

PRELIMINARY DRAINAGE REPORT

FOR

Vesting Tentative Tract Map 5972

MOORPARK, CALIFORNIA

Prepared for:

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October 21, 2015

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PURPOSE OF REPORT

The purpose of this report is to outline the existing drainage conditions of the site and present a description of the proposed Project, associated drainage improvements, drainage impacts and necessary mitigation measures. Significant on-site and off-site facilities, as applicable, shall be described and analyzed. This report has been prepared in accordance with the requirements of the City of Moorpark and Ventura County regulations based on the proposed grading and drainage improvement plans for the project site.

LOCATION

The project site is located North of Los Angeles Avenue (State Highway 118), West of Gabbert Road, East and adjacent to the Ventura County Watershed Protection District (VCWPD) Gabbert Rd Debris Basin in the City of Moorpark, California. The approximate geographic position of the project is 32.2886 degrees latitude and -118.9060 degrees longitude. See Figure A below:

Figure A.



BACKGROUND

The owner proposes to develop the subject property which is currently undeveloped terrain and covers an area of approximately 68 acres from into Master Planned Residential Community. The entire property predominantly consists of sparse vegetation over rolling hills and valleys that range in elevation from 1,500 to 1,640 in elevation (NAVD 88).

There are existing improvements on the site that include, graded pads, concrete roadways, an existing residence which include abandoned pool, tennis courts and shed. Along the Southeast corner of the site there are existing High Voltage Transmission lines that run North-South.

METHOD OF ANALYSIS

The methodology used in this Hydrology report is to show that the proposed project will comply with the guidelines presented in the Ventura County Watershed Protection District Hydrology Manual -2010 and the County of Ventura Storm Water Quality Urban Impact Mitigation Management Plan (SQUIMP), NPDES Permit No. CAS004002, Order 2010-0108. In order to accomplish the following are addressed:

- Improve water quality and mitigate potential water quality impacts caused by the land development, through the implementation of Best Management Practices (BMPs), prior to discharging off-site. Based on the proposed improvements, the development will disturb an area greater than one acre and will add more than 10,000 square feet of impervious surface area.
- Minimize the impacts of the development on the existing drainage system by attenuating the developed condition peak flows to the existing condition peak flows. Mitigation of any increase in flow rate can be achieved by on-site detention.

Hydrology

The hydrologic analysis was based on research that included on-site investigations, review of available existing and proposed storm drain plans, and review of aerial and field surveyed topography. Detailed hydrology maps were prepared based on topography and project site plans in the existing and proposed conditions.

Watershed subarea boundaries were defined based on existing drainage patterns and proposed drainage system layouts. The tributary area of each subarea was calculated to the nearest hundredth of an acre. Points of flow concentration based on drainage patterns



were identified. Site characteristics such as soil number, rainfall zone, and land use were identified.

The hydrology analysis was conducted using available Hydrology Data provided by the VCWPD from their 2003 Calleguas Watershed Hydrology Model. This was used to develop Existing Condition Flow Rates from the project site. The data from the 2003 study was replicated in a VCRat model for the project for the 100-year storm event; a unit flow rate was then calculated and Total Q's for the drainage sub-areas within the limits of the project were calculated. 10-year and 50-year storm event Q's were calculated using Hydrologic Multipliers.

For the Proposed Condition analysis, the Ventura County Watershed Protection District (VCWPD) 2006 Hydrology Manual, VCRat 2.6, and the Tc calculator were used to calculate the proposed developed condition Peak Flows and Volumes. The project was divided into Major sub-areas to design overall drainage intent for Detention/ Retention and Stormwater Quality design.

Hydraulic Analysis

Hydraulic capacity analysis is accomplished using Hydraflow Express Extension for AutoCAD Civil 3D by Autodesk Inc., which uses manning's equations to calculate depth of flow given design flow rates. Local residential and private streets were designed to have at least one (1) dry travel lane available during a ten (10) year frequency storm. Collector streets were designed to have a minimum of one (1) dry travel lane in each direction available during a ten (10) year frequency storm. The road way section was designed so that a Q50 storm occurrence can be contained within the street right-of-way. The onsite catch basins were sized so that the hydraulic grade line within any catch basin may not extend higher than nine (9) inches below the flow line grade elevation at the inlet.

Hydraulic analysis of underground pipeline facilities was performed utilizing the Ventura County TC calculator and AutoCAD Hydraflow Express Extension. The program computes uniform and non-uniform steady flow water surface profiles and pressure gradients in open channels or closed conduits. Pipes are designed to carry the 10-year frequency storm with the intent that pressure manholes for storm drains are avoided. As design progresses, some reaches of the proposed storm drain system may need to be under pressure and in such cases those sections will have rubber gasket joints. In general, pipes are sized to carry the design flow at 0.7 the diameter of the conduit. Pipes under pressure are designed so that the hydraulic grade line does not rise above the ground surface and restrict the capacity of the inlets. To meet these requirements the pipes are designed so that the HGL is at least

12 inches below the grate or flow line of the upstream inlet. The maximum velocity in any storm drain system may not exceed twenty (20) feet per second.

Stormwater/ NPDES Requirements

The City of Moorpark requires all new development within the city to incorporate stormwater quality control measures into the proposed improvement plans as part of the County Storm Water Quality Urban Impact Mitigation Management Plan (SQUIMP), NPDES Permit No. CAS004002, Order 2010-0108. Drainage from the proposed project development is subject to this requirement and will be designed in accordance with the Ventura County Technical Guidance Manual, July 2011 per the above-mentioned Order.

Detention/ Retention Requirements

The detention system will follow and meet the requirements of the City of Moorpark, which is to detain the difference between pre and post development flows such that all storm event flows between the 10-year and 100-year do not increase the discharge in the proposed condition. (17.76.050 Development standards)

100-year Flood Protection

The Projects location straddles two FEMA FIRM Maps, (Panel 06111C0816E eff. 1/20/2010 and Panel 06111C0817E eff. 1/20/2010) and is in an area designated as Zone X which is defined as areas outside the 0.2% annual chance flood plain.

ANALYSIS

Hydrology

Existing Condition

The existing conditions of the site are such that it can be divided in to 4 distinct drainage sub-areas. Starting on the eastside of the site where it abuts Gabbert Road and labeled as sub-area A1 (7.65 acres) is mostly grassy hillside terrain and is the site where the only occupied existing residence exists and is also the site of the towers for the existing High Voltage Transmission Lines. This drainage sub-area is part of a larger drainage area labeled as 1601C in the 2003 Calleguas Watershed Report (2003 Report) which is also in series with upstream sub-areas 1598C, 1599C and 1600C, all which confluence 199 cfs (235 acres) and are conveyed on Gabbert Road. Gabbert Road drains in the southerly direction and discharges into Walnut Canyon Drain, a rectangular concrete red line channel that runs



parallel to Los Angeles Avenue. Gabbert Road is also shown within an area designated as Zone A in FEMA FIRM Map Panel 06111C0817E, eff. 1/20/2010. Zone A is defined as a Special Flood Hazard Area subject to inundation by the annual 1%(100-yr) chance of flood.

Moving westward is sub-area B and is divided into sub-areas B1 & B2 to distinguish between onsite and offsite contributing flows. Sub-area B is a portion of sub-area 1609C in the 2003 report and drains towards Walnut Canyon Drain via natural valleys.

Sub-Area C1 is a portion of sub-area 1672C and drains via natural valleys and Gabbert Drain which begins at the southwest corner of the site and is the discharge line to the Gabbert Rad Debris Basin. This rectangular concrete channel is a red line channel that is also within an area designated as Zone A in FEMA FIRM Map Panel 06111C0816E, eff 1/20/2010.

Finally, Sub-Area A1, is located on the Northwest corner of the site and is 1.61 acres of hillside and discharges directly into the Gabbert Debris Basin.

Table 1.0 shows a summary of the existing condition hydrology.

Table 1.0: Existing Condition Hydrology

Sub-Area Name	Area (acres)	Q10	Q50	Q100
D1	1.61	2.47	3.30	3.78
C1	27.2	41.74	55.81	63.78
B1 (offsite)	5.22	10.22	13.35	15.21
B2	31.49	61.63	80.52	91.77
A1	7.65	14.17	18.56	21.39
Total	73.17	130.22	171.54	195.93

Proposed Condition

Drainage improvement plans include streets with curb and gutter, area inlets, and underground drain pipes. The proposed project will have significant impact on the existing area as most of the natural valleys will be fill in to create buildable pad and the hillside peaks trimmed off to generate fill material and balance the earthwork within the project limits.

Starting on the east side of the project where the site abuts Gabbert road, the proposed project will have limited impact on this area. The drainage area, sub-area A1, will be reduced from 7.65 acres to 7.33 acres which is a result of grading the estate lots. Drainage from that developed portion will be conveyed to the proposed detention basins and stormwater BMP's as part of sub-area B.

Sub-Area A2 is comprised of the eastern portion of North Hills Parkway. Drainage from the street and the perimeter slopes of the project will be treated in proprietary structural bio-retention BMPs to storm drain pipes within the street and discharge to the southside of Northhills parkway where the concentrated flows would discharge to the surface and dissipated by rip-rap. Drainage will merge with the remaining part of 1609C which ends up in Walnut Canyon Drain. Detention for this area will be accounted for in the project detention basin located in sub-area B.

Sub-Area B which now represents most the project, comprises of graded residential pads and estate lots with long private driveways that will surface drain onto the proposed streets and enter a storm drain system via curb opening catch basins. Sub-Area B1 will continue to drain onto the project property as it did in the existing condition but will be collected in a drainage basin that will take the flow into the projects storm drain system. All drainage from Sub-area B1 and B2 will be conveyed to an Infiltration Basin located at the entrance of the project at the proposed North Village Drive. The proposed Detention basin will also provide stormwater infiltration to meet the NPDES requirements. The Detention basin will drain via a storm drain pipe and make a direct connection to the Gabbert Debris Basin Drain, a rectangular concrete line channel that runs in the southerly direction towards Los Angeles Avenue.

Sub-Area C1 is comprised of the western portion of North Hills Parkway and North Village Parkway. Drainage from the street and the perimeter slopes of the project will be treated in proprietary structural bio-retention BMPs and discharge into the storm drain system of sub-area B that make a connection to the Gabbert Canyon Drain. Detention for this area will be accounted for in the project detention basin located in sub-area Below.

Table 1.1: Proposed Conditions Hydrology

Developed Condition Hydrology				
		q10	q50	q100
		1.90	3.04	3.79
Sub-Area Name	Area (acres)	Q10	Q50	Q100
D1 (existing)	1.78	2.73	3.65	4.17
C1 (North Hills & North Village Pkwy)	13.19	25.01	40.12	50.02
B1	5.22	10.22	13.35	15.21
B2	47.88	90.77	145.64	181.58
A1 (existing)	7.33	13.57	17.78	20.50
A2 (North Hills Pkwy)	4.44	8.42	13.51	16.84
	79.84	150.72	234.04	288.33

Hydraulics

Hydraulic analysis of all drainage facilities began with a definition of drainage patterns and design flows based on a unit flowrate developed using the Total Q and Total Area for the project. Next, these results were evaluated against the City of Moorpark drainage design criteria which required a dry lane of travel during the 10-year storm event. The site was divided into smaller sub-areas, of no more than 2 acres in size, with W=7' wide catch basin inlets. This allowed for the maximum drainage spread to have a top width measured from the curb face toward the crown to be no more than 12 feet wide in each direction which leaves a 12 ft wide dry lane centered on the street for a 36 ft wide street. The maximum peak design flows for proposed onsite catch basin inlets and storm drain pipes was defined to be the peak runoff from the 10-year storm event. The street capacity limits the 50-year storm within the Right of Way and Pads are elevated so that they are at least 1 ft above the highest lot grade at Right of Way. Hydraulic analysis of the proposed streets and drainage catch basins was performed using the Hydraflow Express Extension for AutoCAD Civil 3D 2012 by Autodesk, Inc. (Hydraflow Express). The program calculated the resultant spread and depth of ponding given inlet geometry and design flow based on weir and orifice flow formulas.

100-yr Flood Protection

Detention Requirements

Detention is required for the site since the developed condition runoff quantities for storm events between the 10-year and 100-year were found to be larger than that calculated for the proposed condition. This is mainly attributed to the redevelopment of the site from an Undeveloped property to a Residential project. Detention will be addressed in an Infiltration Basin for the Residential area. Peak flows from the perimeter of the site will not be processed through the project detention basin but will be accounted for by minimizing the allowable outflow from the residential tract.

100-yr Overflow

Should there be a storm event greater than from a 100-year storm event; an overflow path through the site has been provided. The analysis was performed using Hydraflow Express. The 100-year overflow path is via A Street. A cross-sectional area of this street was modeled with the full Q_{100} that can be developed by the site.

NPDES Requirements

The City of Moorpark requires all new development projects within the city to incorporate stormwater quality control measures as part of the County Storm Water Quality Urban Impact Mitigation Management Plan (SQUIMP), NPDES Permit No. CAS004002, Order 2010-0108. The Ventura County Technical Guidance Manual, 2011 shall be used to demonstrate how the proposed BMPS for this project meet the design criteria of the SQUIMP.

The project is a new development that is greater than 1 acre in size and proposes to add more than 10,000 square feet of impervious surface area and therefore falls into one of the categories making it applicable to comply with conditioning approval for the design and implementation of post-construction stormwater management control measure as contained in subpart 4.E.11 or Order R4-2010-0108.

Table 1.3: Project Characteristics

Area Name	
Total Project Site Area	68 Acres
Pre-developed Impervious Area	10 acres (15%)
Post Project Impervious Area	17 acres (25%)

The site is proposed to be redeveloped into a multi-family residential project. The topography is flat with 100% of the site draining south towards the Arroyo Simi. The soil type is classified as Ventura County Soil number 4 or NRCS Soil Group B which is expected to have moderate infiltration rates with a layer that allow downward movement of water. The site is also located in an area of Moorpark that has had historically high ground water. There is no offsite drainage that passes over the site, and there are no environmentally sensitive areas onsite and no known geotechnical hazardous features.

Table 1.4: Land Use Pollutants of Concern

Activity	Pollutants
Residential Development	Sediment, Nutrients, Metals, Oxygen Demanding Substances, Toxic Organics, Bacteria, Trash & Debris
Roadways and Parking Lot	Sediment, Metals, Oils & Grease, Trash & Debris
Landscaping	Pesticides, Sediment, Organics

The site indirectly discharges to the Arroyo Simi via the Gabbert Canyon Drain and Walnut Canyon Channel, which are concrete lined channels. The portion that of the Arroyo Simi

where the site is tributary to is also known as Calleguas Creek Reach 6 (was Arroyo Las Posas Reaches 1 and 2 on 1998 303d list)

Table 1.5: Ventura County 2010 303(d)-Listed Water Quality Pollutants for Receiving Water (Calleguas Creek Reach 6)

Class of Pollutant	Specific Pollutants
Sediment (TSS Turbidity)	Sedimentation/ Siltation
Nutrients	Ammonia, Nitrate, Nitrites,
Pesticides	Chlordane, Chlorpyrifos, DDT, Diazinon, Dieldrin,
Trash and Debris (Gross Solids and Floatables)	Total Dissolved Solids
Bacteria and Viruses	Fecal Coliform
Salinity	Chloride
Toxicity	Toxicity
Miscellaneous	Sulfates

Since the site discharges into an impaired water body and that water body has more than one pollutant of concern, the project shall choose a BMP that is on the top 3 list of top BMPs used to treat said pollutant as listed in Table 3-4 of the TGM 2011. Biofiltration BMPs are among those listed in the top 3 of recommended BMPs and is chosen for the project. Proprietary Biofiltration BMPs such as Filterra by Contech Engineered Solutions and Modular Wetlands by Bioclean Environmental Services Inc. meet the performance standards listed in Attachment C in Order R4-2010-0108 (Appendix D of TGM 2011) and are considered for the project.

EIA Reduction to < 5%

Order R4-2010-0108 requires applicable projects to reduce the Effective Impervious Area (EIA) to less than or equal to five percent of the total project area, unless infeasible.

An Infiltration Basin and Biofiltration BMPs shall be used to achieve the 5% EIA standard and as required, the Biofiltration BMPs must be designed to bio-filter the required retention volume multiplied by a factor of 1.5. The proposed Biofiltration BMPs shall also treat flows from the site landscape areas but the SQDF contributed from those areas are not penalized the 1.5 factor. The total SQDF are added and prorated to size each BMP for their respective Sub-area.

The proposed Biofiltration BMP for the project shall be located on the inlets at Norht Hills Parkway and North Village Drive. The site and shall treat all stormwater within each sub-areas prior to leaving the site via the Infiltration Basin located at the entrance of the project.

RESULTS

Preliminary hydraulic analysis shows that the proposed project can meet the City of Moorpark's drainage design standards. Storm drain main line pipe sizes range from 24" to 48" and can convey flows in open flow conditions.

Inlet and street capacities have also been checked using Hydraflow Express, with results that verify the proposed sizing to be adequate to capture the design flows. The calculations show the capture of the 50-year storm event and maintained 1 dry lane path of travel within the backbone streets 'A'.

100-year analysis shows that the site is in Zone X and not subject to 100-year storm flooding and the project proposes to grade elevated pads would ensure that this will continue to be the case.

CONCLUSIONS

The proposed project improvements will provide adequate storm water collection and treatment control measures, and local flooding protection in compliance with all City of Moorpark and Ventura County Standards.

Onsite features such as that of paved gutters, driveway section and curb and gutters show capacity to safely convey drainage through the site. Detention is required for the project and reduction of peak flows are expected as the site has been transformed from an Undeveloped site to a Residential development with detention basin provided.

The proposed BMP's are sized to meet the Ventura County requirements as outlined in the Storm Water Quality Urban Impact Mitigation Management Plan (SQUIMP), in conformance with the guidelines provided in the Ventura County Technical Guidance Manual, 2011. Additionally, the proposed Proprietary Bio-filtration BMP's are in sync with the current standards for natural treatment of pollutants and represent treatment of storm water to the Maximum Extent Practicable. The BMP's require simple maintenance which will ensure that they are maintained and thus function as intended.

All Structures will be protected during a 100-year storm event in the case where all inlets become plugged by elevating pads and providing surface overflow. Building structures will also be elevated above the FEMA BFE elevations.

Drainage from the project site will be controlled in a manner, which will allow the development to occur as intended without conflicting with any applicable State, County, or City of Moorpark regulations and without adversely affecting adjacent properties and/or the project itself.

REFERENCES

- *Ventura County Watershed Protection District Hydrology Manual, December 2006*
- *Ventura County Technical Guidance Manual for Stormwater Quality Control Measures, 2011*
- *FEMA, National Flood Insurance Rate Maps*

APPENDIX

APPENDIX A

Existing Conditions

VENTURA COUNTY PUBLIC WORKS AGENCY

HYDROLOGIC MULTIPLIERS
STORM DURATION, PRECIP. FREQ.
PEAK FLOW FREQ. DEV., UNDEV.

