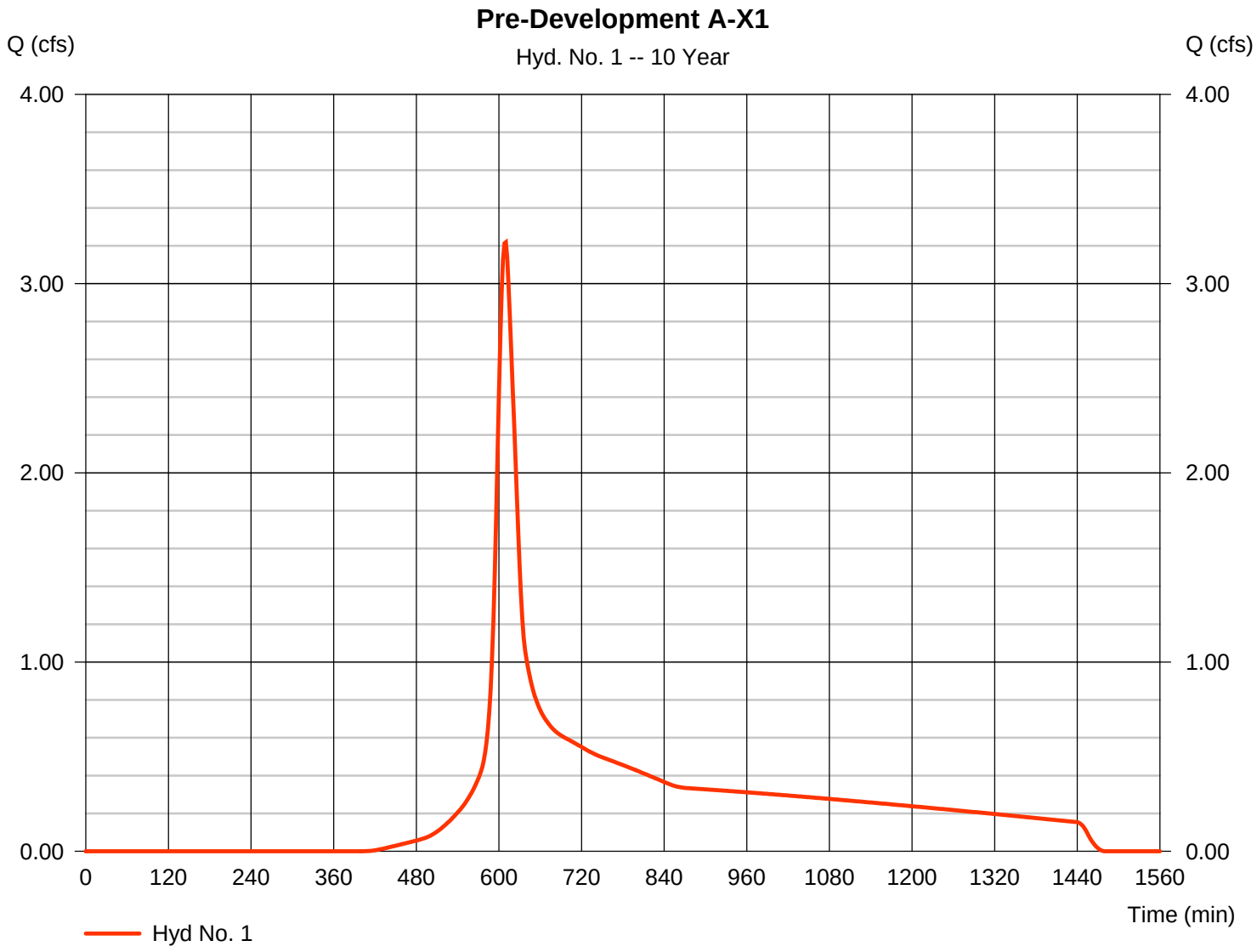
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.219 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	24,031 cuft
Drainage area	=	4.090 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.092 x 80)] / 4.090



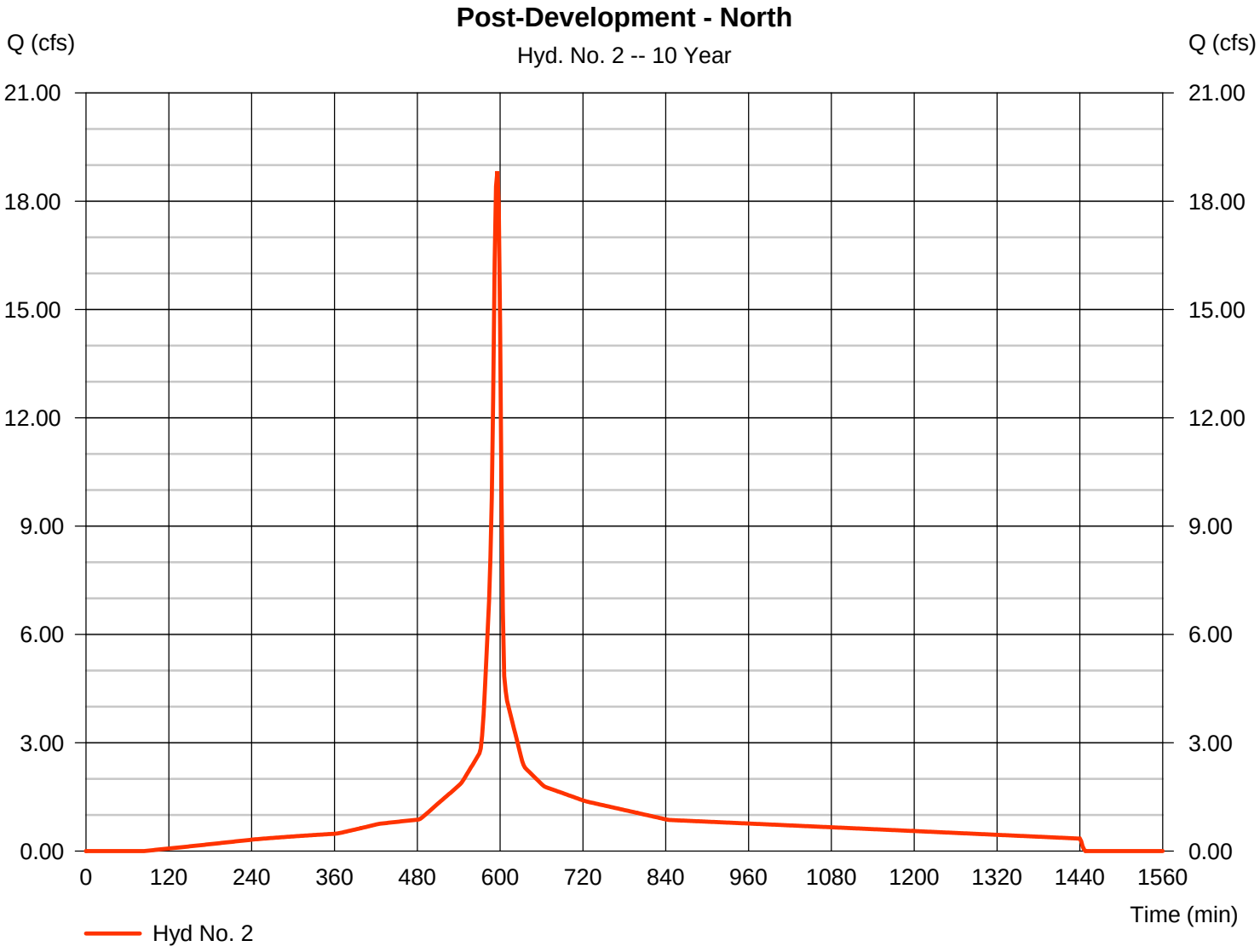
Hydrograph Report

Hyd. No. 2

Post-Development - North

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.83 cfs
Storm frequency	=	10 yrs	Time to peak	=	596 min
Time interval	=	2 min	Hyd. volume	=	83,489 cuft
Drainage area	=	8.030 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.803 x 80) + (7.231 x 98)] / 8.030



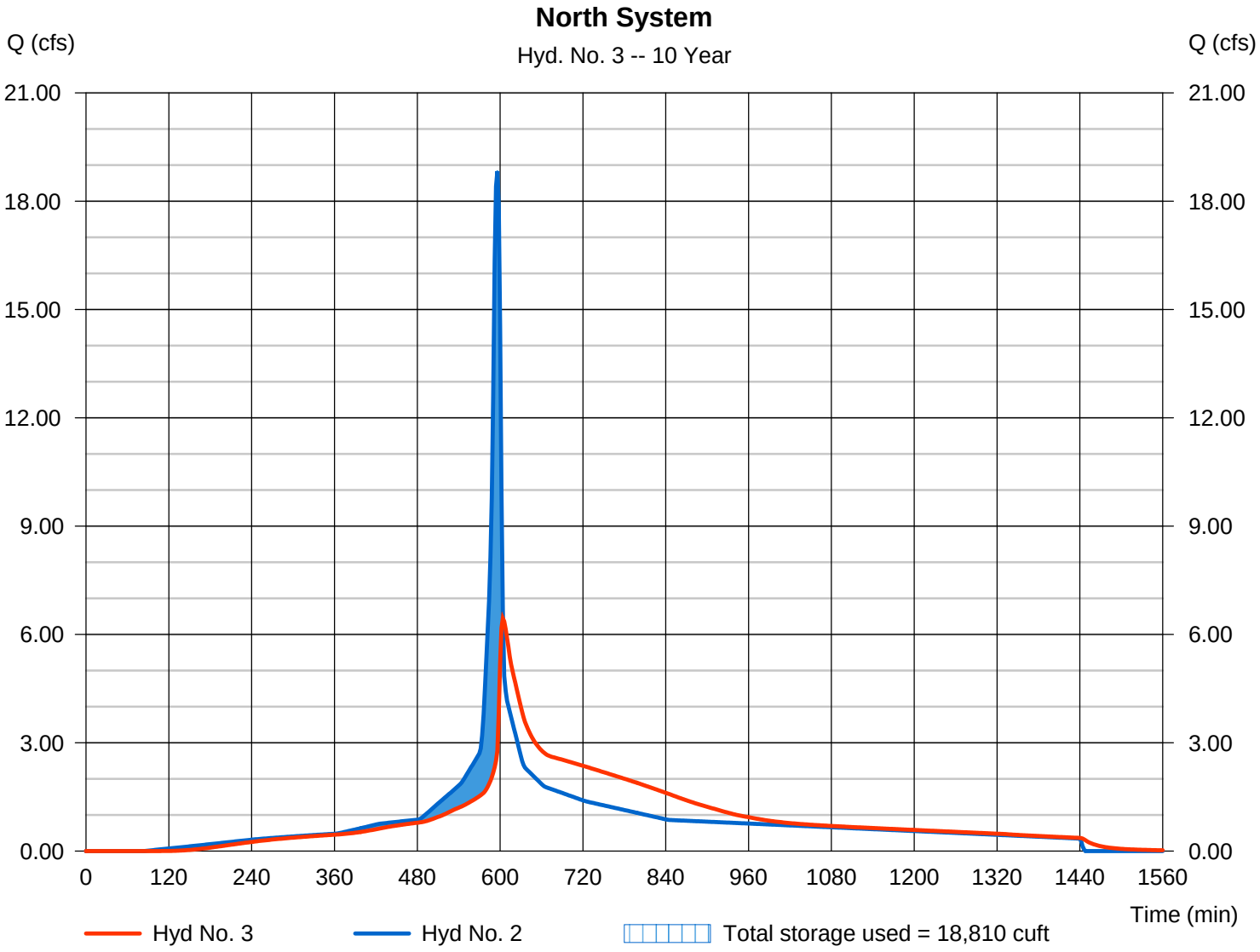
Hydrograph Report

Hyd. No. 3

North System

Hydrograph type	=	Reservoir	Peak discharge	=	6.446 cfs
Storm frequency	=	10 yrs	Time to peak	=	604 min
Time interval	=	2 min	Hyd. volume	=	83,472 cuft
Inflow hyd. No.	=	2 - Post-Development - North	Max. Elevation	=	103.99 ft
Reservoir name	=	North UG Detention	Max. Storage	=	18,810 cuft

Storage Indication method used.



