

DRAFT

Duke Patterson and Nance

P21-00005

City of Perris, Riverside County, California

Preliminary Drainage Study

Prepared for:

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SECTION 1 - SUMMARY

PURPOSE

The purpose of this report is to document the hydrologic and hydraulic analyses performed in support of the Duke Patterson and Nance project located in the City of Perris, County of Riverside, California. The Duke Patterson and Nance Project is located south of Harley Knox Boulevard, north of Nance Street, and situated between Patterson Avenue and Nevada Avenue. The existing land use is mostly vacant and barren with minimal vegetative scrub. There is an existing pervious area in the northwest corner that seems to be an area where container trailers are stored. The trailers will be moved and none of the existing buildings between the northerly property boundary and Harley Knox Boulevard will be demolished. The planned site condition will propose a commercial/ industrial warehouse on roughly 35.6 acres. This report will summarize the hydrologic and hydraulic analyses that were conducted to determine the necessary drainage improvements required to provide flood protection for the proposed building and safely convey the runoff through the site.

The scope of this report will include the following:

- Determine the peak 100-year and 10-year flow rates for the developed condition using the Riverside County Flood Control and Water Conservation District (RCFC&WCD) Rational Method.
- Determine the required storm drain facilities, alignment, and sizes required to flood protect the project site.
- Preparation of a preliminary report summarizing the hydrology and hydraulic results.

DESCRIPTION OF WATERSHED

As previously described, the Duke Patterson & Nance Project is located south of Harley Knox Boulevard, north of Nance Street, and situated between Patterson Avenue and Nevada Avenue. The existing land use is mostly vacant and barren with minimal vegetative scrub. There is an existing pervious area in the northwest corner that seems to be an area where container trailers are stored. The trailers will be moved and none of the existing buildings between the northerly property boundary and Harley Knox Boulevard will be demolished. The existing topography slopes approximately 1.0% in a southwest to northeast direction. Existing elevations range from approximately 1499 in the southwest corner to 1486 in the northeast corner (NAVD88). The existing drainage path is characterized by sheet flows that follow the existing topography.

The project is located within the Perris Valley Commerce Center (PVCC) specific plan and is also within the Perris Valley Master Drainage Plan (PVMDP) watershed area.

PROPOSED CONDITIONS

The planned site condition will propose a commercial/ industrial warehouse (approximately 760,000 square-feet) on roughly 35.6 acres. The project proposes truck and auto parking as well as 10% of landscaped area. All on-site flows generated from the project will be collected by proposed underground chambers located in the easternmost drive aisle. The underground chambers will fully store the water quality volume which will be pumped into a Contech Bioscape modular wetland for treatment. All high intensity flows will overflow into a high flow bypass within the underground chambers and gravity flow north via MDP Lateral-B6.1 in Nevada Avenue to the existing Caltrans RCB running parallel to Harley Knox Boulevard. The proposed project is within an HCOC exemption area; proposed land use flowrates will not be required to match existing land use flowrates.

Two Perris Valley MDP drainage facilities will have to be constructed to flood protect this project and the surrounding area. A portion of MDP Lateral-B6 in Patterson Avenue is needed to flood protect the site

from the tributary area between Patterson Avenue and Interstate-215; it will have to be designed to ultimate tributary runoff conditions. MDP Lateral-B6.1 in Nevada Avenue is needed to drain the proposed project.

The tributary drainage capacity of these two MDP facilities highly depends on the capacity of the existing 8'Wx7'H to 8'Wx6'H Caltrans RCB running parallel to Harley Knox Boulevard. Currently, there is roughly 50 cfs of capacity in the Caltrans RCB assuming 5" of freeboard per the Caltrans RCB Capacity technical memo provided in Appendix C. The two MDP storm drains will add approximately 180-cfs during the ultimate condition.

However, Perris Valley MDP facility Lateral-B Stage 4 (currently under design) will cutoff roughly 300-cfs of tributary runoff, after accounting for confluences, from the existing Caltrans RCB. The Lateral-B Stage 4 plan is proposing to construct a stub out for future connection to the existing Caltrans RCB. The Lateral B-Stage 4 and the future connection will be constructed by RCFC&WCD from the proposed Lateral-B stub out, across APN(s) 294-220-007 and/or -010 to the existing Caltrans RCB where it turns south along Patterson Avenue (see long axis exhibit in Line-B references in Appendix C).

The upstream connection to MDP Lateral-B will provide an additional 300-cfs of capacity in the Caltrans RCB. This connection must be made for the Caltrans RCB to have capacity for unrestricted runoff from MDP Lateral-B6 and Lateral-B6.1 under ultimate conditions. However, in the interim condition the timing of the runoff from the project is such that the time to drain down is significantly less than the time of concentration of waters upstream have to travel to reach the connection point for Lateral-B6 and Lateral B6.1.

METHODOLOGY

HYDROLOGY

Hydrologic calculations were performed in accordance with the RCFC&WCD Hydrology Manual, dated April 1978. The Rational Method was utilized in determining peak flow rates.

The hydrological parameters, including rainfall values and soil types were derived from the RCFC&WCD Hydrology Manual. The isohyetal maps and soil map have been included in Section 2.

Rational Method calculations were performed using a computer program developed by CivilDesign Corporation and Joseph E. Bonadiman and Associates Inc. The computer program is commonly referred to as CivilD which incorporates the hydrological parameters outlined in the RCFC&WCD Hydrology Manual.

The Rational Method was used to determine the peak flow rates to size and design the drainage facilities need to convey on-site flows through the site to the proposed basin. The flow rates were computed by generating a hydrologic "link-node" model in which the overall area is divided into separate drainage sub-areas, each tributary to a concentration point (node) determined by the proposed/existing layout and grading. See Section 2 for additional information and results regarding the hydrologic analyses performed for this project

HYDRAULICS

Hydraulic analyses were completed using CivilD normal depth calculations provided by the rational method output. Analyses were also completed using normal depth calculations from FHWA Hydraulic Toolbox v. 4.4. See section 3 for additional information and results regarding the hydraulic analyses performed for this project.

FIG. 1 VICINITY MAP

FIG. 2 USGS TOPOGRAPHY MAP

FIG. 3 AERIAL PHOTOGRAPH

FIG. 4 RECEIVING WATERBODIES

FIG. 5 SOILS MAP

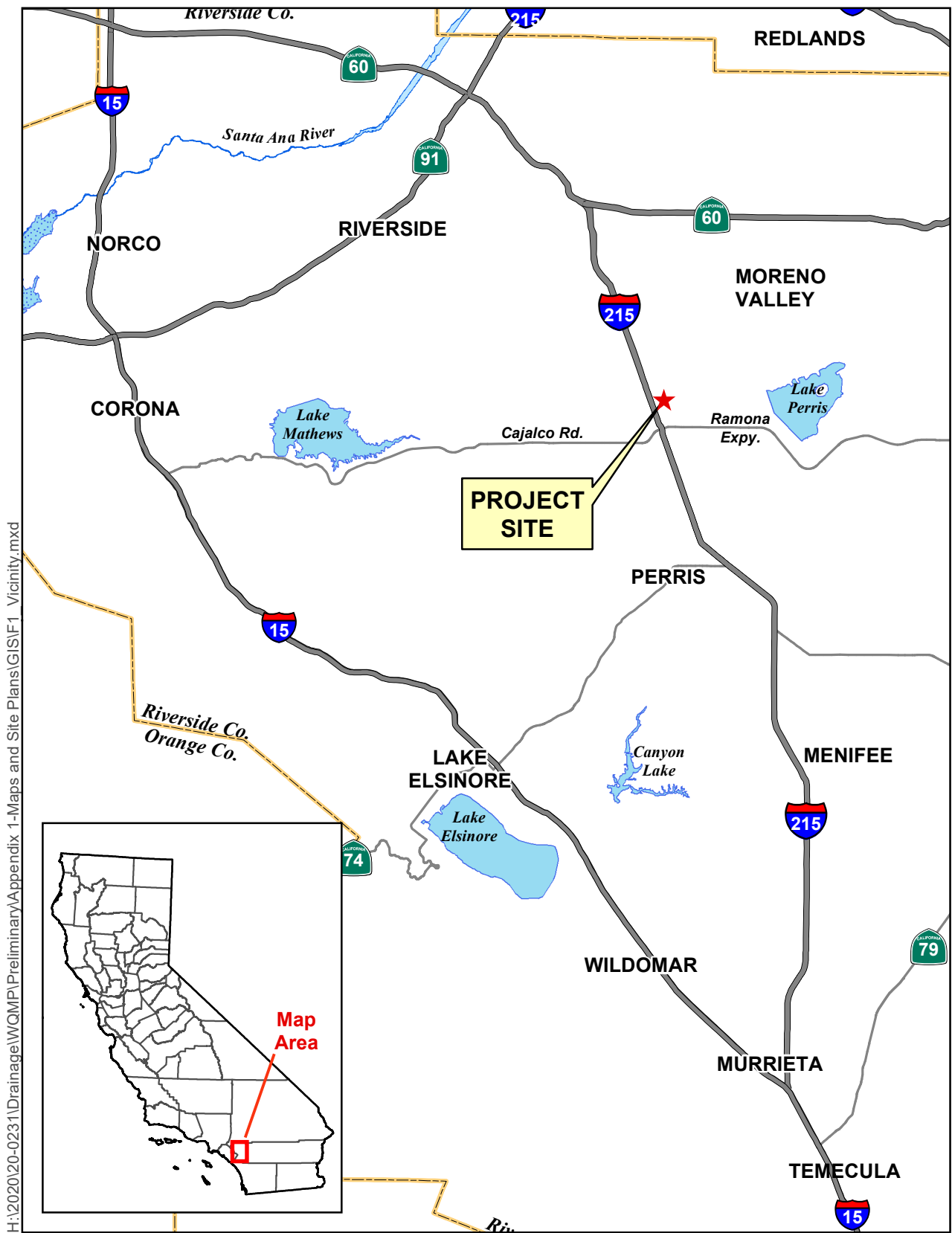
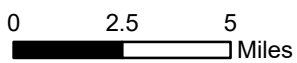
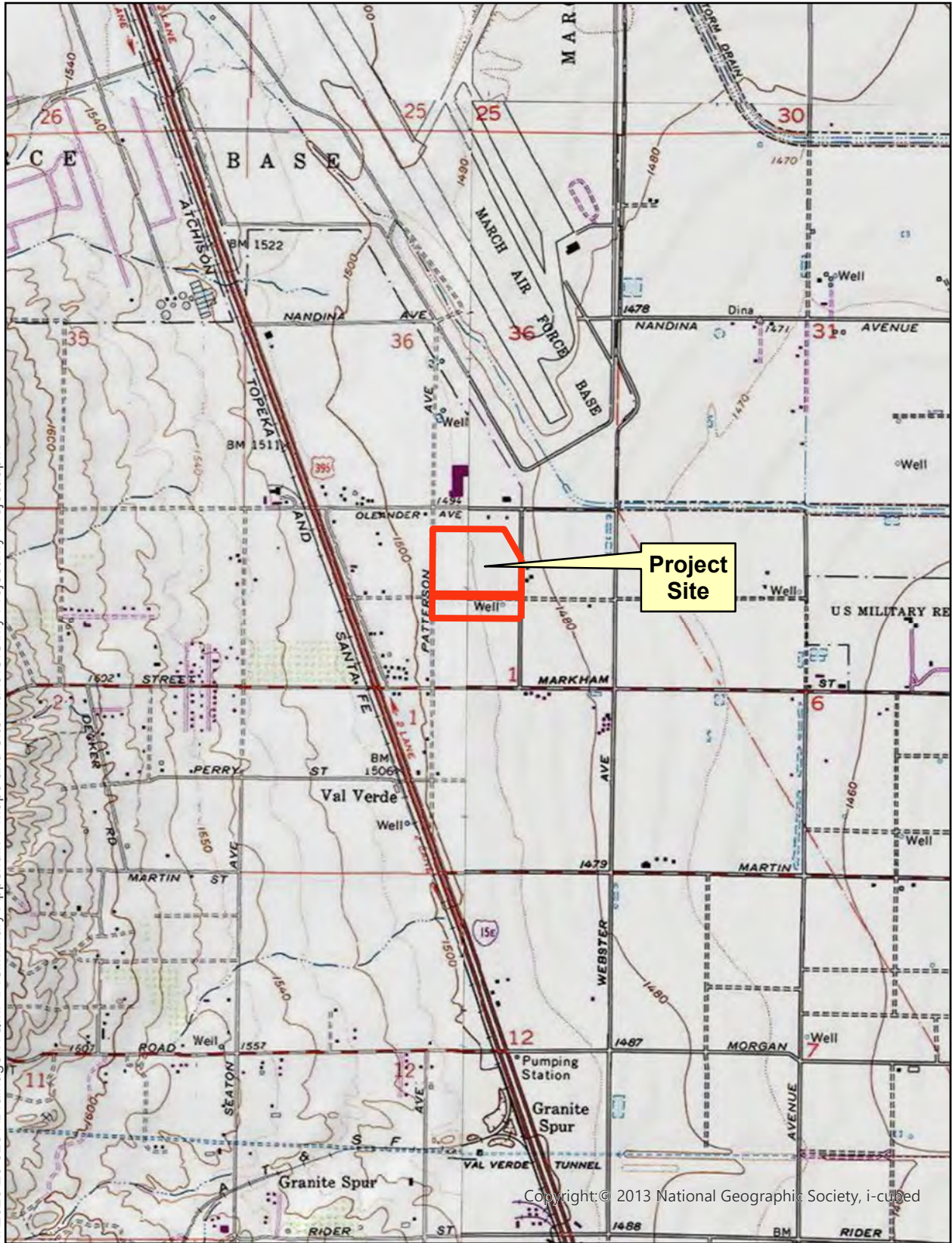


Figure 1. Vicinity Map



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Copyright © 2013 National Geographic Society, i-cubed

Sources: ESRI / USGS 7.5min Quad
DRGs: PERRIS

Figure 2. USGS Topography Map

0 1,000 2,000
Feet



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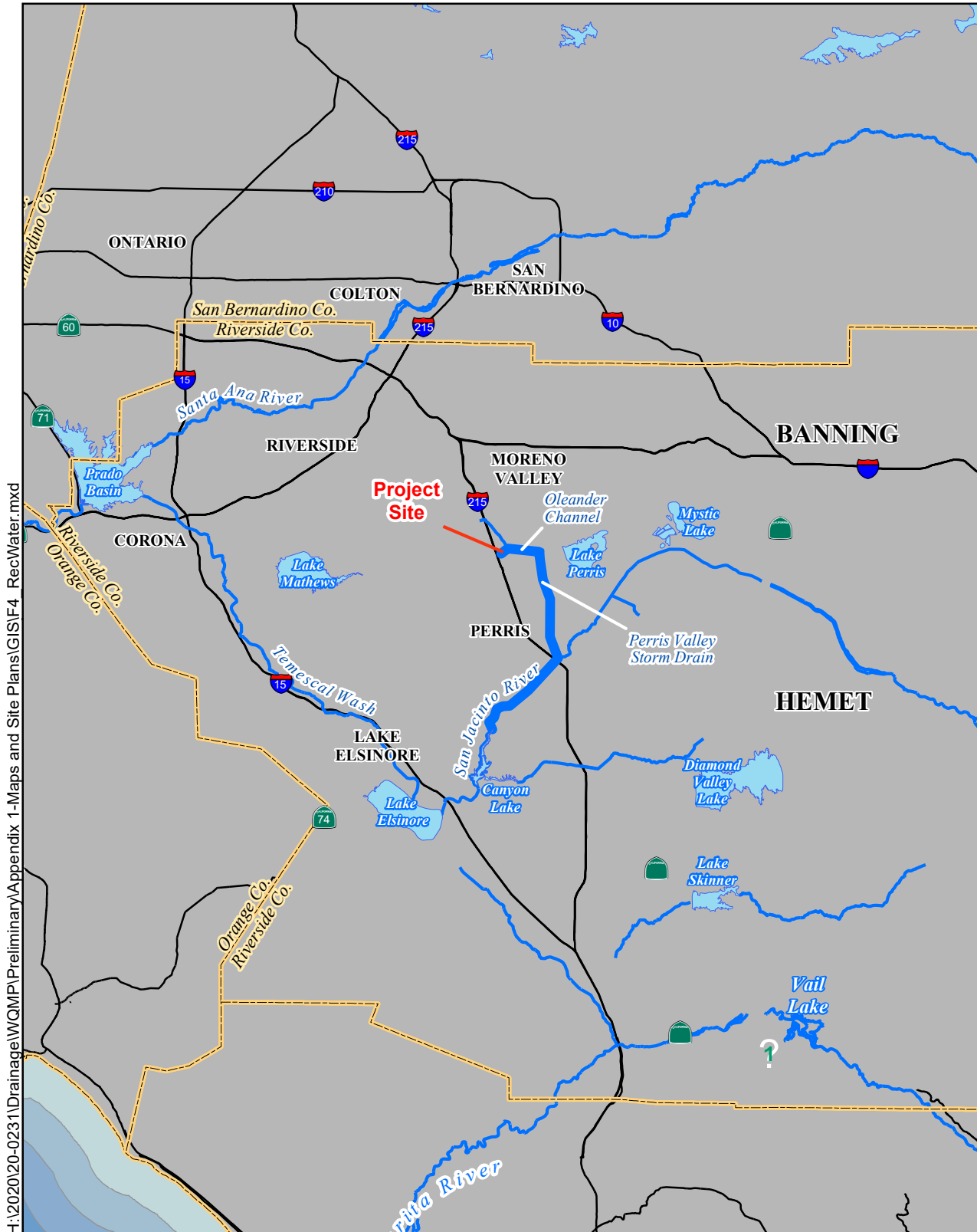


Sources: County of Riverside GIS; Eagle Aerial, 2016.

Figure 3. Aerial Photograph

0 500 1,000 Feet





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Sources: USGS 30 Meter DEM;
USGS Digital Line Graph

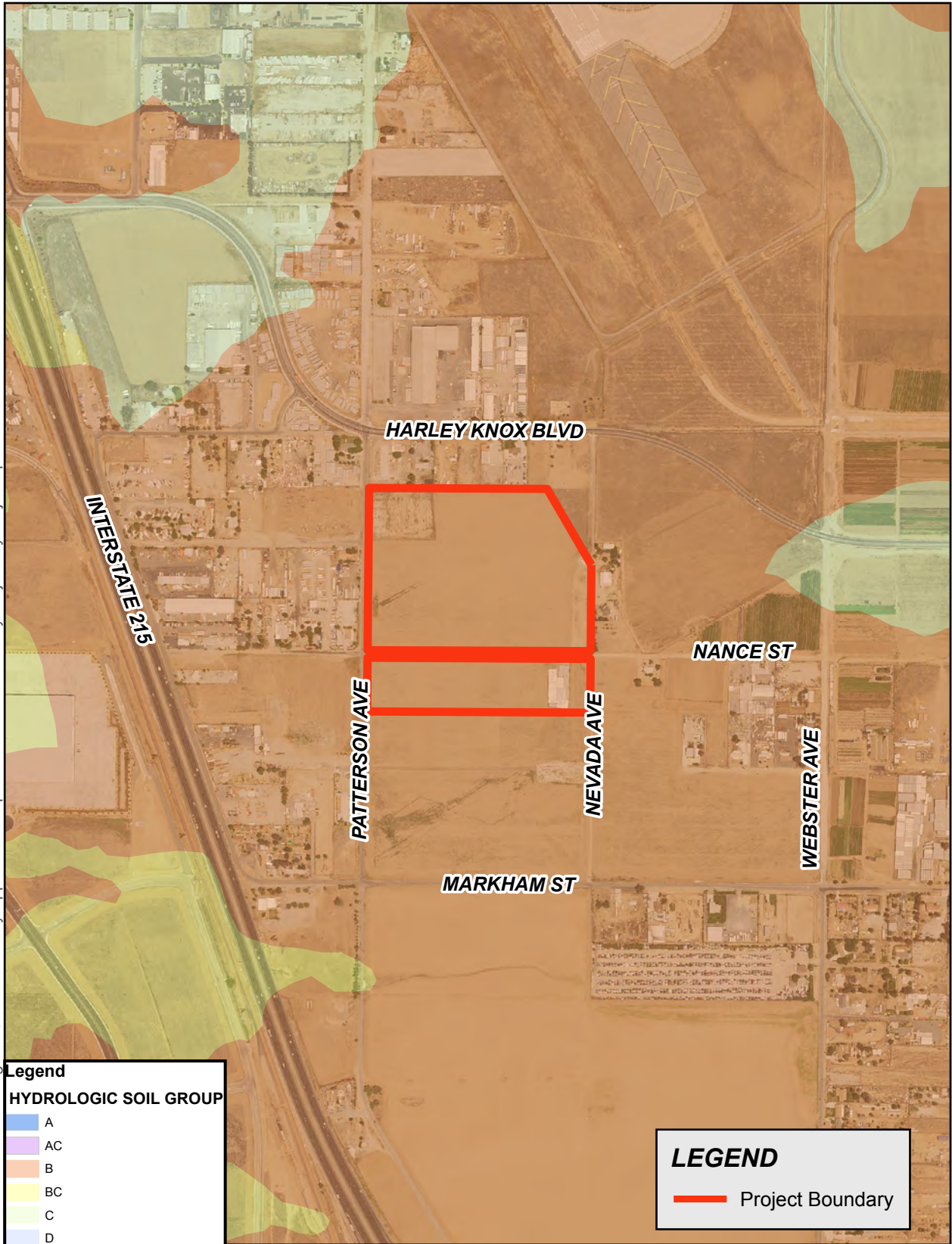
Figure 4. Receiving Waterbodies

0 2 4 6
Miles

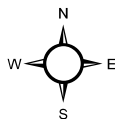


Flowpath

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Eagle Aerial, April 2010;
Riverside County GIS, 2012
RCFC&WCD Hydology Manual Plate C-1.30



0 500 1,000
Feet

Figure 5. Soils Map

SECTION 2 - HYDROLOGY ANALYSIS

HYDROLOGY PARAMETERS

The RCFC&WCD Hydrology Manual was used to determine several of the hydrological parameters. The following rainfall depths were utilized in the hydrology analyses, which were obtained from Plate D-4.1 provided in the RCFC&WCD Hydrology Manual:

Table 1 - Precipitation Values

	Duration
Storm Event	1-Hour (inches)
10-Year	0.78
100-Year	1.12

The value for slope of intensity was determined to be 0.49. The hydrological parameters have been included in Appendix A.

Based on the Plates C-1.29 and -1.30 in the RCFC&WCD Hydrology Manual, the project site is classified as soil type B. The soils maps are included in Appendix A.

The cover type was determined based on the existing land cover and proposed land use of the site. Hydrological computations for the existing condition were done using 'Undeveloped - Poor Cover'. The residential\commercial landscaping cover type was used to represent the developed condition. Table 2 below summarizes the runoff index values and the recommended values for percentage of impervious cover for each category:

Table 2 - Cover Type

Cover Type	Soil Group A	Soil Group B	Soil Group C	Soil Group D	Percentage of Impervious Cover
Undeveloped Poor Cover	67	78	86	89	0%
Commercial Landscaping	32	56	69	75	90%

ON-SITE RATIONAL METHOD HYDROLOGY

The rational method was used to determine peak flow rates to adequately size the proposed subsurface storm drains and associated inlets used to convey on-site flows through the site and into the existing Caltrans RCB via MDP Lateral-B6.1.

The site is broken up into two watersheds, north and south. Watershed-1 is the northern portion of the site tributary to Line-1, and Watershed-2 is the southern portion tributary to Line-2. Watershed-1 produces 35.9-cfs and Watershed-2 produces 41.2-cfs during a 100-yr storm event.

A peak 100-year flow rate of 72.4-cfs is generated by the site. An emergency outlet in the proposed underground chambers will be provided that is capable of bypassing the peak 100-year flow rate.