STORM DURATION

DURATION (HOURS)	1	3	6	9	12	18	24	36	48	72
MULTIPLIER	0.28	0.44	0.58	0.68	0.76	0.89	1.00	1.18	1.32	1.56

PRECIPITATION FREQUENCY

FREQUENCY OF OCCURRENCE (YEARS)	2	5	10	25	50	100
MULTIPLIER	0.43	0.61	0.73	0.88	1.00	1.11

PEAK FLOWS FROM DEVELOPED WATERSHEDS: $P_{FREQ} = Q_{FREQ}$

FREQUENCY OF OCCURRENCE (YEARS)	2	5	10	25	50	100
MULTIPLIER	0.16	0.45	0.68	0.83	1.00	1.20

PEAK FLOWS FROM UNDEVELOPED WATERSHEDS: Q_{FREQ}

FREQUENCY OF OCCURRENCE (YEARS)	2	5	10	25	50	100
MULTIPLIER	0.08	0.23	0.50	0.70	1.00	1.38

Existing Condition Hydrology				
Multipliers		0.5	1	1.38
		q10	q50	q100
		0.97	1.94	2.68
Sub-Area Name	Area (acres)	Q10	Q50	Q100
D1	1.61	1.56	3.12	3.78
C1	27.2	26.39	52.78	63.78
B1	5.22	5.06	10.13	15.21
B2	31.49	30.55	61.10	91.77
A1	7.65	7.42	14.84	21.39
Total	73.17	70.99	141.98	195.93

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Modified Rational Model Results Report

Job: 115 Project: Tract 5847

Project Description

Existing Condition Model - Q100
Model Data from 2003 VCWPD Calleguas Creek Hydrology Model
Prepared by: Delane Engineering
Rainfall Zone K (B98)

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

Model Results																		
SUBAREA DATA AND RESULTS						ROUTING AFTER ACCUMULATION												
MODE	SOIL	RAIN	TC	%	AREA	FLOW	AREA	ACCUMULATED DATA	TIME	CHANNEL	LENGTH	SLOPE	SIZE	H:V	N VALUES	VEL	DEPTH	
ID	TYPE	ZONE	(MIN)	IMP	(AC)	(CFS)	(AC)	(CFS)	(MIN)	TYPE	(FT)	(FT/FT)	(FT)	(Z)	CHNL	SIDES	(FT/S)	(FT)
1A : 1598C																		
1A	040	K100	10	0	54	146	54	146	1154	MOUNTAIN	3800	0.04000	---	---	---	---	---	---
2A : 1599C																		
2A	040	K100	11	0	71	180	125	195	1155	MOUNTAIN	1700	0.04120	---	---	---	---	---	---
3A : 1600C																		
3A	040	K100	9	15	56	165	181	288	1157	#PIPE	1900	0.03950	4.00	---	---	---	---	---
4A : 1601C																		
4A	040	K100	10	15	54	151	235	404	1158	---	---	---	---	---	---	---	---	---
5A : Total Q Sub-Area A																		
5A	---	---	---	---	---	---	235	404	1158	---	---	---	---	---	---	---	---	---
6B : 1609C																		
6B	020	K100	11	15	70	204	70	204	1154	CHANNEL	1275	0.00470	12	0.00	0.000	0.000	---	---
7B : 1672C																		
7B	---	---	---	---	---	---	70	195	1158	---	---	---	---	---	---	---	---	---
8C : 1672C																		
8C	050	K100	12	15	58	136	58	136	1154	CHANNEL	720	0.01850	8	1.50	0.000	0.000	---	---
9C	---	---	---	---	---	---	58	135	1156	---	---	---	---	---	---	---	---	---

Issue/Warning Messages

TYPE	ERR	NO	PROCEDURE	LOCATION	MESSAGE
NO ISSUES OR WARNINGS DETECTED					

CALLEGUA. 990

CONFLUENCE Q'S

1159 QD

TYPE	LENGTH
------	--------

CONFLUENCE Q'S

CONELIENCE O'S

CONV CONV

VENTURA COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY / PC 2.21-952

DL/OR, 11/2002

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CALLEGUA. 990

CONFLUENCE Q'S

1160 QD

	LOCATION	SUBAREA	SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LENGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
	15031 1622BD	173.	1789.	376.	2300.	300.	5	1730.	0.00470	16.00	0.00	0.	40	0	A97	0.00
	15031 1623C	64.	64.	130.	130.	130.	1	2300.	0.06740	0.00	0.00	0.	40	16	B98	0.05
	15031 1624C	59.	123.	130.	223.	223.	1	2100.	0.06670	0.00	0.00	0.	40	14	B98	0.05
	15031 1625C	48.	171.	87.	285.	285.	1	1250.	0.04800	0.00	0.00	0.	40	19	B98	0.05
	15031 1626C	68.	239.	146.	362.	362.	1	1900.	0.05000	0.00	0.00	0.	40	15	B98	0.10
	15031 1627C	82.	321.	156.	463.	463.	1	3400.	0.04560	0.00	0.00	0.	40	18	B98	0.10
	15031 1628C	113.	434.	199.	539.	539.	1	2225.	0.03150	0.00	0.00	0.	40	21	B98	0.15
	15031 1629C	95.	529.	138.	522.	522.	0	0.	0.00000	0.00	0.00	0.	60	19	B98	0.15
	15031 1630D	68.	68.	163.	163.	163.	1	3750.	0.06530	0.00	0.00	0.	20	15	B98	0.05
	15031 1631D	70.	138.	123.	238.	238.	1	2600.	0.05380	0.00	0.00	0.	40	20	B98	0.05
	15031 1632D	56.	194.	87.	286.	286.	0	0.	0.00000	0.00	0.00	0.	50	21	B98	0.05
	15031 1633D	0.	194.	0.	286.	286.	0	0.	0.00000	0.00	0.00	0.	50	99	B98	0.00
	15031 1634E	96.	96.	168.	168.	168.	1	1700.	0.05880	0.00	0.00	0.	40	20	B98	0.05
	15031 1635E	69.	165.	138.	290.	290.	1	2200.	0.03860	0.00	0.00	0.	30	18	B98	0.05
	15031 1636E	46.	211.	90.	343.	343.	0	0.	0.00000	0.00	0.00	0.	30	19	B98	0.10
	15031 1637DE	211.	405.	343.	621.	621.	4	1600.	0.04000	5.25	0.00	0.	30	0	B98	0.00
	15031 1638D	48.	453.	105.	654.	654.	0	0.	0.00000	0.00	0.00	0.	40	15	B98	0.15
	15031 1639F	85.	85.	135.	135.	135.	0	0.	0.00000	0.00	0.00	0.	50	22	B98	0.15

* * *

LOCATION	SUBAREA	SUBAREA AREA	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LENGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
15031 1640DF	85	135.	538.	775.	1	1700.	0.03530	0.00	0.00	0.	50	0	B98	0.00
15031 1641D	45	100.	583.	831.	1	1700.	0.03530	0.00	0.00	0.	10	20	B98	0.15
15031 1642D	75	154.	658.	904.	0	0.	0.00000	0.00	0.00	0.	20	20	B98	0.15
15031 1643D	53	99.	533.	99.	1	450.	0.08890	0.00	0.00	0.	40	18	B98	0.05

VENTURA COUNTY FLOOD CONTROL DISTRICT
MODIFIED RATIONAL METHOD HYDROLOGY / PC 2.21-952

[illegible][illegible]

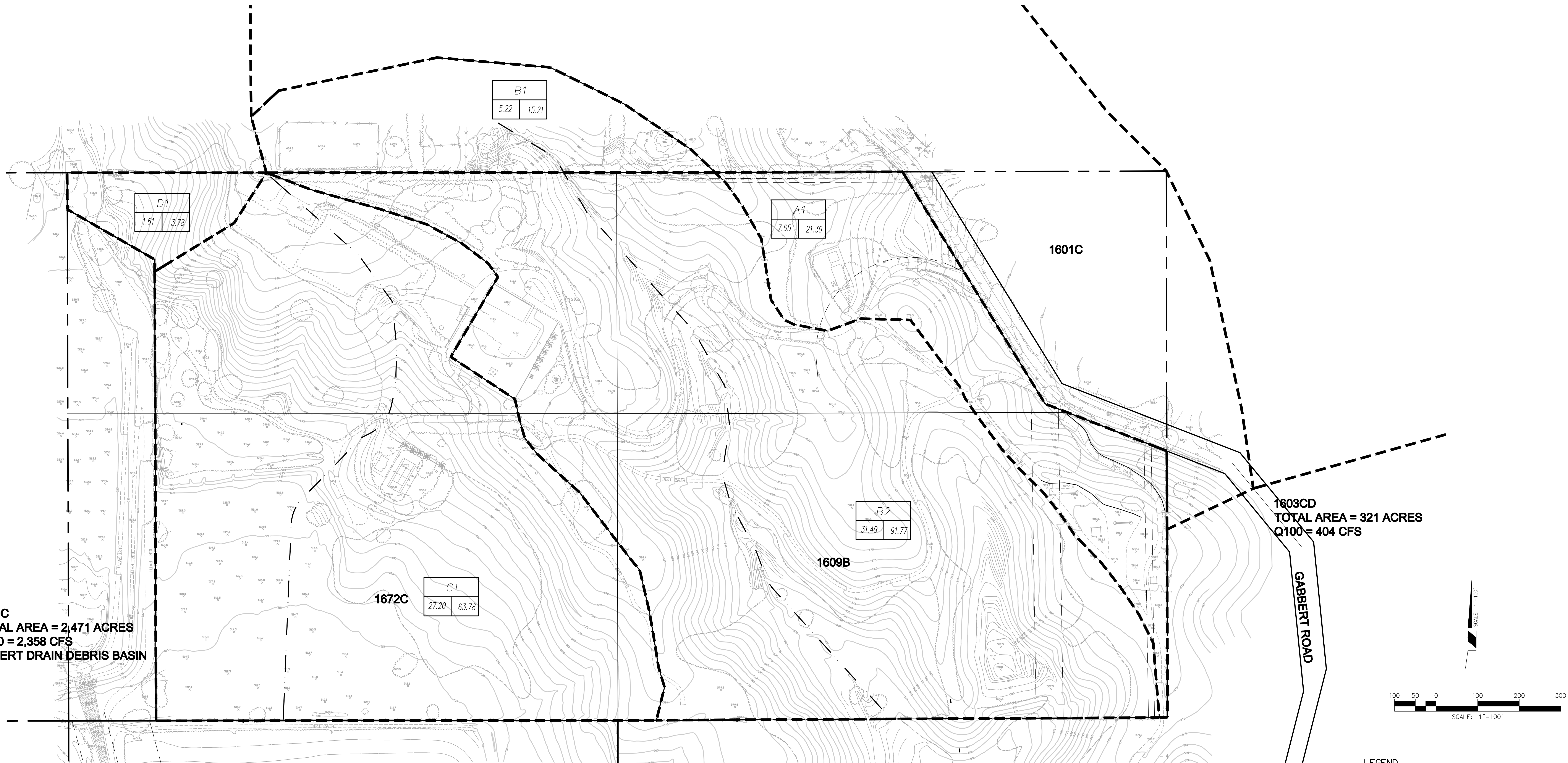
Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

VCRat Model Input

Model Lines		-----	
005	115	001A Header place holder	
005	115	004A Header place holder	
005	115	009C Header place holder	
999			
999			
006	115	001A 040000005410B98103800004000	G1
006	115	002A 040000007111B98101700004120	
006	115	003A 040015005609B98 01900003950	
006	115	004A 040015005410B98	1
006	115	005A 010 099A97	
006	115	006B 020015007011B98501275000470 001200	000000
006	115	007B 010 099A97	
006	115	008C 050015005812B98500720001850150000800	000000
006	115	009C 010 099A97	1 2
999			





1670C
TOTAL AREA = 2,471 ACRES
Q100 = 2,358 CFS
GABERT DRAIN DEBRIS BASIN

1672C
C1
27.20 63.78

A1
7.65 21.39

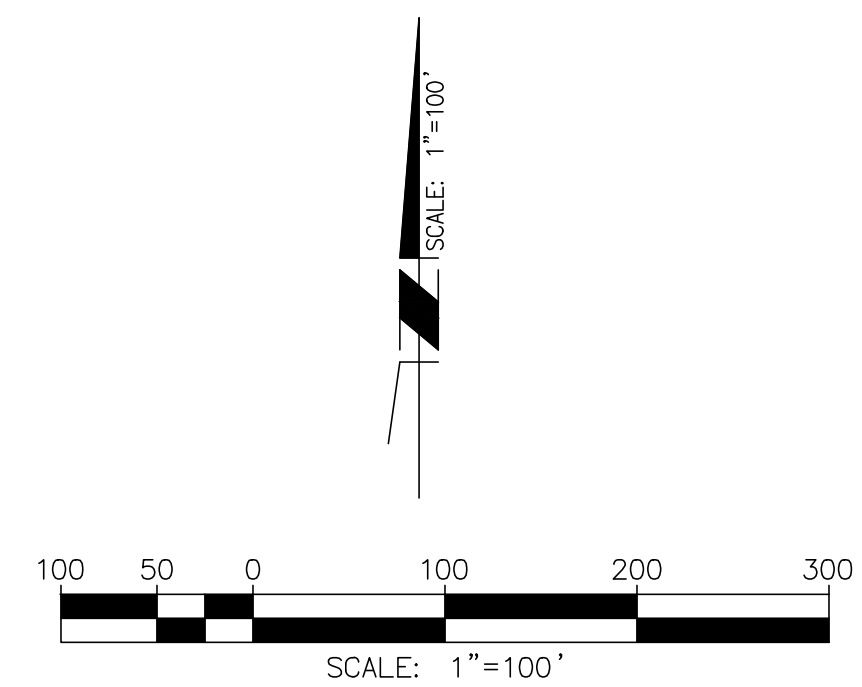
B2
31.49 91.77

1609B

1601C

1603CD
TOTAL AREA = 321 ACRES
Q100 = 404 CFS

GABBERT ROAD



LEGEND
EXISTING WATERSHED BOUNDARY
FLOW DIRECTION
EXISTING CONTOUR
CONCENTRATION POINT

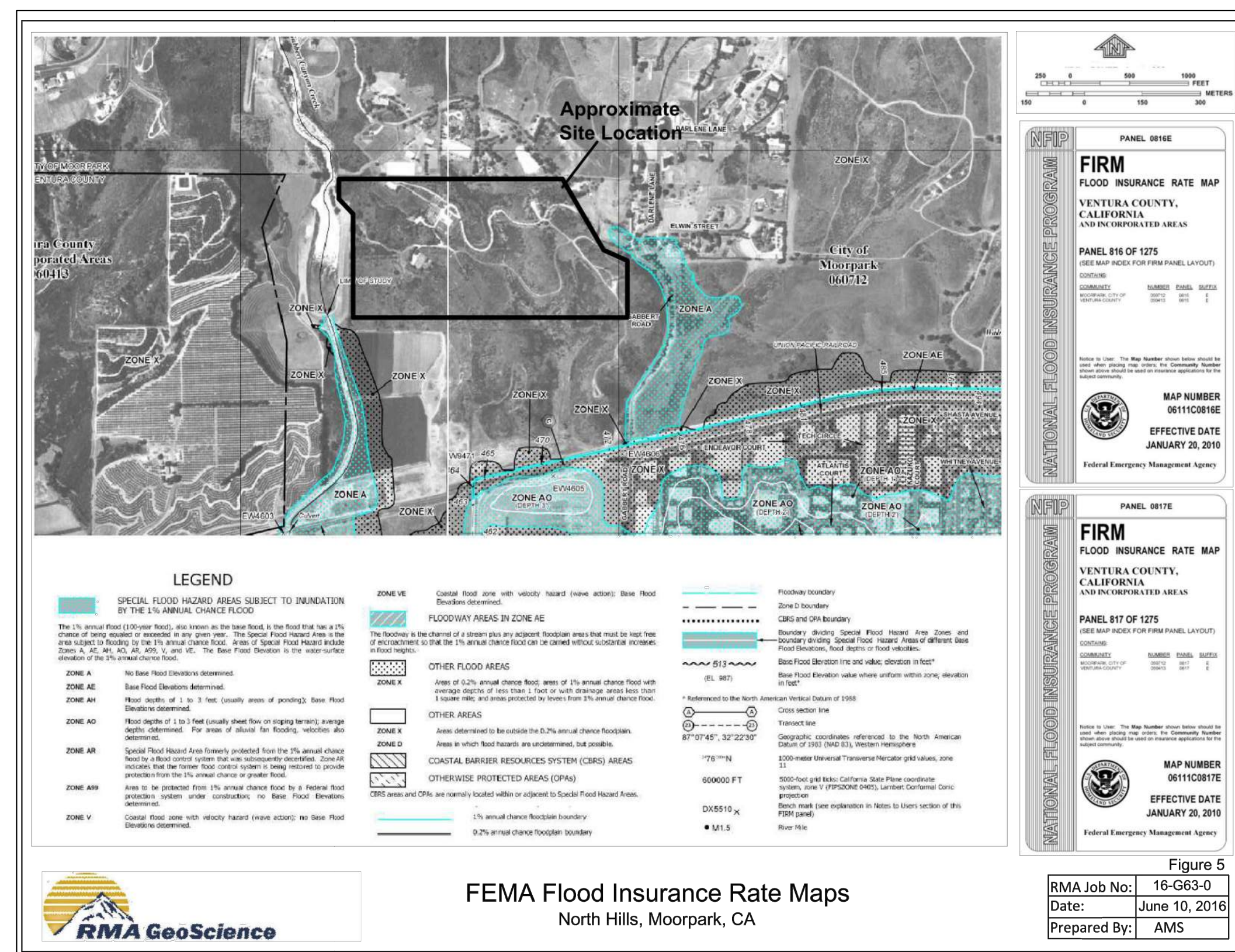
B2
31.49 91.77
DRAINAGE AREA DESIGNATION
Q100 (CFS)
AREA (AC)

1601C SUBAREA DESIGNATION FROM 2003 STUDY

ABBREVIATIONS

CFS CUBIC FEET PER SECOND
Q100 100 YEAR STORM RUNOFF
AC ACRES

Existing Condition Hydrology				
Multipliers		0.5	1	1.38
		q10	q50	q100
Sub-Area Name	Area (acres)	Q10	Q50	Q100
		Q10	Q50	Q100
D1	1.61	1.56	3.12	3.78
C1	27.2	26.39	52.78	63.78
B1	5.22	5.06	10.13	15.21
B2	31.49	30.55	61.10	91.77
A1	7.65	7.42	14.84	21.39
Total	73.17	70.99	141.98	195.93



FEMA Flood Insurance Rate Maps
North Hills, Moorpark, CA

Figure 5
RMA Job No: 16-G63-0
Date: June 10, 2016
Prepared By: AMS

DRAINAGE EXHIBITS

VTTM NO. 5847

EXISTING CONDITION DRAINAGE MAP

OWNER/SUBDIVIDER

WEST POINTE HOMES
RASMUSSEN DEVELOPMENT
26500 WEST AGOURA ROAD #652
CALABASAS, CA 91302 OFFICE:
805.370.0165
805.370.0165
JAMES RASMUSSEN

SHEET
1
OF 1 SHEETS

PREPARED BY

DELANE
ENGINEERING
2812 SANTA MONICA BLVD., SUITE 206
SANTA MONICA, CA 90404
PHONE: 310.546.5711 WWW.DELANEENGINEERING.COM

APPENDIX B

Proposed Conditions

Developed Condition Hydrology				
		q10	q50	q100
		1.90	3.04	3.79
Sub-Area Name	Area (acres)	Q10	Q50	Q100
D1	1.78	2.73	3.65	4.17
C1	13.19	25.01	40.12	50.02
B1	5.22	10.22	13.35	15.21
B2	47.88	90.77	145.64	181.58
A1	7.33	13.57	17.78	20.50
A2	4.44	8.42	13.51	16.84
	79.84	150.72	234.04	288.33

Hydrograph Report

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

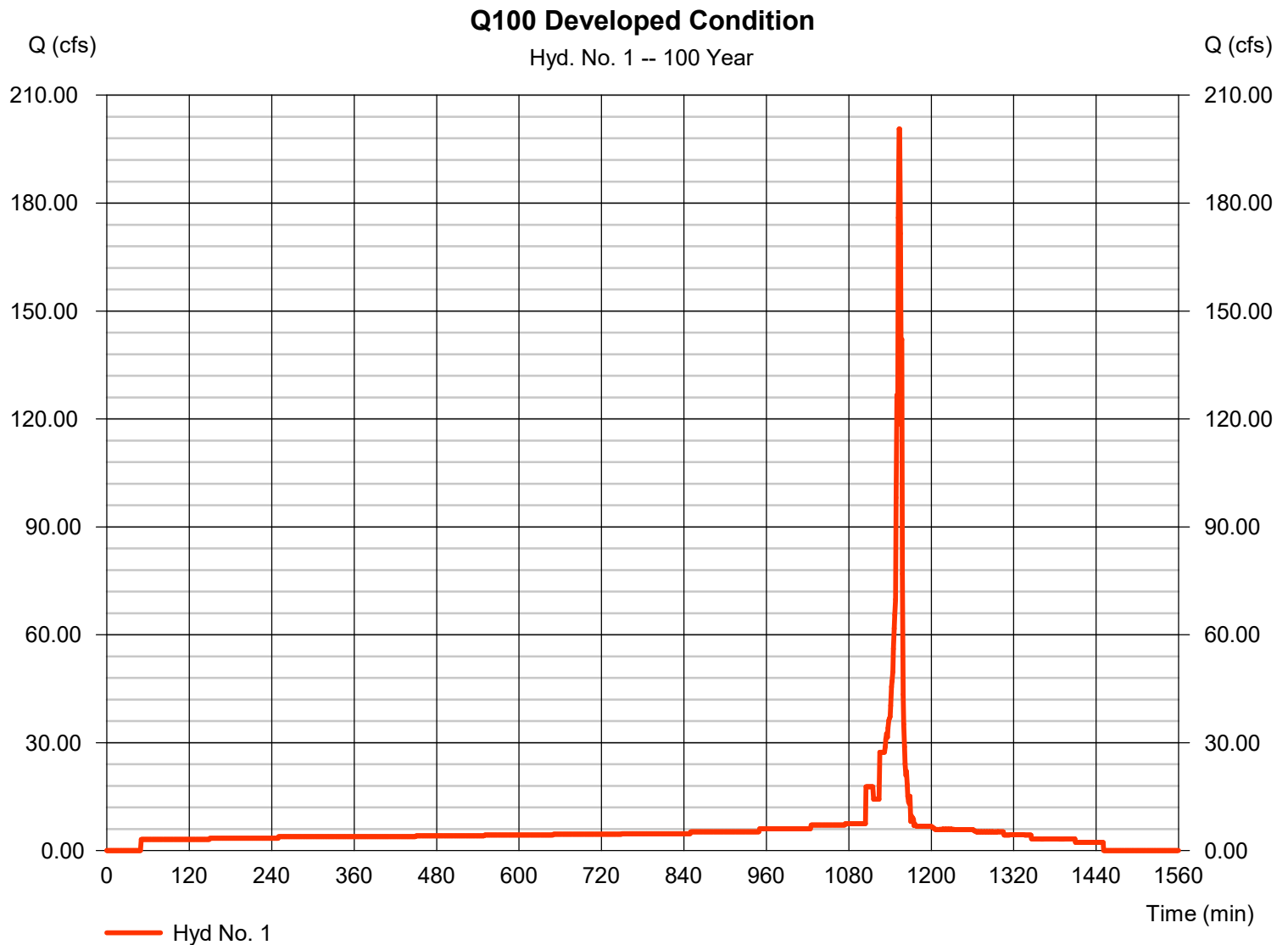
Wednesday, 11 / 2 / 2016

Hyd. No. 1

Q100 Developed Condition

Hydrograph type = Manual
Storm frequency = 100 yrs
Time interval = 1 min

Peak discharge = 200.58 cfs
Time to peak = 1153 min
Hyd. volume = 538,849 cuft



Hydrograph Report

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

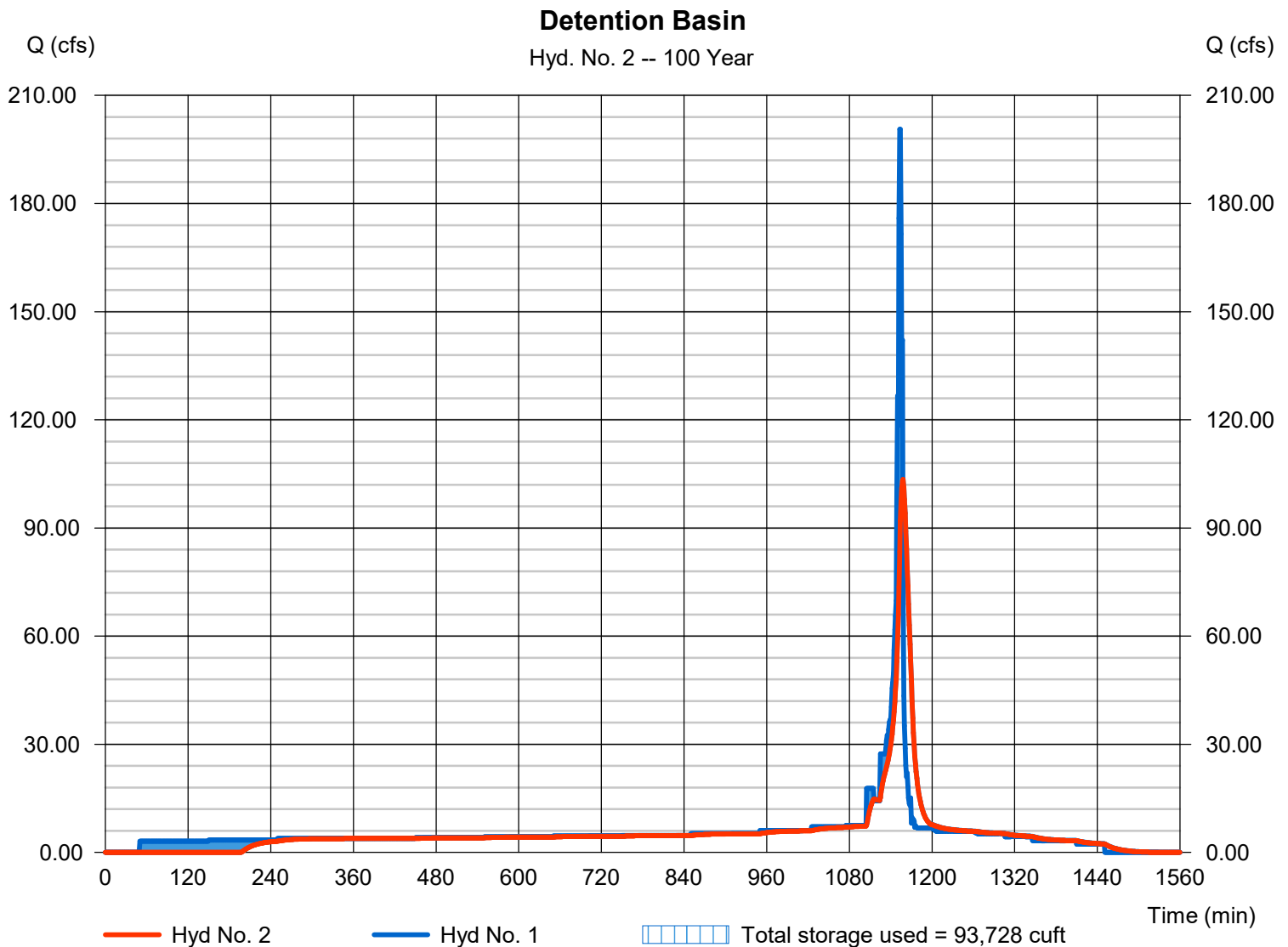
Wednesday, 11 / 2 / 2016

Hyd. No. 2

Detention Basin

Hydrograph type	= Reservoir	Peak discharge	= 103.46 cfs
Storm frequency	= 100 yrs	Time to peak	= 1158 min
Time interval	= 1 min	Hyd. volume	= 505,359 cuft
Inflow hyd. No.	= 1 - Q100 Developed Condition	Max. Elevation	= 540.00 ft
Reservoir name	= Detention Basin	Max. Storage	= 93,728 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