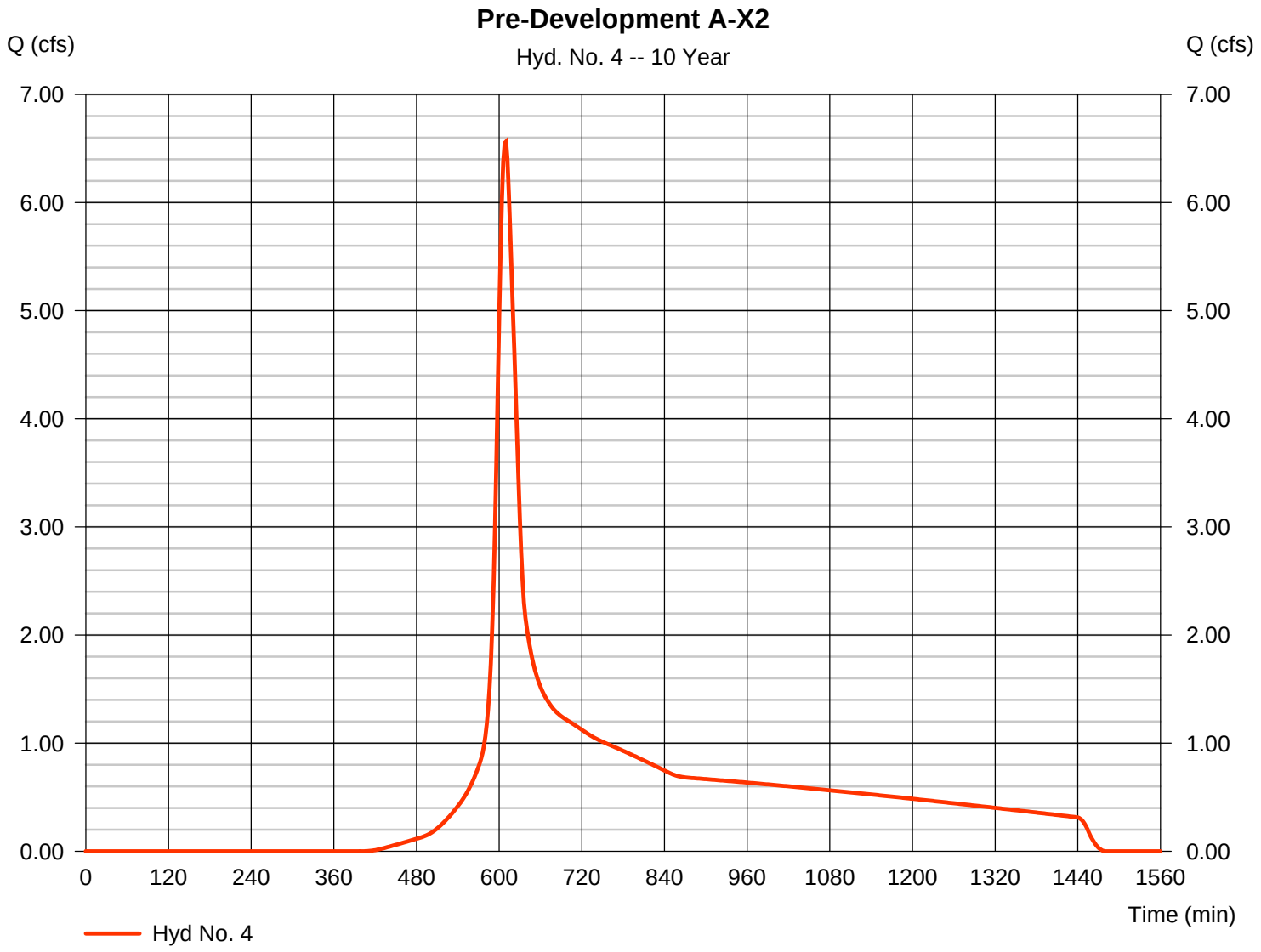
Hydrograph Report

Hyd. No. 4

Pre-Development A-X2

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.564 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	49,002 cuft
Drainage area	=	8.340 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.174 x 80) + (0.161 x 98)] / 8.340



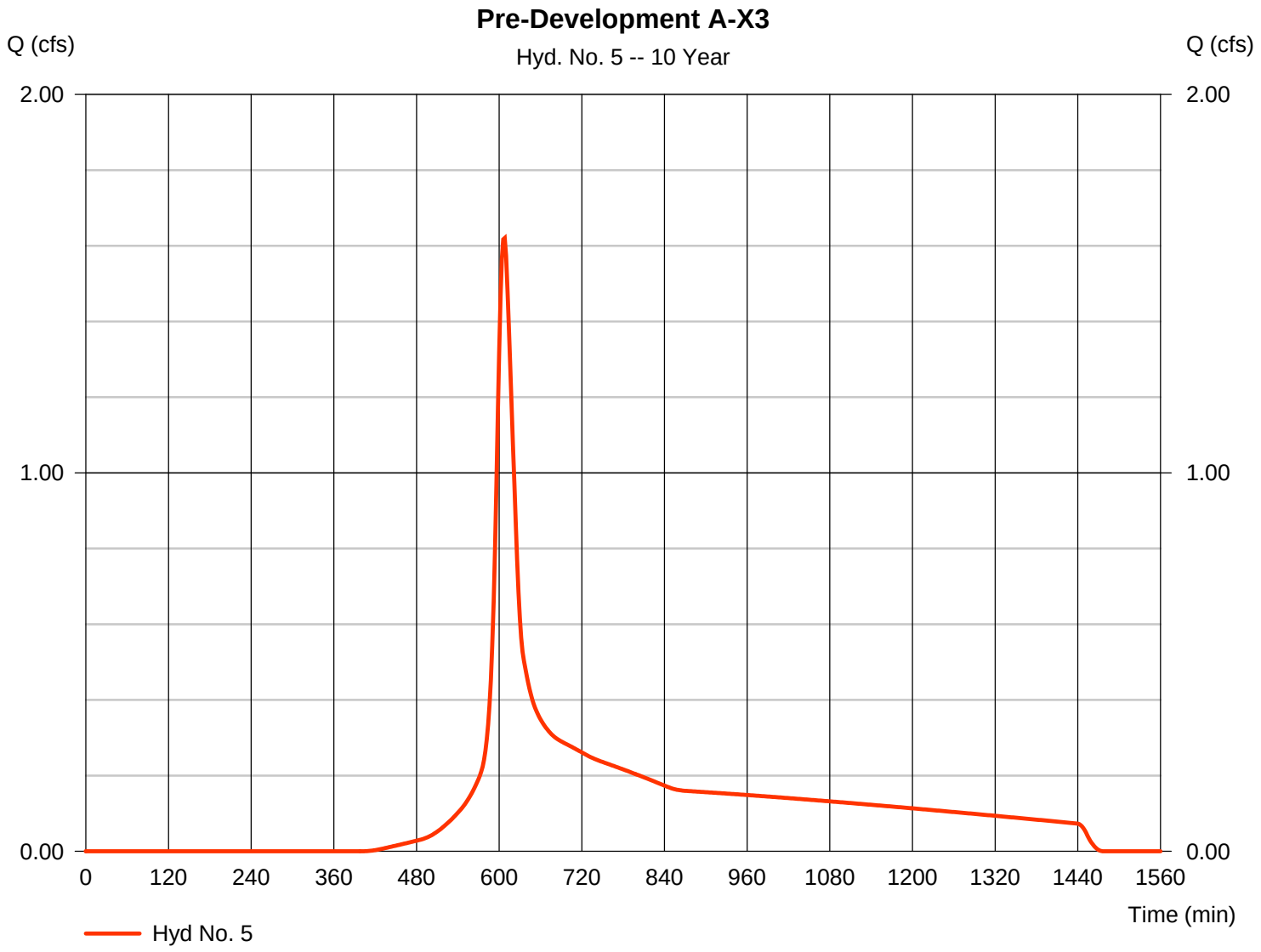
Hydrograph Report

Hyd. No. 5

Pre-Development A-X3

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.620 cfs
Storm frequency	=	10 yrs	Time to peak	=	608 min
Time interval	=	2 min	Hyd. volume	=	11,482 cuft
Drainage area	=	1.890 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.00 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.840 x 80) + (0.050 x 98)] / 1.890



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	3.3705	0.1000	0.4857	--------
3	0.0000	0.0000	0.0000	--------
5	0.0000	0.0000	0.0000	--------
10	4.9332	0.1000	0.4842	--------
25	0.0000	0.0000	0.0000	--------
50	0.0000	0.0000	0.0000	--------
100	6.9679	0.1000	0.4832	--------

File name: Montano MAP 24 IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.53	1.10	0.90	0.78	0.70	0.65	0.60	0.56	0.53	0.50	0.48	0.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.24	1.61	1.33	1.15	1.04	0.95	0.88	0.83	0.78	0.74	0.71	0.68
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	3.17	2.28	1.88	1.63	1.47	1.35	1.25	1.17	1.11	1.05	1.00	0.96

Tc = time in minutes. Values may exceed 60.

ip. file name: Z:\2013 Projects\21335 Montano Ph III\Admin\Calcs\Prelim Drainage Study\Montano MAP 24 Depths.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.38	0.00	3.30	3.51	5.77	6.80	4.98
SCS 6-Hr	0.00	1.16	0.00	0.00	1.72	0.00	0.00	2.43
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

Hydraflow Table of Contents

Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development A-X1
2	SCS Runoff	Post-Development - South
3	Reservoir	South System

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	5.600	-------	-------	12.41	-------	-------	-------	Pre-Development A-X1
2	SCS Runoff	------	-------	8.722	-------	-------	13.48	-------	-------	-------	Post-Development - South
3	Reservoir	2	-------	1.507	-------	-------	5.258	-------	-------	-------	South System

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.600	2	610	45,765	------	------	------	Pre-Development A-X1
2	SCS Runoff	8.722	1	593	34,864	------	------	------	Post-Development - South
3	Reservoir	1.507	1	617	33,422	2	102.79	9,737	South System

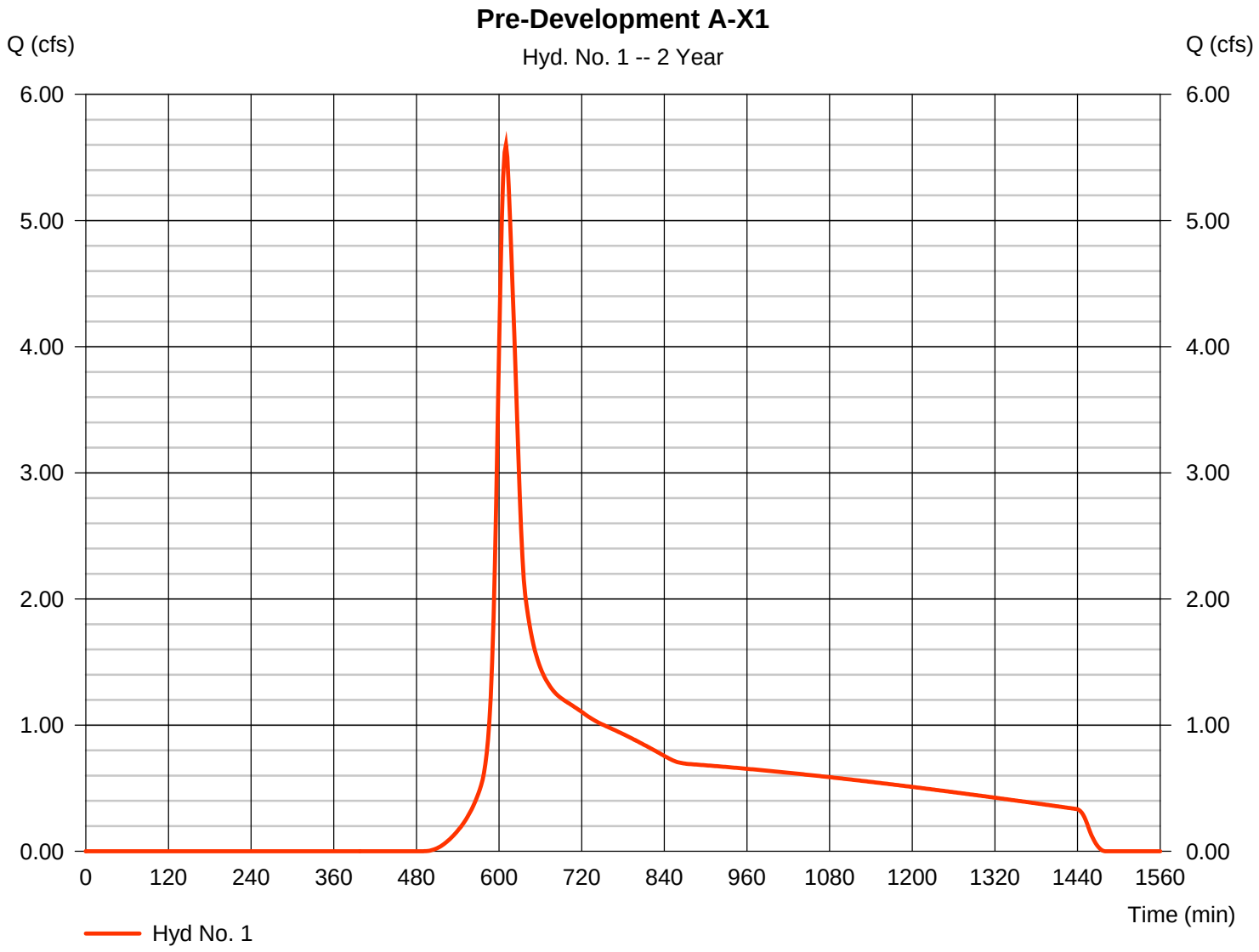
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.600 cfs
Storm frequency	=	2 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	45,765 cuft
Drainage area	=	14.930 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.446 x 80) + (0.487 x 98)] / 14.930



TR55 Tc Worksheet

Hyd. No. 1

Pre-Development A-X1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.60		0.00		0.00		
Travel Time (min)	**= 23.34**	**+**	**0.00**	**+**	**0.00**	**=**	**23.34**
Shallow Concentrated Flow							
Flow length (ft)	= 206.00		0.00		0.00		
Watercourse slope (%)	= 7.90		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.53		0.00		0.00		
Travel Time (min)	**= 0.76**	**+**	**0.00**	**+**	**0.00**	**=**	**0.76**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 24.10 min