Table 3 - On-Site Rational Method Results

Point of Interest	10-Year Peak Flow Rate (cfs)	100-Year Peak Flow Rate (cfs)
Node 101 - Flow tributary to upstream Line-1	11.4	16.6
Node 102 - Flow tributary to Lat-1B	6.0	8.0
Node 103 - Flow tributary to Lat-1A	7.2	10.6
Node 104 - Flow tributary to downstream Line-1	24.7	35.9
Node 201 - Flow tributary to upstream Line-2	15.6	22.6
Node 202 - Flow tributary to Lat-2B	6.8	10.0
Node 203 - Flow tributary to Lat-2A	5.8	8.6
Node 204 - Flow tributary to downstream Line-2	28.2	41.2
Total Site Runoff - Flow tributary to Lateral-B6.1	49.8	72.4

OFF-SITE RATIONAL METHOD HYDROLOGY

The off-site rational method was used to determine peak flow rates to adequately size MDP Lateral-B6 and its associated inlets in the ultimate and interim conditions. Lateral-B6 will convey 53.3-cfs in the interim and 101.7-cfs in the ultimate. Lateral-B6 is designed for the ultimate flowrates, but the interim surface inlets west adjacent of Patterson Avenue will be designed for the interim flowrates.

The ultimate condition assumes all tributary areas are commercial land use and are connected directly to Lateral-B6 via yet to be designed laterals.

The interim condition uses the existing land use of a mix between undeveloped poor cover and commercial. The interim condition will require runoff south of California Avenue to be collected in the west flowline of Patterson Avenue just south of the California/Patterson intersection; this is to keep the flow spread from overtopping the Patterson Avenue crown. Because of this, Lateral-B6 only needs to be constructed up to California Avenue in the interim.

Interim subarea boundaries were based off available topography from RCFC&WCD.

The following table summarizes the rational method results at key points:

Table 4 - Off-Site Rational Method Results

Point of Interest	10-Year Peak Flow Rate (cfs)	100-Year Peak Flow Rate (cfs)
Interim Condition		
Node OSB-2 - Flow tributary to Lateral-B6-3	23.8	36.4
Node OSB-3 - Flow tributary to Lateral-B6-1	11.2	16.9
Total Interim Flow to Lateral-B6	35.0	53.3
Ultimate Condition		
Node OSB-1 - Flow tributary to upstream Lateral-B6	12.6	18.2
Node OSB-2 - Flow tributary to downstream Lateral-B6	39.5	58.1
Total Ultimate Flow to Lateral-B6	69.9	101.7

The rational method output files and hydrology map have been included in Appendix A.

SECTION 3 - HYDRAULIC ANALYSIS

ON-SITE STORM DRAIN FACILITIES

The project proposes two subsurface storm drain systems and will utilize curb and gutter to convey on-site flows to the proposed underground chambers located in the easternmost drive aisle and Line-B6.1. From Line-B6.1, the runoff continues north to an existing Caltrans RCB before entering the Perris Valley Storm Drain Channel.

A brief summary of each system has been provided. The peak flow rates determined during the 100-year rational method on-site hydrology analysis were utilized to evaluate the proposed storm drain systems.

See Appendix B for all hydraulic calculations.

Line-1

The northern portion of the project site will surface flow and be collected by Line-1. Line-1 is a 24-inch HDPE storm drain that transitions into a 36-inch HDPE storm drain. Line-1 proposes to convey the 100-year peak flow rate to the proposed underground chambers. A normal depth calculation from the CivilD rational method output was used to determine the appropriate size for Line-1. A hydraulic model for Line-1 will be provided during final engineering to further assess the storm drain design.

Line-2

The southern portion of the project site will surface flow and be collected by Line-2. Line-2 is a 27-inch HDPE storm drain that transitions into a 36-inch HDPE storm drain. Line-2 proposes to convey the 100-year peak flow rate to the proposed underground chambers. A normal depth calculation from the CivilD rational method output was used to determine the appropriate size for Line-2. A hydraulic model for Line-2 will be provided during final engineering to further assess the storm drain design.

High Flow Bypass Outlet Structure

The proposed underground chambers will fully store the water quality volume. All high intensity flows will push out of the chambers from a raised outlet pipe and gravity flow to Lateral-B6.1. It will be sized to convey the 100-yr flowrate of 72.4-cfs.

West Collector Channel

The west collector channel will convey nuisance runoff from three CMP culverts under Patterson Avenue. The nuisance runoff was calculated by finding the capacity of a 12-inch CMP pipe at 2% slope and multiplying by three. The design runoff of the west collector channel is 14-cfs. The channel will be 2-feet deep with 2:1 side slopes and a 4-foot bottom width. The channel will have a concrete bottom up to one foot above the channel invert. The flow depth will be approximately 6-inches and will convey flow to Lateral-B6 via Lateral-B6-2.

OFF-SITE STORM DRAIN FACILITIES

Lateral-B6.1 (On-site/Off-site)

Lateral-B6.1 is a Perris Valley MDP facility proposed to be a 48-inch RCP that connects to the existing Caltrans RCB storm drain. It will convey all runoff produced on-site and by Nevada Avenue; approximately 80-cfs. A normal depth calculation was used to determine the appropriate size for Lateral-B6.1. A hydraulic model for Lateral-B6.1 will be provided during final engineering to further assess the storm drain design.

Lateral-B6

Lateral-B6 is a Perris Valley MDP facility proposed to be a 48-inch RCP that transitions to a 24-inch RCP upstream. It will connect to the existing Caltrans RCB storm drain. A normal depth calculation from the ultimate condition CivilD rational method output was used to determine the appropriate size for Lateral-B6. A hydraulic model for Lateral-B6 will be provided during final engineering to further assess the storm drain design.

Lateral-B6 will be designed for the ultimate condition flowrates. However, Lateral-B6 only needs to be constructed up to California Avenue in the interim since Patterson Avenue has capacity to convey interim condition runoff north within the westerly half of the street up to the intersection with California Avenue.

The interim inlets and laterals along the west edge-of-pavement of Patterson Avenue will be designed for the interim condition since the ultimate condition tributary areas will likely result in direct connection to Lateral-B6 via additional laterals.

Lateral-B6-1 and Inlet

Lateral-B6-1 will convey interim runoff from the tributary between California Avenue and Old Oleander. Lateral-B6-1 is a 24-inch RCP that will convey roughly 17-cfs. A normal depth calculation was used to determine the appropriate size for Lateral-B6-1. A hydraulic model for Lateral-B6-1 will be provided during final engineering to further assess the storm drain design.

The inlet for Lateral-B6-1 is sized using a weir equation. It will be a grated inlet with 3-grates and produce approximately 0.4-feet of head to capture the runoff.

Lateral-B6-2

Lateral-B6-2 will convey nuisance runoff collected by the on-site west collector channel. Lateral-B6-2 is an 18-inch RCP that will convey roughly 15-cfs. A normal depth calculation was used to determine the appropriate size for Lateral-B6-2. A hydraulic model for Lateral-B6-2 will be provided during final engineering to further assess the storm drain design.

Lateral-B6-3 and Inlet

Lateral-B6-3 will convey interim runoff from the tributary between California Avenue and Old Oleander. Lateral-B6-3 is a 30-inch RCP that will convey roughly 36-cfs. A normal depth calculation was used to determine the appropriate size for Lateral-B6-3. A hydraulic model for Lateral-B6-3 will be provided during final engineering to further assess the storm drain design.

The inlet for Lateral-B6-3 is sized using a weir equation. It will be a grated inlet with 8-grates and produce approximately 0.4-feet of head to capture the runoff.

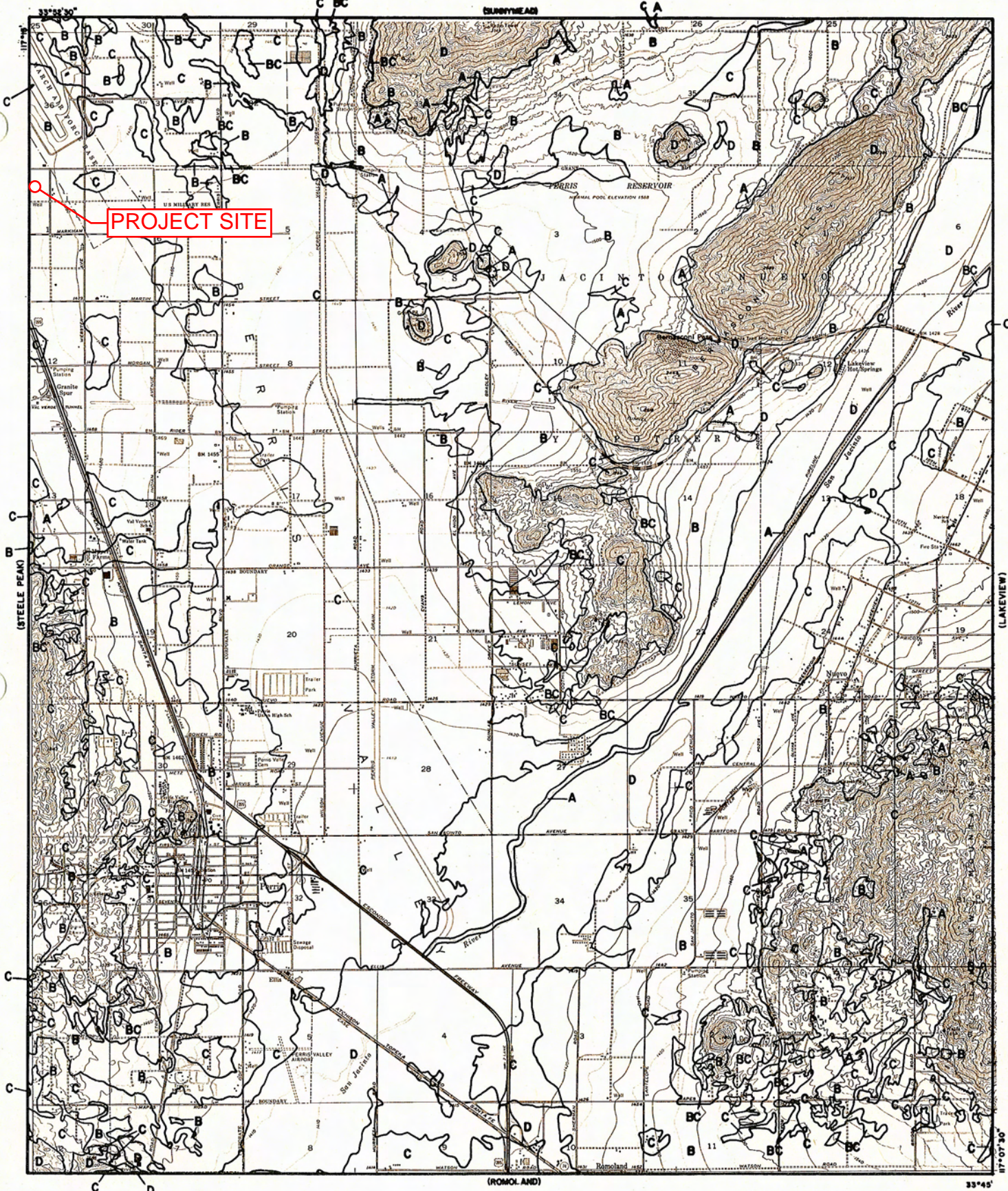
SECTION 4 - CONCLUSION

Based on the analyses and results of this report, the following conclusions were derived from the hydrology and hydraulic results:

- The proposed drainage improvements will adequately convey flows to and from the underground chambers and provide flood protection for the 100-year storm event.
- The proposed project will not impact flooding condition to upstream or downstream properties.

APPENDIX A – HYDROLOGY

HYDROLOGICAL PARAMETERS

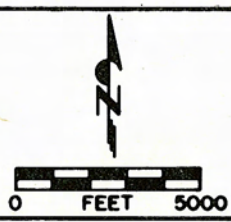


PROJECT SITE

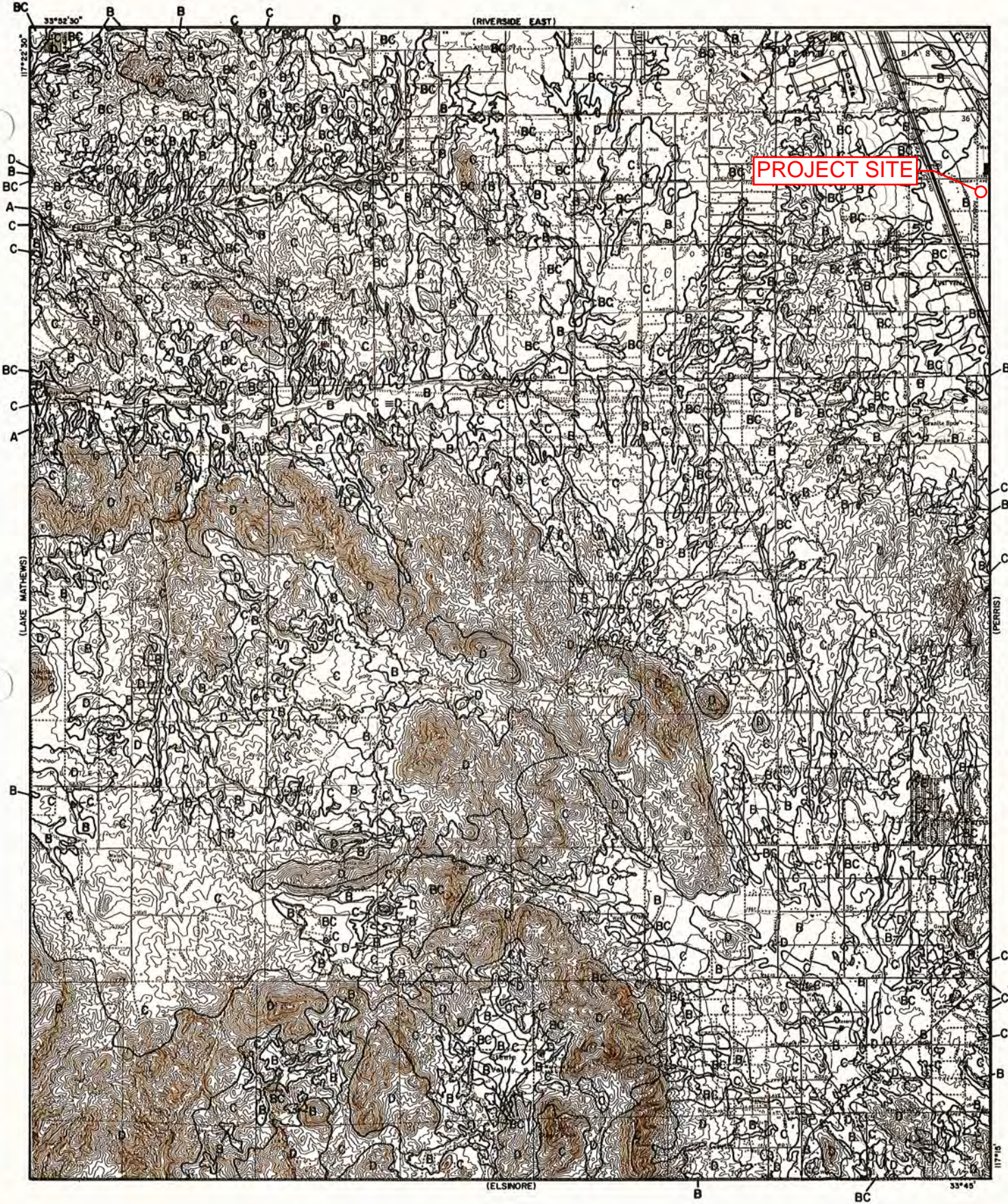
LEGEND

- SOILS GROUP BOUNDARY
- A SOILS GROUP DESIGNATION

RCFC & WCD
HYDROLOGY MANUAL



**HYDROLOGIC SOILS GROUP MAP
FOR
PERRIS**



PROJECT SITE

LEGEND

- SOILS GROUP BOUNDARY
- A SOILS GROUP DESIGNATION

RCFC & WCD
 Hydrology Manual



**HYDROLOGIC SOILS GROUP MAP
 FOR
 STEELE PEAK**

RAINFALL INTENSITY—INCHES PER HOUR

RCFC & WCD
 HYDROLOGY MANUAL

STANDARD
 INTENSITY - DURATION
 CURVES DATA

MIRA LOMA			MURRIETA - TEMECULA & RANCHO CALIFORNIA			NORCO			PALM SPRINGS			PERRIS VALLEY		
DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY	
	10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR
5	2.84	4.48	5	3.45	5.10	5	2.77	4.16	5	4.23	6.76	5	2.64	3.78
6	2.58	4.07	6	3.12	4.61	6	2.53	3.79	6	3.80	6.08	6	2.41	3.46
7	2.37	3.75	7	2.87	4.24	7	2.34	3.51	7	3.48	5.56	7	2.24	3.21
8	2.21	3.49	8	2.67	3.94	8	2.19	3.29	8	3.22	5.15	8	2.09	3.01
9	2.08	3.28	9	2.50	3.69	9	2.07	3.10	9	3.01	4.81	9	1.98	2.84
10	1.96	3.10	10	2.36	3.48	10	1.96	2.94	10	2.83	4.52	10	1.88	2.69
11	1.87	2.95	11	2.24	3.30	11	1.87	2.80	11	2.67	4.28	11	1.79	2.57
12	1.78	2.82	12	2.13	3.15	12	1.79	2.68	12	2.54	4.07	12	1.72	2.46
13	1.71	2.70	13	2.04	3.01	13	1.72	2.58	13	2.43	3.88	13	1.65	2.37
14	1.64	2.60	14	1.96	2.89	14	1.66	2.48	14	2.33	3.72	14	1.59	2.29
15	1.58	2.50	15	1.89	2.79	15	1.60	2.40	15	2.23	3.58	15	1.54	2.21
16	1.53	2.42	16	1.82	2.69	16	1.55	2.32	16	2.15	3.44	16	1.49	2.14
17	1.48	2.34	17	1.76	2.60	17	1.50	2.25	17	2.08	3.32	17	1.45	2.08
18	1.44	2.27	18	1.71	2.52	18	1.46	2.19	18	2.01	3.22	18	1.41	2.02
19	1.40	2.21	19	1.66	2.45	19	1.42	2.13	19	1.95	3.12	19	1.37	1.97
20	1.36	2.15	20	1.61	2.38	20	1.39	2.08	20	1.89	3.03	20	1.34	1.92
22	1.29	2.04	22	1.53	2.26	22	1.32	1.98	22	1.79	2.86	22	1.28	1.83
24	1.24	1.95	24	1.46	2.15	24	1.26	1.90	24	1.70	2.72	24	1.22	1.75
26	1.18	1.87	26	1.39	2.06	26	1.22	1.82	26	1.62	2.60	26	1.18	1.69
28	1.14	1.80	28	1.34	1.98	28	1.17	1.76	28	1.56	2.49	28	1.13	1.63
30	1.10	1.73	30	1.29	1.90	30	1.13	1.70	30	1.49	2.39	30	1.10	1.57
32	1.06	1.67	32	1.24	1.84	32	1.10	1.64	32	1.44	2.30	32	1.06	1.52
34	1.03	1.62	34	1.20	1.78	34	1.06	1.59	34	1.39	2.22	34	1.03	1.48
36	1.00	1.57	36	1.17	1.72	36	1.03	1.55	36	1.34	2.15	36	1.00	1.44
38	.97	1.53	38	1.13	1.67	38	1.01	1.51	38	1.30	2.09	38	.98	1.40
40	.94	1.49	40	1.10	1.62	40	.98	1.47	40	1.27	2.02	40	.95	1.37
45	.89	1.40	45	1.03	1.52	45	.92	1.39	45	1.18	1.89	45	.90	1.29
50	.84	1.32	50	.97	1.44	50	.88	1.31	50	1.11	1.78	50	.85	1.22
55	.80	1.26	55	.92	1.36	55	.84	1.25	55	1.05	1.68	55	.81	1.17
60	.76	1.20	60	.88	1.30	60	.80	1.20	60	1.00	1.60	60	.78	1.12
65	.73	1.15	65	.84	1.24	65	.77	1.15	65	.95	1.53	65	.75	1.08
70	.70	1.11	70	.81	1.19	70	.74	1.11	70	.91	1.46	70	.72	1.04
75	.68	1.07	75	.78	1.15	75	.72	1.07	75	.88	1.41	75	.70	1.00
80	.65	1.03	80	.75	1.11	80	.69	1.04	80	.85	1.35	80	.68	.97
85	.63	1.00	85	.73	1.07	85	.67	1.01	85	.82	1.31	85	.66	.94
SLOPE = .530			SLOPE = .550			SLOPE = .500			SLOPE = .580			SLOPE = .490		

10-YEAR ON-SITE HYDROLOGY (RATIONAL METHOD)

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 03/09/22 File:PROP10.out

20-0231 - DUKE NANCE
ONSITE RATIONAL METHOD HYDROLOGY
10 YEAR STORM EVENT
FN: PROP10.OUT ABE

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Perris Valley] area used.
10 year storm 10 minute intensity = 1.880(In/Hr)
10 year storm 60 minute intensity = 0.780(In/Hr)
100 year storm 10 minute intensity = 2.690(In/Hr)
100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.780(In/Hr)
Slope of intensity duration curve = 0.4900

Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 935.000(Ft.)
Top (of initial area) elevation = 1501.400(Ft.)
Bottom (of initial area) elevation = 1487.900(Ft.)
Difference in elevation = 13.500(Ft.)
Slope = 0.01444 s(percent)= 1.44
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.803 min.
Rainfall intensity = 1.807(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.867
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 11.436(CFS)
Total initial stream area = 7.300(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 101.000 to Point/Station 102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.100(Ft.)
Downstream point/station elevation = 1481.100(Ft.)
Pipe length = 840.00(Ft.) Manning's N = 0.012

No. of pipes = 1 Required pipe flow = 11.436(CFS)
Nearest computed pipe diameter = 24.00(In.)
Calculated individual pipe flow = 11.436(CFS)
Normal flow depth in pipe = 15.96(In.)
Flow top width inside pipe = 22.65(In.)
Critical Depth = 14.57(In.)
Pipe flow velocity = 5.16(Ft/s)
Travel time through pipe = 2.71 min.
Time of concentration (TC) = 13.52 min.

Process from Point/Station 102.000 to Point/Station 102.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.865
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 13.52 min.
Rainfall intensity = 1.619(In/Hr) for a 10.0 year storm
Subarea runoff = 6.019(CFS) for 4.300(Ac.)
Total runoff = 17.456(CFS) Total area = 11.600(Ac.)

Process from Point/Station 102.000 to Point/Station 103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1481.100(Ft.)
Downstream point/station elevation = 1478.500(Ft.)
Pipe length = 798.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 17.456(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 17.456(CFS)
Normal flow depth in pipe = 20.25(In.)
Flow top width inside pipe = 23.38(In.)
Critical Depth = 17.53(In.)
Pipe flow velocity = 5.46(Ft/s)
Travel time through pipe = 2.44 min.
Time of concentration (TC) = 15.95 min.

Process from Point/Station 103.000 to Point/Station 103.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.863
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 15.95 min.
Rainfall intensity = 1.493(In/Hr) for a 10.0 year storm
Subarea runoff = 7.213(CFS) for 5.600(Ac.)
Total runoff = 24.669(CFS) Total area = 17.200(Ac.)

Process from Point/Station 103.000 to Point/Station 104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1478.500(Ft.)
Downstream point/station elevation = 1478.400(Ft.)
Pipe length = 30.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 24.669(CFS)
Nearest computed pipe diameter = 30.00(In.)
Calculated individual pipe flow = 24.669(CFS)

Normal flow depth in pipe = 23.63(In.)
Flow top width inside pipe = 24.54(In.)
Critical Depth = 20.32(In.)
Pipe flow velocity = 5.95(Ft/s)
Travel time through pipe = 0.08 min.
Time of concentration (TC) = 16.04 min.