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

Wednesday, 11 / 2 / 2016

Pond No. 2 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 533.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	530.00	5,060	0	0
10.00	540.00	14,632	94,312	94,312

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	Inactive	Inactive	Inactive
Span (in)	= 42.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 533.00	0.00	0.00	0.00
Length (ft)	= 1250.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	Inactive	Inactive	Inactive
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.500 (by Contour)			
TW Elev. (ft)	= 0.00			

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	530.00	0.00	---	---	---	---	---	---	---	0.000	---	0.000
1.00	9,431	531.00	0.00	---	---	---	---	---	---	---	0.017	---	0.017
2.00	18,862	532.00	0.00	---	---	---	---	---	---	---	0.034	---	0.034
3.00	28,294	533.00	0.00	---	---	---	---	---	---	---	0.051	---	0.051
4.00	37,725	534.00	7.75 ic	---	---	---	---	---	---	---	0.068	---	7.816
5.00	47,156	535.00	27.40 ic	---	---	---	---	---	---	---	0.085	---	27.48
6.00	56,587	536.00	51.78 ic	---	---	---	---	---	---	---	0.102	---	51.88
7.00	66,019	537.00	69.48 ic	---	---	---	---	---	---	---	0.119	---	69.60
8.00	75,450	538.00	83.50 ic	---	---	---	---	---	---	---	0.135	---	83.64
9.00	84,881	539.00	95.49 ic	---	---	---	---	---	---	---	0.152	---	95.64
10.00	94,312	540.00	103.99 oc	---	---	---	---	---	---	---	0.169	---	104.16

VENTURA COUNTY WATERSHED PROTECTION DISTRICT

TIME OF CONCENTRATION

TC Program Version: 2.6.2009.7

Project: 01-10115

Date: 12:00:00 AM

Engineer: CMS

Consultant: Delane Engineering

S U M M A R Y O F C O M P U T A T I O N S

Watershed Name: Watershed

Name	Zone	Storm	Soil	Area (acres)	TC (min)
SubArea	K	10	4.00	53.1 / 53	9.140 / 9
SubArea	K	25	4.00	53.1 / 53	7.834 / 8
SubArea	K	50	4.00	53.1 / 53	6.982 / 7
SubArea	K	100	4.00	53.1 / 53	5.807 / 6

Watershed Name: Watershed

Sub-Area Name: SubArea

Computing Tc for all rainfall frequencies for sub-area SubArea...

Tc for frequency = 10.00: 9.140 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 9.140 min. = 9 min.

SUB AREA INPUT DATA

Sub Area Name: SubArea

Total Area (ac): 53.1

Flood Zone: 3

Rainfall Zone: K

Storm Frequency (years): 10

Development Type: Residential

Soil Type: 4.00

Percent Impervious: 23

SUB AREA OUTPUT

Intensity (in/hr): 2.680

C Total: 0.761

Sum Q Segments (cfs): 108.30

Q Total (cfs): 108.30

Sum Percent Area (%): 100.0

Sum of Flow Path Travel Times (sec): 548.37

Time of Concentration (min): 9.140

DATA FOR FLOW PATH 1

Flow Path Name: FlowPath

FLOW PATH TRAVEL TIME (min): 5.3177

Flow Type: Overland

Length (ft): 200

Top Elevation (ft): 640

Bottom Elevation (ft): 623

Contributing Area (acres): 2

Percent of Sub-Area (%): 3.8

Overland Type: Mountain

Development Type: Undeveloped

Map Slope: 0.0850

Effective Slope: 0.0850

Q for Flow Path (cfs): 4.08

Avg Velocity (ft/s): 0.63

Passed Scour Check: YES

Scour Velocity (ft/sec): 2.55

DATA FOR FLOW PATH 2

Flow Path Name: FlowPath

FLOW PATH TRAVEL TIME (min): 2.2806

Flow Type: Natural Channel

Length (ft): 1200
Top Elevation (ft): 630
Bottom Elevation (ft): 576
Contributing Area (acres): 15.22
Percent of Sub-Area (%): 28.7
Overland Type: Valley
Map Slope: 0.0450
Effective Slope: 0.0450
Q for Flow Path (cfs): 31.04
Q Top (cfs): 4.08
Q Bottom (cfs): 35.12
Velocity Top (ft/s): 4.27
Velocity Bottom (ft/s): 7.42
Avg Velocity (ft/s): 5.85
Wave Velocity (ft/s): 8.77
DATA FOR FLOW PATH 3

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 1.5413
Flow Type: Pipe
Length (ft): 1270
Top Elevation (ft): 576
Bottom Elevation (ft): 530
Contributing Area (acres): 35.88
Percent of Sub-Area (%): 67.6
Initial Pipe Diameter (in): 48
Calculated Pipe Diameter (in): 36
Used Pipe Diameter (in): 48
Manning's N: 0.013
Map Slope: 0.0362
Q for Flow Path (cfs): 73.18
Q Top (cfs): 35.12
Q Bottom (cfs): 108.30
Avg Velocity (ft/s): 10.40
Wave Velocity (ft/s): 13.73

Tc for frequency = 25.00: 7.834 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 7.834 min. = 8 min.

SUB AREA INPUT DATA

Sub Area Name: SubArea
Total Area (ac): 53.1
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 25
Development Type: Residential
Soil Type: 4.00
Percent Impervious: 23
SUB AREA OUTPUT

Intensity (in/hr): 3.191
C Total: 0.786
Sum Q Segments (cfs): 133.13
Q Total (cfs): 133.13
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 470.05
Time of Concentration (min): 7.834

DATA FOR FLOW PATH 1

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 4.4300
Flow Type: Overland
Length (ft): 200
Top Elevation (ft): 640
Bottom Elevation (ft): 623
Contributing Area (acres): 2
Percent of Sub-Area (%): 3.8
Overland Type: Mountain
Development Type: Undeveloped
Map Slope: 0.0850
Effective Slope: 0.0850
Q for Flow Path (cfs): 5.01
Avg Velocity (ft/s): 0.75
Passed Scour Check: YES
Scour Velocity (ft/sec): 2.72
DATA FOR FLOW PATH 2

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 2.1592
Flow Type: Natural Channel
Length (ft): 1200
Top Elevation (ft): 630
Bottom Elevation (ft): 576
Contributing Area (acres): 15.22
Percent of Sub-Area (%): 28.7
Overland Type: Valley

Map Slope: 0.0450
Effective Slope: 0.0450
Q for Flow Path (cfs): 38.16
Q Top (cfs): 5.01
Q Bottom (cfs): 43.17
Velocity Top (ft/s): 4.48
Velocity Bottom (ft/s): 7.87
Avg Velocity (ft/s): 6.18
Wave Velocity (ft/s): 9.26
DATA FOR FLOW PATH 3

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 1.2450
Flow Type: Pipe
Length (ft): 1270
Top Elevation (ft): 576
Bottom Elevation (ft): 530
Contributing Area (acres): 35.88
Percent of Sub-Area (%): 67.6
Initial Pipe Diameter (in): 48
Calculated Pipe Diameter (in): 39
Used Pipe Diameter (in): 48
Manning's N: 0.013
Map Slope: 0.0362
Q for Flow Path (cfs): 89.96
Q Top (cfs): 43.17
Q Bottom (cfs): 133.13
Avg Velocity (ft/s): 12.88
Wave Velocity (ft/s): 17.00

Tc for frequency = 50.00: 6.982 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 6.982 min. = 7 min.

SUB AREA INPUT DATA

Sub Area Name: SubArea
Total Area (ac): 53.1
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 50
Development Type: Residential
Soil Type: 4.00
Percent Impervious: 23
SUB AREA OUTPUT

Intensity (in/hr): 3.771
C Total: 0.805
Sum Q Segments (cfs): 161.22
Q Total (cfs): 161.22
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 418.94
Time of Concentration (min): 6.982

DATA FOR FLOW PATH 1

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 3.9082
Flow Type: Overland
Length (ft): 200
Top Elevation (ft): 640
Bottom Elevation (ft): 623
Contributing Area (acres): 2
Percent of Sub-Area (%): 3.8
Overland Type: Mountain
Development Type: Undeveloped
Map Slope: 0.0850
Effective Slope: 0.0850
Q for Flow Path (cfs): 6.07
Avg Velocity (ft/s): 0.85
Passed Scour Check: YES
Scour Velocity (ft/sec): 2.90
DATA FOR FLOW PATH 2

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 2.0506
Flow Type: Natural Channel
Length (ft): 1200
Top Elevation (ft): 630
Bottom Elevation (ft): 576
Contributing Area (acres): 15.22
Percent of Sub-Area (%): 28.7
Overland Type: Valley

Map Slope: 0.0450
Effective Slope: 0.0450
Q for Flow Path (cfs): 46.21
Q Top (cfs): 6.07
Q Bottom (cfs): 52.28
Velocity Top (ft/s): 4.69
Velocity Bottom (ft/s): 8.32
Avg Velocity (ft/s): 6.50
Wave Velocity (ft/s): 9.75
DATA FOR FLOW PATH 3

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 1.0235
Flow Type: Pipe
Length (ft): 1270
Top Elevation (ft): 576
Bottom Elevation (ft): 530
Contributing Area (acres): 35.88
Percent of Sub-Area (%): 67.6
Initial Pipe Diameter (in): 48
Calculated Pipe Diameter (in): 42
Used Pipe Diameter (in): 48
Manning's N: 0.013
Map Slope: 0.0362
Q for Flow Path (cfs): 108.94
Q Top (cfs): 52.28
Q Bottom (cfs): 161.22
Avg Velocity (ft/s): 15.65
Wave Velocity (ft/s): 20.68

Tc for frequency = 100.00: 5.807 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 5.807 min. = 6 min.

SUB AREA INPUT DATA

Sub Area Name: SubArea
Total Area (ac): 53.1
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 100
Development Type: Residential
Soil Type: 4.00
Percent Impervious: 23
SUB AREA OUTPUT

Intensity (in/hr): 4.590
C Total: 0.824
Sum Q Segments (cfs): 200.91
Q Total (cfs): 200.91
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 348.44
Time of Concentration (min): 5.807

DATA FOR FLOW PATH 1

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 3.1450
Flow Type: Overland
Length (ft): 200
Top Elevation (ft): 640
Bottom Elevation (ft): 623
Contributing Area (acres): 2
Percent of Sub-Area (%): 3.8
Overland Type: Mountain
Development Type: Undeveloped
Map Slope: 0.0850
Effective Slope: 0.0850
Q for Flow Path (cfs): 7.57
Avg Velocity (ft/s): 1.06
Passed Scour Check: YES
Scour Velocity (ft/sec): 3.11
DATA FOR FLOW PATH 2

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 1.9306
Flow Type: Natural Channel
Length (ft): 1200
Top Elevation (ft): 630
Bottom Elevation (ft): 576
Contributing Area (acres): 15.22
Percent of Sub-Area (%): 28.7
Overland Type: Valley

Map Slope: 0.0450
Effective Slope: 0.0450
Q for Flow Path (cfs): 57.59
Q Top (cfs): 7.57
Q Bottom (cfs): 65.16
Velocity Top (ft/s): 4.94
Velocity Bottom (ft/s): 8.87
Avg Velocity (ft/s): 6.91
Wave Velocity (ft/s): 10.36
DATA FOR FLOW PATH 3

Flow Path Name: FlowPath
FLOW PATH TRAVEL TIME (min): 0.7318
Flow Type: Pipe
Length (ft): 1270
Top Elevation (ft): 576
Bottom Elevation (ft): 530
Contributing Area (acres): 35.88
Percent of Sub-Area (%): 67.6
Initial Pipe Diameter (in): 48
Calculated Pipe Diameter (in): 48
Used Pipe Diameter (in): 48
Manning's N: 0.013
Map Slope: 0.0362
Q for Flow Path (cfs): 135.76
Q Top (cfs): 65.16
Q Bottom (cfs): 200.91
Avg Velocity (ft/s): 21.68
Wave Velocity (ft/s): 28.92

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Modified Rational Model Results Report

Job: 115 Project: Tract 5847

Project Description

Developed Condition Model - Q10
Date Prepared: 2016-10-26
Prepared by: Delane Engineering
Rainfall Zone K (B98)

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

Page: 2

Model Results													
SUBAREA DATA AND RESULTS				ACCUMULATED DATA				ROUTING AFTER ACCUMULATION					
MODE	SOIL	RAIN	TC	%	AREA	FLOW	TIME	CHANNEL	LENGTH	SLOPE	SIZE	H:V	VEL
ID	TYPE	ZONE	(MIN)	IMP	(AC)	(CFS)	(MIN)	TYPE	(FT)	(FT/FT)	(FT)	(Z)	(FT/S)
1A : 1672C- A (Developed)													
1A	040	K10	10	23	48	91	1154	---	---	---	---	---	---
2A	---	---	---	---	48	91	1154	---	---	---	---	---	---

Issue/Warning Messages

TYPE	ERR	NO	PROCEDURE	LOCATION	MESSAGE
NO ISSUES OR WARNINGS DETECTED					

1270	2.05	1271	2.05	1272	2.05	1273	2.05	1274	2.05
1275	2.05	1276	2.05	1277	2.05	1278	2.05	1279	2.05
1280	2.05	1281	2.05	1282	2.05	1283	2.05	1284	2.05
1285	2.05	1286	2.05	1287	2.05	1288	2.05	1289	2.05
1290	2.05	1291	2.05	1292	2.05	1293	2.05	1294	2.05
1295	2.05	1296	2.05	1297	2.05	1298	2.05	1299	2.05
1300	2.04	1310	1.49	1320	1.49	1330	1.49	1340	1.49
1350	0.94	1360	0.94	1370	0.94	1380	0.94	1390	0.94
1400	0.94	1420	0.63	1440	0.63	1460	0.63	1500	0.00

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

Page: 4

VCRat Model Input

Model Lines		-----	
005	115	001A Header place holder	
005	115	002A Header place holder	
999			
999			
006	115	001A 040023004810K10	G1
006	115	002A 010 099J10	1 2
999			

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Modified Rational Model Results Report

Job: 115 Project: Tract 5847

Project Description

Developed Condition Model - Q50
Date Prepared: 2016-10-26
Prepared by: Delane Engineering
Rainfall Zone K (B98)

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

Page: 2

Model Results													
SUBAREA DATA AND RESULTS				ACCUMULATED DATA				ROUTING AFTER ACCUMULATION					
MODE	SOIL	RAIN	TC	AREA	FLOW	AREA	FLOW	TIME	CHANNEL	LENGTH	SLOPE	SIZE	H:V
ID	TYPE	ZONE	(MIN)	IMP	(AC)	(CFS)	(MIN)	(MIN)	TYPE	(FT)	(FT/FT)	(FT)	(Z)
1A : 1672C- A (Developed)													
1A	040	K50	7	23	48	146	48	1154	---	---	---	---	---
2A	---	---	---	---	---	---	48	1154	---	---	---	---	---

Issue/Warning Messages

TYPE	ERR	NO	PROCEDURE	LOCATION	MESSAGE
NO ISSUES OR WARNINGS DETECTED					

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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Hydrograph Printouts

HYDROGRAPH PRINTOUT AT: 2A

TOTAL AREA TO HYDROGRAPH: 48 acres
HYDROGRAPH PEAK: 146 cfs
TIME OF PEAK: 1153 minutes
HYDROGRAPH VOLUME: 8.49 acre-ft

TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)
0	0.00	100	0.63	200	1.13	300	1.45	400	1.89
500	2.33	600	2.89	700	3.37	800	3.74	900	4.41
1000	5.48	1050	5.59	1100	6.63	1110	8.79	1120	14.35
1100	16.37	1131	16.74	1132	17.12	1133	17.49	1134	17.86
1135	18.23	1136	21.49	1137	24.73	1138	27.56	1139	30.38
1140	33.21	1141	37.97	1142	42.73	1143	44.67	1144	46.61
1145	48.44	1146	51.38	1147	54.33	1148	55.87	1149	58.89
1150	67.06	1151	92.09	1152	123.34	1153	145.82	1154	145.82
1155	141.71	1156	134.61	1157	122.22	1158	92.54	1159	58.01
1160	29.17	1161	21.45	1162	17.74	1163	15.67	1164	13.61
1165	11.54	1166	9.42	1167	7.31	1168	7.31	1169	7.31
1170	7.31	1171	6.89	1172	6.74	1173	6.65	1174	6.56
1175	6.47	1176	6.38	1177	6.29	1178	6.29	1179	6.29
1180	6.29	1181	6.29	1182	6.29	1183	6.29	1184	6.29
1185	6.29	1186	6.29	1187	6.29	1188	6.29	1189	6.29
1190	6.29	1191	6.16	1192	6.02	1193	5.89	1194	5.75
1195	5.62	1196	5.48	1197	5.35	1198	5.35	1199	5.35
1200	5.35	1201	5.35	1202	5.35	1203	5.35	1204	5.35
1205	5.35	1206	5.35	1207	5.35	1208	5.35	1209	5.35
1210	5.35	1211	5.21	1212	5.08	1213	4.94	1214	4.81
1215	4.67	1216	4.54	1217	4.40	1218	4.40	1219	4.40
1220	4.40	1221	4.40	1222	4.40	1223	4.40	1224	4.40
1225	4.40	1226	4.40	1227	4.40	1228	4.40	1229	4.40
1230	4.40	1231	4.32	1232	4.23	1233	4.14	1234	4.05
1235	3.96	1236	3.87	1237	3.78	1238	3.78	1239	3.78
1240	3.78	1241	3.78	1242	3.78	1243	3.78	1244	3.78
1245	3.78	1246	3.78	1247	3.78	1248	3.78	1249	3.78
1250	3.78	1251	3.78	1252	3.78	1253	3.78	1254	3.78
1255	3.78	1256	3.78	1257	3.78	1258	3.78	1259	3.78
1260	3.78	1261	3.73	1262	3.69	1263	3.64	1264	3.60
1265	3.55	1266	3.51	1267	3.46	1268	3.46	1269	3.46

1270	3.46	1271	3.46	1272	3.46	1273	3.46	1274	3.46	1275	3.46
1275	3.46	1276	3.46	1277	3.46	1278	3.46	1279	3.46	1280	3.46
1280	3.46	1281	3.46	1282	3.46	1283	3.46	1284	3.46	1285	3.46
1285	3.46	1286	3.46	1287	3.46	1288	3.46	1289	3.46	1290	3.46
1290	3.46	1291	3.46	1292	3.46	1293	3.46	1294	3.46	1295	3.46
1295	3.46	1296	3.46	1297	3.46	1298	3.46	1299	3.46	1300	2.52
1300	3.46	1310	2.52	1320	2.52	1330	2.52	1340	2.52	1350	1.57
1350	1.57	1360	1.57	1370	1.57	1380	1.57	1390	1.57	1400	0.00
1400	1.57	1420	0.79	1440	0.79	1460	0.79	1500	0.00		

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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VCRat Model Input

Model Lines

005	115	001A	Header	place holder	
005	115	002A	Header	place holder	
999					
999					
006	115	001A	040023004807K50	G1	
006	115	002A	010	099J50	1 2
999					

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Modified Rational Model Results Report