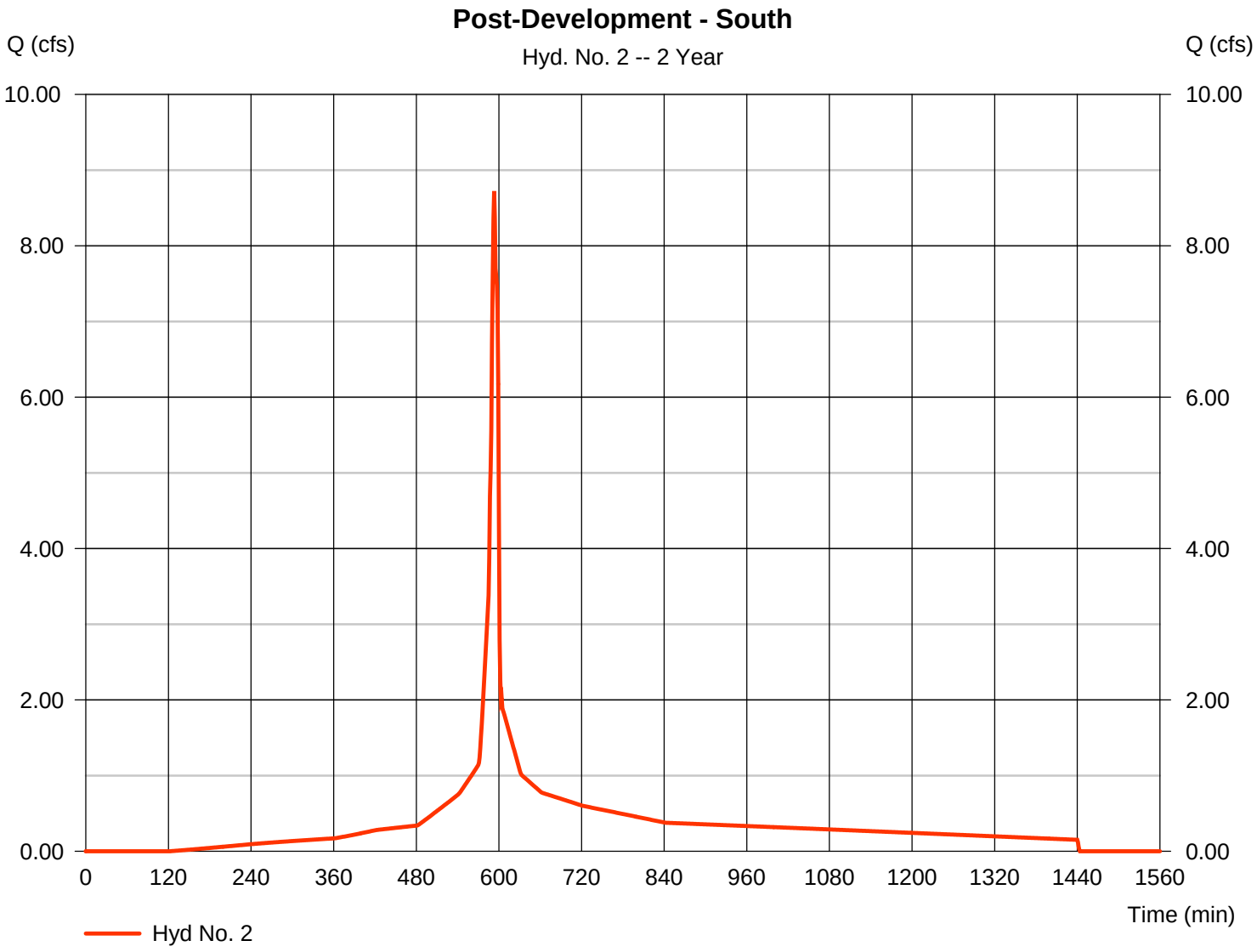
Hydrograph Report

Hyd. No. 2

Post-Development - South

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.722 cfs
Storm frequency	=	2 yrs	Time to peak	=	593 min
Time interval	=	1 min	Hyd. volume	=	34,864 cuft
Drainage area	=	5.270 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	2.70 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.527 x 80) + (4.739 x 98)] / 5.270



TR55 Tc Worksheet

Hyd. No. 2

Post-Development - South

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 231.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 2.40		0.00		0.00		
Travel Time (min)	**= 2.55**	**+**	**0.00**	**+**	**0.00**	**=**	**2.55**
Shallow Concentrated Flow							
Flow length (ft)	= 12.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=1.44		0.00		0.00		
Travel Time (min)	**= 0.14**	**+**	**0.00**	**+**	**0.00**	**=**	**0.14**
Channel Flow							
X sectional flow area (sqft)	= 0.79		0.00		0.00		
Wetted perimeter (ft)	= 3.14		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=4.90						
			0.00				
					0.00		
Flow length (ft)	({0})13.0		0.0		0.0		
Travel Time (min)	**= 0.04**	**+**	**0.00**	**+**	**0.00**	**=**	**0.04**

Total Travel Time, Tc ..... 2.70 min

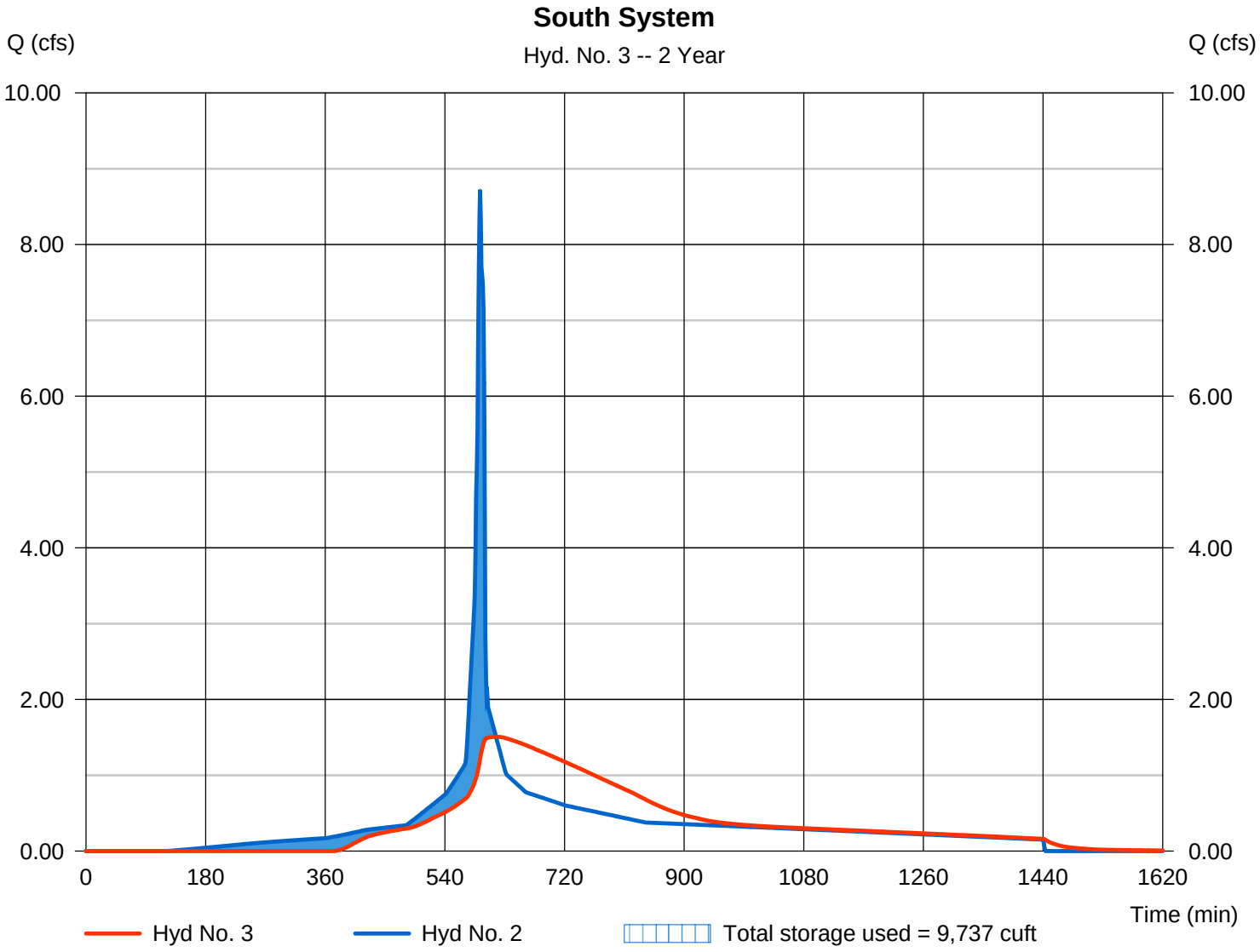
Hydrograph Report

Hyd. No. 3

South System

Hydrograph type	=	Reservoir	Peak discharge	=	1.507 cfs
Storm frequency	=	2 yrs	Time to peak	=	617 min
Time interval	=	1 min	Hyd. volume	=	33,422 cuft
Inflow hyd. No.	=	2 - Post-Development - South	Max. Elevation	=	102.79 ft
Reservoir name	=	South UG Detention	Max. Storage	=	9,737 cuft

Storage Indication method used.



Pond No. 1 - South UG Detention

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 350.00 ft, No. Barrels = 2, Slope = 0.10%, Headers = No
Encasement -Invert elev. = 99.00 ft, Width = 6.00 ft, Height = 6.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.00	n/a	0	0
0.63	99.64	n/a	773	773
1.27	100.27	n/a	1,114	1,887
1.90	100.90	n/a	1,683	3,570
2.54	101.54	n/a	1,997	5,567
3.17	102.18	n/a	2,114	7,681
3.81	102.81	n/a	2,114	9,795
4.45	103.44	n/a	1,997	11,792
5.08	104.08	n/a	1,682	13,474
5.72	104.72	n/a	1,114	14,588
6.35	105.35	n/a	1,067	15,655

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	12.00	Inactive	0.00
Span (in)	= 6.00	12.00	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	103.00	103.00	0.00
Length (ft)	= 0.00	0.00	1.00	0.00
Slope (%)	= 0.00	0.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	99.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.63	773	99.64	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.27	1,887	100.27	0.19 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.191
1.90	3,570	100.90	0.77 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.765
2.54	5,567	101.54	1.07 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.074
3.17	7,681	102.18	1.31 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.312
3.81	9,795	102.81	1.51 ic	0.00	0.00	---	0.00	---	---	---	---	---	1.512
4.45	11,792	103.44	1.69 ic	0.77 ic	0.00	---	0.00	---	---	---	---	---	2.457
5.08	13,474	104.08	1.85 ic	2.88 ic	0.00	---	0.00	---	---	---	---	---	4.730
5.72	14,588	104.72	2.00 ic	4.17 ic	0.00	---	0.00	---	---	---	---	---	6.165
6.35	15,655	105.35	2.13 ic	5.14 ic	0.00	---	0.00	---	---	---	---	---	7.278

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	12.41	2	610	91,582	------	------	------	Pre-Development A-X1
2	SCS Runoff	13.48	1	593	54,793	------	------	------	Post-Development - South
3	Reservoir	5.258	1	601	53,350	2	104.31	13,840	South System

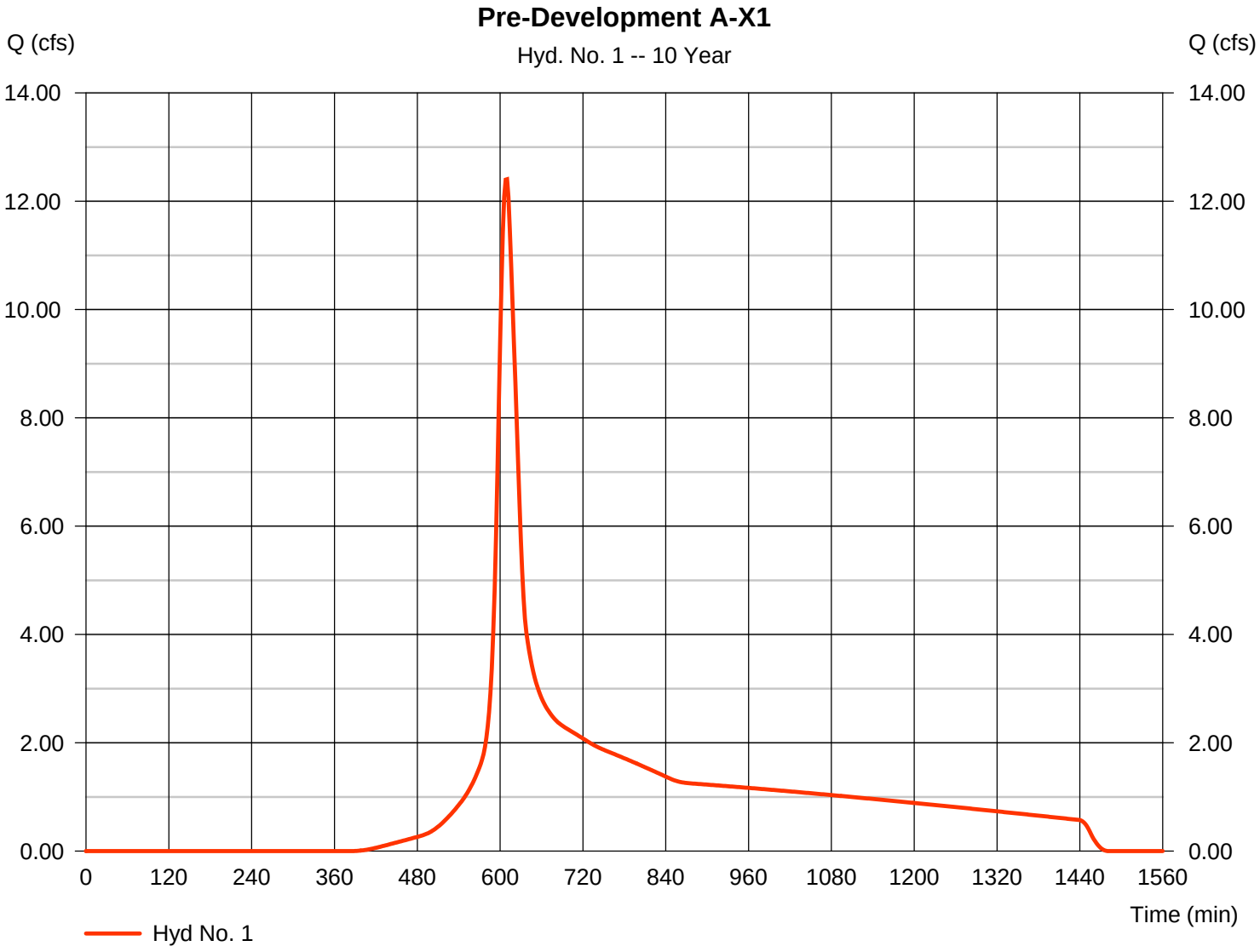
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.41 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	91,582 cuft
Drainage area	=	14.930 ac	Curve number	=	81*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(14.446 x 80) + (0.487 x 98)] / 14.930