++++
Process from Point/Station 104.000 to Point/Station 105.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 1
Stream flow area = 17.200(Ac.)
Runoff from this stream = 24.669(CFS)
Time of concentration = 16.04 min.
Rainfall intensity = 1.489(In/Hr)
Program is now starting with Main Stream No. 2

++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 590.000(Ft.)
Top (of initial area) elevation = 1500.900(Ft.)
Bottom (of initial area) elevation = 1487.900(Ft.)
Difference in elevation = 13.000(Ft.)
Slope = 0.02203 s(percent)= 2.20
TC = $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 8.257 min.
Rainfall intensity = 2.061(In/Hr) for a 10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.870
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 15.596(CFS)
Total initial stream area = 8.700(Ac.)
Pervious area fraction = 0.100

++++
Process from Point/Station 201.000 to Point/Station 202.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.000(Ft.)
Downstream point/station elevation = 1478.700(Ft.)
Pipe length = 1468.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 15.596(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 15.596(CFS)
Normal flow depth in pipe = 17.84(In.)
Flow top width inside pipe = 25.57(In.)
Critical Depth = 16.52(In.)
Pipe flow velocity = 5.60(Ft/s)
Travel time through pipe = 4.37 min.
Time of concentration (TC) = 12.63 min.

++++
Process from Point/Station 202.000 to Point/Station 202.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.865
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00

Pervious area fraction = 0.100; Impervious fraction = 0.900
 Time of concentration = 12.63 min.
 Rainfall intensity = 1.674(In/Hr) for a 10.0 year storm
 Subarea runoff = 6.808(CFS) for 4.700(Ac.)
 Total runoff = 22.404(CFS) Total area = 13.400(Ac.)

 Process from Point/Station 202.000 to Point/Station 203.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1478.700(Ft.)
 Downstream point/station elevation = 1477.400(Ft.)
 Pipe length = 380.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 22.404(CFS)
 Nearest computed pipe diameter = 30.00(In.)
 Calculated individual pipe flow = 22.404(CFS)
 Normal flow depth in pipe = 21.47(In.)
 Flow top width inside pipe = 27.07(In.)
 Critical Depth = 19.34(In.)
 Pipe flow velocity = 5.96(Ft/s)
 Travel time through pipe = 1.06 min.
 Time of concentration (TC) = 13.69 min.

 Process from Point/Station 203.000 to Point/Station 203.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Runoff Coefficient = 0.865
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 56.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Time of concentration = 13.69 min.
 Rainfall intensity = 1.609(In/Hr) for a 10.0 year storm
 Subarea runoff = 5.842(CFS) for 4.200(Ac.)
 Total runoff = 28.246(CFS) Total area = 17.600(Ac.)

 Process from Point/Station 203.000 to Point/Station 204.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1477.400(Ft.)
 Downstream point/station elevation = 1477.200(Ft.)
 Pipe length = 100.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 28.246(CFS)
 Nearest computed pipe diameter = 36.00(In.)
 Calculated individual pipe flow = 28.246(CFS)
 Normal flow depth in pipe = 26.06(In.)
 Flow top width inside pipe = 32.19(In.)
 Critical Depth = 20.62(In.)
 Pipe flow velocity = 5.15(Ft/s)
 Travel time through pipe = 0.32 min.
 Time of concentration (TC) = 14.01 min.

 Process from Point/Station 204.000 to Point/Station 105.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 2
 Stream flow area = 17.600(Ac.)
 Runoff from this stream = 28.246(CFS)
 Time of concentration = 14.01 min.
 Rainfall intensity = 1.591(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)

1	24.669	16.04	1.489
2	28.246	14.01	1.591

Largest stream flow has longer or shorter time of concentration

Qp = 28.246 + sum of

	Qa	Tb/Ta	
	24.669 *	0.874 =	21.556

Qp = 49.802

Total of 2 main streams to confluence:
Flow rates before confluence point:

24.669	28.246
--------	--------

Area of streams before confluence:

17.200	17.600
--------	--------

Results of confluence:
Total flow rate = 49.802(CFS)
Time of concentration = 14.015 min.
Effective stream area after confluence = 34.800(Ac.)
End of computations, total study area = 34.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

100-YEAR ON-SITE HYDROLOGY (RATIONAL METHOD)

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 03/09/22 File:PROP100.out

20-0231 - DUKE NANCE
ONSITE RATIONAL METHOD HYDROLOGY
100 YEAR STORM EVENT
FN: PROP100.OUT ABE

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Perris Valley] area used.
10 year storm 10 minute intensity = 1.880(In/Hr)
10 year storm 60 minute intensity = 0.780(In/Hr)
100 year storm 10 minute intensity = 2.690(In/Hr)
100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.120(In/Hr)
Slope of intensity duration curve = 0.4900

Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 935.000(Ft.)
Top (of initial area) elevation = 1501.400(Ft.)
Bottom (of initial area) elevation = 1487.900(Ft.)
Difference in elevation = 13.500(Ft.)
Slope = 0.01444 s(percent)= 1.44
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.803 min.
Rainfall intensity = 2.595(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.874
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 16.556(CFS)
Total initial stream area = 7.300(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 101.000 to Point/Station 102.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.100(Ft.)
Downstream point/station elevation = 1481.100(Ft.)
Pipe length = 840.00(Ft.) Manning's N = 0.012

No. of pipes = 1 Required pipe flow = 16.556(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 16.556(CFS)
Normal flow depth in pipe = 18.70(In.)
Flow top width inside pipe = 24.91(In.)
Critical Depth = 17.04(In.)
Pipe flow velocity = 5.63(Ft/s)
Travel time through pipe = 2.48 min.
Time of concentration (TC) = 13.29 min.

Process from Point/Station 102.000 to Point/Station 102.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.872
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 13.29 min.
Rainfall intensity = 2.344(In/Hr) for a 100.0 year storm
Subarea runoff = 8.792(CFS) for 4.300(Ac.)
Total runoff = 25.349(CFS) Total area = 11.600(Ac.)

Process from Point/Station 102.000 to Point/Station 103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1481.100(Ft.)
Downstream point/station elevation = 1478.500(Ft.)
Pipe length = 798.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 25.349(CFS)
Nearest computed pipe diameter = 30.00(In.)
Calculated individual pipe flow = 25.349(CFS)
Normal flow depth in pipe = 24.56(In.)
Flow top width inside pipe = 23.11(In.)
Critical Depth = 20.60(In.)
Pipe flow velocity = 5.89(Ft/s)
Travel time through pipe = 2.26 min.
Time of concentration (TC) = 15.55 min.

Process from Point/Station 103.000 to Point/Station 103.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 15.55 min.
Rainfall intensity = 2.171(In/Hr) for a 100.0 year storm
Subarea runoff = 10.585(CFS) for 5.600(Ac.)
Total runoff = 35.934(CFS) Total area = 17.200(Ac.)

Process from Point/Station 103.000 to Point/Station 104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1478.500(Ft.)
Downstream point/station elevation = 1478.400(Ft.)
Pipe length = 30.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 35.934(CFS)
Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 35.934(CFS)

Normal flow depth in pipe = 25.78(In.)
Flow top width inside pipe = 32.46(In.)
Critical Depth = 23.37(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.08 min.
Time of concentration (TC) = 15.62 min.

++++
Process from Point/Station 104.000 to Point/Station 105.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 1
Stream flow area = 17.200(Ac.)
Runoff from this stream = 35.934(CFS)
Time of concentration = 15.62 min.
Rainfall intensity = 2.166(In/Hr)
Program is now starting with Main Stream No. 2

++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 590.000(Ft.)
Top (of initial area) elevation = 1500.900(Ft.)
Bottom (of initial area) elevation = 1487.900(Ft.)
Difference in elevation = 13.000(Ft.)
Slope = 0.02203 s(percent)= 2.20
TC = $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 8.257 min.
Rainfall intensity = 2.960(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 22.569(CFS)
Total initial stream area = 8.700(Ac.)
Pervious area fraction = 0.100

++++
Process from Point/Station 201.000 to Point/Station 202.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.000(Ft.)
Downstream point/station elevation = 1478.700(Ft.)
Pipe length = 1468.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 22.569(CFS)
Nearest computed pipe diameter = 30.00(In.)
Calculated individual pipe flow = 22.569(CFS)
Normal flow depth in pipe = 21.14(In.)
Flow top width inside pipe = 27.37(In.)
Critical Depth = 19.38(In.)
Pipe flow velocity = 6.10(Ft/s)
Travel time through pipe = 4.01 min.
Time of concentration (TC) = 12.27 min.

++++
Process from Point/Station 202.000 to Point/Station 202.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.873
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00

Pervious area fraction = 0.100; Impervious fraction = 0.900
 Time of concentration = 12.27 min.
 Rainfall intensity = 2.438(In/Hr) for a 100.0 year storm
 Subarea runoff = 10.002(CFS) for 4.700(Ac.)
 Total runoff = 32.571(CFS) Total area = 13.400(Ac.)

 Process from Point/Station 202.000 to Point/Station 203.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1478.700(Ft.)
 Downstream point/station elevation = 1477.400(Ft.)
 Pipe length = 380.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 32.571(CFS)
 Nearest computed pipe diameter = 33.00(In.)
 Calculated individual pipe flow = 32.571(CFS)
 Normal flow depth in pipe = 26.25(In.)
 Flow top width inside pipe = 26.62(In.)
 Critical Depth = 22.79(In.)
 Pipe flow velocity = 6.43(Ft/s)
 Travel time through pipe = 0.99 min.
 Time of concentration (TC) = 13.25 min.

 Process from Point/Station 203.000 to Point/Station 203.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Runoff Coefficient = 0.872
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 56.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Time of concentration = 13.25 min.
 Rainfall intensity = 2.347(In/Hr) for a 100.0 year storm
 Subarea runoff = 8.599(CFS) for 4.200(Ac.)
 Total runoff = 41.170(CFS) Total area = 17.600(Ac.)

 Process from Point/Station 203.000 to Point/Station 204.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1477.400(Ft.)
 Downstream point/station elevation = 1477.200(Ft.)
 Pipe length = 100.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 41.170(CFS)
 Nearest computed pipe diameter = 39.00(In.)
 Calculated individual pipe flow = 41.170(CFS)
 Normal flow depth in pipe = 33.09(In.)
 Flow top width inside pipe = 27.96(In.)
 Critical Depth = 24.53(In.)
 Pipe flow velocity = 5.49(Ft/s)
 Travel time through pipe = 0.30 min.
 Time of concentration (TC) = 13.56 min.

 Process from Point/Station 204.000 to Point/Station 105.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 2
 Stream flow area = 17.600(Ac.)
 Runoff from this stream = 41.170(CFS)
 Time of concentration = 13.56 min.
 Rainfall intensity = 2.321(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)

1	35.934	15.62	2.166
2	41.170	13.56	2.321

Largest stream flow has longer or shorter time of concentration

Qp = 41.170 + sum of

	Qa	Tb/Ta	
	35.934 *	0.868 =	31.187

Qp = 72.357

Total of 2 main streams to confluence:
Flow rates before confluence point:
35.934 41.170
Area of streams before confluence:
17.200 17.600

Results of confluence:
Total flow rate = 72.357(CFS)
Time of concentration = 13.558 min.
Effective stream area after confluence = 34.800(Ac.)
End of computations, total study area = 34.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

10-YEAR OFF-SITE HYDROLOGY (RATIONAL METHOD)

INTERIM CONDITION

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 10/13/21 File:OFF10INT.out

20-0231 - DUKE NANCE
OFFSITE RATIONAL METHOD HYDROLOGY - LAT-B6: INTERIM CONDITION
10 YEAR STORM EVENT
FN: OFF10INT.OUT TSW

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Perris Valley] area used.

10 year storm 10 minute intensity = 1.880(In/Hr)

10 year storm 60 minute intensity = 0.780(In/Hr)

100 year storm 10 minute intensity = 2.690(In/Hr)

100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.780(In/Hr)

Slope of intensity duration curve = 0.4900

++++
Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 1000.000(Ft.)

Top (of initial area) elevation = 1512.100(Ft.)

Bottom (of initial area) elevation = 1500.000(Ft.)

Difference in elevation = 12.100(Ft.)

Slope = 0.01210 s(percent)= 1.21

TC = k(0.530)*[(length^3)/(elevation change)]^0.2

Initial area time of concentration = 20.310 min.

Rainfall intensity = 1.326(In/Hr) for a 10.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.701
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 7.718(CFS)
Total initial stream area = 8.300(Ac.)
Pervious area fraction = 1.000

++++
Process from Point/Station 1.000 to Point/Station 2.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 15.782(CFS)
Depth of flow = 1.079(Ft.), Average velocity = 1.451(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 1.64
2 60.00 0.65
3 64.70 0.00
4 68.50 1.27
5 90.70 1.70

Manning's 'N' friction factor = 0.025

Sub-Channel flow = 15.782(CFS)
' ' flow top width = 33.958(Ft.)
' ' velocity = 1.451(Ft/s)
' ' area = 10.878(Sq.Ft)
' ' Froude number = 0.452

Upstream point elevation = 1500.000(Ft.)
Downstream point elevation = 1498.300(Ft.)
Flow length = 620.000(Ft.)
Travel time = 7.12 min.
Time of concentration = 27.43 min.
Depth of flow = 1.079(Ft.)
Average velocity = 1.451(Ft/s)
Total irregular channel flow = 15.782(CFS)
Irregular channel normal depth above invert elev. = 1.079(Ft.)
Average velocity of channel(s) = 1.451(Ft/s)

Adding area flow to channel

USER INPUT of soil data for subarea

Runoff Coefficient = 0.731
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 66.00
Pervious area fraction = 0.500; Impervious fraction = 0.500
Rainfall intensity = 1.145(In/Hr) for a 10.0 year storm
Subarea runoff = 16.069(CFS) for 19.200(Ac.)

Total runoff = 23.787(CFS) Total area = 27.500(Ac.)
Depth of flow = 1.189(Ft.), Average velocity = 1.587(Ft/s)

++++
Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1488.500(Ft.)
Downstream point/station elevation = 1484.400(Ft.)
Pipe length = 578.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 23.787(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 23.787(CFS)
Normal flow depth in pipe = 20.25(In.)
Flow top width inside pipe = 23.38(In.)
Critical Depth = 20.48(In.)
Pipe flow velocity = 7.44(Ft/s)
Travel time through pipe = 1.30 min.
Time of concentration (TC) = 28.73 min.

++++
Process from Point/Station 3.000 to Point/Station 3.000
**** SUBAREA FLOW ADDITION ****

USER INPUT of soil data for subarea
Runoff Coefficient = 0.752
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 63.00
Pervious area fraction = 0.400; Impervious fraction = 0.600
Time of concentration = 28.73 min.
Rainfall intensity = 1.119(In/Hr) for a 10.0 year storm
Subarea runoff = 11.188(CFS) for 13.300(Ac.)
Total runoff = 34.975(CFS) Total area = 40.800(Ac.)

++++
Process from Point/Station 3.000 to Point/Station 4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.400(Ft.)
Downstream point/station elevation = 1483.200(Ft.)
Pipe length = 189.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 34.975(CFS)
Nearest computed pipe diameter = 33.00(In.)
Calculated individual pipe flow = 34.975(CFS)
Normal flow depth in pipe = 22.95(In.)
Flow top width inside pipe = 30.38(In.)
Critical Depth = 23.64(In.)
Pipe flow velocity = 7.93(Ft/s)
Travel time through pipe = 0.40 min.
Time of concentration (TC) = 29.13 min.

End of computations, total study area = 40.80 (Ac.)

The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.569

Area averaged RI index number = 67.5

ULTIMATE CONDITION

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 10/13/21 File:OFF10ULT.out

20-0231 - DUKE NANCE
OFFSITE RATIONAL METHOD HYDROLOGY - LAT-B6: ULTIMATE CONDITION
10 YEAR STORM EVENT
FN: OFF10ULT.OUT TSW

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Perris Valley] area used.

10 year storm 10 minute intensity = 1.880(In/Hr)

10 year storm 60 minute intensity = 0.780(In/Hr)

100 year storm 10 minute intensity = 2.690(In/Hr)

100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.780(In/Hr)

Slope of intensity duration curve = 0.4900

++++
Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 1000.000(Ft.)

Top (of initial area) elevation = 1512.100(Ft.)

Bottom (of initial area) elevation = 1500.000(Ft.)

Difference in elevation = 12.100(Ft.)

Slope = 0.01210 s(percent)= 1.21

TC = k(0.300)*[(length^3)/(elevation change)]^0.2

Initial area time of concentration = 11.496 min.

Rainfall intensity = 1.753(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.866
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 12.603(CFS)
Total initial stream area = 8.300(Ac.)
Pervious area fraction = 0.100

++++
Process from Point/Station 1.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1493.000(Ft.)
Downstream point/station elevation = 1488.400(Ft.)
Pipe length = 610.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 12.603(CFS)
Nearest computed pipe diameter = 21.00(In.)
Calculated individual pipe flow = 12.603(CFS)
Normal flow depth in pipe = 15.82(In.)
Flow top width inside pipe = 18.10(In.)
Critical Depth = 15.86(In.)
Pipe flow velocity = 6.49(Ft/s)
Travel time through pipe = 1.57 min.
Time of concentration (TC) = 13.06 min.

++++
Process from Point/Station 2.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.865
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 13.06 min.
Rainfall intensity = 1.646(In/Hr) for a 10.0 year storm
Subarea runoff = 27.342(CFS) for 19.200(Ac.)
Total runoff = 39.945(CFS) Total area = 27.500(Ac.)

++++
Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1488.400(Ft.)
Downstream point/station elevation = 1484.400(Ft.)
Pipe length = 563.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 39.945(CFS)

Nearest computed pipe diameter = 33.00(In.)
Calculated individual pipe flow = 39.945(CFS)
Normal flow depth in pipe = 24.38(In.)
Flow top width inside pipe = 29.00(In.)
Critical Depth = 25.24(In.)
Pipe flow velocity = 8.49(Ft/s)
Travel time through pipe = 1.11 min.
Time of concentration (TC) = 14.17 min.

++++
Process from Point/Station 3.000 to Point/Station 3.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.864
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.17 min.
Rainfall intensity = 1.582(In/Hr) for a 10.0 year storm
Subarea runoff = 29.941(CFS) for 21.900(Ac.)
Total runoff = 69.886(CFS) Total area = 49.400(Ac.)

++++
Process from Point/Station 3.000 to Point/Station 4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.400(Ft.)
Downstream point/station elevation = 1483.200(Ft.)
Pipe length = 189.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 69.886(CFS)
Nearest computed pipe diameter = 39.00(In.)
Calculated individual pipe flow = 69.886(CFS)
Normal flow depth in pipe = 34.88(In.)
Flow top width inside pipe = 23.99(In.)
Critical Depth = 31.84(In.)
Pipe flow velocity = 8.93(Ft/s)
Travel time through pipe = 0.35 min.
Time of concentration (TC) = 14.52 min.
End of computations, total study area = 49.40 (Ac.)

The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

100-YEAR OFF-SITE HYDROLOGY (RATIONAL METHOD)

INTERIM CONDITION

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 10/13/21 File:OFF100INT.out

20-0231 - DUKE NANCE
OFFSITE RATIONAL METHOD HYDROLOGY - LAT-B6: INTERIM CONDITION
100 YEAR STORM EVENT
FN: OFF100INT.OUT TSW

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Perris Valley] area used.

10 year storm 10 minute intensity = 1.880(In/Hr)

10 year storm 60 minute intensity = 0.780(In/Hr)

100 year storm 10 minute intensity = 2.690(In/Hr)

100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.120(In/Hr)

Slope of intensity duration curve = 0.4900

++++
Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 1000.000(Ft.)

Top (of initial area) elevation = 1512.100(Ft.)

Bottom (of initial area) elevation = 1500.000(Ft.)

Difference in elevation = 12.100(Ft.)

Slope = 0.01210 s(percent)= 1.21

TC = k(0.530)*[(length^3)/(elevation change)]^0.2

Initial area time of concentration = 20.310 min.

Rainfall intensity = 1.904(In/Hr) for a 100.0 year storm

UNDEVELOPED (poor cover) subarea

Runoff Coefficient = 0.752
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 78.00
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 11.879(CFS)
Total initial stream area = 8.300(Ac.)
Pervious area fraction = 1.000

++++
Process from Point/Station 1.000 to Point/Station 2.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 24.192(CFS)
Depth of flow = 1.194(Ft.), Average velocity = 1.593(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 1.64
2 60.00 0.65
3 64.70 0.00
4 68.50 1.27
5 90.70 1.70

Manning's 'N' friction factor = 0.025

Sub-Channel flow = 24.192(CFS)
' ' flow top width = 41.248(Ft.)
' ' velocity = 1.593(Ft/s)
' ' area = 15.189(Sq.Ft)
' ' Froude number = 0.463

Upstream point elevation = 1500.000(Ft.)
Downstream point elevation = 1498.300(Ft.)
Flow length = 620.000(Ft.)
Travel time = 6.49 min.
Time of concentration = 26.80 min.
Depth of flow = 1.194(Ft.)
Average velocity = 1.593(Ft/s)
Total irregular channel flow = 24.192(CFS)
Irregular channel normal depth above invert elev. = 1.194(Ft.)
Average velocity of channel(s) = 1.593(Ft/s)

Adding area flow to channel

USER INPUT of soil data for subarea

Runoff Coefficient = 0.768
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 66.00
Pervious area fraction = 0.500; Impervious fraction = 0.500
Rainfall intensity = 1.662(In/Hr) for a 100.0 year storm
Subarea runoff = 24.527(CFS) for 19.200(Ac.)

Total runoff = 36.406(CFS) Total area = 27.500(Ac.)
Depth of flow = 1.328(Ft.), Average velocity = 1.702(Ft/s)

++++
Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1488.500(Ft.)
Downstream point/station elevation = 1484.400(Ft.)
Pipe length = 578.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 36.406(CFS)
Nearest computed pipe diameter = 30.00(In.)
Calculated individual pipe flow = 36.406(CFS)
Normal flow depth in pipe = 26.34(In.)
Flow top width inside pipe = 19.63(In.)
Critical Depth = 24.54(In.)
Pipe flow velocity = 7.96(Ft/s)
Travel time through pipe = 1.21 min.
Time of concentration (TC) = 28.01 min.

++++
Process from Point/Station 3.000 to Point/Station 3.000
**** SUBAREA FLOW ADDITION ****

USER INPUT of soil data for subarea
Runoff Coefficient = 0.783
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 63.00
Pervious area fraction = 0.400; Impervious fraction = 0.600
Time of concentration = 28.01 min.
Rainfall intensity = 1.627(In/Hr) for a 100.0 year storm
Subarea runoff = 16.942(CFS) for 13.300(Ac.)
Total runoff = 53.348(CFS) Total area = 40.800(Ac.)

++++
Process from Point/Station 3.000 to Point/Station 4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.400(Ft.)
Downstream point/station elevation = 1483.200(Ft.)
Pipe length = 189.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 53.348(CFS)
Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 53.348(CFS)
Normal flow depth in pipe = 29.63(In.)
Flow top width inside pipe = 27.49(In.)
Critical Depth = 28.49(In.)
Pipe flow velocity = 8.57(Ft/s)
Travel time through pipe = 0.37 min.
Time of concentration (TC) = 28.38 min.

End of computations, total study area = 40.80 (Ac.)

The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.569

Area averaged RI index number = 67.5

ULTIMATE CONDITION

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
Rational Hydrology Study Date: 10/13/21 File:OFF100ULT.out

20-0231 - DUKE NANCE
OFFSITE RATIONAL METHOD HYDROLOGY - LAT-B6: ULTIMATE CONDITION
100 YEAR STORM EVENT
FN: OFF100ULT.OUT TSW

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Perris Valley] area used.
10 year storm 10 minute intensity = 1.880(In/Hr)
10 year storm 60 minute intensity = 0.780(In/Hr)
100 year storm 10 minute intensity = 2.690(In/Hr)
100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.120(In/Hr)
Slope of intensity duration curve = 0.4900

++++
Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 1512.100(Ft.)
Bottom (of initial area) elevation = 1500.000(Ft.)
Difference in elevation = 12.100(Ft.)
Slope = 0.01210 s(percent)= 1.21
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.496 min.
Rainfall intensity = 2.517(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type

Runoff Coefficient = 0.874
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 18.247(CFS)
Total initial stream area = 8.300(Ac.)
Pervious area fraction = 0.100

++++
Process from Point/Station 1.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1493.000(Ft.)
Downstream point/station elevation = 1488.400(Ft.)
Pipe length = 610.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 18.247(CFS)
Nearest computed pipe diameter = 24.00(In.)
Calculated individual pipe flow = 18.247(CFS)
Normal flow depth in pipe = 18.28(In.)
Flow top width inside pipe = 20.45(In.)
Critical Depth = 18.47(In.)
Pipe flow velocity = 7.10(Ft/s)
Travel time through pipe = 1.43 min.
Time of concentration (TC) = 12.93 min.