Job: 115 Project: Tract 5847

Project Description

Developed Condition Model - Q100
Date Prepared: 2016-10-26
Prepared by: Delane Engineering
Rainfall Zone K (B98)

VCRat version: 2.6.2009.7
VCRain version: 200703
DOS EXE version: PC 2.2-200809

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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Model Results													
SUBAREA DATA AND RESULTS							ROUTING AFTER ACCUMULATION						
MODE	SOIL	RAIN	TC	%	AREA	FLOW	AREA	FLOW	TIME	CHANNEL	LENGTH	SLOPE	H:V
ID	TYPE	ZONE	(MIN)	IMP	(AC)	(CFS)	(AC)	(CFS)	(MIN)	TYPE	(FT)	(FT/FT)	(Z)
1A : 1598C													
1A	040	K100	10	0	54	146	54	146	1154	MOUNTAIN	3800	0.04000	---
2A : 1599C													
2A	040	K100	11	0	71	180	125	195	1155	MOUNTAIN	1700	0.04120	---
3A : 1600C													
3A	040	K100	9	15	56	165	181	288	1157	#PIPE	1900	0.03950	4.00
4A : 1601C													
4A	040	K100	10	15	54	151	235	404	1158	-----	----	-----	---
5A : Total Q Sub-Area A													
5A	---	---	---	---	---	---	235	404	1158	-----	----	-----	---
6B : 1609C													
6B	020	K100	11	15	70	204	70	204	1154	CHANNEL	1275	0.00470	12
7B : 1672C- A (DeveIoped)													
7B	---	---	---	---	---	---	70	195	1158	-----	----	-----	---
8C : 1672C- A (DeveIoped)													
8C	050	K100	9	23	48	137	48	137	1153	CHANNEL	720	0.01850	8
9C	---	---	---	---	---	---	48	136	1155	-----	----	-----	---

Issue/Warning Messages

TYPE	ERR	NO	PROCEDURE	LOCATION	MESSAGE
NO ISSUES OR WARNINGS DETECTED					

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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Hydrograph Printouts

HYDROGRAPH PRINTOUT AT: 4A

DESCRIPTION: 1601C

TOTAL AREA TO HYDROGRAPH: 235 acres
HYDROGRAPH PEAK: 404 cfs
TIME OF PEAK: 1158 minutes
HYDROGRAPH VOLUME: 28.72 acre-ft

TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)
0	0.00	100	4.63	200	4.99	300	5.65
500	5.93	600	6.23	700	6.50	800	6.79
1000	8.56	1050	9.89	1100	12.37	1110	31.19
1130	57.55	1131	59.91	1132	61.85	1133	64.33
1135	70.12	1136	71.87	1137	75.65	1138	79.01
1140	87.25	1141	93.21	1142	99.27	1143	104.62
1145	117.73	1146	128.53	1147	138.35	1148	148.81
1150	204.40	1151	221.30	1152	274.77	1153	314.72
1155	372.04	1156	384.96	1157	395.12	1158	404.31
1160	372.77	1161	369.42	1162	318.19	1163	271.20
1165	228.92	1166	216.05	1167	203.84	1168	191.80
1170	163.90	1171	152.95	1172	143.43	1173	135.83
1175	122.67	1176	118.18	1177	114.32	1178	110.57
1180	102.62	1181	98.44	1182	94.14	1183	89.90
1185	81.90	1186	78.10	1187	74.57	1188	71.25
1190	65.07	1191	62.17	1192	59.35	1193	56.83
1195	52.22	1196	50.08	1197	48.04	1198	46.11
1200	42.65	1201	41.07	1202	39.62	1203	38.14
1205	35.43	1206	34.18	1207	32.99	1208	31.78
1210	29.61	1211	28.64	1212	27.72	1213	26.90
1215	25.26	1216	24.63	1217	23.97	1218	23.30
1220	22.00	1221	21.43	1222	20.88	1223	20.41
1225	19.76	1226	19.39	1227	19.05	1228	18.78
1230	18.20	1231	17.88	1232	17.64	1233	17.36
1235	16.78	1236	16.50	1237	16.23	1238	15.99
1240	15.44	1241	15.24	1242	14.97	1243	14.74
1245	14.32	1246	14.11	1247	13.96	1248	13.73
1250	13.41	1251	13.19	1252	13.02	1253	12.90
1255	12.54	1256	12.44	1257	12.25	1258	12.11
1260	11.84	1261	11.71	1262	11.55	1263	11.34
						1264	11.21

1265	11.09	1266	10.86	1267	10.69	1268	10.56	1269	10.37
1270	10.19	1271	10.01	1272	9.94	1273	9.87	1274	9.72
1275	9.59	1276	9.56	1277	9.52	1278	9.39	1279	9.28
1280	9.26	1281	9.24	1282	9.13	1283	9.03	1284	9.02
1285	9.00	1286	8.90	1287	8.81	1288	8.81	1289	8.80
1290	8.70	1291	8.63	1292	8.64	1293	8.59	1294	8.55
1295	8.47	1296	8.48	1297	8.48	1298	8.40	1299	8.33
1300	8.35	1310	7.19	1320	6.75	1330	6.61	1340	6.46
1350	5.34	1360	4.86	1370	4.85	1380	4.86	1390	4.78
1400	4.81	1420	4.06	1440	4.06	1460	2.55	1500	2.55

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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Hydrograph Printouts

HYDROGRAPH PRINTOUT AT: 9C

TOTAL AREA TO HYDROGRAPH: 48 acres
HYDROGRAPH PEAK: 136 cfs
TIME OF PEAK: 1155 minutes
HYDROGRAPH VOLUME: 11.04 acre-ft

TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)	TIME (min)	FLOW (cfs)
0	0.00	100	2.83	200	3.07	300	3.51
500	3.70	600	3.90	700	4.07	800	4.28
1000	5.45	1050	6.33	1100	6.78	1110	9.14
1100	17.15	1131	19.06	1132	20.33	1133	20.94
1135	22.46	1136	23.57	1137	24.10	1138	24.61
1140	26.97	1141	28.39	1142	30.33	1143	32.42
1145	35.83	1146	39.46	1147	44.15	1148	47.97
1150	63.39	1151	76.80	1152	88.88	1153	108.70
1155	136.22	1156	133.96	1157	130.72	1158	124.33
1160	96.61	1161	85.05	1162	66.76	1163	44.86
1165	25.42	1166	21.10	1167	17.70	1168	14.60
1170	9.57	1171	9.04	1172	8.60	1173	8.26
1175	7.63	1176	7.40	1177	7.23	1178	7.10
1180	6.71	1181	6.57	1182	6.47	1183	6.38
1185	6.23	1186	6.18	1187	6.14	1188	6.13
1190	6.14	1191	6.14	1192	6.12	1193	6.11
1195	6.09	1196	6.10	1197	6.10	1198	6.10
1200	6.09	1201	6.09	1202	6.08	1203	6.05
1205	5.93	1206	5.85	1207	5.77	1208	5.68
1210	5.51	1211	5.44	1212	5.39	1213	5.35
1215	5.32	1216	5.32	1217	5.32	1218	5.32
1220	5.33	1221	5.33	1222	5.35	1223	5.35
1225	5.34	1226	5.35	1227	5.36	1228	5.35
1230	5.35	1231	5.36	1232	5.35	1233	5.34
1235	5.33	1236	5.31	1237	5.31	1238	5.30
1240	5.27	1241	5.26	1242	5.25	1243	5.25
1245	5.25	1246	5.25	1247	5.24	1248	5.24
1250	5.24	1251	5.24	1252	5.24	1253	5.24
1255	5.24	1256	5.24	1257	5.24	1258	5.24
1260	5.24	1261	5.24	1262	5.24	1263	5.23
1265	5.13	1266	5.09	1267	5.04	1268	4.98
						1269	4.92

1270	4.86	1271	4.82	1272	4.77	1273	4.75	1274	4.74
1275	4.74	1276	4.72	1277	4.72	1278	4.73	1279	4.73
1280	4.72	1281	4.71	1282	4.72	1283	4.73	1284	4.72
1285	4.71	1286	4.72	1287	4.73	1288	4.72	1289	4.71
1290	4.72	1291	4.73	1292	4.72	1293	4.71	1294	4.72
1295	4.71	1296	4.70	1297	4.70	1298	4.72	1299	4.72
1300	4.71	1310	4.21	1320	3.90	1330	3.98	1340	3.92
1350	3.33	1360	2.86	1370	2.95	1380	2.95	1390	2.92
1400	2.93	1420	2.83	1440	2.83	1460	2.83	1500	2.83

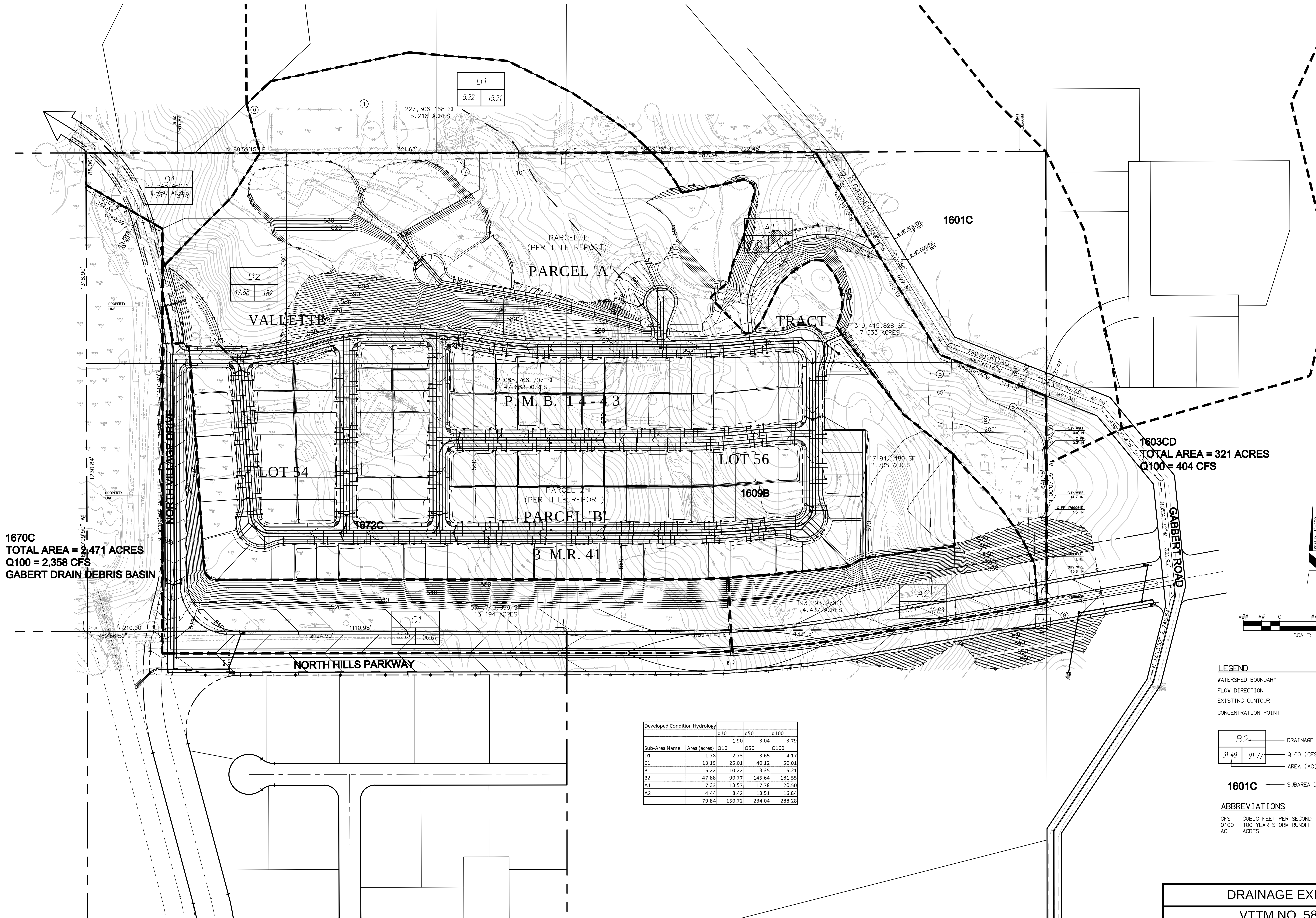
Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.6)

Job: 115 Project: Tract 5847

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VCRat Model Input

Model Lines		-----	
005	115	001A Header place holder	
005	115	004A Header place holder	
005	115	009C Header place holder	
999			
999			
006	115	001A 040000005410B98103800004000	G1
006	115	002A 040000007111B98101700004120	
006	115	003A 040015005609B98 01900003950	
006	115	004A 040015005410B98	1
006	115	005A 010 099A97	
006	115	006B 020015007011B98501275000470 001200	000000
006	115	007B 010 099A97	
006	115	008C 050023004809B98500720001850150000800	000000
006	115	009C 010 099A97	1 2
999			



1670C
TOTAL AREA = 2,471 ACRES
Q100 = 2,358 CFS
GABERT DRAIN DEBRIS BASIN

1603CD
TOTAL AREA = 321 ACRES
Q100 = 404 CFS

Developed Condition Hydrology				
	q10	q50	q100	
Sub-Area Name	Area (acres)	Q10	Q50	Q100
D1	1.78	2.73	3.85	4.17
C1	13.19	25.01	40.12	50.01
B1	5.22	10.22	13.35	15.21
B2	47.88	90.77	145.64	181.55
A1	7.33	13.57	17.78	20.50
A2	4.44	8.42	13.51	16.84
	79.84	150.72	234.04	288.28

- LEGEND
- WATERSHED BOUNDARY
 - FLOW DIRECTION
 - EXISTING CONTOUR
 - CONCENTRATION POINT

B2	31.49	91.77

— DRAINAGE AREA DESIGNATION
— Q100 (CFS)
— AREA (AC)

1601C ← SUBAREA DESIGNATION FROM 2003 STUDY

ABBREVIATIONS

CFS CUBIC FEET PER SECOND
Q100 100 YEAR STORM RUNOFF
AC ACRES

DRAINAGE EXHIBITS

VTTM NO. 5847

PROPOSED CONDITION DRAINAGE MAP

PREPARED BY
DELANE ENGINEERING
2812 SANTA MONICA BLVD., SUITE 206
SANTA MONICA, CA 90404
PHONE: 310.546.5711 WWW.DELANEENGINEERING.COM

OWNER/SUBDIVIDER
WEST POINTE HOMES
RASMUSSEN DEVELOPMENT
26500 WEST AGOURA ROAD #652
CALABASAS, CA 91302 OFFICE:
805.370.0075 FAX:
805.370.0165
JAMES RASMUSSEN

SHEET
1
OF 1 SHEETS

APPENDIX C

Storm Water BMP Calculation



www.DelaneEngineering.com | Info@DelaneGroup.com

2812 Santa Monica Blvd, Ste. 206, Santa Monica, CA 90404. | P. 310.546.5711. | F. 866.579.6415

Sizing Worksheet

Designer: <u>DELANE ENGINEERING</u> Project Proponent: Date: <u>10/26/16</u> Project: <u>TRACT 5847</u> Location: <u>MOORPARK, CA</u>	
	☐ Native Grasses ☐ Irrigated Turf Grass ☐ Other
Outflow Collection:	
Step 1: Determine water quality design volume	
1-1. Enter Project area (acres), $A_{project}$	$A_{project} = 68$ acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable} = 5$ %
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project}) * (\%_{allowable})$	$EIA_{allowable} =$ acres $(68)(5) = 3.4$
1-4. Enter Project impervious fraction, Imp (e.g. 60% = 0.60)	$Imp = 0.23$
1-5. Determine the Project Total Impervious area (acres), $TIA = A_{project} * Imp$	$TIA =$ acres 15.64
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain} = TIA - EIA_{allowable}$	$A_{retain} =$ acres 12.24
1-7. Determine pervious runoff coefficient using Table E-1, C_p	$C_p = 0.05$
1-8. Calculate runoff coefficient, $C = 0.95 * imp + C_p (1 - imp)$	$0.95(0.23) + 0.05(1 - 0.23)$ $C = 0.257$
1-9. Enter design rainfall depth of the storm (in), P_i	$P_i = \frac{3}{4}$ in

1-10. Calculate rainfall depth (ft), $P = P_i/12$	$P =$ ft 0.0625
1-11. Calculate water quality design volume (ft ³), $SQDV = 43560 \times C \times P \times A_{\text{retain}}$	$SQDV =$ ft ³ 8,564.11
Step 2: Determine the design percolation rate	
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), P_{measured}	$P_{\text{measured}} =$ 2.5 in/hr
2-2. Determine percolation rate correction factor, S_A based on suitability assessment (see Section 6 INF-1)	$S_A =$ 2
2-3. Determine percolation rate correction factor, S_B based on design (see Section 6 INF-1)	$S_b =$ 3
2-4. Calculate combined safety factor, $S = S_A \times S_b$	$S =$ 6
2-5. Calculate the design percolation rate (in/hr), $P_{\text{design}} = P_{\text{measured}}/S$	$P_{\text{design}} =$ in/hr 0.41
Step 3: Calculate the surface area	
3-1. Enter required drain time(hours, 72 hrs max.), t	$t =$ 72 hrs
3-2. Calculate max. depth of runoff that can be infiltrated within the t (ft), $d_{\text{max}} = P_{\text{design}} t/12$	$d_{\text{max}} =$ ft 2.5
3-3. For basins, select ponding depth (ft), d_p , such that $d_p \leq d_{\text{max}}$	$d_p =$ 2 ft
3-4. For trenches, enter trench fill aggregate porosity, n_t	$n_t =$ 1/4
3-5. For trenches, enter depth of trench fill (ft), d_t	$d_t =$ 1/4 ft
3-5. For trenches, select ponding depth d_p such that $d_p \leq d_{\text{max}} - n_t d_t$	$d_p =$ 1/4 ft
3-6. Enter the time to fill infiltration basin or trench with water (Use 2 hours for most designs), T	$T =$ 2 hrs

3-7. Calculate infiltrating surface area for infiltration basin (ft²): $A_b = SQDV / ((T P_{design} / 12) + d_p)$ OR Calculate infiltrating surface area for infiltration trenches or aggregate- filled drywells (ft²): $A_t = SQDV / ((T P_{design} / 12) + n_t d_t + d_p)$	$= \frac{8504}{\frac{72}{12} + 2} = 1,070.50 \text{ sf}$ $A_b = \quad \text{ft}^2$ $A_t = \frac{1}{2} \text{ ft}^2$
Step 4: Size the forebay (infiltration basins or trenches)	
If a separate pre-treatment unit is designed for the infiltration facility, skip to Step 5. If not, continue through 4-1 through 4-4.	
4-1. Calculate the volume of the forebay (ft³), $V_{forebay} = 0.25 * SQDV$	$V_{forebay} = \quad \text{ft}^3$
4-2. Determine forebay depth (ft), $d_{forebay}$	$d_{forebay} = \quad \text{ft}$
4-3. Calculate forebay bottom surface area (ft²), $A_{forebay} = V_{forebay} / d_{forebay}$	$A_{forebay} = \quad \text{ft}^2$
4-4. Provide outlet pipe such that the forebay drains to the infiltration facility within 10 minutes.	
Step 5: Provide conveyance capacity for filter clogging	
5-1. The infiltration facility should be placed off-line, but an emergency overflow must still be provided in the event the filter becomes clogged. Design emergency overflow in accordance with applicable standards of the Ventura County Flood Control District or local jurisdiction.	