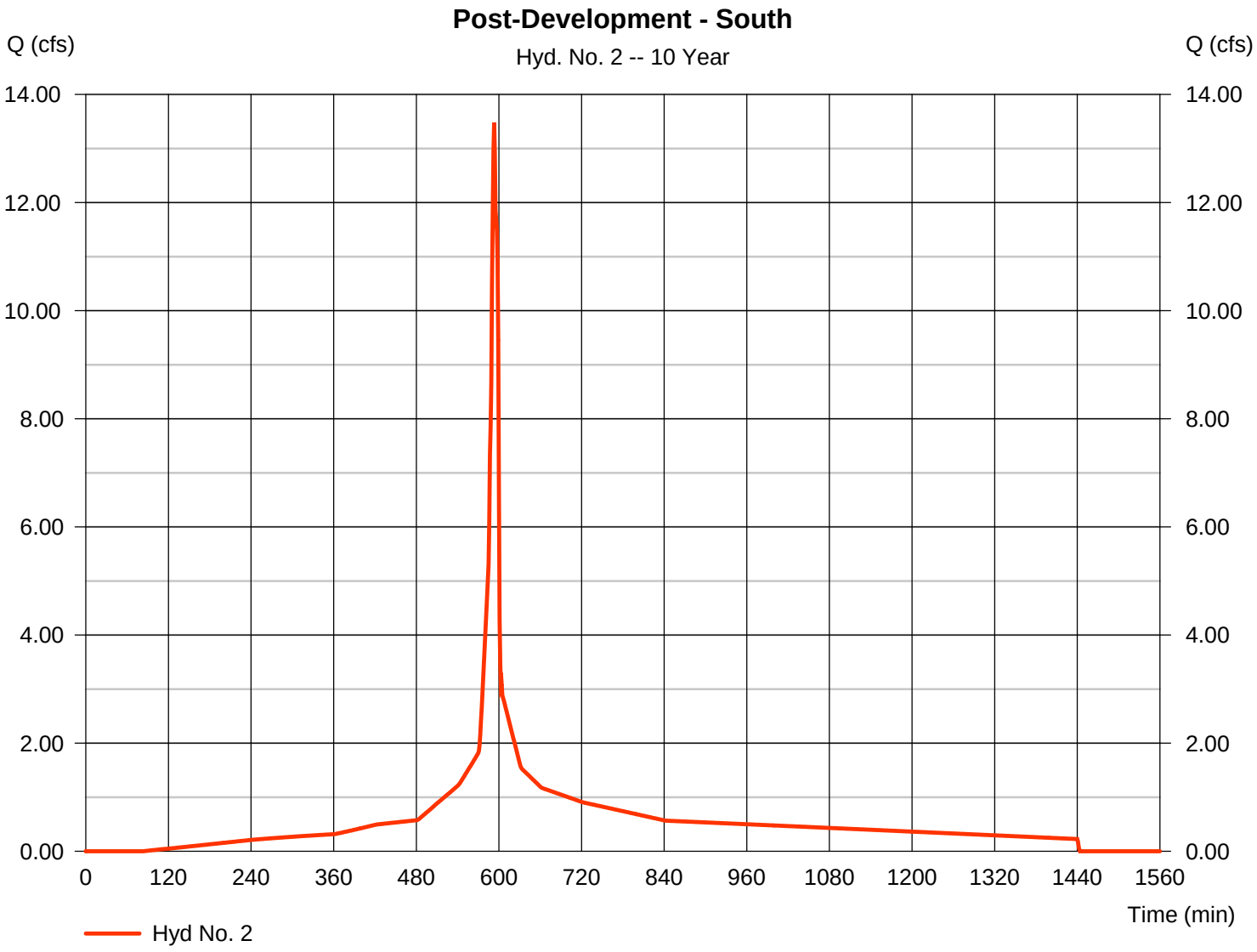
Hydrograph Report

Hyd. No. 2

Post-Development - South

Hydrograph type	= SCS Runoff	Peak discharge	= 13.48 cfs
Storm frequency	= 10 yrs	Time to peak	= 593 min
Time interval	= 1 min	Hyd. volume	= 54,793 cuft
Drainage area	= 5.270 ac	Curve number	= 96*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 2.70 min
Total precip.	= 3.51 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.527 x 80) + (4.739 x 98)] / 5.270



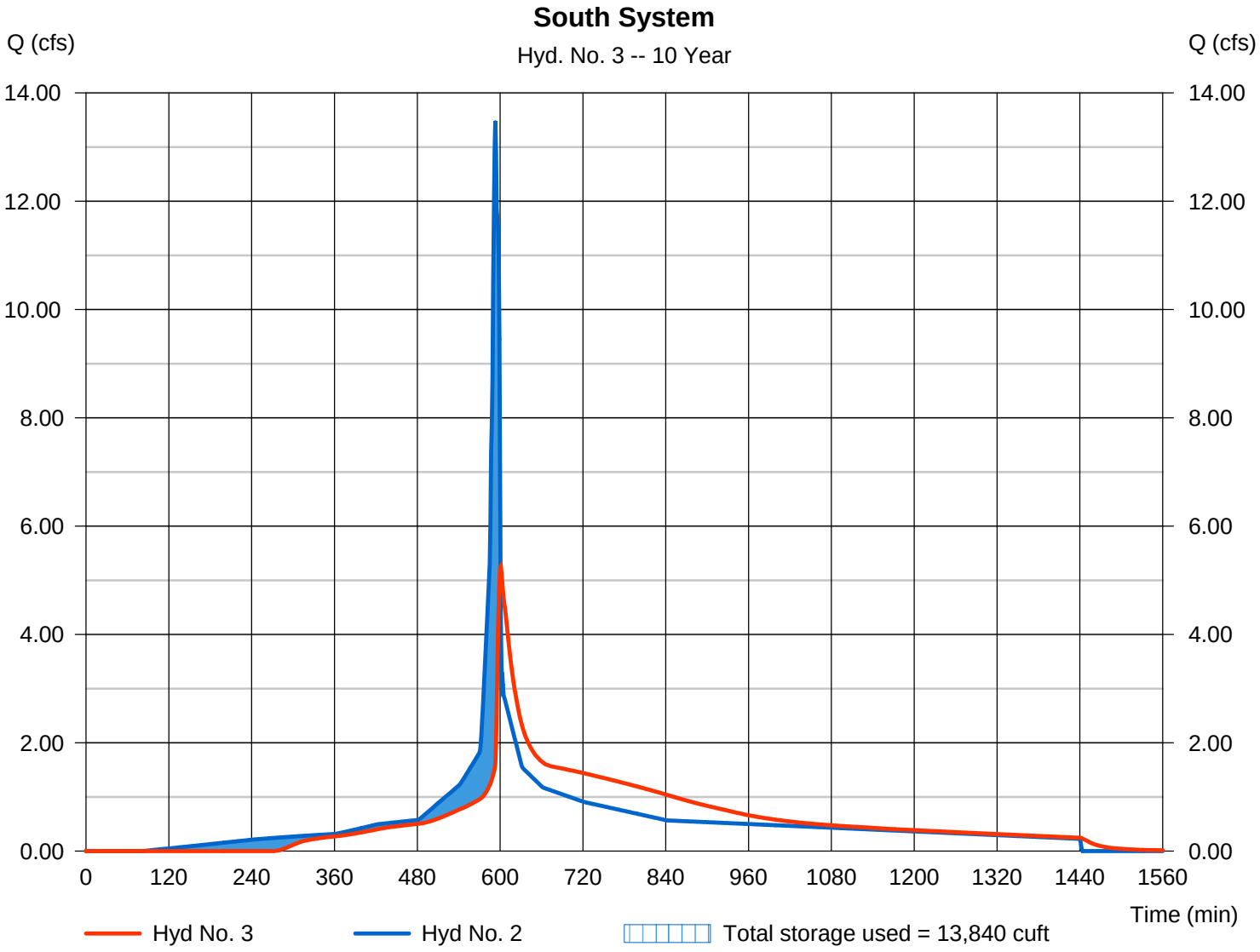
Hydrograph Report

Hyd. No. 3

South System

Hydrograph type	=	Reservoir	Peak discharge	=	5.258 cfs
Storm frequency	=	10 yrs	Time to peak	=	601 min
Time interval	=	1 min	Hyd. volume	=	53,350 cuft
Inflow hyd. No.	=	2 - Post-Development - South	Max. Elevation	=	104.31 ft
Reservoir name	=	South UG Detention	Max. Storage	=	13,840 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	3.3705	0.1000	0.4857	--------
3	0.0000	0.0000	0.0000	--------
5	0.0000	0.0000	0.0000	--------
10	4.9332	0.1000	0.4842	--------
25	0.0000	0.0000	0.0000	--------
50	0.0000	0.0000	0.0000	--------
100	6.9679	0.1000	0.4832	--------

File name: Montano MAP 24 IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.53	1.10	0.90	0.78	0.70	0.65	0.60	0.56	0.53	0.50	0.48	0.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.24	1.61	1.33	1.15	1.04	0.95	0.88	0.83	0.78	0.74	0.71	0.68
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	3.17	2.28	1.88	1.63	1.47	1.35	1.25	1.17	1.11	1.05	1.00	0.96

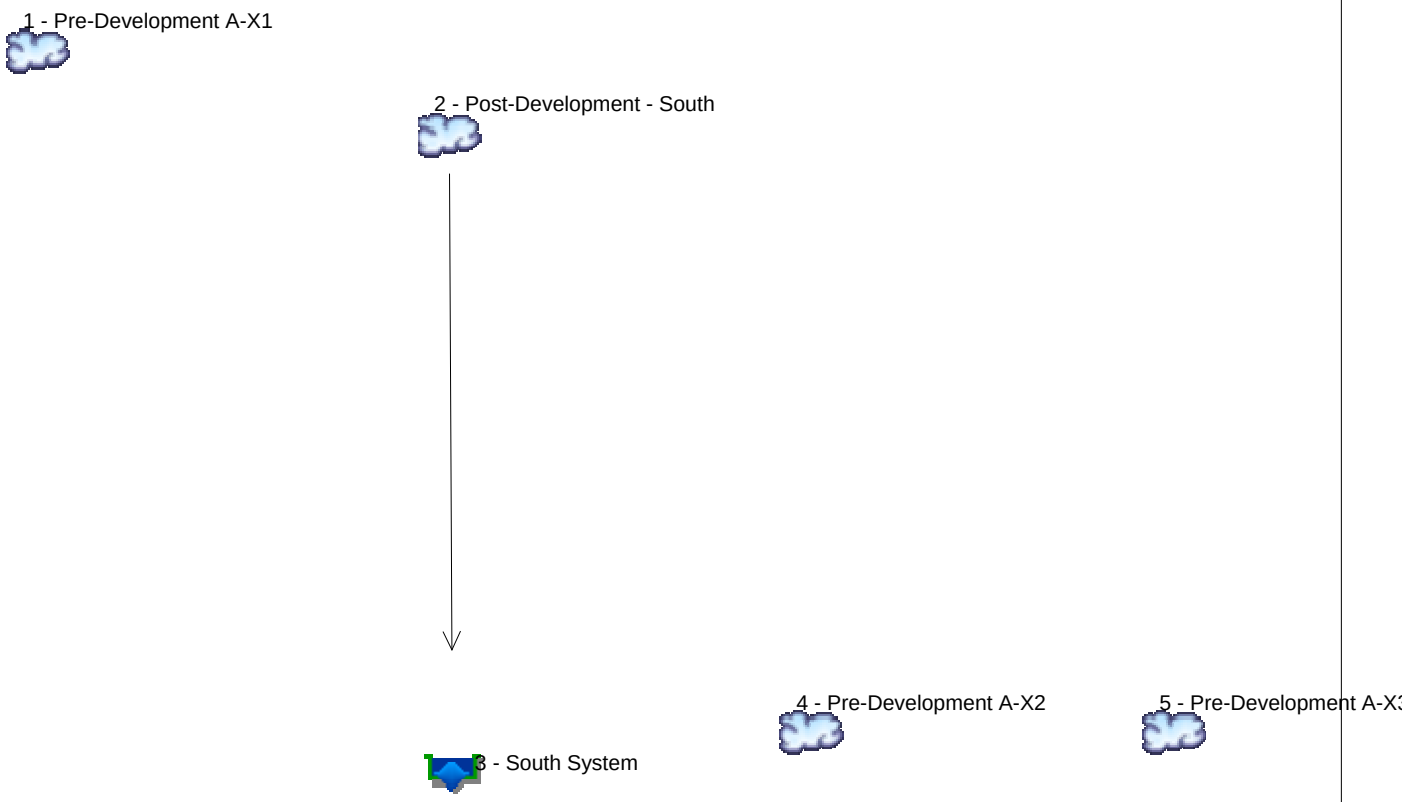
Tc = time in minutes. Values may exceed 60.

ip. file name: Z:\2013 Projects\21335 Montano Ph III\Admin\Calcs\Prelim Drainage Study\Montano MAP 24 Depths.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.38	0.00	3.30	3.51	5.77	6.80	4.98
SCS 6-Hr	0.00	1.16	0.00	0.00	1.72	0.00	0.00	2.43
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development A-X1
2	SCS Runoff	Post-Development - South
3	Reservoir	South System
4	SCS Runoff	Pre-Development A-X2
5	SCS Runoff	Pre-Development A-X3

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	1.404	-------	-------	3.219	-------	-------	-------	Pre-Development A-X1
2	SCS Runoff	------	-------	8.722	-------	-------	13.48	-------	-------	-------	Post-Development - South
3	Reservoir	2	-------	0.638	-------	-------	1.539	-------	-------	-------	South System
4	SCS Runoff	------	-------	2.360	-------	-------	5.853	-------	-------	-------	Pre-Development A-X2
5	SCS Runoff	------	-------	0.708	-------	-------	1.620	-------	-------	-------	Pre-Development A-X3

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.404	2	610	11,793	------	------	------	Pre-Development A-X1
2	SCS Runoff	8.722	1	593	34,864	------	------	------	Post-Development - South
3	Reservoir	0.638	1	709	34,838	2	102.47	13,044	South System
4	SCS Runoff	2.360	2	610	21,195	------	------	------	Pre-Development A-X2
5	SCS Runoff	0.708	2	608	5,635	------	------	------	Pre-Development A-X3