++++
Process from Point/Station 2.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.872
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 12.93 min.
Rainfall intensity = 2.376(In/Hr) for a 100.0 year storm
Subarea runoff = 39.802(CFS) for 19.200(Ac.)
Total runoff = 58.050(CFS) Total area = 27.500(Ac.)

++++
Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1488.400(Ft.)
Downstream point/station elevation = 1484.400(Ft.)
Pipe length = 563.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 58.050(CFS)

Nearest computed pipe diameter = 36.00(In.)
Calculated individual pipe flow = 58.050(CFS)
Normal flow depth in pipe = 30.66(In.)
Flow top width inside pipe = 25.60(In.)
Critical Depth = 29.59(In.)
Pipe flow velocity = 9.04(Ft/s)
Travel time through pipe = 1.04 min.
Time of concentration (TC) = 13.97 min.

++++
Process from Point/Station 3.000 to Point/Station 3.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.872
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 13.97 min.
Rainfall intensity = 2.288(In/Hr) for a 100.0 year storm
Subarea runoff = 43.678(CFS) for 21.900(Ac.)
Total runoff = 101.727(CFS) Total area = 49.400(Ac.)

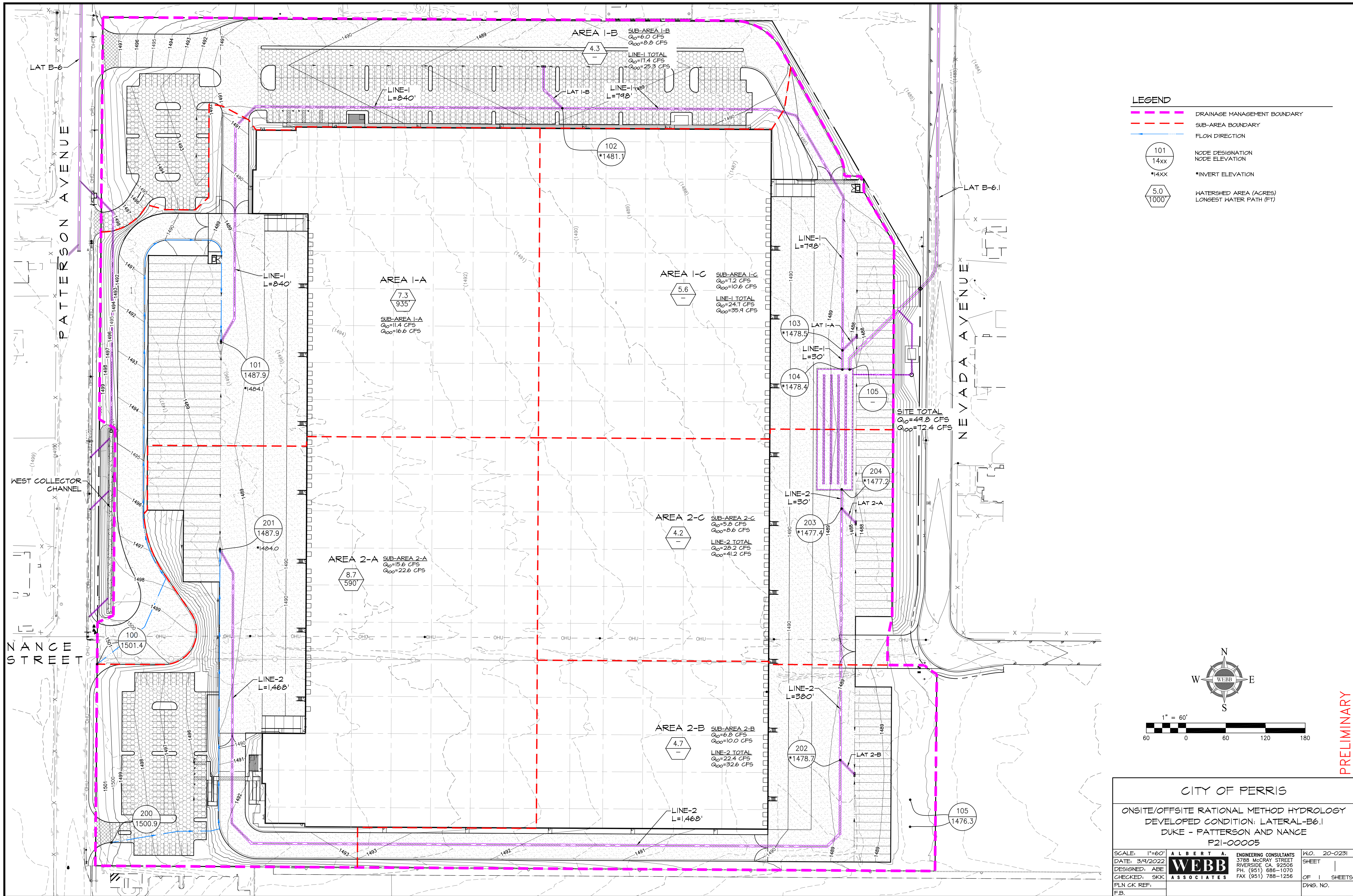
++++
Process from Point/Station 3.000 to Point/Station 4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1484.400(Ft.)
Downstream point/station elevation = 1483.200(Ft.)
Pipe length = 189.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 101.727(CFS)
Nearest computed pipe diameter = 45.00(In.)
Calculated individual pipe flow = 101.727(CFS)
Normal flow depth in pipe = 39.75(In.)
Flow top width inside pipe = 28.89(In.)
Critical Depth = 37.02(In.)
Pipe flow velocity = 9.86(Ft/s)
Travel time through pipe = 0.32 min.
Time of concentration (TC) = 14.29 min.
End of computations, total study area = 49.40 (Ac.)

The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 56.0

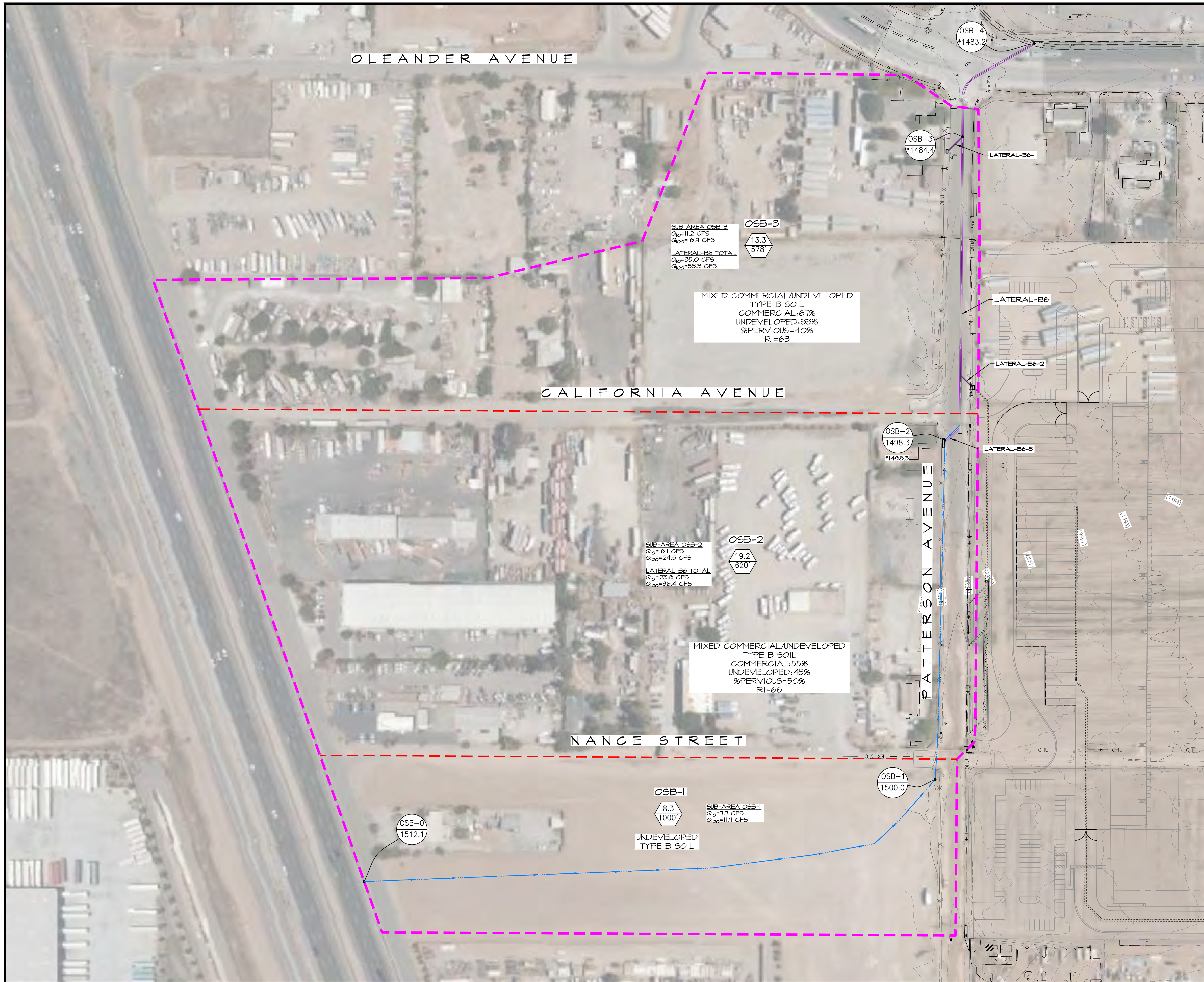
HYDROLOGY MAPS



PRELIMINARY

CITY OF PERRIS	
ONSITE/OFFSITE RATIONAL METHOD HYDROLOGY DEVELOPED CONDITION: LATERAL-B6.1 DUKE - PATTERSON AND NANCE P21-00005	
SCALE: 1"=60' DATE: 3/4/2022 DESIGNED: ABE CHECKED: SKK PLN CK REF: F.B.	ALBERT A. WEBB ASSOCIATES ENGINEERING CONSULTANTS 3788 MCCRAY STREET RIVERSIDE CA 92506 PH. (951) 686-1070 FAX (951) 788-1256
W.O. 20-0231 SHEET 1 OF 1 SHEETS DWS. NO.	

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LEGEND

- DRAINAGE MANAGEMENT BOUNDARY
- SUB-AREA BOUNDARY
- FLOW DIRECTION
- 101
14xx NODE DESIGNATION
NODE ELEVATION
- *14xx *INVERT ELEVATION
- 5.0
1000 WATERSHED AREA (ACRES)
LONGEST WATER PATH (FT)

NOTES:
1. OFFSITE AREAS (OSB-X) ARE BASED OFF INTERIM CONDITION LAND COVER.

SUB-AREA OSB-3
Q₀=11.2 CFS
Q₁₀₀=16.9 CFS
LATERAL-B6 TOTAL
Q₀=35.0 CFS
Q₁₀₀=53.3 CFS

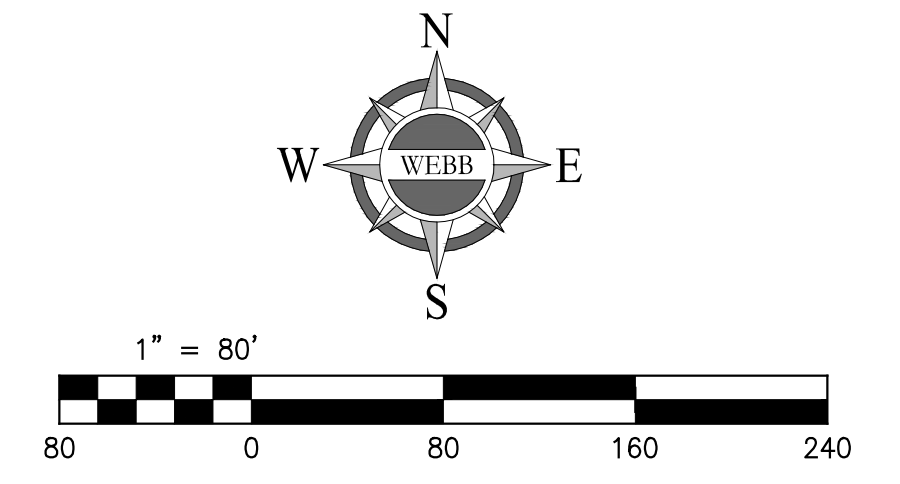
MIXED COMMERCIAL/UNDEVELOPED
TYPE B SOIL
COMMERCIAL: 67%
UNDEVELOPED: 33%
%PERVIOUS= 40%
RI=63

SUB-AREA OSB-2
Q₀=16.1 CFS
Q₁₀₀=24.5 CFS
LATERAL-B6 TOTAL
Q₀=23.8 CFS
Q₁₀₀=36.4 CFS

MIXED COMMERCIAL/UNDEVELOPED
TYPE B SOIL
COMMERCIAL: 55%
UNDEVELOPED: 45%
%PERVIOUS= 50%
RI=66

SUB-AREA OSB-1
Q₀=7.7 CFS
Q₁₀₀=11.9 CFS

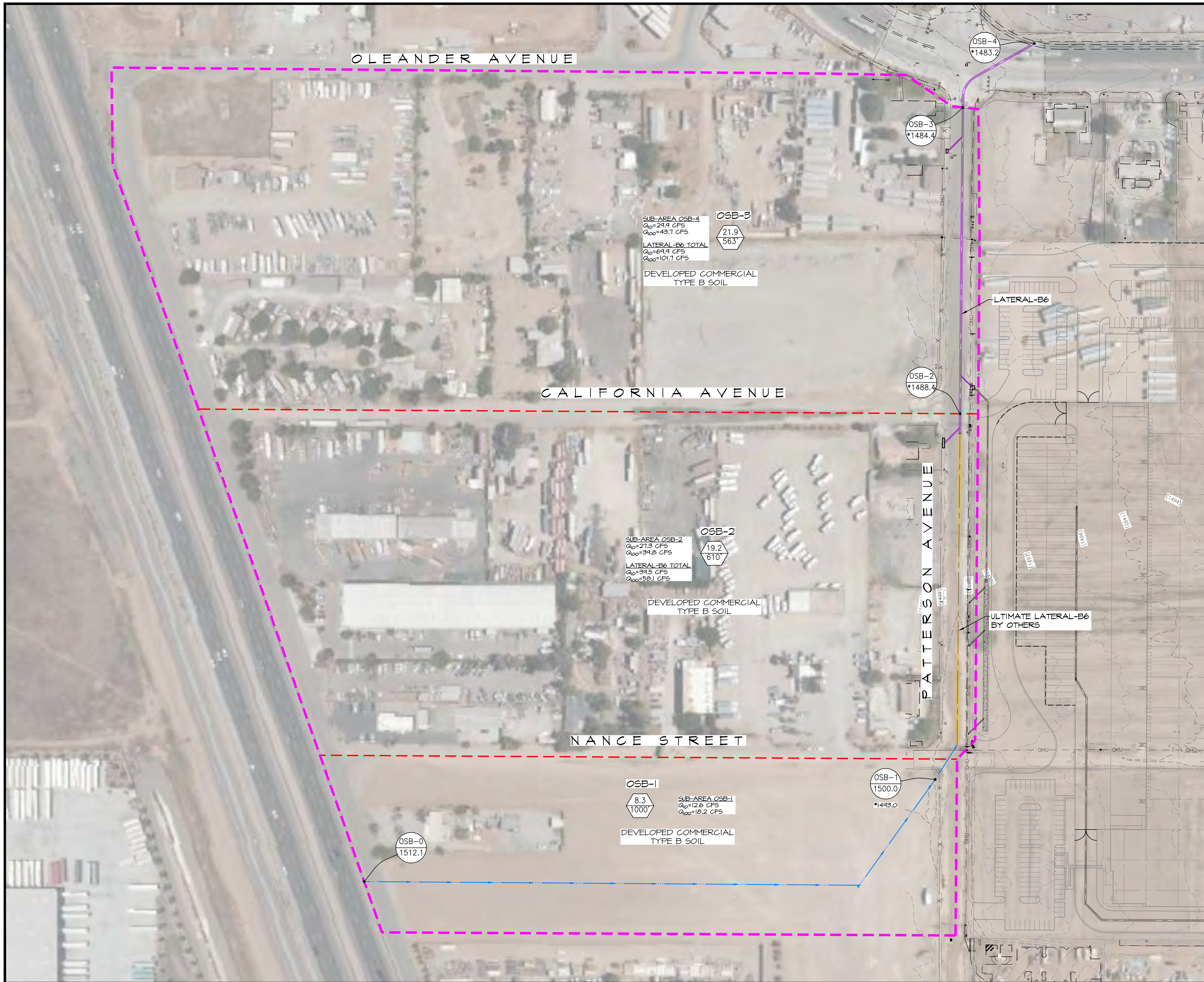
UNDEVELOPED
TYPE B SOIL



CITY OF PERRIS		
OFFSITE RATIONAL METHOD HYDROLOGY INTERIM CONDITION: LATERAL-B6 DUKE - PATTERSON AND NANCE P21-0005		
SCALE: 1"=80' DATE: 10/4/2021 DESIGNED: CHECKED: PLN CK REF: F.B.	WEBB ASSOCIATES	ENGINEERING CONSULTANTS 3788 MCCRAY STREET RIVERSIDE CA 92506 PH. (951) 686-1070 FAX (951) 788-1256
W.O. 20-0231	SHEET 1	OF 2 SHEETS
		DWS. NO.

PRELIMINARY

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LEGEND

- DRAINAGE MANAGEMENT BOUNDARY
- SUB-AREA BOUNDARY
- FLOW DIRECTION
- 101
14xx
*14xx NODE DESIGNATION
NODE ELEVATION
*INVERT ELEVATION
- 5.0
1000' WATERSHED AREA (ACRES)
LONGEST WATER PATH (FT)

NOTES:
 1. OFFSITE AREAS (OSB-X) ARE BASED OFF ULTIMATE CONDITION LANDCOVER AND DIRECT CONNECTION TO LATERAL-B6.

OSB-3
 SUB-AREA OSB-3
 $Q_{10} = 24.9$ CFS
 $Q_{100} = 43.7$ CFS
 LATERAL-B6 TOTAL
 $Q_{10} = 64.9$ CFS
 $Q_{100} = 101.7$ CFS
 DEVELOPED COMMERCIAL
 TYPE B SOIL
21.9
563'

OSB-2
 SUB-AREA OSB-2
 $Q_{10} = 21.3$ CFS
 $Q_{100} = 34.8$ CFS
 LATERAL-B6 TOTAL
 $Q_{10} = 34.5$ CFS
 $Q_{100} = 50.1$ CFS
 DEVELOPED COMMERCIAL
 TYPE B SOIL
19.2
610'

OSB-1
 SUB-AREA OSB-1
 $Q_{10} = 12.6$ CFS
 $Q_{100} = 18.2$ CFS
 DEVELOPED COMMERCIAL
 TYPE B SOIL
8.3
1000'

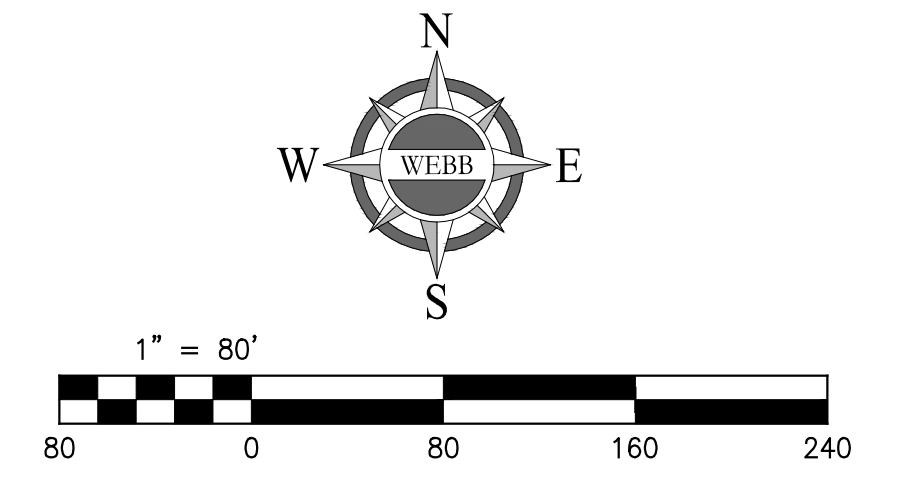
OSB-0
 1512.1

OSB-1
 1500.0
 *1493.0

OSB-2
 *1488.4

OSB-3
 *1484.4

OSB-4
 *1483.2



CITY OF PERRIS		
OFFSITE RATIONAL METHOD HYDROLOGY ULTIMATE CONDITION: LATERAL-B6 DUKE - PATTERSON AND NANCE P21-00005		
SCALE: 1"=80' DATE: 10/4/2021 DESIGNED: CHECKED: PLN CK REF: F.B.	ALBERT A. WEBB ASSOCIATES ENGINEERING CONSULTANTS 3788 McCRAY STREET RIVERSIDE CA 92506 PH. (951) 686-1070 FAX (951) 788-1256	W.O. 20-0231 SHEET 2 OF 2 SHEETS DWS. NO.