Table 6-8: Design Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pre-treatment/ expected influent sediment loads	Pre-treatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens, AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pre-treatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pre-treatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

Table 6-4: Infiltration Facility Safety Factor Determination Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	2	0.50
		Site soil variability	0.25	2	0.50
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, S _A = Σp			
B	Design	Tributary area size	0.25	3	0.75
		Level of pre-treatment/ expected sediment loads	0.25	3	0.75
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, S _B = Σp			
Combined Safety Factor = S _A x S _B				6	

Table 6-2: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Assessment methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of ≥ 20 percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of ≥ 50 percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods
Ventura Hydrology Manual soil number (measured infiltration rate)	3 ($f = 0.5 - 0.64$)	4 or 5 ($f = 0.65 - 0.91$)	6 or 7 ($f = 0.92$ or higher)
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils
Depth to groundwater/impervious layer	<10 ft below facility bottom	10-30 ft below facility bottom	>30 below facility bottom

Calculation Procedure

- 1) Determine the area from which runoff must be retained on-site (A_{retain}) using method above.
- 2) Determine the runoff coefficient per the following method:

$$C = 0.95 \cdot \text{imp} + C_p (1 - \text{imp}) \quad (\text{Equation E-7})$$

Where:

- C = runoff coefficient
- imp = impervious fraction of watershed
- C_p = pervious runoff coefficient, determined using table below

Table E-1: Pervious Runoff Coefficient Based on Ventura Soil Type

Ventura Soil Type (Soil Number)	C_p value
1	0.15
2	0.10
3	0.10
4	0.05
5	0.05
6	0
7	0

$\leftarrow C_p$

- 3) The volume can be calculated using equation E-8 below:

$$\text{SQDV} = C \cdot (0.75/12) \cdot A_{\text{retain}} \quad (\text{Equation E-8})$$

Where:

- SQDV = the water quality design volume (acre-feet)
- C = runoff coefficient, calculated by equation (E-7) above
- 0.75 = the design rainfall depth (in) [based on sizing method (c)]
- A_{retain} = the drainage area from which runoff must be retained (acres)

APPENDIX D

Hydraulic Calculations

Channel Report

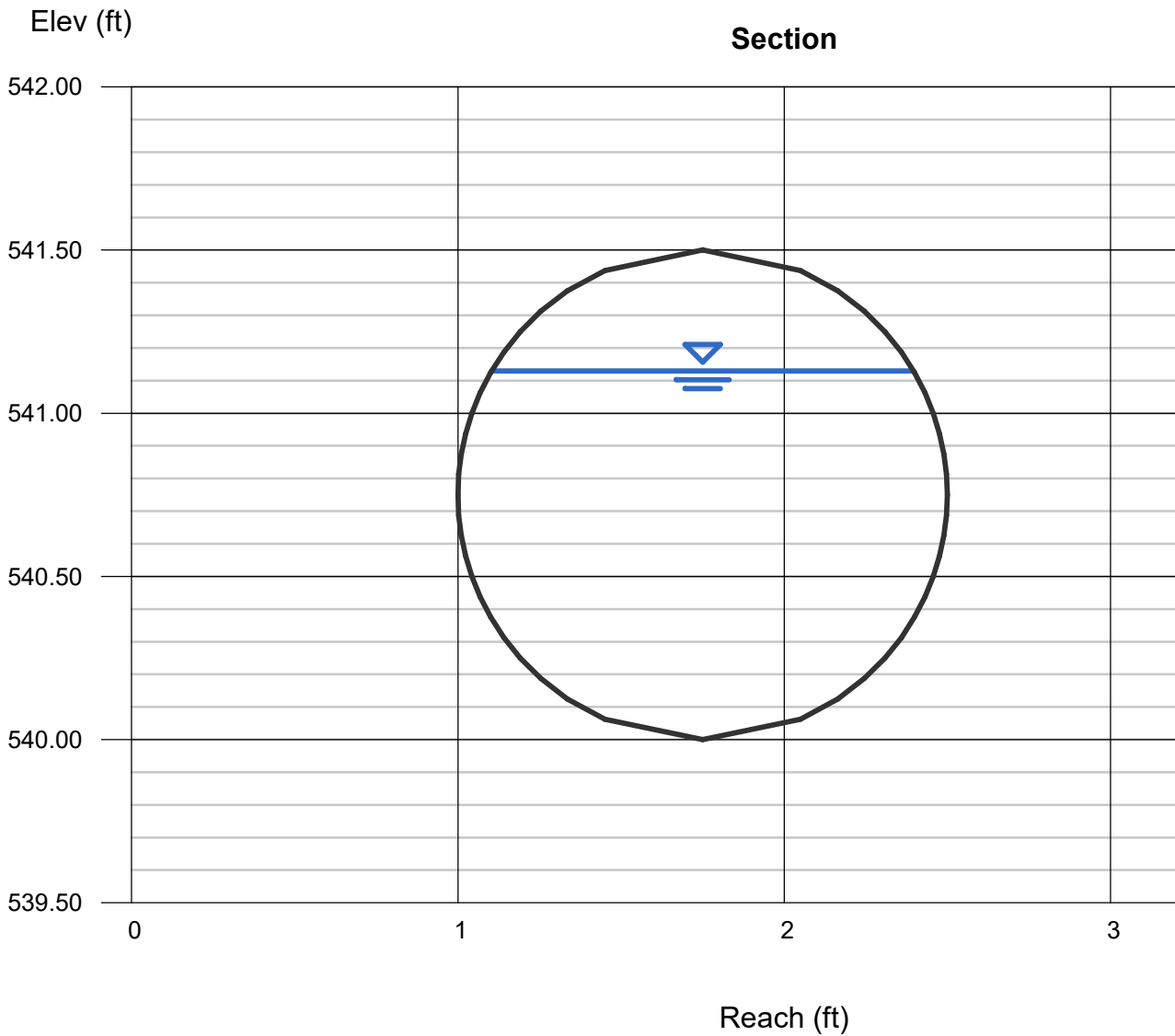
18in RCP SD, S=0.0200, dept= 0.75 full

Circular

Diameter (ft)	= 1.50
Invert Elev (ft)	= 540.00
Slope (%)	= 2.00
N-Value	= 0.010
Calculations	
Compute by:	Known Depth
Known Depth (ft)	= 1.13

Highlighted

Depth (ft)	= 1.13
Q (cfs)	= 17.73
Area (sqft)	= 1.43
Velocity (ft/s)	= 12.39
Wetted Perim (ft)	= 3.16
Crit Depth, Yc (ft)	= 1.45
Top Width (ft)	= 1.29
EGL (ft)	= 3.52



Channel Report

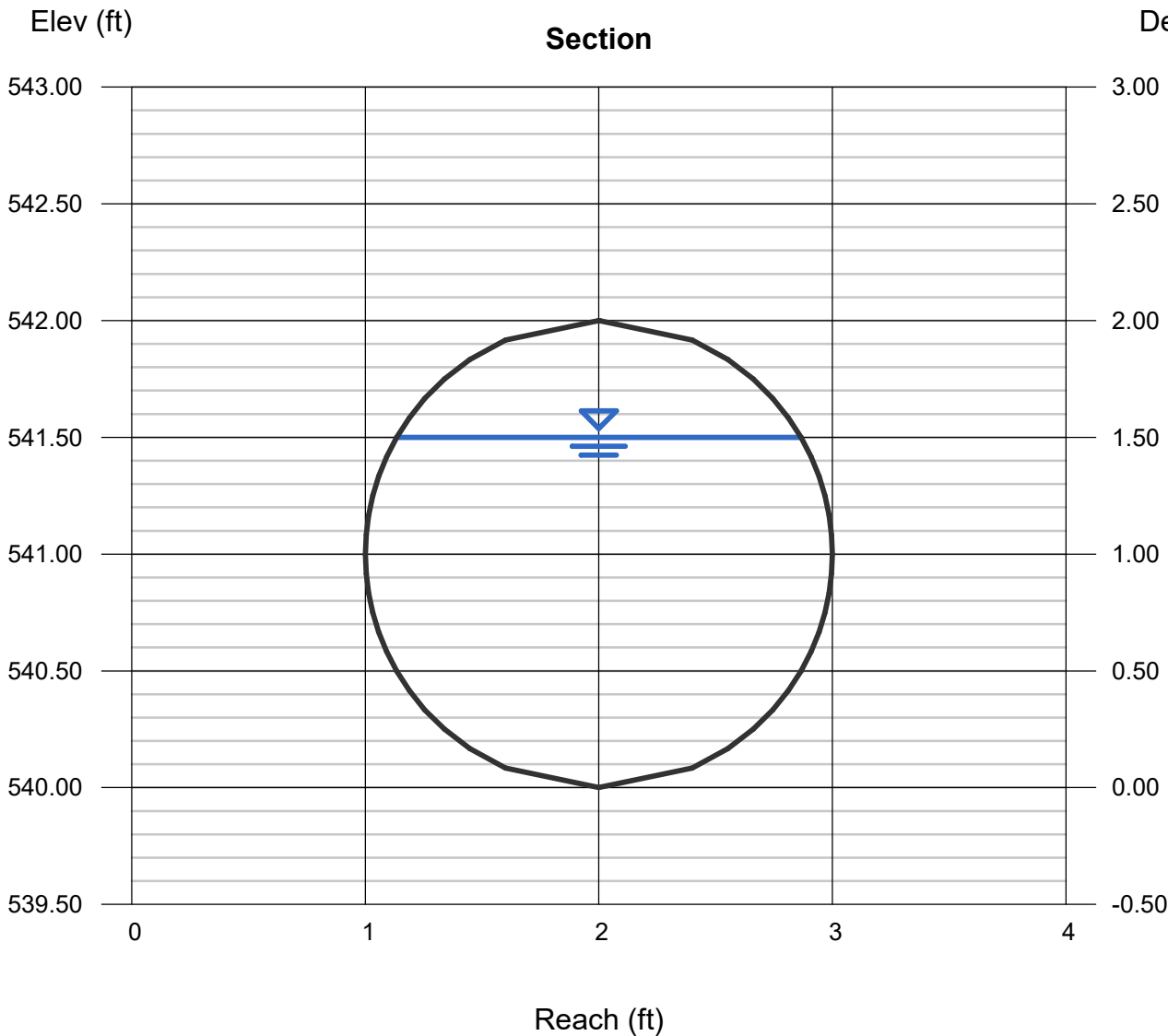
24in RCP SD, S=0.0200, dept= 0.75 full

Circular

Diameter (ft)	= 2.00
Invert Elev (ft)	= 540.00
Slope (%)	= 2.00
N-Value	= 0.010
Calculations	
Compute by:	Known Depth
Known Depth (ft)	= 1.50

Highlighted

Depth (ft)	= 1.50
Q (cfs)	= 37.93
Area (sqft)	= 2.53
Velocity (ft/s)	= 15.00
Wetted Perim (ft)	= 4.19
Crit Depth, Yc (ft)	= 1.95
Top Width (ft)	= 1.73
EGL (ft)	= 5.00



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Nov 2 2016

36in RCP SD, S=0.0200, dept= 0.75 full

Circular

Diameter (ft) = 3.00

Invert Elev (ft) = 540.00

Slope (%) = 2.00

N-Value = 0.010

Calculations

Compute by: Known Depth

Known Depth (ft) = 2.25

Highlighted

Depth (ft) = 2.25

Q (cfs) = 111.86

Area (sqft) = 5.69

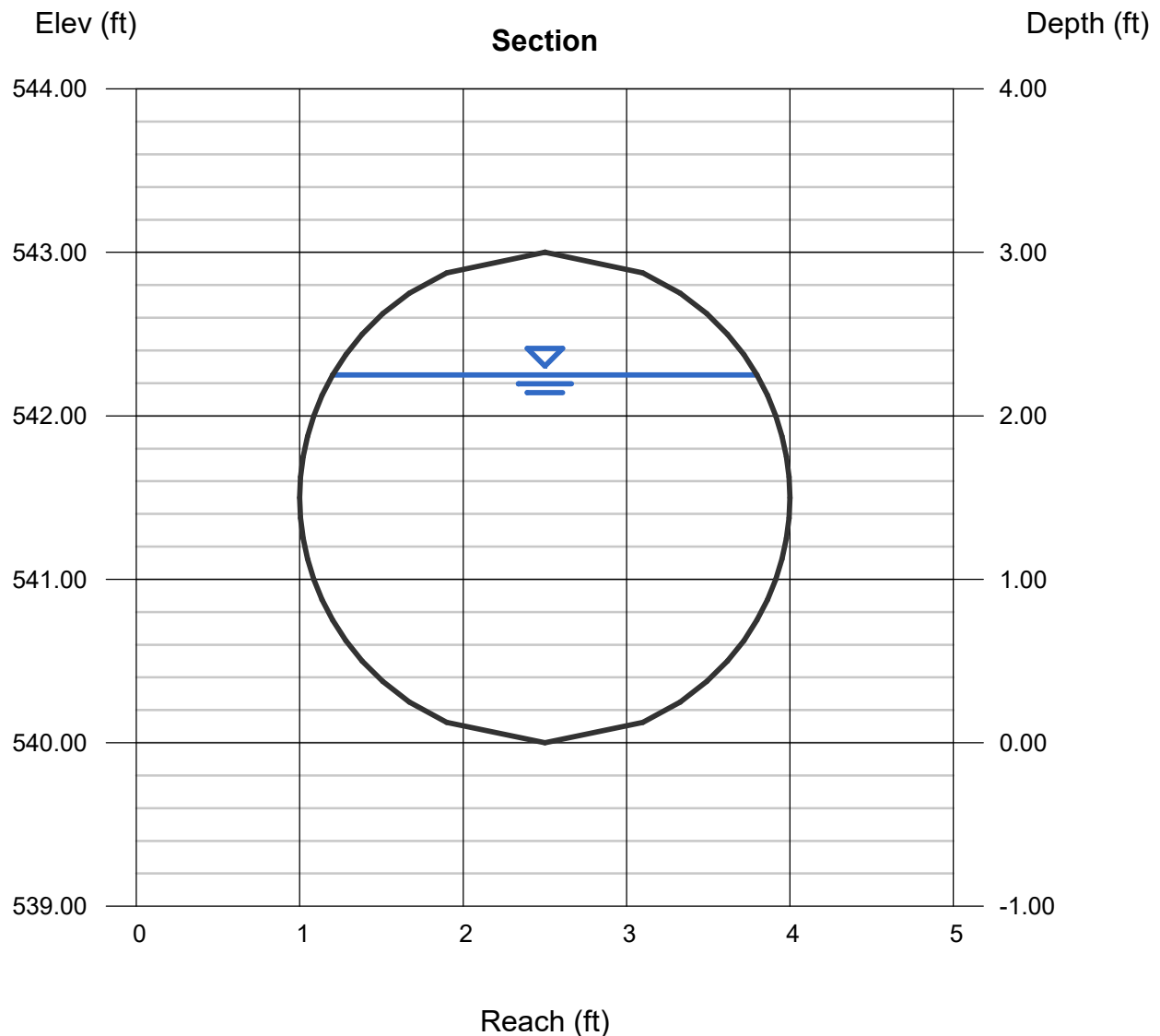
Velocity (ft/s) = 19.66

Wetted Perim (ft) = 6.29

Crit Depth, Yc (ft) = 2.94

Top Width (ft) = 2.60

EGL (ft) = 8.26



Inlet Report

W=7, S=0.0020 for A=2ac

Curb Inlet

Location	= On grade
Curb Length (ft)	= 7.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

Slope, Sw (ft/ft)	= 0.083
Slope, Sx (ft/ft)	= 0.020
Local Depr (in)	= 2.00
Gutter Width (ft)	= 4.00
Gutter Slope (%)	= 2.00
Gutter n-value	= 0.016

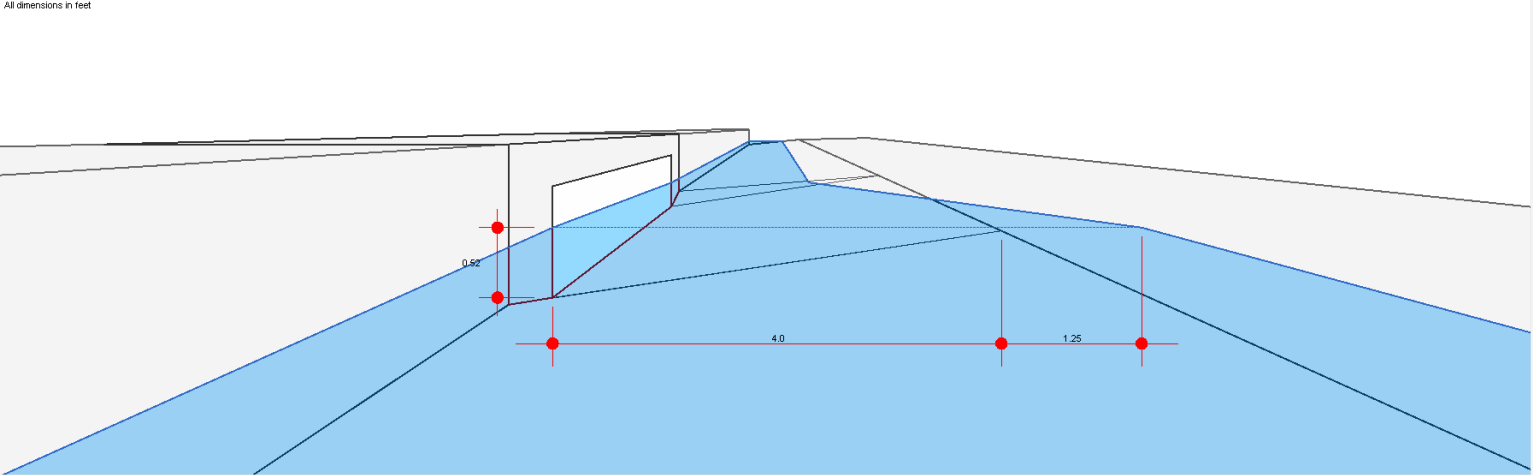
Calculations

Compute by:	Known Q
Q (cfs)	= 3.80

Highlighted

Q Total (cfs)	= 3.80
Q Capt (cfs)	= 2.77
Q Bypass (cfs)	= 1.03
Depth at Inlet (in)	= 6.28
Efficiency (%)	= 73
Gutter Spread (ft)	= 5.25
Gutter Vel (ft/s)	= 4.87
Bypass Spread (ft)	= 2.65
Bypass Depth (in)	= 2.64

All dimensions in feet



Inlet Report

W=14, S=0.0020 for Q=8cfs

Curb Inlet

Location	= On grade
Curb Length (ft)	= 14.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

Slope, Sw (ft/ft)	= 0.083
Slope, Sx (ft/ft)	= 0.020
Local Depr (in)	= 2.00
Gutter Width (ft)	= 4.00
Gutter Slope (%)	= 2.00
Gutter n-value	= 0.016

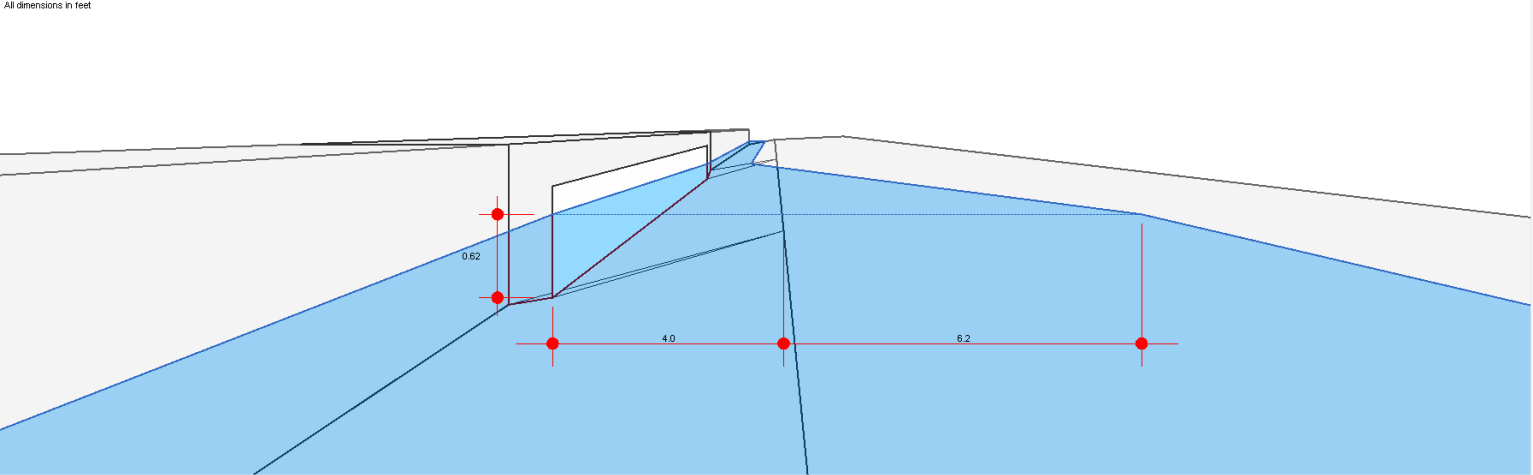
Calculations

Compute by:	Known Q
Q (cfs)	= 8.00

Highlighted

Q Total (cfs)	= 8.00
Q Capt (cfs)	= 7.15
Q Bypass (cfs)	= 0.85
Depth at Inlet (in)	= 7.47
Efficiency (%)	= 89
Gutter Spread (ft)	= 10.20
Gutter Vel (ft/s)	= 5.18
Bypass Spread (ft)	= 2.53
Bypass Depth (in)	= 2.52

All dimensions in feet



Weir Report

Q100= Inflow to Detention Basin from Street Q100-Q10

Rectangular Weir

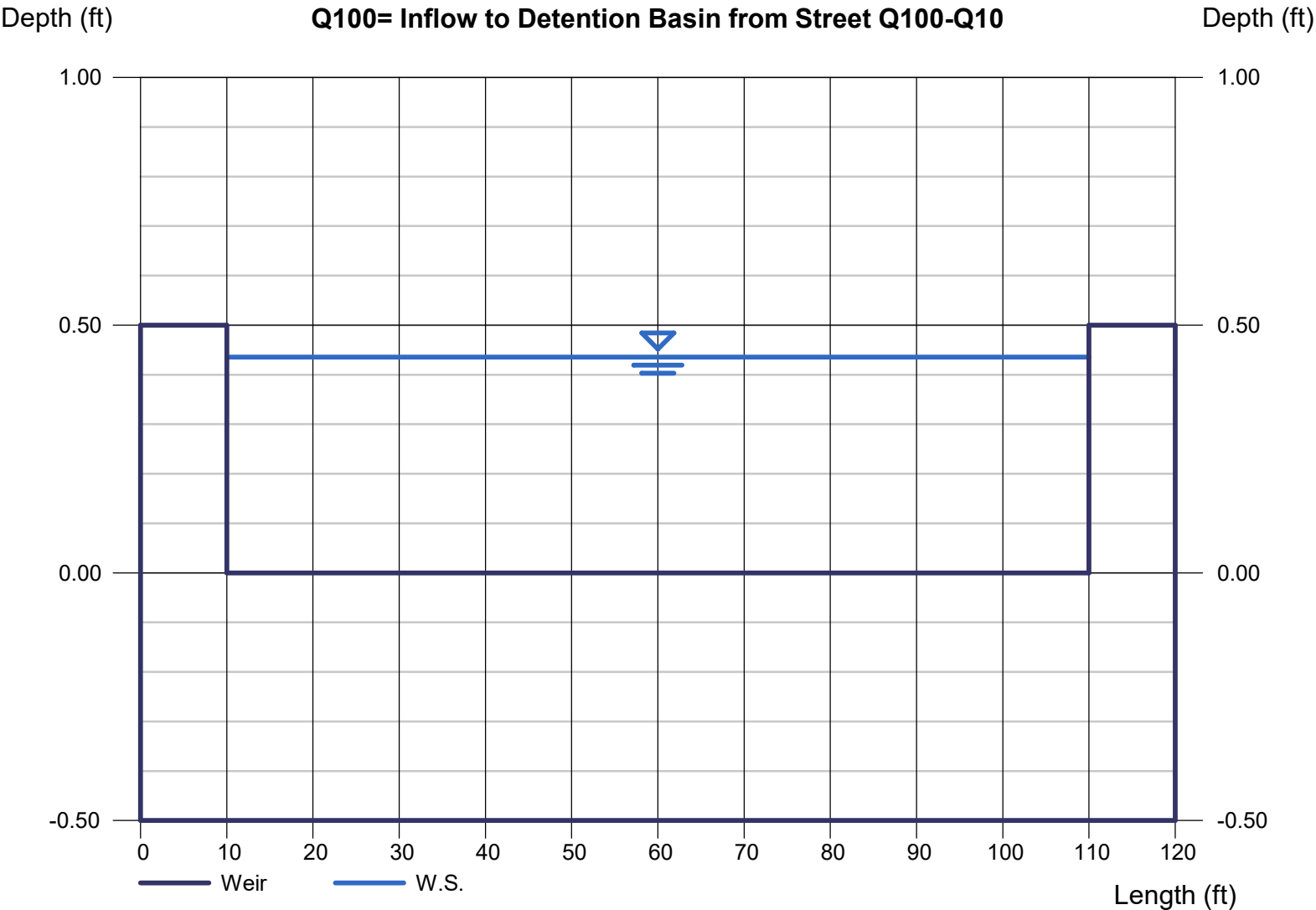
Crest = Sharp
Bottom Length (ft) = 100.00
Total Depth (ft) = 0.50