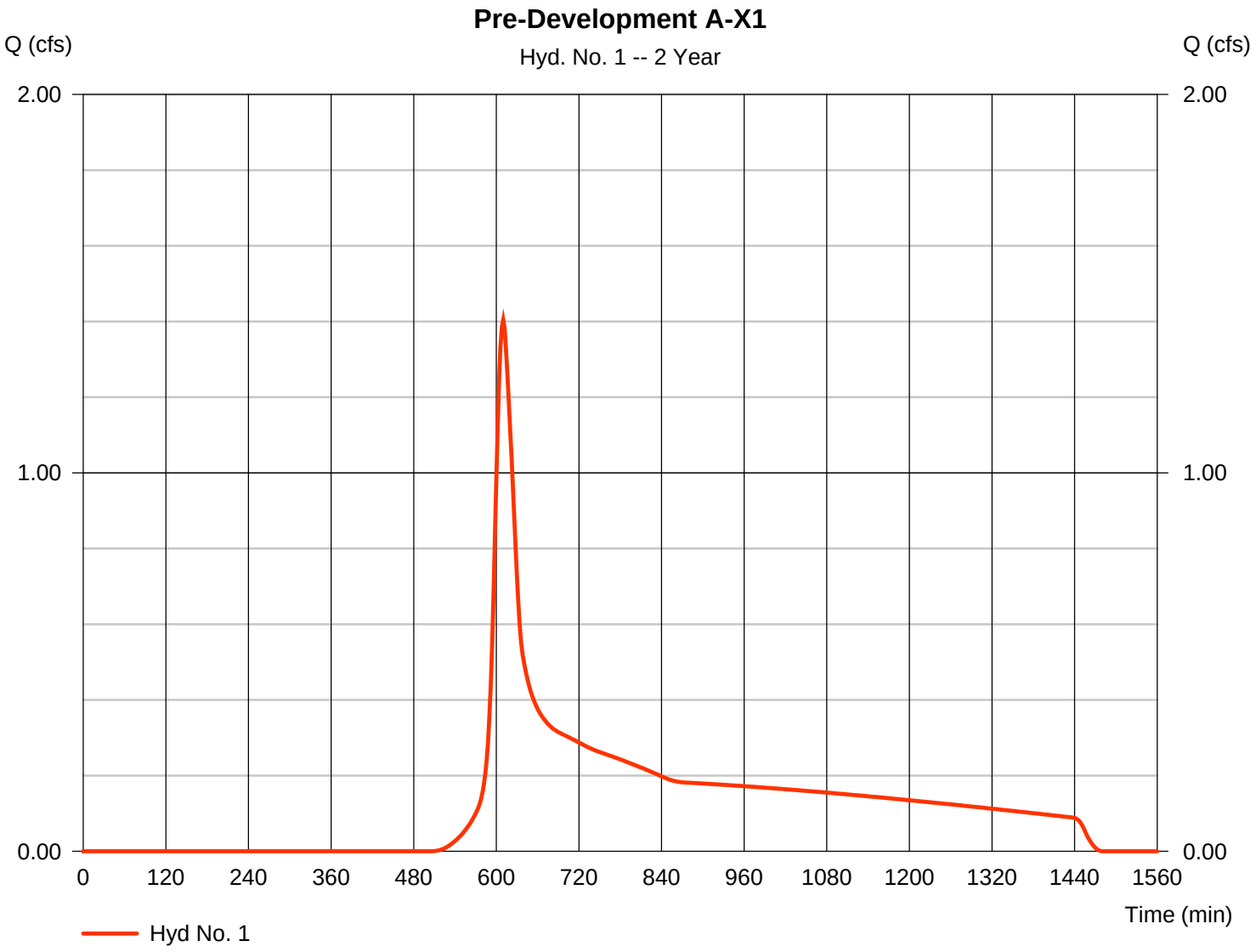
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.404 cfs
Storm frequency	= 2 yrs	Time to peak	= 610 min
Time interval	= 2 min	Hyd. volume	= 11,793 cuft
Drainage area	= 4.090 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.90 min
Total precip.	= 2.38 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.092 x 80)] / 4.090



TR55 Tc Worksheet

Hyd. No. 1

Pre-Development A-X1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.30		0.00		0.00		
Travel Time (min)	**= 23.72**	**+**	**0.00**	**+**	**0.00**	**=**	**23.72**
Shallow Concentrated Flow							
Flow length (ft)	= 92.00		0.00		0.00		
Watercourse slope (%)	= 20.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=7.36		0.00		0.00		
Travel Time (min)	**= 0.21**	**+**	**0.00**	**+**	**0.00**	**=**	**0.21**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 23.90 min

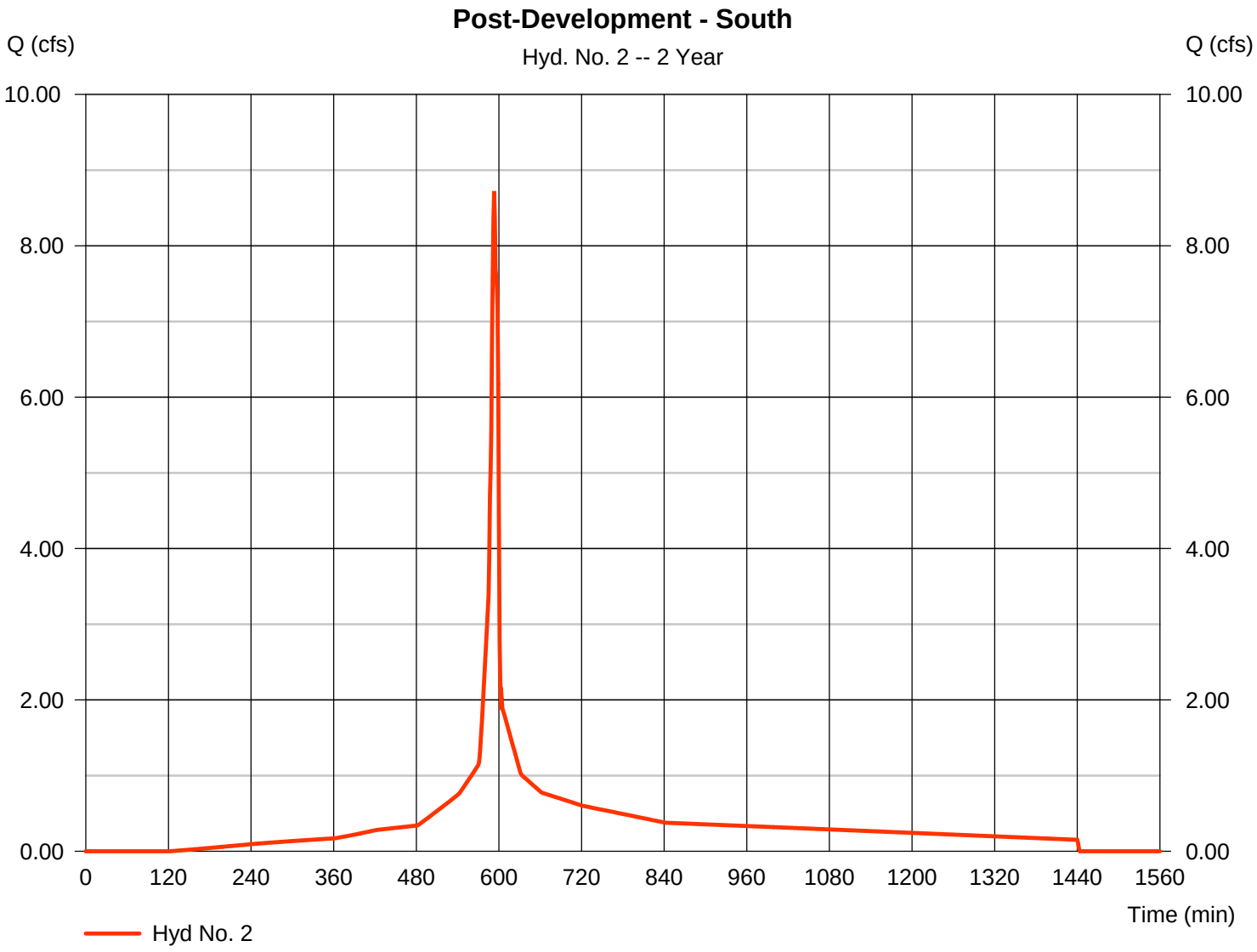
Hydrograph Report

Hyd. No. 2

Post-Development - South

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.722 cfs
Storm frequency	=	2 yrs	Time to peak	=	593 min
Time interval	=	1 min	Hyd. volume	=	34,864 cuft
Drainage area	=	5.270 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	2.70 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.527 x 80) + (4.739 x 98)] / 5.270



TR55 Tc Worksheet

Hyd. No. 2

Post-Development - South

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 231.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 2.40		0.00		0.00		
Travel Time (min)	**= 2.55**	**+**	**0.00**	**+**	**0.00**	**=**	**2.55**
Shallow Concentrated Flow							
Flow length (ft)	= 12.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=1.44		0.00		0.00		
Travel Time (min)	**= 0.14**	**+**	**0.00**	**+**	**0.00**	**=**	**0.14**
Channel Flow							
X sectional flow area (sqft)	= 0.79		0.00		0.00		
Wetted perimeter (ft)	= 3.14		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.012		0.015		0.015		
Velocity (ft/s)	=4.90						
			0.00				
					0.00		
Flow length (ft)	({0})13.0		0.0		0.0		
Travel Time (min)	**= 0.04**	**+**	**0.00**	**+**	**0.00**	**=**	**0.04**

Total Travel Time, Tc ..... 2.70 min

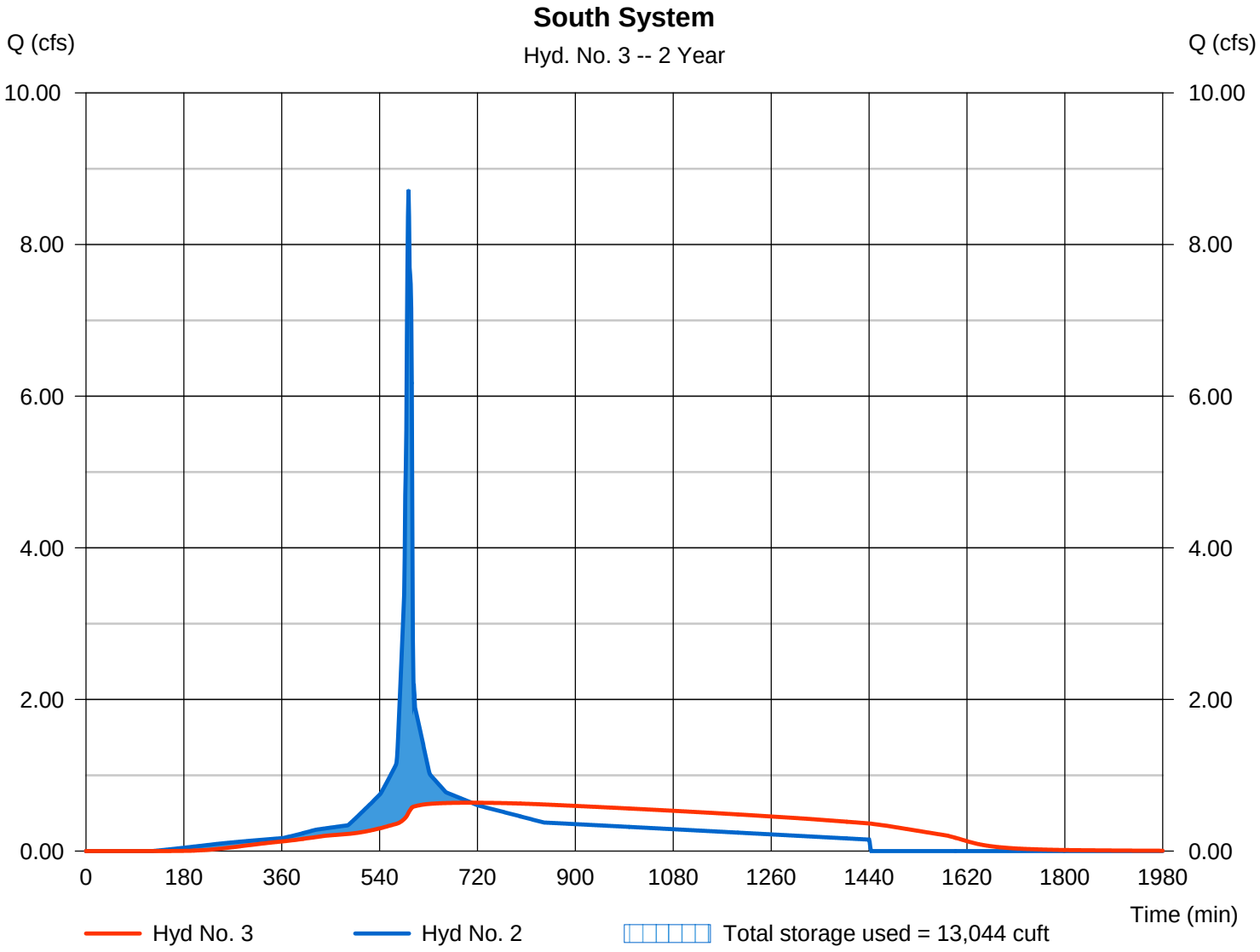
Hydrograph Report

Hyd. No. 3

South System

Hydrograph type	=	Reservoir	Peak discharge	=	0.638 cfs
Storm frequency	=	2 yrs	Time to peak	=	709 min
Time interval	=	1 min	Hyd. volume	=	34,838 cuft
Inflow hyd. No.	=	2 - Post-Development - South	Max. Elevation	=	102.47 ft
Reservoir name	=	South UG Detention	Max. Storage	=	13,044 cuft

Storage Indication method used.