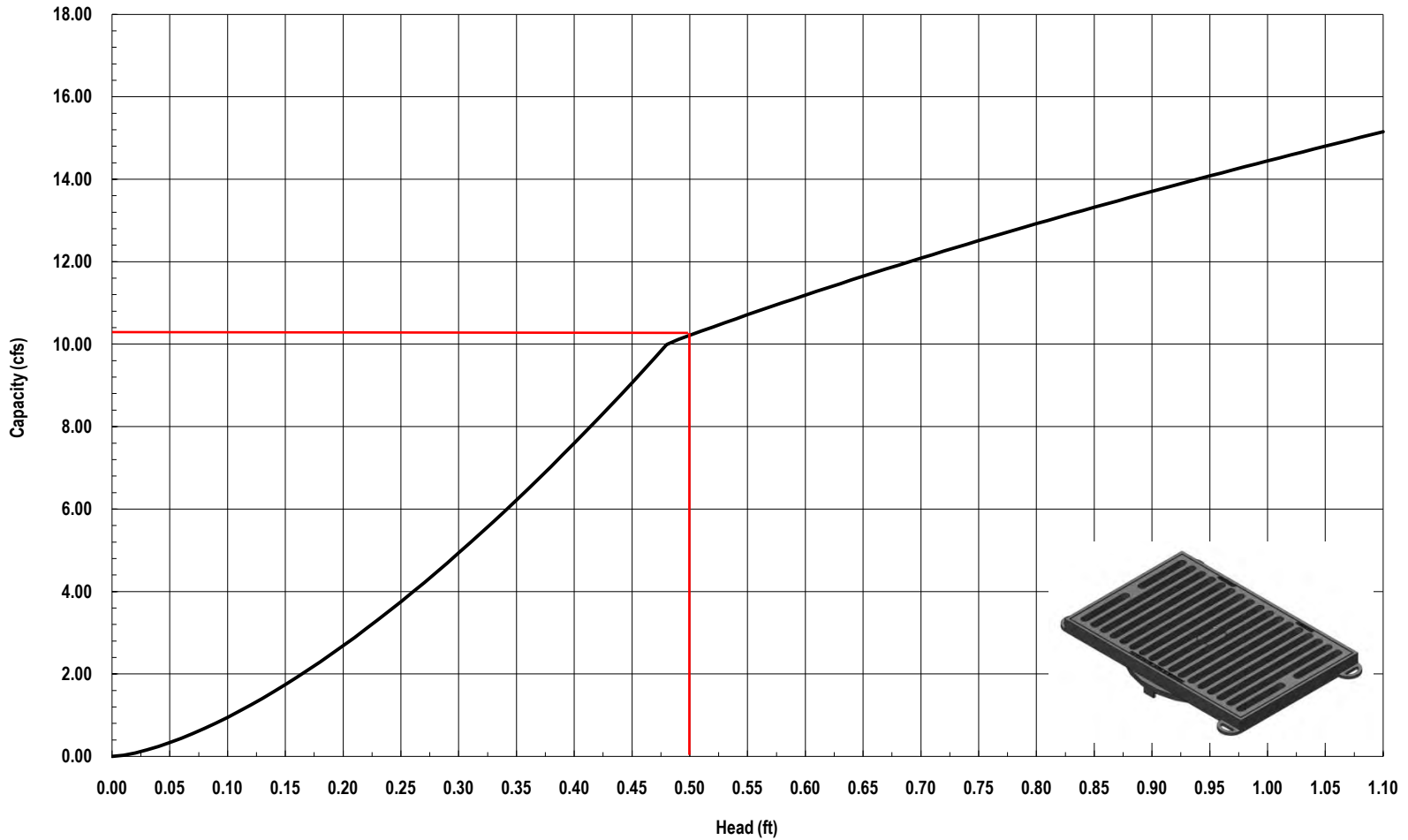
PRELIMINARY

H:\2020\20-0231\DRAINAGE\HYDROLOGY\PRELIMINARY.DWG FOLDER\20-0231-PRHD-RAT.DWG 12/3/2021 3:32:36 PM

APPENDIX B – HYDRAULICS

ON-SITE INLETS

Nyloplast 2' x 3' Road & Highway Grate Inlet Capacity Chart



3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490
© Nyloplast Inlet Capacity Charts June 2012

EXISTING 12-INCH CMP CULVERTS

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, October 13, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: 12in CMP

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0160

Depth: 0.9000 ft

Result Parameters

Flow: 4.3632 cfs

Area of Flow: 0.7445 ft²

Wetted Perimeter: 2.4981 ft

Hydraulic Radius: 0.2980 ft

Average Velocity: 5.8604 ft/s

Top Width: 0.6000 ft

Froude Number: 0.9271

Critical Depth: 0.8770 ft

Critical Velocity: 5.9768 ft/s

Critical Slope: 0.0205 ft/ft

Critical Top Width: 0.66 ft

Calculated Max Shear Stress: 1.1232 lb/ft²

Calculated Avg Shear Stress: 0.3719 lb/ft²

WEST COLLECTOR CHANNEL

Hydraulic Analysis Report

Project Data

Project Title:
Designer:
Project Date: Wednesday, October 13, 2021
Project Units: U.S. Customary Units
Notes:

Channel Analysis: West Collector

Notes:

Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 2.0000 ft/ft
Side Slope 2 (Z2): 2.0000 ft/ft
Channel Width: 4.0000 ft
Longitudinal Slope: 0.0140 ft/ft
Manning's n: 0.0150
Flow: 14.0000 cfs

12" CMP flow rate multiplied
by 3 because of 3 total
tributary culverts

Result Parameters

Depth: 0.4642 ft
Area of Flow: 2.2875 ft²
Wetted Perimeter: 6.0758 ft
Hydraulic Radius: 0.3765 ft
Average Velocity: 6.1201 ft/s
Top Width: 5.8567 ft
Froude Number: 1.7257
Critical Depth: 0.6468 ft
Critical Velocity: 4.0886 ft/s
Critical Slope: 0.0043 ft/ft
Critical Top Width: 6.59 ft
Calculated Max Shear Stress: 0.4055 lb/ft²
Calculated Avg Shear Stress: 0.3289 lb/ft²

LATERAL-B6-1 AND INLET

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, October 13, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: LAT-B6-1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0130

Flow: 16.9000 cfs

Result Parameters

Depth: 1.0332 ft

Area of Flow: 1.6371 ft²

Wetted Perimeter: 3.2079 ft

Hydraulic Radius: 0.5103 ft

Average Velocity: 10.3230 ft/s

Top Width: 1.9989 ft

Froude Number: 2.0102

Critical Depth: 1.4824 ft

Critical Velocity: 6.7687 ft/s

Critical Slope: 0.0069 ft/ft

Critical Top Width: 1.75 ft

Calculated Max Shear Stress: 1.2894 lb/ft²

Calculated Avg Shear Stress: 0.6369 lb/ft²

Weir Inlet Ponding Depth Calculation



Designer: TSW

Date: 10/13/2021

Project: Duke Nance and Patterson

Location: Interim inlet for Lateral-B6-1

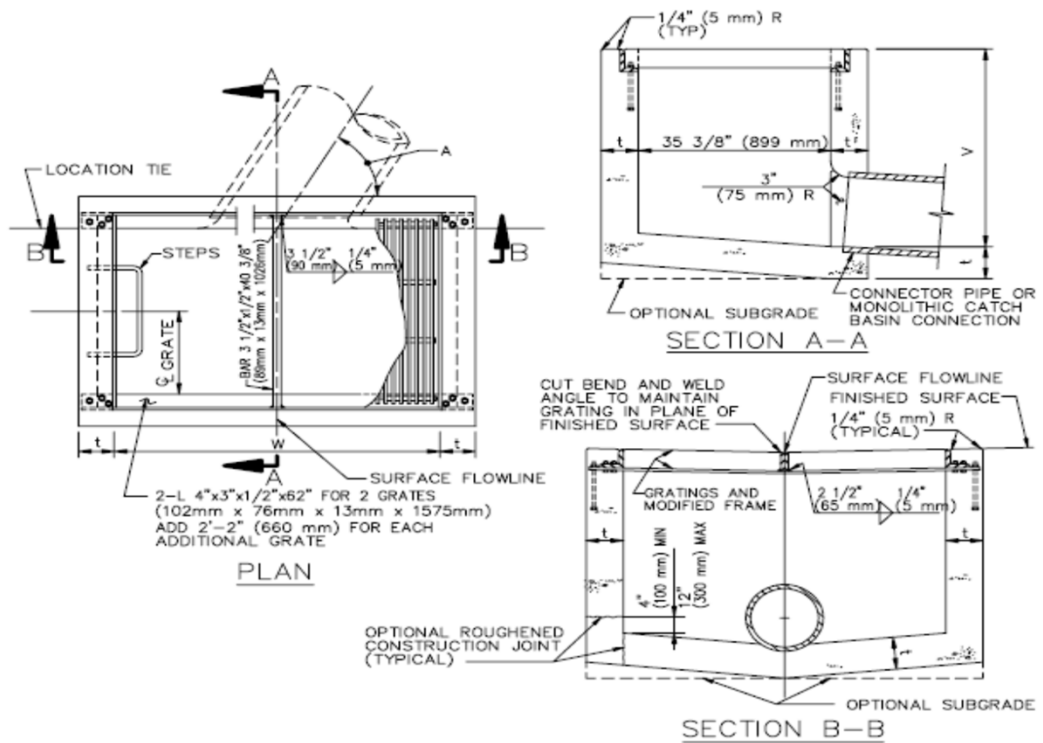
OUTLET STRUCTURE PONDING DEPTH SPPWC 305-4 (Transverse)

DISCHARGE (cfs) 16.9
 NUMBER OF GRATES 3
 LENGTH (ft) 20.736

$$Q = CL(h)^{3/2}$$

WEIR COEFFICIENT	C	3	
WEIR LENGTH	L	20.736	ft ²
HEAD	h	0.42	ft
Flow	Q	16.90	cfs

Top of Weir Elevation: 1496.5
 Water Surface Elevation: 1496.92



LATERAL-B6-2

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, October 13, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: LAT-B6-2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0130

Flow: 15.0000 cfs

Result Parameters

Depth: 1.2431 ft

Area of Flow: 1.5658 ft²

Wetted Perimeter: 3.4324 ft

Hydraulic Radius: 0.4562 ft

Average Velocity: 9.5797 ft/s

Top Width: 1.1302 ft

Froude Number: 1.4343

Critical Depth: 1.4055 ft

Critical Velocity: 8.7178 ft/s

Critical Slope: 0.0176 ft/ft

Critical Top Width: 0.73 ft

Calculated Max Shear Stress: 1.5514 lb/ft²

Calculated Avg Shear Stress: 0.5693 lb/ft²

LATERAL-B6-3 AND INLET

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, October 13, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: LAT-B6-3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Flow: 36.4000 cfs

Result Parameters

Depth: 1.8326 ft

Area of Flow: 3.8563 ft²

Wetted Perimeter: 5.1391 ft

Hydraulic Radius: 0.7504 ft

Average Velocity: 9.4391 ft/s

Top Width: 2.2118 ft

Froude Number: 1.2598

Critical Depth: 2.0447 ft

Critical Velocity: 8.4697 ft/s

Critical Slope: 0.0079 ft/ft

Critical Top Width: 1.93 ft

Calculated Max Shear Stress: 1.1435 lb/ft²

Calculated Avg Shear Stress: 0.4682 lb/ft²

Weir Inlet Ponding Depth Calculation



Designer: TSW

Date: 10/13/2021

Project: Duke Nance and Patterson

Location: Interim inlet for Lateral-B6-3

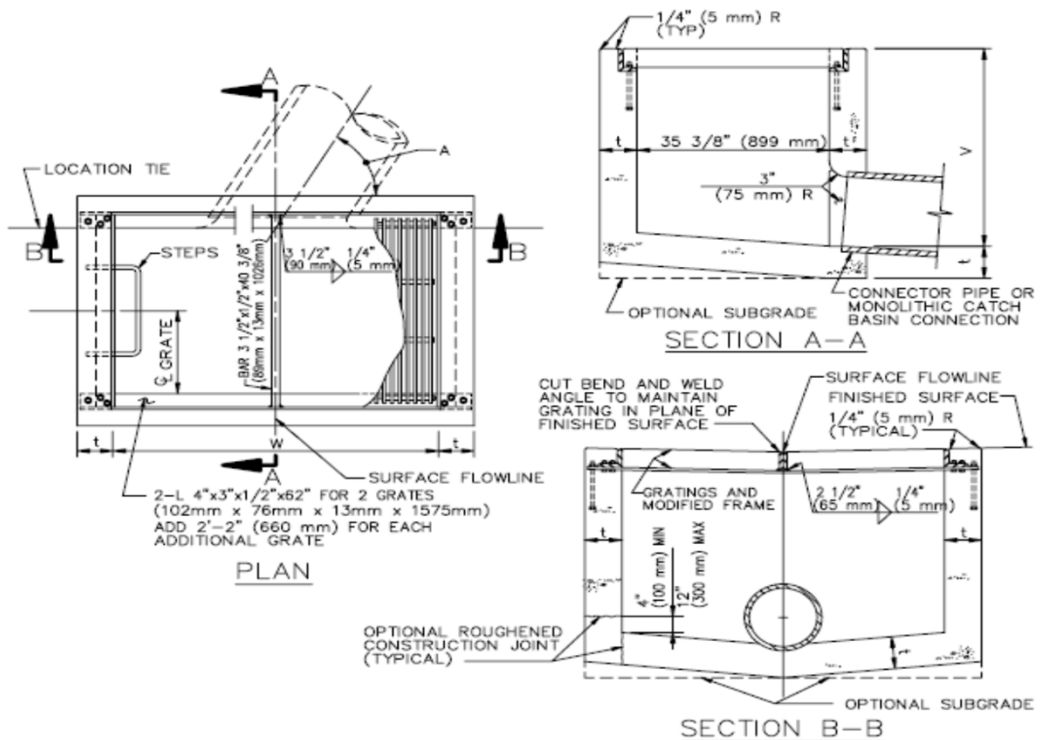
OUTLET STRUCTURE PONDING DEPTH SPPWC 305-4 (Transverse)

DISCHARGE (cfs) 36.4
 NUMBER OF GRATES 8
 LENGTH (ft) 52.021

$$Q = CL(h)^{3/2}$$

WEIR COEFFICIENT C 3
 WEIR LENGTH L 52.021 ft
 HEAD h 0.38 ft
 Flow Q 36.40 cfs

Top of Weir Elevation: 1498.2
 Water Surface Elevation: 1498.58



LATERAL-B6.1

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, October 13, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: LAT-B61

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 4.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0130

Flow: 80.0000 cfs

Result Parameters

Depth: 2.9137 ft

Area of Flow: 9.8064 ft²

Wetted Perimeter: 8.1809 ft

Hydraulic Radius: 1.1987 ft

Average Velocity: 8.1579 ft/s

Top Width: 3.5582 ft

Froude Number: 0.8660

Critical Depth: 2.7090 ft

Critical Velocity: 8.8314 ft/s

Critical Slope: 0.0048 ft/ft

Critical Top Width: 3.74 ft

Calculated Max Shear Stress: 0.7272 lb/ft²

Calculated Avg Shear Stress: 0.2992 lb/ft²

APPENDIX C – REFERENCES

CALTRANS RCB TECHNICAL MEMO



10/4/21

To: WHOM IT MAY CONCERN

From: Eric T. Hays, PE. Senior Engineer

Date: October 4, 2021

Re: Revised Existing CALTRANS Storm Drain Capacity Analysis

INTRODUCTION

The purpose of this memorandum is to document the capacity analysis that runs along Harley Knox Blvd. A future industrial building will propose to connect to the existing CALTRANS RCB east of Patterson Ave. This memorandum will document the flows tributary to the CALTRANS facilities west of the I-215 freeway, hereon referred as Connection Points 1, 2, and 3 (see Figure 1 and Exhibit 1). This memorandum will also

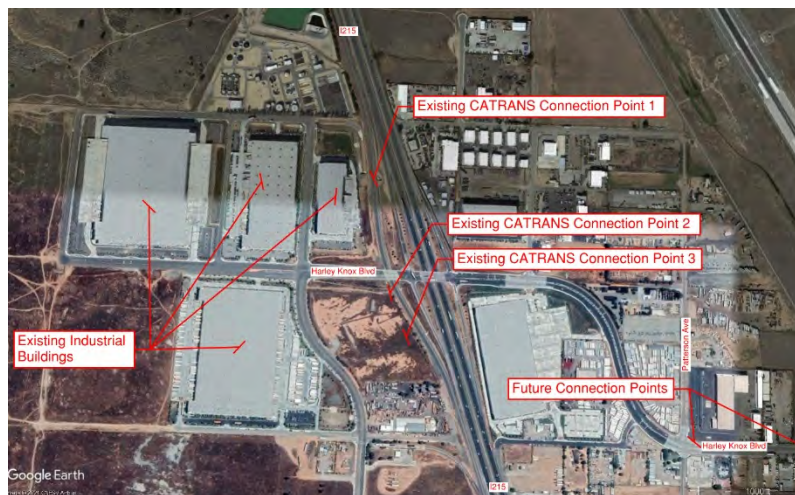


Figure 1 Vicinity Map

assess the inflows east of I-215 Freeway that are tributary to the CALTRANS facility that runs parallel to Harley Knox east of Patterson Ave. This will be accomplished by documenting the flows from the industrial developments, streets, and local hydrology. Hydrology studies have been prepared in the area. Selected pages from the approved Knox Logistics Center Hydrology Report are included in Appendix 1. For locations of the Connection Points 1, 2, and 3 existing facilities and local hydrology areas, see Exhibit 1- Existing CALTRANS Facility Inlet Points. Lastly, this memorandum will determine the available capacity of the CALTRANS facility via an iterative hydraulic analysis.

EXISTING DRAINAGE FACILITIES

Currently the area to the west of the I-215 is almost completely built out except for one property bounded by Harley Knox, Harvill Ave, and Old Oleander Ave. The ultimate drainage facilities that have been constructed in the area connect into the existing CALTRANS facilities shown in Exhibit 1 as Connection Points 1 and 2.

Also see Appendix 1, Figure 2, for photos of each connection point. Below are the existing facilities that connect to Connection Points 1, 2 and 3:

- Connection Point 1 – Line B per RCFC&WCD approved Drawing No. 4-1061
 - Existing (2) 54” RCP @ Railroad & 5’(W)x3’(H) RCB @ I-215 Freeway
- Connection Point 2 – Lateral B-8 per RCFC&WCD approved Drawing No. 4-1060
 - Existing (2) 42” RCP @ Railroad & 5’(W)x4’(H) RCB @ I-215 Freeway
- Connection Point 3 – Future developed industrial center
 - Existing (2) 36” RCP @ Railroad & 6’(W)x4’(H) RCB @ I-215 Freeway

To understand the design capacity of Connection Points 1, 2, and 3, US Federal Highway Administration (FHWA) Nomographs were utilized. Exhibit 1 references the picture numbers that correlate to Figure 2 in Appendix 1. The corresponding nomograph calculations can also be found in Appendix 1.

On the east side of I-215 Freeway the existing facilities are considered ultimate due to the area being completely built out. The existing facilities include CALTRANS and City of Perris maintained drainage facilities. These facilities are shown in Exhibit 1 and are outlined below:

- 8’(W)x6’(H) & 8’(W)x7’(H) RCB per CALTRANS Plans ACNH-215-1(220)87E
 - Alignment – Flows north to south along Patterson Ave and west to east along Harley Knox
 - Inlets-2 inlets along Patterson Ave north of Harley Knox
- 5’(W)x2’(H) RCB CALTRANS per CALTRANS Plans 076461 D-20 & D-52
 - Alignment is perpendicular to Harley Knox– Flows west to east
 - Connection with Gateway Commerce Center onsite basin
- Line A – 24” RCP PER City of Perris approved plans City File No. P8-1271
- Lateral A2– 36” RCP PER City of Perris approved plans City File No. P8-1271

Relevant Plan sheets have been included in Appendix 2 for reference. The Gateway Commerce existing and proposed Hydrology Maps are included for reference in Appendix 2 as well.

FLOW RATE ASSESSMENT & LOCAL HYDROLOGY

To understand the inflows into Connection Points (1, 2, and 3), flows from the Railroad/Freeway area, and the flows from existing facilities located on the east of the I-215, a flow rate assessment was conducted. The flows were primarily obtained from approved as-built plans for Connection Points 1 and 2. There are 3 locations that required local hydrology calculations which can be found in Appendix 1. The first location is a future industrial development located on the west side of the I-215 freeway and is bounded by Harley Knox, Harvill Ave and Old Oleander Ave. This area required local hydrology calculation using an area yield of 2.1 cfs/acre which is consistent with the adjacent industrial buildings. See Appendix 1 for the future industrial building yield calculation backup. This area contributes flows to Connection Point 3. The second location is the railroad and I-215 Freeway contribution, with an area yield of 3 cfs/acre. This area also contributes flows to Connection Point 3. The third location is on the east side of I-215 Freeway bounded by Harley Knox and Patterson Ave, this area receives flow from the CALTRANS culvert under Harley Knox and flows to two inlets located within Patterson Ave right of way. This analysis also assumed that flow generated from the property is also picked up in the two inlets that connect to the CALTRANS facility. The area yield for this location was assumed to be 2 cfs/acre. See Exhibit 1 for additional information and Table 1 below for summary of the flow contributions. There are 3 inlets along Harley Knox east of the Patterson Ave intersection. Each of the 3 inlets picks up street and local property drainage. The total flow contribution for the 3 inlets are detailed in Table 1 and Exhibit 1.

Table 1, Inflow rate to CALTRANS facility within Harley Knox Right of Way.

Inflow Rates		
Connection Point	Facility	Q [cfs]
1	(2) 5'(W)x3'(H) RCB	173
2	5(W)x4'(H) RCB	195.3
3*	(2) 36" RCP	52
	6'(W)x4'(H) RCB	
Freeway & Railroad**		45
Inlets along Patterson		33.3
	LATERAL A2	30
Inlets along East Harley Knox		24
Total		552.6

The results of the local hydrology calculations and flow assessment results in a revised flow of 553 cfs. The CALTRANS design flowrate is 536cfs per the approved as-built plan located in Appendix 2. Without a capacity analysis the available capacity in the CALTRANS 8'(W)x7'(H) RCB is 0 cfs at the point of the future connection. It should be noted that the CALTRANS design flow has 1.5 feet of freeboard within the most upstream connection. See Appendix 2 for annotations.

CAPACITY ANALYSIS

To assess the excess capacity of the CALTRANS 8'(W)x6'(H) RCB along Patterson Ave and CALTRANS 8'(W)x7'(H) RCB that runs parallel north of the Harley Knox centerline, a WSPG model was built. The model converts the metric units to US units and was iteratively ran with increasing flows. The goal was to understand what the maximum flow is without causing the RCB to seal in the 100-year event. The iterative WSPG analysis can be found in Appendix 3. Based on the results the maximum capacity for the CALTRANS RCB facility is 600 cfs. With a flow rate of 600 cfs there is still approximately 5" of freeboard available within the RCB. Therefore, the available capacity is the difference between the revised flow rate and the WSPG max capacity. Based on this assumption, the available capacity is 71 cfs [600cfs-553cfs= 47cfs].

CONCLUSION

Based on this analysis, the following items are concluded:

- The As-built flow rate in the Caltrans RCB is 536 CFS
- The actual flow rate based on this analysis is 553 cfs
- The max capacity of the CALTRANS RCB is 600cfs assuming 5" freeboard at upstream end.
- The available capacity is 0 CFS based on the As-built flow rate
- The available capacity is 47 cfs based on the excess capacity analysis.