Highlighted

Depth (ft) = 0.44
Q (cfs) = 95.80
Area (sqft) = 43.56
Velocity (ft/s) = 2.20
Top Width (ft) = 100.00

Calculations

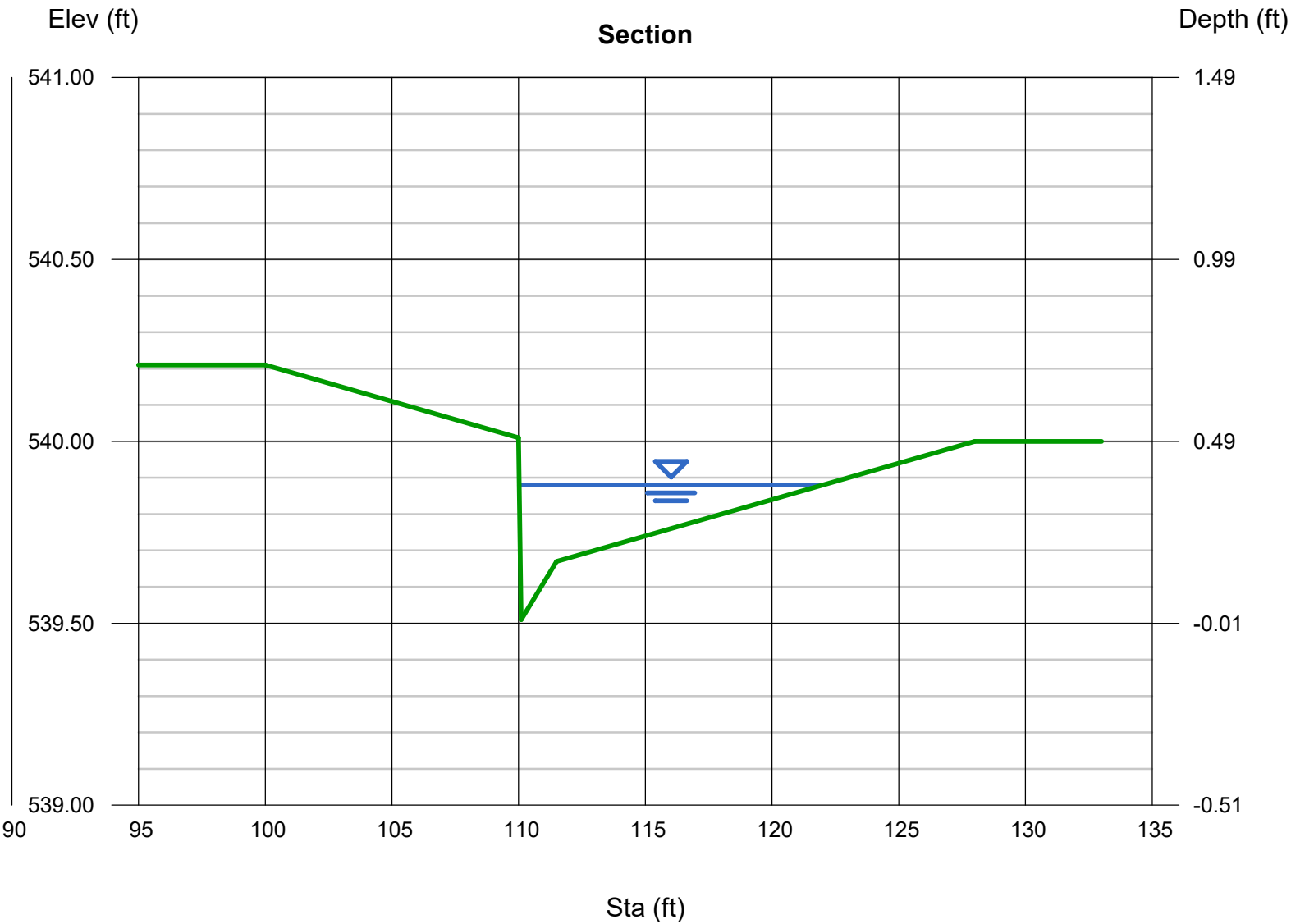
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 95.80



Channel Report

Street Dry Lane Calc- Max 10-yr Tributary Q

User-defined		Highlighted	
Invert Elev (ft)	= 539.51	Depth (ft)	= 0.37
Slope (%)	= 2.00	Q (cfs)	= 7.963
N-Value	= 0.010	Area (sqft)	= 1.52
		Velocity (ft/s)	= 5.23
		Wetted Perim (ft)	= 12.29
Calculations		Crit Depth, Yc (ft)	= 0.49
Compute by:	Known Depth	Top Width (ft)	= 11.97
Known Depth (ft)	= 0.37	EGL (ft)	= 0.80



Channel Report

Street Right of Way Q50- Capacity

User-defined

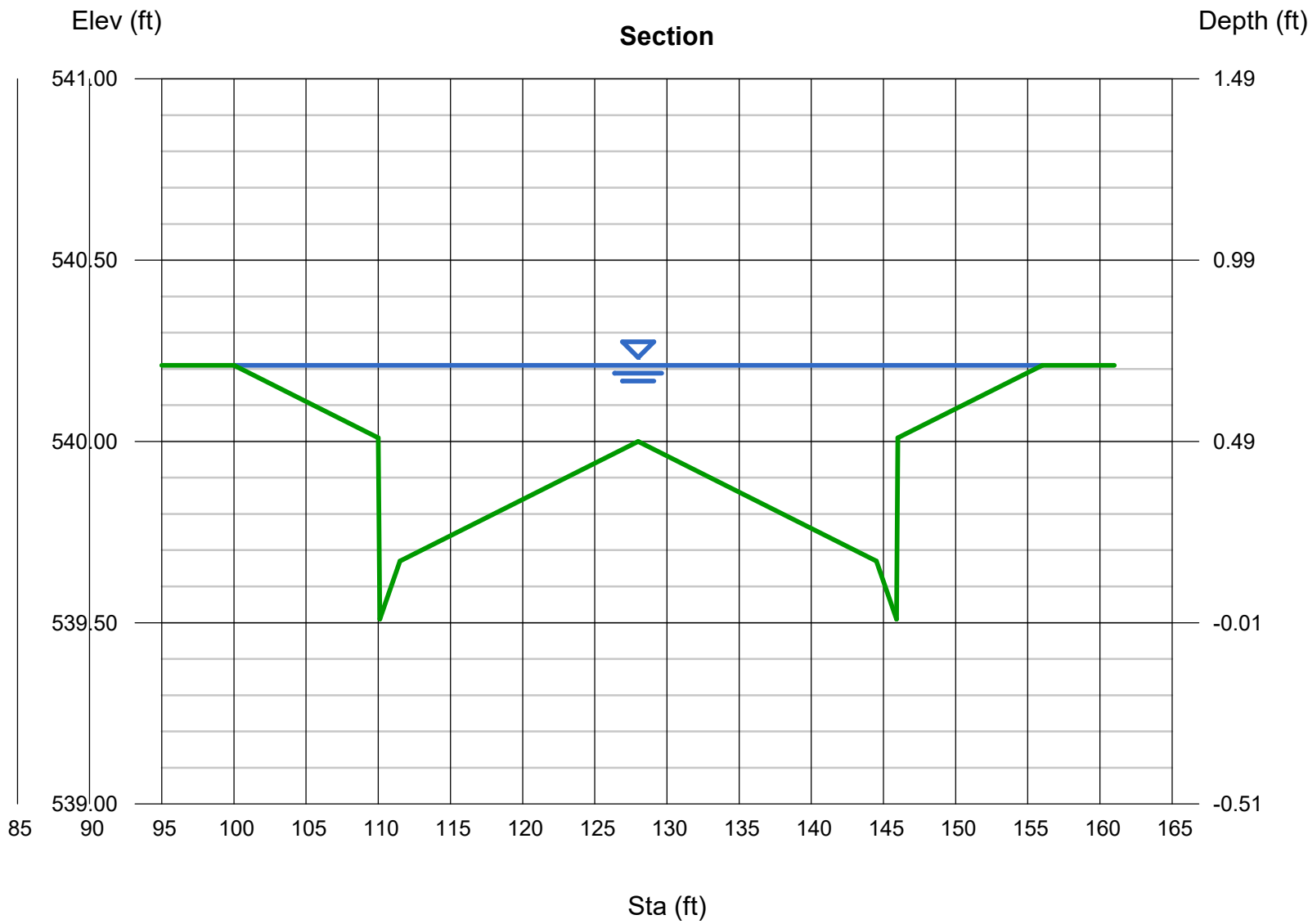
Invert Elev (ft) = 539.51
Slope (%) = 2.00
N-Value = 0.013

Highlighted

Depth (ft) = 0.70
Q (cfs) = 113.63
Area (sqft) = 16.20
Velocity (ft/s) = 7.01
Wetted Perim (ft) = 56.85
Crit Depth, Yc (ft) = 0.70
Top Width (ft) = 56.00
EGL (ft) = 1.46

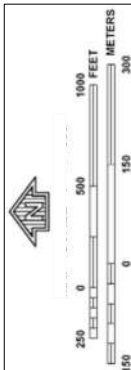
Calculations

Compute by: Known Depth
Known Depth (ft) = 0.70



APPENDIX E

Reference



NFIP

FIRM

FLOOD INSURANCE RATE MAP

VENTURA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 816 OF 1275

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS: MAP NUMBER 06111C0816E, EFFECTIVE DATE JANUARY 20, 2010

Federal Emergency Management Agency

MAP NUMBER 06111C0816E

EFFECTIVE DATE JANUARY 20, 2010

Federal Emergency Management Agency

NFIP

FIRM

FLOOD INSURANCE RATE MAP

VENTURA COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 817 OF 1275

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

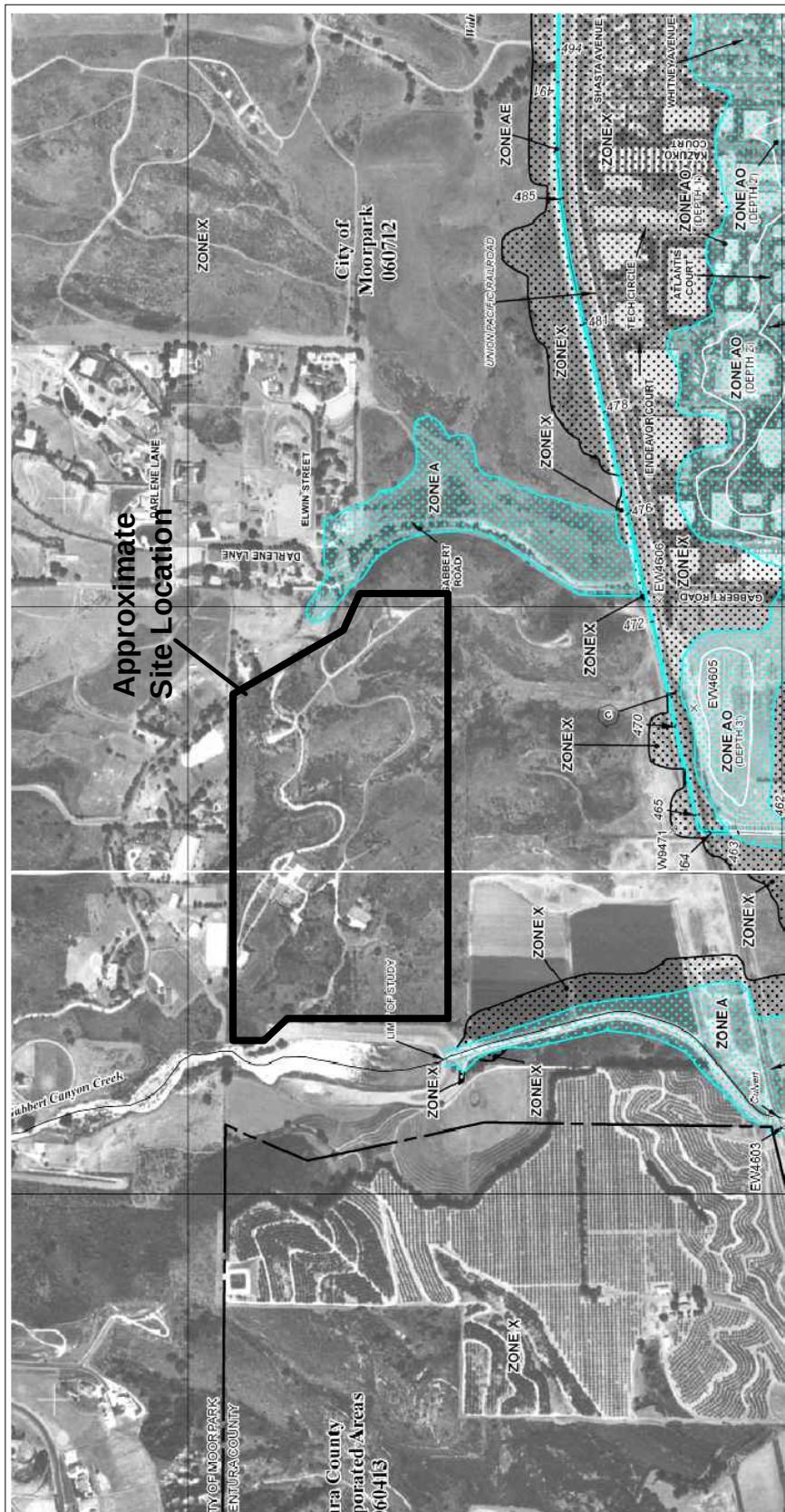
CONTAINS: MAP NUMBER 06111C0817E, EFFECTIVE DATE JANUARY 20, 2010

Federal Emergency Management Agency

MAP NUMBER 06111C0817E

EFFECTIVE DATE JANUARY 20, 2010

Federal Emergency Management Agency



LEGEND

- SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
 - ZONE A** The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
 - ZONE AE** No Base Flood Elevations determined.
 - ZONE AH** Base Flood Elevations determined.
 - ZONE AO** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
 - ZONE AR** Flood depths of 1 to 3 feet (usually sheet flow or sloping terrain); average depths of 3 to 6 feet (usually areas of ponding); Base Flood Elevations determined.
 - ZONE A99** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed. Zone AR is included in the 1% annual chance flood protection from the 1% annual chance or greater flood.
 - ZONE V** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
 - ZONE VE** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- OTHER FLOOD AREAS**
 - ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
 - ZONE X** Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
 - COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS** CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
 - OTHERWISE PROTECTED AREAS (OPAs)** CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- FLOODWAY AREAS IN ZONE AE**
 - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
 - ZONE X** The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
 - ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
 - ZONE X** Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
 - COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS** CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
 - OTHERWISE PROTECTED AREAS (OPAs)** CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- Map Symbols and Notes**
 - Legend:** Floodway boundary, Zone D boundary, CBRS and OPA boundary, Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities, Base Flood Elevation line and value, elevation in feet, Base Flood Elevation value where uniform within zone, elevation in feet, Cross section line, Transverse line, Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere, 100-meter Universal Transverse Mercator grid values, zone, 5000-foot grid ticks: California State Plane coordinate system, zone V (PPSZONE 0405), Lambert Conformal Conic projection, Bench mark (see explanation in Notes to Users section of this FIRM panel), River Mile.
 - Coordinates:** 87°07'45", 32°22'30"
 - Scale:** 600000 FT, DX5510 X, M1.5
 - Reference:** Referenced to the North American Vertical Datum of 1988



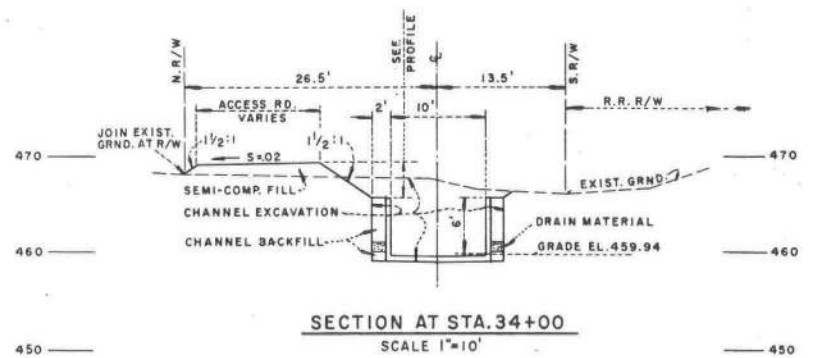
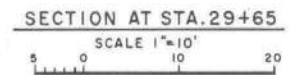
FEMA Flood Insurance Rate Maps

North Hills, Moorpark, CA

RMA Job No:	16-G63-0
Date:	June 10, 2016
Prepared By:	AMS

Figure 5

HORIZ. SCALE: 1" = 40'
VERT. SCALE: 1" = 4'

[illegible]

SCALE 1" = 40'



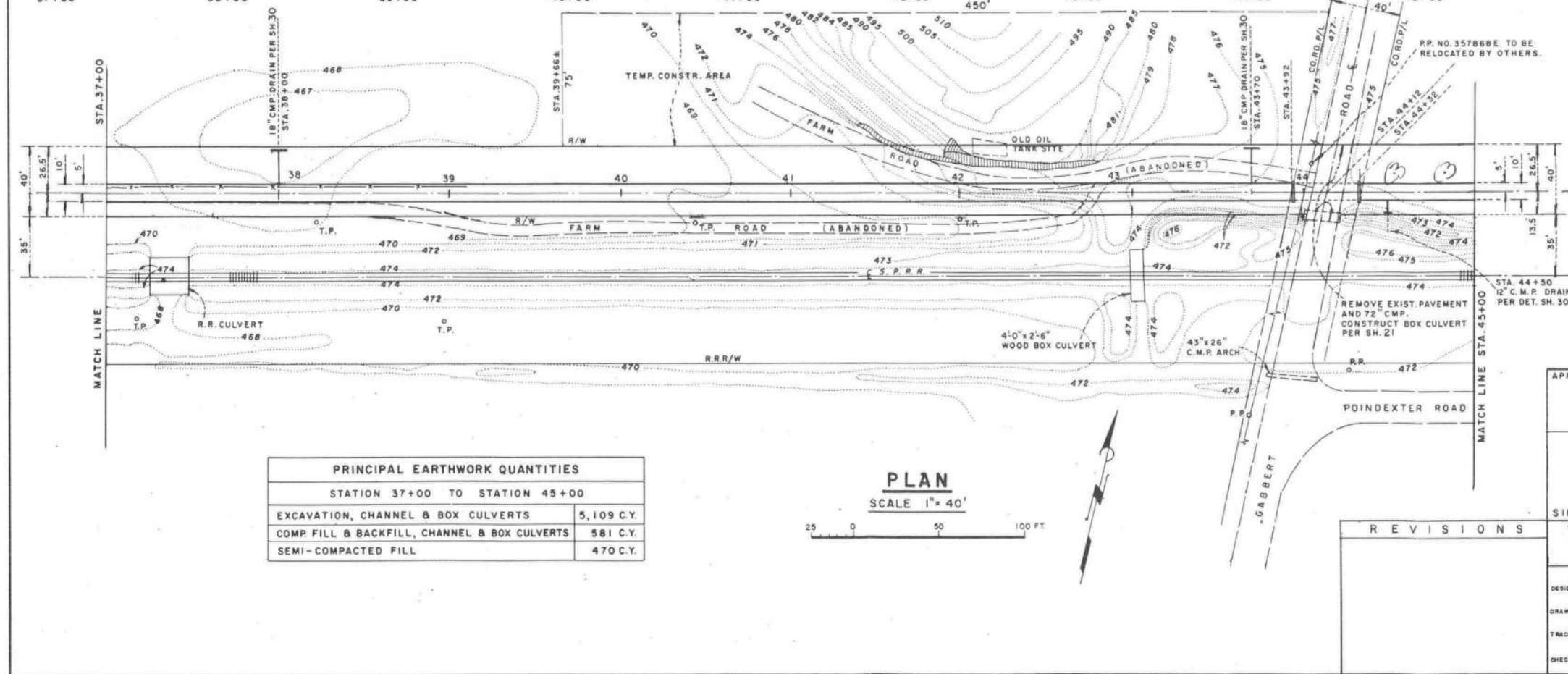
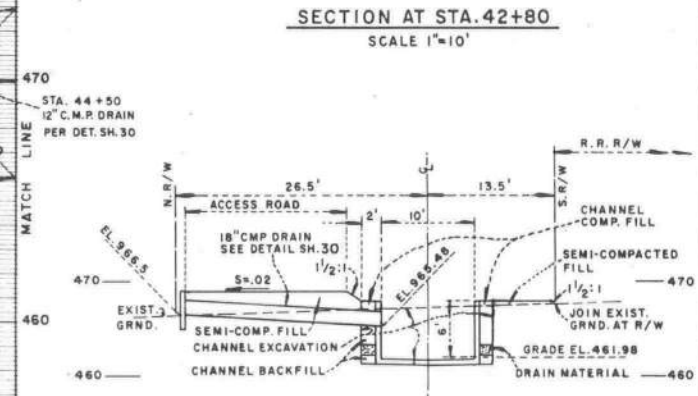
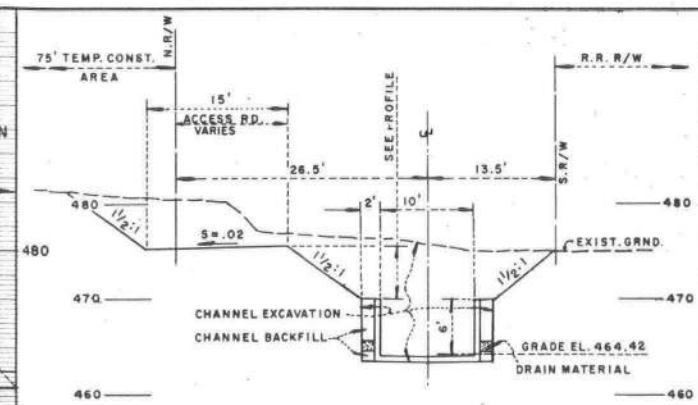
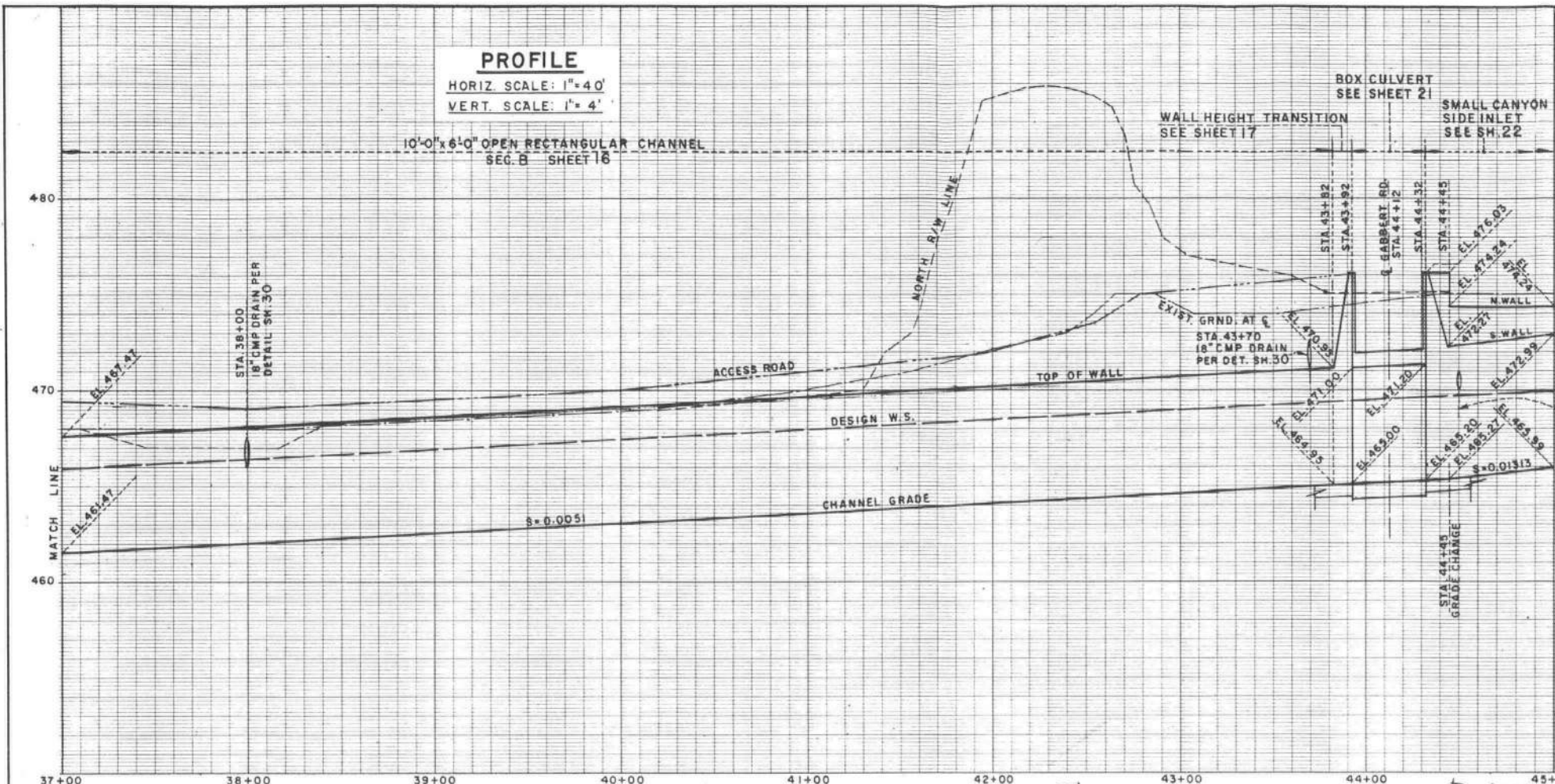
APPROVED: VENTURA COUNTY FLOOD CONTROL DISTRICT