Pond No. 1 - South UG Detention

Pond Data

UG Chambers -Invert elev. = 100.00 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 400.00 ft, No. Barrels = 4, Slope = 0.00%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	n/a	0	0
0.40	100.40	n/a	1,049	1,049
0.80	100.80	n/a	1,816	2,865
1.20	101.20	n/a	2,212	5,077
1.60	101.60	n/a	2,436	7,512
2.00	102.00	n/a	2,545	10,057
2.40	102.40	n/a	2,545	12,602
2.80	102.80	n/a	2,435	15,038
3.20	103.20	n/a	2,211	17,248
3.60	103.60	n/a	1,817	19,065
4.00	104.00	n/a	1,045	20,110

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 4.00	6.00	Inactive	0.00
Span (in)	= 4.00	6.00	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	103.00	103.00	0.00
Length (ft)	= 0.00	0.00	1.00	0.00
Slope (%)	= 0.00	0.00	1.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	100.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.04	105	100.04	0.00 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.004
0.08	210	100.08	0.02 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.016
0.12	315	100.12	0.03 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.033
0.16	420	100.16	0.06 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.056
0.20	524	100.20	0.08 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.083
0.24	629	100.24	0.11 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.112
0.28	734	100.28	0.14 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.141
0.32	839	100.32	0.17 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.166
0.36	944	100.36	0.18 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.185
0.40	1,049	100.40	0.20 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.203
0.44	1,231	100.44	0.22 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.220
0.48	1,412	100.48	0.24 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.235
0.52	1,594	100.52	0.25 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.250
0.56	1,775	100.56	0.26 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.263
0.60	1,957	100.60	0.28 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.277
0.64	2,139	100.64	0.29 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.289
0.68	2,320	100.68	0.30 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.301
0.72	2,502	100.72	0.31 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.313
0.76	2,683	100.76	0.32 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.324
0.80	2,865	100.80	0.33 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.334
0.84	3,086	100.84	0.34 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.345
0.88	3,307	100.88	0.35 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.355
0.92	3,529	100.92	0.36 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.365
0.96	3,750	100.96	0.37 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.374
1.00	3,971	101.00	0.38 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.384
1.04	4,192	101.04	0.39 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.393
1.08	4,413	101.08	0.40 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.402
1.12	4,634	101.12	0.41 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.410
1.16	4,855	101.16	0.42 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.419
1.20	5,077	101.20	0.43 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.427
1.24	5,320	101.24	0.44 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.435

Continues on next page...

South UG Detention

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	5,564	101.28	0.44 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.443
1.32	5,807	101.32	0.45 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.451
1.36	6,051	101.36	0.46 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.459
1.40	6,295	101.40	0.47 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.467
1.44	6,538	101.44	0.47 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.474
1.48	6,782	101.48	0.48 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.481
1.52	7,025	101.52	0.49 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.489
1.56	7,269	101.56	0.50 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.496
1.60	7,512	101.60	0.50 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.503
1.64	7,767	101.64	0.51 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.510
1.68	8,021	101.68	0.52 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.517
1.72	8,276	101.72	0.52 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.524
1.76	8,530	101.76	0.53 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.530
1.80	8,785	101.80	0.54 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.537
1.84	9,039	101.84	0.54 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.543
1.88	9,294	101.88	0.55 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.550
1.92	9,548	101.92	0.56 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.556
1.96	9,803	101.96	0.56 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.563
2.00	10,057	102.00	0.57 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.569
2.04	10,312	102.04	0.58 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.575
2.08	10,566	102.08	0.58 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.581
2.12	10,821	102.12	0.59 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.587
2.16	11,075	102.16	0.59 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.593
2.20	11,330	102.20	0.60 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.599
2.24	11,584	102.24	0.60 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.605
2.28	11,839	102.28	0.61 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.611
2.32	12,093	102.32	0.62 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.617
2.36	12,348	102.36	0.62 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.622
2.40	12,602	102.40	0.63 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.628
2.44	12,846	102.44	0.63 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.633
2.48	13,089	102.48	0.64 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.639
2.52	13,333	102.52	0.64 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.645
2.56	13,576	102.56	0.65 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.650
2.60	13,820	102.60	0.66 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.655
2.64	14,063	102.64	0.66 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.661
2.68	14,307	102.68	0.67 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.666
2.72	14,550	102.72	0.67 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.671
2.76	14,794	102.76	0.68 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.677
2.80	15,038	102.80	0.68 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.682
2.84	15,259	102.84	0.69 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.687
2.88	15,480	102.88	0.69 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.692
2.92	15,701	102.92	0.70 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.697
2.96	15,922	102.96	0.70 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.702
3.00	16,143	103.00	0.71 ic	0.00 ic	0.00	---	0.00	---	---	---	---	---	0.707
3.04	16,364	103.04	0.71 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.717
3.08	16,585	103.08	0.72 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.737
3.12	16,806	103.12	0.72 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.765
3.16	17,027	103.16	0.73 ic	0.07 ic	0.00	---	0.00	---	---	---	---	---	0.801
3.20	17,248	103.20	0.73 ic	0.11 ic	0.00	---	0.00	---	---	---	---	---	0.843
3.24	17,430	103.24	0.74 ic	0.16 ic	0.00	---	0.00	---	---	---	---	---	0.892
3.28	17,611	103.28	0.74 ic	0.20 ic	0.00	---	0.00	---	---	---	---	---	0.945
3.32	17,793	103.32	0.75 ic	0.26 ic	0.00	---	0.00	---	---	---	---	---	1.002
3.36	17,975	103.36	0.75 ic	0.31 ic	0.00	---	0.00	---	---	---	---	---	1.060
3.40	18,157	103.40	0.76 ic	0.36 ic	0.00	---	0.00	---	---	---	---	---	1.118
3.44	18,338	103.44	0.76 ic	0.41 ic	0.00	---	0.00	---	---	---	---	---	1.173
3.48	18,520	103.48	0.76 ic	0.46 ic	0.00	---	0.00	---	---	---	---	---	1.222
3.52	18,702	103.52	0.77 ic	0.49 ic	0.00	---	0.00	---	---	---	---	---	1.261
3.56	18,883	103.56	0.77 ic	0.53 ic	0.00	---	0.00	---	---	---	---	---	1.300
3.60	19,065	103.60	0.78 ic	0.56 ic	0.00	---	0.00	---	---	---	---	---	1.338
3.64	19,170	103.64	0.78 ic	0.59 ic	0.00	---	0.00	---	---	---	---	---	1.373
3.68	19,274	103.68	0.79 ic	0.62 ic	0.00	---	0.00	---	---	---	---	---	1.407
3.72	19,379	103.72	0.79 ic	0.65 ic	0.00	---	0.00	---	---	---	---	---	1.440
3.76	19,483	103.76	0.80 ic	0.68 ic	0.00	---	0.00	---	---	---	---	---	1.471
3.80	19,588	103.80	0.80 ic	0.70 ic	0.00	---	0.00	---	---	---	---	---	1.502
3.84	19,692	103.84	0.81 ic	0.73 ic	0.00	---	0.00	---	---	---	---	---	1.531
3.88	19,797	103.88	0.81 ic	0.75 ic	0.00	---	0.00	---	---	---	---	---	1.560
3.92	19,901	103.92	0.81 ic	0.77 ic	0.00	---	0.00	---	---	---	---	---	1.588
3.96	20,006	103.96	0.82 ic	0.80 ic	0.00	---	0.00	---	---	---	---	---	1.615
4.00	20,110	104.00	0.82 ic	0.82 ic	0.00	---	0.00	---	---	---	---	---	1.641

...End

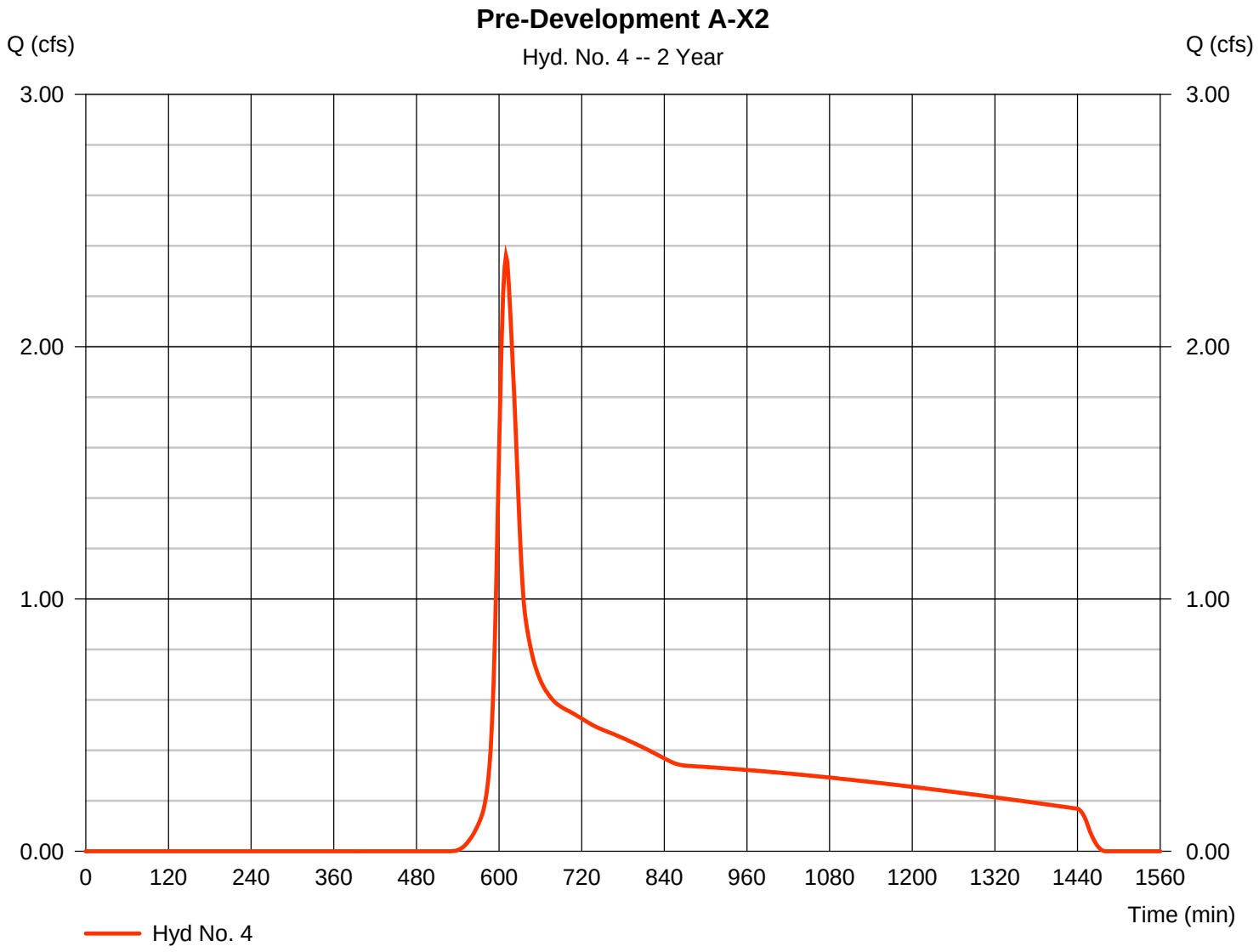
Hydrograph Report

Hyd. No. 4

Pre-Development A-X2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.360 cfs
Storm frequency	=	2 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	21,195 cuft
Drainage area	=	8.340 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.174 x 80)] / 8.340



TR55 Tc Worksheet

Hyd. No. 4

Pre-Development A-X2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 7.60		0.00		0.00		
Travel Time (min)	**= 23.34**	**+**	**0.00**	**+**	**0.00**	**=**	**23.34**
Shallow Concentrated Flow							
Flow length (ft)	= 206.00		0.00		0.00		
Watercourse slope (%)	= 7.90		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.53		0.00		0.00		
Travel Time (min)	**= 0.76**	**+**	**0.00**	**+**	**0.00**	**=**	**0.76**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 24.10 min

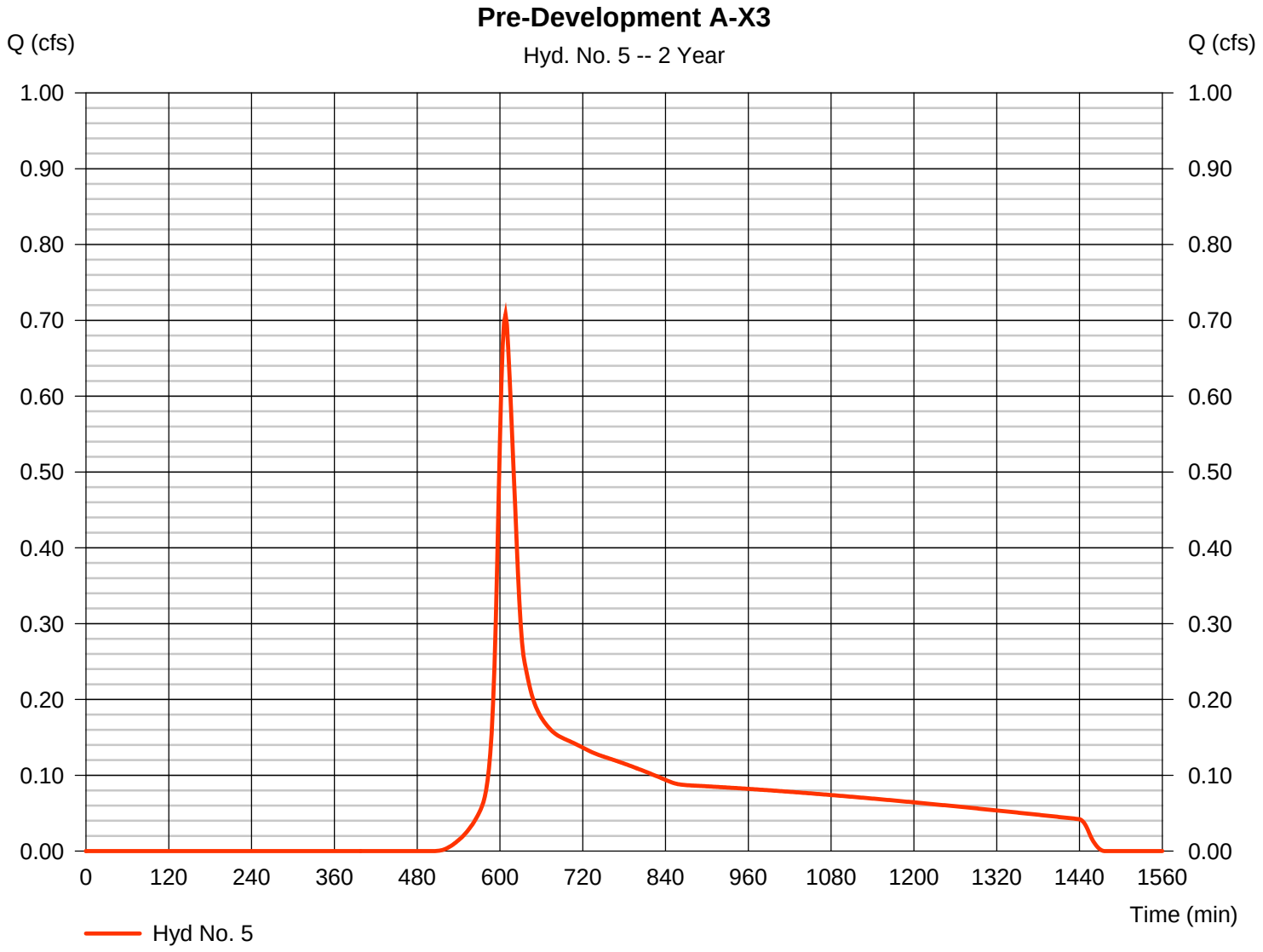
Hydrograph Report

Hyd. No. 5

Pre-Development A-X3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.708 cfs
Storm frequency	=	2 yrs	Time to peak	=	608 min
Time interval	=	2 min	Hyd. volume	=	5,635 cuft
Drainage area	=	1.890 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.00 min
Total precip.	=	2.38 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.840 x 80) + (0.047 x 98)] / 1.890