EXHIBIT 1

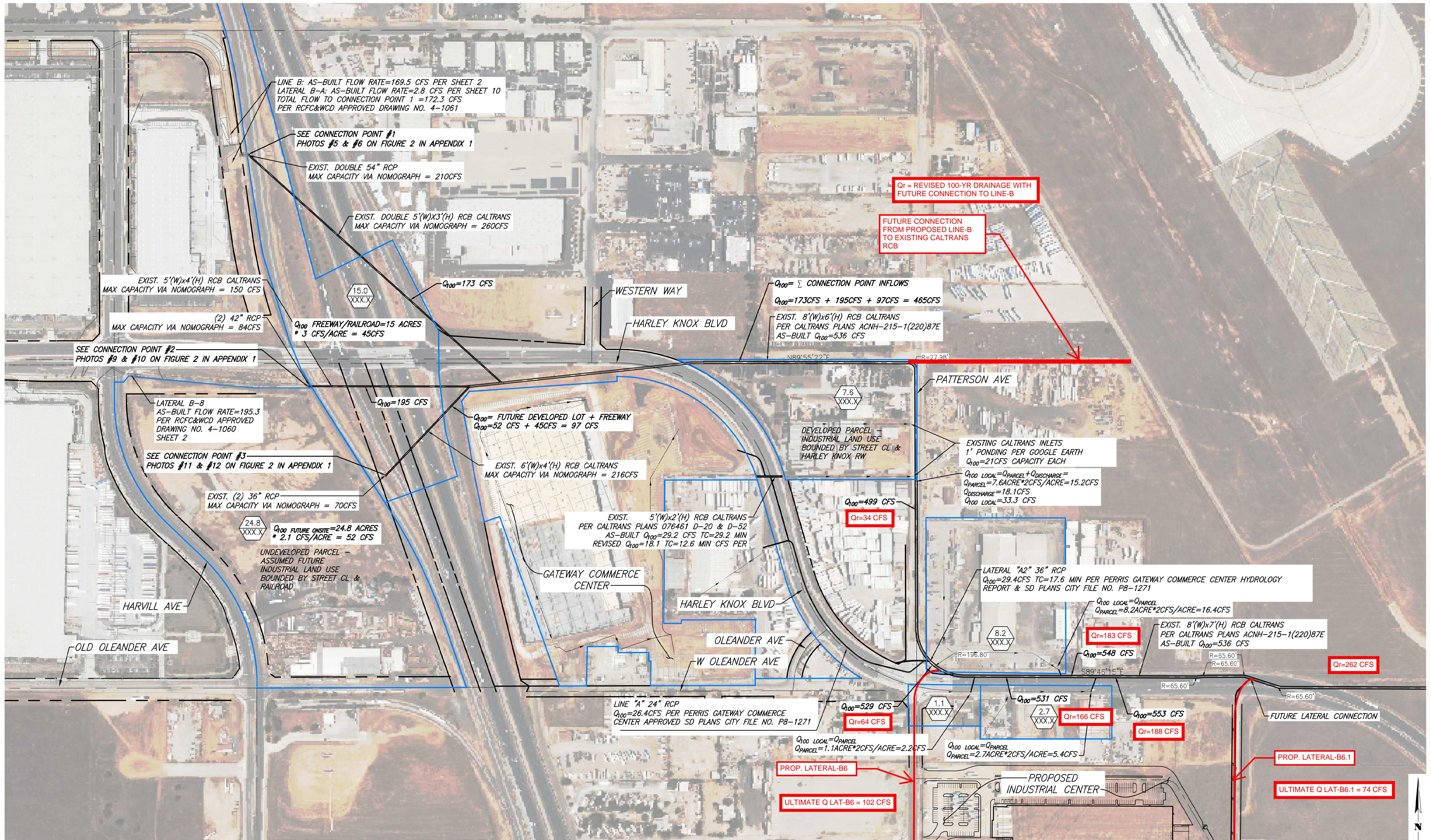


EXHIBIT 1
EXISTING CALTRANS FACILITY INLET POINTS

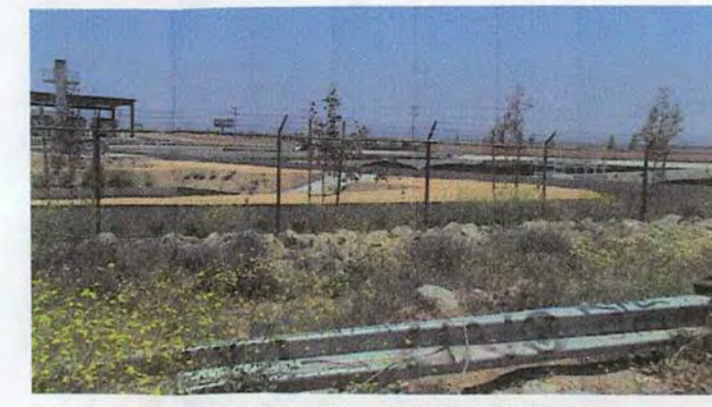


PRELIMINARY
 H:\2020\20_0231\DRAINAGE\CALTRANS_CAPACITY_ANALYSIS\FIGURE 2.DWG 10/4/2021 7:20:33 AM

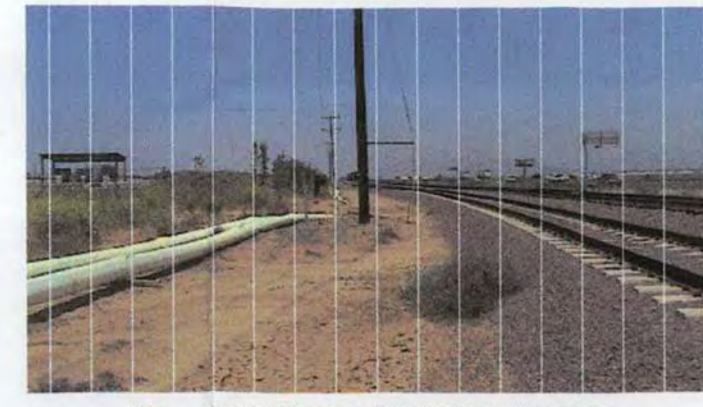
APPENDIX 1

Figure 2

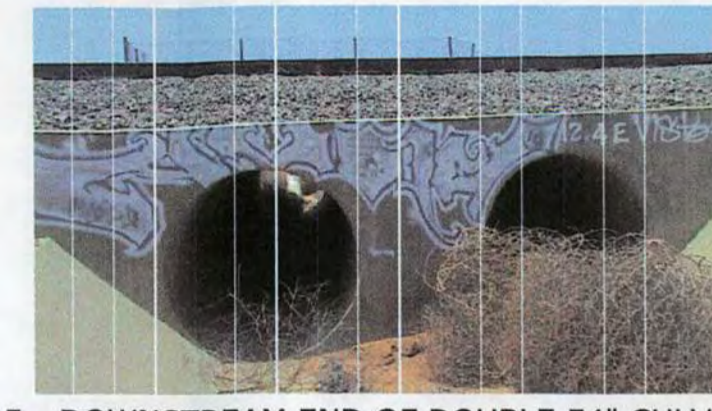
PLOT PLAN 20699R - TRAMMELL CROW BUSINESS PARK
 COUNTY OF RIVERSIDE, STATE OF CALIFORNIA
 FIELD RECONNAISSANCE MAP



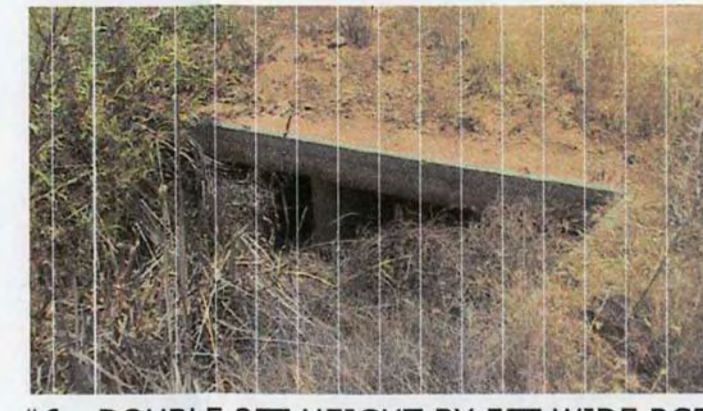
#1 - CHANNEL AGAINST FENCE



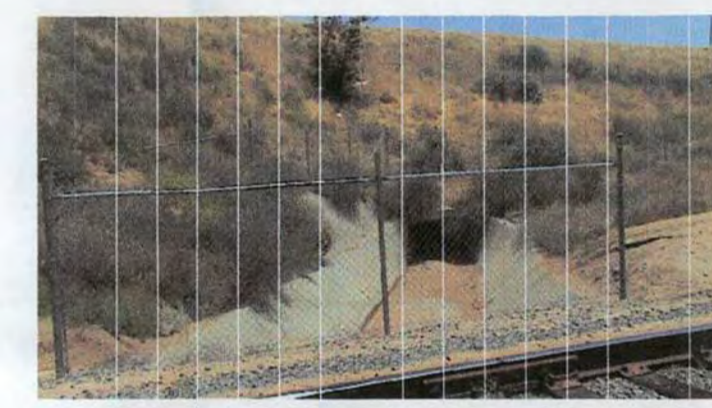
#2 - RAILROAD FACING NORTH



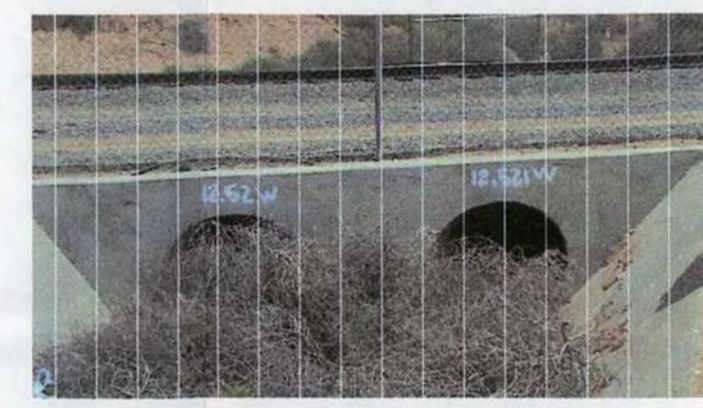
#5 - DOWNSTREAM END OF DOUBLE 54" CULVERT



#6 - DOUBLE 3FT HEIGHT BY 5FT WIDE RCB CROSSING RAILROAD FACING EAST



#9 - SINGLE 4FT HEIGHT BY 6FT WIDE RCB FACING EAST



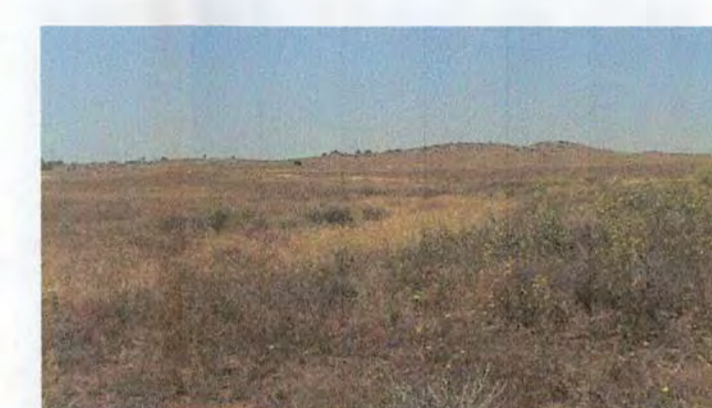
#10 - DOUBLE 42IN PIPE UNDER RAILROAD FACING EAST



#13 - DOUBLE 36IN PIPE AT THE UPSTREAM END FACING EAST



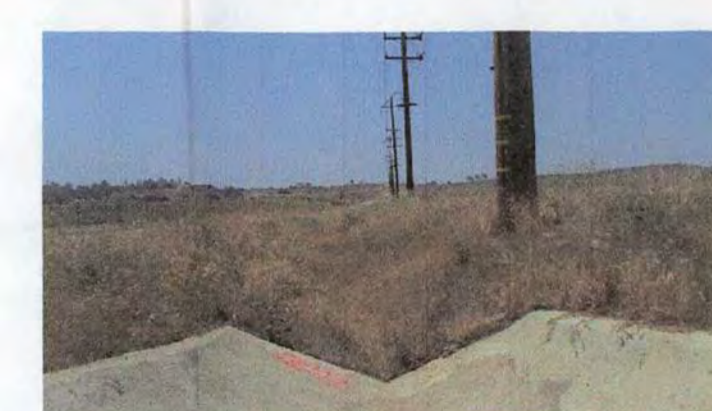
#14 - EROSION AT DOUBLE 36IN PIPE FACING NORTH



#17 - LOOKING UPSTREAM FROM HARVILL AVE FACING NORTH WEST



#18 - SINGLE 42IN PIPE CROSSING HARVILL AVE FACING NORTH EAST



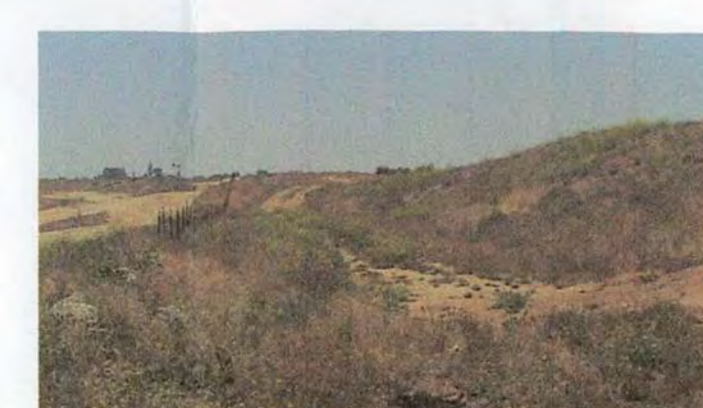
#21 - LOOKING UPSTREAM AT OLEANDER AVE AND HARVILL AVE FACING WEST



#22 - SINGLE 36IN PIPE AT HARVILL AVE AND OLEANDER AVE FACING SOUTH



#25 - NORTHEASTERN PANORAMIC VIEW OF WHERE FLOWS POSSIBLY SPLIT



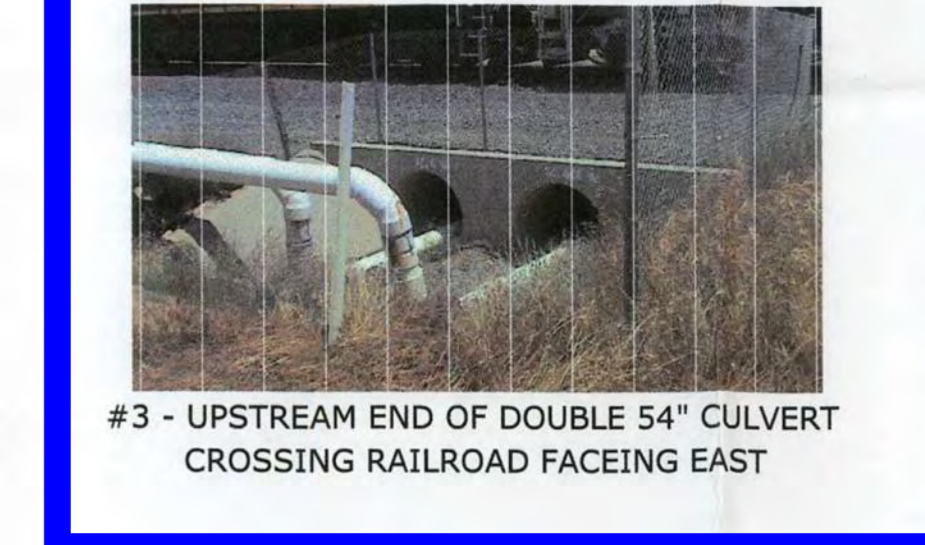
#26 - WESTERN PANORAMIC VIEW OF WHERE FLOWS POSSIBLY SPLIT



#28 - SOUTHERN PANORAMIC VIEW OF WHERE THE FLOWS POSSIBLY SPLIT



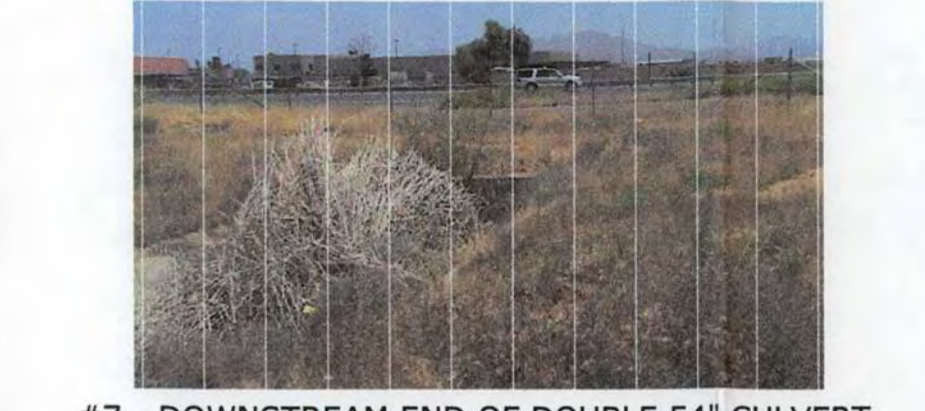
#29 - WESTERN VIEW OF WHERE THE FLOWS POSSIBLY SPLIT



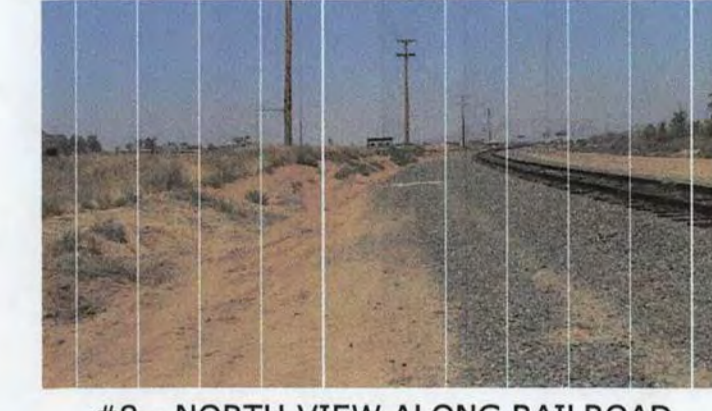
#3 - UPSTREAM END OF DOUBLE 54" CULVERT CROSSING RAILROAD FACING EAST



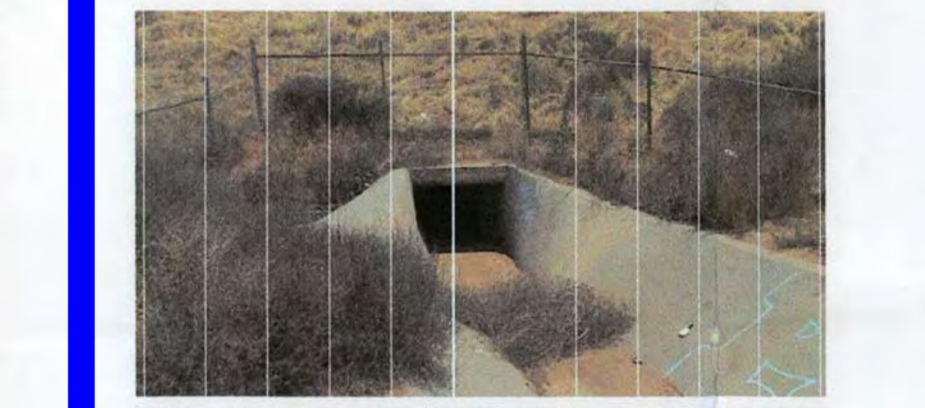
#4 - WATER PIPES FROM WATER TREATMENT PLANT



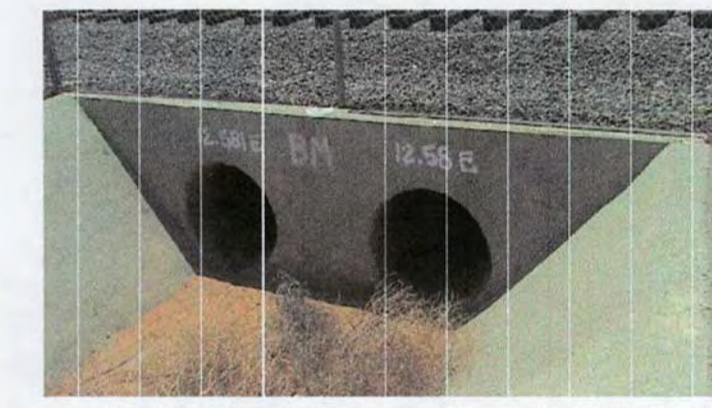
#7 - DOWNSTREAM END OF DOUBLE 54" CULVERT FACING EAST



#8 - NORTH VIEW ALONG RAILROAD



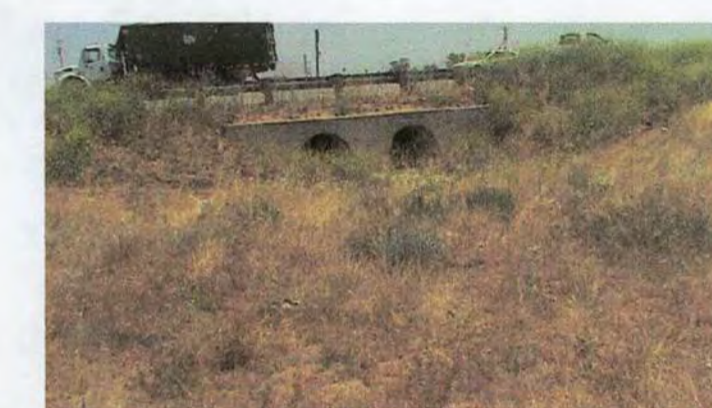
#11 - SINGLE 4FT HEIGHT BY 5FT WIDE RCB FACING EAST



#12 - DOUBLE 36 IN PIPE AT THE DOWNSTREAM END FACING WEST



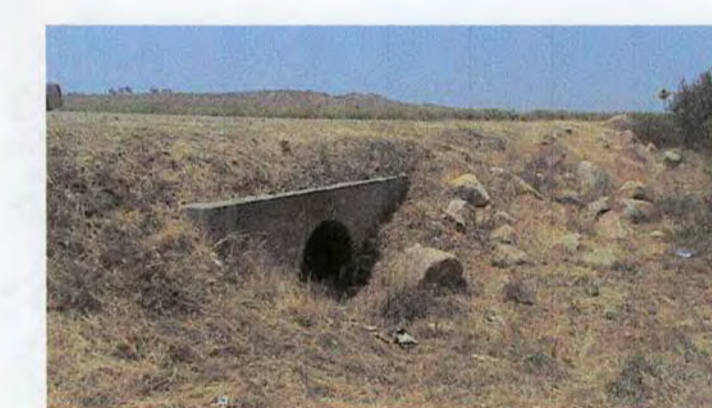
#15 - EROSION AT DOUBLE 36IN PIPE FACING SOUTH



#16 - DOUBLE 54IN PIPE CROSSING HARVILL AVE FACING SOUTHEAST



#19 - DOWNSTREAM END OF SINGLE 42IN PIPE CROSSING HARVILL AVE FACING SOUTHWEST



#20 - DOWNSTREAM END OF SINGLE 42IN PIPE CROSSING HARVILL AVE FACING WEST



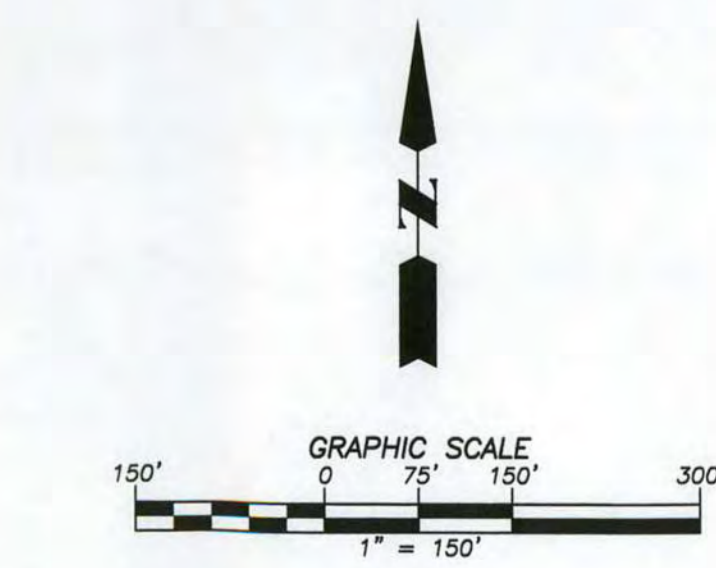
#23 - CATCH BASIN ON HARVILL AVE AND OLEANDER AVE FACING SOUTHEAST



#24 - CATCH BASIN ON HARVILL AVE AND OLEANDER AVE FACING SOUTHWEST



#27 - SOUTHWESTERN PANORAMIC VIEW OF WHERE THE FLOWS POSSIBLY SPLIT



DBL 54" crossing RR

PHOTO 5

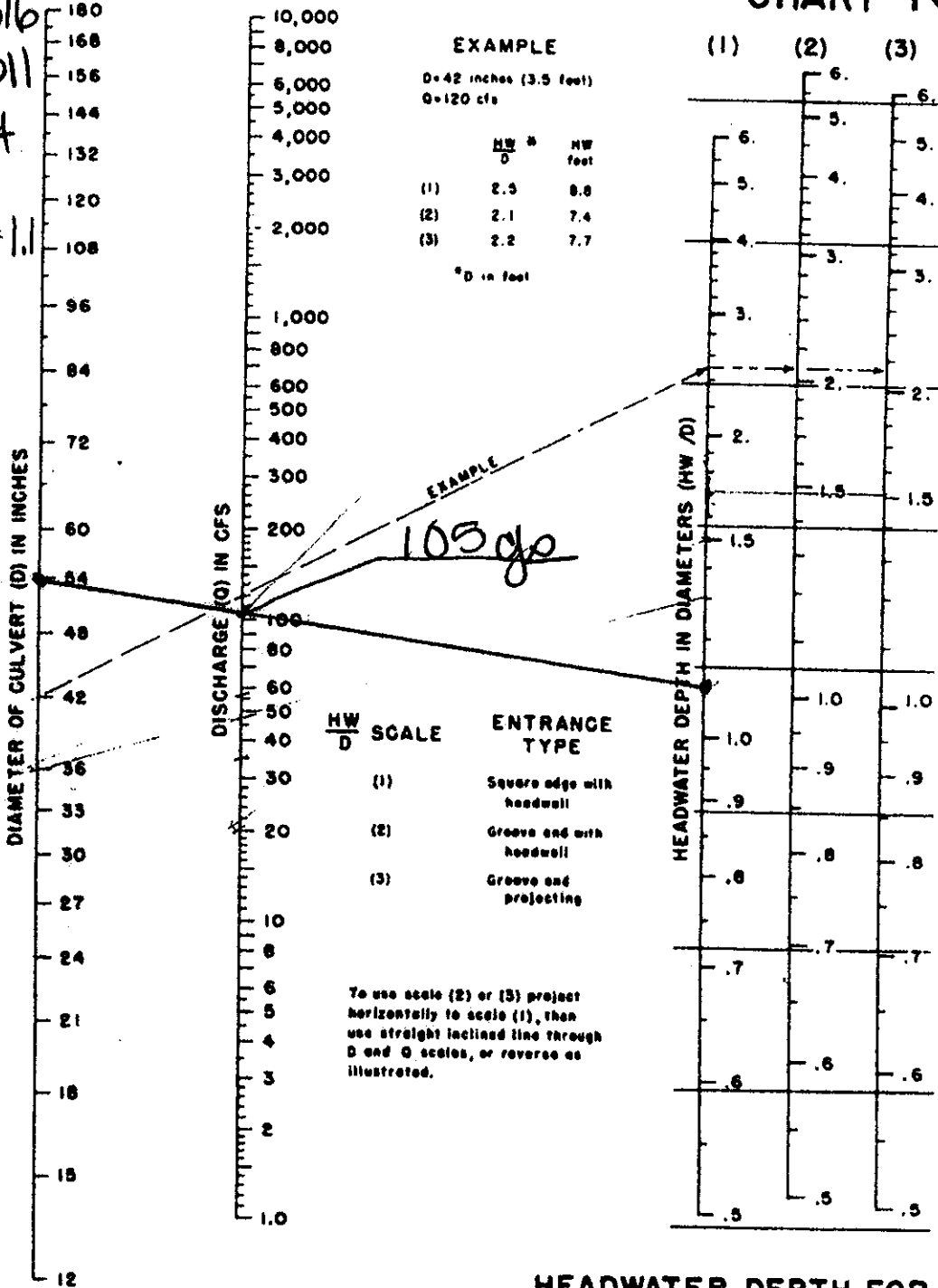
Max Elev. = 151.6

Inv. Elev. = 151.1

Max H = 5 ft

$$\frac{HW}{D} = \frac{5}{4.5} = 1.1$$

CHART 1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2 & 3
 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