BY *C. White*
ENGINEER - MANAGER

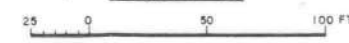
WALNUT CANYON CHANNEL
PLAN, PROFILE & SECTIONS
STA. 29+00 TO STA. 37+00
CALLEGUAS CREEK W.P.P.
SIMI VALLEY AND CALLEGUAS S.C. DISTRICTS - CALIFORNIA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	M. A. T.	Date	10/61	Approved by	<i>W. H. Rayner</i>
Drawn	J. R. & C. E. R.		12/61-3/62	Title	FOR STATE CONSERVATION ENGINEER
Traced	J. R. & C. E. R.		12/61-3/62	Approved by	<i>3K Thuermer</i>
Checked	W. H. P. & C. F. B.		3/62	Title	ROAD & W. P. UNIT
			SHEET	DRAWING NO.	
			NO. 5	7-E-15518	
			OF 33		



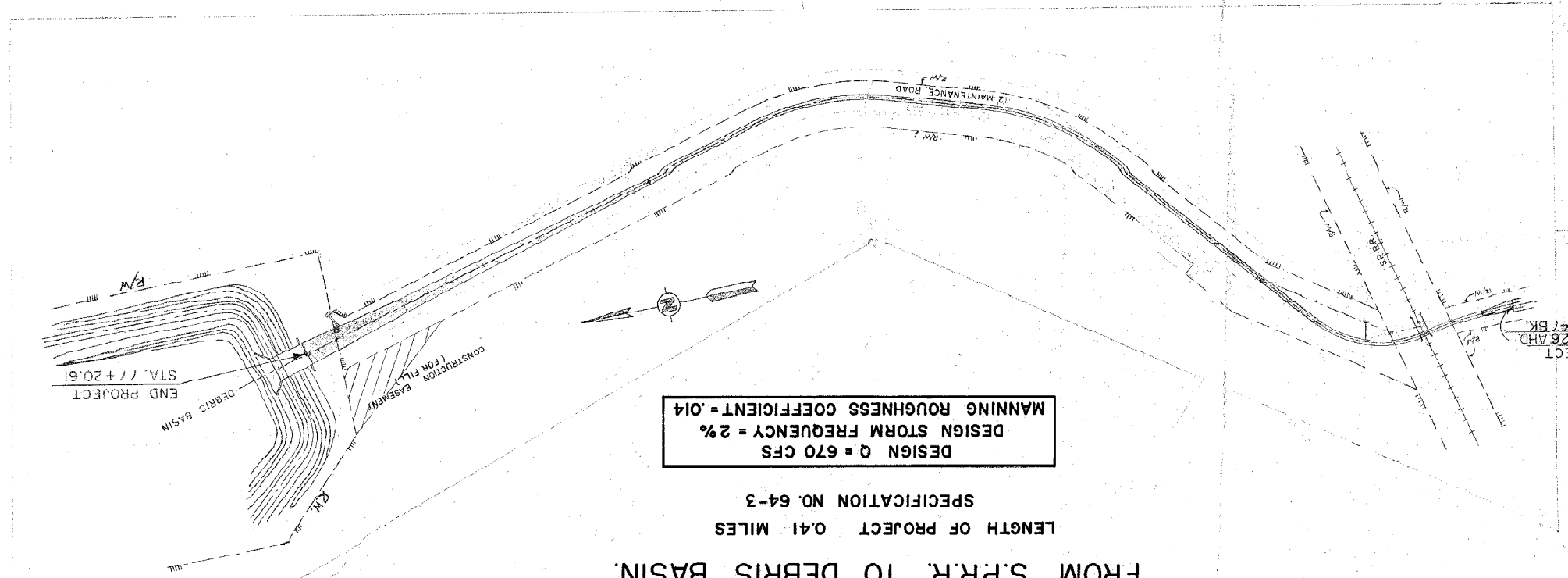
PRINCIPAL EARTHWORK QUANTITIES	
STATION 37+00 TO STATION 45+00	
EXCAVATION, CHANNEL & BOX CULVERTS	5,109 C.Y.
COMP. FILL & BACKFILL, CHANNEL & BOX CULVERTS	581 C.Y.
SEMI-COMPACTED FILL	470 C.Y.



REVISIONS			
DESIGNED	M.A.T.	DATE	10/61
DRAWN	J.R.B. & C.E.R.	DATE	12/61-3/62
TRACED	J.R.B. & C.E.R.	DATE	12/61-3/62
CHECKED	W.H.P. & C.F.B.	DATE	3/62

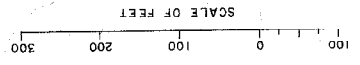
APPROVED:		VENTURA COUNTY FLOOD CONTROL DISTRICT	
BY		<i>C. White</i>	
		ENGINEER-MANAGER	
WALNUT CANYON CHANNEL			
PLAN, PROFILE & SECTIONS			
STA. 37+00 TO STA. 45+00			
CALLEGUAS CREEK W.P.P.			
SIMI VALLEY AND CALLEGUAS S.C. DISTRICTS - CALIFORNIA			
U. S. DEPARTMENT OF AGRICULTURE			
SOIL CONSERVATION SERVICE			
APPROVED BY		<i>W.A. Payne</i>	
DATE		10/61	
TITLE		FOR STATE CONSERVATION ENGINEER	
APPROVED BY		<i>J.R. Thomas</i>	
DATE		12/61-3/62	
TITLE		HEAD E. & W.P. UNIT	
SHEET		NO. 6	
DRAWING NO.		7-E-15518	
OF 33			

COUNTY OF VENTURA
DEPARTMENT OF PUBLIC WORKS
VENTURA COUNTY FLOOD CONTROL DISTRICT
ZONE 3
GABBERT CANYON CHANNEL LINING
FROM S.F.R.R. TO DEBRIS BASIN

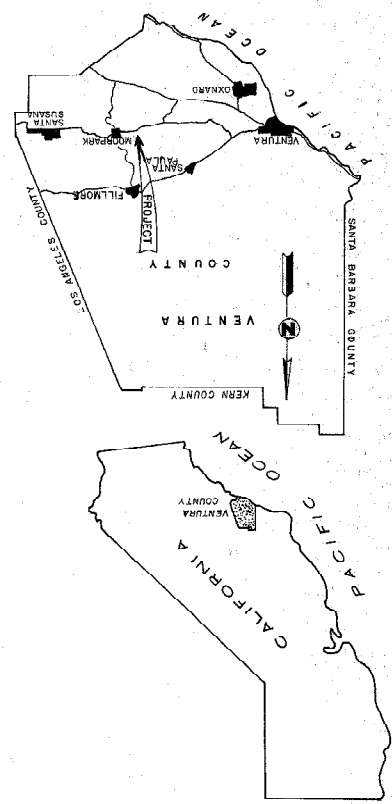
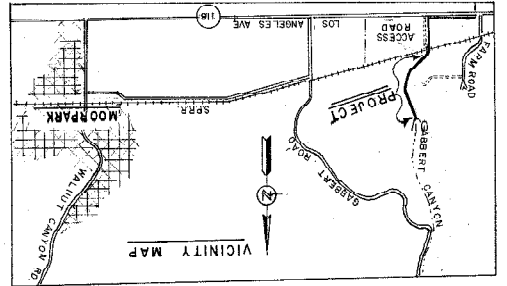


DESIGN Q = 670 CFS
DESIGN STORM FREQUENCY = 2%
MANNING ROUGHNESS COEFFICIENT = .014

LENGTH OF PROJECT 0.41 MILES
SPECIFICATION NO. 64-3



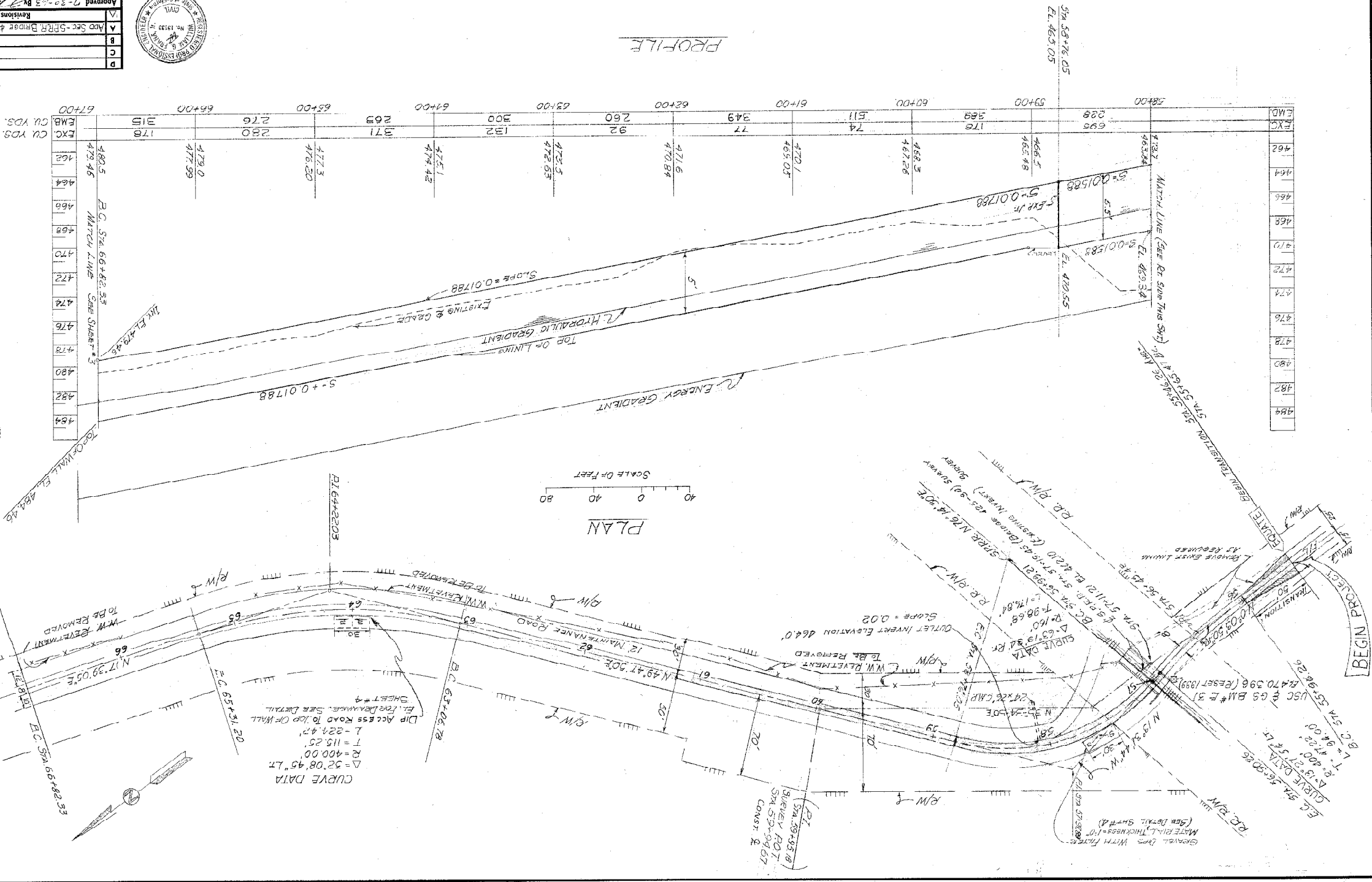
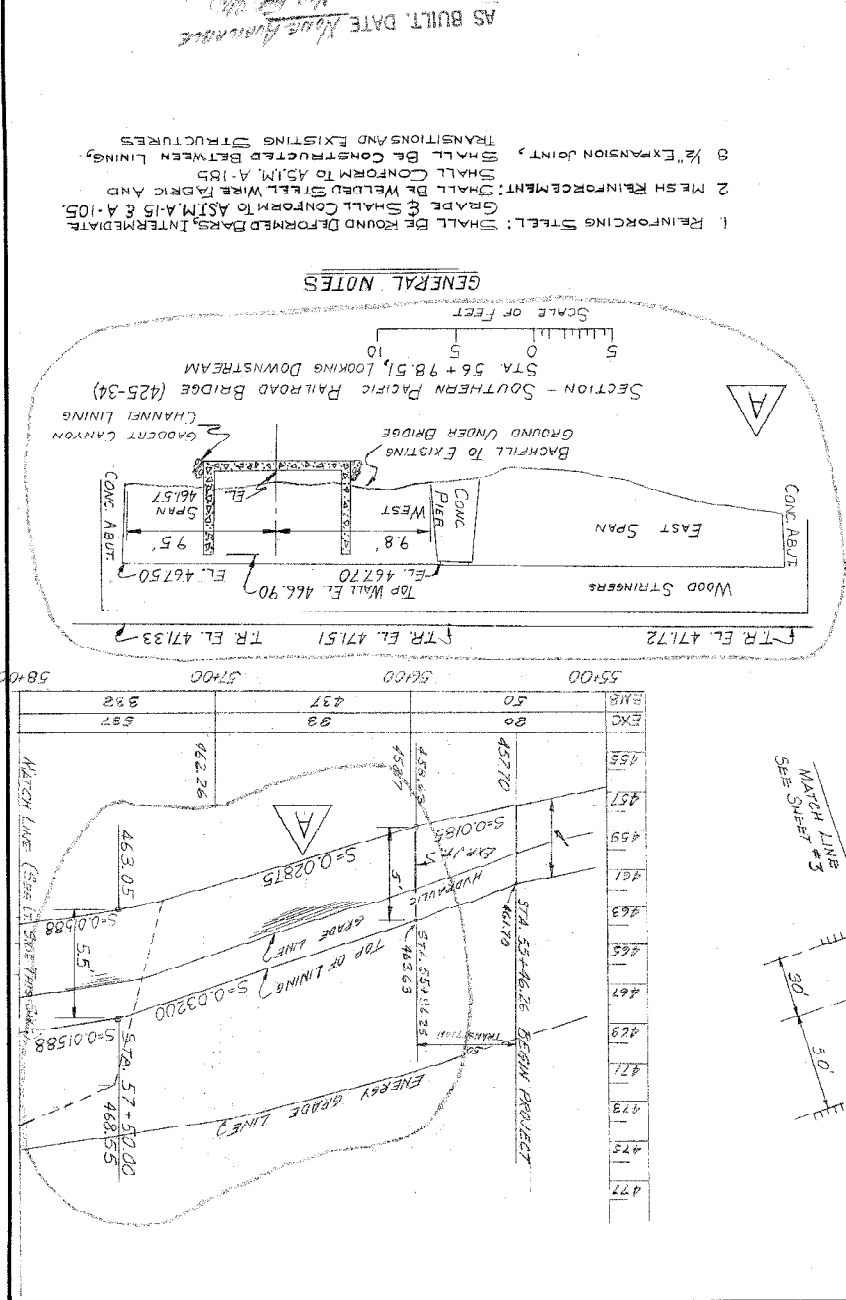
GENERAL PLAN



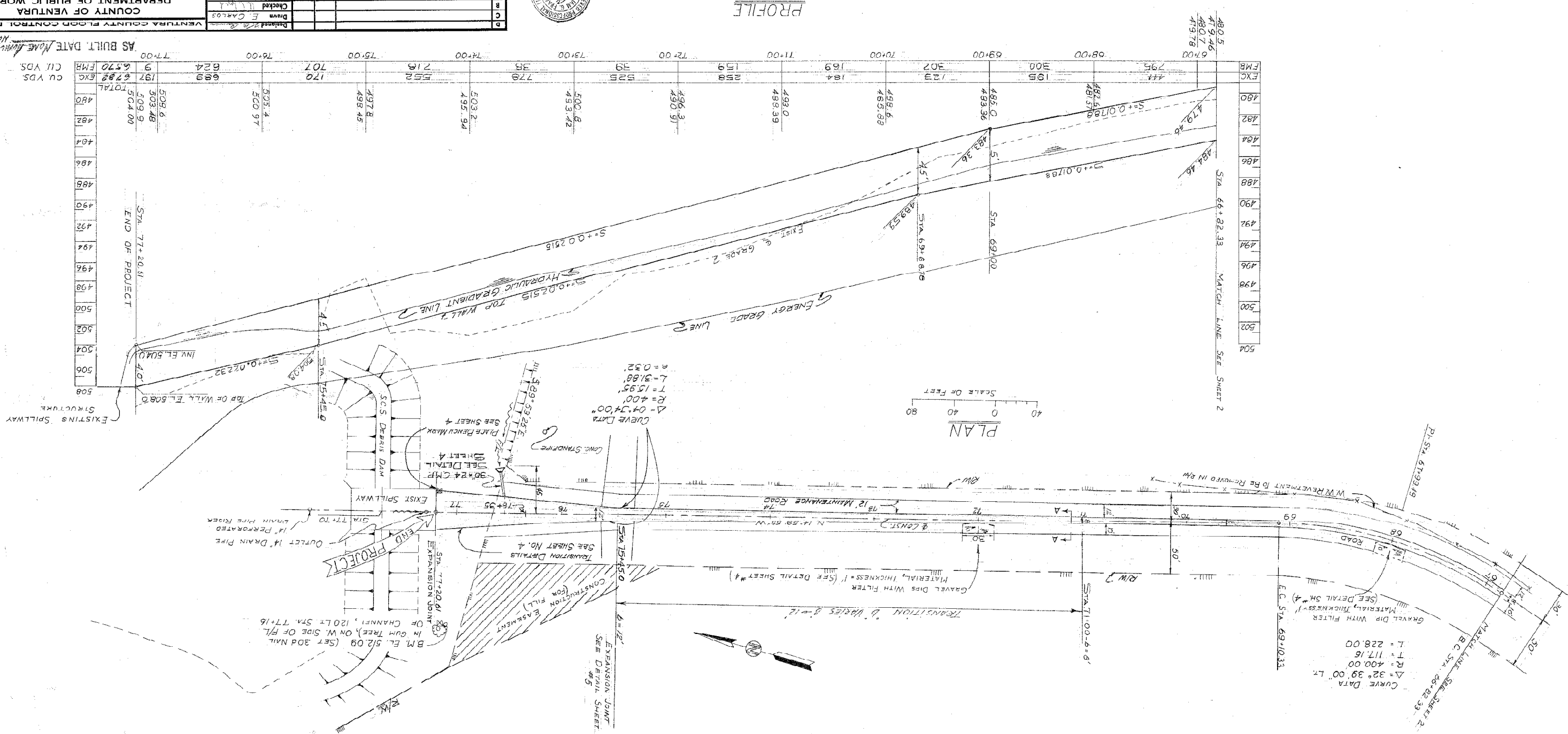
INDEX OF SHEETS
1 COVER SHEET
2 PLAN & PROFILE STA 55+46.26 TO STA 66+82.33 WITH GENERAL NOTES
3 PLAN & PROFILE STA 66+82.33 TO STA 77+20.61
4 TRANSITIONS, TYPICAL SECTIONS & DETAILS
5 CROSS SECTIONS & DETAILS
AS BUILT, DATE *NONE AVAILABLE*
DRAWING NO. Y-3-192
37-429