TR55 Tc Worksheet

Hyd. No. 5

Pre-Development A-X3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 294.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.38		0.00		0.00		
Land slope (%)	= 11.10		0.00		0.00		
Travel Time (min)	**= 19.73**	**+**	**0.00**	**+**	**0.00**	**=**	**19.73**
Shallow Concentrated Flow							
Flow length (ft)	= 158.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.14		0.00		0.00		
Travel Time (min)	**= 2.31**	**+**	**0.00**	**+**	**0.00**	**=**	**2.31**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 22.00 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.219	2	610	24,031	------	------	------	Pre-Development A-X1
2	SCS Runoff	13.48	1	593	54,793	------	------	------	Post-Development - South
3	Reservoir	1.539	1	633	54,767	2	103.85	19,722	South System
4	SCS Runoff	5.853	2	610	44,850	------	------	------	Pre-Development A-X2
5	SCS Runoff	1.620	2	608	11,482	------	------	------	Pre-Development A-X3

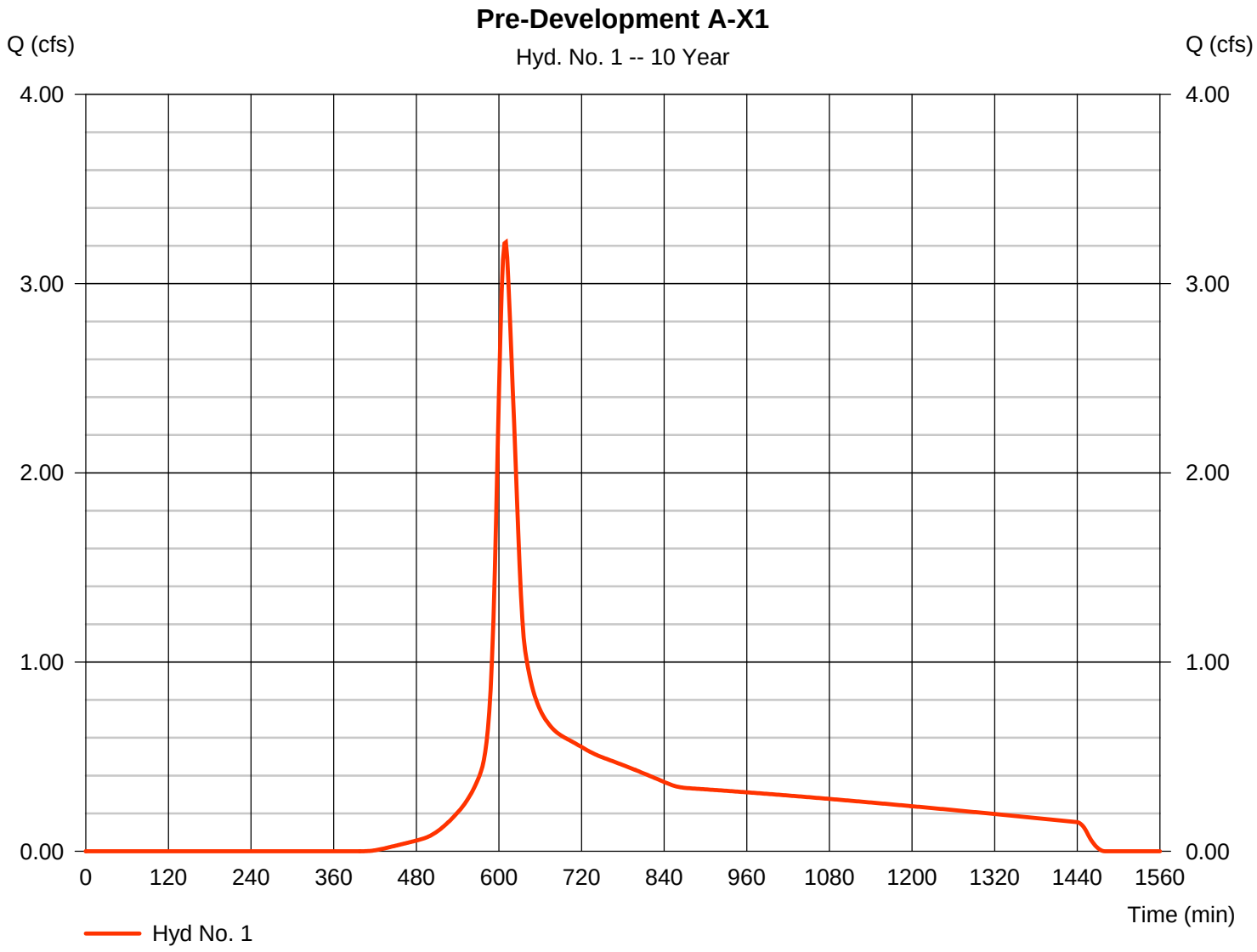
Hydrograph Report

Hyd. No. 1

Pre-Development A-X1

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.219 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	24,031 cuft
Drainage area	=	4.090 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.90 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(4.092 x 80)] / 4.090



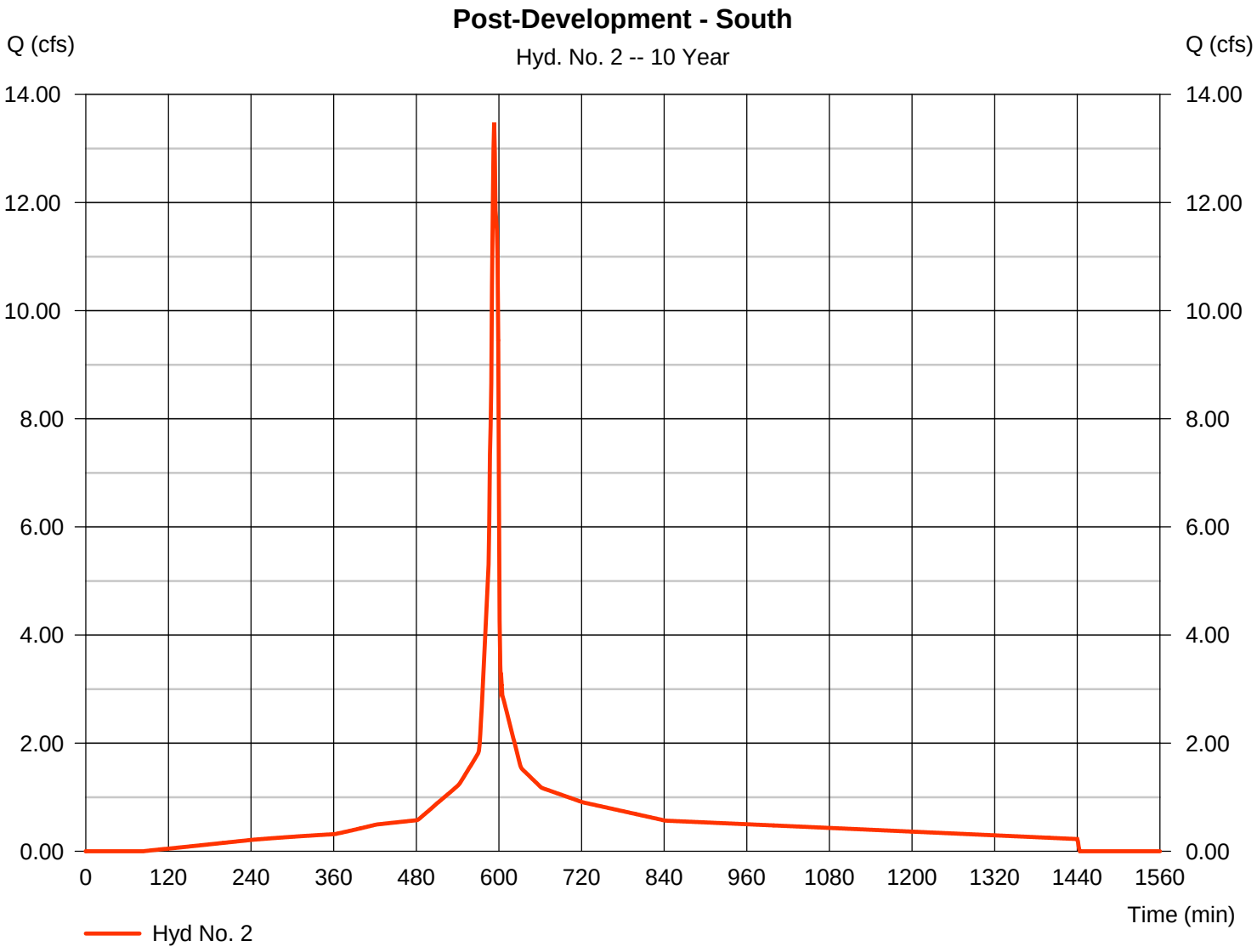
Hydrograph Report

Hyd. No. 2

Post-Development - South

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.48 cfs
Storm frequency	=	10 yrs	Time to peak	=	593 min
Time interval	=	1 min	Hyd. volume	=	54,793 cuft
Drainage area	=	5.270 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	2.70 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.527 x 80) + (4.739 x 98)] / 5.270



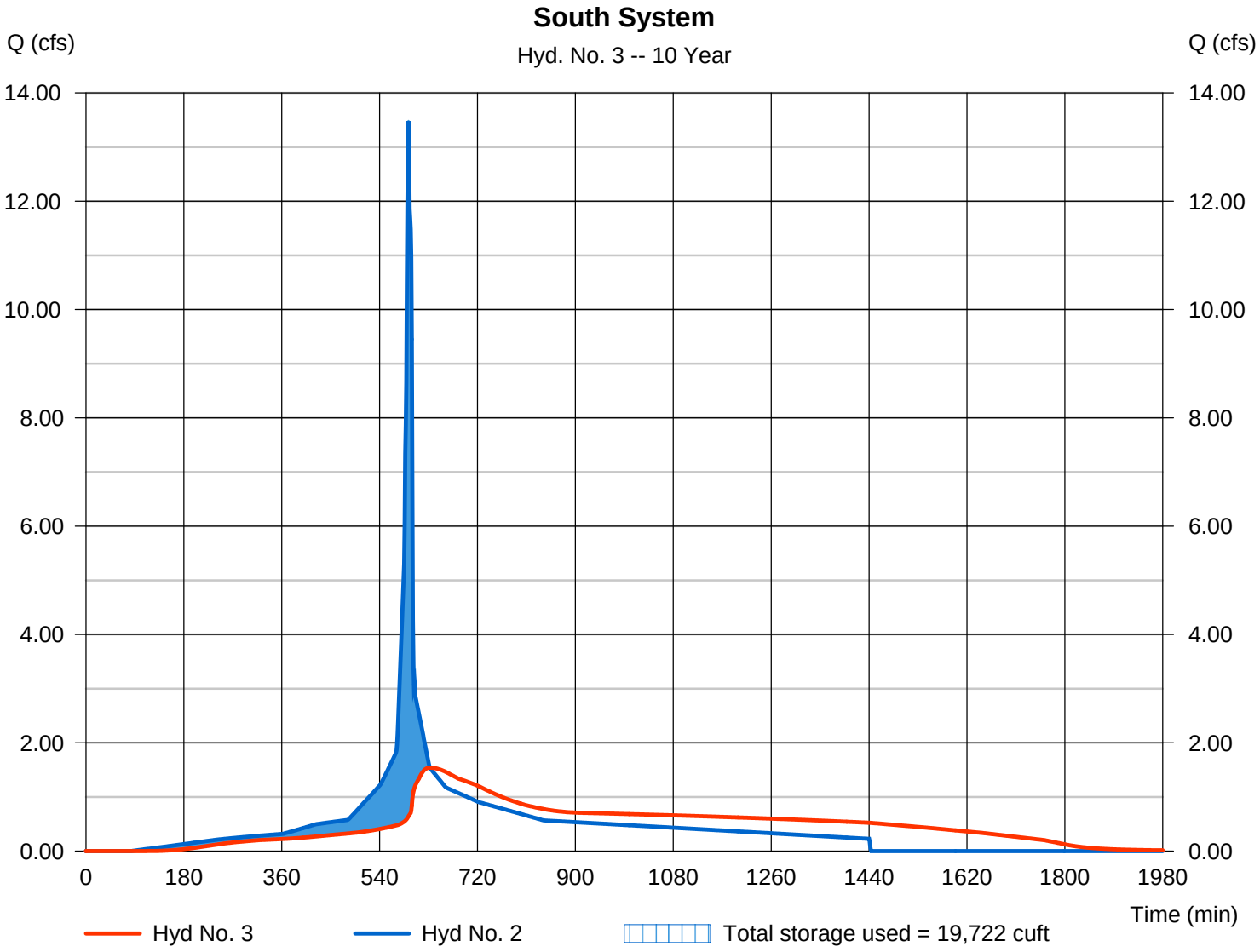
Hydrograph Report

Hyd. No. 3

South System

Hydrograph type	=	Reservoir	Peak discharge	=	1.539 cfs
Storm frequency	=	10 yrs	Time to peak	=	633 min
Time interval	=	1 min	Hyd. volume	=	54,767 cuft
Inflow hyd. No.	=	2 - Post-Development - South	Max. Elevation	=	103.85 ft
Reservoir name	=	South UG Detention	Max. Storage	=	19,722 cuft

Storage Indication method used.