DBL 54" capacity

$$= 105 \text{ cfs} * 2 = \boxed{210 \text{ cfs}}$$

DBL 3' H X 5' W D.S. of DBL 54"

PHOTO 6



Max Elev. = 1514

Invert Elev. = 1509

Max H = 5'

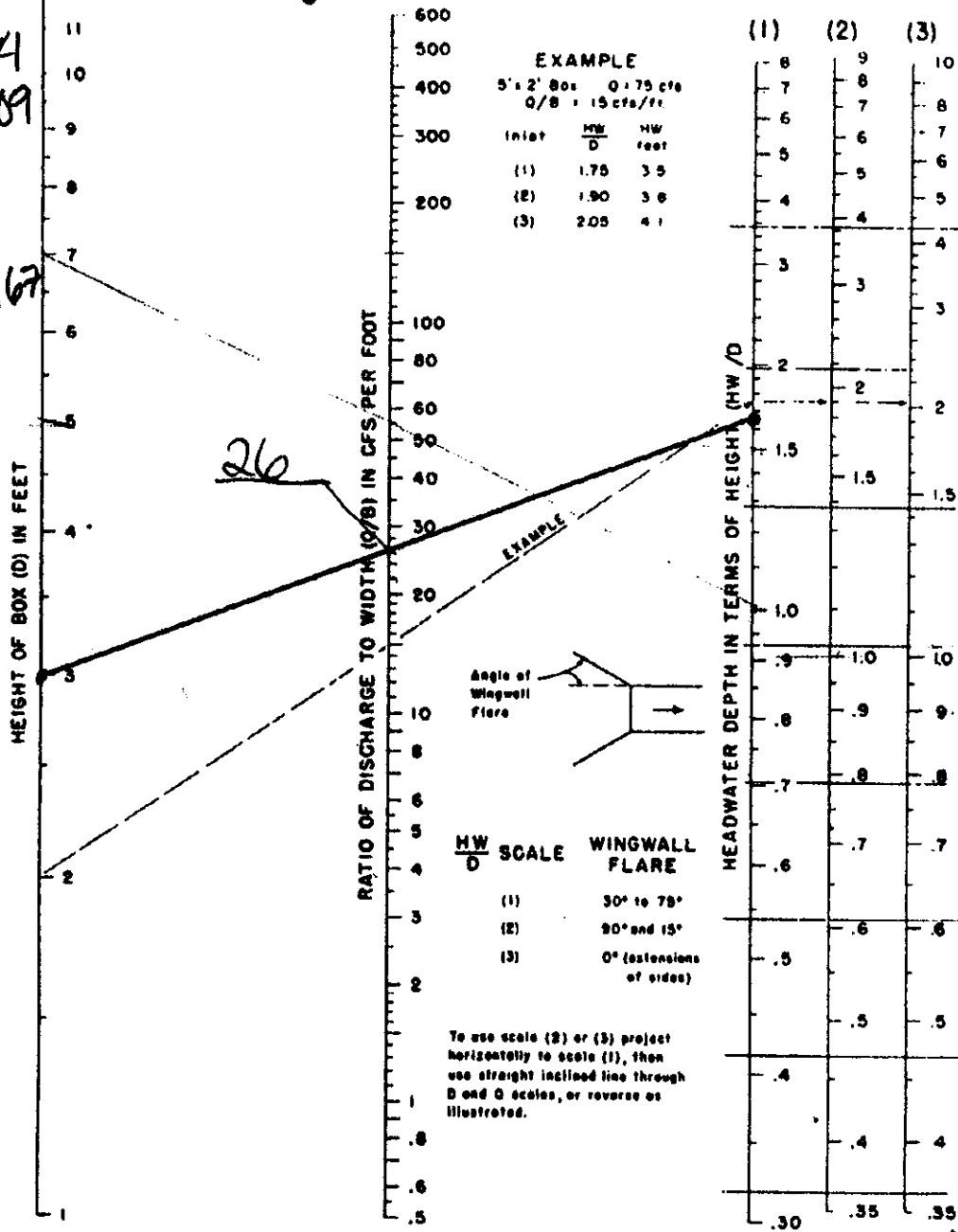
$$\frac{HW}{D} = \frac{5}{3} = 1.67$$

$$\frac{Q}{B} = 26$$

$$Q = 26 * B$$

$$Q = 26 * 5$$

$$Q = 130 \text{ cfs}$$



BUREAU OF PUBLIC ROADS JAN 1963

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

DBL 3' H X 5' W Capacity

$$= 130 \text{ cfs} * 2 = \boxed{260 \text{ cfs}}$$

~~Q_{BOX} > Q_{PIPE} so DBL 54" pipes control~~

DBL 42" crossing Railroad

PHOTO 10

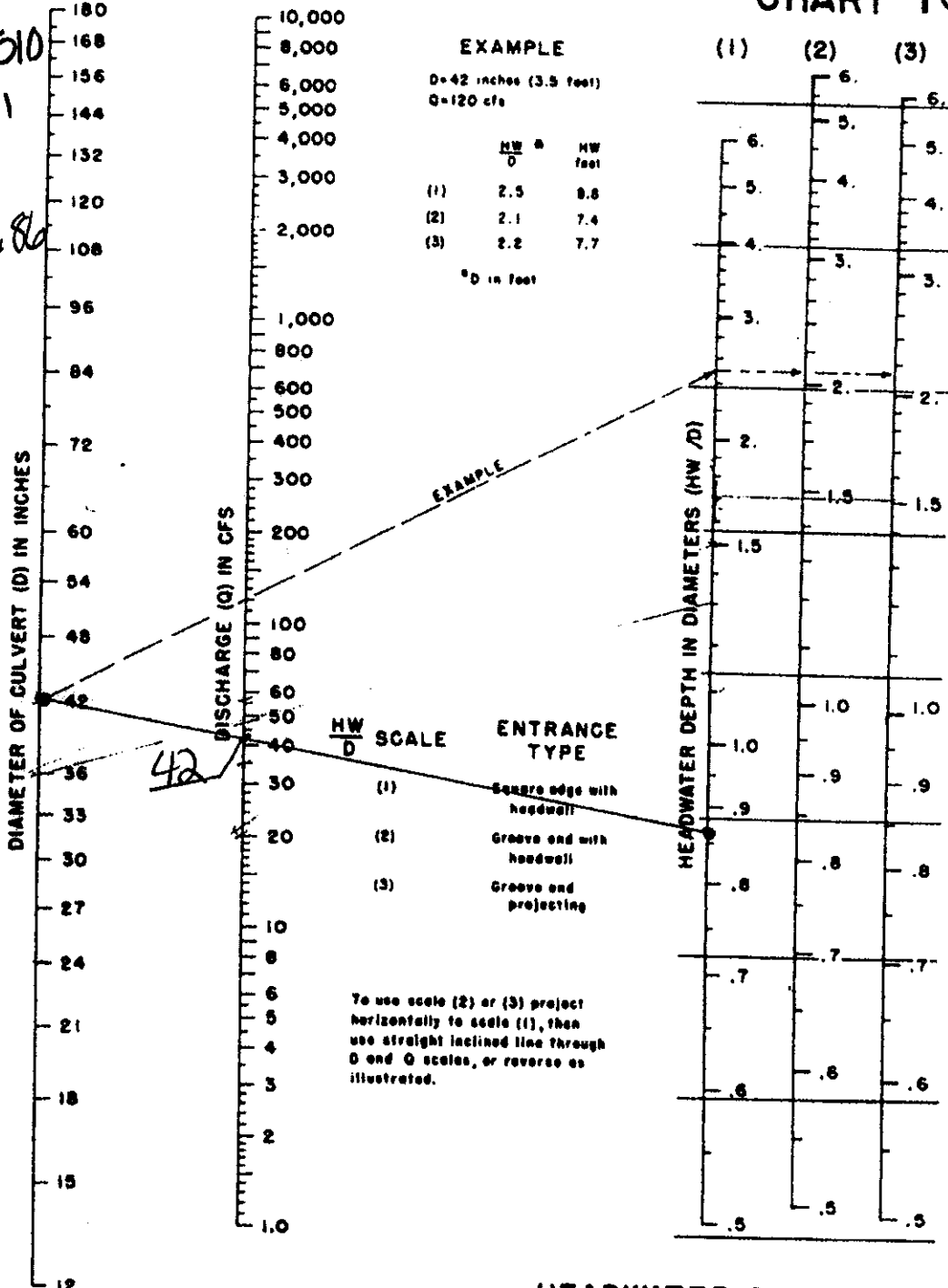
Max Elev. = 1513

Inw. Elev. = 1510

Max H = 3'

$$\frac{HW}{D} = \frac{3}{35} = .86$$

CHART 1



HEADWATER SCALES 283

REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

**HEADWATER DEPTH FOR
 CONCRETE PIPE CULVERTS
 WITH INLET CONTROL**

DBL 42" Capacity
 = 42 cfs * 2 = 84 cfs

4' H x 6' W Box Crossing 215

PHOTO 11



Max Elev. = 1514

Inv. Elev. = 1508

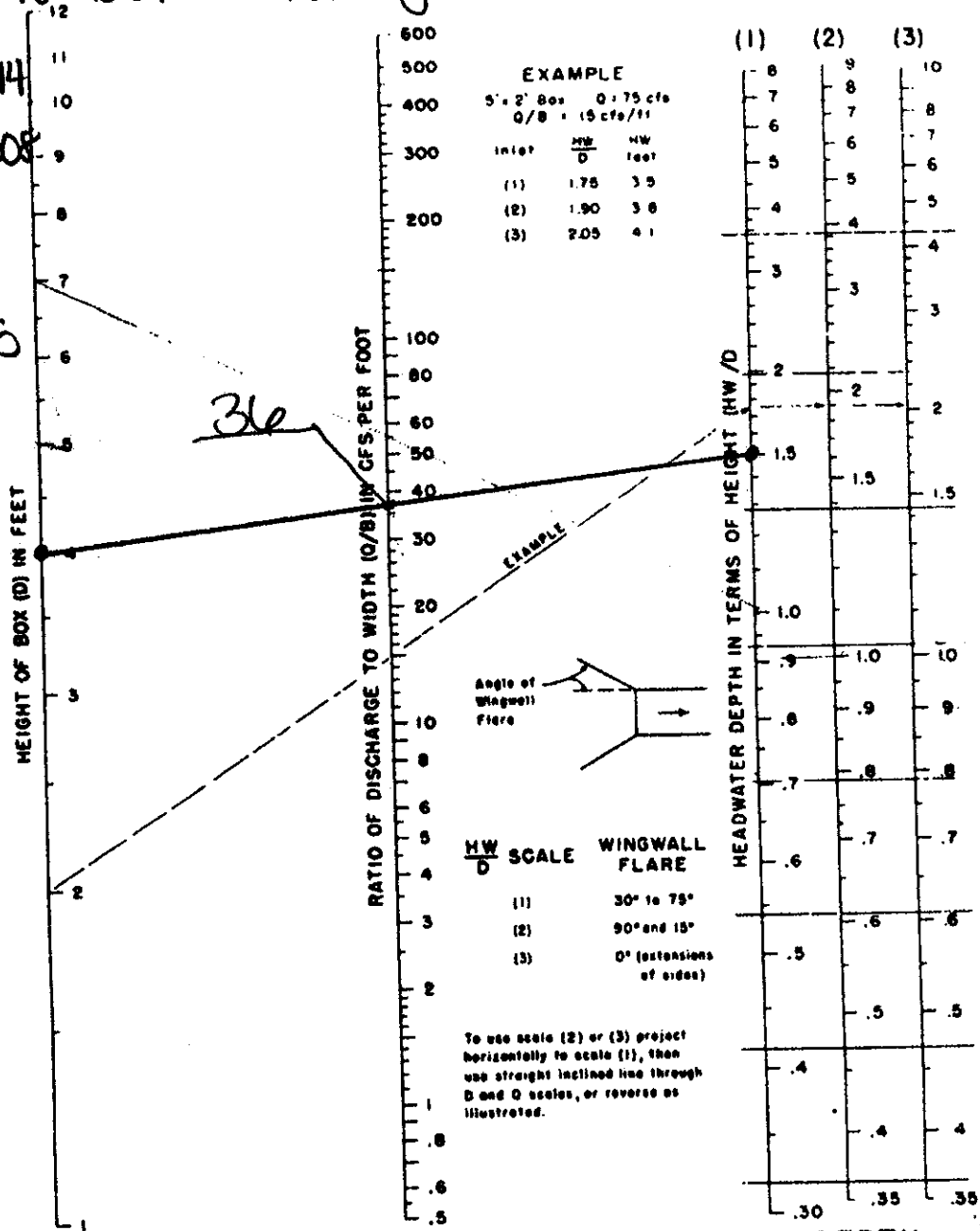
Max H = 6'

$$\frac{HW}{D} = \frac{6}{4} = 1.5$$

$$\frac{Q}{B} = 36$$

$$Q = 36 * B$$

$$Q = 216$$



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

4' H x 6' W max capacity
 = 216 cfs

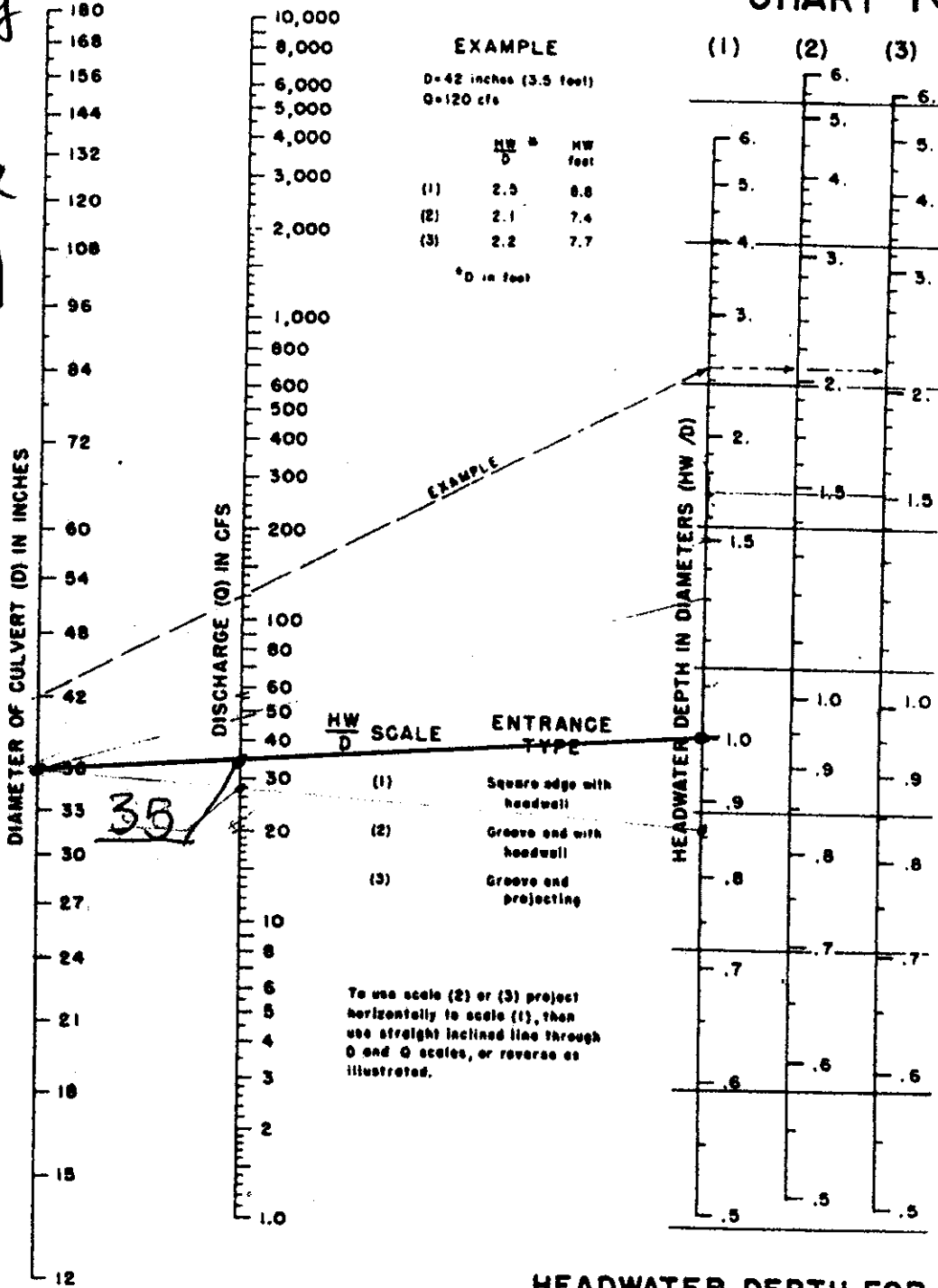
DBL 36" Crossing Rail Road

Since elevations are unknown, will use

lowest H/D of
 B&O for
 facilities
 Crossing RR

$$\frac{HW}{D} = \frac{3}{3} = 1$$

CHART 1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2 & 3
 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

DBL 36" Capacity
 = 35 cfs * 2 = 70 cfs

4' H x 5' W Box Crossing Freeway

PHOTO 9



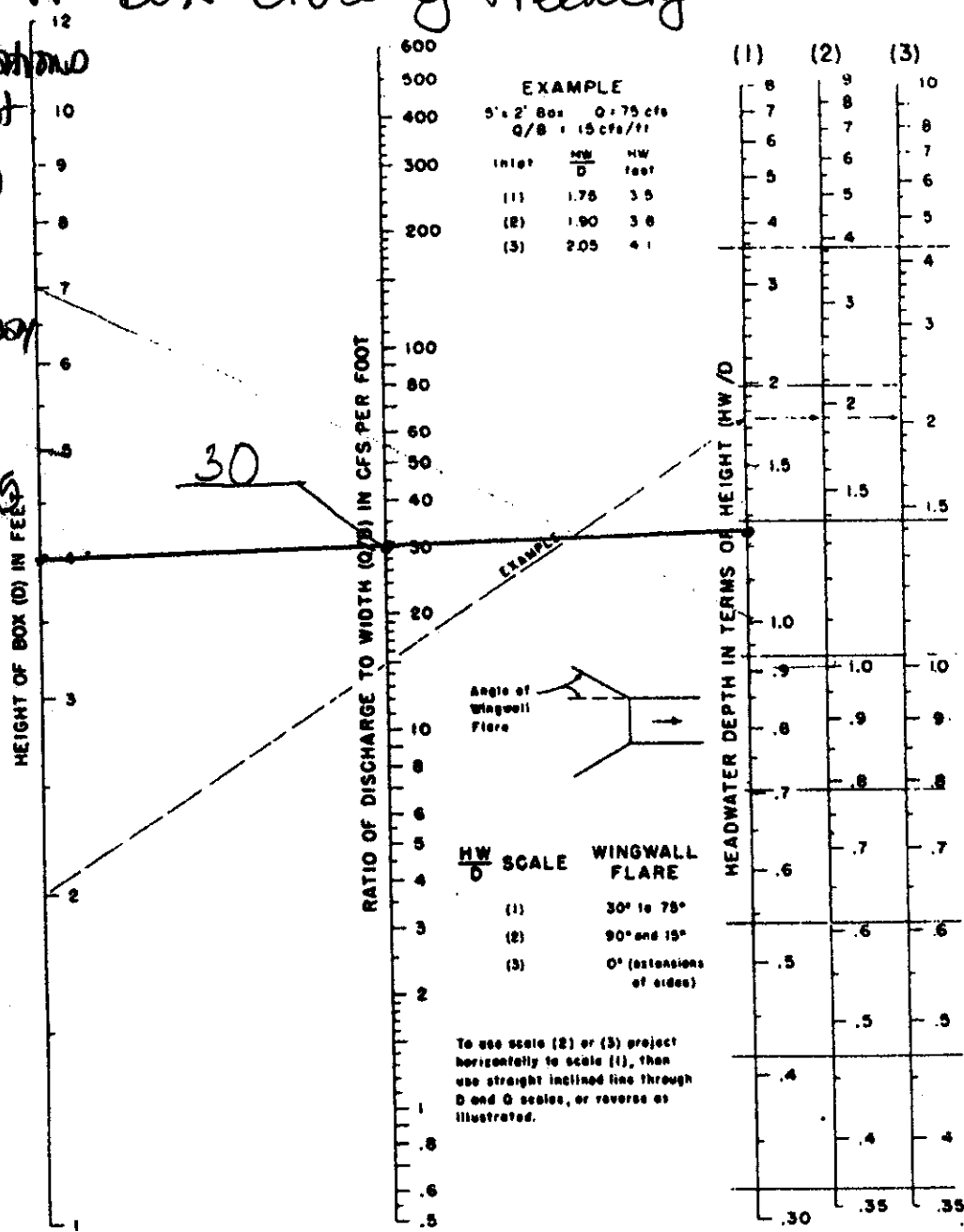
Unknown Elevation
Assume lowest
of other
facilities
Crossing freeway
of 50

$$\frac{HW}{D} = \frac{5}{4} = 1.25$$

$$\frac{Q}{B} = 30$$

$$Q = 30 * B$$

$$Q = 150$$



EXAMPLE

5' x 2' Box Q = 75 cfs
Q/B = 15 cfs/ft

Inlet	HW/D	HW feet
(1)	1.75	3.5
(2)	1.90	3.8
(3)	2.05	4.1

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

Max Capacity for
4' H x 5' W = 150 cfs



Knox Logistics Center Drainage Study

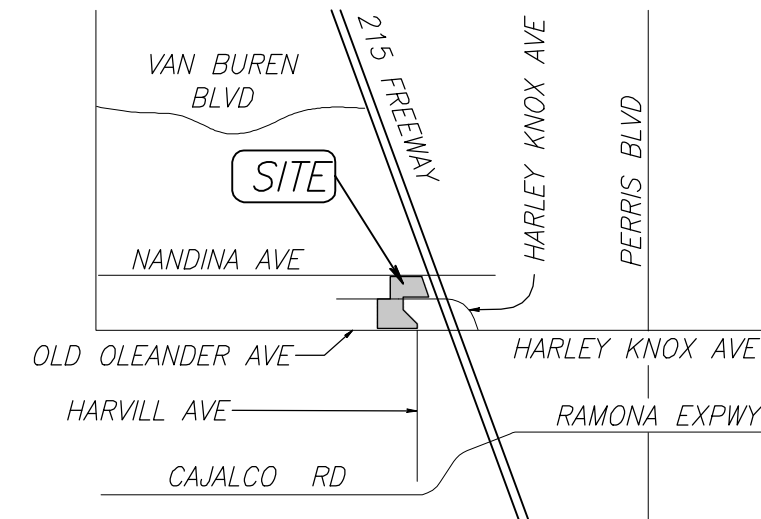
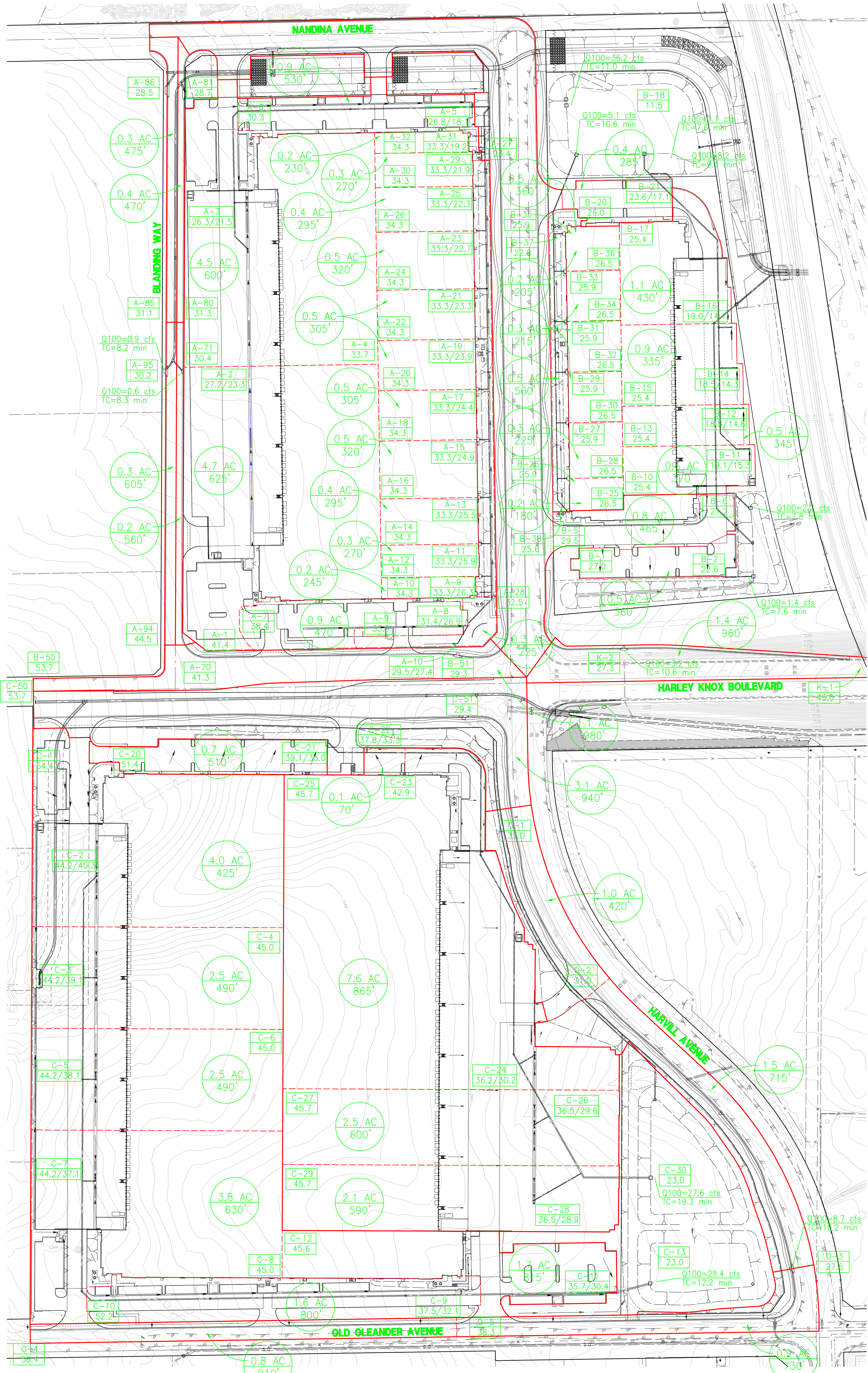
Prepared for
Trammell Crow Company

Unincorporated Area West of the City of Perris, Riverside
County, California



October 2012

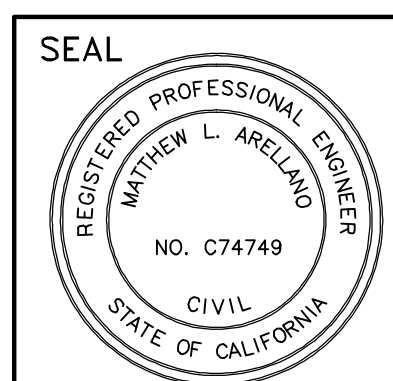
TRAMMELL CROW BUSINESS CENTER ULTIMATE HYDROLOGY MAP



LEGEND

- HYDROLOGIC BOUNDARY
- - - DRAINAGE AREA (SUBAREA)
- FLOW DIRECTION

94 45.0	NODE ELEVATION
98.6 AC 1834'	ACREAGE FLOW DISTANCE



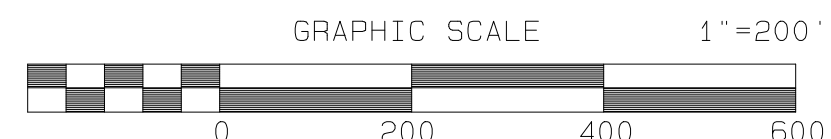
ALBERT A. **WEBB** ASSOCIATES
 CIVIL ENGINEERS
 3788 McCRA Y STREET
 RIVERSIDE, CA 92506
 (951) 686-1070

APPROVED BY _____ DATE _____
 R.C.E. NO. C74749

SCALE: 1"=80'
 DATE: Mar 2012

COUNTY OF RIVERSIDE
 SHEET 1
 OF 1 SHEETS
 DWG. NO. 11-0054HY.pro

FOR: TRAMMELL CROW COMPANY W.O. 11-0054



Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 09/14/11 File:A.out

11-0054 Knox Logistics Center
100-Year Rational Method Hydrology
Building A Area
mla 09-14-2011

***** Hydrology Study Control Information *****

English (in-lb) Units used in input data file

Program License Serial Number 4010

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Perris Valley] area used.
10 year storm 10 minute intensity = 1.880(In/Hr)
10 year storm 60 minute intensity = 0.780(In/Hr)
100 year storm 10 minute intensity = 2.690(In/Hr)
100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.120(In/Hr)
Slope of intensity duration curve = 0.4900

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 625.000(Ft.)
Top (of initial area) elevation = 41.400(Ft.)
Bottom (of initial area) elevation = 27.200(Ft.)
Difference in elevation = 14.200(Ft.)
Slope = 0.02272 s(percent)= 2.27
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.398 min.
Rainfall intensity = 2.935(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.885
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 12.206(CFS)
Total initial stream area = 4.700(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 23.300(Ft.)
 Downstream point/station elevation = 21.500(Ft.)
 Pipe length = 350.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 12.206(CFS)
 Nearest computed pipe diameter = 21.00(In.)
 Calculated individual pipe flow = 12.206(CFS)
 Normal flow depth in pipe = 17.06(In.)
 Flow top width inside pipe = 16.39(In.)
 Critical Depth = 15.64(In.)
 Pipe flow velocity = 5.83(Ft/s)
 Travel time through pipe = 1.00 min.
 Time of concentration (TC) = 9.40 min.

++++++
 Process from Point/Station 3.000 to Point/Station 3.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 1
 Stream flow area = 4.700(Ac.)
 Runoff from this stream = 12.206(CFS)
 Time of concentration = 9.40 min.
 Rainfall intensity = 2.778(In/Hr)
 Program is now starting with Main Stream No. 2

++++++
 Process from Point/Station 4.000 to Point/Station 3.000
 **** INITIAL AREA EVALUATION ****

Initial area flow distance = 600.000(Ft.)
 Top (of initial area) elevation = 33.700(Ft.)
 Bottom (of initial area) elevation = 26.300(Ft.)
 Difference in elevation = 7.400(Ft.)
 Slope = 0.01233 s(percent) = 1.23
 $TC = k(0.300) * [(length^3) / (elevation\ change)]^{0.2}$
 Initial area time of concentration = 9.336 min.
 Rainfall intensity = 2.787(In/Hr) for a 100.0 year storm
 COMMERCIAL subarea type
 Runoff Coefficient = 0.884
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 1.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 69.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Initial subarea runoff = 11.088(CFS)
 Total initial stream area = 4.500(Ac.)
 Pervious area fraction = 0.100

++++++
 Process from Point/Station 3.000 to Point/Station 3.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 2
 Stream flow area = 4.500(Ac.)
 Runoff from this stream = 11.088(CFS)
 Time of concentration = 9.34 min.
 Rainfall intensity = 2.787(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	12.206	9.40	2.778
2	11.088	9.34	2.787

Largest stream flow has longer time of concentration

Qp = 12.206 + sum of
Qb Ia/Ib
11.088 * 0.997 = 11.052
Qp = 23.258

Total of 2 main streams to confluence:

Flow rates before confluence point:
12.206 11.088

Area of streams before confluence:
4.700 4.500

Results of confluence:

Total flow rate = 23.258(CFS)
Time of concentration = 9.398 min.
Effective stream area after confluence = 9.200(Ac.)

Process from Point/Station 3.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 21.500(Ft.)
Downstream point/station elevation = 18.100(Ft.)
Pipe length = 675.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 23.258(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 23.258(CFS)
Normal flow depth in pipe = 21.56(In.)
Flow top width inside pipe = 21.66(In.)
Critical Depth = 20.25(In.)
Pipe flow velocity = 6.83(Ft/s)
Travel time through pipe = 1.65 min.
Time of concentration (TC) = 11.05 min.

Process from Point/Station 5.000 to Point/Station 5.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 1
Stream flow area = 9.200(Ac.)
Runoff from this stream = 23.258(CFS)
Time of concentration = 11.05 min.
Rainfall intensity = 2.566(In/Hr)
Program is now starting with Main Stream No. 2

Process from Point/Station 6.000 to Point/Station 5.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 530.000(Ft.)
Top (of initial area) elevation = 30.300(Ft.)
Bottom (of initial area) elevation = 26.800(Ft.)
Difference in elevation = 3.500(Ft.)
Slope = 0.00660 s(percent)= 0.66
TC = $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 10.066 min.
Rainfall intensity = 2.686(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.883
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.030
Decimal fraction soil group C = 0.970
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 68.61
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 2.135(CFS)

Total initial stream area = 0.900(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 5.000 to Point/Station 5.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.900(Ac.)
Runoff from this stream = 2.135(CFS)
Time of concentration = 10.07 min.
Rainfall intensity = 2.686(In/Hr)
Program is now starting with Main Stream No. 3

Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 470.000(Ft.)
Top (of initial area) elevation = 38.400(Ft.)
Bottom (of initial area) elevation = 31.400(Ft.)
Difference in elevation = 7.000(Ft.)
Slope = 0.01489 s(percent)= 1.49
TC = $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 8.154 min.
Rainfall intensity = 2.978(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.885
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 2.372(CFS)
Total initial stream area = 0.900(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 8.000 to Point/Station 8.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 0.900(Ac.)
Runoff from this stream = 2.372(CFS)
Time of concentration = 8.15 min.
Rainfall intensity = 2.978(In/Hr)

Process from Point/Station 9.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 225.000(Ft.)
Top (of initial area) elevation = 33.900(Ft.)
Bottom (of initial area) elevation = 29.500(Ft.)
Difference in elevation = 4.400(Ft.)
Slope = 0.01956 s(percent)= 1.96
TC = $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 5.751 min.
Rainfall intensity = 3.534(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.887
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000

RI index for soil(AMC 2) = 69.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Initial subarea runoff = 0.940(CFS)
 Total initial stream area = 0.300(Ac.)
 Pervious area fraction = 0.100

 Process from Point/Station 10.000 to Point/Station 8.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 27.400(Ft.)
 Downstream point/station elevation = 26.900(Ft.)
 Pipe length = 50.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 0.940(CFS)
 Nearest computed pipe diameter = 9.00(In.)
 Calculated individual pipe flow = 0.940(CFS)
 Normal flow depth in pipe = 4.63(In.)
 Flow top width inside pipe = 9.00(In.)
 Critical Depth = 5.33(In.)
 Pipe flow velocity = 4.10(Ft/s)
 Travel time through pipe = 0.20 min.
 Time of concentration (TC) = 5.95 min.

 Process from Point/Station 8.000 to Point/Station 8.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2
 Stream flow area = 0.300(Ac.)
 Runoff from this stream = 0.940(CFS)
 Time of concentration = 5.95 min.
 Rainfall intensity = 3.474(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	2.372	8.15	2.978
2	0.940	5.95	3.474

Largest stream flow has longer time of concentration

Qp = 2.372 + sum of
 Qb Ia/Ib
 0.940 * 0.857 = 0.806
 Qp = 3.178

Total of 2 streams to confluence:
 Flow rates before confluence point:
 2.372 0.940

Area of streams before confluence:
 0.900 0.300

Results of confluence:
 Total flow rate = 3.178(CFS)
 Time of concentration = 8.154 min.
 Effective stream area after confluence = 1.200(Ac.)

 Process from Point/Station 8.000 to Point/Station 9.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 26.900(Ft.)
 Downstream point/station elevation = 26.300(Ft.)
 Pipe length = 120.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 3.178(CFS)
 Nearest computed pipe diameter = 15.00(In.)
 Calculated individual pipe flow = 3.178(CFS)
 Normal flow depth in pipe = 8.74(In.)
 Flow top width inside pipe = 14.79(In.)

Critical Depth = 8.61(In.)
Pipe flow velocity = 4.28(Ft/s)
Travel time through pipe = 0.47 min.
Time of concentration (TC) = 8.62 min.

Process from Point/Station 9.000 to Point/Station 9.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 1.200(Ac.)
Runoff from this stream = 3.178(CFS)
Time of concentration = 8.62 min.
Rainfall intensity = 2.898(In/Hr)

Process from Point/Station 10.000 to Point/Station 9.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 245.000(Ft.)
Top (of initial area) elevation = 34.300(Ft.)
Bottom (of initial area) elevation = 33.300(Ft.)
Difference in elevation = 1.000(Ft.)
Slope = 0.00408 s(percent) = 0.41
TC = $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 8.140 min.
Rainfall intensity = 2.981(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.885
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 0.528(CFS)
Total initial stream area = 0.200(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 9.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 26.300(Ft.)
Downstream point/station elevation = 25.900(Ft.)
Pipe length = 70.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 0.528(CFS)
Nearest computed pipe diameter = 9.00(In.)
Calculated individual pipe flow = 0.528(CFS)
Normal flow depth in pipe = 3.90(In.)
Flow top width inside pipe = 8.92(In.)
Critical Depth = 3.94(In.)
Pipe flow velocity = 2.88(Ft/s)
Travel time through pipe = 0.41 min.
Time of concentration (TC) = 8.55 min.

Process from Point/Station 11.000 to Point/Station 11.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 0.200(Ac.)
Runoff from this stream = 0.528(CFS)
Time of concentration = 8.55 min.
Rainfall intensity = 2.910(In/Hr)

 Process from Point/Station 12.000 to Point/Station 11.000
 **** INITIAL AREA EVALUATION ****

Initial area flow distance = 270.000(Ft.)
 Top (of initial area) elevation = 34.300(Ft.)
 Bottom (of initial area) elevation = 33.300(Ft.)
 Difference in elevation = 1.000(Ft.)
 Slope = 0.00370 s(percent)= 0.37
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 8.629 min.
 Rainfall intensity = 2.897(In/Hr) for a 100.0 year storm
 COMMERCIAL subarea type
 Runoff Coefficient = 0.885
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 1.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 69.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Initial subarea runoff = 0.769(CFS)
 Total initial stream area = 0.300(Ac.)
 Pervious area fraction = 0.100

 Process from Point/Station 11.000 to Point/Station 11.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2
 Stream flow area = 0.300(Ac.)
 Runoff from this stream = 0.769(CFS)
 Time of concentration = 8.63 min.
 Rainfall intensity = 2.897(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.528	8.55	2.910
2	0.769	8.63	2.897

Largest stream flow has longer time of concentration

Qp = 0.769 + sum of
 Qb Ia/Ib
 0.528 * 0.995 = 0.525
 Qp = 1.294

Total of 2 streams to confluence:
 Flow rates before confluence point:
 0.528 0.769

Area of streams before confluence:
 0.200 0.300

Results of confluence:
 Total flow rate = 1.294(CFS)
 Time of concentration = 8.629 min.
 Effective stream area after confluence = 0.500(Ac.)

 Process from Point/Station 11.000 to Point/Station 13.000
 **** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 25.900(Ft.)
 Downstream point/station elevation = 25.500(Ft.)
 Pipe length = 95.00(Ft.) Manning's N = 0.012
 No. of pipes = 1 Required pipe flow = 1.294(CFS)
 Nearest computed pipe diameter = 12.00(In.)
 Calculated individual pipe flow = 1.294(CFS)
 Normal flow depth in pipe = 6.12(In.)
 Flow top width inside pipe = 12.00(In.)

Critical Depth = 5.77(In.)
 Pipe flow velocity = 3.21(Ft/s)
 Travel time through pipe = 0.49 min.
 Time of concentration (TC) = 9.12 min.

 Process from Point/Station 13.000 to Point/Station 13.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
 Stream flow area = 0.500(Ac.)
 Runoff from this stream = 1.294(CFS)
 Time of concentration = 9.12 min.
 Rainfall intensity = 2.819(In/Hr)

 Process from Point/STATION 14.000 to Point/Station 13.000
 **** INITIAL AREA EVALUATION ****

Initial area flow distance = 295.000(Ft.)
 Top (of initial area) elevation = 34.300(Ft.)
 Bottom (of initial area) elevation = 33.300(Ft.)
 Difference in elevation = 1.000(Ft.)
 Slope = 0.00339 s(percent)= 0.34
 $TC = k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 9.099 min.
 Rainfall intensity = 2.822(In/Hr) for a 100.0 year storm
 COMMERCIAL subarea type
 Runoff Coefficient = 0.884
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 1.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 69.00
 Pervious area fraction = 0.100; Impervious fraction = 0.900
 Initial subarea runoff = 0.998(CFS)
 Total initial stream area = 0.400(Ac.)
 Pervious area fraction = 0.100

 Process from Point/Station 13.000 to Point/Station 13.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2
 Stream flow area = 0.400(Ac.)
 Runoff from this stream = 0.998(CFS)
 Time of concentration = 9.10 min.
 Rainfall intensity = 2.822(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	1.294	9.12	2.819
2	0.998	9.10	2.822

Largest stream flow has longer time of concentration

Qp = 1.294 + sum of
 Qb Ia/Ib
 0.998 * 0.999 = 0.997
 Qp = 2.291

Total of 2 streams to confluence:
 Flow rates before confluence point:
 1.294 0.998
 Area of streams before confluence:
 0.500 0.400
 Results of confluence:

Total flow rate = 2.291(CFS)
Time of concentration = 9.121 min.
Effective stream area after confluence = 0.900(Ac.)

Process from Point/Station 13.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 25.500(Ft.)
Downstream point/station elevation = 24.900(Ft.)
Pipe length = 120.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 2.291(CFS)
Nearest computed pipe diameter = 12.00(In.)
Calculated individual pipe flow = 2.291(CFS)
Normal flow depth in pipe = 8.41(In.)
Flow top width inside pipe = 10.99(In.)
Critical Depth = 7.77(In.)
Pipe flow velocity = 3.89(Ft/s)
Travel time through pipe = 0.51 min.
Time of concentration (TC) = 9.63 min.

Process from Point/Station 15.000 to Point/Station 15.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 0.900(Ac.)
Runoff from this stream = 2.291(CFS)
Time of concentration = 9.63 min.
Rainfall intensity = 2.744(In/Hr)

Process from Point/Station 16.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 320.000(Ft.)
Top (of initial area) elevation = 34.300(Ft.)
Bottom (of initial area) elevation = 33.300(Ft.)
Difference in elevation = 1.000(Ft.)
Slope = 0.00313 s(percent) = 0.31
TC = $k(0.300)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 9.555 min.
Rainfall intensity = 2.756(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.884
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 1.218(CFS)
Total initial stream area = 0.500(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 15.000 to Point/Station 15.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2
Stream flow area = 0.500(Ac.)
Runoff from this stream = 1.218(CFS)
Time of concentration = 9.55 min.
Rainfall intensity = 2.756(In/Hr)
Summary of stream data:

Stream	Flow rate	TC	Rainfall Intensity
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No.	(CFS)	(min)	(In/Hr)
1	2.291	9.63	2.744
2	1.218	9.55	2.756

Largest stream flow has longer time of concentration
 $Q_p = 2.291 + \text{sum of}$
 $\quad Q_b \quad I_a/I_b$
 $\quad 1.218 * 0.996 = 1.213$
 $Q_p = 3.504$

Total of 2 streams to confluence:
Flow rates before confluence point:
2.291 1.218
Area of streams before confluence:
0.900 0.500
Results of confluence:
Total flow rate = 3.504(CFS)
Time of concentration = 9.635 min.
Effective stream area after confluence = 1.400(Ac.)

Process from Point/Station 15.000 to Point/Station 17.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 24.900(Ft.)
Downstream point/station elevation = 24.400(Ft.)
Pipe length = 105.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 3.504(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 3.504(CFS)
Normal flow depth in pipe = 9.47(In.)
Flow top width inside pipe = 14.47(In.)
Critical Depth = 9.06(In.)
Pipe flow velocity = 4.29(Ft/s)
Travel time through pipe = 0.41 min.
Time of concentration (TC) = 10.04 min.

Process from Point/Station 17.000 to Point/Station 17.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 1.400(Ac.)
Runoff from this stream = 3.504(CFS)
Time of concentration = 10.04 min.
Rainfall intensity = 2.689(In/Hr)

Process from Point/Station 18.000 to Point/Station 17.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 305.000(Ft.)
Top (of initial area) elevation = 34.300(Ft.)
Bottom (of initial area) elevation = 33.300(Ft.)
Difference in elevation = 1.000(Ft.)
Slope = 0.00328 s(percent) = 0.33
 $TC = k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 9.283 min.
Rainfall intensity = 2.795(In/Hr) for a 100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.884
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900

Initial subarea runoff = 1.235(CFS)
Total initial stream area = 0.500(Ac.)
Pervious area fraction = 0.100

Process from Point/Station 17.000 to Point/Station 17.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2
Stream flow area = 0.500(Ac.)
Runoff from this stream = 1.235(CFS)
Time of concentration = 9.28 min.
Rainfall intensity = 2.795(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
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1	3.504	10.04	2.689
2	1.235	9.28	2.795

Largest stream flow has longer time of concentration

Qp = 3.504 + sum of
Qb Ia/Ib
1.235 * 0.962 = 1.189
Qp = 4.692

Total of 2 streams to confluence:
Flow rates before confluence point:
3.504 1.235

Area of streams before confluence:
1.400 0.500

Results of confluence:
Total flow rate = 4.692(CFS)
Time of concentration = 10.043 min.
Effective stream area after confluence = 1.900(Ac.)

Process from Point/Station 17.000 to Point/Station 19.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 24.400(Ft.)
Downstream point/station elevation = 23.900(Ft.)
Pipe length = 105.00(Ft.) Manning's N = 0.012
No. of pipes = 1 Required pipe flow = 4.692(CFS)
Nearest computed pipe diameter = 15.00(In.)
Calculated individual pipe flow = 4.692(CFS)
Normal flow depth in pipe = 11.93(In.)
Flow top width inside pipe = 12.10(In.)
Critical Depth = 10.54(In.)
Pipe flow velocity = 4.48(Ft/s)
Travel time through pipe = 0.39 min.
Time of concentration (TC) = 10.43 min.

Process from Point/Station 19.000 to Point/Station 19.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1
Stream flow area = 1.900(Ac.)
Runoff from this stream = 4.692(CFS)
Time of concentration = 10.43 min.
Rainfall intensity = 2.639(In/Hr)

Process from Point/Station 20.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****