VENTURA COUNTY FLOOD CONTROL DISTRICT		COUNTY OF VENTURA		DEPARTMENT OF PUBLIC WORKS	
GABBERT CANYON CHANNEL LINING		PLAN, PROFILE TO STA. 66+82.33		ST. 55+46.26	
Project No. 4801		Sheet 2 of 5		Drawing No. T-3-193	
Scale: AS NOTED		Date: 7-30-63		By: J. M. HARRIS	
Approved: 7-30-63		Chief Eng.:		Eng. Mgr.:	
Field Books 1148, 1109		Date: 10/63		Spec. No. RD. 64.13	
Datum: MEAN SEA LEVEL		Checked:		Drawn: J. M. HARRIS	
A: Add Sec. 5-P.R.R. Bridge & Change Profile		Revisions:		By: J. M. HARRIS	
B:					
C:					
D:					



AS BUILT DATE NOV 1964

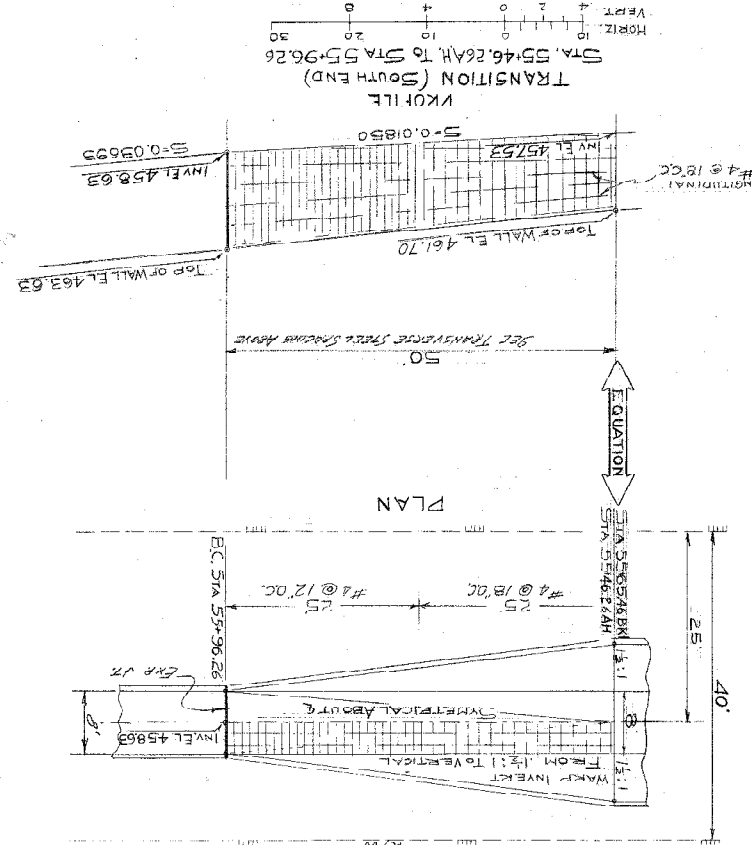
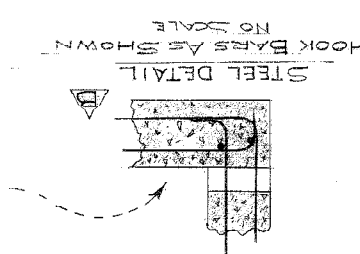
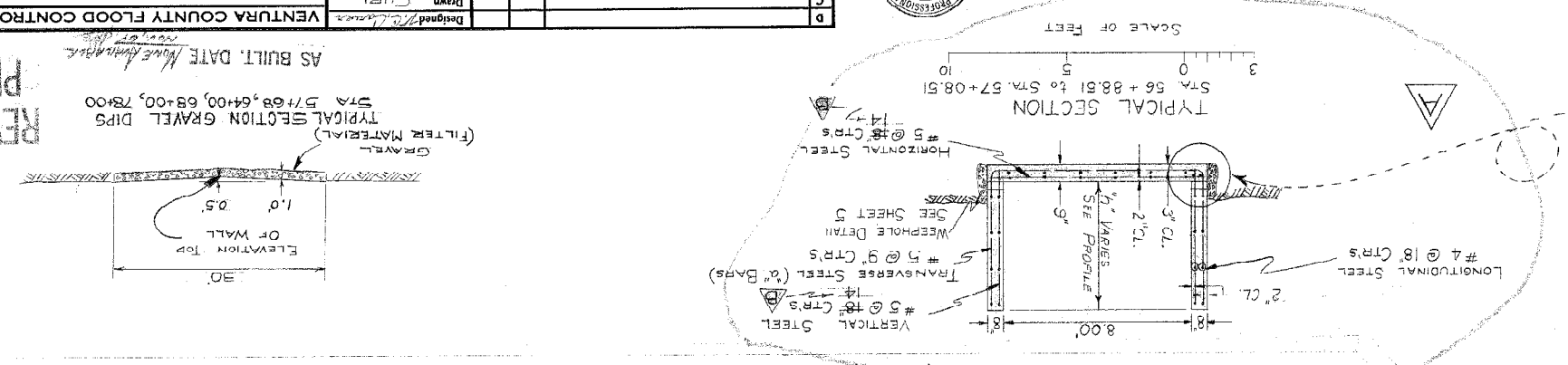
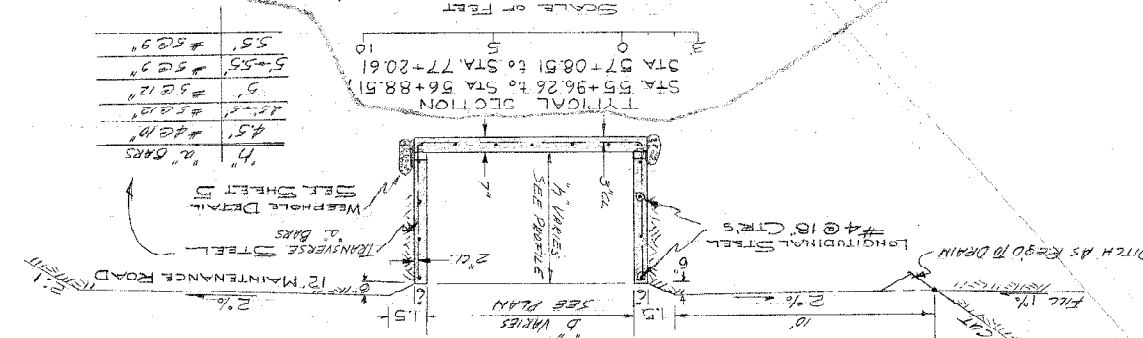
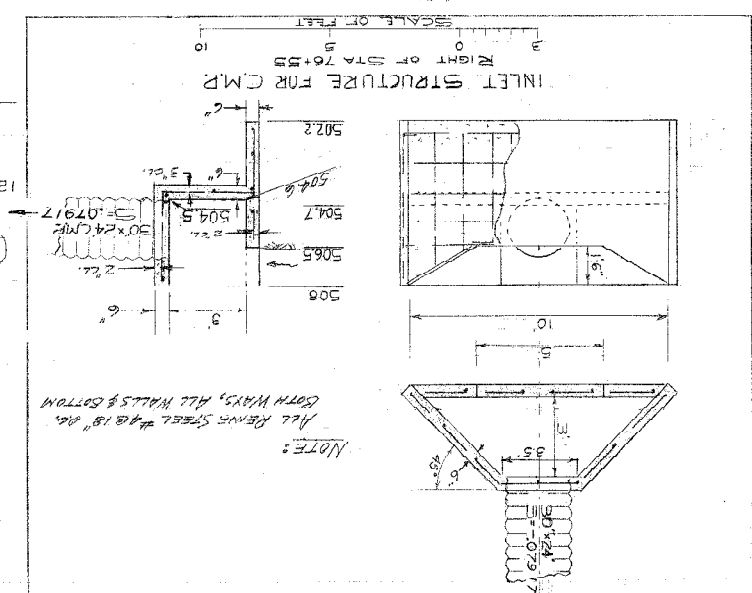
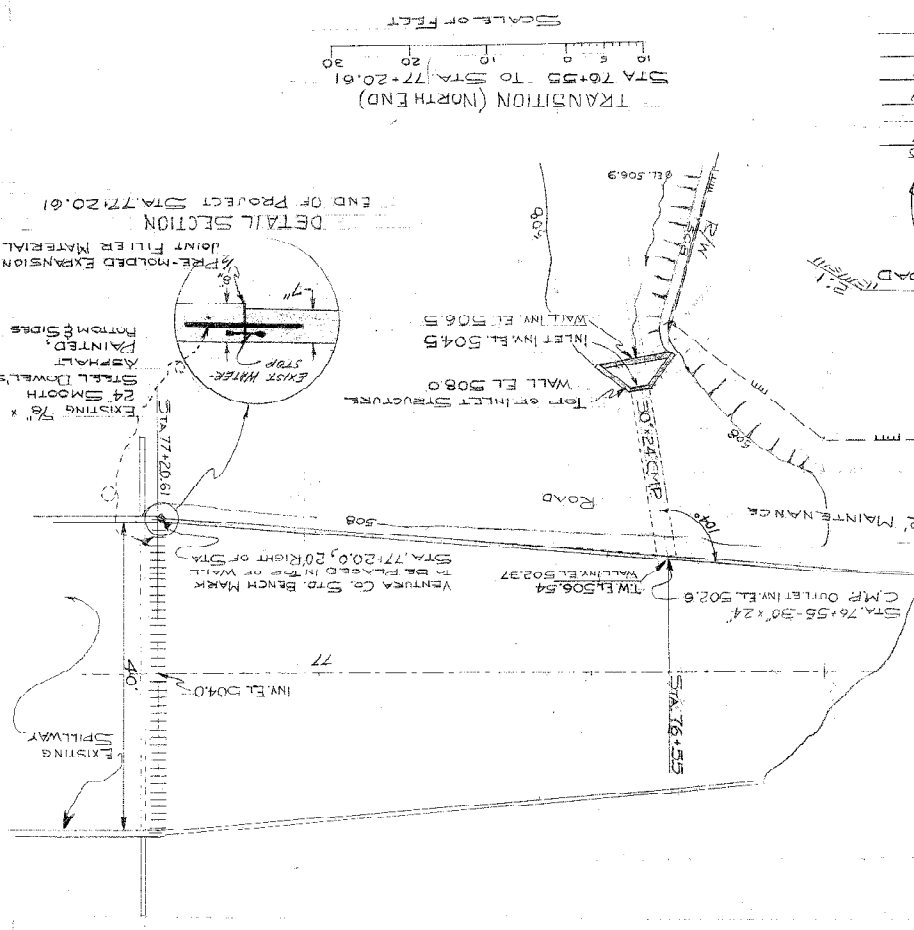


REVISED
PRINT

AS BUILT DATE *None*

VENTURA COUNTY FLOOD CONTROL DIST.
COUNTY OF VENTURA
DEPARTMENT OF PUBLIC W.
GABBERT CANYON CHA.
TRANSITIONS, TYPICAL

VENTURA COUNTY FLOOD CONTROL DIST.		Designed <i>W. L. ...</i>	Drawn <i>C. ...</i>	Checked <i>W. L. ...</i>	Spec. No. <i>FC 14-3</i>	Date <i>11/63</i>	By <i>W. L. ...</i>	Chief Engr. <i>W. L. ...</i>	Field Book <i>1148, 1189</i>	Project No. <i>4801</i>	Sheet <i>4</i> of <i>5</i>
COUNTY OF VENTURA		Approved <i>7-30-63</i> By <i>W. L. ...</i>									
DEPARTMENT OF PUBLIC W.		Approved <i>7-30-63</i> By <i>W. L. ...</i>									
GABBERT CANYON CHA.		Approved <i>7-30-63</i> By <i>W. L. ...</i>									
TRANSITIONS, TYPICAL		Approved <i>7-30-63</i> By <i>W. L. ...</i>									
Scale As Noted		Date <i>12/62, 12/64, 1/69</i>									



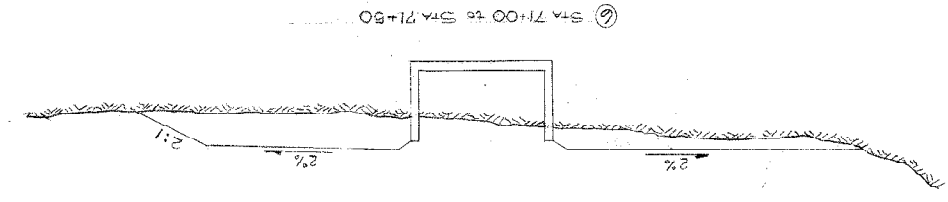
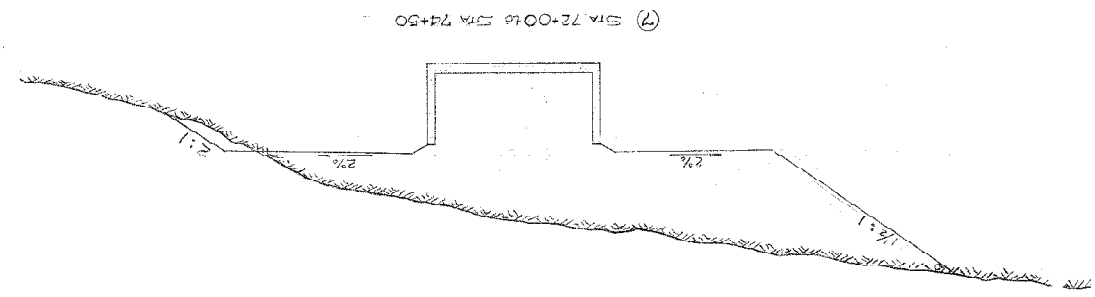
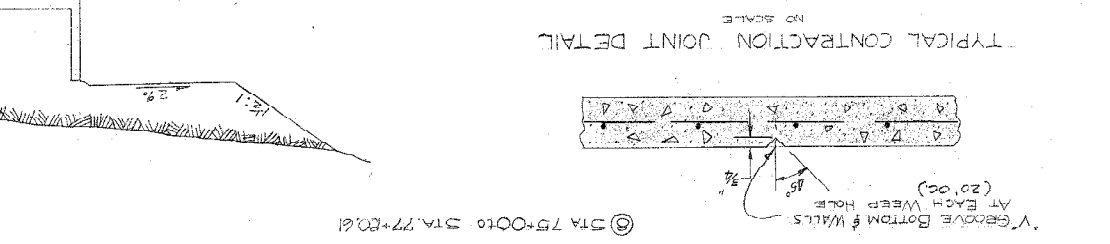
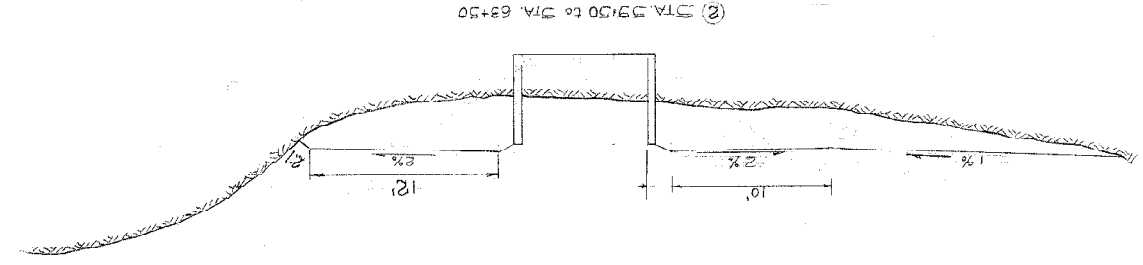
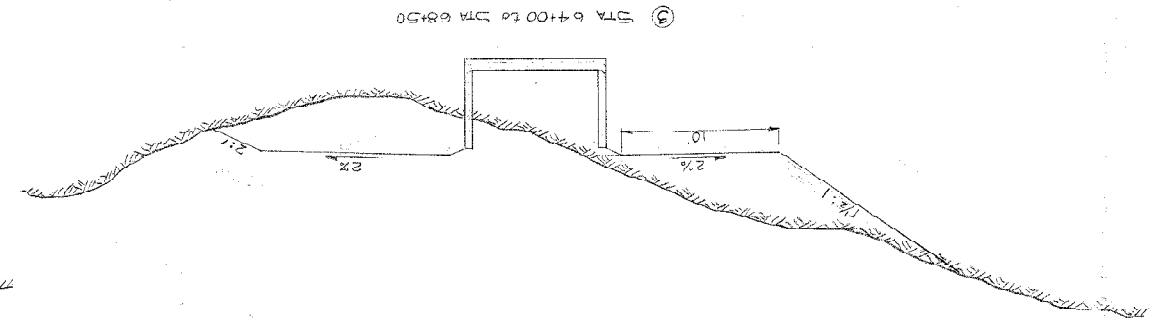
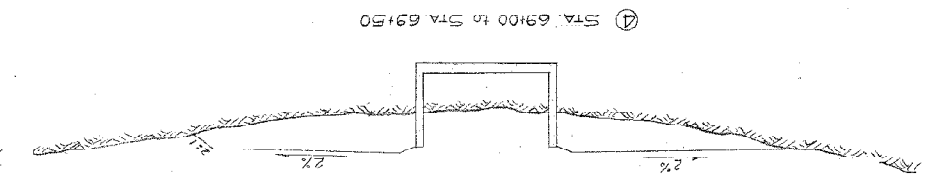
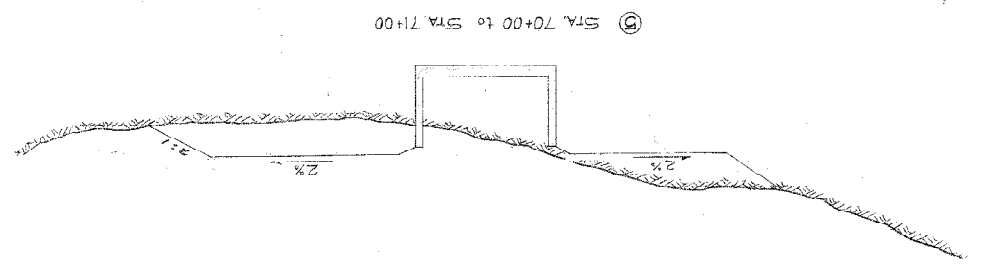
37-432A

37-432

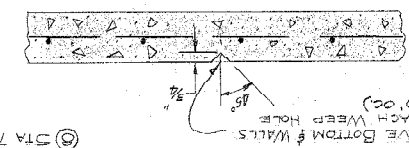
VENTURA COUNTY FLOOD CONTROL DISTRICT	DESIGNED BY: CUREL	DATE: 12-22-63	Scale: NONE
COUNTY OF VENTURA	CHECKED: J. J. J.	APPROVED: 7-30-63 BY: J. J. J.	Project No. 4801
DEPARTMENT OF PUBLIC WORKS	SPEC. NO. F.C.-48-3	Chief Engr. 1262, 1284, 1349	Field Books 1148, 1189
GABBERT CANYON CHANNEL LINING	CROSS SECTIONS & DETAILS	Sheet 3 of 5	Drawing No. 7-3-198



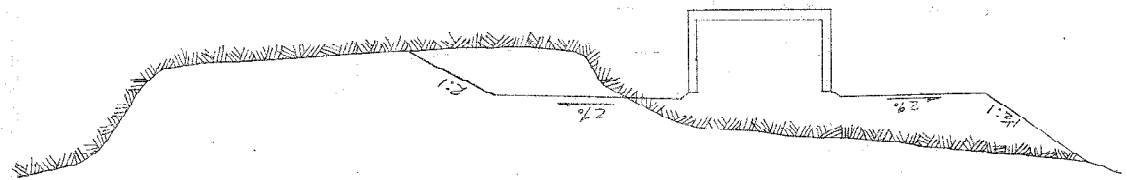
TYPICAL CROSS SECTIONS
NO SCALE



TYPICAL CONTRACTION JOINT DETAIL
NO SCALE

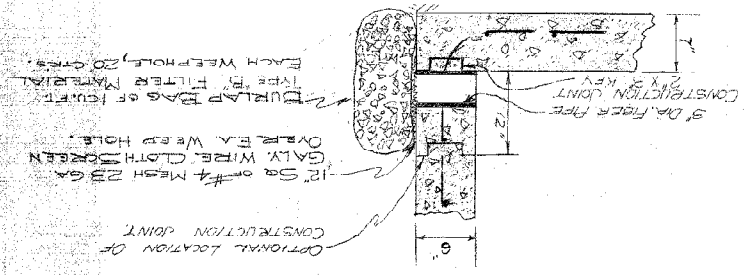


① STA. 57+55 to STA. 59+00

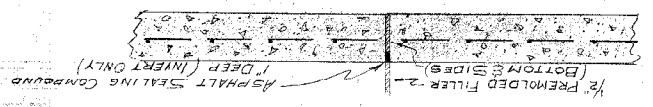


NOT TO SCALE

WEIR HOLE & CONST. JOINT DETAIL
IN VERTICAL WALL SECTION



EXPANSION JOINT DETAIL



37-433A

37-433