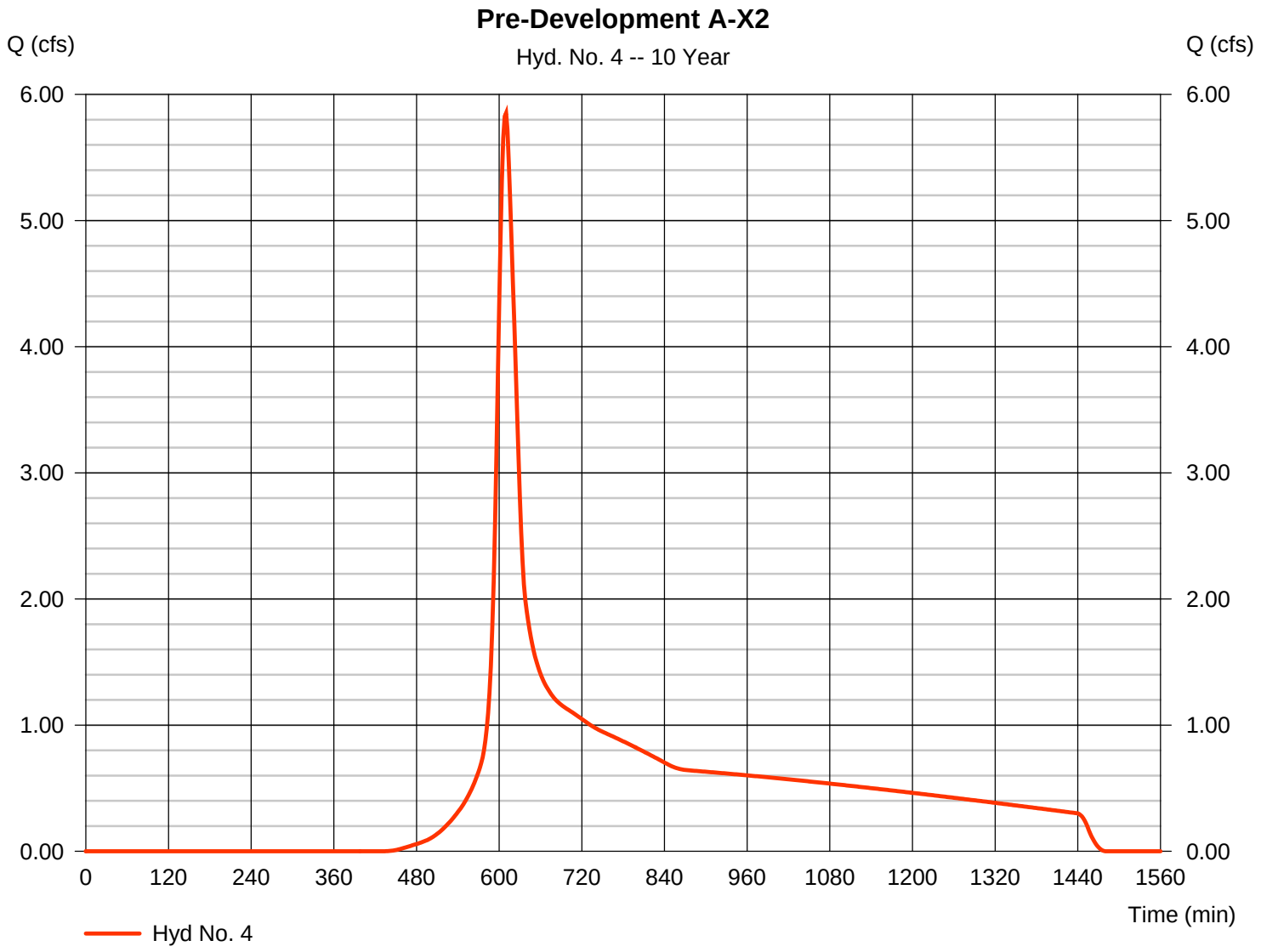
Hydrograph Report

Hyd. No. 4

Pre-Development A-X2

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.853 cfs
Storm frequency	=	10 yrs	Time to peak	=	610 min
Time interval	=	2 min	Hyd. volume	=	44,850 cuft
Drainage area	=	8.340 ac	Curve number	=	78*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.10 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(8.174 x 80)] / 8.340



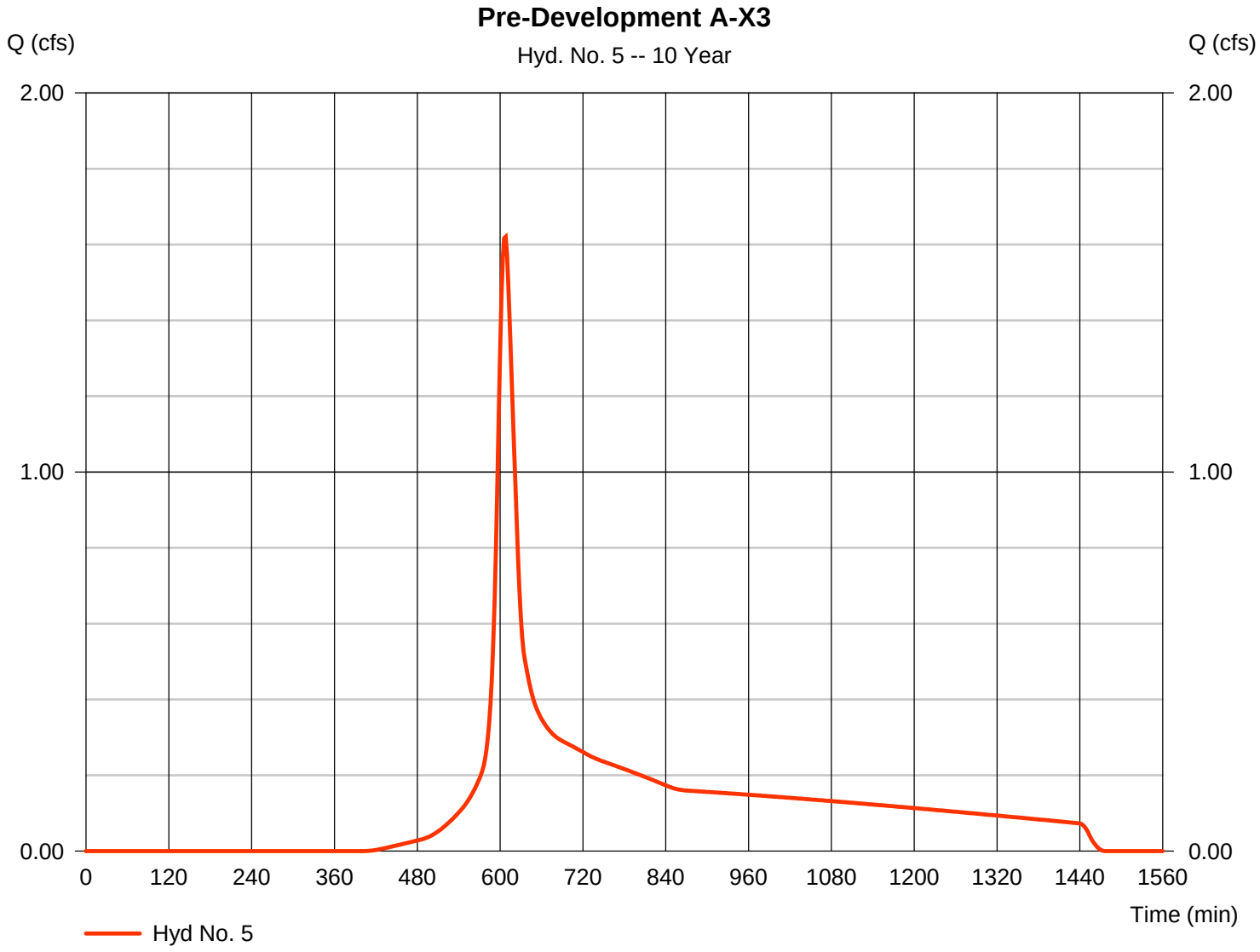
Hydrograph Report

Hyd. No. 5

Pre-Development A-X3

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.620 cfs
Storm frequency	=	10 yrs	Time to peak	=	608 min
Time interval	=	2 min	Hyd. volume	=	11,482 cuft
Drainage area	=	1.890 ac	Curve number	=	80*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.00 min
Total precip.	=	3.51 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.840 x 80) + (0.047 x 98)] / 1.890



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	3.3705	0.1000	0.4857	--------
3	0.0000	0.0000	0.0000	--------
5	0.0000	0.0000	0.0000	--------
10	4.9332	0.1000	0.4842	--------
25	0.0000	0.0000	0.0000	--------
50	0.0000	0.0000	0.0000	--------
100	6.9679	0.1000	0.4832	--------

File name: Montano MAP 24 IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.53	1.10	0.90	0.78	0.70	0.65	0.60	0.56	0.53	0.50	0.48	0.46
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.24	1.61	1.33	1.15	1.04	0.95	0.88	0.83	0.78	0.74	0.71	0.68
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	3.17	2.28	1.88	1.63	1.47	1.35	1.25	1.17	1.11	1.05	1.00	0.96

Tc = time in minutes. Values may exceed 60.

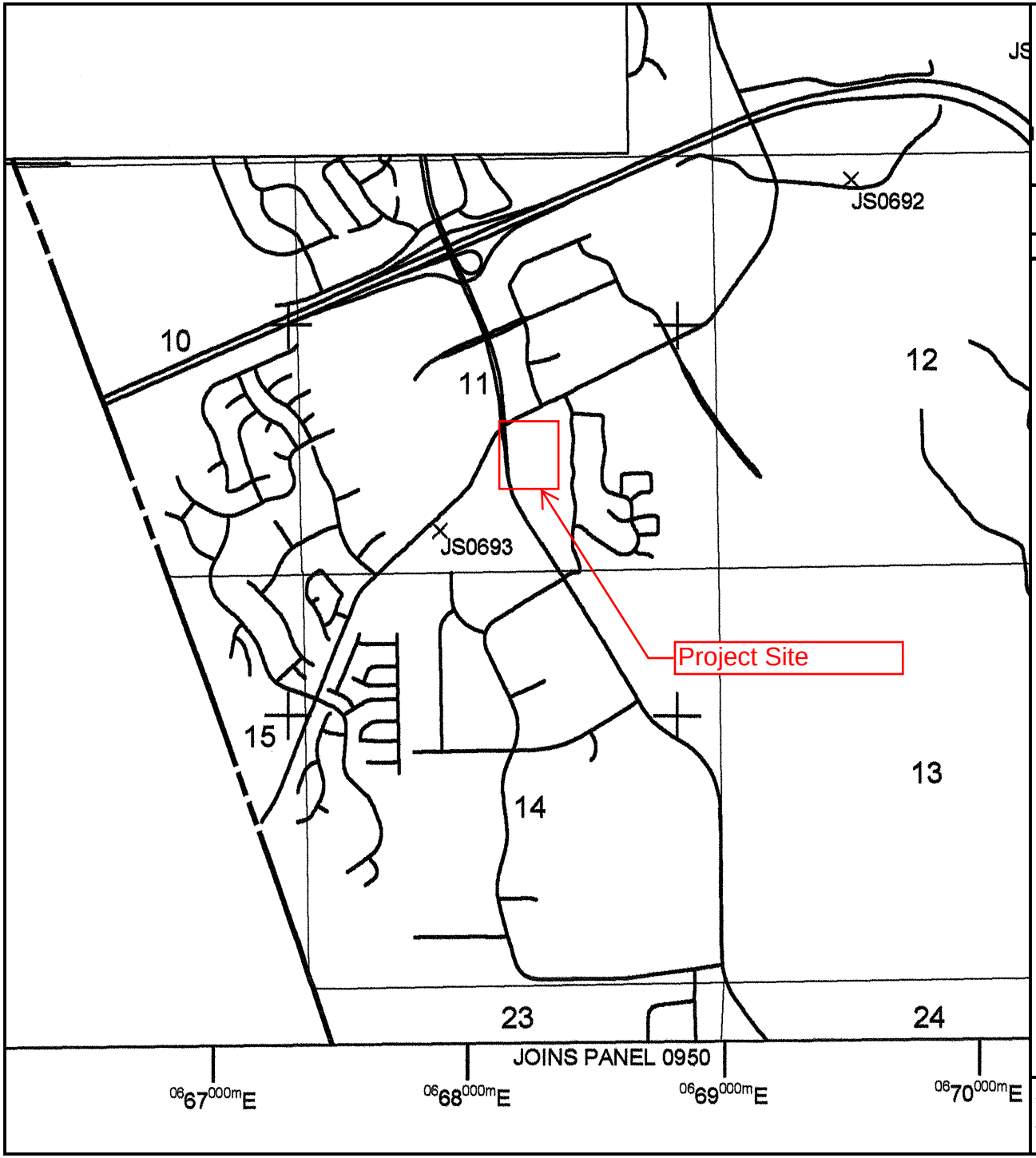
ip. file name: Z:\2013 Projects\21335 Montano Ph III\Admin\Calcs\Prelim Drainage Study\Montano MAP 24 Depths.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.38	0.00	3.30	3.51	5.77	6.80	4.98
SCS 6-Hr	0.00	1.16	0.00	0.00	1.72	0.00	0.00	2.43
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

Hydraflow Table of Contents

APPENDIX F

FEMA FLOOD MAP



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0725E

FIRM

FLOOD INSURANCE RATE MAP

EL DORADO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 725 OF 1125

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL DORADO COUNTY	060040	0725	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06017C0725E

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency