# HYDROLOGY AND HYDRAULICS REPORT: STATE ROUTE 11

*for*

# STATE ROUTE 11 AND THE OTAY MESA EAST PORT OF ENTRY

SAN DIEGO COUNTY, CALIFORNIA
DISTRICT 11–SD –ROUTE 11
PM 0.0/2.8 EA056310
DISTRICT 11–SD –ROUTE 905
PM R8.4/10.1

## TIER II ENVIRONMENTAL IMPACT REPORT/ ENVIRONMENTAL IMPACT STATEMENT

**November 2010**

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Prepared by:

AECOM

# Hydrology & Hydraulics Report

## State Route 11 Corridor & Commercial Vehicle Enforcement Facility

### Caltrans District 11 Hydraulics Department

SR-11 & CVEF

AECOM

April 14, 2010

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April 14, 2010

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# Project Information

## Informative Abstract

This report was prepared to analyze the hydrology and hydraulics of the proposed State Route 11 Corridor, (SR-11) and the proposed Commercial Vehicle Enforcement Facility (CVEF) for the purpose of determining any additional environmental footprint requirements and environmental impacts due to drainage infrastructure needs.

The proposed International Port of Entry (POE) is analyzed under a separate report by AECOM, entitled Hydrology & Hydraulics Report – State Route 11 - Port of Entry (POE).

Due to the preliminary nature of this design, the ultimate design may be different. The drainage infrastructure, (inlet, pipes, basins, outlets, etc) shown herein are preliminary. A section within this report titled, "Features Requiring Additional Discussion" covers the main assumptions and unique considerations taken within this design.

This report will analyze the existing offsite flows for the purpose of sizing and placing of cross culverts. Pre-developed and post-developed peak flows and runoff volumes will be analyzed for the purpose of sizing and placing detention/retention basins.

This report will also analyze the onsite flows generated by the proposed roadway surface and adjacent cut and fill slopes for approximate placement of grated inlets in consideration of spreadwidth and conveyance requirements; and the preliminary design of biofiltration swales.

This design will provide placement location of these inlets and biofiltration swales, along with energy dissipation devices, junction structures, concrete slope ditches, high-sided super elevation ditches (HSSD) and the onsite pipe network but will not specifically size and/or analyze these elements.

The SR-11 and CVEF design must comply with Caltrans criteria as well as several jurisdictional entity criteria. The basin design designs provided in this report allow for the assumption that all the criteria could be met. The final basins design will be based on the feasibility and the reasonability of meeting all the differing criteria. The various criteria are as follows:

1. From the International Border (the Border), extending 60-feet north of the Border, the design must comply with The International Boundary Water Commission, United States and Mexico, United States Section (IBWC) standards and requirements. This agency's *mission is to provide binational solutions to issues that arise during the application of United States - Mexico treaties regarding boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region.*[1] IBWC correspondence specific to this project is located in Appendix G. Note; no portion of the proposed SR-11 drainage infrastructure falls within this 60-foot zone, but treated and detained runoff from the proposed SR-11 facilities will be discharged into watersheds that eventually cross into this zone.
2. From 60-feet north of the Border to the County of San Diego (County) limits, the design must comply with the County standards and requirements to the extent feasible.
3. The City of San Diego references the County of San Diego Hydrology Manual.
4. With respect to Flood Management in East Otay Mesa, all developments are subject to guidelines of the East Otay Mesa Specific Plan Comprehensive Flood Control Master Plan 1994. Essentially, developments within East Otay Mesa are required to provide local or regional detention basins. Correspondence specific to this project is located in Appendix G.

[1] http://www.ibwc.state.gov/home.html

## Project Location

The project site is located within the jurisdictions of the Caltrans right-of-way in the City of San Diego, and San Diego County. The project site covered in this report consists of the following areas: The northbound, southbound lanes of SR-11 from the SR-125/SR-905 Interchange, west of Sanyo Avenue to the proposed alignment of Sempra Viva Road near the International Border with Mexico, within the Caltrans right-of-way.

Also included are improvements to SR-905 west of the SR-125/SR-905 Interchange to Britannia Boulevard.

The proposed CVEF is at the southern end of the SR-11 and along the northern end of the proposed POE. The POE will be studied within a separate report.

The approximate center location of the project is at:

| | | | |
|---|---|---|---|
| Latitude: | 32°33'48.00"N | Longitude: | 116°55'9.00"W |

This location is near the SR-11 control line and the proposed Alta Road Alignment.

The project has defined the following alignments:

- "SD11 Line", SR-11 main lanes
- "ALTA Line", Alta Road
- "ENF Line", Enrico Fermi Road
- "SVI1 Line", Siempre Viva Road
- "WN Line", West to north connector to SR-125
- "WS Line", Westbound connector to SR-905
- "WB Line", Eastbound connector from SR-905
- "NEDC7" Line, North to East connect from SR-905
- "SE Line", South to east flyover, connector from SR-125
- "E4 Line", SR-905 Line to Britannia Boulevard

and associated ramp lines.

## Project Location Map

**Figure 1**

## Project Description

The SR-11 corridor is a 2.1-mile long segment of new four (4) lane freeway, with a 42' wide unpaved median. SR-11 begins at the west with the connector ramps to the SR-905 and SR-125 interchange, and terminates at the CVEF facility (included in this study). The 4-lane freeway is analyzed with three alternative layouts as defined in Table 1:

**Table 1 - Roadway Design Alternatives:**

| Roadway Alternative | Designation | Description |
|---|---|---|
| No Interchange | "0" | No interchanges within entire SR-11 corridor |
| One Interchange | "1" | One interchange at Alta Road |
| Two interchange | "2" | Interchanges at Enrico Fermi Dr. and Siempra Viva Rd. |

Refer to Figures 2, 3 & 4 for a graphical overview of the three interchange options.

With implementation of SR-11, certain modifications to the approved SR-905 design would be required, and are included as part of the proposed project. Refer to Figure 5.

These include SR-11/SR-905 connector ramps (shown in red) and SR-905 outside shoulder (sliver) and inside median widening (shown in green).

The outside shoulder (sliver) widening impact is addressed in Appendix F.

The inside median widening impact, from a hydrology standpoint was previously addressed within the approved Hydrology & Hydraulics Report for SR-905. This analysis assumed for design purposes that the SR-905 was paved to the centerline. No further analysis of this segment will be performed within this report.

## Report Organization

All pre-developed hydrology and hydraulics analysis are in Appendix A.

Each of the three roadway alternative designs will have a separate post-developed hydrology and hydraulics analysis within this report:

- The No-Interchange alternative design is in Appendix B
- The One-Interchange alternative design is in Appendix C
- The Two-Interchange alternative design is in Appendix D

Each of the special design facilities will have a separate post-developed hydrology and hydraulics analysis within this report:

- The CVEF design is in Appendix E
- The SR-11/SR-125/SR-905 Interchange design is in Appendix F

**Figure 2 - No Interchange Alternative**

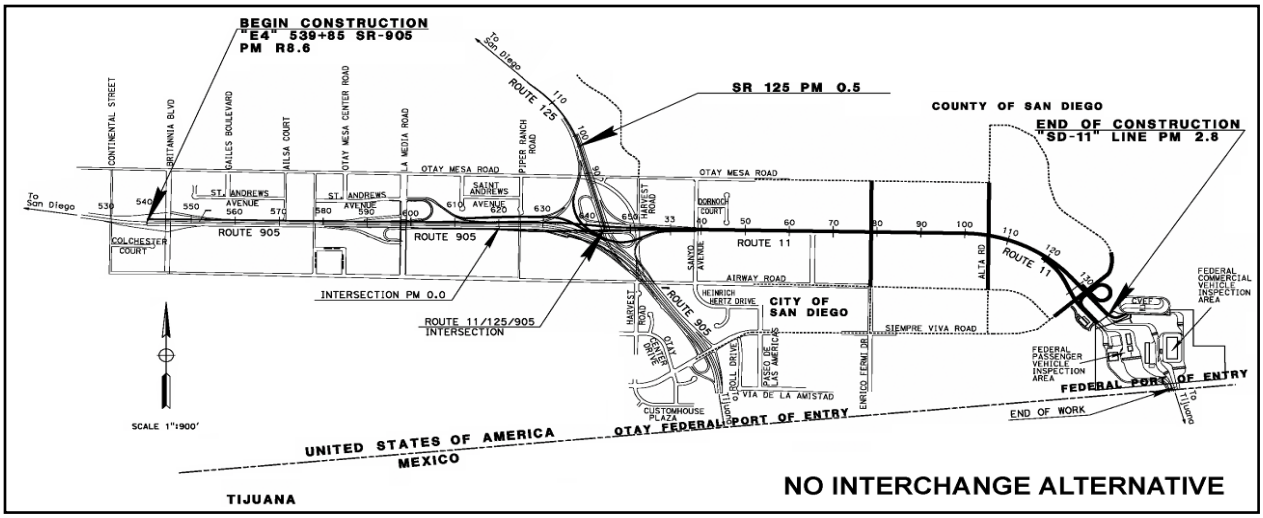



**Figure 3 - One Interchange Alternative**

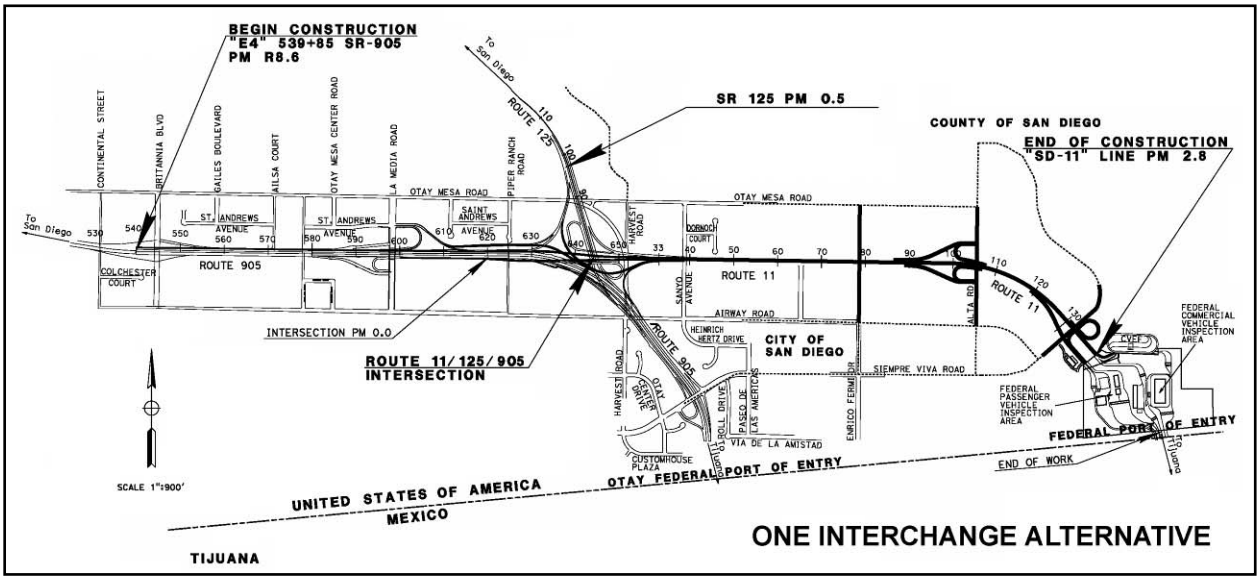


**Figure 4 - Two Interchange Alternative**

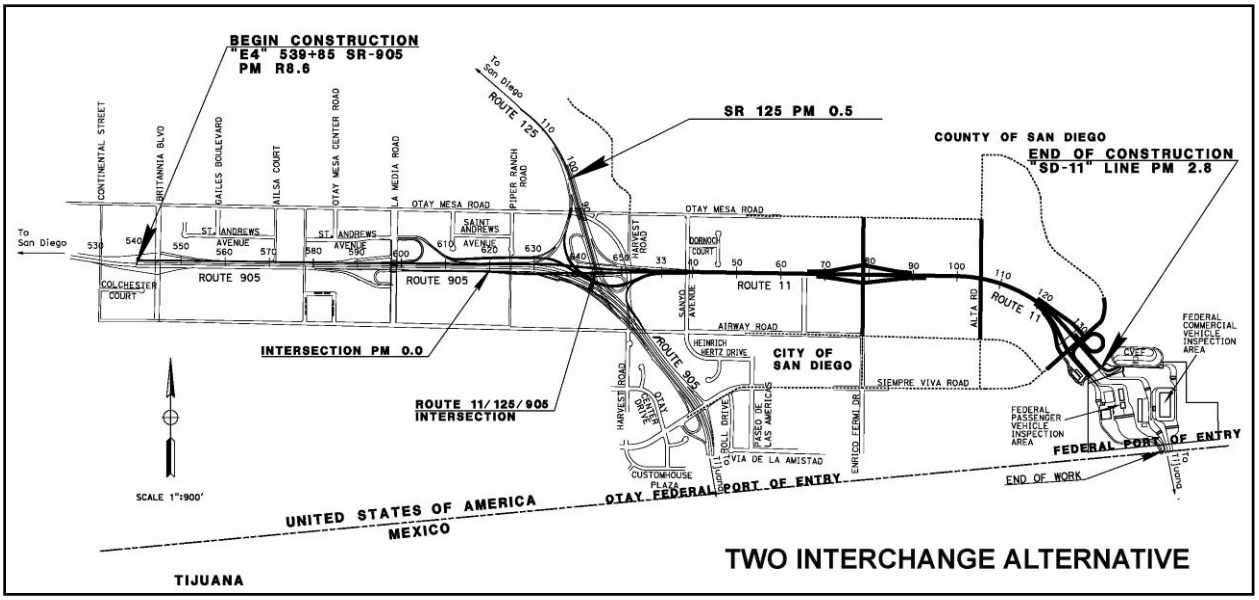
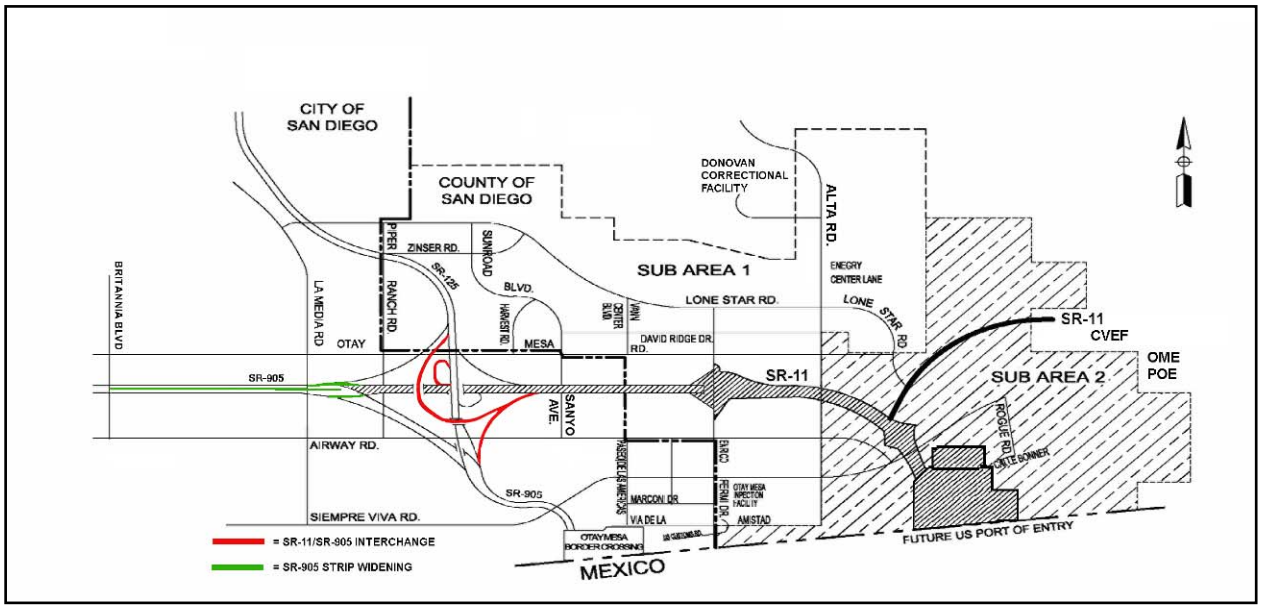



**Figure 5 - SR-905 (from Britannia Boulevard to the SR-11/SR-905 Connectors)**



# Hydrology

## Hydrologic Setting

Surrounding topography and soil conditions are described in a separate report entitled, Hydrogeologic Site Assessment (HSA) Report. This HSA report identifies the type of soil and the infiltration rates at the various basin locations. Topographical mapping generated from SANGIS (5' contour intervals) were utilized to define the large offsite watersheds. Where coverage was available, the use of two-foot topography contours further defined watersheds. Field investigations were conducted to further confirm the extent of each of these watersheds.

San Diego has on average 146 sunny days and 117 partly cloudy days a year. The average annual precipitation is less than 12 inches, resulting in a borderline arid climate. Rainfall is strongly concentrated in the cooler half of the year, particularly the months December through March, although precipitation is lower than any other part of the U.S. west coast. The summer months are virtually rainless. Rainfall is highly variable from year to year and from month to month, and San Diego is subject to both droughts and floods. Thunderstorms and hurricanes are very rare.[2]

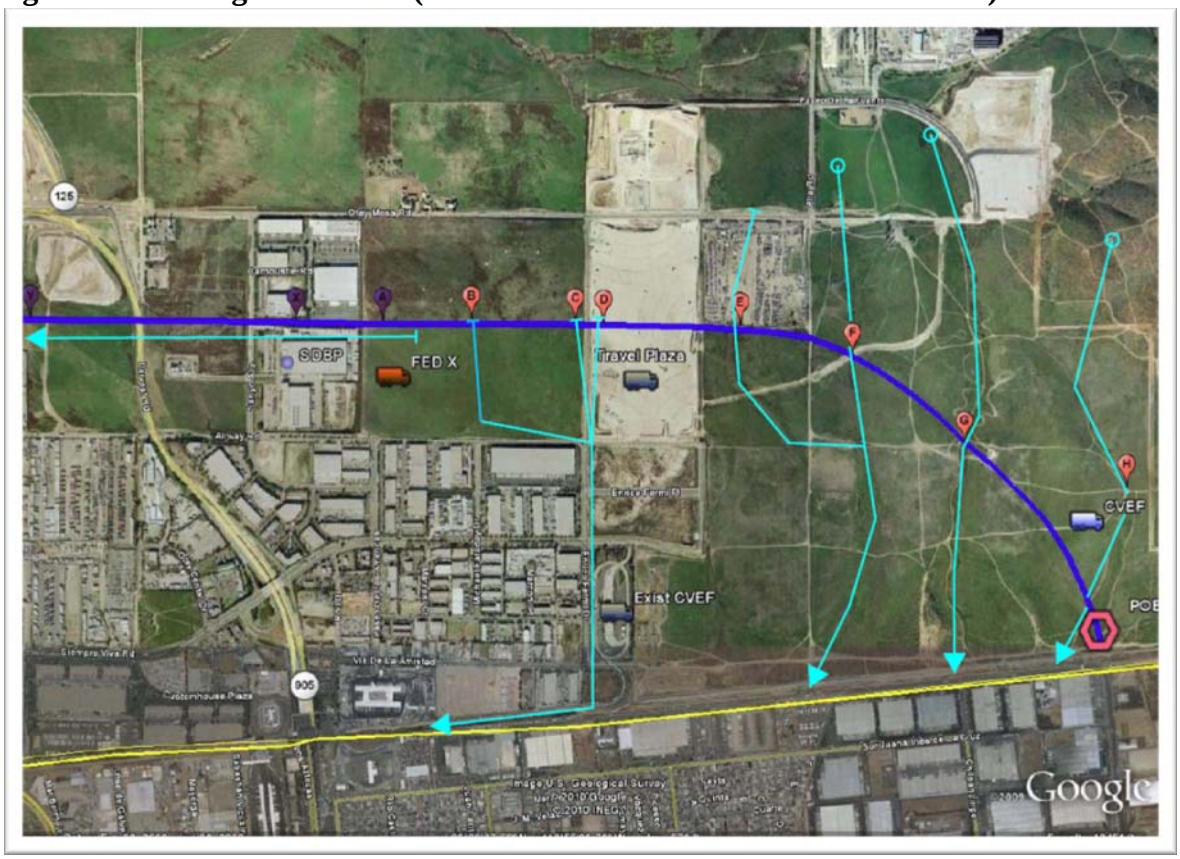
Most soils are thoroughly moistened during this period. Soil moisture however, is used up during rapid plant grown in spring, and unless irrigated, the soils are dry by June. On shallow droughty soils, there is not enough plant growth to control erosion, so some loss of soil can be expected with the first rains in November.

[2] http://en.wikipedia.org/wiki/Climate_of_San_Diego,_California

## Existing Conditions

The SR-11 Corridor footprint primarily consists of undeveloped natural rolling terrain. Slopes are generally flat, (<10%) and the surface is covered with short grasses. The proposed alignment crosses three existing roads: SR-905, Sanyo Avenue and Enrico Fermi Drive, and passes over an existing concrete-lined detention basin. Refer to Appendix A for Pre-developed hydrology and exhibits.

**Figure 6 - Existing Conditions (with watershed labels and flow directions)**




A brief description is provided for each primary area being impacted by this project. From west to east:

## Watershed Y: SR-125/SR-905 Interchange to Sanyo Avenue

This undeveloped area is bound to the west by the existing SR-905 roadway and bound to the east by Sanyo Avenue. This area is very flat (<2%) with no well defined flow line. Runoff from the developments east of Sanyo Avenue discharge via a 66" RCP under Sanyo Avenue and flow westerly overland to an existing double barreled culvert under SR-905. Flow continues west towards the future SR-11/SR-125/SR-905 interchange. This area is designated as *Watershed Y.*

**Figure 7 - Watershed Y**

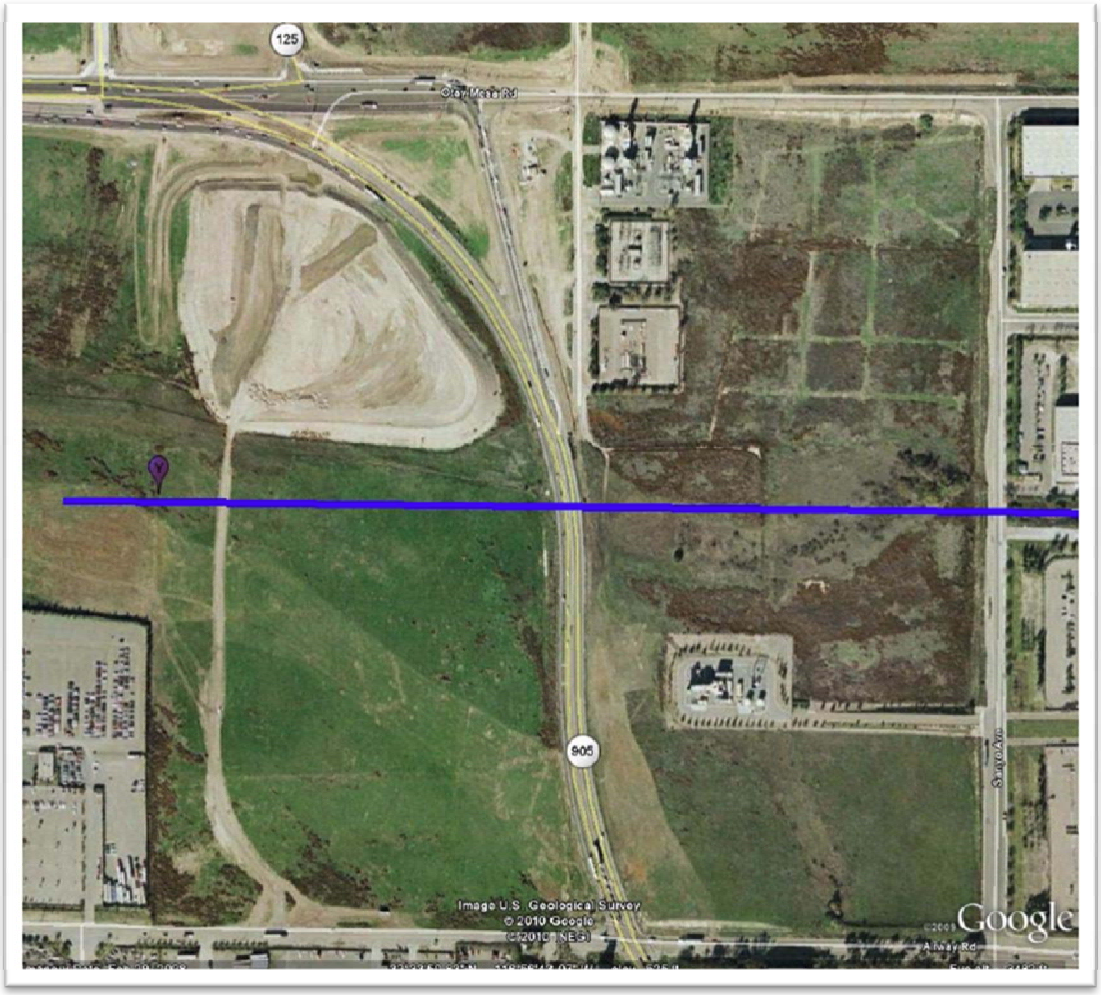


**Figure 8 - Looking west from Sanyo Avenue to SR-905**

## Watershed X: East of Sanyo Road (San Diego Business Park Detention Basin)

This developed area is bound to the west by the Sanyo Avenue and consists primarily of the existing concrete-lined detention basin. This basin collects flow from the north and south development area known as the San Diego Business Park (SDBP) and conveys it west to the 66" RCP under Sanyo Avenue. This basin also takes flow from the east (see next section). This specific area of the SDBP Detention Basin will be referred to as *Watershed X*.

**Figure 9 - Watershed X**

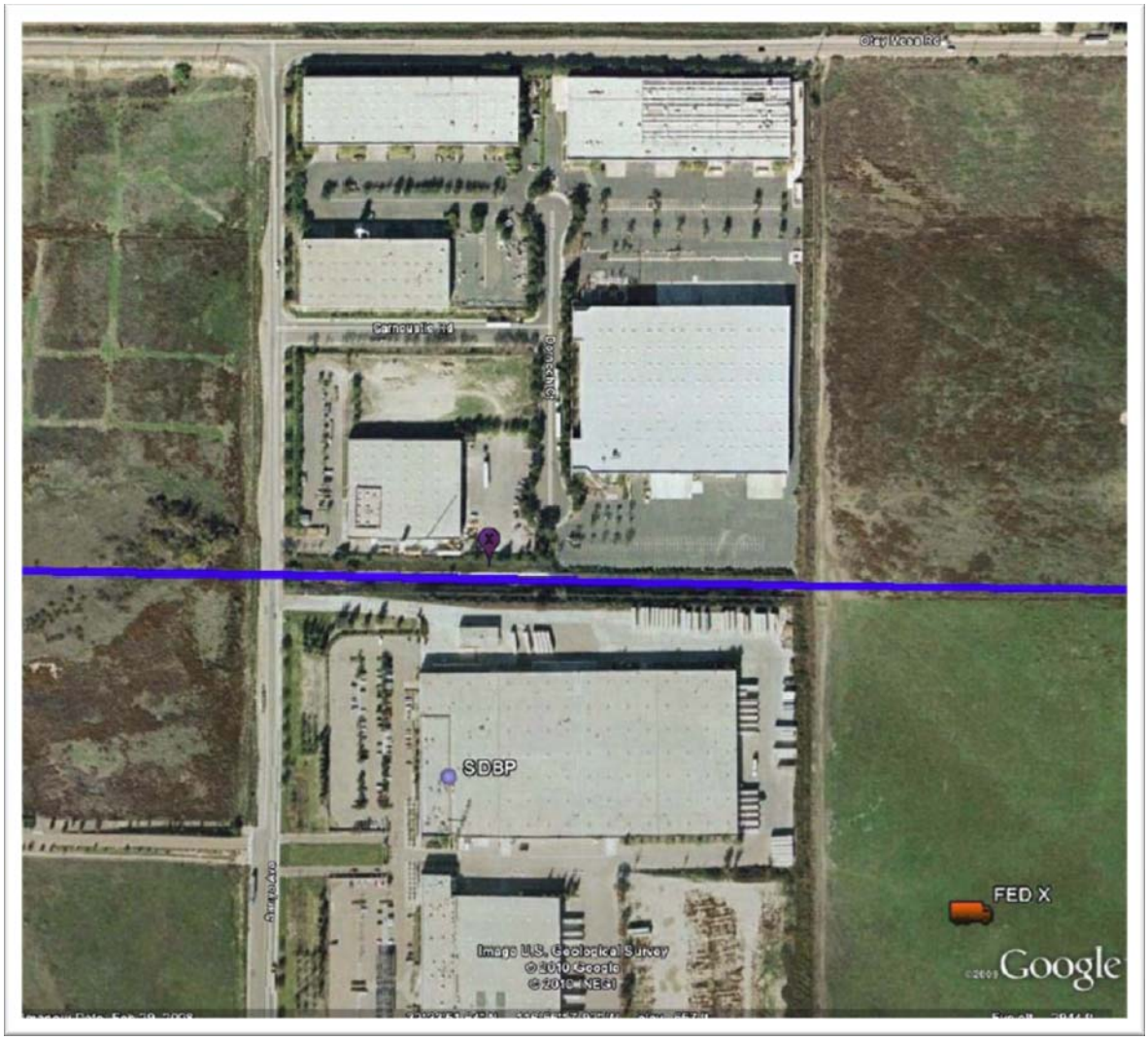


**Figure 10 - Looking north/east at the SDPB Detention Basin**

## Watershed A, B & C: East of San Diego Business Park, west to Enrico Fermi Drive

This area is bound to the west by the San Diego Business Park development and to the east by Enrico Fermi Drive. To the south is the new construction of a Federal Express (Fed X) facility as part of the Airway Business Center (not currently shown in aerial Figures). To the north is relatively flat (5% to 10%) undeveloped natural terrain, primarily covered with short grass which extends north to Otay Mesa Road. Watershed A flows towards the west into watersheds X and Y. Watersheds B and C flow towards the south and are collected and conveyed into storm drain system which discharge just north of the Border.

**Figure 11 - Watershed A**

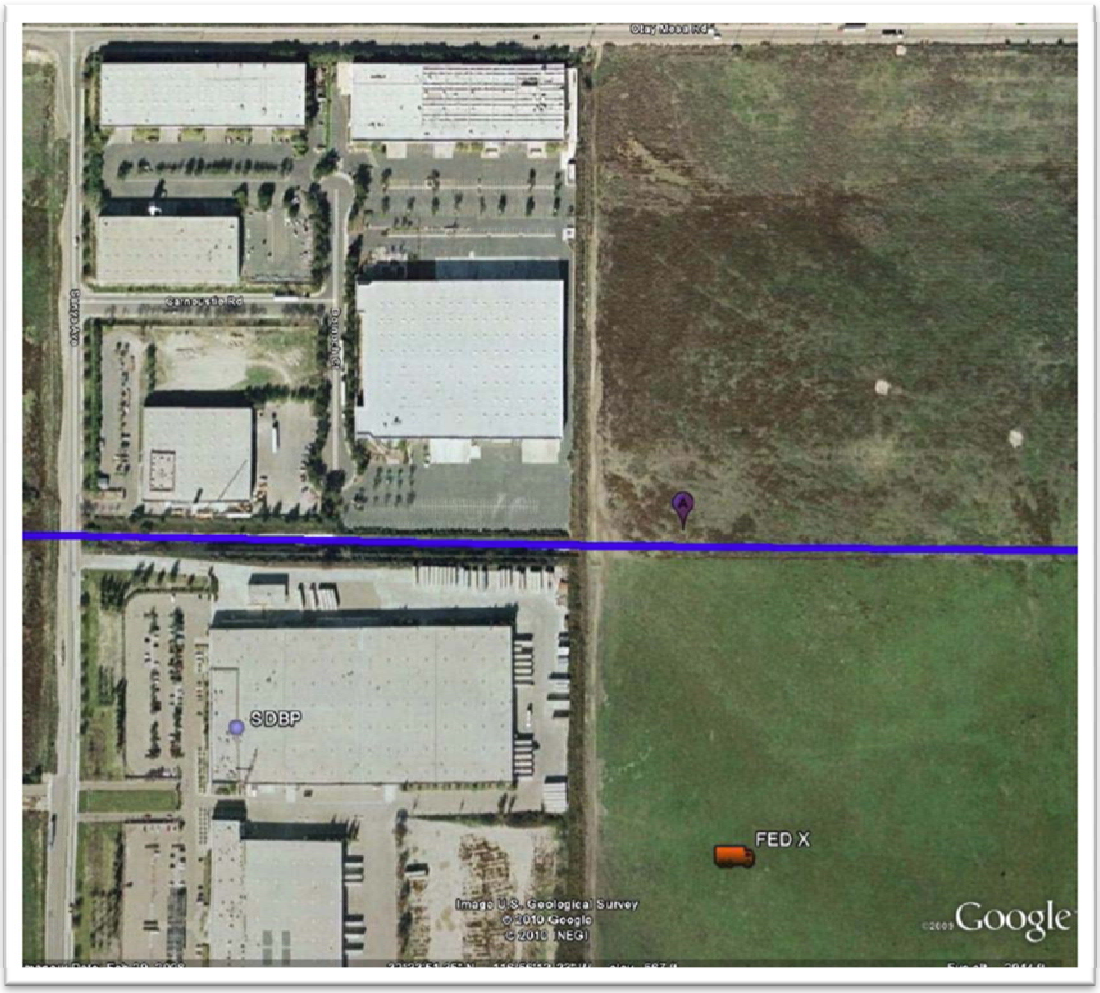


**Figure 12 - Looking west towards SDBP and the Federal Express facility**

**Figure 13 - Watershed B and C**

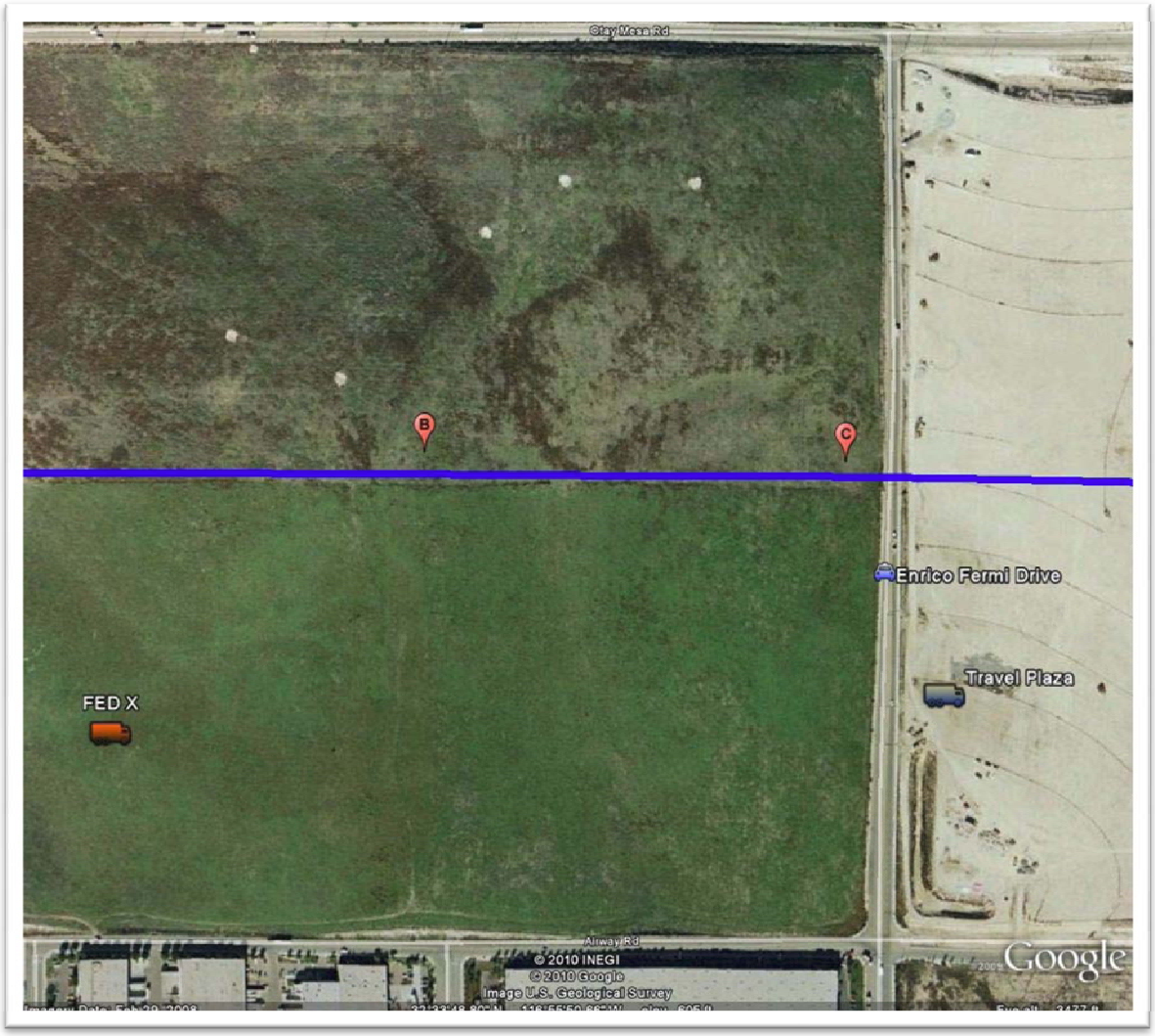


**Figure 14 - Looking east towards Enrico Fermi Drive (Watersheds B and C)**

## Watershed D & E: East of Enrico Fermi Drive, west the future Alta Road alignment

After crossing Enrico Fermi Drive, the SR-11 alignment runs east and passes through the middle of the Transfer Station (aka: Travel Plaza) and along the southern side of the COPART Sales Lot. Both facilities are primarily flat (2% to 4%) earthen surfaced developments for temporary vehicle storage. Within this area are south flowing Watersheds D and E. (Note: Unlike this photo, the topographic mapping used later in this design does not show the regraded contours of the Travel Plaza).

**Figure 15 - Watershed D**

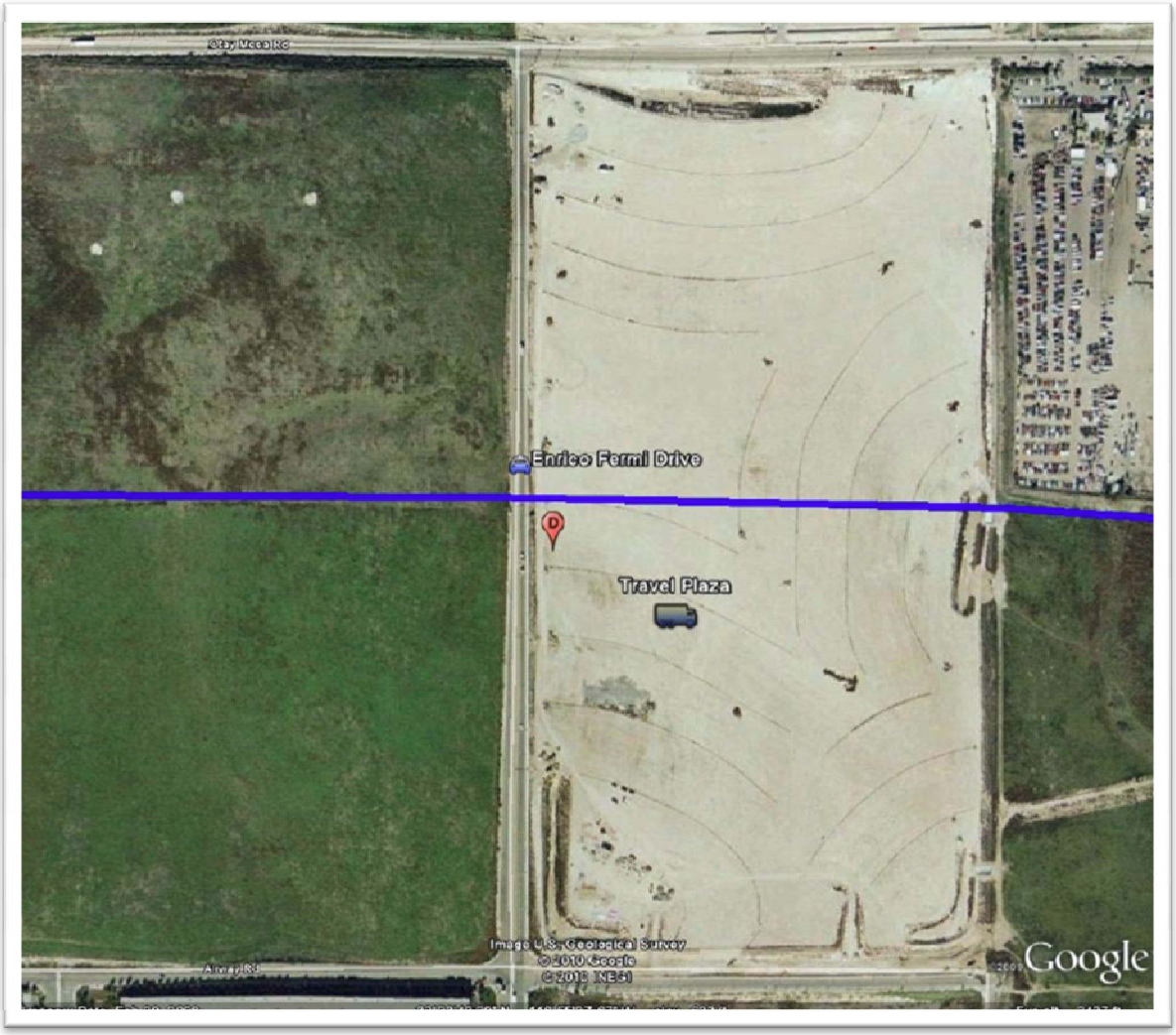


**Figure 16 - Watershed E**

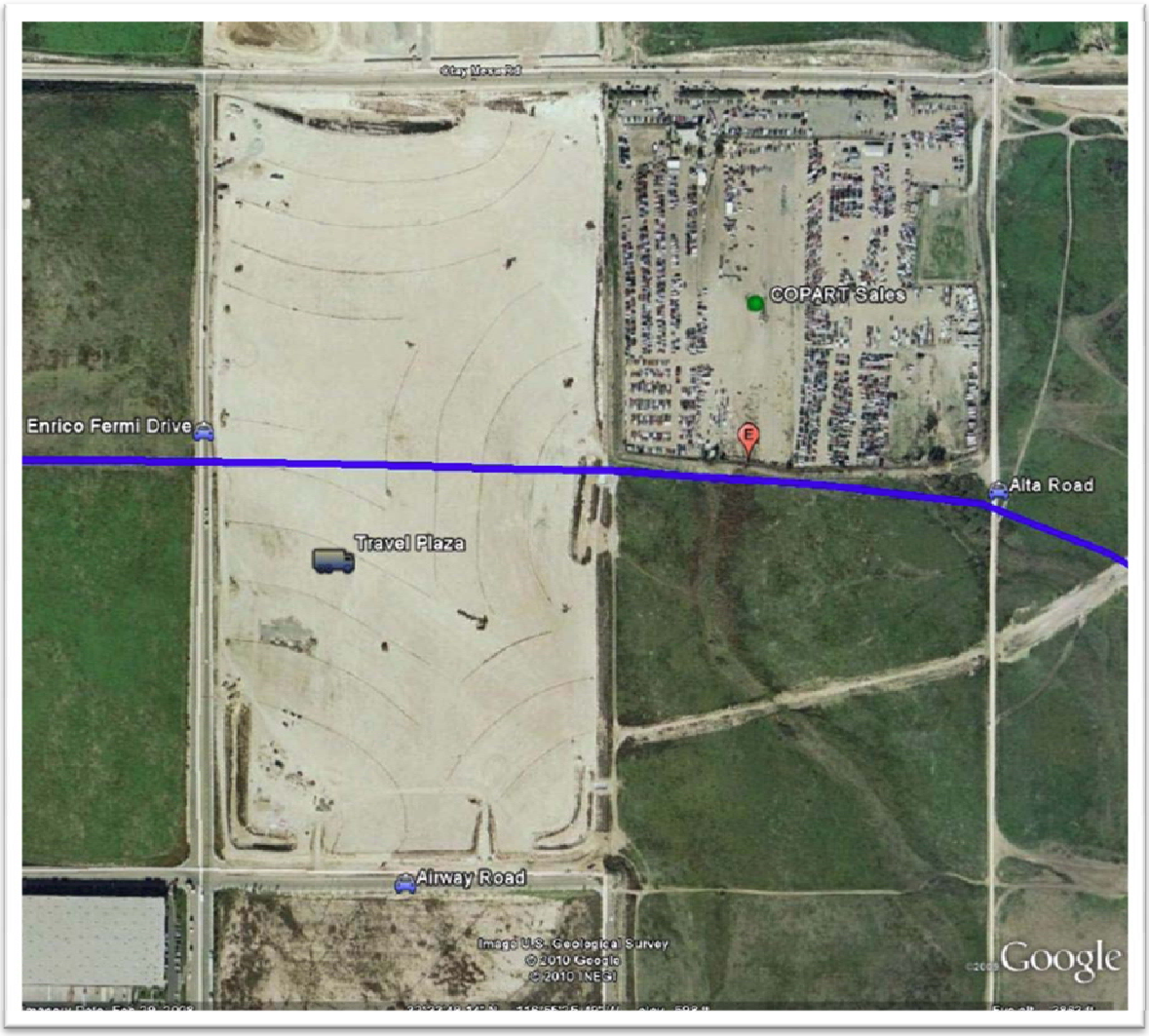


**Figure 17 –Looking southeast from Enrico Fermi Drive (at Transfer Station)**

**Figure 18 - Looking East from Enrico Fermi Drive at COPART Sales site**

## Watersheds F, G & H: East of the future Alta Road alignment, southeast towards the International Border

Relatively flat (3% to 10%) undeveloped grassed land covers the remainder of the footprint of the SR-11 Corridor to the south and east towards the POE. Watersheds F, G and H are located in this stretch of SR-11. All these watersheds flow overland towards the south to existing culverts at the Border. The flow line of Watershed G is designated as a *Waters of the US.*

**Figure 19 - Watershed F**

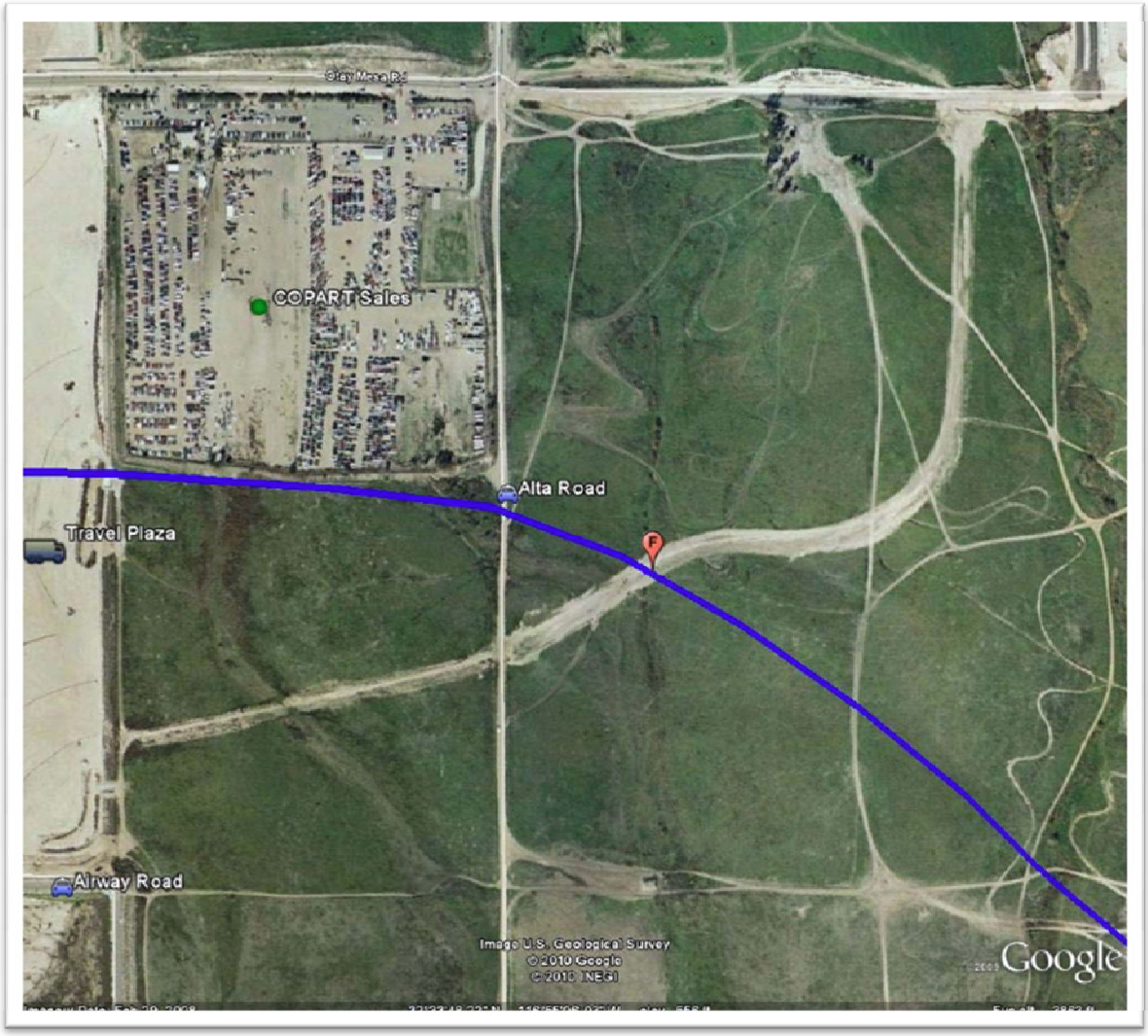


**Figure 20 - Looking East at the Watershed F flow line**

**Figure 21 - Watershed G**

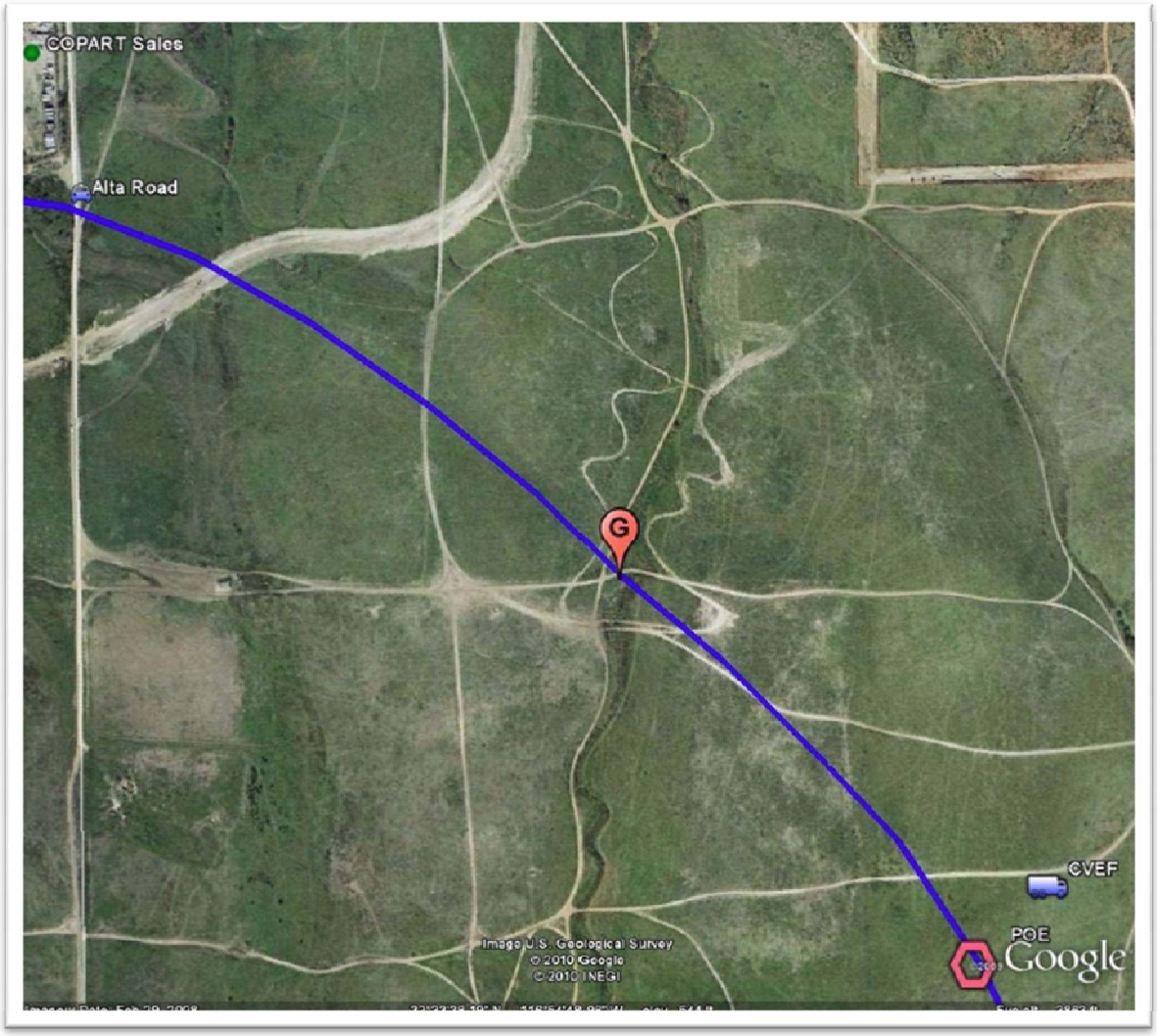


**Figure 22 - Watershed H**

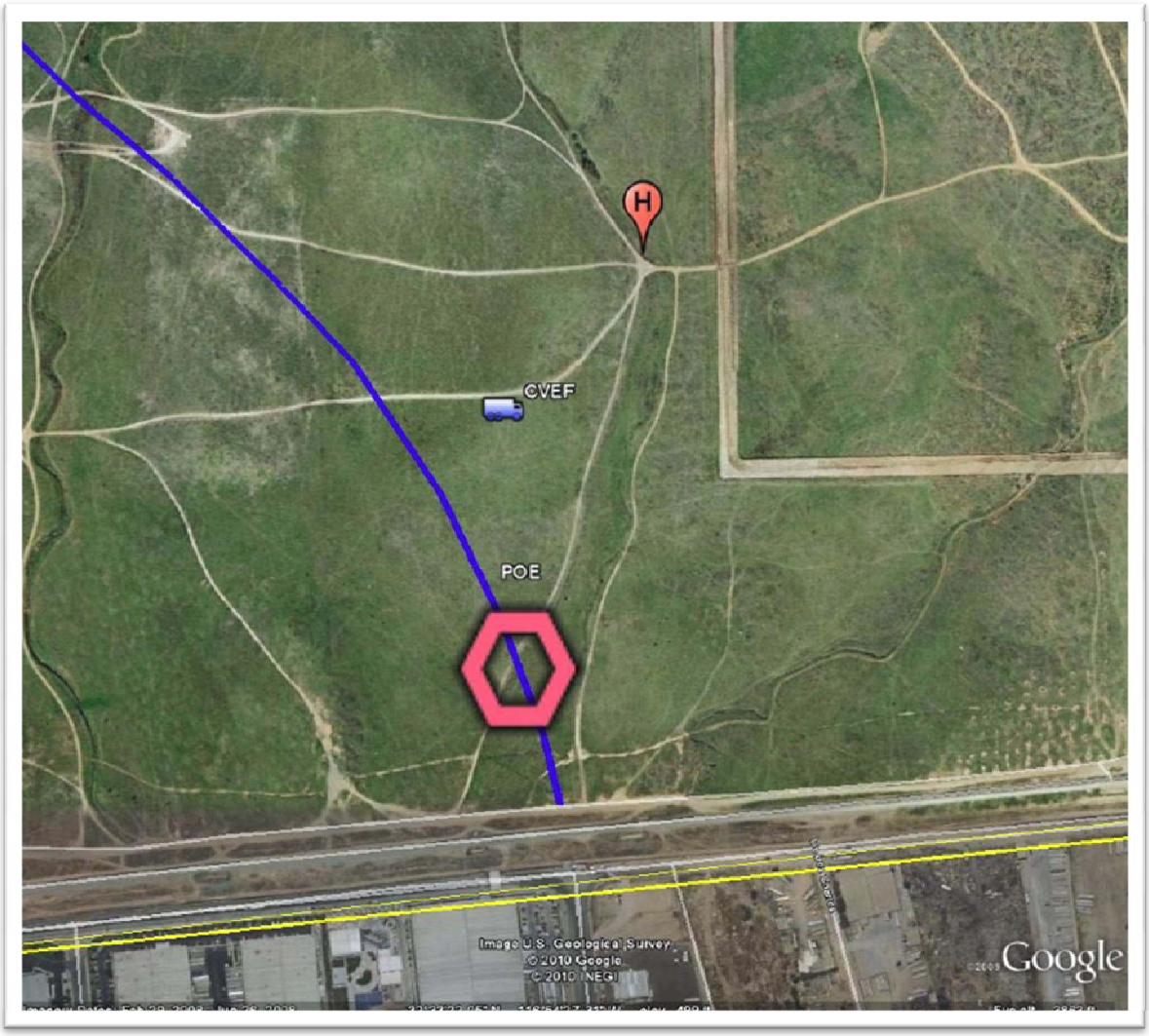


**Figure 23 - Looking North up Watershed H**

**Figure 24 - Typical flow line for Watersheds G & H**

**Figure 25 – Detail of Watershed G and H (w/post developed Culvert/Basin)**

# Hydrologic Analysis

## Watershed Nomenclature

Ten (10) watersheds were determined to be impacted by the SR-11 Corridor, CVEF and SR-11/SR-125/SR-905 Interchange.

They are labeled **A**, **B**, **C**, **D**, **E**, **F**, **G**, **H**, **X** and **Y**. Refer to Table 2 for approximate station, size and flow direction of the watersheds.

All post-developed watersheds and culvert watersheds are additionally labeled with the appropriate interchange alternative number, IE: Watershed B.1 refers to the post developed watershed B for the One (1) interchange alternative. This applies to all watersheds except for watersheds 'H' and 'Y' which do not have alternatives.

## Watershed Description

All of the flow from the watersheds defined in this analysis eventually flow south and across the US/Mexico International Border and ultimately drain into the Tijuana River. Initial flow directions are provided in Table 2.

### Table 2 - Offsite Watersheds

| Name | Approximate Station | Size (in Acres) | Flow Direction |
|---|---|---|---|
| A | 53+00 "SD11" | 23.5 | West |
| B | 69+00 "SD11" | 30.8 | South |
| C | 78+00 "SD11" | 16.4 | South |
| D | 80+00 "SD11" | 18.5 | South |
| E | 96+00 "SD11" | 61.9 | South |
| F | 110+00 "SD11" | 154.0 | South |
| G* | 139+00 "SD11" | 60.0 | South |
| H | CVEF | 31.9 | South |
| X* | 40+00 "SD11" | 10.4 | West |
| Y* | 33+00 "SD11" | 99.9 | West |

* Refer to "Watershed Delineation" section for more detailed information.

## Flow Characteristics

The flow from watersheds A, X and Y travels towards the west. This flow continues for 2-miles westward through a series of natural channels and cross culverts under La Media Road, Airway Road, Sempra Viva Road, ultimately discharging through a large culvert at the Border, one-half mile west of La Media Road.

The flow from watersheds B, C, and D travels south overland, then into more than 3000-feet of storm drain systems within Airway Road and Enrico Fermi Drive. This flow reaches the Border 600-feet south of the existing CVEF. Ponding in this area has been known to occur within an immense shallow man-made depression north of the Border. Installation of infiltration facilities and storm drain pumps on the US side of the Border has been done, yet the functionality, status and performance of these facilities is unknown.

The flow from watersheds E and F travels south overland to an existing culvert at the US Border Control secondary fence (125-feet north of the Border fence) and one-half mile east of Enrico Fermi Drive. There is no existing culvert at the US/Mexico Border due to the construction of Colina Del Sol in Mexico. This road runs parallel to the Border for the length of the project and has a profile that is over 2' higher than the existing ground on the US side. Thus, flow from Watersheds E and F ponds at the Border fence and is regularly pumped out of the area and towards the east to Watershed G discharge point.

The flow from Watershed G travels south overland towards a culvert at the Border, 1200-feet west of the proposed POE.

The flow from Watershed H travels south overland towards a culvert at the Border, 290-feet west of the proposed POE.

## Watershed Delineation

These contributing drainage areas were determined by delineation using Microstation graphic tools.

Topographical mapping generated from SANGIS (5' contour intervals) were utilized to delineate the large offsite watersheds. Where coverage was available, the use of two-foot topography contours further defined watersheds. Field investigations were conducted to further confirm the extent of each of these watersheds including recent development within the watersheds that may not have been included in the topographical mapping.

Refer to the Existing Conditions section and the Pre-Developed Watershed Exhibits in the Appendix A.

Where offsite watersheds exceeded the 320 acre maximum for the use of the Rational Method, a separate program, HEC HMS, was used to determine the watershed flow rates. The output from these HEC HMS runs were provided in the Preliminary Existing Condition Hydrology Calculations for State Route 11 Programmatic EIR/EIS, dated August 2008. This applied to only one watershed: *Watershed G-Culvert*. The flow rates from the HEC HMS run were used to size this culvert.

Watersheds X and Y are sub-basins of much larger watershed. That watershed is approximately 470 acres with an extensive existing pipe network. Smaller, more specific sub-basins were defined and analyzed in this report for both X and Y. This conservative method was used for the purpose of comparing the pre- and post-developed conditions using a smaller detailed sub-basin area.

Watershed G is a sub-basin of a much larger 660 acre watershed, of which a majority (approximately 600 acres) is to be intercepted by a proposed headwall and conveyed beneath SR-11 through a proposed 5'x8' double box culvert. The small sub-basin portion of the larger watershed (approximately 60 acres for each of the three alternatives) is defined and analyzed in this report for the purpose of comparing the pre- and post-developed conditions in a more conservative fashion.

The downstream limits of each watershed were chosen for the purpose of analyzing flow rates and volumes at this point of reference in both pre-project and post-project conditions. For Watersheds B, C, D and E, this natural surface point was chosen slightly upstream of an extensive network of roadways, inlets, pipes, junctions, basins and other drainage infrastructure, ultimately reaching the Border. This method allowed for more accurate overland Time of Concentration values without the inclusion of these extensive existing drainage facilities.

For the onsite and offsite hydrologic design, the Rational Method was used to estimate peak runoff for drainage design purposes. Rainfall intensities were derived per the requirements from the Caltrans Highway Design Manual (HDM) and from the County of San Diego Hydrology Manual. Runoff coefficients were derived for the contributing areas using Caltrans guidelines.

## Rainfall Intensity – Caltrans

Rainfall intensities derived from Caltrans methodology will be used for all on-site design of inlets and pipes and for cross culverts conveying off-site flows under the proposed SR-11 and CVEF. For Caltrans projects, it is required to use the Caltrans Intensity-Duration-Frequency Program, Version IDF 2000. IDF 2000 generated the following rainfall intensity equations:

$$i_2 = 0.49 \bullet D^{-0.500}$$
$$i_{10} = 0.92 \bullet D^{-0.500}$$
$$i_{25} = 1.15 \bullet D^{-0.500}$$
$$i_{50} = 1.33 \bullet D^{-0.500}$$
$$i_{100} = 1.50 \bullet D^{-0.500}$$

*(Note: D is in hours).*

For comparison purposes only, the default minimum on-site pavement Time of Concentration, $T_C$ of 5 minutes is used to calculate the following Caltrans rainfall intensities in Table 3.

**Table 3 - Caltrans Rainfall Intensity Chart**

| Storm Frequency (yr) | i – (inches/hour) | Applies to: |
|---|---|---|
| 2 | 1.70 | ~ |
| 10 | 3.20 | Offsite Culvert Design |
| 25 | 4.00 | Onsite Inlet and Pipe Design |
| 50 | 4.60 | ~ |
| 100 | 5.20 | Offsite Culvert Design |

For actual Caltrans rainfall intensities used in the analysis, refer to actual $T_C$ and intensity calculations for each on-site drainage area and offsite watershed.

## Rainfall Intensity – County of San Diego

San Diego County rainfall intensities were used in the pre-developed and post-development analysis and in the design for sizing of all detention and retention basins. This was done because the San Diego County Hydrology Manual (SDCHM) Rational

Hydrograph Procedure was used to determine basins size and this procedure requires the use of County intensities.

The County intensities calculated were higher and thus more conservative that those of Caltrans. The San Diego County Hydrology Manual was used to establish the following rainfall intensity equation:

$$i_{county} = 7.44 \bullet P_6 \bullet D^{-0.645}$$ *(Note: D is in hours).*

The SD County Isopluvial Maps were utilized to obtain the 6-hour precipitation, $P_6$ at the following location:

| | | | |
|---|---|---|---|
| Latitude: | 32°33'48.00"N | Longitude: | 116°55'9.00"W |

The following table summarizes the County of San Diego precipitation, $P_6$.

**Table 4 - SD County 6-Hour Precipitation**

| Storm Frequency (yr) | $P_6$ – (inches) |
|---|---|
| 2 | 1.1 |
| 10 | 1.6 |
| 25 | 2.0 |
| 50 | 2.4 |
| 100 | 2.5 |

For comparison purposes only, the default minimum on-site pavement $T_C$ of 5 minutes is used to calculate the following County of San Diego rainfall intensities in Table 5.

**Table 5 - SD County Rainfall Intensity Chart**

| Storm Frequency (yr) | i – (inches/hour) | Applies to: |
|---|---|---|
| 2 | 2.90 | ~ |
| 10 | 4.22 | ~ |
| 25 | 5.27 | ~ |
| 50 | 6.32 | ~ |
| 100 | 6.59 | Detention/Retention Basins |

For actual County rainfall intensities used in the analysis, refer to actual $T_C$ and intensity calculations for each detention/retention basin.

## Time of Concentration

To determine the $T_C$ for offsite and onsite watersheds, the California Highway Design Manual, 816.6 Time of Concentration ($T_c$) and Travel Time ($T_t$) was used. Per the HDM, for all proposed paved areas, it is *recommended* that a minimum $T_c$ of 5 minutes be used. For this preliminary design, all onsite drainage areas that are paved were assumed to have this minimum $T_c$. Similarly, for all small offsite watersheds, a minimum $T_c$ of 10 minutes is to be assumed. These are conservative assumptions and will yield higher intensities and flows. Where long onsite watershed lengths are found and additional conveyance mechanism were proposed, such as biofiltration swales, specific $T_c$ analysis should be performed to define a more appropriate $T_c$.

### Table 6 - Design Time of Concentration $T_c$

| Watershed Location | Minimum $T_c$ | Notes |
|---|---|---|
| Offsite | 10 minutes | Overland flow |
| Onsite | 5 minutes | Pavement flow |

## Runoff Coefficient

The runoff coefficient was determined using the HDM, Figure 819.2A. Generally, for paved surfaces of concrete or asphalt, a value of 0.90 was used. For existing natural terrain and proposed slope areas, C values ranged between 0.40 to 0.65 depending on slope and surface material. The HDM suggests increasing the runoff coefficient by the following factors to correct the runoff coefficient for less frequent, higher intensity storms due to lower infiltration, detention and other losses affecting the total runoff.

### Table 7 - Adjustments to Runoff Coefficient $C_{(f)}$

| Storm Frequency (yr) | C(f) | Applies to: |
|---|---|---|
| 2 | 1.00*C | ~ |
| 10 | 1.00*C | Offsite Culvert Design |
| 25 | 1.10*C | Onsite Inlet and Pipe Design |
| 50 | 1.20*C | ~ |
| 100 | 1.25*C | Offsite Culvert & Detention/Retention Basin |

## Units

Imperial Units were used.

# Offsite Drainage

Offsite flow is to be quantified and convey under the proposed roadway to the pre-project location. At this point, the offsite flows can confluence with treated and/or detained onsite flow.

## Culvert Analysis

Watershed flow rates were determined for each cross culvert location using Caltrans methodology described above. There will be no impact by this project to these watersheds that contribute flow to the culverts. It is assumed that headwalls, culverts and energy dissipation devices will be provided as needed to carry these flows under the project unaltered.

If a separate development is proposed within these contributing watersheds, it will be assumed that development will ultimately discharge equal or lesser flows at the historic/pre-project point indicated within the plans. It is also assumed that the developers will meet all NPDES and water quality requirements prior to discharging flows into the proposed Caltrans right-of-way.

For the design of offsite flows through cross culverts, the HDM, 821.3, "Selection of Design Flood", the following events were used:

**Table 8 - Design Event for Offsite Cross Culverts**

| Design Event | Notes |
|---|---|
| 10-year | without causing headwater elevation to rise above the inlet top of culvert |
| 100-year | without headwater rising above an elevation that would cause objectionable backwater depths or outlet velocities |

Culvert sizing was determined using Bentley Culvert Master. This summary table provides preliminary culvert sizing for all the alternatives. Culverts G and H are applicable for all three roadway alternatives.

**Table 9 - Offsite Cross Culvert Flows and Sizes**

| Location (Sta) | Culvert | 10-yr Q (cfs) | 100-yr Q (cfs) | Length (ft) | Slope (%) | Shape and Size |
|---|---|---|---|---|---|---|
| 69+00 | B0 | 7.4 | 15.0 | 226 | 3.8 | Circular – 24” RCP |
| 69+00 | B1 | 7.4 | 15.0 | 226 | 3.8 | Circular – 24” RCP |
| 69+00 | B2 | 6.9 | 13.9 | 272 | 3.5 | Circular – 24” RCP |
| 95+90 | E0 | 16.8 | 34.1 | 195 | 7.2 | Circular – 36” RCP |
| 95+50 | E1 | 15.4 | 31.3 | 571 | 4.6 | Circular – 36” RCP |
| 95+90 | E2 | 14.8 | 30.1 | 292 | 6.5 | Circular – 36" RCP |
| 110+00 | F0 | 63.4 | 128.8 | 326 | 2.8 | Circular – 48” RCP |
| 110+00 | F1 | 57.2 | 116.1 | 326 | 2.8 | Circular – 48” RCP |
| 110+00 | F2 | 63.3 | 128.4 | 326 | 2.8 | Circular – 48” RCP |
| 128+00 | G0,G1,G2 | ~ | 658.0 | 1150 | 2.1 | Box - 2 cells 8' x 4' |
| CVEF | H | 123.9 | 251.6 | 694 | 1.4 | Box - 2 cell 6' x 4' |

The culvert sizes listed here may differ from the assumed sizes provided in the ‘Post-developed TcQ’ calculations. Note, *TcQ* is a special designation in this report which defines a calculation set for determining the Time of Concentration (Tc) and the Flows (Q). This inconsistency in culvert size does not affect the TcQ measurably.

Watersheds A, C and D have no proposed cross culverts.

Watershed X proposes 42” to 66” culverts to collect and convey pre-developed flows from adjacent existing commercial developments. The pre-developed peak flow value has not been analyzed by this report. Discharge from the proposed SR-11 footprint will be collected and routed separately from this offsite facility; therefore flows are expected to decrease into these culverts.

The existing detention basin which these existing developments discharge into will be relocated by this project from the east side of Sanyo Avenue, to the west side. Maintenance of this facility will remain with the developments.

The culvert sizes within Watershed Y have already been pre-determined from the Offsite Systems Calculations for the SR-125/SR-905 Interchange (Caltrans EA 091281).

The peak discharge used to analyze Culvert G, due to its watershed size in excess of 320 acres, was provided in the Preliminary Existing Condition Hydrology Calculations for

State Route 11 Programmatic EIR/EIS, dated November 2007. All other culvert calculations are provided in the appropriate interchange alternative Appendix.

The outlet for Culvert G is discussed in the section entitled, Features Requiring Further Discussion.

Culvert H takes flow from the undeveloped area to the north of the CVEF. This undeveloped area will not be impacted by the CVEF, or the SR-11 project. The flow will be captured and conveyed under the CVEF and will ultimately connect with the proposed culvert under the POE which discharges just north of the Border.

# Onsite Drainage

All on-site flow generated from the SR-11 and the CVEF will be captured, treated, retained and/or detained prior to being released into the original watercourse or the proposed drainage facilities under the POE.

For onsite generated flows, per the Sixth Edition Caltrans Highway Design Manual (HDM), Table 831.3, "Desirable Roadway Drainage Guidelines", all drainage items are to be designed for the expected peak flows during a storm event of such magnitude that there is a 4% chance it may occur in any given year. This is also termed the '25-year storm.'

| | | |
|---|---|---|
| **Design Storm:** | **25-year** | **per HDM 831.3** |

Design guidance is also provided from the Federal Highway Administration, Hydraulic Design Series (HDS) No. 2, HDS No. 5 and HEC 22. Within these key technical resources, methods and procedures are given for the hydraulic design of storm drainage systems. Design methods are presented for evaluating rainfall and runoff magnitude, pavement drainage, gutter flow, inlet design, median and roadside ditch flow, and structure design and storm drain piping. Procedures for the design of detention facilities are also presented.[3]

Caltrans Highway Design Manual design criteria were applied for this project. A brief list of the key design criteria is found below:

**Table 10 - Design Criteria, per Caltrans HDM**

| Issue | Control | Max/Min | HDM Reference |
|---|---|---|---|
| Spreadwidth | Shoulder | 8' or 10' max | Table 831.3 |
| Flow across road | Concentrations of flow | 0.1 cfs max | Section 831.4(1) |
| Flow across road | Hydroplanning | 3 lanes max * | Section 831.4(5) |
| Pipe Diameter | Trunk and lateral | 24" min | Caltrans Policy |
| Pipe Cover | Road to top of pipe | 2' min | Table 854.9 |
| Pipe Slope | Self cleaning velocity | 3 fps min | Section 838.4 |
| Manhole Spacing | Pipe diameter < 48" | 300' to 700' min | Section 838.5 |
| Manhole Spacing | Self cleaning velocity ok | 700' min | Section 838.5 |

* exceptions to the design criteria for cross slope in Index 302.2 must be formally approved in accordance with the requirements Index 82.2, "Approvals for Nonstandard Design."

[3] FHWA-SA-96-078, Technical Report Documentation Page, 16. Abstract

## Drainage Area Layout

For consideration of future built out conditions, in this design, it is assumed that the onsite pavement limits extend to the centerline of the highway and there will be no earthen median. Median inlets are provided in this design to address interim conditions and serve as junction structures, but are not analyzed for capture efficiency.

Onsite Hydrology and Hydraulic Exhibits and Calculations have been provided. Pavement drainage areas and slope drainage areas were separated due to different runoff coefficient values. Pavement areas are designated with a *PV* whereas sloped areas are designated with a *SL*. The C-value for each is defined in the following table.

| Table 11 - Onsite Runoff Coefficients (25-year Design Storm) | | | |
|---|---|---|---|
| **Type** | **Designation** | **C** | **$C_{25}$** |
| Pavement | PV | 0.90 | 0.99 |
| Slope | SL | 0.55 | 0.61 |

### Drainage Area Nomenclature

Onsite drainage areas are labeled based on the following:

- the watershed basin they drain within (A through H, X and Y)
- the design alternative, (No interchange (0), One interchange (1), or Two interchange (2)), and
- the type of surface the watershed consists of (pavement (PV) or slope (SL).

For example, drainage area B1.5.PV refers to the fifth ($5^{th}$) pavement area draining in the one-interchange design alternative of watershed 'B'.

Summary tables of the onsite flows for each watershed are provided.

## Grated Inlet Layout

Standard Caltrans inlet types G1 and G2 are shown along the edges of pavement at key locations. A special Double G1 inlet with two grates will be shown at critical locations where additional capture was necessary. Double G1 inlets are used to capture flows from the detention basins. Where applicable, a concrete apron is used around these inlets as an elevation control device and for the ease of maintenance of the inlet.

Detailed onsite inlet calculations were not performed in this analysis. Inlets have been placed at key locations for collection of runoff and at critical locations such as at the downstream end of biofiltration swales, within basins, at gore points and superelevation transitions. The layout shown is approximate and may change in the final design stage once the appropriate alternative has been selected.

### Drainage Inlet Nomenclature

Onsite drainage inlets are labeled based on the onsite drainage area which drains to the inlet. For example, inlet B1.5 refers to the inlet which drainage areas B1.5.PV and/or B1.5.SL drain into.

Median inlets are placed where they are used as junctions or where interception would normally be required. They are not analyzed in this report.

## Onsite Culvert Layout

The onsite culverts sizes can be assumed to be between the minimum 24” to 36” in diameter. The specific type of culvert material will be chosen based on the allowable alternative pipe tables. The slopes of longitudinal runs of culverts generally follow the slope of the roadway. The minimum longitudinal slope will be 0.50%. This minimum constructible slope may be required in a few cases to reduce structure depths. At this slope, self-cleaning velocities are in compliance with HDM requirements.

Detailed onsite culvert calculations were not performed in this analysis. Quantities are approximate and may change in the final design stage, once the appropriate alternative has been selected.

## Biofiltration Swale Design

A key drainage design approach for this new state route will be to drain roadway-generated flow from the roadway and shoulders directly into biofiltration swales (bioswales) running parallel to the road, where possible. Any adjacent cut slope flow will also be intercepted by these swales. Therefore, in smaller storm events, the traveled ways and roadway shoulders can remain free of longitudinally conveyed flow. Also, the number of shoulder inlets typically required would be reduced. Additionally, the overall length of dikes and curbs would also be reduced and shoulder slopes can vary between 2% and 5%. Caltrans maintenance of drainage facilities (bioswales/inlets) will be located further away from moving traffic.

All of the bioswales shown have a base width ranging between four (4) to thirteen (13) feet and side width slope ratio of 4:1.

The length, shape, width and placement of these bioswales as shown in this report are preliminary. A full analysis of the bioswales has not been performed at this preliminary stage.

In the 25-yr event, the bioswales at a few locations may be flowing full and the adjoining shoulders may be utilized to convey longitudinal flows. Where this is undesirable, or where bioswales are not feasible or reasonable, dikes and shoulder inlets and additional piping will be utilized to capture shoulder flow.

Where it has been determined that the flow within the bioswale exceeds any depth, velocity or location restrictions, they can be reduced in length and inlets will culverts can be installed in place.

These bioswales will capture, convey and treat highway runoff. Inlets with concrete aprons will be placed at the downstream end of the swales as needed to extract flows from the surface. In many cases, these flows will be routed to detention facilities to comply with any retention and/or peak flow attenuation criteria. In a few cases, pavement flows will be captured within bioswales, then discharged to a separate offsite cross culvert, and not routed to a detention/retention facility. Water quality, detention and retention requirements will still be met within these watersheds.

# Detention/Retention Basins

Basin sizes that have been determined within this report are based on the assumption of the preliminary SR-11 Corridor layout. These basins were sized and located based on seven (7) different preliminary design criteria. These criteria being, retention volume, soil infiltration rates, water quality volume, silt accumulation volume, detention volume, freeboard and basin outlet structure. These basin sizes provided during this PA/ED phase assume that all jurisdictional criteria could be met, but that the final basin designs during the PS&E phase will be based on the feasibility and reasonability of meeting the different jurisdictional criteria.

## Retention Volume

The pre-developed and post-developed watershed flow rates and times of concentration were determined using methodology described in the HDM, Section 816 (except for the use of the County of San Diego rainfall intensities). The post-developed watershed boundaries include post-project pavement and graded slope areas. Where the post developed flows and runoff volumes were increased from pre-developed conditions, retention basins were proposed to eliminate excess runoff. This is in compliance with the IBWC correspondence provided in Appendix G, "*disposal of excess water should not go into Mexico*". In a few cases, post-developed watershed runoff volumes were reduced when compared to pre-developed volumes and do not require retention basins.

The volume of retention set aside within the basin was determined using the San Diego County Hydrology Manual (SDCHM) Rational Hydrograph Procedure as described in Chapter 6-1. This procedure uses the rational method (Q=CiA) and develops pre-developed and post-developed hydrographs for the use in determining runoff volumes for use in sizing retention basins within watershed areas up to approximately 1 square mile in size.

The County's RATHYDRO computer program generates hydrograph ordinates using the formulas with the SDCHM. Peak flow rates, time of concentration, 6-hour rainfall depths, watershed area and runoff coefficients are used as the input for the RATHYDRO program.

## Soil Infiltration Rates

Infiltration rates were provided in the Proposed State Route 11 Extension: Hydrogeologic Site Evaluation/Storm Water Data Report. The Percolation Rate Tests results for seven (7) locations from Alta Road to the Border ranged from 1.4 minutes per

inch to 174.5 minutes per inch. At two locations there was no percolation observed during the testing.

For purposes of this preliminary analysis, it is assumed that the volume required for retention will percolate and be disposed of via infiltration or other subsurface engineering methods. (See the section entitled: Items Requiring Further Discussion).

### Basin constraints

Other than environmental constraints, there are no limitations on placement of retention basins since, according to the Hydrogeologic Site Evaluation; *no ground water was encountered in all borings during the exploration program for this project*.

A basin outlet structure will be placed at an invert elevation which allows the retention volume to remain in the basin. See Detention Volume section for more information on the outlet structure. Refer to calculations in Appendix A through F.

## Water Quality Volume

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) May 2007 volume is to be set aside for the use of treatment of pavement runoff – this is the Water Quality Volume (WQV). With the use of Caltrans 'Basin Sizer' Program and the Maximized Volume Method stated in the PPDG, a volume was found for Water Quality purposes. When the WQV was less than that of required for retention of excess runoff, it was assumed treatment will occur within the retention basin and no additional volume was added to the basin. When the WQV was greater than that required for retention, the difference in volume was added to the basin. Refer to calculations in Appendix A through F.

## Silt Accumulation Volume

Per the IBWC, Hydraulic and Hydrological Study reports are to include an analysis for silt accumulation within the basin. The basin design should include additional capacity for a 10-year volume of silt accumulation. See Appendix F for IBWC correspondence. Silt accumulation over a 10-year period was assumed to pass into the retention area and additional volume is to be added for this. The Universal Soil Loss Equation and methodology stated within the SDCHM, Chapter 5.2.3 were used to determine this

volume. This accommodates silt from erosion of new cut slopes within the project limits. Refer to calculations in Appendix A through F.

## Detention Volume

Where the post developed peak flow rates were increased from pre-developed conditions, detention basins were required to reduce flow rates. For the purpose of peak attenuation (or peak shaving) additional volume is added above the retention, silt accumulation and WQV. With the use of a standardized engineered outlet structure, the detention basin volume will be added to reduce post-developed peak flows.

### Basin Outlet Structure

In the Detention Basin Outlet calculations, a 2' reinforced concrete discharge pipe at 2% slope was placed from 1' to 3' above the basin floor allowing for retention below the invert. The appropriate calculated rating table was provided analyzing outlet flows giving a range of headwater elevations.

With the defined outlet structure and using methodology described in HEC 22, Stage Storage Relationships were developed along with the Stage-Discharge Relationship (Performance Curve). A generalized routing procedure was performed to determine the additional volume needed for attenuation of peak flows. Refer to calculations in Appendix A through F.

### Freeboard

A freeboard depth was added to the final calculated depth. All freeboard depths are in excess of one (1) foot in accordance with HEC 22 9.3.9 *Allowable High Water Elevation: The allowable high water (AHW) elevation in the station should be set such that the water surface elevation at the lowest inlet in the collection system provides 0.3 to 0.6 m (1 to 2 ft) of freeboard below the roadway grate.*[4]

[4] HEC 22, 2nd Edition Urban Drainage Design Manual

## Geometrics of the Basin

Rectangular and/or Trapezoidal shapes were chosen for all of the basins. HEC 22 – Equation 8-8 and Figure 8-8 (below) were used to determine basin volumes:

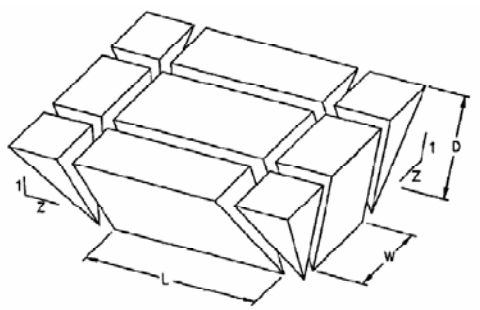



**Figure 8-8. Trapezoidal Basin.**

$$L = \frac{-ZD(r+1) + [(ZD)^2 (r+1)^2 - 5.33(ZD)^2 r + \frac{4rV}{D}]^{0.5}}{2r}$$

V = volume at a specific depth, $m^3$ ($ft^3$)
D = depth of ponding or basin, m (ft)
L = length of basin at base, m (ft)
W = width of basin at base, m (ft)
r = ratio of width to length of basin at the base
Z = side slope factor; ratio of horizontal to vertical components of side slope

# Features Requiring Further Discussion

## SR-11/CVEF Layout

It should be noted that the layouts shown for SR-11 alignment and CVEF are preliminary in nature.

For the purpose of this analysis, it is assumed that the paved and the non-paved area quantity shown herein will be similar to the final design. These areas which are shown to be paved and unpaved were used to calculate basin sizes. If the pavement area is changed from what is shown within this report, re-evaluation of the onsite hydrology and associated appurtenances will be required.

The collection and routing of the onsite flows is schematic and it is assumed that onsite flows can be collected and discharged into either detention/retention basins or other storage devices to be determined.

## Basin Design

A key element of this report was to determine the retention/detention basin sizes due to the proposed SR-11. These graded basin sizes would assist in setting the right-of-way based on the unique footprint of these facilities.

IBWC requires that due to this projects proximity to the Border, (see Appendix F), the design assumes that the increase in volume from the new impervious surfaces will be retained within the Caltrans right-of-way (will not flow into Mexico).

To simplify the design at this preliminary stage, flat-bottomed basins with 1:4 side-slopes are shown. The volume below the outlet structure elevation is always calculated to be

greater than the retention, silt accumulation and water quality volume requirement. The volume above the outlet device is used for peak-shaving/attenuation requirements.

Infiltration rates have been found to be poor due to the soil type found in the area, (see: Proposed State Route 11 Extension: Hydrogeologic Site Assessment/Storm Water Data Report by the Department of Transportation Division of Engineering Services – Geotechnical Services, Office of Geotechnical Design –South 2)

*Results of percolation tests revealed that the percolation rates at the project site are generally low, corresponding with the clayey (bentonite) and silty composition of the surficial soils and the dense, underlying sedimentary formation. In addition, percolation rates fluctuate from no percolation observed to the rate of 1.4 min/inch. However, the relatively fast percolation rate is attributed to the sandy nature of soils encountered only at this test location. This sandy granular soil is believed to be localized and not representative of a pervasive sedimentary stratum capable of absorbing and infiltrating runoff.*[5]

To accommodate this lack of infiltration, the ultimate basin design may incorporate some or all of the following features to address the requirement for volume retention:

- subsurface soil treatments
- concrete floors
- retention vaults
- pump systems

## SR-11/SR-125/SR-905 Interchange Basins

The proposed detention basin within the loop ramp of the "EN" Line as part of the SR-905 project will remain as previously designed and approved. That design assumed the basin would be taking pavement and slope flow from SR-11 to Enrico Fermi Drive. Yet, the preliminary SR-11 drainage design is to capture and redirect flow to the new Basin Y-East at the "WS" and "WN" Lines. Therefore, less flow will be entering the "EN" basin than it was originally designed for. Therefore, no further design modifications will be required for this basin.

[5] Proposed State Route 11 Extension: Hydrogeologic Site Assessment/ SWDR, 09.09.09, page 4.

Slight pavement widening along the outside of SR-905 is proposed from Stations 600+00 to 635+00. This increase in impervious cover will be added to the new Basin Y-West detention and retention requirements. The flow will be captured by proposed inlets and conveyed towards the west into the proposed storm drain system of SR-905.

## Sanyo Basins

The existing concrete lined detention basin serving the existing commercial developments in the immediate vicinity will have to be relocated from Stations 40+00 to 52+00 to approximately Stations 20+00 to 32+00.

The flows from the developments that currently drain to the existing detention basin will be directed to the new basin location via a separate drainage system. This is facilitated by re-routing all of the existing culverts that currently discharge into the existing concrete bottomed detention facility between Stations 40+00 and 52+00 into one large culvert running along the north side of SR-11 and ultimately discharging into the relocated detention facility proposed west of Sanyo Avenue.

This relocated basin will be similar in shape, depth and function and will not receive any flow from SR-11. No further analysis of this basin will be required. Maintenance and ownership of this relocated basin will continue to be a requirement of the commercial site owners and not Caltrans nor the City of San Diego.

## Basin G

Watershed "G" has two basins (*G-North* and *G-South*) proposed for each of the three alternatives. This arrangement was due to the Siempre Viva Road interchange impacts and the limited available area to place basins within and around the interchange. Where *G-South* has been placed, it must ultimately discharge into the flow line of an adjacent existing channel. This existing channel has been defined as a *Waters of the US*. An easement may be required to place a discharge pipe towards this channel. An energy dissipation device will also be required. All drainage elements in this area must be placed within the criteria of the *Waters of the US.*

# Culverts

## Developers Culverts

There are several proposed commercial developments adjacent to the proposed SR-11 Corridor. The storm drain culverts proposed by these developments are shown and labeled in this design for informational purposes only. It is assumed that these developments are required to address detention and retention requirements of the appropriate jurisdictions and discharge flows and volumes that are not in excess of pre-developed conditions.

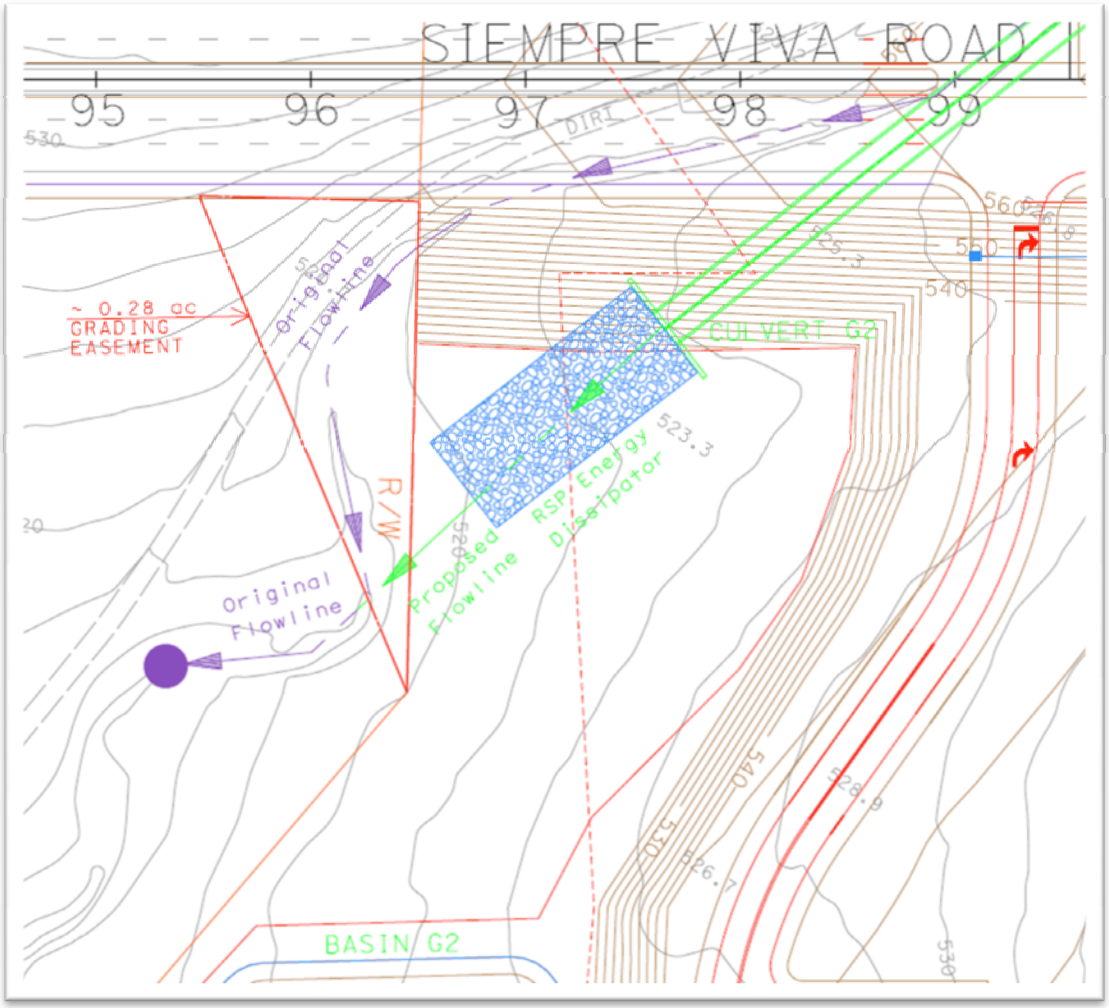
## Culvert B

In all three alternatives for Culvert B, due to the low preliminary SR-11 profile, an upstream drop structure and modifications in the daylight point of the downstream end of this culvert may be required. Grading easements beyond what is shown in this report may be required to daylight the culvert.

## Culvert G

The outlets for all three design alternatives of Culvert G occur along the southwest side of the proposed extension of Siempra Viva Road and the SR-11 alignment. A rock rip rap energy dissipation device is shown with an approximate size. The end of this dissipation device falls short of the confluence with the existing *Waters of the US* flow line. The proposed right-of-way line does not allow for a continuous connection of these flow lines. A grading easement will be necessary per Figure 25 to complete this drainage connection.

**Figure 26 - Culvert G Outlet**




## SR-11 Interchange Flows

Runoff from Enrico Fermi Drive, Alta Road and Siempre Viva Road within the three Alternatives, that are within the proposed Caltrans right-of-way are considered in this design. Flows from these proposed roads that are outside of the proposed Caltrans right-of-way are not considered in the proposed design.

## Watershed A, X and Y (separation of flows)

The intent of the preliminary design for these three watersheds was to separately convey the runoff from the existing commercial developments east of Sanyo Avenue, south of Otay Mesa Road and from that of the proposed SR-11 runoff. Onsite runoff from SR-11, specifically watersheds "A", "X" and "Y" will be captured and conveyed in a separate, smaller culvert along the south side of SR-11. This flow will continue west, through the proposed Sanyo Avenue Undercrossing Structure will be ultimately discharged into Detention Basin "Y-East".

Basin calculations for Watershed A indicate a need for a detention facility. A basin has been designed, sized and placed in the drainage layout. This basin may be omitted in the ultimate design if flows from Watershed "A" are to be collected and routed to Basin "Y-East".

Basin calculations for Watershed X also indicate a need for a detention basin due to increased impervious cover. A basin volume was calculated, but due to this area being entirely on an elevated structure with no possibility of placing a retention/detention facility, runoff from this structure will be captured and conveyed through a network of inlets and pipes and discharge into to Basin "Y-East".

The calculations for Basins in the "Y" watershed include flows from Watershed "A" and "X"

## Commercial Vehicle Enforcement Facility (CVEF)

The Layout for the CVEF shown within this report was patterned from the layout of the existing Otay Mesa CVEF which is 1.5 miles west of the proposed CVEF, at the south east corner of Enrico Fermi Drive and Siempra Viva Road. The ultimate layout cannot be determined at this preliminary stage. However, it is anticipated that the operational footprint will be reduced in order to facilitate detention/retention basin opportunities.

In order to simplify the drainage approach to the preliminary drainage design this facility, only one basin volume was calculated. This volume was distributed over the several basins shown on the plan. In the ultimate condition, basins may be reconfigured; due to adjustments in the CVEF layout.

# References


1. “Highway Design Manual”, State of California Department of Transportation (Caltrans), Sixth Edition, July 2008.

2. “District 11 Hydraulics Section – Guidelines for Consultants Performing Hydraulic Design on Caltrans Projects”, Caltrans, October 2002.

3. “Civil Engineering Reference Manual”, Michael P. Lindeburg, Eighth Edition, 2002.

4. “Urban Drainage Design Manual”, Hydraulic Engineering Circular No.22, USDT Federal Highway Administration, November 1996.

5. “Caltrans Storm Water Quality Handbooks, Project Planning and Design Guide”, State of California Department of Transportation (Caltrans), May 2007

6. “Hydrology Manual”, County of San Diego Public Works Flood Control, January 2003

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# *Appendix A* PRE-Developed Conditions

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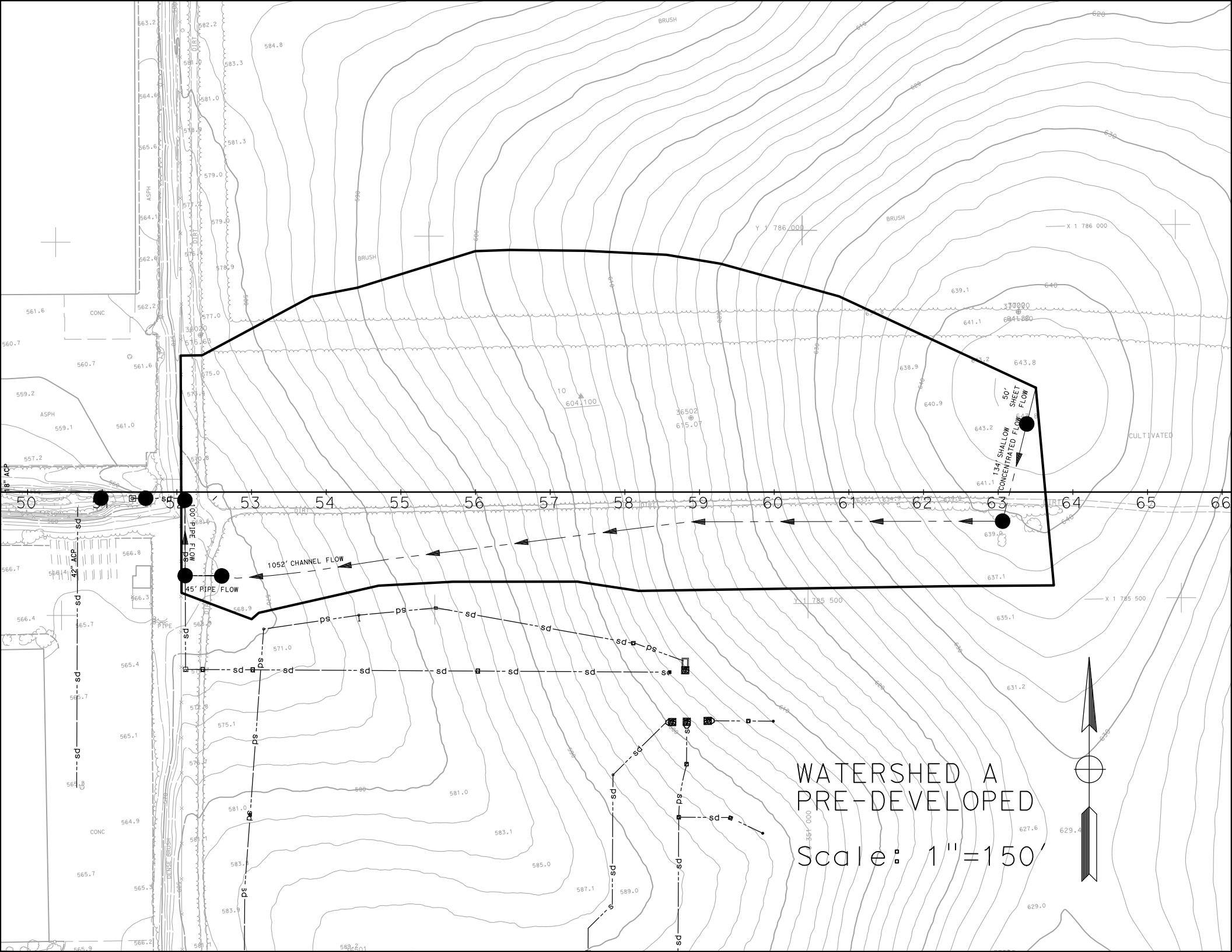
WATERSHED A
PRE-DEVELOPED
Scale: 1"=150'
1052' CHANNEL FLOW
45' PIPE FLOW
100' PIPE FLOW
134' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW
18" ACP
42" ACP
BRUSH
CONC
ASPH
CULTIVATED
DENSE BRUSH
DIRT
PIPE
Y 1 786 000
X 1 786 000
Y 1 785 500
X 1 785 500
50
51
52
53
54
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56
57
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59
60
61
62
63
64
65
66

# A Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 52+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 457636 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.51 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.42 | 0.416 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.47 |
| $C_{50}$ = | 0.51 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 644.0 | ft | Ridgeline |
| LOW POINT ELEVATION | 643.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 50 | ft | From high point |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.050 | | <=n from Table 816.6A Fallow |
| $T_t$ (SFF)= | 3.12 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 643.0 | ft | |
| LOW POINT ELEVATION | 639.8 | ft | |
| ELEVATION DIFF (H) | 3.2 | ft | |
| LENGTH (L) | 134 | ft | |
| SLOPE (S) = (H/L) | 2.4% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V from Figure 816.6 Nearly bare ground |
| $T_C$ (SH)= | 1.49 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 639.8 | ft | Brow ditch |
| LOW POINT ELEVATION | 568.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 71.8 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 1052 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 6.8% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Rough concrete |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 12.99 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.35 | minutes | |

# A Pre-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 564.0 | ft | |
| LOW POINT ELEVATION | 563.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 45 | ft | |
| SLOPE (S) = (H/L) | 2.2% | | |
| MANNING'S n | 0.013 | | RCP - Exist Fed X |
| PIPE DIAMETER d | 1.5 | ft | |
| HYDRAULIC RADIUS R | 0.4 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 8.9 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.08 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft | |
| LOW POINT ELEVATION | 562.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.013 | | RCP - Exist Fed X |
| PIPE DIAMETER d | 3.5 | ft | |
| HYDRAULIC RADIUS R | 0.9 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 10.5 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.16 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 6.20 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 8.3 |
| **$Q_{10}$ =** | 12.0 |
| **$Q_{25}$ =** | 16.5 |
| **$Q_{50}$ =** | 21.7 |
| **$Q_{100}$ =** | **23.5** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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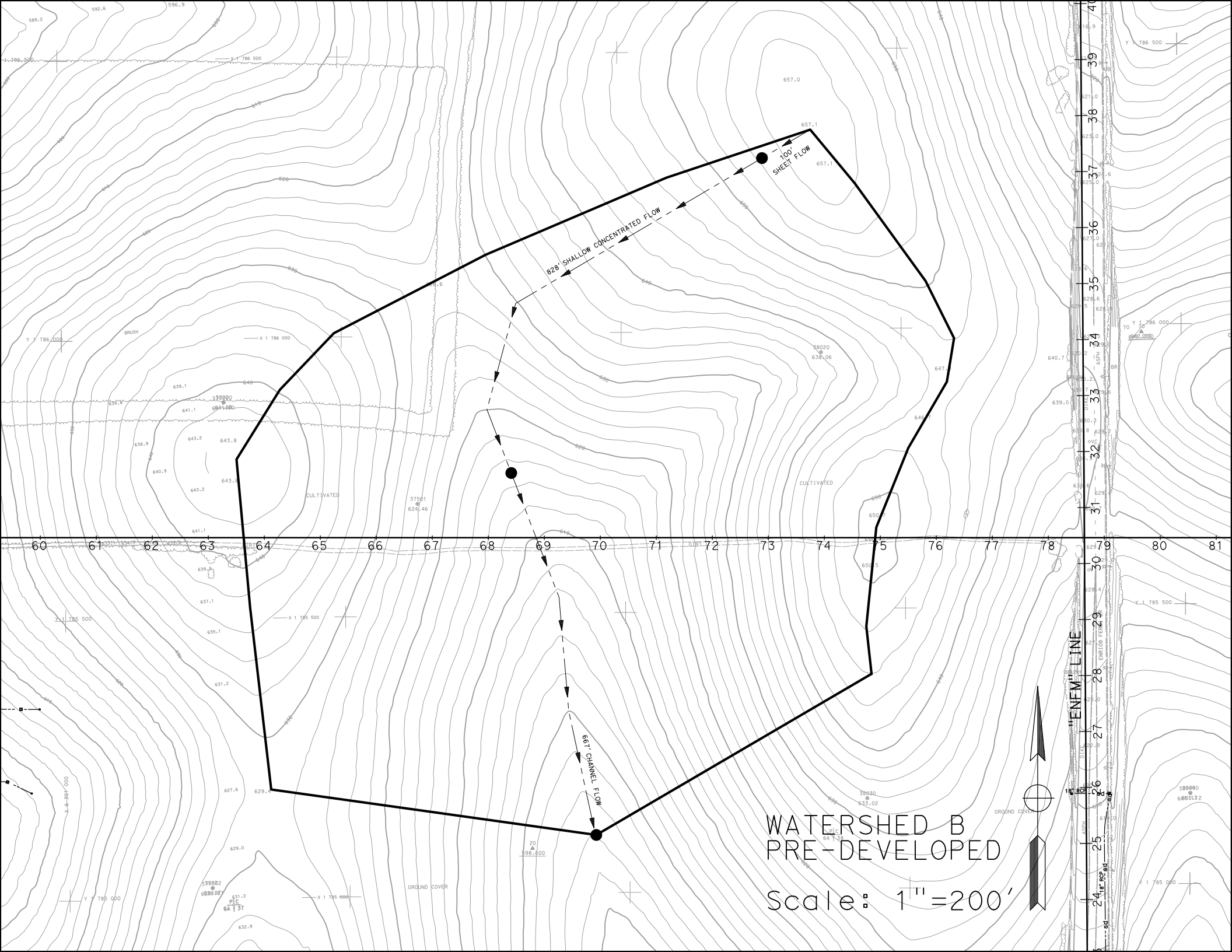
100' SHEET FLOW
828' SHALLOW CONCENTRATED FLOW
667' CHANNEL FLOW
"ENFM" LINE
CULTIVATED
GROUND COVER
BRUSH
DIRT
WATERSHED B
PRE-DEVELOPED
Scale: 1"=200'

# B Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1129872 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 25.94 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | $C_{2,10}$ = | 0.42 |
| | (100%) | | $C_{25}$ = | 0.46 |
| | | | $C_{50}$ = | 0.50 |
| | | | $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}S^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass prarie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 654.0 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 39.0 | ft | |
| LENGTH (L) | 828 | ft | |
| SLOPE (S) = (H/L) | 4.7% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_c$ (SH)= | 9.20 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Begins to form natural channel |
| LOW POINT ELEVATION | 594.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 667 | ft | b = 10 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 3.1% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | grass |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.84 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_c$ (CH)= | 6.06 | minutes | |

# B Pre-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 26.22 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **26.22** | minutes |

**INTENSITY CHART:** $I = 7.44\ P_6\ D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | $Q_2$ = | 10.8 |
| $i_{10}$ = | 1.4 | in/hr | X CA = | $Q_{10}$ = | 15.8 |
| $i_{25}$ = | 1.8 | in/hr | X CA = | $Q_{25}$ = | 21.7 |
| $i_{50}$ = | 2.2 | in/hr | X CA = | $Q_{50}$ = | 28.4 |
| $i_{100}$ = | 2.3 | in/hr | X CA = | $Q_{100}$ = | **30.8** |

**FLOW RESULTS:**

**cfs**

**COUNTY $P_6$**

| | **inches** |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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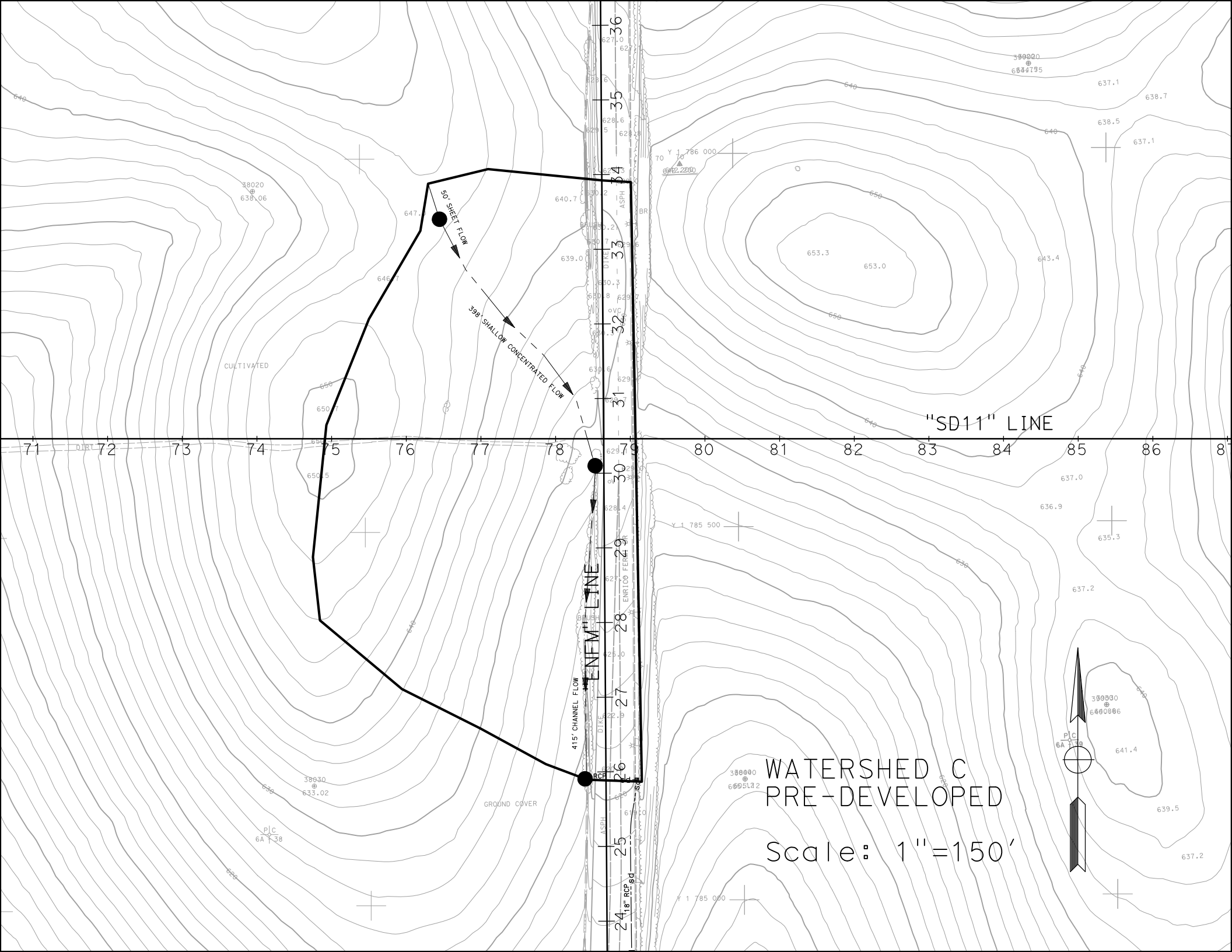

50' SHEET FLOW
398' SHALLOW CONCENTRATED FLOW
415' CHANNEL FLOW
"SD11" LINE
"ENFM" LINE
CULTIVATED
GROUND COVER
18" RCP
WATERSHED C
PRE-DEVELOPED
Scale: 1"=150'

# C Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 78+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | C |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 282823 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 6.49 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Poor natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 88% | AT | 0.42 | 0.368 |
| PAVED SURFACE | 12% | AT | 0.90 | 0.111 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.48 |
| $C_{25}$ = | 0.53 |
| $C_{50}$ = | 0.58 |
| $C_{100}$ = | 0.60 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 647.0 | ft | High Point in Watershed, north of alignment |
| LOW POINT ELEVATION | 646.5 | ft | |
| ELEVATION DIFF (H) | 0.5 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 4.11 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 646.5 | ft | |
| LOW POINT ELEVATION | 628.0 | ft | origin of existing concrete ditch along west side of Enrico Ferm |
| ELEVATION DIFF (H) | 18.5 | ft | |
| LENGTH (L) | 398 | ft | |
| SLOPE (S) = (H/L) | 4.6% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_c$ (SH)= | 4.42 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 628.0 | ft | Existing concrete ditch along west side of Enrico Fermi |
| LOW POINT ELEVATION | 619.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 1 ANG-RAD 0.785 |
| LENGTH (L) | 415 | ft | b = 1.5 ANG-DEG 45.000 |
| SLOPE (S) = (H/L) | 2.2% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | rough concrete |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 7.17 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_c$ (CH)= | 0.96 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 9.50 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\, P_6\, D^{-0.645}$

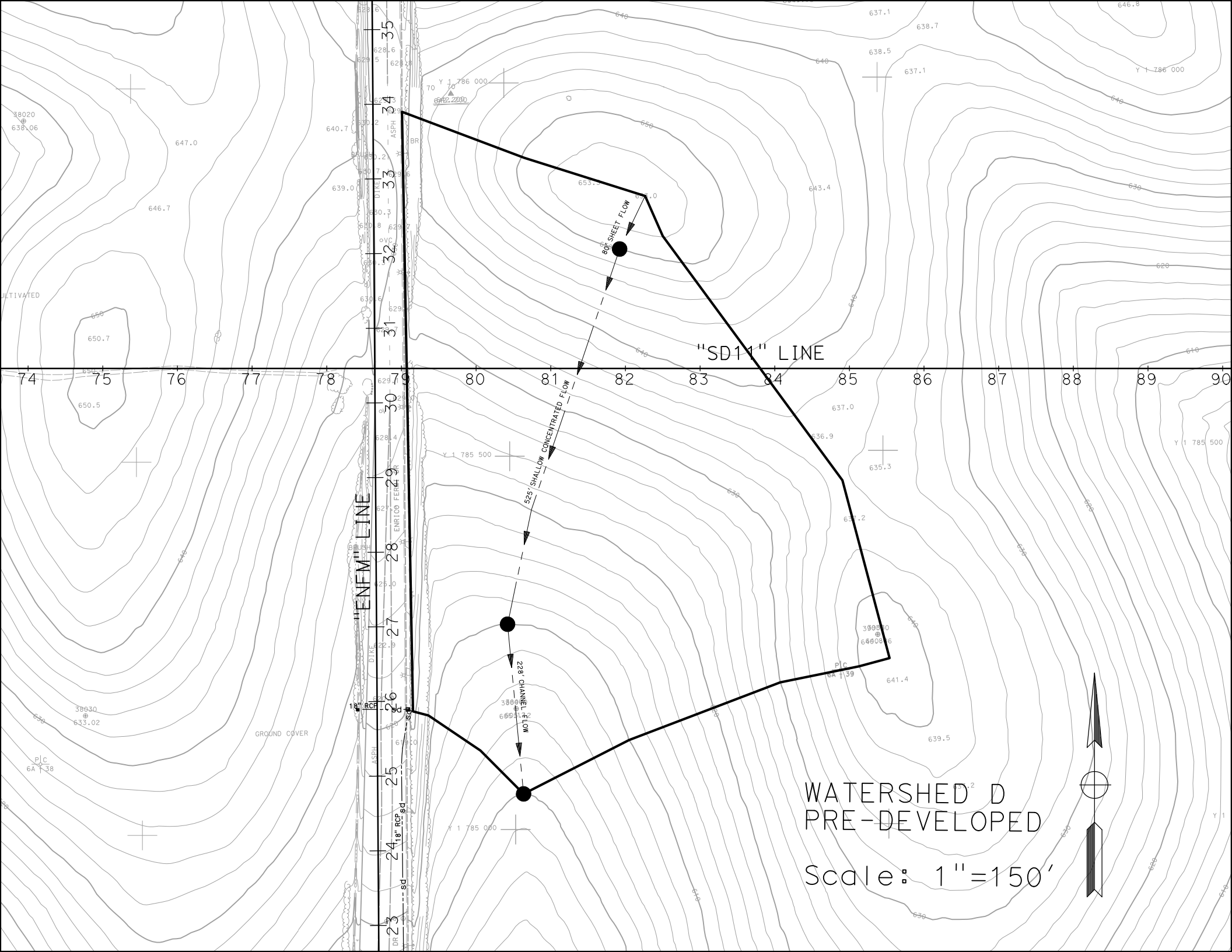
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 5.8 |
| $Q_{10}$ = | 8.4 |
| $Q_{25}$ = | 11.5 |
| $Q_{50}$ = | 15.1 |
| $Q_{100}$ = | **16.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


"SD11" LINE
"ENFM" LINE
80' SHEET FLOW
525' SHALLOW CONCENTRATED FLOW
228' CHANNEL FLOW
18" RCP
18" RCP sd
WATERSHED D
PRE-DEVELOPED
Scale: 1"=150'

# D Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 80+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | D |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 387314 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 8.89 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 653.0 | ft | High Point in Watershed, north of SR-11 |
| LOW POINT ELEVATION | 650.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 80 | ft | |
| SLOPE (S) = (H/L) | 3.8% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 3.53 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 650.0 | ft | |
| LOW POINT ELEVATION | 610.0 | ft | |
| ELEVATION DIFF (H) | 40.0 | ft | |
| LENGTH (L) | 525 | ft | |
| SLOPE (S) = (H/L) | 7.6% | | |
| VELOCITY (SCF) | 2.5 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 3.50 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | begins to channelize |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 10.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 228 | ft | b = 2 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 4.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.150 | | short prairie grass |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 0.97 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.93 | minutes | |

# D Pre-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 10.96 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.96** | minutes |

**INTENSITY CHART:** $I = 7.44\ P_6\ D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.7 | in/hr | X CA = | |
| $i_{10}$ = | 2.5 | in/hr | X CA = | |
| $i_{25}$ = | 3.2 | in/hr | X CA = | |
| $i_{50}$ = | 3.8 | in/hr | X CA = | |
| $i_{100}$ = | 4.0 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 6.5 |
| **$Q_{10}$ =** | 9.5 |
| **$Q_{25}$ =** | 13.0 |
| **$Q_{50}$ =** | 17.1 |
| **$Q_{100}$ =** | **18.5** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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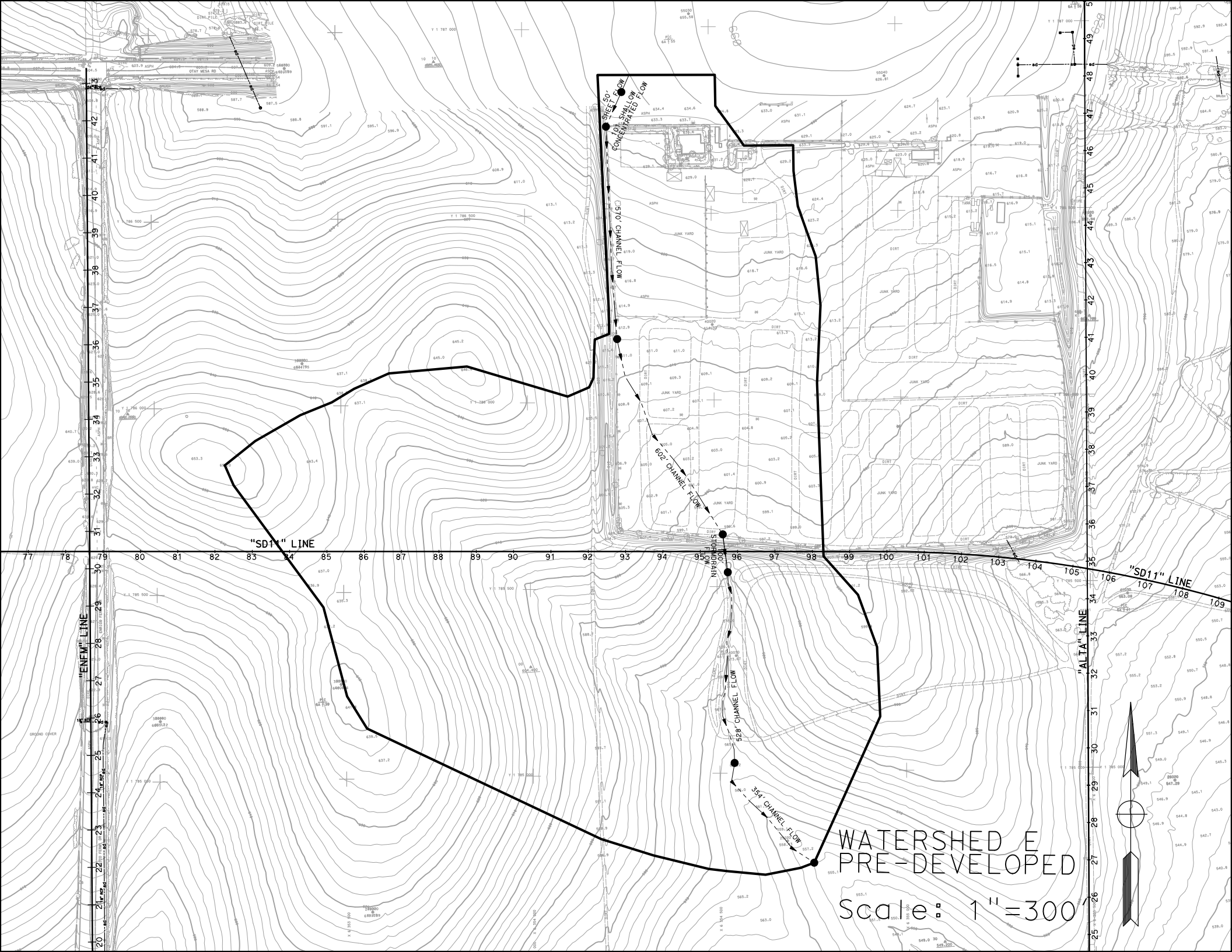
WATERSHED E
PRE-DEVELOPED
Scale: 1"=300'
"SD11" LINE
"ENFM" LINE
"ALTA" LINE
SHEET FLOW
70' SHALLOW CONCENTRATED FLOW
510' CHANNEL FLOW
602' CHANNEL FLOW
STORM DRAIN FLOW
528' CHANNEL FLOW
354' CHANNEL FLOW
JUNK YARD
DIRT
ASPH
OTAY MESA RD

# E Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | E |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 2097450 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 48.15 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.43 | 0.426 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.43 |
| $C_{25}$ = | 0.48 |
| $C_{50}$ = | 0.52 |
| $C_{100}$ = | 0.54 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.5 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E Pre-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 596.0 | ft |
| ELEVATION DIFF (H) | 16.0 | ft |
| LENGTH (L) | 602 | ft |
| SLOPE (S) = (H/L) | 2.7% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 1.06 | fps |
| $T_C$ (CH)= | 9.49 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 596.0 | ft |
| LOW POINT ELEVATION | 580.0 | ft |
| ELEVATION DIFF (H) | 16.0 | ft |
| LENGTH (L) | 100 | ft |
| SLOPE (S) = (H/L) | 16.0% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 28.9 | fps |
| $T_C$ (SD)= | 0.06 | minutes |

**NOTES:**

Existing down drain at southern end of junk yard

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 580.0 | ft |
| LOW POINT ELEVATION | 565.2 | ft |
| ELEVATION DIFF (H) | 14.8 | ft |
| LENGTH (L) | 528 | ft |
| SLOPE (S) = (H/L) | 2.8% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 1.81 | fps |
| $T_C$ (CH)= | 4.86 | minutes |

**NOTES:**

Natural Channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 2 | ANG-DEG | 26.565 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 565.2 | ft |
| LOW POINT ELEVATION | 556.0 | ft |
| ELEVATION DIFF (H) | 9.2 | ft |
| LENGTH (L) | 354 | ft |
| SLOPE (S) = (H/L) | 2.6% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.7 | ft |
| VELOCITY (CHANNEL) | 1.81 | fps |
| $T_C$ (CH)= | 3.26 | minutes |

**NOTES:**

Begins to broaden

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 4 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 24.46 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **24.46** | minutes |

Total Length of Run (ft) = 2305

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | |
| $i_{10}$ = | 1.5 | in/hr | X CA = | |
| $i_{25}$ = | 1.9 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.4 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 21.8 |
| **$Q_{10}$ =** | 31.7 |
| **$Q_{25}$ =** | 43.6 |
| **$Q_{50}$ =** | 57.0 |
| **$Q_{100}$ =** | **61.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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WATERSHED F
PRE-DEVELOPED
Scale: 1"=450'
100' SHORT FLOW Ele=8.3
667' SHALLOW CONCENTRATED FLOW
318' CHANNEL FLOW
100' STORM DRAIN FLOW
311' CHANNEL FLOW
957' CHANNEL FLOW
328' CHANNEL FLOW
700' CHANNEL FLOW
"SD11" LINE
"ALTA" LINE
"SD11" LINE

# F Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 110+50 |
| BY: | M.BRUNING | DATE: | 10.24.09 | WATERSHED: | F |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 5460656 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 125.36 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.20 | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.47 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.47 | 0.466 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.008 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.47 |
| $C_{25}$ = | 0.52 |
| $C_{50}$ = | 0.57 |
| $C_{100}$ = | 0.59 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.45}n^{.45}}{P_2^{1/2}s^{.25}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.5 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F Pre-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft | Exist Cross Culvert under berm |
| LOW POINT ELEVATION | 587.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | defined broad channel south of berm (field verified new berm) |
| LOW POINT ELEVATION | 576.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 / ANG-RAD / 0.197 |
| LENGTH (L) | 311 | ft | b = 50 / ANG-DEG / 11.310 |
| SLOPE (S) = (H/L) | 3.5% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.9 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.30 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 555.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 957 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.2% | | d = 1.5 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.74 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 555.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 546.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 328 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.7% | | d = 2 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 1.0 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 4.95 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.10 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 546.0 | ft | channellized - natural |
| LOW POINT ELEVATION | 536.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 10.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 700 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 2 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 1.0 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.58 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.26 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 30.01 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **30.01** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = | |
| $i_{10}$ = | 1.3 | in/hr | X CA = | |
| $i_{25}$ = | 1.7 | in/hr | X CA = | |
| $i_{50}$ = | 2.0 | in/hr | X CA = | |
| $i_{100}$ = | 2.1 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 54.2 |
| $Q_{10}$ = | 78.8 |
| $Q_{25}$ = | 108.4 |
| $Q_{50}$ = | 141.9 |
| $Q_{100}$ = | **154.0** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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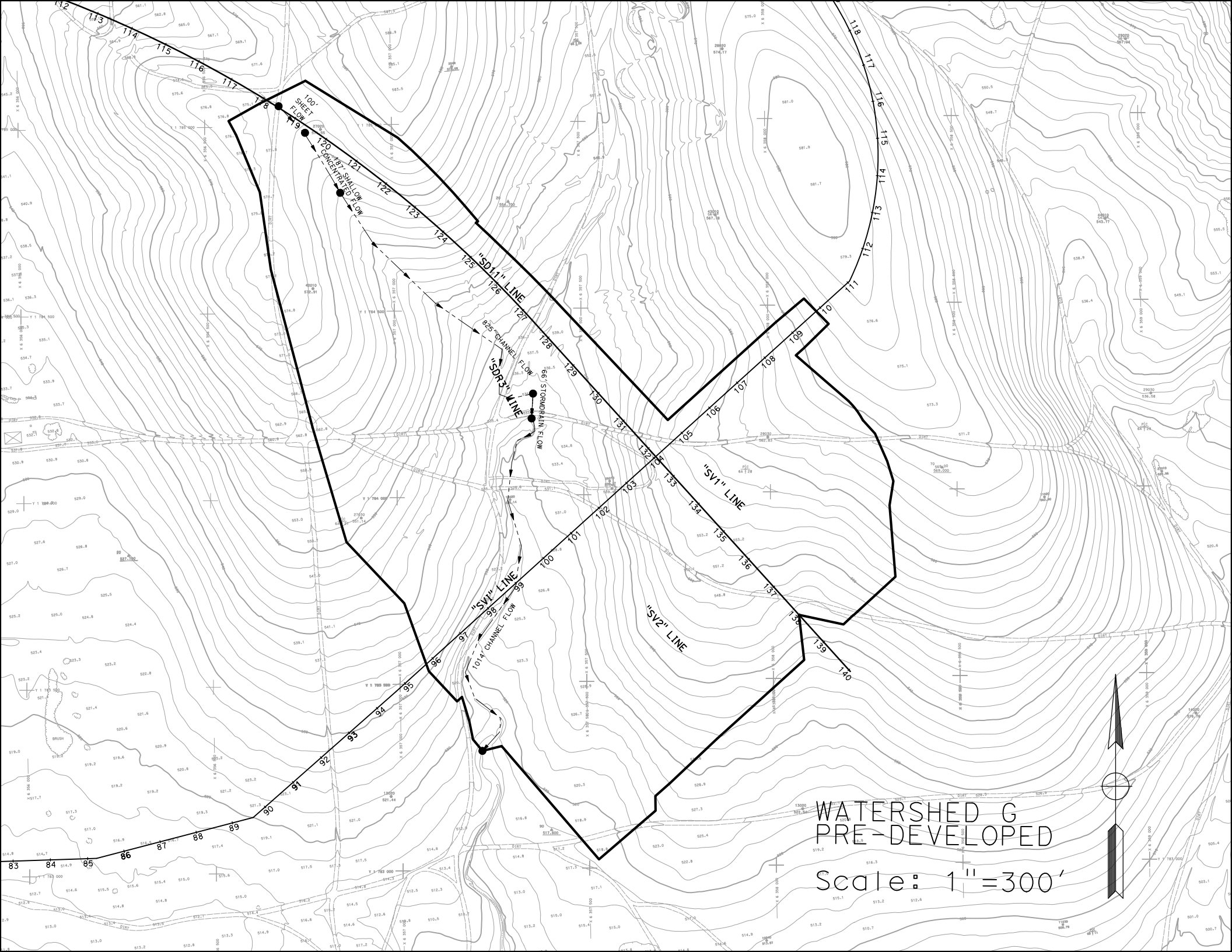
100' SHEET FLOW
187' SHALLOW CONCENTRATED FLOW
"SD11" LINE
825' CHANNEL FLOW
"SDR3" LINE
66' STORMDRAIN FLOW
"SV1" LINE
"SV2" LINE
"SV1" LINE
1014' CHANNEL FLOW
WATERSHED G
PRE-DEVELOPED
Scale: 1"=300'

# G Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 12.31.09 | WATERSHED: | G |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1789591 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 41.08 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | NOTES: |
|---|---|---|---|
| RELIEF (.08-.35) | 0.12 | | Relatively Flat ~ 4% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.39 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.39 | 0.390 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | $C_{2,10}$ = | 0.39 |
| | (100%) | | $C_{25}$ = | 0.43 |
| | | | $C_{50}$ = | 0.47 |
| | | | $C_{100}$ = | 0.49 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 574.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 572.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.050 | | < = FROM TABLE 816.6A Fallow |
| $T_t$ (SFF)= | 5.42 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 572.0 | ft | |
| LOW POINT ELEVATION | 566.0 | ft | |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 187 | ft | |
| SLOPE (S) = (H/L) | 3.2% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V FROM FIG 816.5 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 1.78 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 566.0 | ft | channelized |
| LOW POINT ELEVATION | 535.4 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 30.6 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 825 | ft | b = 20 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 3.7% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.22 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

# G Pre-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 535.4 | ft | Existing culvert under path |
| LOW POINT ELEVATION | 532.0 | ft | |
| ELEVATION DIFF (H) | 3.4 | ft | |
| LENGTH (L) | 66 | ft | |
| SLOPE (S) = (H/L) | 5.2% | | |
| MANNING'S n | 0.022 | | CMP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 12.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.09 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft | large channel at base of watershed |
| LOW POINT ELEVATION | 514.0 | ft | CHANNEL DATA — TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 18.0 | ft | Z= 2 — ANG-RAD 0.464 |
| LENGTH (L) | 1014 | ft | b = 8 — ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.8% | | d = 2 — FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 1.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.13 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.40 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 16.97 | minutes |
| **Minimum Tc =** | 5 | minutes |
| **USE Tc =** | **16.97** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.3 | in/hr | X CA = | |
| $i_{10}$ = | 1.9 | in/hr | X CA = | |
| $i_{25}$ = | 2.4 | in/hr | X CA = | |
| $i_{50}$ = | 2.9 | in/hr | X CA = | |
| $i_{100}$ = | 3.0 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 21.1 |
| **$Q_{10}$ =** | 30.7 |
| **$Q_{25}$ =** | 42.2 |
| **$Q_{50}$ =** | 55.3 |
| **$Q_{100}$ =** | **60.0** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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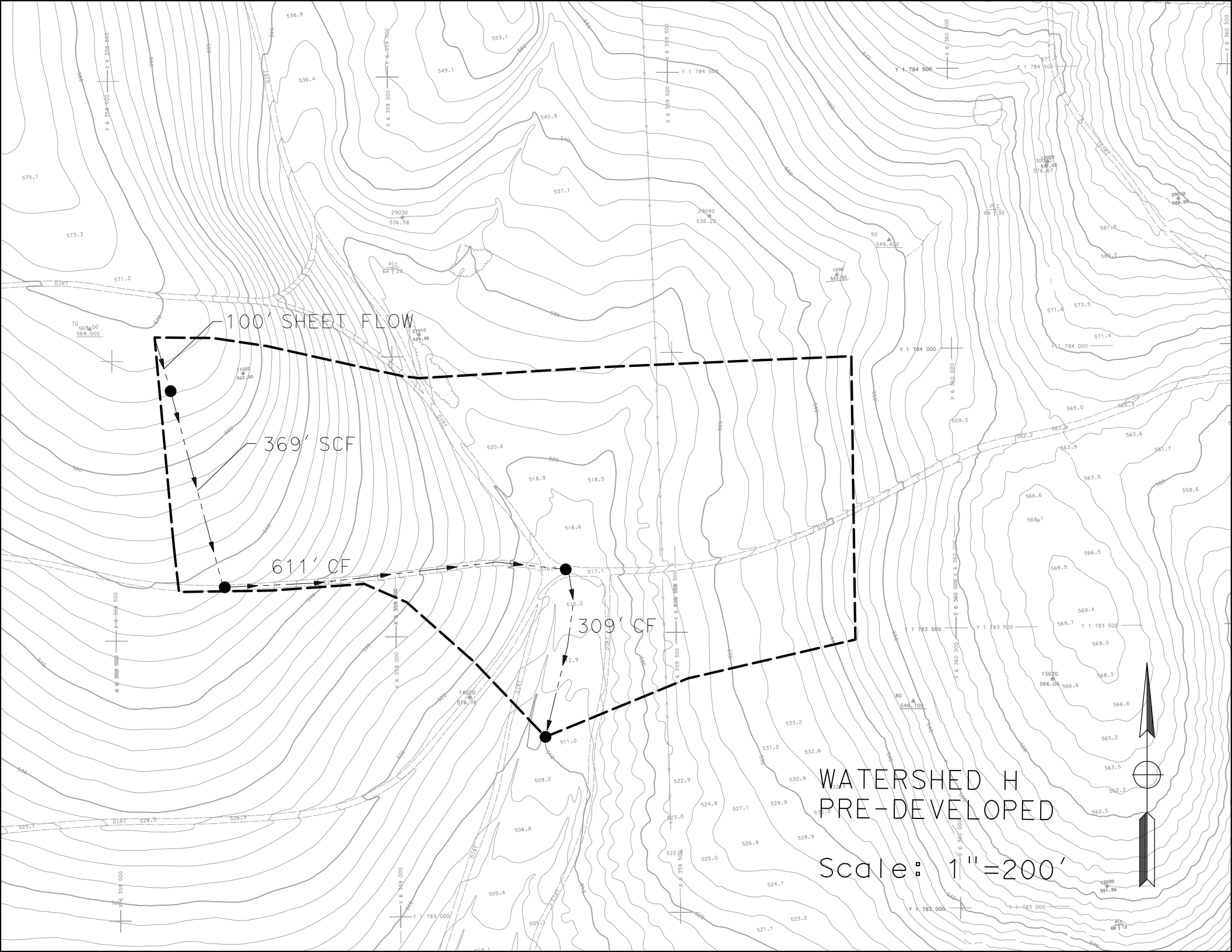
100' SHEET FLOW
369' SCF
611' CF
309' CF
WATERSHED H
PRE-DEVELOPED
Scale: 1"=200'

# H Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | CVEF |
| BY: | M.BRUNING | DATE: | 01.12.10 | WATERSHED: | H |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 624154 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 14.33 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | |
|---|---|---|---|
| RELIEF (.08-.35) | 0.22 | | Hilly Slopes ~ 15% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.49 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.49 | 0.490 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.49 |
| $C_{25}$ = | 0.54 |
| $C_{50}$ = | 0.59 |
| $C_{100}$ = | 0.61 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 569.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 566.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 4.61 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 566.0 | ft | down slope |
| LOW POINT ELEVATION | 548.0 | ft | |
| ELEVATION DIFF (H) | 18.0 | ft | |
| LENGTH (L) | 369 | ft | |
| SLOPE (S) = (H/L) | 4.9% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V From Figure 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 4.10 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 548.0 | ft | channelizes in dirt trail |
| LOW POINT ELEVATION | 516.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 32.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 611 | ft | b = 10 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 5.2% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural Channel |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 4.00 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.54 | minutes | |

# H Pre-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 516.0 | ft |
| LOW POINT ELEVATION | 510.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 309 | ft |
| SLOPE (S) = (H/L) | 1.9% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 1.9 | ft |
| VELOCITY (CHANNEL) | 3.92 | fps |
| $T_C$ (CH)= | 1.31 | minutes |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.57 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **12.57** | minutes |

**NOTES:**

broader channel at confluence

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 100 | ANG-DEG | 14.036 |
| d = | 2 | FLOWING FULL ASS'M | |

Natural Channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = | $Q_2$ = | 11.2 |
| $i_{10}$ = | 2.3 | in/hr | X CA = | $Q_{10}$ = | 16.3 |
| $i_{25}$ = | 2.9 | in/hr | X CA = | $Q_{25}$ = | 22.5 |
| $i_{50}$ = | 3.5 | in/hr | X CA = | $Q_{50}$ = | 29.4 |
| $i_{100}$ = | 3.6 | in/hr | X CA = | $Q_{100}$ = | **31.9** |

**FLOW RESULTS:** cfs

**COUNTY $P_6$** inches

| | |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

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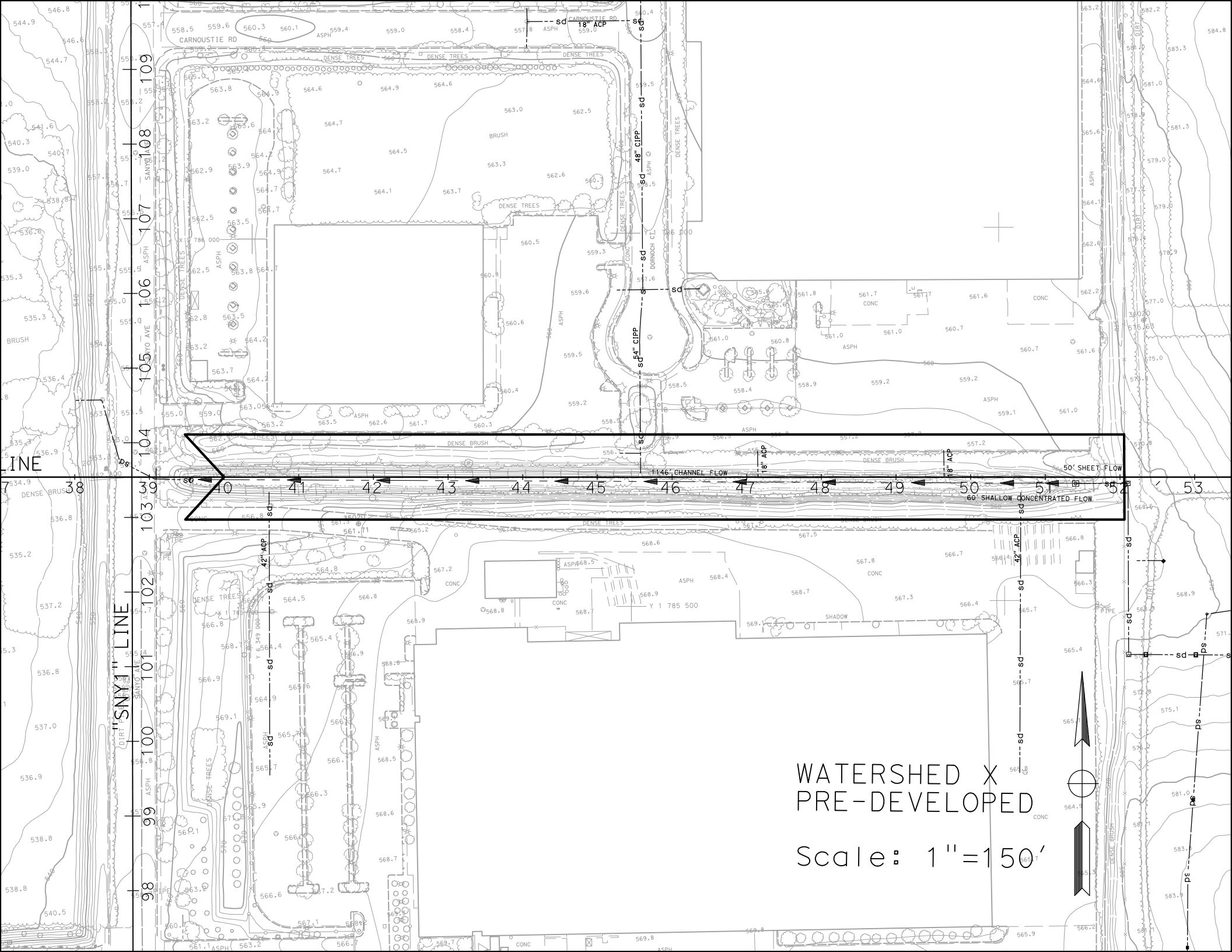

WATERSHED X
PRE-DEVELOPED
Scale: 1"=150'
CARNOUSTIE RD
18" ACP
48" CIPP
54" CIPP
DORNOCH CT
SANYO AVE
SNY1" LINE
1146' CHANNEL FLOW
50' SHEET FLOW
60' SHALLOW CONCENTRATED FLOW
42" ACP
18" ACP
DENSE TREES
DENSE BRUSH
BRUSH
ASPH
CONC
SHADOW

# X Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Pre-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.25.10** | **WATERSHED:** | **X** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **140433** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **3.22** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.30 | Steep, Rugged Slopes ~ 30% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.06 | Good natural cover |
| STORAGE (.04-.12) | 0.04 | High |
| TOTAL C = | 0.52 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 76% | AT | 0.52 | 0.395 |
| PAVED SURFACE | 24% | AT | 0.90 | 0.217 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.61 |
| $C_{25}$ = | 0.67 |
| $C_{50}$ = | 0.73 |
| $C_{100}$ = | 0.76 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} S^{2/5}}$

**NOTES:** $P_{2,24}$ **(in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 568.0 | ft | Upstream end of existing detention facility |
| LOW POINT ELEVATION | 560.0 | ft | |
| ELEVATION DIFF (H) | 8.0 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 16.0% | | |
| MANNING'S n | 0.150 | | < = from Table 816.6A Grass |
| $T_t$ (SFF)= | 3.27 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 560.0 | ft | slope towards detention facility |
| LOW POINT ELEVATION | 550.0 | ft | |
| ELEVATION DIFF (H) | 10.0 | ft | |
| LENGTH (L) | 60 | ft | |
| SLOPE (S) = (H/L) | 16.7% | | |
| VELOCITY (SCF) | 2.5 | fps | <=V FROM FIG 816.6 Grass |
| $T_C$ (SH)= | 0.40 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 550.0 | ft | channelizes towards Sanyo |
| LOW POINT ELEVATION | 542.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 8.0 | ft | Z= 1.5 ANG-RAD 0.588 |
| LENGTH (L) | 1146 | ft | b = 15 ANG-DEG 33.690 |
| SLOPE (S) = (H/L) | 0.7% | | d = 5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | concrete - per as-builts |
| HYDRAULIC RADIUS R | 3.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 18.79 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.02 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 4.68 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

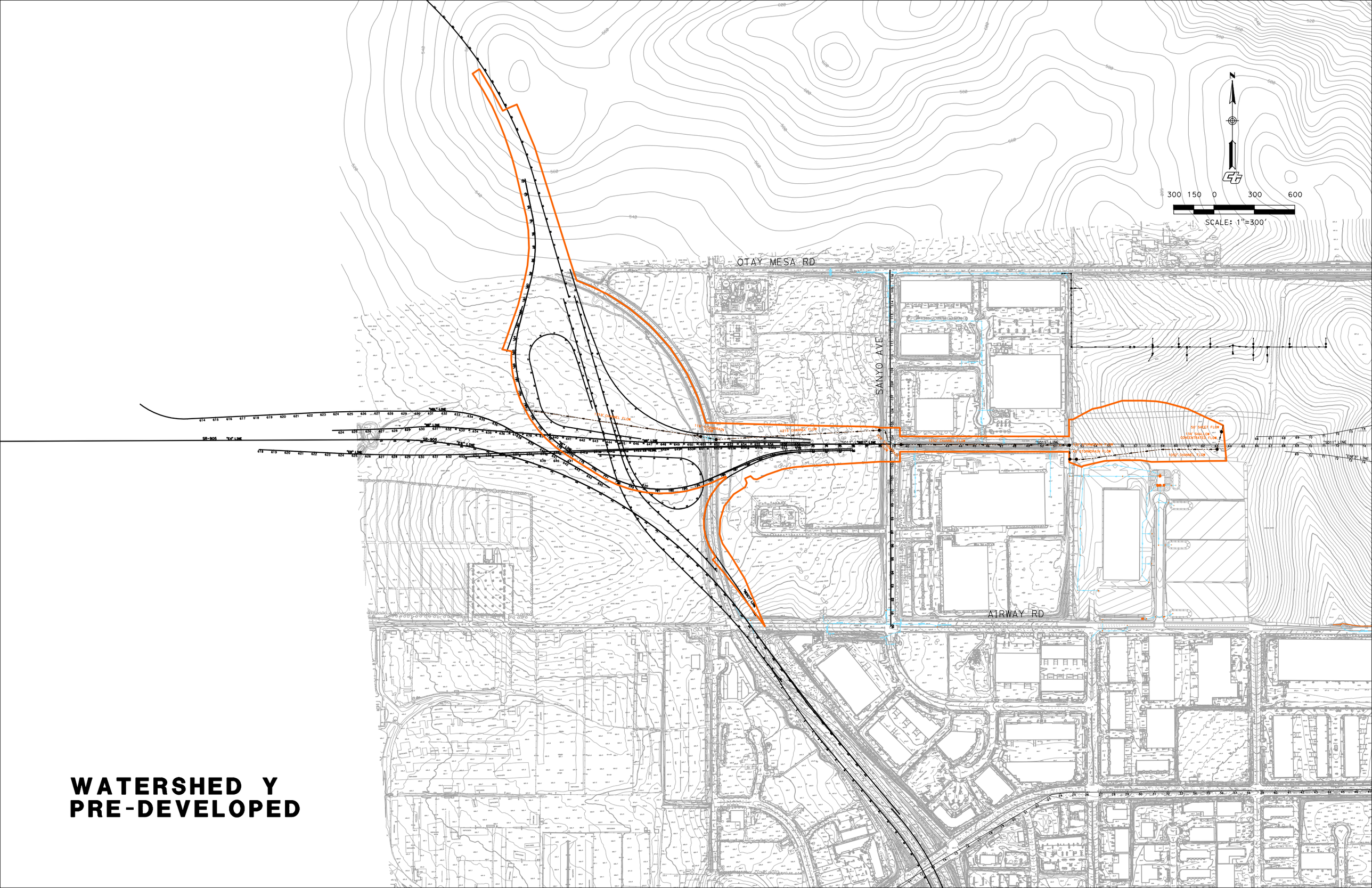
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.7 |
| **$Q_{10}$ =** | 5.3 |
| **$Q_{25}$ =** | 7.3 |
| **$Q_{50}$ =** | 9.6 |
| **$Q_{100}$ =** | **10.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


OTAY MESA RD
SANYO AVE
AIRWAY RD
SR-905
"E4" LINE
"W1" LINE
"SD11" LINE
"SD12" LINE
"SD13" LINE
"SD14" LINE
"SD15" LINE
"SD16" LINE
"SD17" LINE
"SD18" LINE
"SD19" LINE
"SD20" LINE
"SD21" LINE
"SD22" LINE
"SD23" LINE
"SD24" LINE
"SD25" LINE
"SD26" LINE
"SD27" LINE
"SD28" LINE
"SD29" LINE
"SD30" LINE

# Y Pre-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Pre-Developed |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 3170368 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 72.78 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.09 | Average Slopes ~ 1% |
| INFILTRATION (.04-.16) | 0.12 | Negligible Infiltration Capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.12 | Poor Natural Cover |
| STORAGE (.04-.12) | 0.10 | Low Surface Storage |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 93% | AT | 0.43 | 0.398 |
| PAVED SURFACE | 7% | AT | 0.90 | 0.067 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.47 |
| $C_{25}$ = | 0.51 |
| $C_{50}$ = | 0.56 |
| $C_{100}$ = | 0.58 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}S^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 644.0 | ft | Ridgeline at Watershed A |
| LOW POINT ELEVATION | 643.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 50 | ft | From HP |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.050 | | <=n From Table 816.6A Fallow |
| $T_t$ (SFF)= | 3.12 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 643.0 | ft | Watershed A |
| LOW POINT ELEVATION | 639.8 | ft | |
| ELEVATION DIFF (H) | 3.2 | ft | |
| LENGTH (L) | 134 | ft | |
| SLOPE (S) = (H/L) | 2.4% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V From Figure 816.6 Nearly Bare Ground |
| $T_C$ (SH)= | 1.49 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 639.8 | ft | Brow Ditch |
| LOW POINT ELEVATION | 568.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 71.8 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 1052 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 6.8% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Rough Concrete |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 12.99 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.35 | minutes | |

# Y Pre-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 564.0 | ft |
| LOW POINT ELEVATION | 563.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 45 | ft |
| SLOPE (S) = (H/L) | 2.2% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 1.5 | ft |
| HYDRAULIC RADIUS R | 0.4 | ft |
| VELOCITY (STORMDRAIN) | 8.9 | fps |
| $T_C$ (SD)= | 0.08 | minutes |

**NOTES:**

Watershed A

RCP - Exist Fed X

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft |
| LOW POINT ELEVATION | 562.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 100 | ft |
| SLOPE (S) = (H/L) | 1.0% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.5 | ft |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (STORMDRAIN) | 10.5 | fps |
| $T_C$ (SD)= | 0.16 | minutes |

**NOTES:**

Watershed A

RCP - Exist Fed X

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 562.0 | ft |
| LOW POINT ELEVATION | 542.0 | ft |
| ELEVATION DIFF (H) | 20.0 | ft |
| LENGTH (L) | 1252 | ft |
| SLOPE (S) = (H/L) | 1.6% | |
| MANNING'S n | 0.015 | |
| HYDRAULIC RADIUS R | 3.4 | ft |
| VELOCITY (CHANNEL) | 28.42 | fps |
| $T_C$ (CH)= | 0.73 | minutes |

**NOTES:**

Detention Facilty X

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 1.5 | ANG-RAD | 0.588 |
| b = | 15 | ANG-DEG | 33.690 |
| d = | 5 | FLOWING FULL ASS'M | |

Concrete per as-builts

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 542.0 | ft |
| LOW POINT ELEVATION | 538.0 | ft |
| ELEVATION DIFF (H) | 4.0 | ft |
| LENGTH (L) | 228 | ft |
| SLOPE (S) = (H/L) | 1.8% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 5.5 | ft |
| HYDRAULIC RADIUS R | 1.4 | ft |
| VELOCITY (STORMDRAIN) | 18.8 | fps |
| $T_C$ (SD)= | 0.20 | minutes |

**NOTES:**

Under Sanyo

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 538.0 | ft |
| LOW POINT ELEVATION | 522.0 | ft |
| ELEVATION DIFF (H) | 16.0 | ft |
| LENGTH (L) | 1215 | ft |
| SLOPE (S) = (H/L) | 1.3% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 1.7 | ft |
| VELOCITY (CHANNEL) | 3.03 | fps |
| $T_C$ (CH)= | 6.68 | minutes |

**NOTES:**

West of Sanyo

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 20 | ANG-RAD | 0.588 |
| b = | 20 | ANG-DEG | 33.690 |
| d = | 2 | FLOWING FULL ASS'M | |

Dirt/Grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

# Y Pre-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 522.0 | ft |
| LOW POINT ELEVATION | 520.0 | ft |
| ELEVATION DIFF (H) | 2.0 | ft |
| LENGTH (L) | 116 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 6.0 | ft |
| HYDRAULIC RADIUS R | 1.5 | ft |
| VELOCITY (STORMDRAIN) | 19.7 | fps |
| $T_C$ (SD)= | 0.10 | minutes |

**NOTES:**

Under Existing SR905

RCP BOX

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 520.0 | ft |
| LOW POINT ELEVATION | 510.0 | ft |
| ELEVATION DIFF (H) | 10.0 | ft |
| LENGTH (L) | 1319 | ft |
| SLOPE (S) = (H/L) | 0.8% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 1.7 | ft |
| VELOCITY (CHANNEL) | 2.30 | fps |
| $T_C$ (CH)= | 9.55 | minutes |

**NOTES:**

West of Existing SR905

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 20 | ANG-RAD | 0.588 |
| b = | 20 | ANG-DEG | 33.690 |
| d = | 2 | FLOWING FULL ASS'M | |

Dirt/Grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 23.46 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **23.46** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

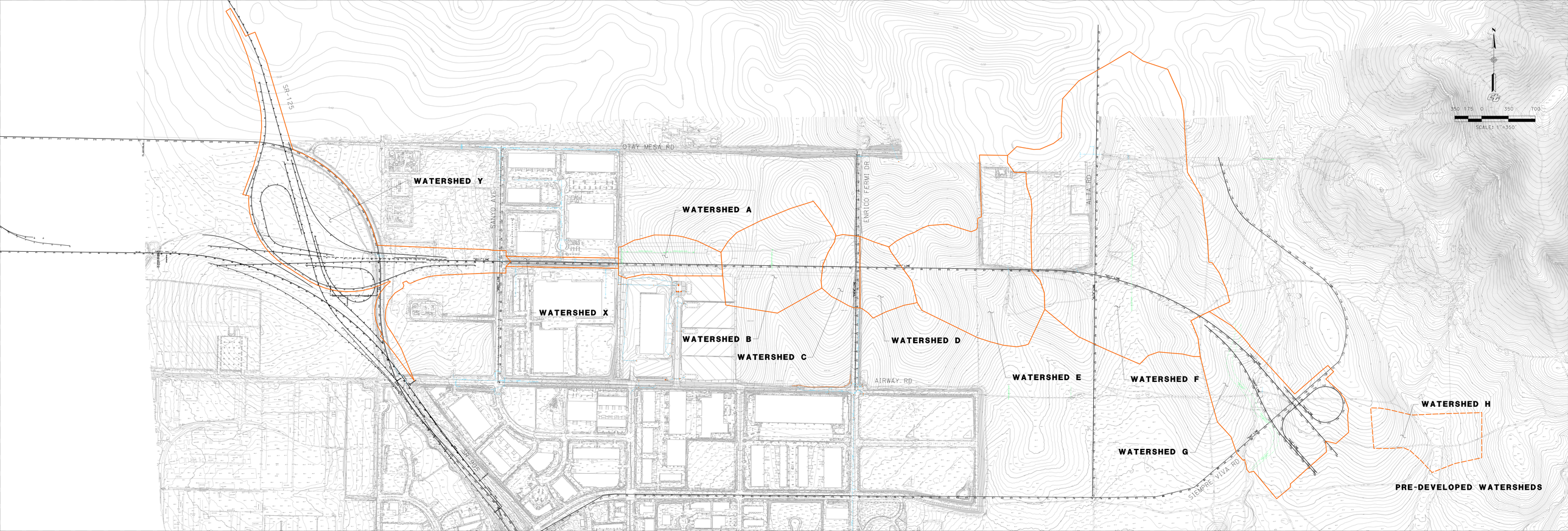
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.1 | in/hr | X CA = | |
| $i_{10}$ = | 1.6 | in/hr | X CA = | |
| $i_{25}$ = | 1.9 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.4 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 36.2 |
| **$Q_{10}$ =** | 52.6 |
| **$Q_{25}$ =** | 72.4 |
| **$Q_{50}$ =** | 94.8 |
| **$Q_{100}$ =** | **102.8** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


SR-125
OTAY MESA RD
SANYO AVE
ENRICO FERMI DR
ALTA RD
AIRWAY RD
SIEMPRE VIVA RD
WATERSHED Y
WATERSHED A
WATERSHED X
WATERSHED B
WATERSHED C
WATERSHED D
WATERSHED E
WATERSHED F
WATERSHED G
WATERSHED H
PRE-DEVELOPED WATERSHEDS
350 175 0 350 700
SCALE: 1"=350'

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# *Appendix B* NO-Interchange Alternative

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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**AECOM**
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SAN DIEGO, CA 92111


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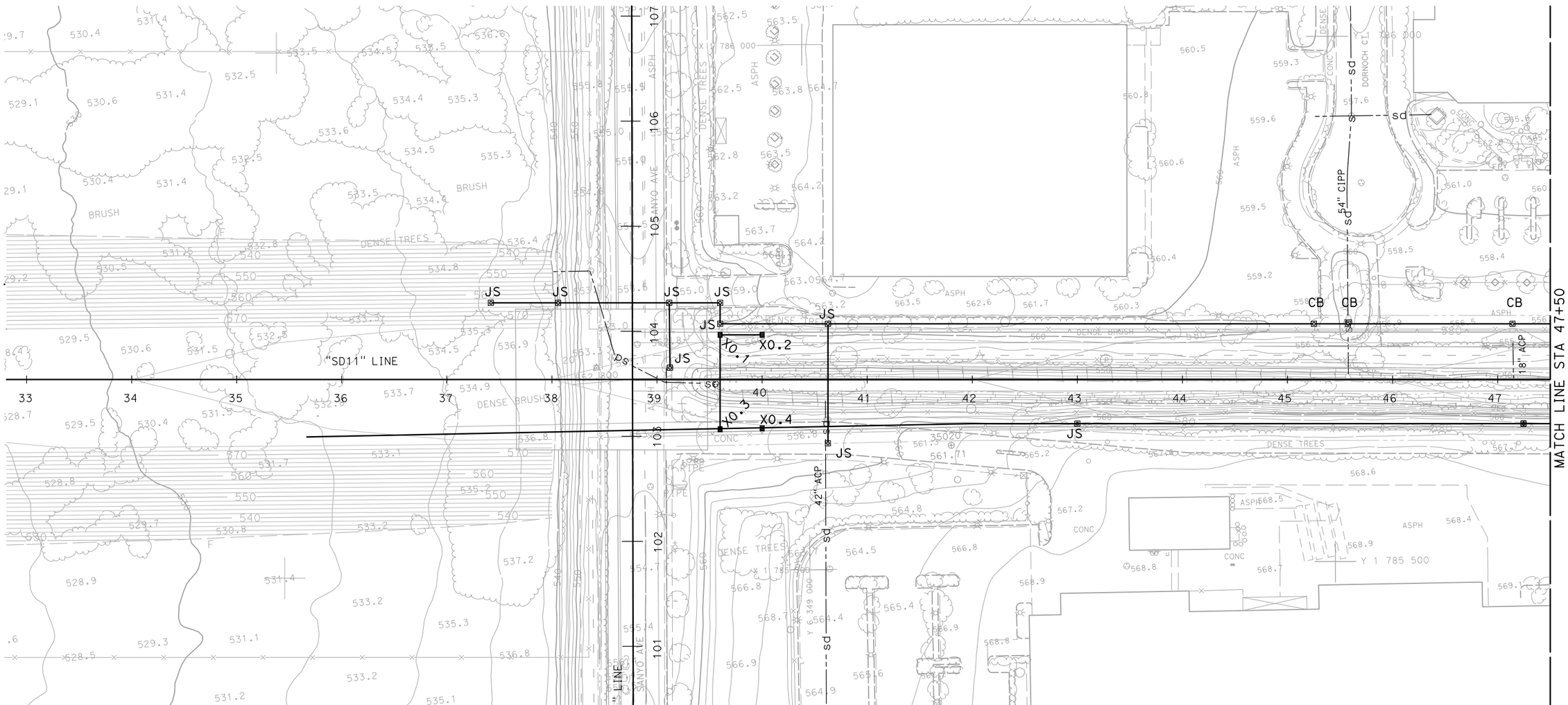
LEGEND:

- JS
- PIPE
- INLET W/APRON
- RSP
- HEADWALL
- --sd— EXISTING STORMDRAIN




# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-1**

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

| REVISED BY | DATE REVISED |
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CALCULATED-DESIGNED BY

CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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60099859

2/3/2010 8:40:42 AM CarrilloG H:\Caltrans\2208300\Cad\planset\b056300ia00L.dgn

BORDER LAST REVISED 4/11/2008

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USERNAME => CarrilloG
DGN FILE => ...\b056300ia001.dgn

CU XXXXX

EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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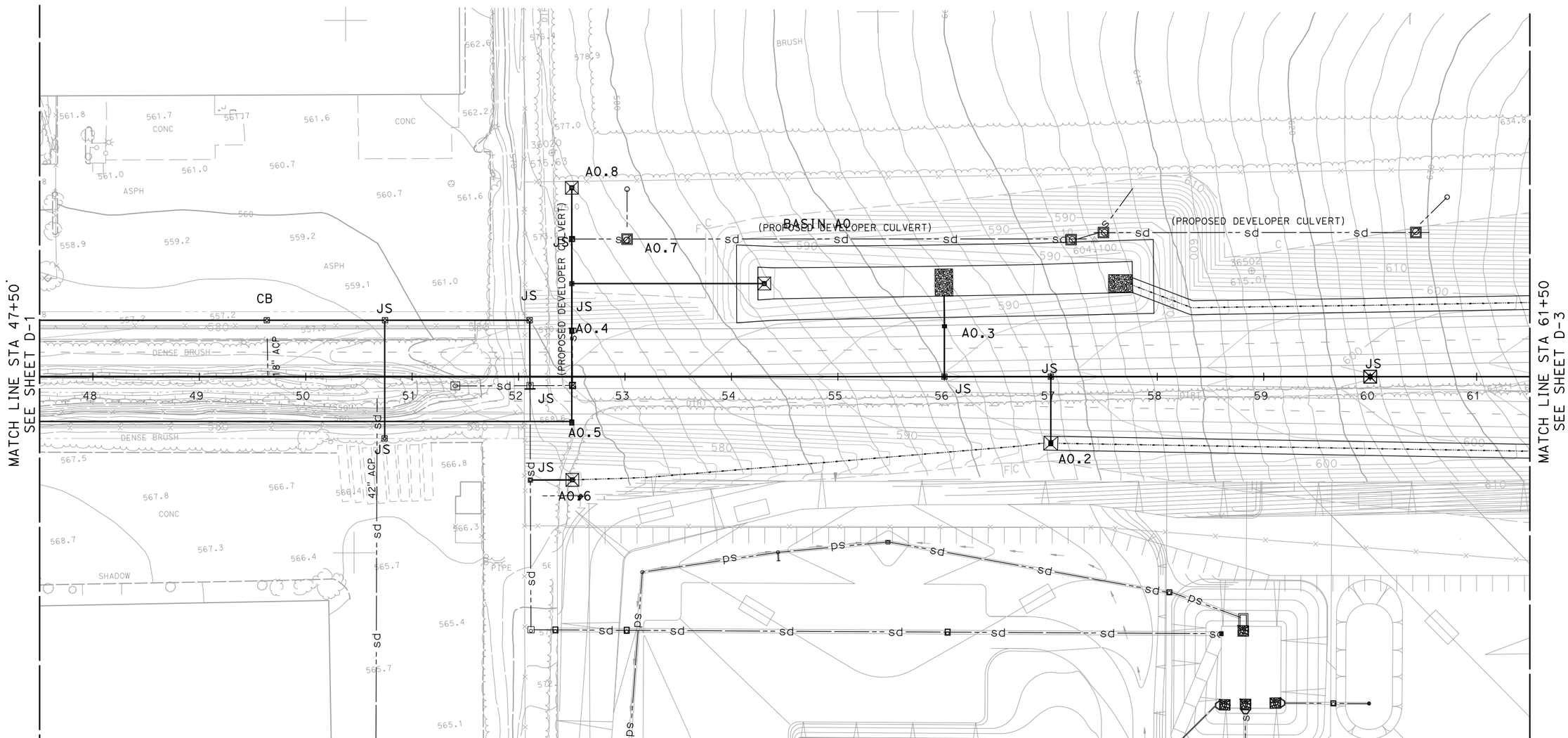


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SCALE 1"=50'

# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

**D-2**

| REVISED BY | DATE REVISED |
|---|---|
| | |
| | |
| | |
| | |

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
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| 11 | SD | 11 | 23.3/26.6 | | |

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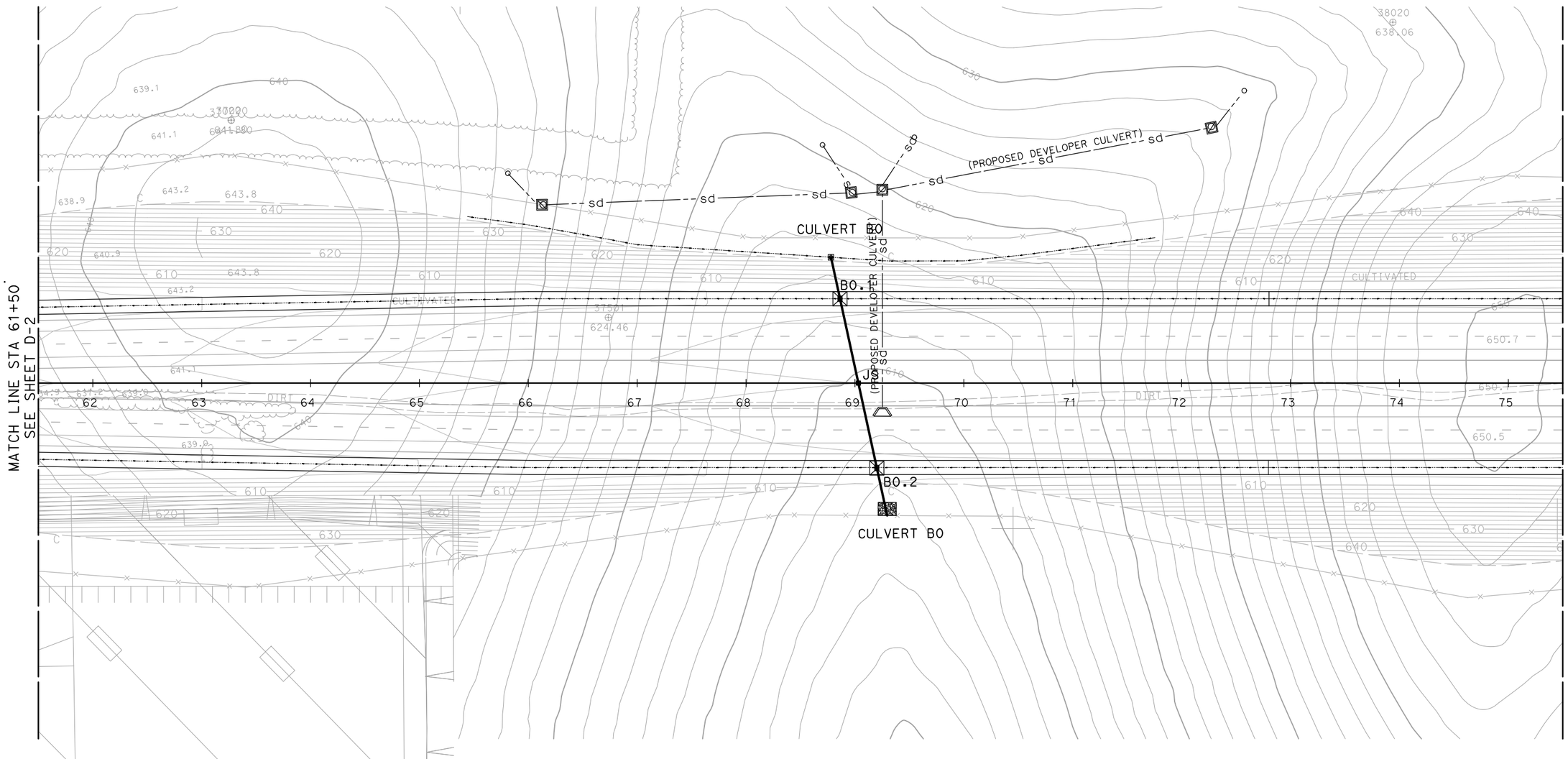


**NO INTERCHANGE ALTERNATIVE**

**DRAINAGE PLAN**

**D-3**

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SCALE 1"=50'

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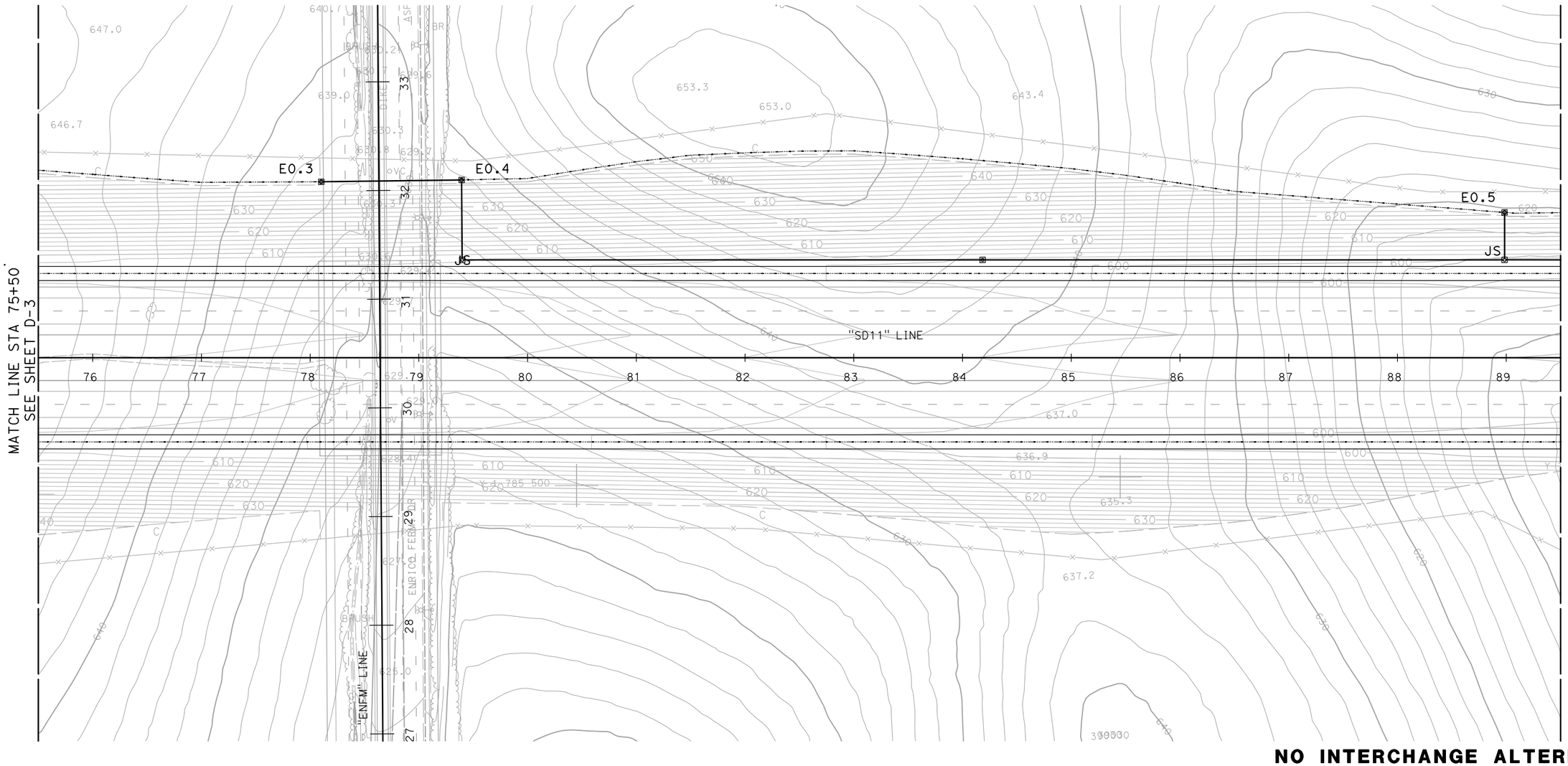


**NO INTERCHANGE ALTERNATIVE**

**DRAINAGE PLAN**

**D-4**

SCALE 1"=50'

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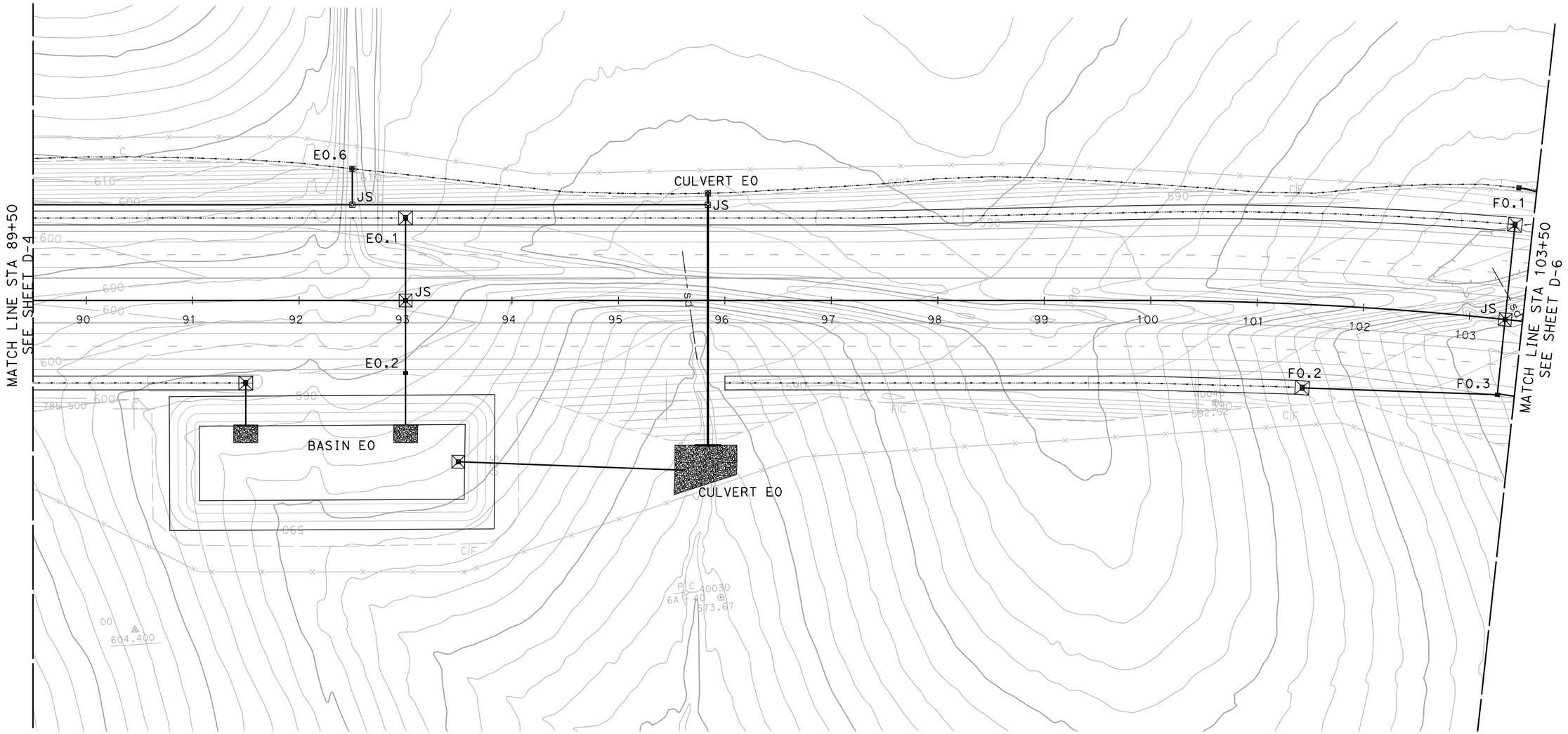


# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-5**

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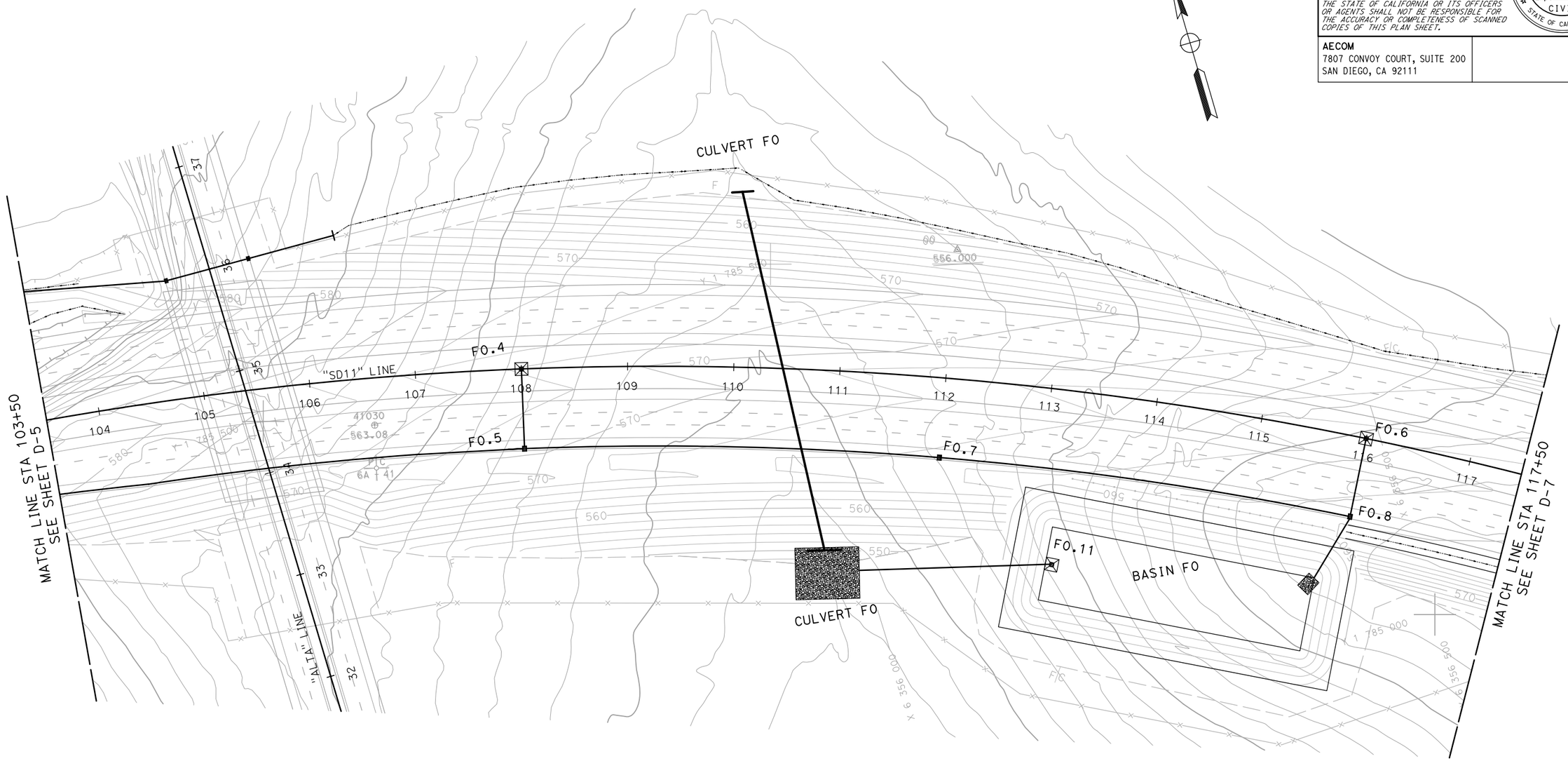


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# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-6**

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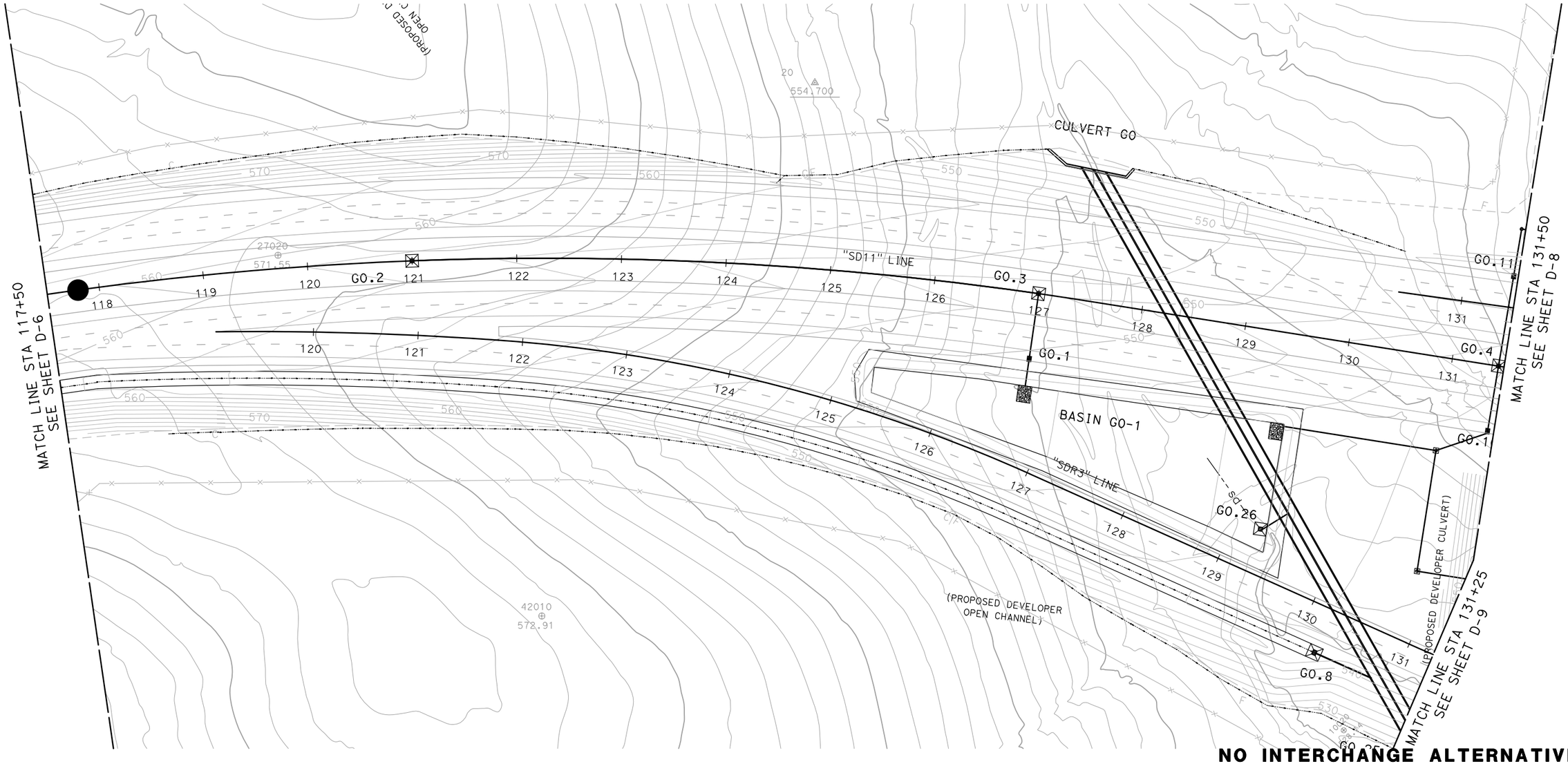


# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-7**

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CALCULATED-DESIGNED BY: MIKE BRUNING

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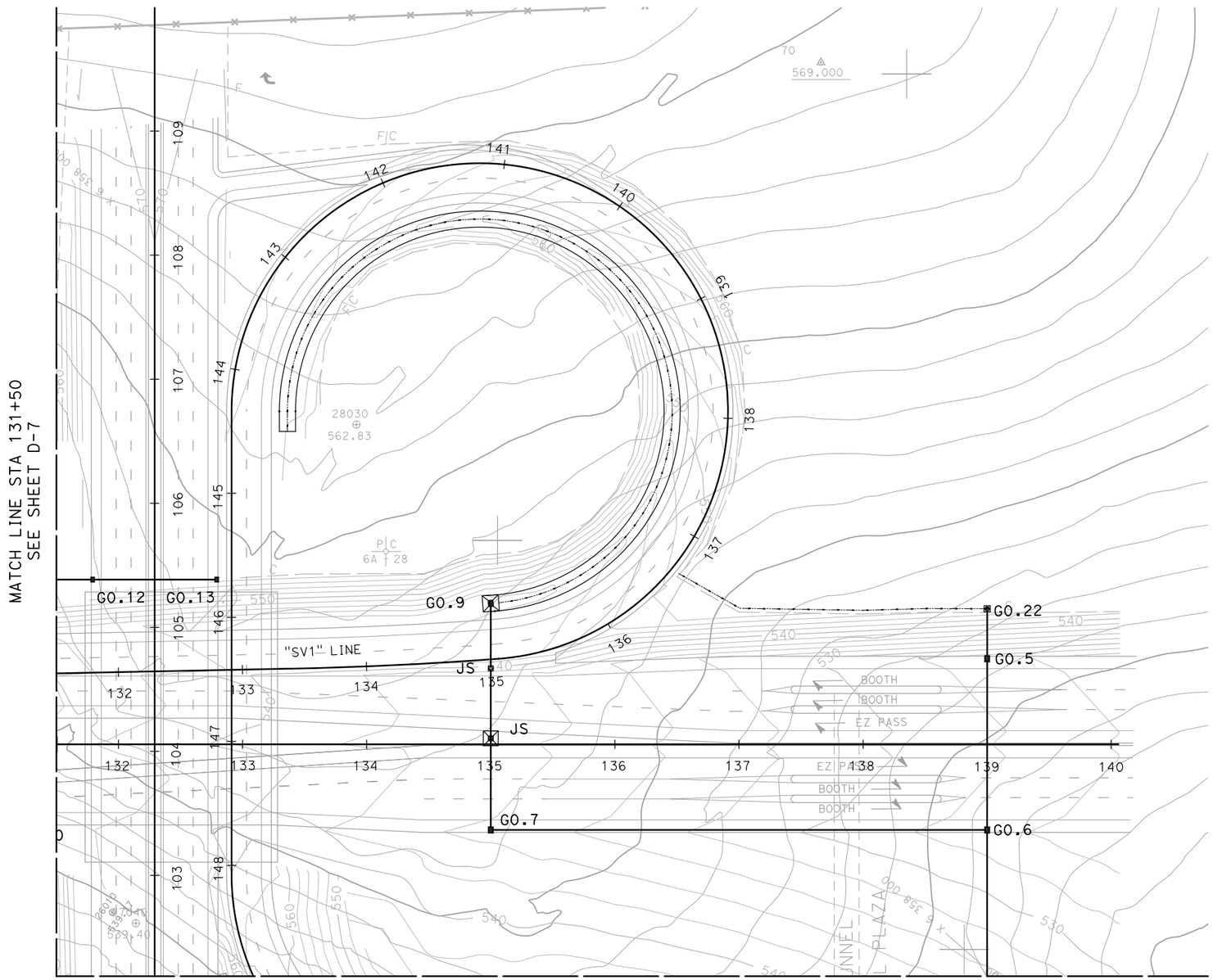


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# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-8**

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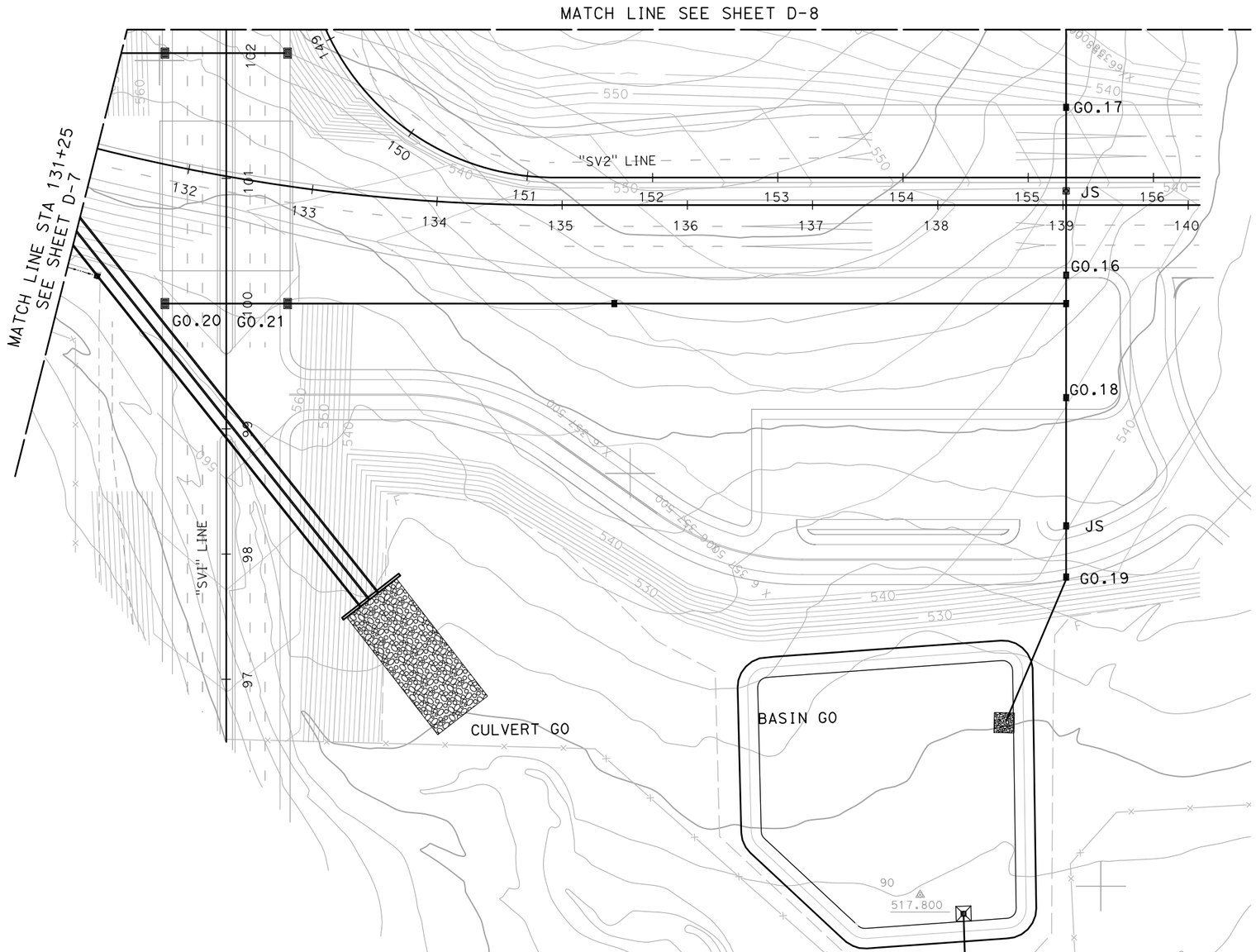


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# NO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-9**

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| 11 | SD | 11 | 23.3/26.6 | | |

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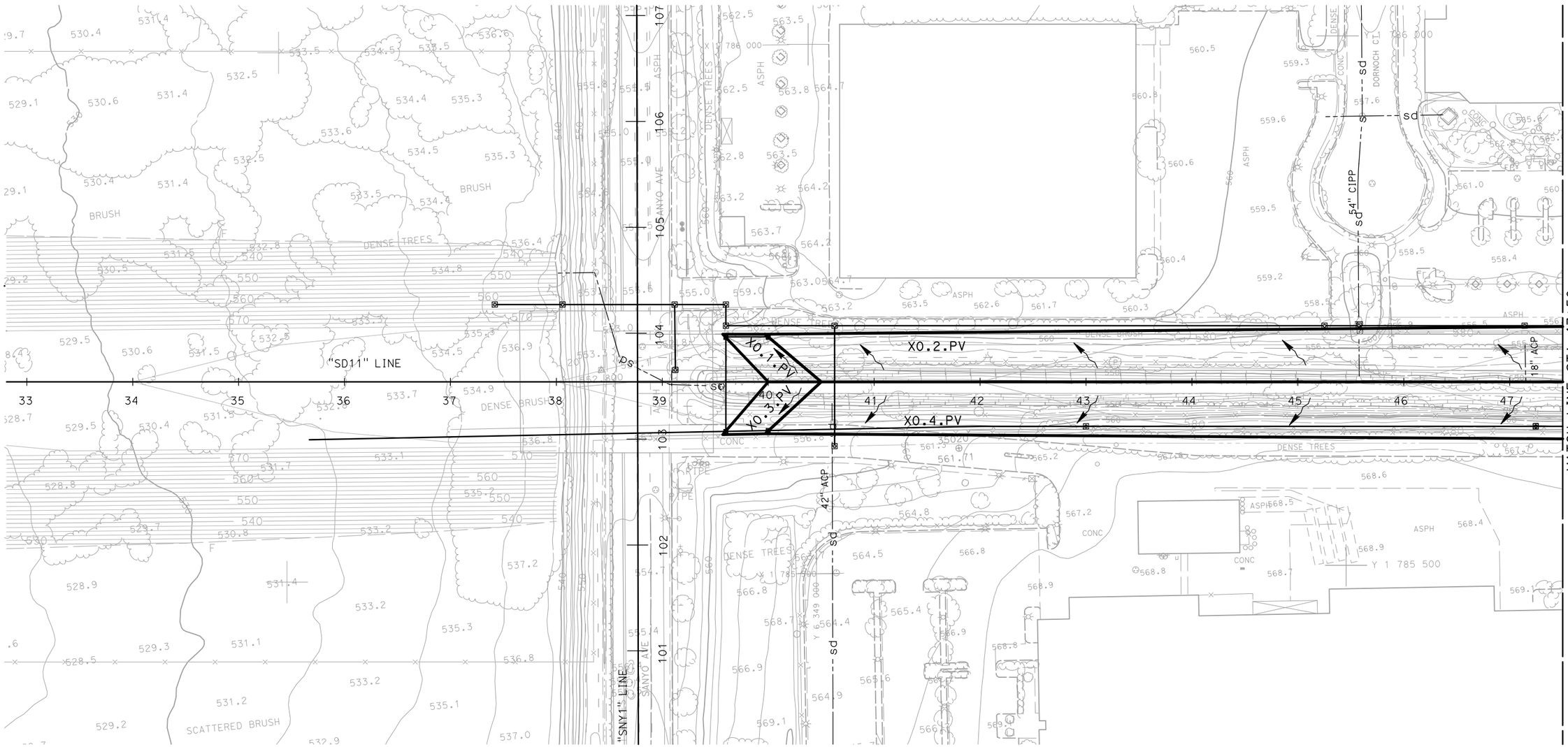
LEGEND:

- JS
- PIPE
- INLET W/APRON
- RSP
- HEADWALL
- --sd-- EXISTING STORMDRAIN




# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-1**

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ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

| REVISED BY | DATE REVISED |
|---|---|
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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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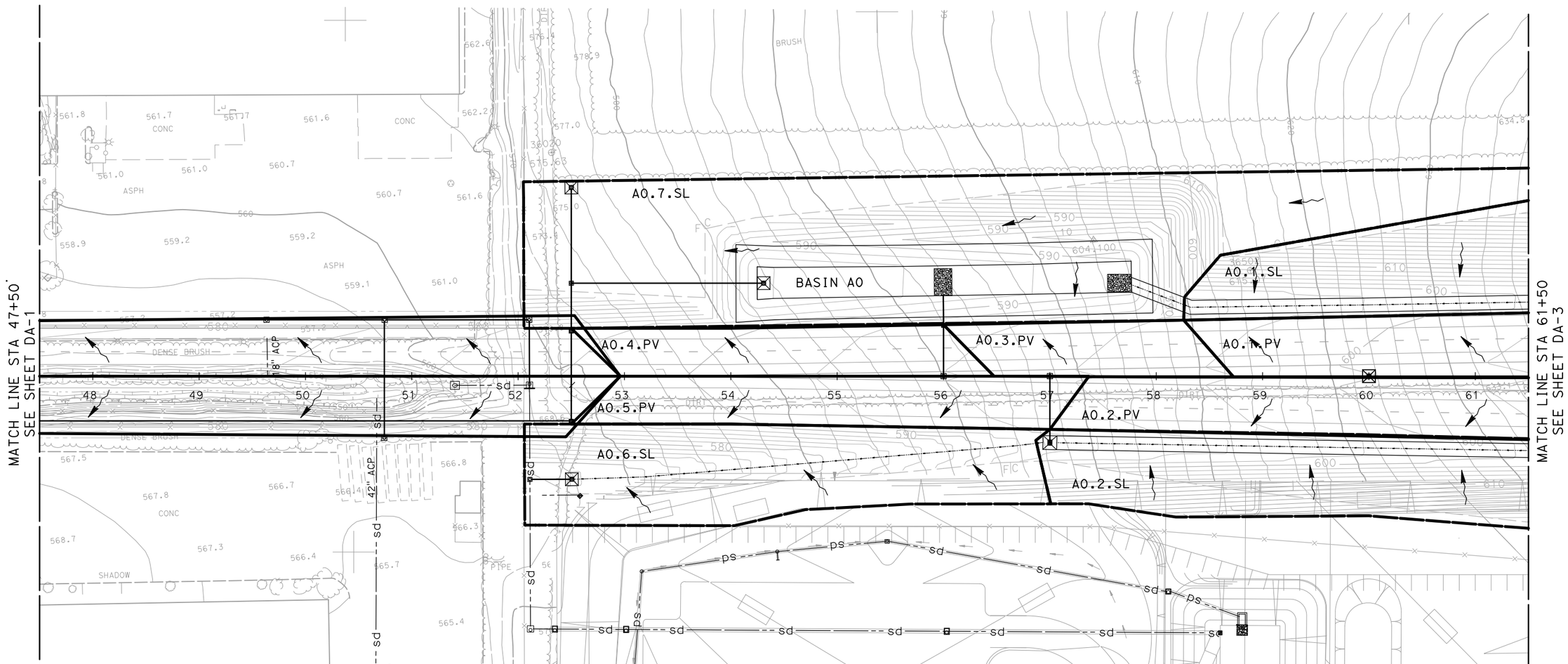


# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-2**

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ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

| REVISED BY | DATE REVISED |
|---|---|
| | |

CALCULATED-DESIGNED BY: MIKE BRUNING
CHECKED BY: GERARD DALZIEL

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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2/3/2010 8:47:16 AM CarrilloG H:\Caltrans\2208300\Cad\planset\b056300la002_0DA.dgn

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => CarrilloG
DGN FILE => ...\b056300la002_0DA.dgn

CU XXXXX

EA 06002

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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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**AECOM**
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SAN DIEGO, CA 92111


NOTE:

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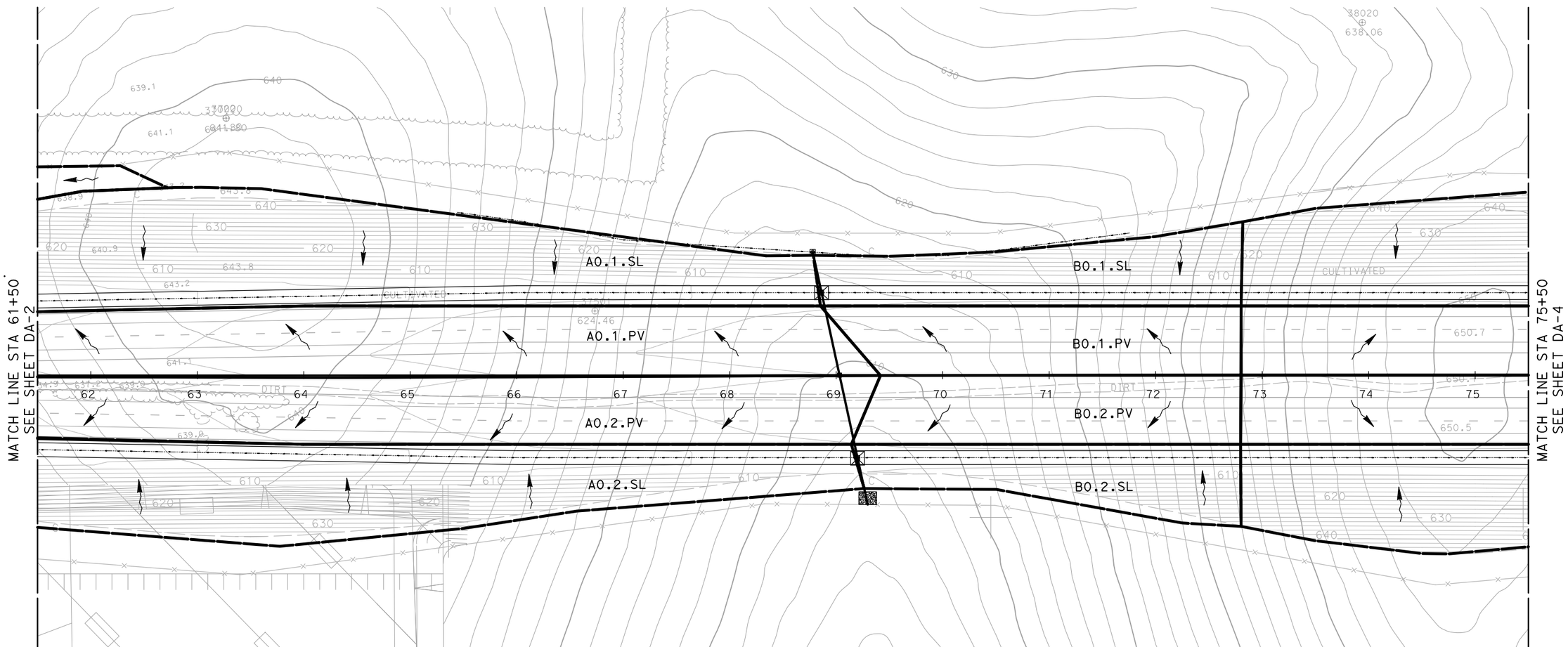


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# NO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-3**

REVISED BY | DATE REVISED

MIKE BRUNING | GERARD DALZIEL

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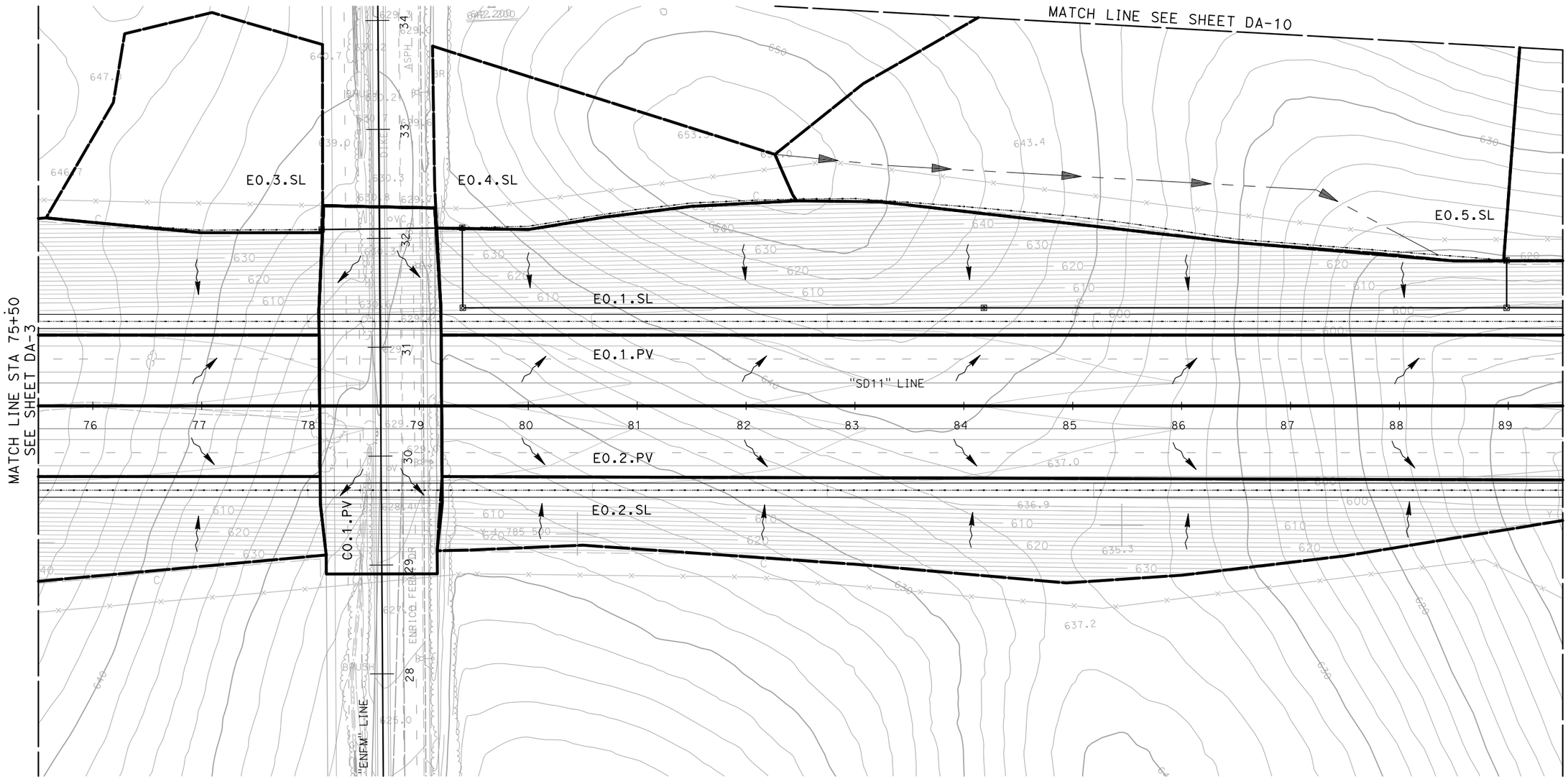


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-4**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

DATE REVISED

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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

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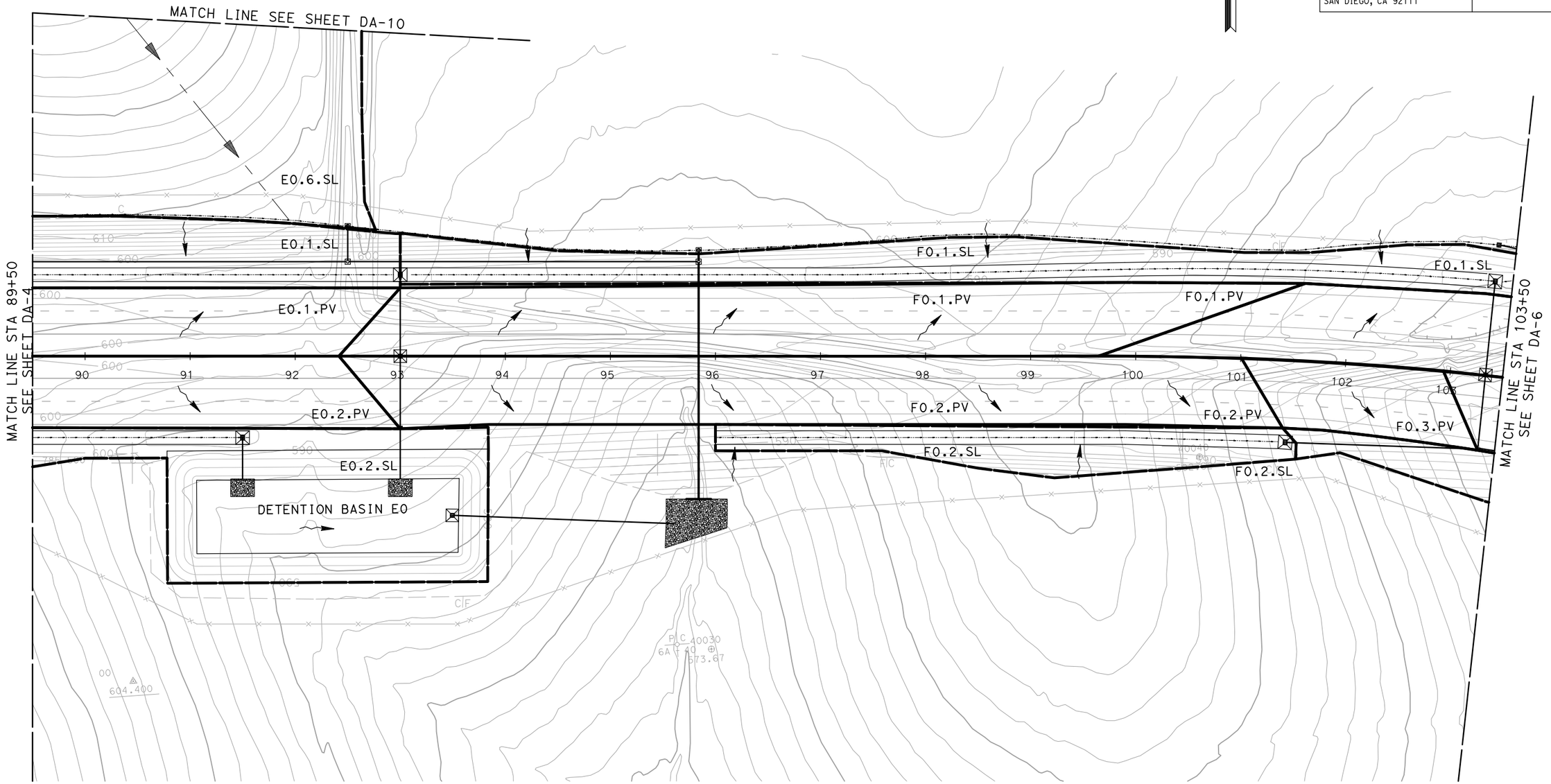


# NO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-5**

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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|---|---|
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| CALCULATED-DESIGNED BY | CHECKED BY |
| CONSULTANT FUNCTIONAL SUPERVISOR | KIRK BRADBURY |

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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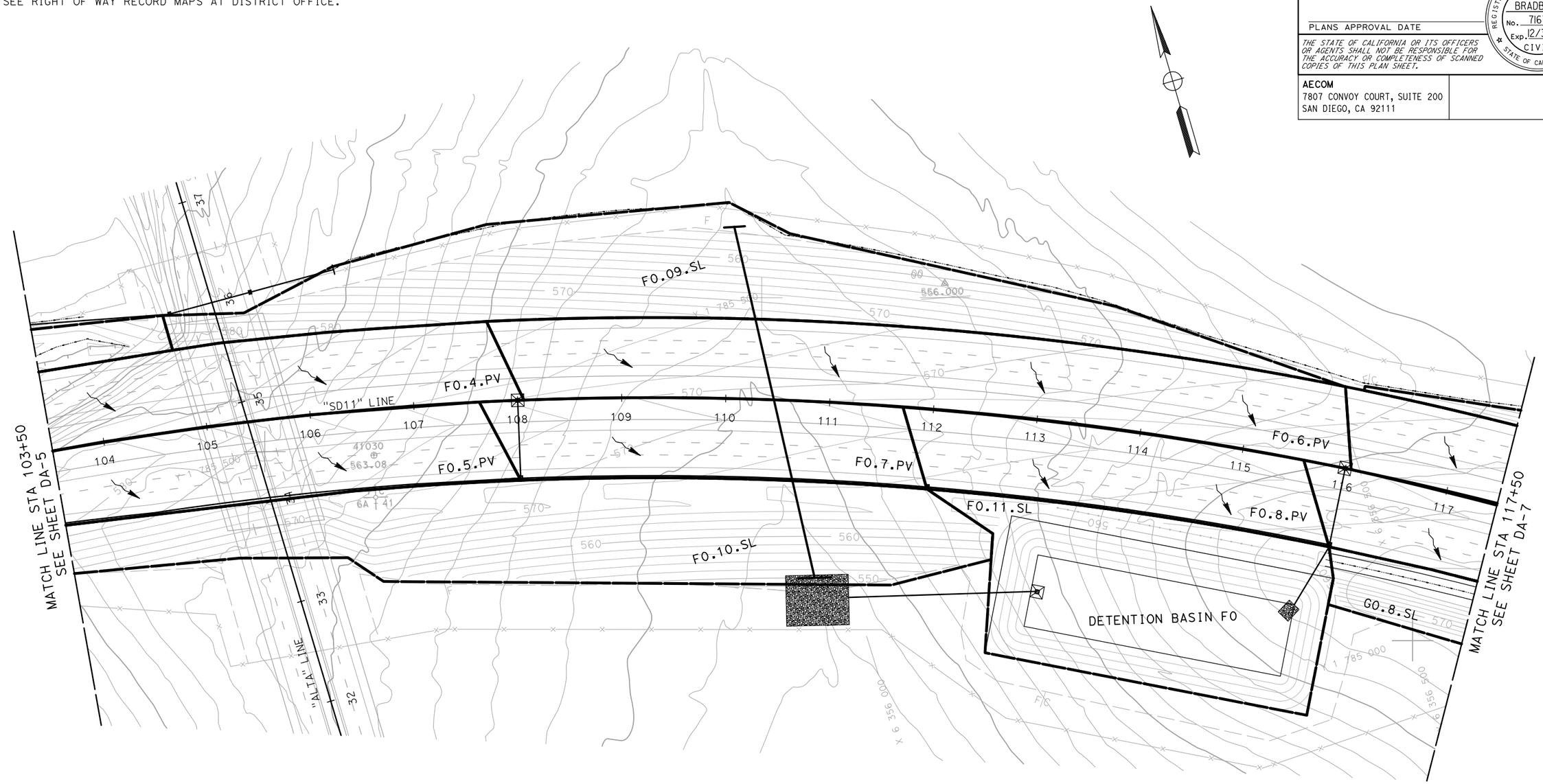


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-6**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

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DATE REVISED

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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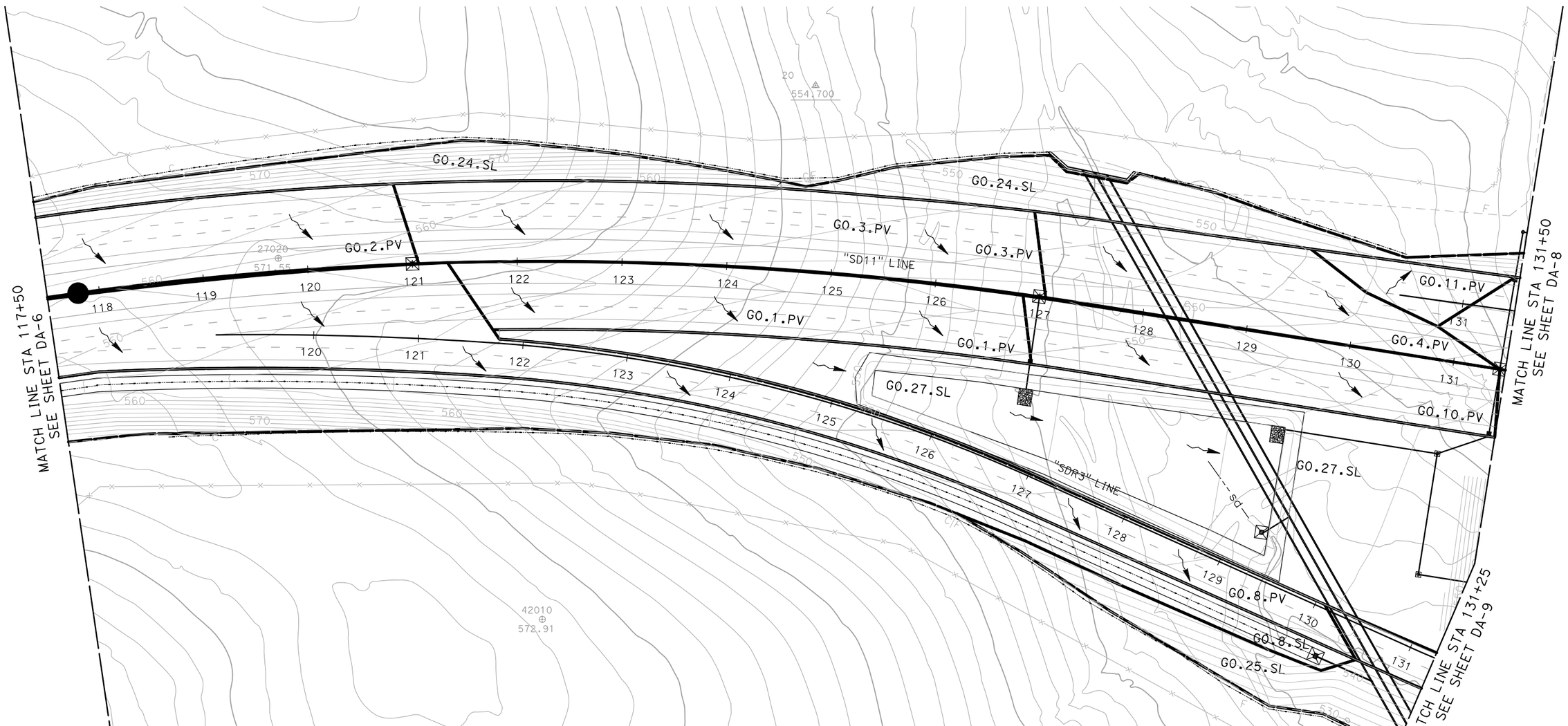


# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-7**

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

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|---|---|
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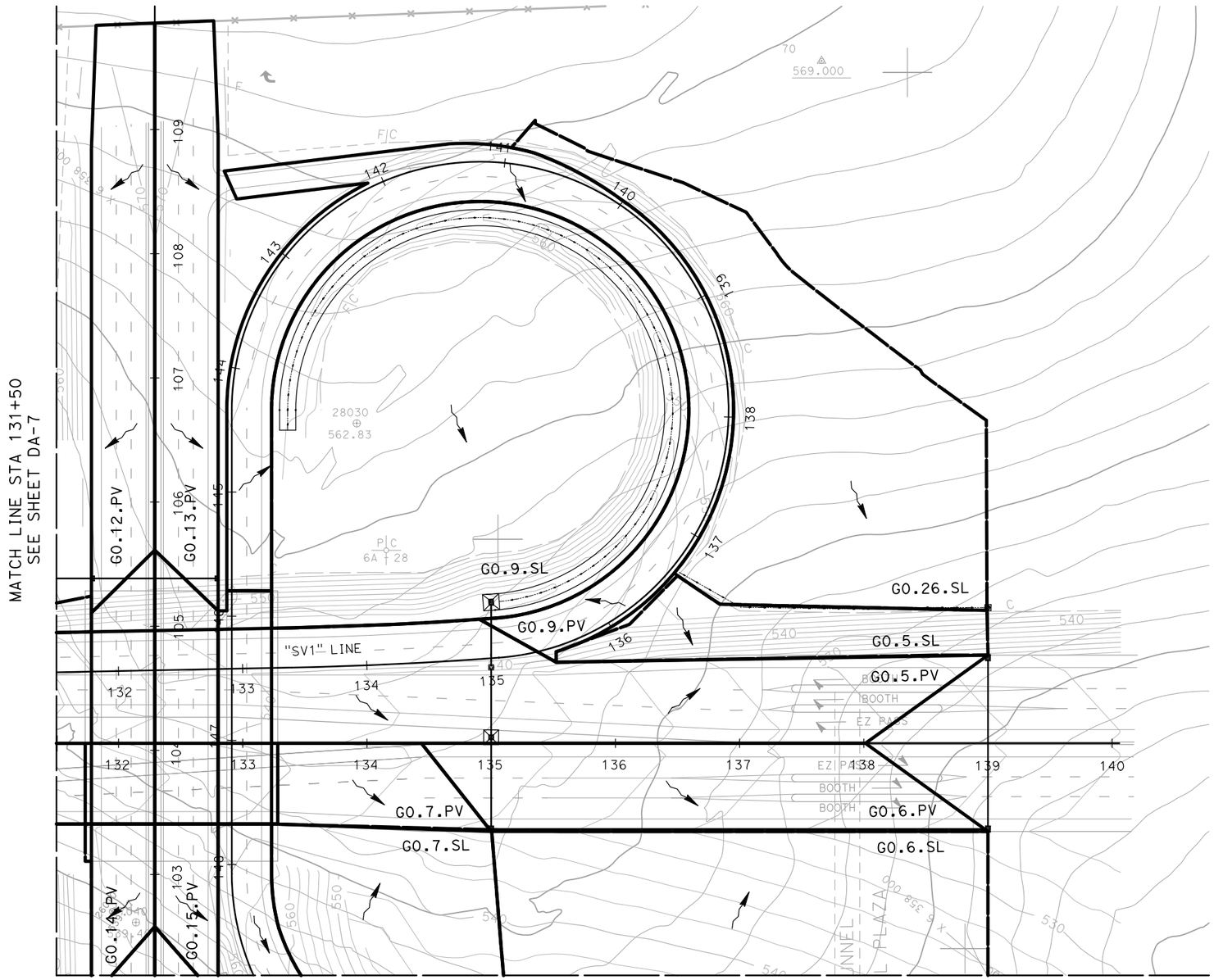


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-8**

| REVISED BY | DATE REVISED |
|---|---|
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2/3/2010 5:51:59 PM YamanakaG h:\caltrans\2208300\cad\planset\b056300ia008_0da.dgn

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => YamanakaG
DGN FILE => ...\b056300ia008_0da.dgn

CU XXXXX

EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

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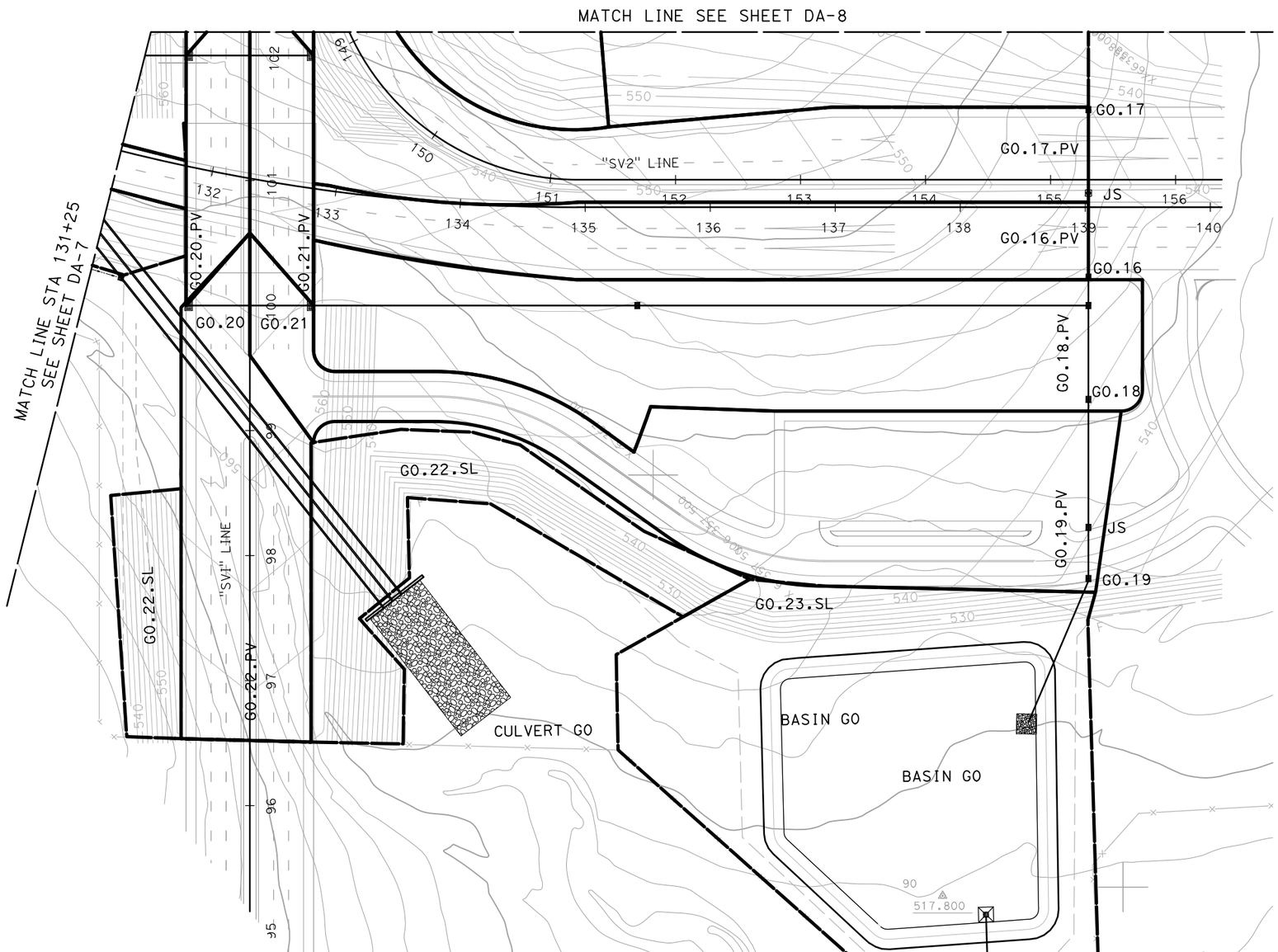


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-9**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

DATE REVISED

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TIME PLOTTED => 9:08:52 AM

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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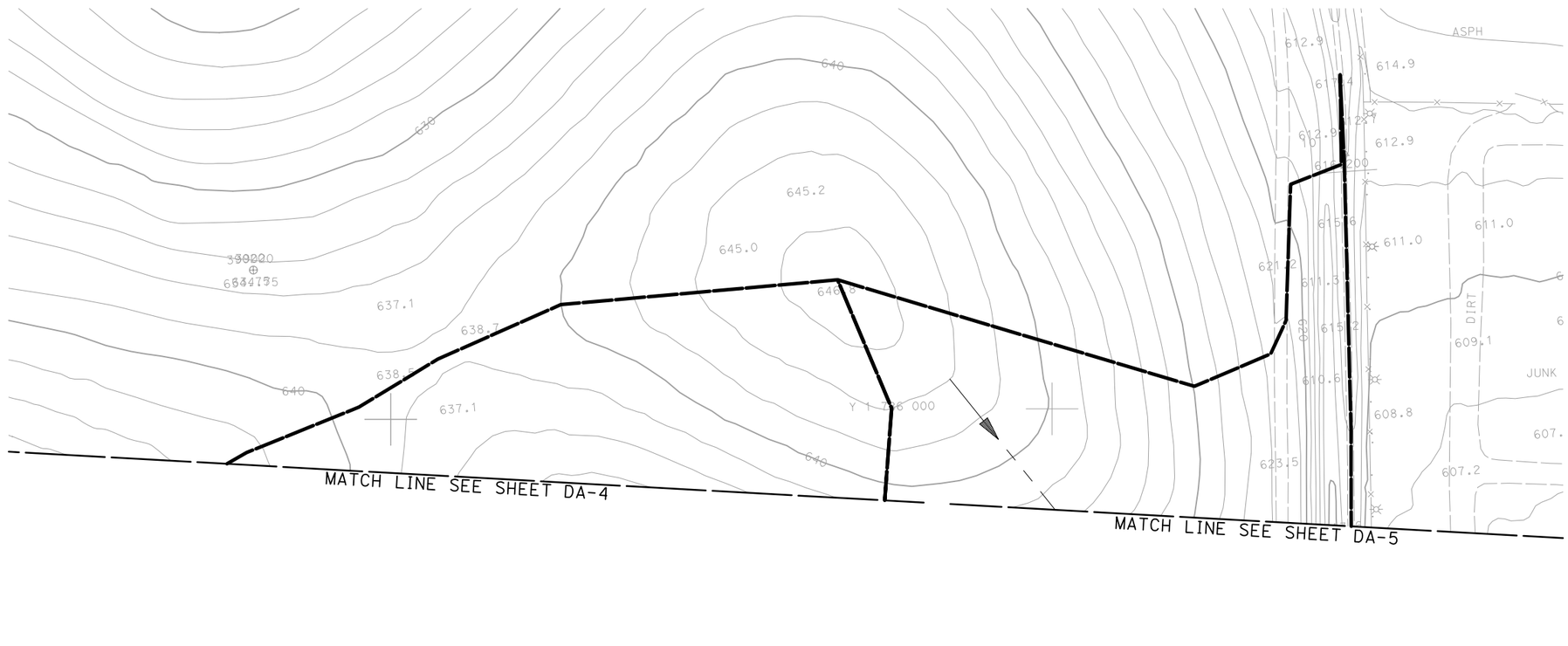


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# NO INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-10**

| REVISED BY | DATE REVISED |
|---|---|
| | |
| | |
| | |
| MIKE BRUNING | GERARD DALZIEL |

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CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => YamanakaG
DGN FILE => ...\b056300ia010_0da.dgn

CU XXXXX

EA 06002

# A0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | A0.1.PV | 0.99 | 67400 | 1.5 | 10 | 2.8 | 4.33 | 4.2 | 6.45 | A0.1 | ~ | Basin A0 | 57+75 | Lt |
| | A0.2.PV | 0.99 | 72100 | 1.7 | 10 | 2.8 | 4.64 | 4.2 | 6.90 | A0.2 | A0.2 | Basin A0 | 57+00 | Rt |
| | A0.3.PV | 0.99 | 11600 | 0.3 | 5 | 4.0 | 1.05 | 6.6 | 1.74 | ~ | A0.3 | Basin A0 | 56+00 | Lt |
| | A0.4.PV | 0.99 | 16200 | 0.4 | 5 | 4.0 | 1.47 | 6.6 | 2.43 | ~ | A0.4 | *bypass** | 52+50 | Lt |
| | A0.5.PV | 0.99 | 20900 | 0.5 | 5 | 4.0 | 1.90 | 6.6 | 3.13 | ~ | A0.5 | *bypass** | 52+50 | Rt |

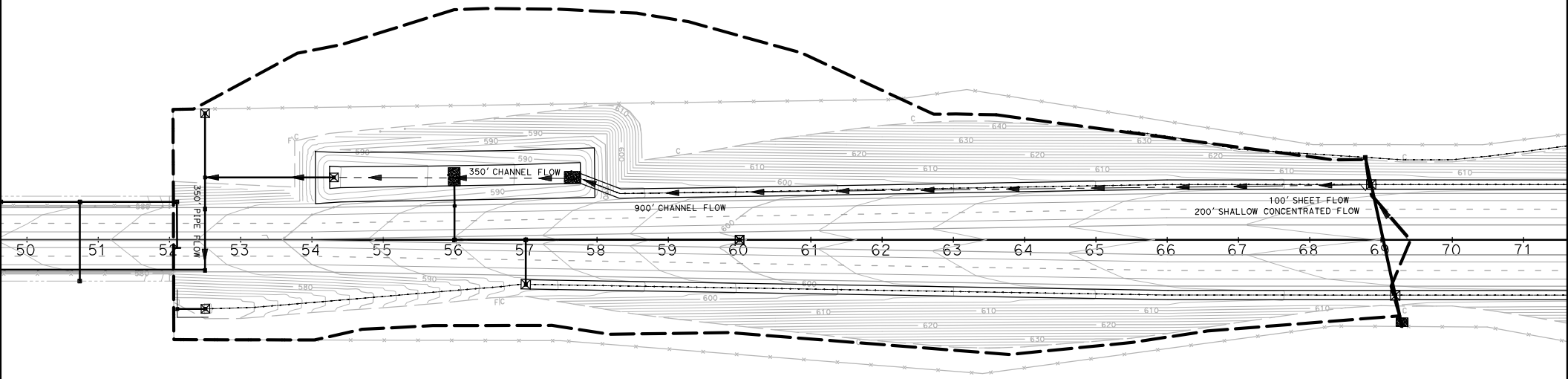
Σ 188200 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | A0.1.SL | 0.61 | 88600 | 2.0 | 10 | 2.8 | 3.51 | 4.2 | 5.23 | A0.1 | ~ | Basin A0 | 57+75 | Lt |
| | A0.2.SL | 0.61 | 92400 | 2.1 | 10 | 2.8 | 3.66 | 4.2 | 5.45 | A0.2 | A0.2 | Basin A0 | 57+00 | Rt |
| | A0.6.SL | 0.61 | 41100 | 0.9 | 10 | 2.8 | 1.63 | 4.2 | 2.42 | ~ | A0.6 | *bypass** | 52+50 | Rt |
| | A0.7.SL | 0.61 | 107500 | 2.5 | 10 | 2.8 | 4.26 | 4.2 | 6.34 | ~ | A0.7 | Basin A0 | 54+25 | Lt |

Σ 329600 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 517800 | 11.9 |
| | *SF* | *ac* |




WATERSHED A0
NO INTERCHANGE
ALTERNATIVE

Scale: 1"=200'

# A0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 52+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 613381 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 14.08 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 16% | AT | 0.42 | 0.065 |
| PAVED SURFACE | 31% | AT | 0.90 | 0.276 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 54% | AT | 0.55 | 0.296 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.64 |
| $C_{25}$ = | 0.70 |
| $C_{50}$ = | 0.76 |
| $C_{100}$ = | 0.80 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 607.8 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 100 | ft | To Bioswale |
| SLOPE (S) = (H/L) | 0.7% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.32 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | Origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | Assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 Grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 16.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 900 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.42 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.38 | minutes | |

# A0 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 590.0 | ft |
| LOW POINT ELEVATION | 584.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 350 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 3.36 | fps |
| $T_C$ (CH)= | 1.73 | minutes |

**NOTES:**

Assume basin floor has same dimensions of bioswale

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft |
| LOW POINT ELEVATION | 583.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 350 | ft |
| SLOPE (S) = (H/L) | 0.3% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 3.9 | fps |
| $T_C$ (SD)= | 1.51 | minutes |

**NOTES:**

Proposed basin outlet pipe

Discharge at watershed end (Sta 52+00)

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.85 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **12.85** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = |
| $i_{10}$ = | 2.3 | in/hr | X CA = |
| $i_{25}$ = | 2.9 | in/hr | X CA = |
| $i_{50}$ = | 3.4 | in/hr | X CA = |
| $i_{100}$ = | 3.6 | in/hr | X CA = |

**FLOW RESULTS:**

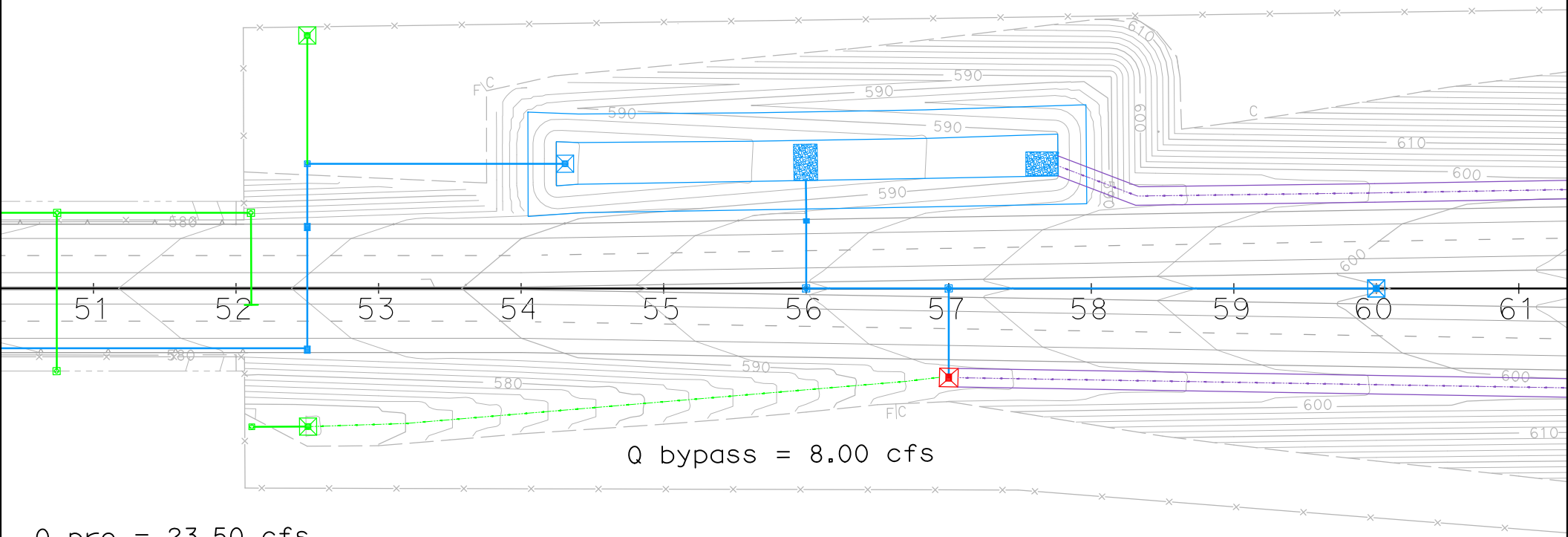
| | cfs |
|---|---|
| **$Q_2$ =** | 14.1 |
| **$Q_{10}$ =** | 20.6 |
| **$Q_{25}$ =** | 28.3 |
| **$Q_{50}$ =** | 37.0 |
| **$Q_{100}$ =** | **40.2** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass

Q in = 35.60 cfs
Q out = 1.32 cfs




Q bypass = 8.00 cfs

Q pre = 23.50 cfs
Q final = 9.32 cfs

BASIN AO
FLOW SUMMARY

Scale: 1"=100'

# Basin A0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 58+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 23.5 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 10.51 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 480 | 0.8 |
| 20 | 480 | 0.8 |
| 30 | 540 | 0.9 |
| 40 | 540 | 0.9 |
| 50 | 540 | 0.9 |
| 60 | 600 | 1 |
| 70 | 600 | 1 |
| 80 | 600 | 1 |
| 90 | 660 | 1.1 |
| 100 | 660 | 1.1 |
| 110 | 720 | 1.2 |
| 120 | 720 | 1.2 |
| 130 | 780 | 1.3 |
| 140 | 840 | 1.4 |
| 150 | 900 | 1.5 |
| 160 | 960 | 1.6 |
| 170 | 1020 | 1.7 |
| 180 | 1080 | 1.8 |
| 190 | 1260 | 2.1 |
| 200 | 1380 | 2.3 |
| 210 | 1680 | 2.8 |
| 220 | 1920 | 3.2 |
| 230 | 2760 | 4.6 |
| 240 | 3900 | 6.5 |
| 250 | 14100 | 23.5 |
| 260 | 2220 | 3.7 |
| 270 | 1500 | 2.5 |
| 280 | 1140 | 1.9 |
| 290 | 960 | 1.6 |
| 300 | 840 | 1.4 |
| 310 | 780 | 1.3 |
| 320 | 720 | 1.2 |
| 330 | 660 | 1.1 |
| 340 | 600 | 1 |
| 350 | 540 | 0.9 |
| 360 | 540 | 0.9 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **50220** | **$ft^3$** |
| | **1.15** | **acre-feet** |

Check: $V = C*A*P_6$

V= 1.16 acre-feet

***OK***

# Basin A0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 40.2 | cfs | | | |
| Tc= | 12.8 | min | C= | 0.80 | |
| $P_{100,6}$= | 2.5 | in | A= | 14.08 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 1092 | 1.4 |
| 26 | 1326 | 1.7 |
| 39 | 1404 | 1.8 |
| 52 | 1482 | 1.9 |
| 65 | 1482 | 1.9 |
| 78 | 1560 | 2 |
| 91 | 1638 | 2.1 |
| 104 | 1716 | 2.2 |
| 117 | 1794 | 2.3 |
| 130 | 1950 | 2.5 |
| 143 | 2106 | 2.7 |
| 156 | 2262 | 2.9 |
| 169 | 2418 | 3.1 |
| 182 | 2808 | 3.6 |
| 195 | 3042 | 3.9 |
| 208 | 3666 | 4.7 |
| 221 | 4212 | 5.4 |
| 234 | 6162 | 7.9 |
| 247 | 8580 | 11 |
| 260 | 31356 | 40.2 |
| 273 | 4992 | 6.4 |
| 286 | 3354 | 4.3 |
| 299 | 2574 | 3.3 |
| 312 | 2184 | 2.8 |
| 325 | 1872 | 2.4 |
| 338 | 1716 | 2.2 |
| 351 | 1560 | 2 |
| 364 | 1404 | 1.8 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 101712 $ft^3$**
**2.33 acre-feet**

Check: $V = C*A*P_6$
V= 2.34 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **2.33** | *(Post)* | | |
| | **-** | **1.15** | *(Pre)* | | |
| **Retention volume =** | | **1.18** | **acre-feet** | **=** | **51492 $ft^3$** **Basin Required** |

# Basin A0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.84
A= 10.09 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **24178** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

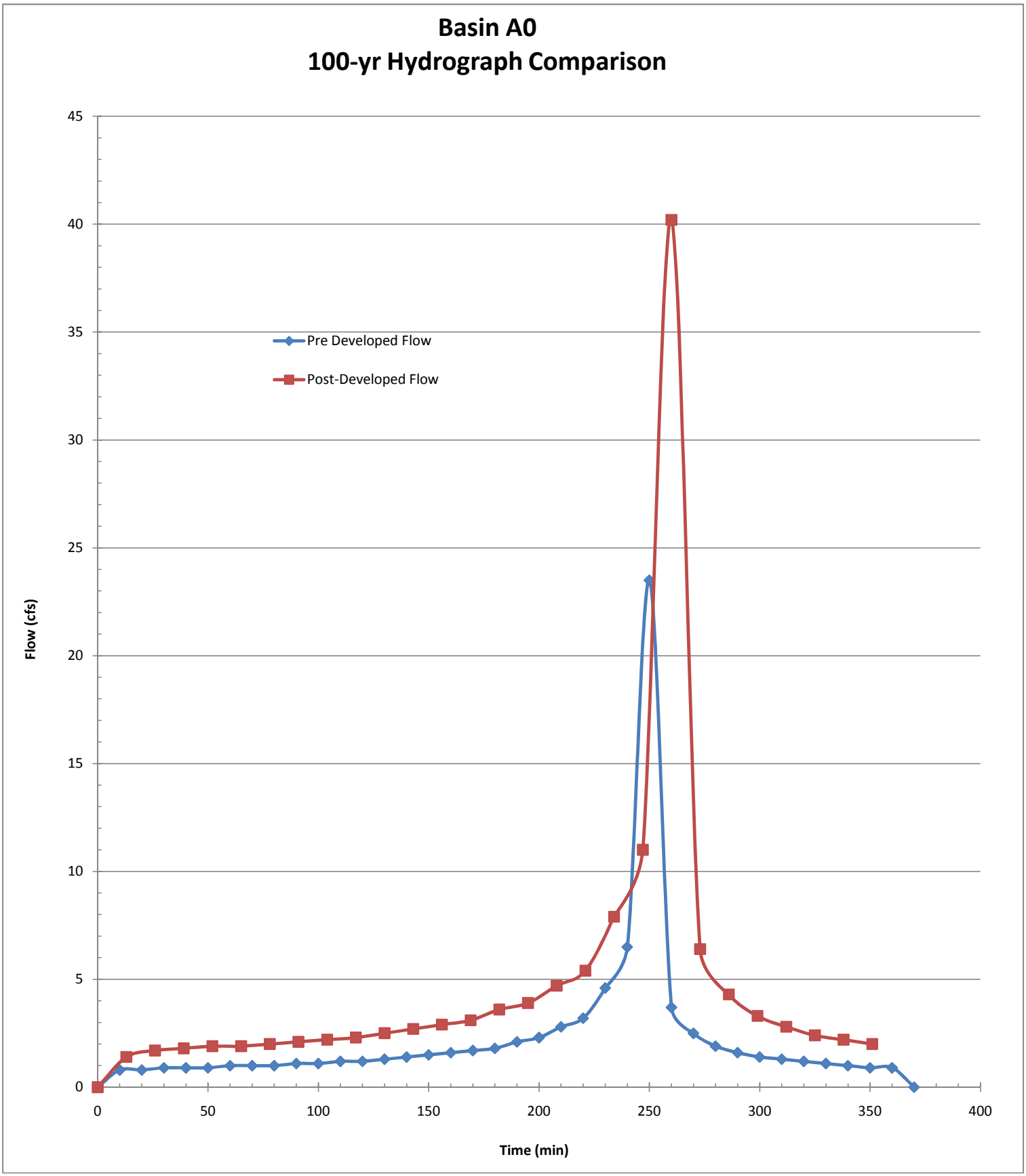
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 288500 | $ft^2$ |
| | A: | 6.62 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 103.00 tons

**Silt Accumulation Basin volume =** **2289** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**

.


Basin A0
100-yr Hydrograph Comparison
Pre Developed Flow
Post-Developed Flow
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
45
0
50
100
150
200
250
300
350
400

# Basin A0 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 57+75 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 439600 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.09 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 34% | AT | 0.90 | 0.309 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 66% | AT | 0.55 | 0.361 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.67 |
| $C_{25}$ = | 0.74 |
| $C_{50}$ = | 0.80 |
| $C_{100}$ = | 0.84 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 607.8 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 100 | ft | To Bioswale |
| SLOPE (S) = (H/L) | 0.7% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.32 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | Origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | Assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 Grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 16.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 900 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.42 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.38 | minutes | |

# Basin A0 Inflow TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 9.60 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 12.5 |
| **$Q_{10}$ =** | 18.2 |
| **$Q_{25}$ =** | 25.1 |
| **$Q_{50}$ =** | 32.8 |
| **$Q_{100}$ =** | **35.6** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin A0 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 58+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 35.6 | cfs | | | |
| Tc= | 10.0 | min | $C_{100}$= | 0.84 | |
| $P_{100,6}$= | 2.5 | in | A= | 10.09 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 780 | 1.3 |
| 20 | 780 | 1.3 |
| 30 | 780 | 1.3 |
| 40 | 840 | 1.4 |
| 50 | 840 | 1.4 |
| 60 | 900 | 1.5 |
| 70 | 900 | 1.5 |
| 80 | 960 | 1.6 |
| 90 | 1020 | 1.7 |
| 100 | 1020 | 1.7 |
| 110 | 1080 | 1.8 |
| 120 | 1140 | 1.9 |
| 130 | 1200 | 2 |
| 140 | 1260 | 2.1 |
| 150 | 1380 | 2.3 |
| 160 | 1440 | 2.4 |
| 170 | 1560 | 2.6 |
| 180 | 1680 | 2.8 |
| 190 | 1920 | 3.2 |
| 200 | 2100 | 3.5 |
| 210 | 2520 | 4.2 |
| 220 | 2880 | 4.8 |
| 230 | 4260 | 7.1 |
| 240 | 6060 | 10.1 |
| 250 | 21360 | 35.6 |
| 260 | 3420 | 5.7 |
| 270 | 2280 | 3.8 |
| 280 | 1800 | 3 |
| 290 | 1500 | 2.5 |
| 300 | 1320 | 2.2 |
| 310 | 1140 | 1.9 |
| 320 | 1080 | 1.8 |
| 330 | 960 | 1.6 |
| 340 | 900 | 1.5 |
| 350 | 840 | 1.4 |
| 360 | 780 | 1.3 |
| 370 | 0 | 0 |

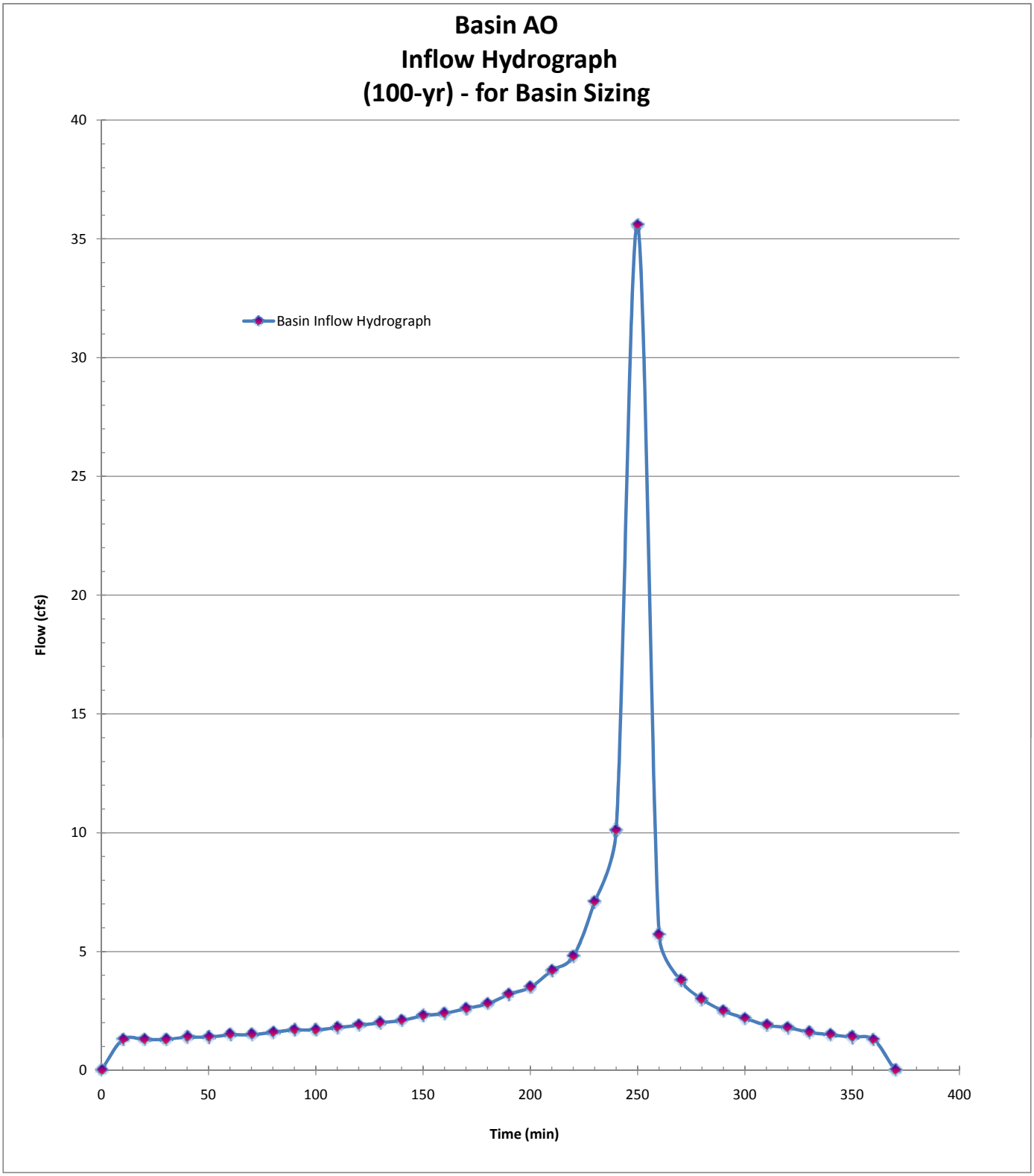
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 76680 $ft^3$**
**1.76 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 1.76 acre-feet
***OK***


Basin AO
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400

# Basin A0 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **A0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

Required Retention Basin Volume = 53781 $ft^3$

Actual Basin Inflow = 76680 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

Predeveloped Peak 100-year Flow: 23.5 cfs

Post-Developed Peak Flow through Cross Culvert: 0.0 cfs

Flow that does not reach detention basin (bypass per DA table): 8.0 cfs ~ $Q_{100}$ of: A0.4.PVA0.5.PVA0.6.SL

Maximum flow allowed to be released by this detention basin: 15.5 cfs

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

Basin - Top of basin berm elevation = 589.20 ft

Basin flowline elevation = 584.00 ft

Maximum Basin Depth = 5.20 ft

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

Outlet pipe invert from basin floor = 3.40 ft 587.40 ft

Outlet pipe diameter = 2 ft

***Basin Characteristics***

Base Length (L) 350 ft

Base Width (W) 30 ft

W/L Ratio ® 0.09

Side Slopes (Z) 1: 4

Total Volume (V): 103123 $ft^2$

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 584.00 | 0.00 | 0 | 0 | | 584.00 | 0.00 | | 0.00 |
| 1 | 584.20 | 0.20 | 2161 | 2161 | | 584.20 | 0.00 | | 0.00 |
| 2 | 584.40 | 0.40 | 2284 | 4445 | | 584.40 | 0.00 | | 0.00 |
| 3 | 584.60 | 0.60 | 2410 | 6855 | | 584.60 | 0.00 | | 0.00 |
| 4 | 584.80 | 0.80 | 2539 | 9394 | | 584.80 | 0.00 | | 0.00 |
| 5 | 585.00 | 1.00 | 2670 | 12063 | | 585.00 | 0.00 | | 0.00 |
| 6 | 585.20 | 1.20 | 2804 | 14867 | | 585.20 | 0.00 | | 0.00 |
| 7 | 585.40 | 1.40 | 2940 | 17808 | | 585.40 | 0.00 | | 0.00 |
| 8 | 585.60 | 1.60 | 3079 | 20887 | | 585.60 | 0.00 | | 0.00 |
| 9 | 585.80 | 1.80 | 3221 | 24108 | | 585.80 | 0.00 | | 0.00 |
| 10 | 586.00 | 2.00 | 3366 | 27474 | | 586.00 | 0.00 | | 0.00 |
| 11 | 586.20 | 2.20 | 3513 | 30987 | | 586.20 | 0.00 | | 0.00 |
| 12 | 586.40 | 2.40 | 3662 | 34649 | | 586.40 | 0.00 | | 0.00 |
| 13 | 586.60 | 2.60 | 3815 | 38464 | | 586.60 | 0.00 | 0.00 | 0.00 |
| 14 | 586.80 | 2.80 | 3970 | 42434 | | 586.80 | 0.00 | | 0.00 |
| 15 | 587.00 | 3.00 | 4127 | 46561 | | 587.00 | 0.00 | | 0.00 |
| 16 | 587.20 | 3.20 | 4288 | 50849 | | 587.20 | 0.00 | | 0.00 |
| 17 | 587.40 | 3.40 | 4451 | 55300 | * | 587.40 | 0.00 | | 0.00 |
| 18 | 587.60 | 3.60 | 4616 | 59916 | | 587.60 | 0.15 | | 0.15 |
| 19 | 587.80 | 3.80 | 4784 | 64700 | | 587.80 | 0.59 | | 0.59 |
| 20 | 588.00 | 4.00 | 4955 | 69656 | | 588.00 | 1.30 | | 1.30 |
| 21 | 588.20 | 4.20 | 5129 | 74785 | | 588.20 | 2.25 | | 2.25 |
| 22 | 588.40 | 4.40 | 5305 | 80090 | | 588.40 | 3.42 | | 3.42 |
| 23 | 588.60 | 4.60 | 5484 | 85573 | | 588.60 | 4.79 | | 4.79 |
| 24 | 588.80 | 4.80 | 5665 | 91238 | | 588.80 | 6.32 | | 6.32 |
| 25 | 589.00 | 5.00 | 5849 | 97087 | | 589.00 | 7.99 | | 7.99 |
| 26 | 589.20 | 5.20 | 6036 | 103123 | | 589.20 | 9.77 | | 9.77 |

# Basin A0 Routing

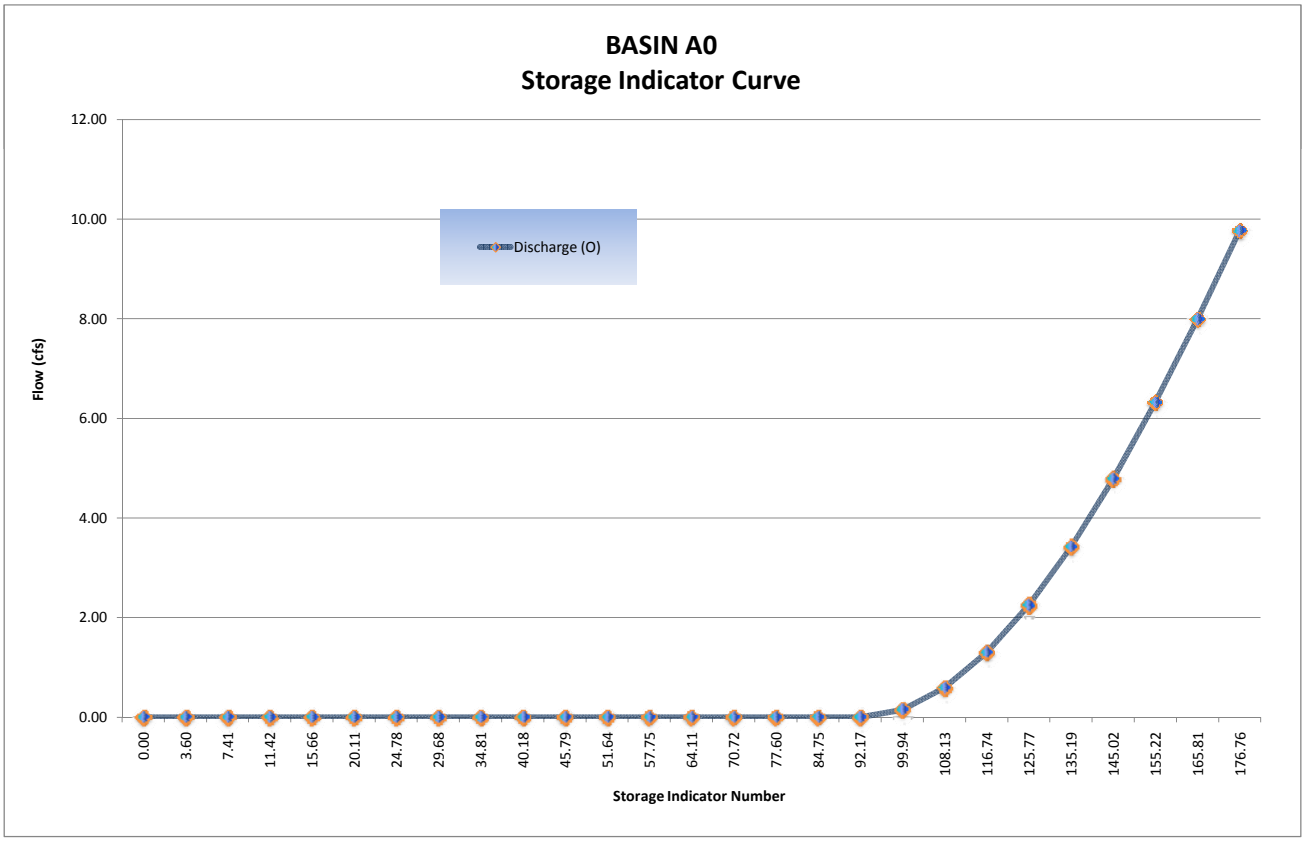
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 54+25 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | A |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 584.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 584.20 | 0.00 | 2161 | 0.00 | 3.60 | 3.60 |
| 584.40 | 0.00 | 4445 | 0.00 | 7.41 | 7.41 |
| 584.60 | 0.00 | 6855 | 0.00 | 11.42 | 11.42 |
| 584.80 | 0.00 | 9394 | 0.00 | 15.66 | 15.66 |
| 585.00 | 0.00 | 12063 | 0.00 | 20.11 | 20.11 |
| 585.20 | 0.00 | 14867 | 0.00 | 24.78 | 24.78 |
| 585.40 | 0.00 | 17808 | 0.00 | 29.68 | 29.68 |
| 585.60 | 0.00 | 20887 | 0.00 | 34.81 | 34.81 |
| 585.80 | 0.00 | 24108 | 0.00 | 40.18 | 40.18 |
| 586.00 | 0.00 | 27474 | 0.00 | 45.79 | 45.79 |
| 586.20 | 0.00 | 30987 | 0.00 | 51.64 | 51.64 |
| 586.40 | 0.00 | 34649 | 0.00 | 57.75 | 57.75 |
| 586.60 | 0.00 | 38464 | 0.00 | 64.11 | 64.11 |
| 586.80 | 0.00 | 42434 | 0.00 | 70.72 | 70.72 |
| 587.00 | 0.00 | 46561 | 0.00 | 77.60 | 77.60 |
| 587.20 | 0.00 | 50849 | 0.00 | 84.75 | 84.75 |
| 587.40 | 0.00 | 55300 | 0.00 | 92.17 | 92.17 |
| 587.60 | 0.15 | 59916 | 0.08 | 99.86 | 99.94 |
| 587.80 | 0.59 | 64700 | 0.30 | 107.83 | 108.13 |
| 588.00 | 1.30 | 69656 | 0.65 | 116.09 | 116.74 |
| 588.20 | 2.25 | 74785 | 1.13 | 124.64 | 125.77 |
| 588.40 | 3.42 | 80090 | 1.71 | 133.48 | 135.19 |
| 588.60 | 4.79 | 85573 | 2.40 | 142.62 | 145.02 |
| 588.80 | 6.32 | 91238 | 3.16 | 152.06 | 155.22 |
| 589.00 | 7.99 | 97087 | 4.00 | 161.81 | 165.81 |
| 589.20 | 9.77 | 103123 | 4.89 | 171.87 | 176.76 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



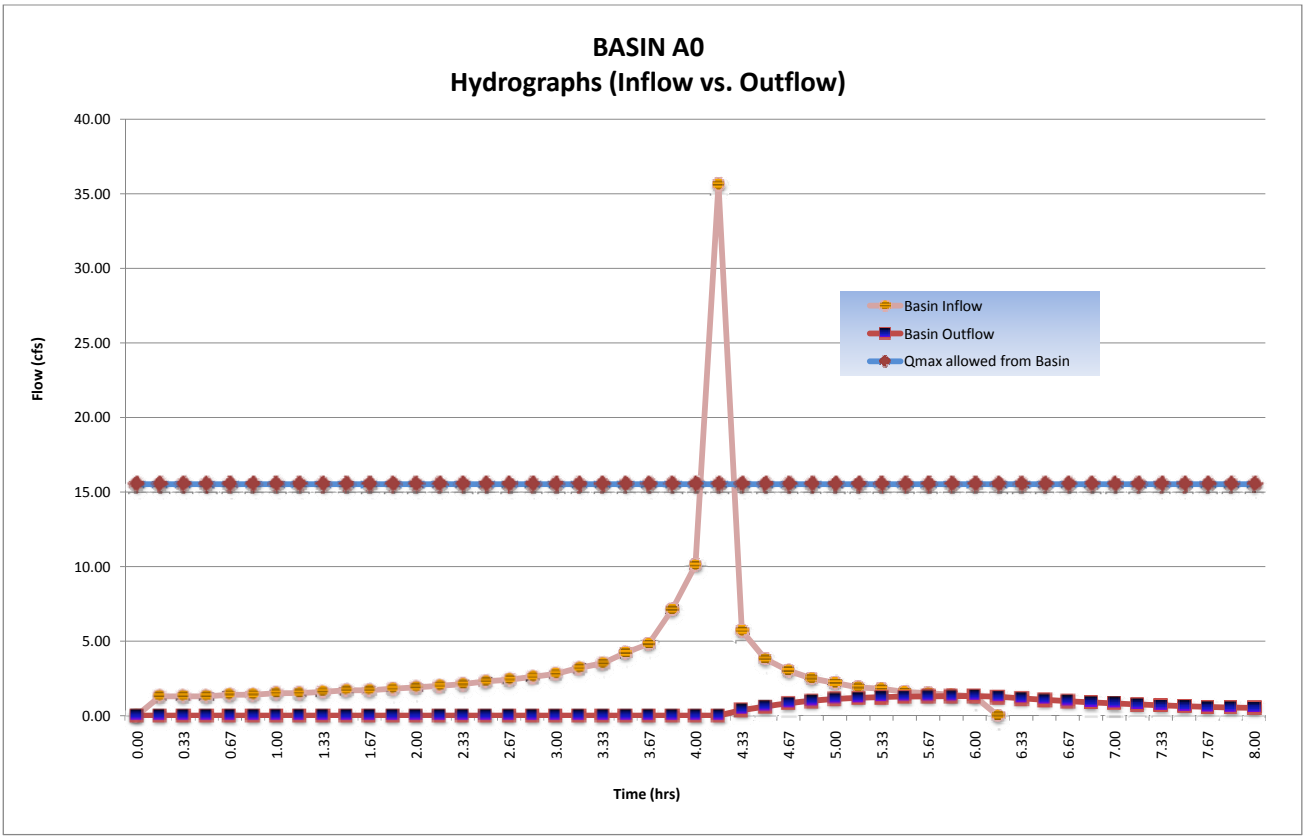
# Basin A0 Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

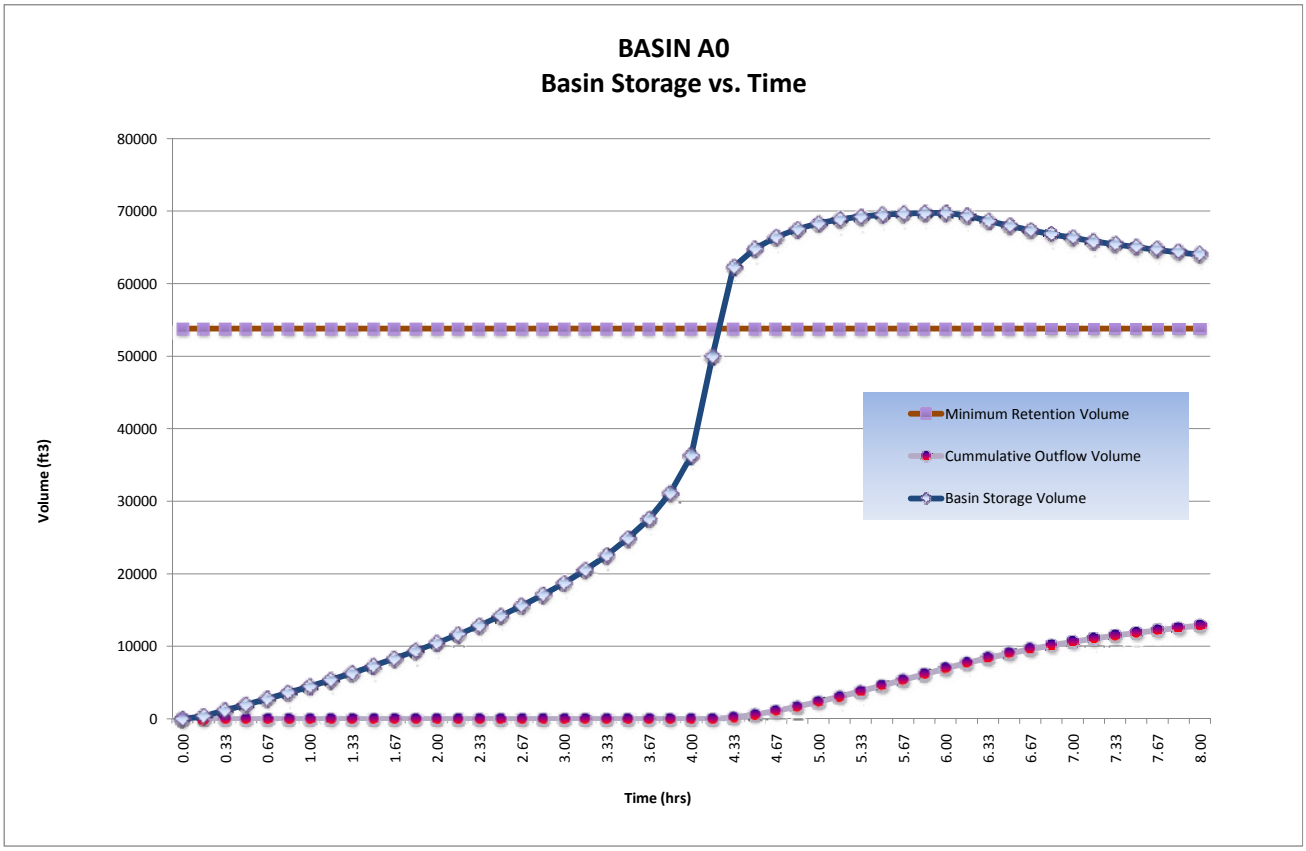
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 1.30 | 0.65 | 0.00 | 0.00 | 0.65 | 0.00 | 390 | 0 | 0 |
| 0.33 | 1.30 | 1.30 | 0.65 | 0.00 | 1.95 | 0.00 | 1170 | 0 | 0 |
| 0.50 | 1.30 | 1.30 | 1.95 | 0.00 | 3.25 | 0.00 | 1950 | 0 | 0 |
| 0.67 | 1.40 | 1.35 | 3.25 | 0.00 | 4.60 | 0.00 | 2760 | 0 | 0 |
| 0.83 | 1.40 | 1.40 | 4.60 | 0.00 | 6.00 | 0.00 | 3600 | 0 | 0 |
| 1.00 | 1.50 | 1.45 | 6.00 | 0.00 | 7.45 | 0.00 | 4470 | 0 | 0 |
| 1.17 | 1.50 | 1.50 | 7.45 | 0.00 | 8.95 | 0.00 | 5370 | 0 | 0 |
| 1.33 | 1.60 | 1.55 | 8.95 | 0.00 | 10.50 | 0.00 | 6300 | 0 | 0 |
| 1.50 | 1.70 | 1.65 | 10.50 | 0.00 | 12.15 | 0.00 | 7290 | 0 | 0 |
| 1.67 | 1.70 | 1.70 | 12.15 | 0.00 | 13.85 | 0.00 | 8310 | 0 | 0 |
| 1.83 | 1.80 | 1.75 | 13.85 | 0.00 | 15.60 | 0.00 | 9360 | 0 | 0 |
| 2.00 | 1.90 | 1.85 | 15.60 | 0.00 | 17.45 | 0.00 | 10470 | 0 | 0 |
| 2.17 | 2.00 | 1.95 | 17.45 | 0.00 | 19.40 | 0.00 | 11640 | 0 | 0 |
| 2.33 | 2.10 | 2.05 | 19.40 | 0.00 | 21.45 | 0.00 | 12870 | 0 | 0 |
| 2.50 | 2.30 | 2.20 | 21.45 | 0.00 | 23.65 | 0.00 | 14190 | 0 | 0 |
| 2.67 | 2.40 | 2.35 | 23.65 | 0.00 | 26.00 | 0.00 | 15600 | 0 | 0 |
| 2.83 | 2.60 | 2.50 | 26.00 | 0.00 | 28.50 | 0.00 | 17100 | 0 | 0 |
| 3.00 | 2.80 | 2.70 | 28.50 | 0.00 | 31.20 | 0.00 | 18720 | 0 | 0 |
| 3.17 | 3.20 | 3.00 | 31.20 | 0.00 | 34.20 | 0.00 | 20520 | 0 | 0 |
| 3.33 | 3.50 | 3.35 | 34.20 | 0.00 | 37.55 | 0.00 | 22530 | 0 | 0 |
| 3.50 | 4.20 | 3.85 | 37.55 | 0.00 | 41.40 | 0.00 | 24840 | 0 | 0 |
| 3.67 | 4.80 | 4.50 | 41.40 | 0.00 | 45.90 | 0.00 | 27540 | 0 | 0 |
| 3.83 | 7.10 | 5.95 | 45.90 | 0.00 | 51.85 | 0.00 | 31110 | 0 | 0 |
| 4.00 | 10.10 | 8.60 | 51.85 | 0.00 | 60.45 | 0.00 | 36270 | 0 | 0 |
| 4.17 | 35.60 | 22.85 | 60.45 | 0.00 | 83.30 | 0.00 | 49980 | 0 | 0 |
| 4.33 | 5.70 | 20.65 | 83.30 | 0.00 | 103.95 | 0.37 | 62259 | 222 | 222 |
| 4.50 | 3.80 | 4.75 | 103.95 | 0.37 | 108.33 | 0.61 | 64815 | 366 | 588 |
| 4.67 | 3.00 | 3.40 | 108.33 | 0.61 | 111.12 | 0.84 | 66420 | 504 | 1092 |
| 4.83 | 2.50 | 2.75 | 111.12 | 0.84 | 113.03 | 0.99 | 67521 | 594 | 1686 |
| 5.00 | 2.20 | 2.35 | 113.03 | 0.99 | 114.39 | 1.11 | 68301 | 666 | 2352 |
| 5.17 | 1.90 | 2.05 | 114.39 | 1.11 | 115.33 | 1.18 | 68844 | 708 | 3060 |
| 5.33 | 1.80 | 1.85 | 115.33 | 1.18 | 116.00 | 1.24 | 69228 | 744 | 3804 |
| 5.50 | 1.60 | 1.70 | 116.00 | 1.24 | 116.46 | 1.28 | 69492 | 768 | 4572 |
| 5.67 | 1.50 | 1.55 | 116.46 | 1.28 | 116.73 | 1.30 | 69648 | 780 | 5352 |
| 5.83 | 1.40 | 1.45 | 116.73 | 1.30 | 116.88 | 1.31 | 69735 | 786 | 6138 |
| 6.00 | 1.30 | 1.35 | 116.88 | 1.31 | 116.92 | 1.32 | 69756 | 792 | 6930 |
| 6.17 | 0.00 | 0.65 | 116.92 | 1.32 | 116.25 | 1.26 | 69372 | 756 | 7686 |
| 6.33 | | 0.00 | 116.25 | 1.26 | 114.99 | 1.16 | 68646 | 696 | 8382 |
| 6.50 | | 0.00 | 114.99 | 1.16 | 113.83 | 1.06 | 67980 | 636 | 9018 |
| 6.67 | | 0.00 | 113.83 | 1.06 | 112.77 | 0.97 | 67371 | 582 | 9600 |
| 6.83 | | 0.00 | 112.77 | 0.97 | 111.80 | 0.89 | 66813 | 534 | 10134 |
| 7.00 | | 0.00 | 111.80 | 0.89 | 110.91 | 0.82 | 66300 | 492 | 10626 |
| 7.17 | | 0.00 | 110.91 | 0.82 | 110.09 | 0.75 | 65829 | 450 | 11076 |
| 7.33 | | 0.00 | 110.09 | 0.75 | 109.34 | 0.69 | 65397 | 414 | 11490 |
| 7.50 | | 0.00 | 109.34 | 0.69 | 108.65 | 0.63 | 65001 | 378 | 11868 |
| 7.67 | | 0.00 | 108.65 | 0.63 | 108.02 | 0.58 | 64638 | 348 | 12216 |
| 7.83 | | 0.00 | 108.02 | 0.58 | 107.44 | 0.55 | 64299 | 330 | 12546 |
| 8.00 | | 0.00 | 107.44 | 0.55 | 106.89 | 0.52 | 63978 | 312 | 12858 |

## Basin A0 Routing



## Basin A0 Routing




| | | |
|---|---|---|
| **Detention / Retention Basin Volume Required:** | **69,756** | **$ft^3$** |
| **@ Stage:** | **588.20** | **ft** |
| **Freeboard:** | **1.0** | **ft** |
| **Final Total Basin Volume Provided:** | **103,123** | **$ft^3$** |
| **Maximum flow rate released from this basin:** | **1.32** | **cfs** |

>1' Freeboard

Basin **A0**

# B0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| B0.1.PV | 0.99 | 23900 | 0.5 | 10 | 2.8 | 1.54 | 4.2 | 2.29 | B0.1 | B0.1 | *bypass** | 69+00 | Lt |
| B0.2.PV | 0.99 | 22900 | 0.5 | 10 | 2.8 | 1.47 | 4.2 | 2.19 | B0.2 | B0.2 | *bypass** | 69+00 | Rt |

Σ 46800 *PAVED*

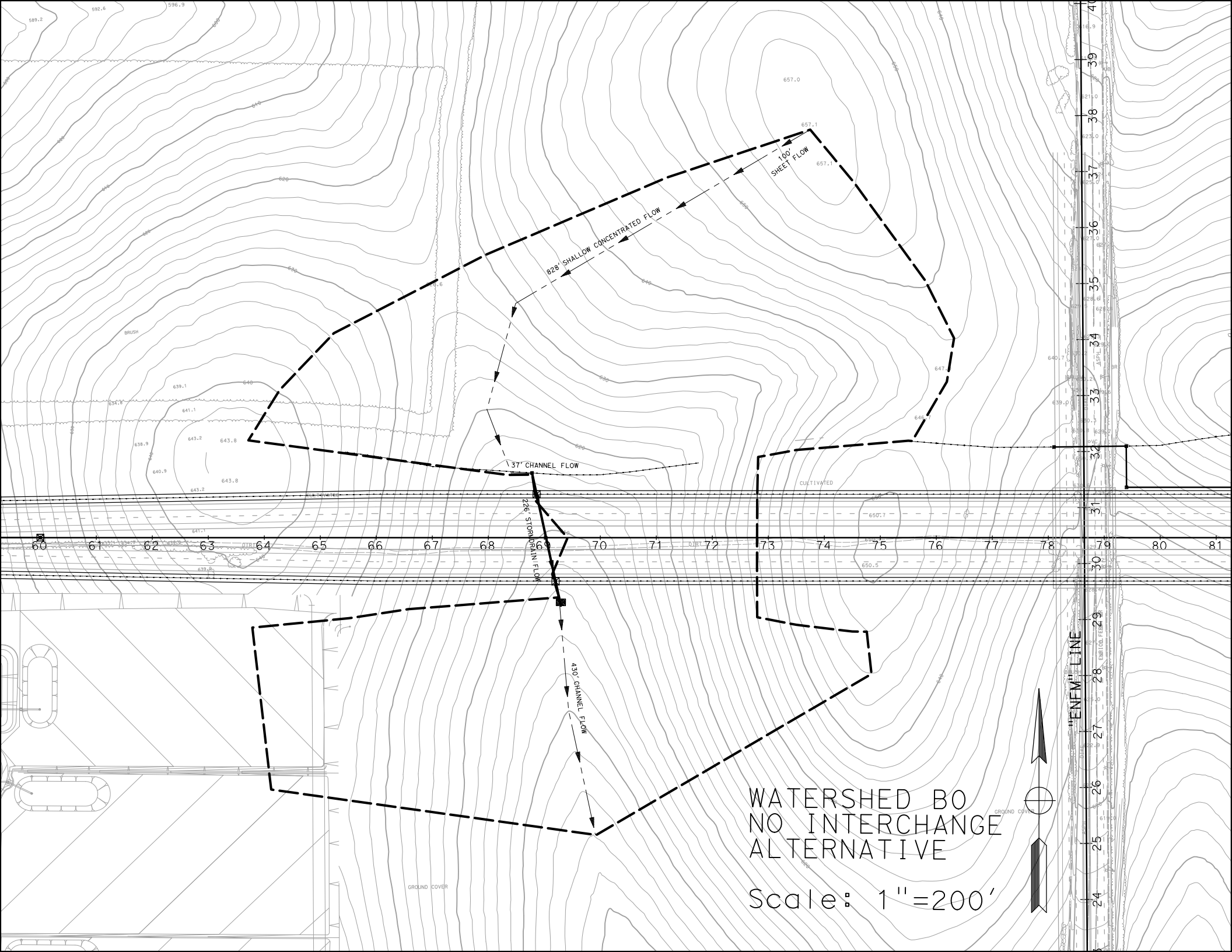
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| B0.1.SL | 0.61 | 22700 | 0.5 | 10 | 2.8 | 0.90 | 4.2 | 6.98 | B0.1 | B0.1 | *bypass** | 69+00 | Lt |
| B0.2.SL | 0.61 | 19800 | 0.5 | 10 | 2.8 | 0.78 | 4.2 | 7.98 | B0.2 | B0.2 | *bypass** | 69+00 | Rt |

Σ 42500 *SLOPE*

**flow that does not reach the basin*

| Total : | 89300 | 2.1 |
|---|---|---|
| | *SF* | *ac* |


160' SHEET FLOW
828' SHALLOW CONCENTRATED FLOW
37' CHANNEL FLOW
226' STORM DRAIN FLOW
430' CHANNEL FLOW
"ENFM" LINE
CULTIVATED
BRUSH
GROUND COVER
WATERSHED BO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# B0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 910258 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 20.90 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 90% | AT | 0.42 | 0.379 |
| PAVED SURFACE | 5% | AT | 0.90 | 0.046 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 5% | AT | 0.55 | 0.026 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.45 |
| $C_{25}$ = | 0.50 |
| $C_{50}$ = | 0.54 |
| $C_{100}$ = | 0.56 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass - prairie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 654.0 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 39.0 | ft | |
| LENGTH (L) | 828 | ft | |
| SLOPE (S) = (H/L) | 4.7% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.5 short grass |
| $T_C$ (SH)= | 9.20 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 37 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.78 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.11 | minutes | |

# B0 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 614.5 | ft | Cross Culvert |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 8.5 | ft | |
| LENGTH (L) | 226 | ft | |
| SLOPE (S) = (H/L) | 3.8% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 18.3 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.21 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begins to form natural channel |
| LOW POINT ELEVATION | 594.0 | ft | CHANNEL DATA — TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 12.0 | ft | Z= 5 — ANG-RAD — 0.197 |
| LENGTH (L) | 430 | ft | b = 10 — ANG-DEG — 11.310 |
| SLOPE (S) = (H/L) | 2.8% | | d = 0.5 — FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | grass |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.73 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.15 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 24.62 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **24.62** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | |
| $i_{10}$ = | 1.5 | in/hr | X CA = | |
| $i_{25}$ = | 1.9 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.4 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 9.8 |
| **$Q_{10}$ =** | 14.2 |
| **$Q_{25}$ =** | 19.5 |
| **$Q_{50}$ =** | 25.6 |
| **$Q_{100}$ =** | **27.7** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

100' SHEET FLOW
625' SHALLOW CONCENTRATED FLOW
Culvert BO
37' CHANNEL FLOW
"ENFM" LINE
CULVERT BO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# Culvert Calculator Report
# B0 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 616.50 | ft | Headwater Depth/Height | 0.77 | |
| Computed Headwater Elevation | 616.03 | ft | Discharge | 7.40 | cfs |
| Inlet Control HW Elev. | 615.86 | ft | Tailwater Elevation | 606.56 | ft |
| Outlet Control HW Elev. | 616.03 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 606.00 | ft |
| Length | 226.00 | ft | Constructed Slope | 3.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.56 | ft |
| Slope Type | Steep | | Normal Depth | 0.56 | ft |
| Flow Regime | Supercritical | | Critical Depth | 0.97 | ft |
| Velocity Downstream | 10.39 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 616.03 | ft | Upstream Velocity Head | 0.38 | ft |
| Ke | 0.50 | | Entrance Loss | 0.19 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 615.86 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## B0 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 617.00 | ft | Headwater Depth/Height | 1.18 | |
| Computed Headwater Elevation | 616.85 | ft | Discharge | 15.00 | cfs |
| Inlet Control HW Elev. | 616.72 | ft | Tailwater Elevation | 606.81 | ft |
| Outlet Control HW Elev. | 616.85 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 606.00 | ft |
| Length | 226.00 | ft | Constructed Slope | 3.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.81 | ft |
| Slope Type | Steep | | Normal Depth | 0.81 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.40 | ft |
| Velocity Downstream | 12.65 | ft/s | Critical Slope | 0.6 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 616.85 | ft | Upstream Velocity Head | 0.64 | ft |
| Ke | 0.50 | | Entrance Loss | 0.32 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 616.72 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# B0 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B0 Culvert |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | B0 Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 483334 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 11.10 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass prarie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 42.1 | ft | |
| LENGTH (L) | 828 | ft | |
| SLOPE (S) = (H/L) | 5.1% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_C$ (SH)= | 9.20 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 37 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.78 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.11 | minutes | |

# B0 Culvert TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 20.27 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **20.27** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | **$Q_2$ =** | 3.9 |
| $i_{10}$ = | 1.6 | in/hr | X CA = | **$Q_{10}$ =** | 7.4 |
| $i_{25}$ = | 2.0 | in/hr | X CA = | **$Q_{25}$ =** | 10.2 |
| $i_{50}$ = | 2.3 | in/hr | X CA = | **$Q_{50}$ =** | 12.8 |
| $i_{100}$ = | 2.6 | in/hr | X CA = | **$Q_{100}$ =** | **15.0** |

**FLOW RESULTS**

**cfs**

**COUNTY $P_6$**

| | **inches** |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin B0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **69+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 30.8 | cfs | | | |
| Tc= | 26.2 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 25.94 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 26 | 3276 | 2.1 |
| 52 | 3588 | 2.3 |
| 78 | 3744 | 2.4 |
| 104 | 4368 | 2.8 |
| 130 | 4680 | 3 |
| 156 | 5772 | 3.7 |
| 182 | 6552 | 4.2 |
| 208 | 9672 | 6.2 |
| 234 | 14352 | 9.2 |
| 260 | 48048 | 30.8 |
| 286 | 7800 | 5 |
| 312 | 5148 | 3.3 |
| 338 | 4056 | 2.6 |
| 364 | 3432 | 2.2 |
| 390 | 0 | 0 |

**SUM= 124488 $ft^3$**
**2.86 acre-feet**

Check: $V = C*A*P_6$
V= 2.84 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin B0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 27.7 | cfs | | | |
| Tc= | 24.6 | min | C= | 0.56 | |
| $P_{100,6}$= | 2.5 | in | A= | 20.90 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 25 | 2700 | 1.8 |
| 50 | 3000 | 2 |
| 75 | 3150 | 2.1 |
| 100 | 3600 | 2.4 |
| 125 | 3900 | 2.6 |
| 150 | 4800 | 3.2 |
| 175 | 5550 | 3.7 |
| 200 | 8100 | 5.4 |
| 225 | 10800 | 7.2 |
| 250 | 41550 | 27.7 |
| 275 | 6450 | 4.3 |
| 300 | 4350 | 2.9 |
| 325 | 3450 | 2.3 |
| 350 | 2850 | 1.9 |
| 375 | 0 | 0 |

*

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 104250 $ft^3$**
**2.39 acre-feet**

Check: $V = C*A*P_6$
V= 2.45 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **2.39** | *(Post)* | | |
| | **-** | **2.86** | *(Pre)* | | |
| **Retention volume =** | | **-0.46** | **acre-feet** | **=** | **-20238 $ft^3$** | **No Basin Required** |

# Basin B0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 1.07 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **2847** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 42500 $ft^2$
A: 0.98 acres
10.00 years
where: R= 30.00
K= 0.24
Ls= 18.00
C= 0.012
P= 1.00
As 1.56 tons/yr*Ac

Volume for 10-year Silt Accumulation = 15.17 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

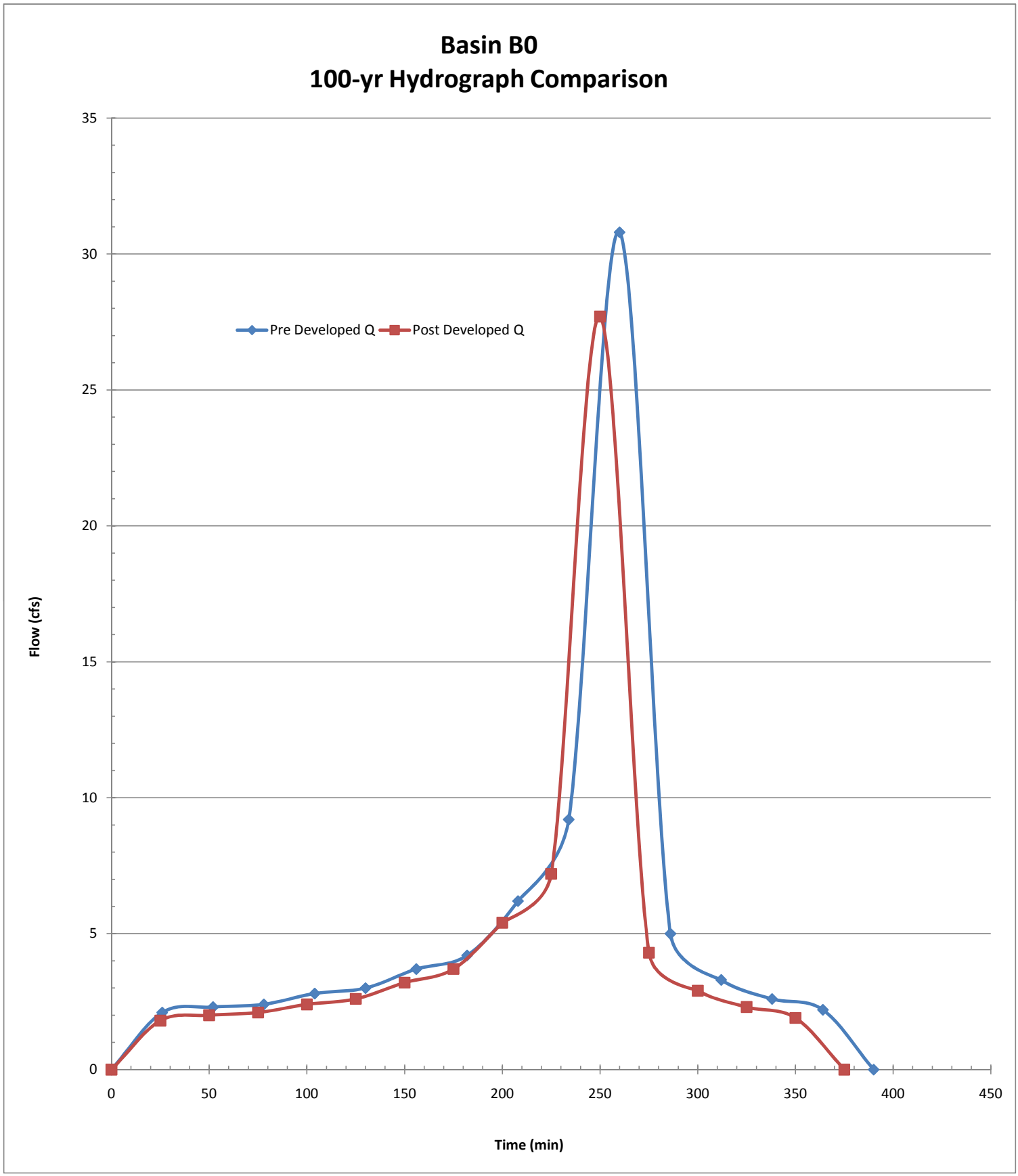
where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **337** **$ft^3$**

**Silt extracted within biofiltration swale**

.


Basin B0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400
450

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# C0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C0.1.PV | 0.99 | 36900 | 0.8 | 10 | 2.8 | 2.37 | 4.2 | 3.53 | ~ | C0.1 | *bypass** | 29+00 | ENFM |

Σ 36900 *PAVED*

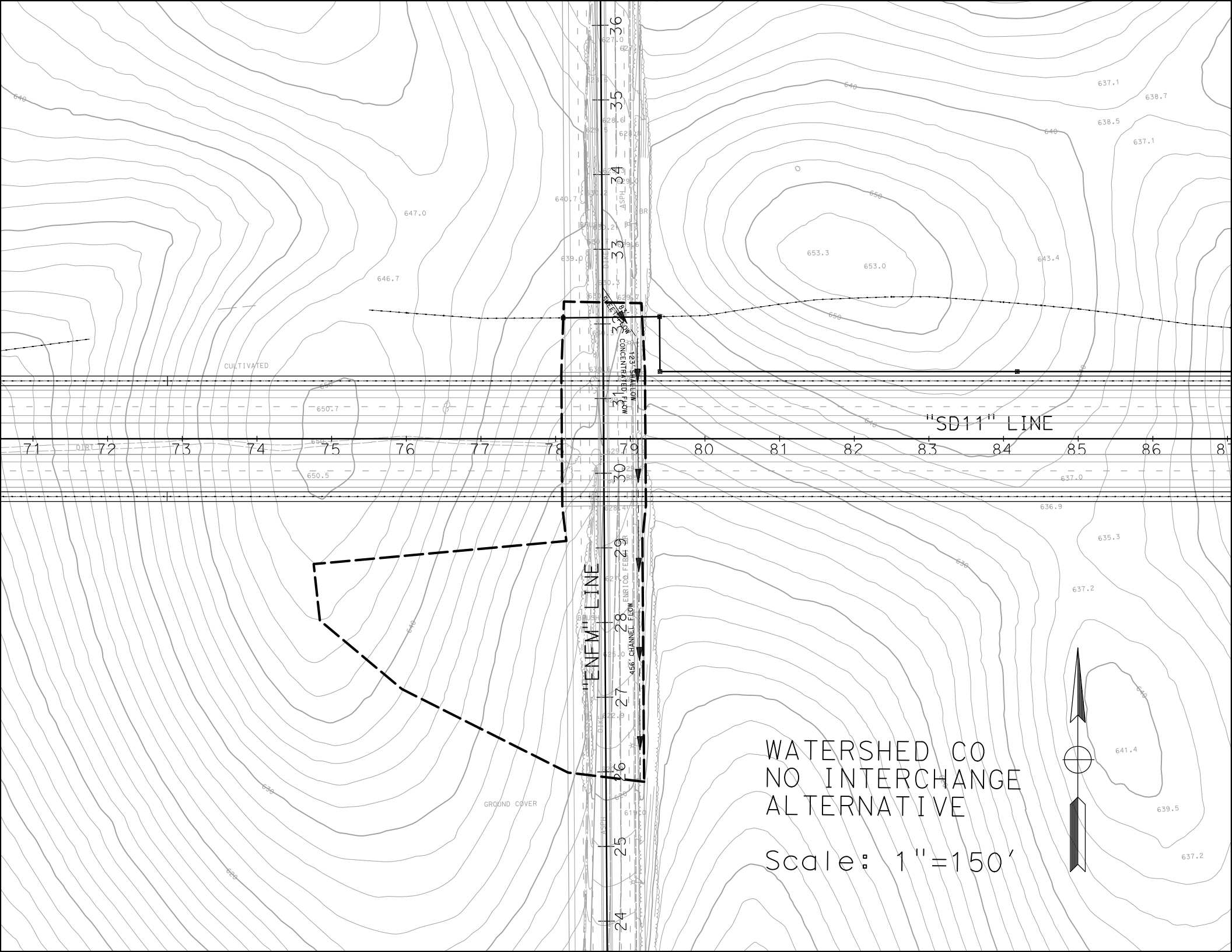
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C0.1.SL | 0.61 | 98800 | 2.3 | 10 | 2.8 | 3.91 | 4.2 | 5.83 | ~ | C0.1 | *bypass** | 26+00 | ENFM |

Σ 98800 *SLOPE*

**flow that does not reach the basin*

| Total : | 135700 | 3.12 |
|---|---|---|
| | *SF* | *ac* |


"SD11" LINE
"ENEM" LINE
123' SHALLOW CONCENTRATED FLOW
456' CHANNEL FLOW
CULTIVATED
GROUND COVER
WATERSHED CO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=150'

# C0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Post-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **78+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **135700** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **3.12** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 73% | AT | 0.42 | 0.306 |
| PAVED SURFACE | 27% | AT | 0.90 | 0.245 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.55 |
| $C_{25}$ = | 0.61 |
| $C_{50}$ = | 0.66 |
| $C_{100}$ = | 0.69 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.8 | ft | High Point on Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 630.0 | ft | |
| ELEVATION DIFF (H) | 0.8 | ft | |
| LENGTH (L) | 83 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.47 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Eastern Gutter of Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 629.0 | ft | Caltrans ROW |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 123 | ft | |
| SLOPE (S) = (H/L) | 0.8% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 1.37 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | Enrico Fermi Gutter - east |
| LOW POINT ELEVATION | 620.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 12 ANG-RAD 0.083 |
| LENGTH (L) | 456 | ft | b = 2 ANG-DEG 4.764 |
| SLOPE (S) = (H/L) | 2.0% | | d = 0.25 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Gutter |
| HYDRAULIC RADIUS R | 0.16 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 4.04 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.88 | minutes | |

# C0 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 5.71 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\ P_6\ D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.2 |
| **$Q_{10}$ =** | 4.6 |
| **$Q_{25}$ =** | 6.4 |
| **$Q_{50}$ =** | 8.3 |
| **$Q_{100}$ =** | **9.0** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin C0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **78+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 16.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.60 | |
| $P_{100,6}$= | 2.5 | in | A= | 6.49 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 360 | 0.6 |
| 20 | 360 | 0.6 |
| 30 | 360 | 0.6 |
| 40 | 360 | 0.6 |
| 50 | 420 | 0.7 |
| 60 | 420 | 0.7 |
| 70 | 420 | 0.7 |
| 80 | 420 | 0.7 |
| 90 | 480 | 0.8 |
| 100 | 480 | 0.8 |
| 110 | 480 | 0.8 |
| 120 | 540 | 0.9 |
| 130 | 540 | 0.9 |
| 140 | 600 | 1 |
| 150 | 600 | 1 |
| 160 | 660 | 1.1 |
| 170 | 720 | 1.2 |
| 180 | 780 | 1.3 |
| 190 | 900 | 1.5 |
| 200 | 960 | 1.6 |
| 210 | 1140 | 1.9 |
| 220 | 1320 | 2.2 |
| 230 | 1920 | 3.2 |
| 240 | 2760 | 4.6 |
| 250 | 9840 | 16.4 |
| 260 | 1560 | 2.6 |
| 270 | 1020 | 1.7 |
| 280 | 840 | 1.4 |
| 290 | 660 | 1.1 |
| 300 | 600 | 1 |
| 310 | 540 | 0.9 |
| 320 | 480 | 0.8 |
| 330 | 420 | 0.7 |
| 340 | 420 | 0.7 |
| 350 | 360 | 0.6 |
| 360 | 360 | 0.6 |
| 370 | 0 | 0 |

**SUM= 35100 $ft^3$**
**0.81 acre-feet**

Check: V = C*A*$P_6$
V= 0.81 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin C0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 9.0 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.69 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.12 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 180 | 0.3 |
| 20 | 180 | 0.3 |
| 30 | 180 | 0.3 |
| 40 | 180 | 0.3 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 240 | 0.4 |
| 90 | 240 | 0.4 |
| 100 | 240 | 0.4 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 300 | 0.5 |
| 140 | 300 | 0.5 |
| 150 | 360 | 0.6 |
| 160 | 360 | 0.6 |
| 170 | 420 | 0.7 |
| 180 | 420 | 0.7 |
| 190 | 480 | 0.8 |
| 200 | 540 | 0.9 |
| 210 | 660 | 1.1 |
| 220 | 720 | 1.2 |
| 230 | 1080 | 1.8 |
| 240 | 1560 | 2.6 |
| 250 | 5400 | 9 |
| 260 | 840 | 1.4 |
| 270 | 600 | 1.0 |
| 280 | 480 | 0.8 |
| 290 | 360 | 0.6 |
| 300 | 300 | 0.5 |
| 310 | 300 | 0.5 |
| 320 | 240 | 0.4 |
| 330 | 240 | 0.4 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 180 | 0.3 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 19380 $ft^3$**
**0.44 acre-feet**

Check: $V = C*A*P_6$
V= 0.45 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **0.44** | *(Post)* | |
| - | **0.81** | *(Pre)* | |
| **Retention volume =** | **-0.36** | **acre-feet** | **= -15720 $ft^3$** **No Basin Required** |

# Basin C0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

| | | |
|---|---|---|
| $C_{100}$= | 0.99 | |
| A= | 0.85 | acres |
| $WQ_{72}$: | 0.73 | in/area |

**Water Quality Volume (WQV) =** **2245** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 98800 | $ft^2$ |
| | A: | 2.27 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 35.27 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

$$A_s = RKLsCP$$

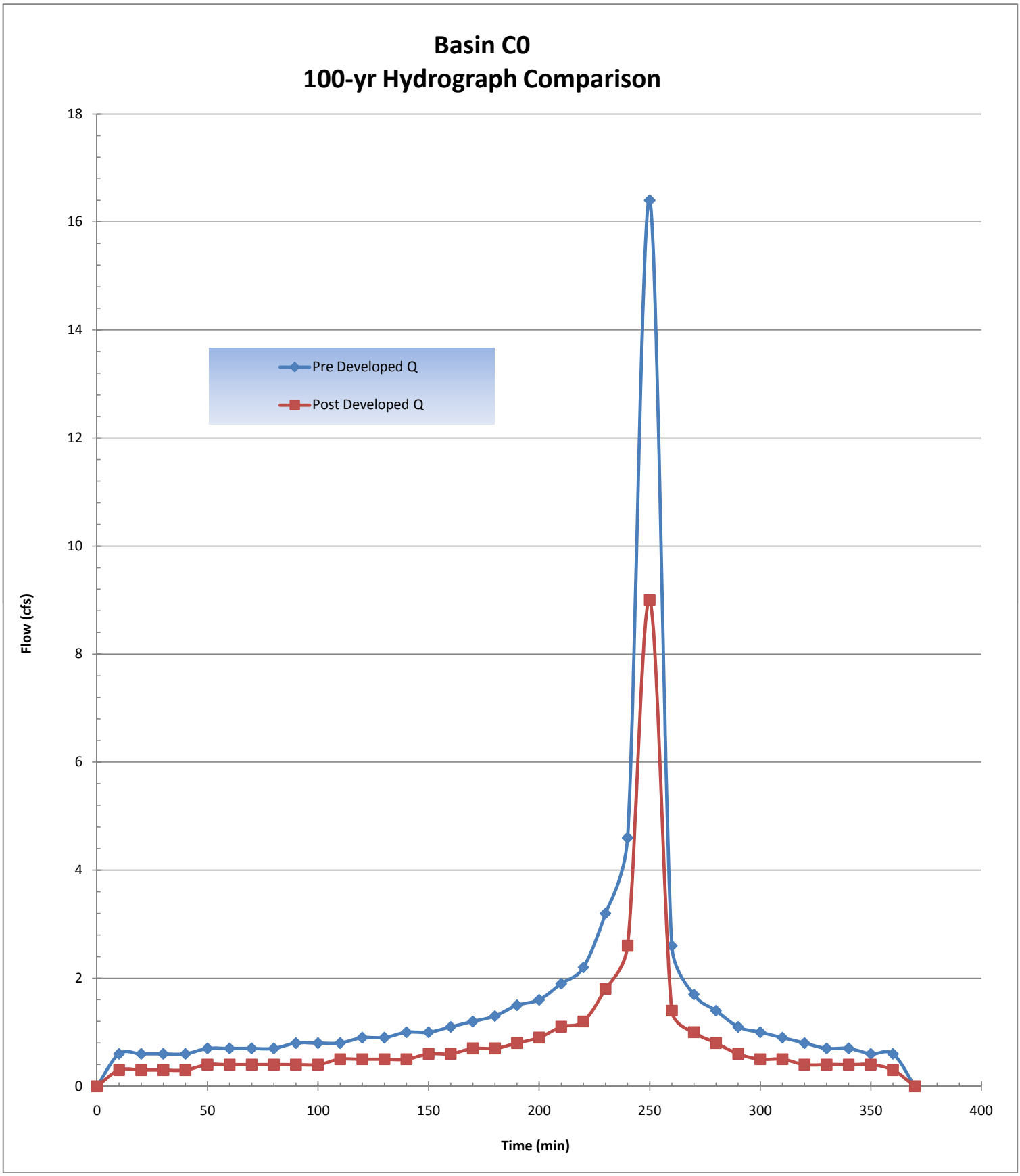
where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **784** **$ft^3$**

**Silt extracted within biofiltration swale**

.


Basin C0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
300
350
400

# D0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| ~ | 0.99 | 0 | 0.0 | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ |

Σ 0 *PAVED*

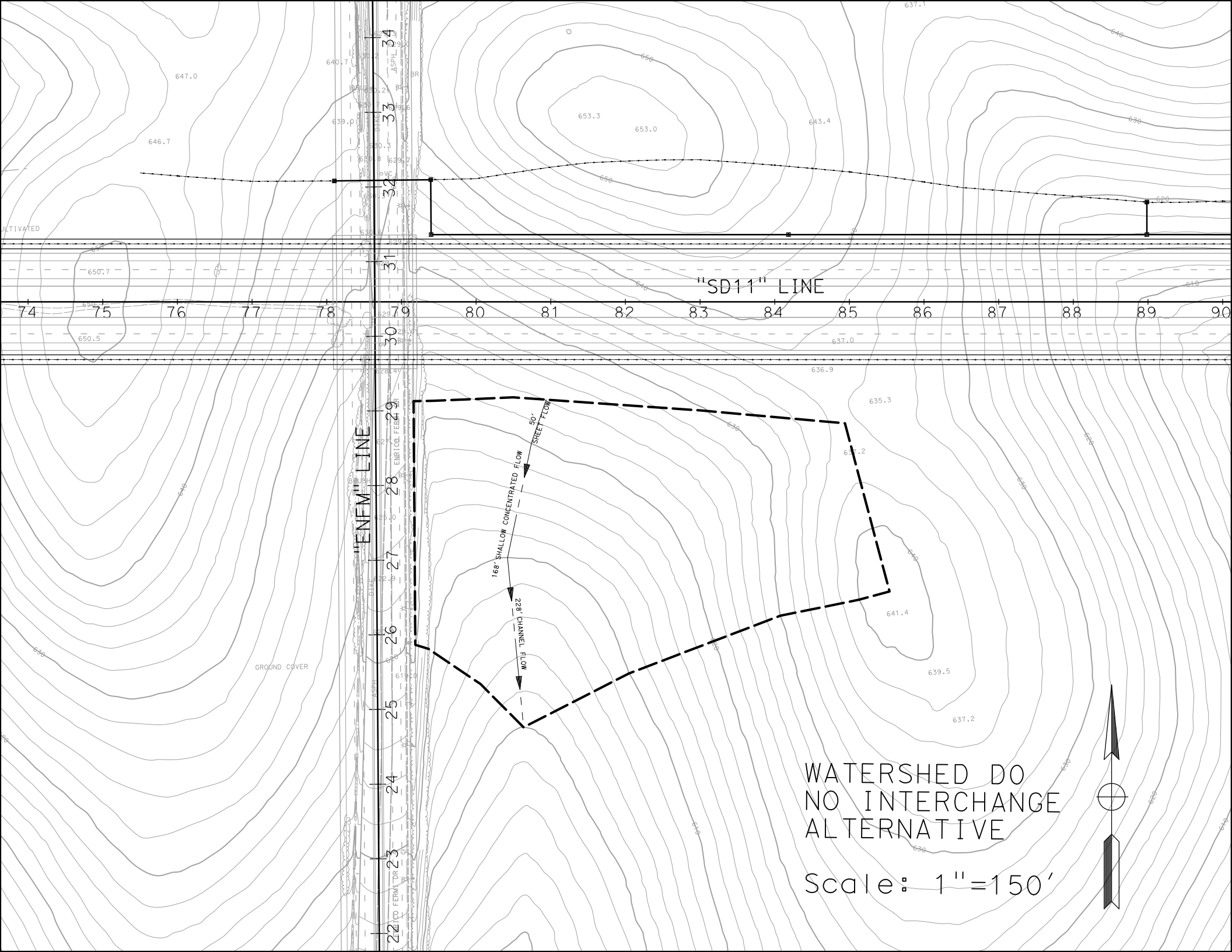
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| D0.1.SL | 0.61 | 203800 | 4.7 | 10 | 2.8 | 8.04 | 4.2 | 12.02 | ~ | D0.1 | **bypass* | 26+00 | ENFM |

Σ 203800 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 203800 | 4.7 |
| | *SF* | *ac* |


"SD11" LINE
"ENFM" LINE
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
22
23
24
25
26
27
28
29
30
31
32
33
34
50' SHEET FLOW
168' SHALLOW CONCENTRATED FLOW
228' CHANNEL FLOW
GROUND COVER
WATERSHED DO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=150'

# D0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 81+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | D0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 203800 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 4.68 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 624.0 | ft | High Point in Watershed, south of SR-11 |
| LOW POINT ELEVATION | 621.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 6.0% | | |
| MANNING'S n | 0.100 | | < = From Table 816.6A nearly bare ground |
| $T_t$ (SFF)= | 3.50 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 621.0 | ft | |
| LOW POINT ELEVATION | 610.0 | ft | |
| ELEVATION DIFF (H) | 11.0 | ft | |
| LENGTH (L) | 168 | ft | |
| SLOPE (S) = (H/L) | 6.5% | | |
| VELOCITY (SCF) | 2.4 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 1.17 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | begins to channelize |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 10.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 228 | ft | b = 2 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 4.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.150 | | short prairie grass |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 0.97 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.93 | minutes | |

# D0 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.59 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.6 |
| **$Q_{10}$ =** | 5.3 |
| **$Q_{25}$ =** | 7.3 |
| **$Q_{50}$ =** | 9.5 |
| **$Q_{100}$ =** | **10.3** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin D0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **81+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

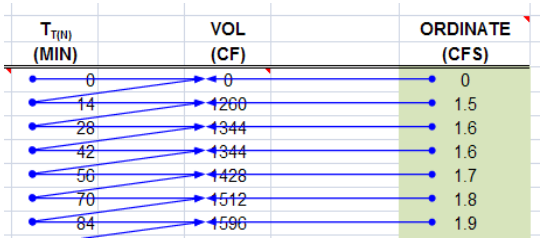
100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 18.5 | cfs | | | |
| Tc= | 11.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 8.89 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 11 | 462 | 0.7 |
| 22 | 462 | 0.7 |
| 33 | 462 | 0.7 |
| 44 | 528 | 0.8 |
| 55 | 528 | 0.8 |
| 66 | 528 | 0.8 |
| 77 | 594 | 0.9 |
| 88 | 594 | 0.9 |
| 99 | 594 | 0.9 |
| 110 | 660 | 1 |
| 121 | 660 | 1 |
| 132 | 726 | 1.1 |
| 143 | 792 | 1.2 |
| 154 | 792 | 1.2 |
| 165 | 924 | 1.4 |
| 176 | 990 | 1.5 |
| 187 | 1122 | 1.7 |
| 198 | 1188 | 1.8 |
| 209 | 1452 | 2.2 |
| 220 | 1650 | 2.5 |
| 231 | 2442 | 3.7 |
| 242 | 3564 | 5.4 |
| 253 | 12210 | 18.5 |
| 264 | 1980 | 3 |
| 275 | 1320 | 2 |
| 286 | 1056 | 1.6 |
| 297 | 858 | 1.3 |
| 308 | 726 | 1.1 |
| 319 | 660 | 1 |
| 330 | 594 | 0.9 |
| 341 | 528 | 0.8 |
| 352 | 528 | 0.8 |
| 363 | 462 | 0.7 |
| 374 | 0 | 0 |

Example of Steps:



| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **42636** | **$ft^3$** |
| | **0.98** | **acre-feet** |

Check: $V = C*A*P_6$

V= 0.97 acre-feet

***OK***

# Basin D0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 10.3 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 4.68 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 240 | 0.4 |
| 20 | 240 | 0.4 |
| 30 | 240 | 0.4 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 300 | 0.5 |
| 90 | 300 | 0.5 |
| 100 | 300 | 0.5 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 360 | 0.6 |
| 140 | 360 | 0.6 |
| 150 | 420 | 0.7 |
| 160 | 420 | 0.7 |
| 170 | 480 | 0.8 |
| 180 | 480 | 0.8 |
| 190 | 540 | 0.9 |
| 200 | 600 | 1 |
| 210 | 720 | 1.2 |
| 220 | 840 | 1.4 |
| 230 | 1260 | 2.1 |
| 240 | 1800 | 3 |
| 250 | 6180 | 10.3 |
| 260 | 960 | 1.6 |
| 270 | 660 | 1.1 |
| 280 | 540 | 0.9 |
| 290 | 420 | 0.7 |
| 300 | 360 | 0.6 |
| 310 | 360 | 0.6 |
| 320 | 300 | 0.5 |
| 330 | 300 | 0.5 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 240 | 0.4 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 22260 $ft^3$**
**0.51 acre-feet**

Check: $V = C*A*P_6$
V= 0.51 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **0.51** | *(Post)* | |
| - | **0.98** | *(Pre)* | |
| **Retention volume =** | **-0.47** | **acre-feet** | **= -20376 $ft^3$** **No Basin Required** |

# Basin D0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 0.00 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **0** **$ft^3$**

**No pavement areas proposed in this watershed**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

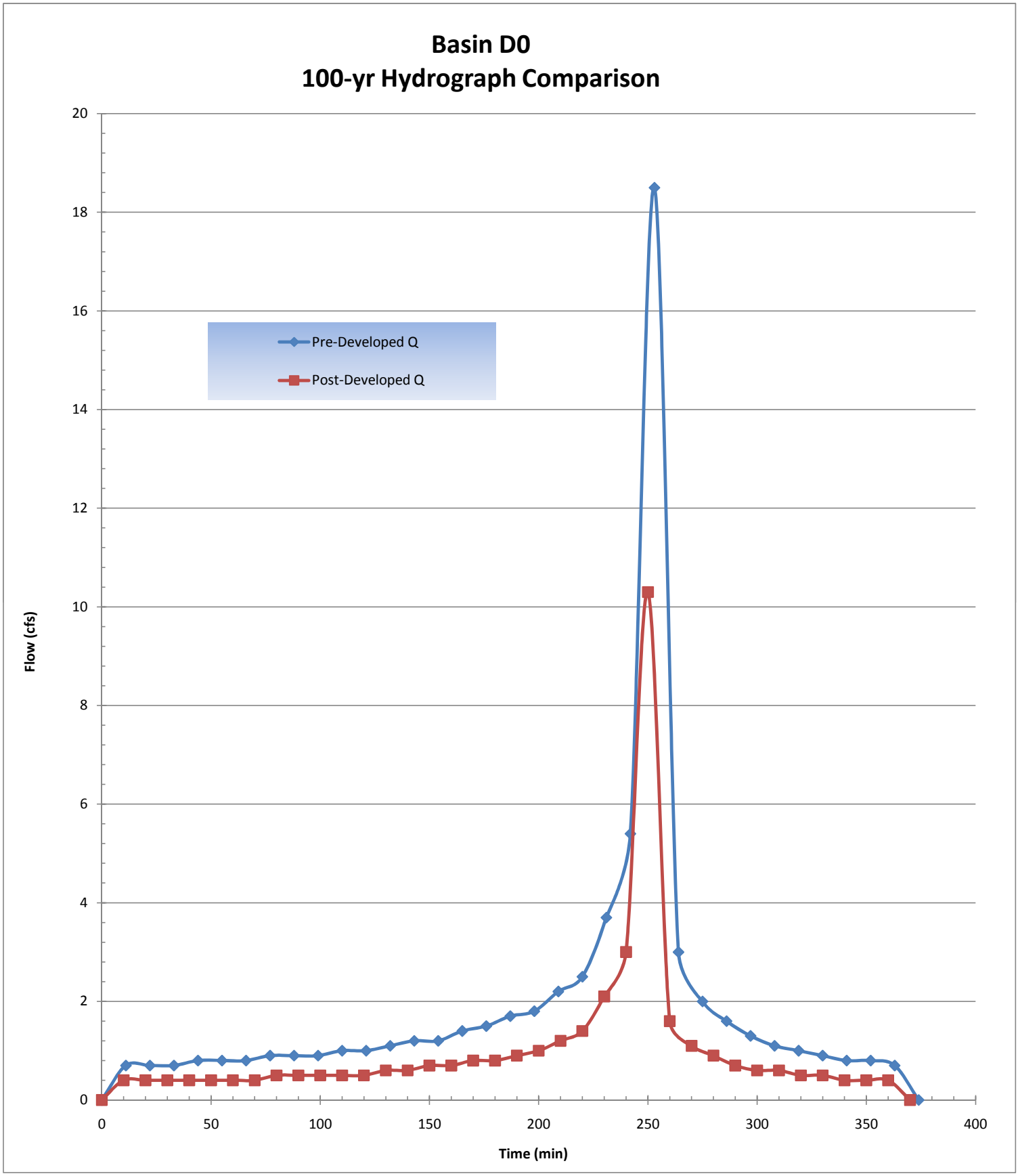
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 203800 | $ft^2$ |
| | A: | 4.68 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 72.76 tons

**Silt Accumulation Basin volume =** **1617** **$ft^3$**

**These are existing Sloped Areas to remain**

.


Basin D0
100-yr Hydrograph Comparison
Pre-Developed Q
Post-Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
20
0
50
100
150
200
250
300
350
400

# E0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **E0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Area | | Tc | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | Drains to: | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| E0.1.PV | 0.99 | 122200 | 2.8 | 10 | 2.8 | 7.86 | 4.2 | 11.70 | E0.1 | E0.1 | Basin E0 | 93+00 | Lt |
| E0.2.PV | 0.99 | 124900 | 2.9 | 10 | 2.8 | 8.03 | 4.2 | 11.96 | E0.2 | E0.2 | Basin E0 | 93+00 | Rt |

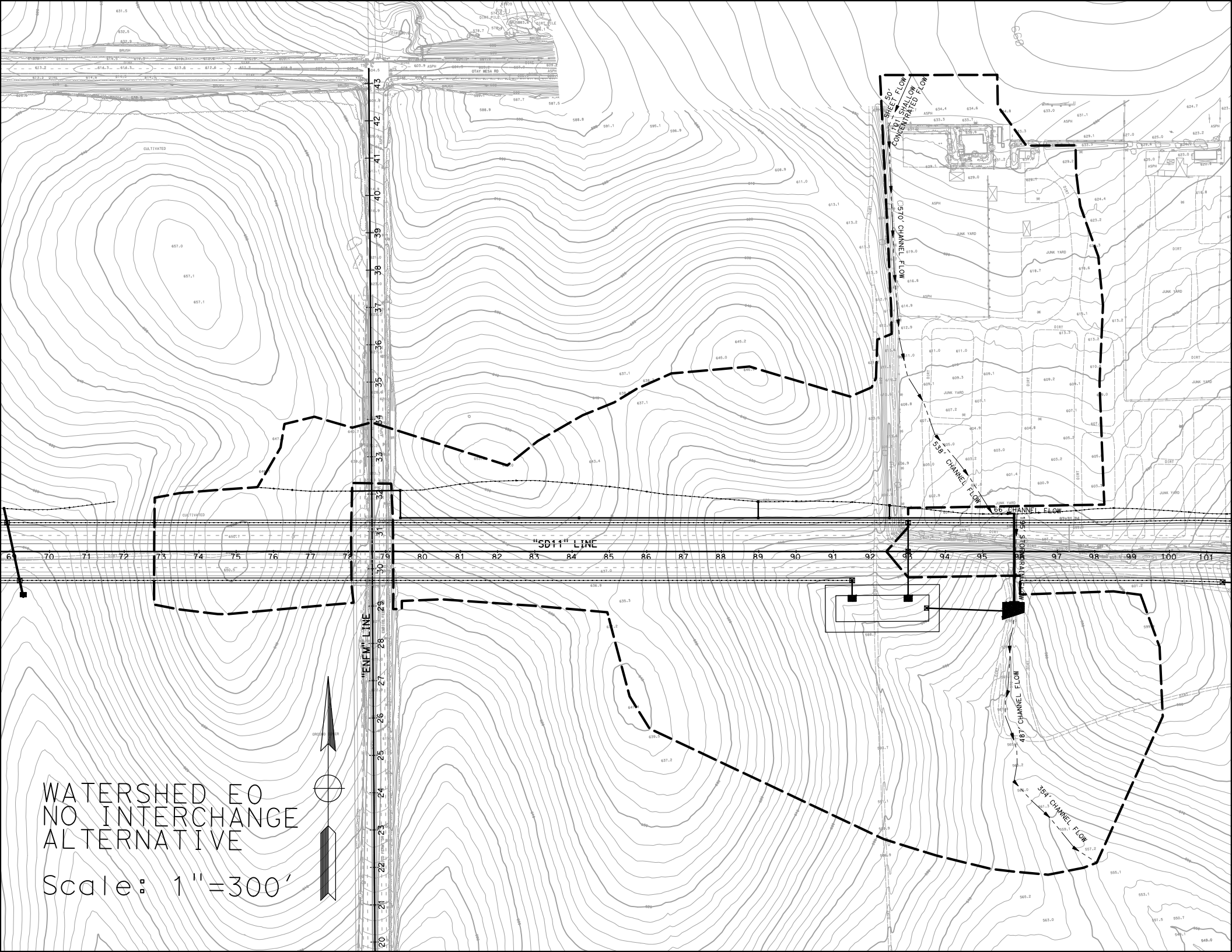
Σ 247100 *PAVED*

SLOPE

| | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Area | | Tc | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | Drains to: | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| E0.1.SL | 0.61 | 174800 | 4.0 | 10 | 2.8 | 6.92 | 4.2 | 10.31 | E0.1 | E0.1 | Basin E0 | 93+00 | Lt |
| E0.2.SL | 0.61 | 172100 | 4.0 | 10 | 2.8 | 6.82 | 4.2 | 10.15 | E0.2 | E0.2 | Basin E0 | 93+00 | Rt |
| E0.3.SL | 0.61 | 39200 | 0.9 | 10 | 2.8 | 1.55 | 4.2 | 2.31 | ~ | E0.3 | Culvert | 78+00 | Lt |
| E0.4.SL | 0.61 | 34000 | 0.8 | 10 | 2.8 | 1.35 | 4.2 | 2.01 | ~ | E0.4 | Culvert | 79+50 | Lt |
| E0.5.SL | 0.61 | 167600 | 3.8 | 10 | 2.8 | 6.64 | 4.2 | 9.89 | ~ | E0.5 | Culvert | 89+00 | Lt |
| E0.6.SL | 0.61 | 120100 | 2.8 | 10 | 3.3 | 5.47 | 4.2 | 7.08 | ~ | E0.6 | Culvert | 92+50 | Lt |

Σ 707800 *SLOPE*

| | | |
|---|---|---|
| Total : | 954900 | 21.9 |
| | *SF* | *ac* |


WATERSHED EO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=300'
"SD11" LINE
"ENFW" LINE
OTAY MESA RD
50' SHEET FLOW TO SHALLOW CONCENTRATED FLOW
570' CHANNEL FLOW
538' CHANNEL FLOW
66' CHANNEL FLOW
487' CHANNEL FLOW
354' CHANNEL FLOW
CULTIVATED
JUNK YARD
DIRT
ASPH
BRUSH

# E0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | E0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 2378044 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 54.59 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 60% | AT | 0.43 | 0.257 |
| PAVED SURFACE | 10% | AT | 0.90 | 0.094 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 30% | AT | 0.55 | 0.164 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.51 |
| $C_{25}$ = | 0.57 |
| $C_{50}$ = | 0.62 |
| $C_{100}$ = | 0.64 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E0 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 599.0 | ft |
| ELEVATION DIFF (H) | 13.0 | ft |
| LENGTH (L) | 538 | ft |
| SLOPE (S) = (H/L) | 2.4% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 1.01 | fps |
| $T_C$ (CH)= | 8.90 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 599.0 | ft |
| LOW POINT ELEVATION | 598.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 66 | ft |
| SLOPE (S) = (H/L) | 1.5% | |
| MANNING'S n | 0.015 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 5.59 | fps |
| $T_C$ (CH)= | 0.20 | minutes |

**NOTES:**

Proposed Slope Ditch

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 0.5 | FLOWING FULL ASS'M | |

concrete - rough

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 592.0 | ft |
| LOW POINT ELEVATION | 578.0 | ft |
| ELEVATION DIFF (H) | 14.0 | ft |
| LENGTH (L) | 195 | ft |
| SLOPE (S) = (H/L) | 7.2% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.5 | ft |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (STORMDRAIN) | 28.1 | fps |
| $T_C$ (SD)= | 0.12 | minutes |

**NOTES:**

Proposed Cross Culvert (assumed 6' drop to invert)

Proposed Rip Rap Pad

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 578.0 | ft |
| LOW POINT ELEVATION | 565.2 | ft |
| ELEVATION DIFF (H) | 12.8 | ft |
| LENGTH (L) | 487 | ft |
| SLOPE (S) = (H/L) | 2.6% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 1.75 | fps |
| $T_C$ (CH)= | 4.63 | minutes |

**NOTES:**

Natural Channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 2 | ANG-DEG | 26.565 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 565.2 | ft |
| LOW POINT ELEVATION | 556.0 | ft |
| ELEVATION DIFF (H) | 9.2 | ft |
| LENGTH (L) | 354 | ft |
| SLOPE (S) = (H/L) | 2.6% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.7 | ft |
| VELOCITY (CHANNEL) | 1.81 | fps |
| $T_C$ (CH)= | 3.26 | minutes |

**NOTES:**

Begins to broaden

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 4 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 23.89 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **23.89** | minutes |

Total Length of Run (ft) = 2361

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

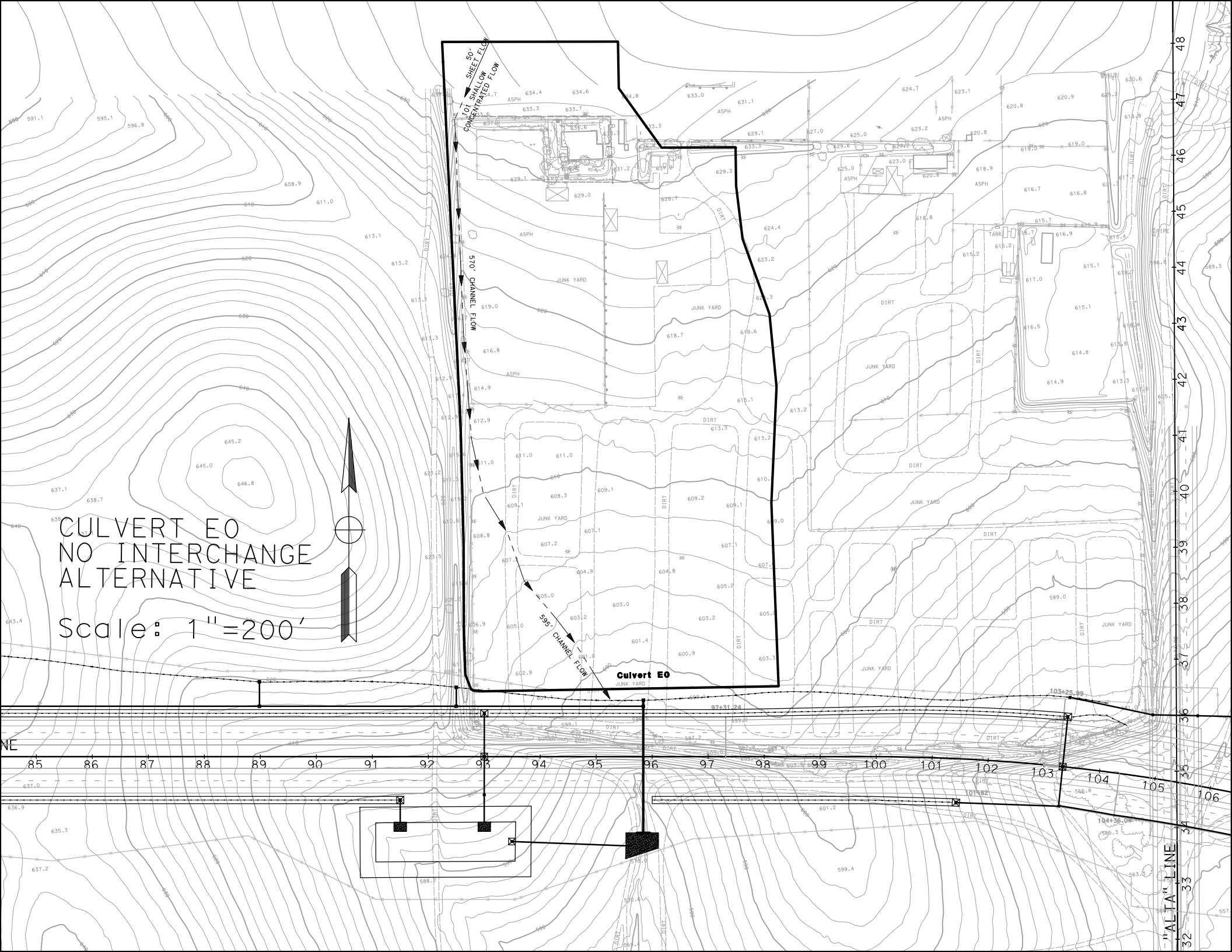
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.1 | in/hr | X CA = | |
| $i_{10}$ = | 1.5 | in/hr | X CA = | |
| $i_{25}$ = | 1.9 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.4 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 29.7 |
| **$Q_{10}$ =** | 43.2 |
| **$Q_{25}$ =** | 59.4 |
| **$Q_{50}$ =** | 77.7 |
| **$Q_{100}$ =** | **84.3** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


CULVERT EO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'
50' SHEET FLOW
101' SHALLOW CONCENTRATED FLOW
570' CHANNEL FLOW
595' CHANNEL FLOW
Culvert EO
JUNK YARD
ASPH
DIRT
TANK
"ALTA" LINE
97+31.24
103+25.99
101+82
104+36.00

# Culvert Calculator Report
# E0 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 595.00 | ft | Headwater Depth/Height | 0.69 | |
| Computed Headwater Elevation | 594.06 | ft | Discharge | 16.80 | cfs |
| Inlet Control HW Elev. | 593.76 | ft | Tailwater Elevation | 578.62 | ft |
| Outlet Control HW Elev. | 594.06 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 592.00 | ft | Downstream Invert | 578.00 | ft |
| Length | 195.00 | ft | Constructed Slope | 7.2 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.62 | ft |
| Slope Type | Steep | | Normal Depth | 0.62 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.31 | ft |
| Velocity Downstream | 15.88 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 594.06 | ft | Upstream Velocity Head | 0.50 | ft |
| Ke | 0.50 | | Entrance Loss | 0.25 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 593.76 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
# E0 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 596.00 | ft | Headwater Depth/Height | 1.04 | |
| Computed Headwater Elevation | 595.12 | ft | Discharge | 34.10 | cfs |
| Inlet Control HW Elev. | 594.83 | ft | Tailwater Elevation | 578.89 | ft |
| Outlet Control HW Elev. | 595.12 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 592.00 | ft | Downstream Invert | 578.00 | ft |
| Length | 195.00 | ft | Constructed Slope | 7.2 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.89 | ft |
| Slope Type | Steep | | Normal Depth | 0.89 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.90 | ft |
| Velocity Downstream | 19.48 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 595.12 | ft | Upstream Velocity Head | 0.81 | ft |
| Ke | 0.50 | | Entrance Loss | 0.41 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 594.83 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# E0 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Culvert** |
| **JOB #:** | **11A1190** | | | **STATION:** | **95+90** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **E0.Culvert** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Culvert** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **953896** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **21.90** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.43 | 0.426 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.43 |
| $C_{25}$ = | 0.48 |
| $C_{50}$ = | 0.52 |
| $C_{100}$ = | 0.54 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.4\,5}n^{.4\,5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E0 Culvert TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 597.0 | ft |
| ELEVATION DIFF (H) | 15.0 | ft |
| LENGTH (L) | 595 | ft |
| SLOPE (S) = (H/L) | 2.5% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 1.03 | fps |
| $T_C$ (CH)= | 9.64 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 16.42 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **16.42** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | **FLOW RESULTS** | **cfs** |
|---|---|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = | **$Q_2$ =** | 8.9 |
| $i_{10}$ = | 1.8 | in/hr | X CA = | **$Q_{10}$ =** | 16.8 |
| $i_{25}$ = | 2.2 | in/hr | X CA = | **$Q_{25}$ =** | 23.1 |
| $i_{50}$ = | 2.5 | in/hr | X CA = | **$Q_{50}$ =** | 29.0 |
| $i_{100}$ = | 2.9 | in/hr | X CA = | **$Q_{100}$ =** | **34.1** |

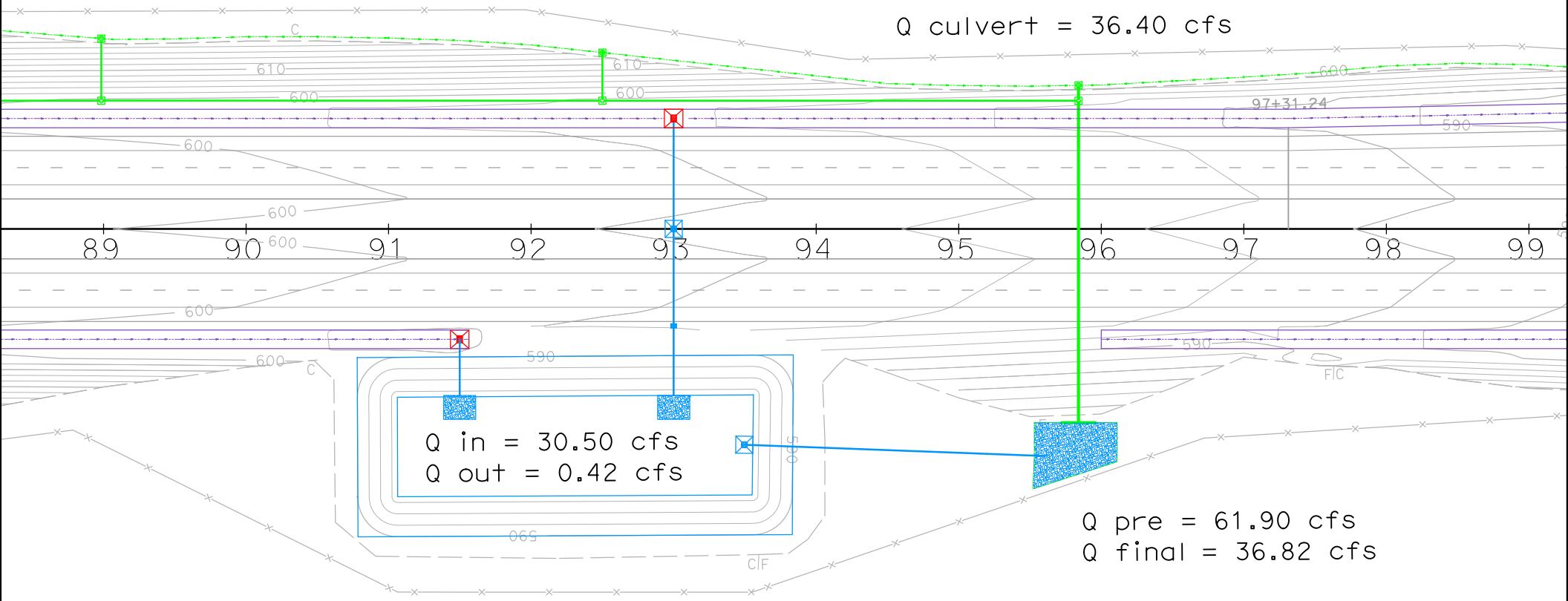
**COUNTY $P_6$**

| | **inches** |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | **FLOW RESULTS** | **cfs** |
|---|---|---|---|---|---|
| $i_2$ = | 1.3 | in/hr | X CA = | **$Q_2$ =** | 12.8 |
| $i_{10}$ = | 2.0 | in/hr | X CA = | **$Q_{10}$ =** | 18.6 |
| $i_{25}$ = | 2.4 | in/hr | X CA = | **$Q_{25}$ =** | 25.6 |
| $i_{50}$ = | 2.9 | in/hr | X CA = | **$Q_{50}$ =** | 33.5 |
| $i_{100}$ = | 3.1 | in/hr | X CA = | **$Q_{100}$ =** | **36.4** |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN E0
FLOW SUMMARY

Scale: 1"=100'

# Basin E0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **E0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 61.9 | cfs | | | |
| Tc= | 24.5 | min | C= | 0.54 | |
| $P_{100,6}$= | 2.5 | in | A= | 48.15 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 25 | 6000 | 4 |
| 50 | 6750 | 4.5 |
| 75 | 7050 | 4.7 |
| 100 | 8100 | 5.4 |
| 125 | 8850 | 5.9 |
| 150 | 10800 | 7.2 |
| 175 | 12300 | 8.2 |
| 200 | 18000 | 12 |
| 225 | 23550 | 15.7 |
| 250 | 92850 | 61.9 |
| 275 | 14400 | 9.6 |
| 300 | 9600 | 6.4 |
| 325 | 7500 | 5 |
| 350 | 6300 | 4.2 |
| 375 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 232050 $ft^3$**
**5.33 acre-feet**

Check: $V = C*A*P_6$
V= 5.45 acre-feet
***OK***

# Basin E0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 84.3 | cfs | | | |
| Tc= | 23.9 | min | C= | 0.64 | |
| $P_{100,6}$= | 2.5 | in | A= | 54.59 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 24 | 7632 | 5.3 |
| 48 | 7920 | 5.5 |
| 72 | 8784 | 6.1 |
| 96 | 9360 | 6.5 |
| 120 | 10800 | 7.5 |
| 144 | 11664 | 8.1 |
| 168 | 14256 | 9.9 |
| 192 | 16272 | 11.3 |
| 216 | 23904 | 16.6 |
| 240 | 32688 | 22.7 |
| 264 | 121392 | 84.3 |
| 288 | 19152 | 13.3 |
| 312 | 12816 | 8.9 |
| 336 | 10080 | 7 |
| 360 | 8352 | 5.8 |
| 384 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 315072 $ft^3$**
**7.23 acre-feet**

Check: V = C*A*$P_6$
V= 7.32 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **7.23** | *(Post)* | | |
| | **-** | **5.33** | *(Pre)* | | |
| **Retention volume =** | | **1.91** | **acre-feet** | **=** | **83022 $ft^3$** **Basin Required** |

# Basin E0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.87
A= 13.64 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **32670** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

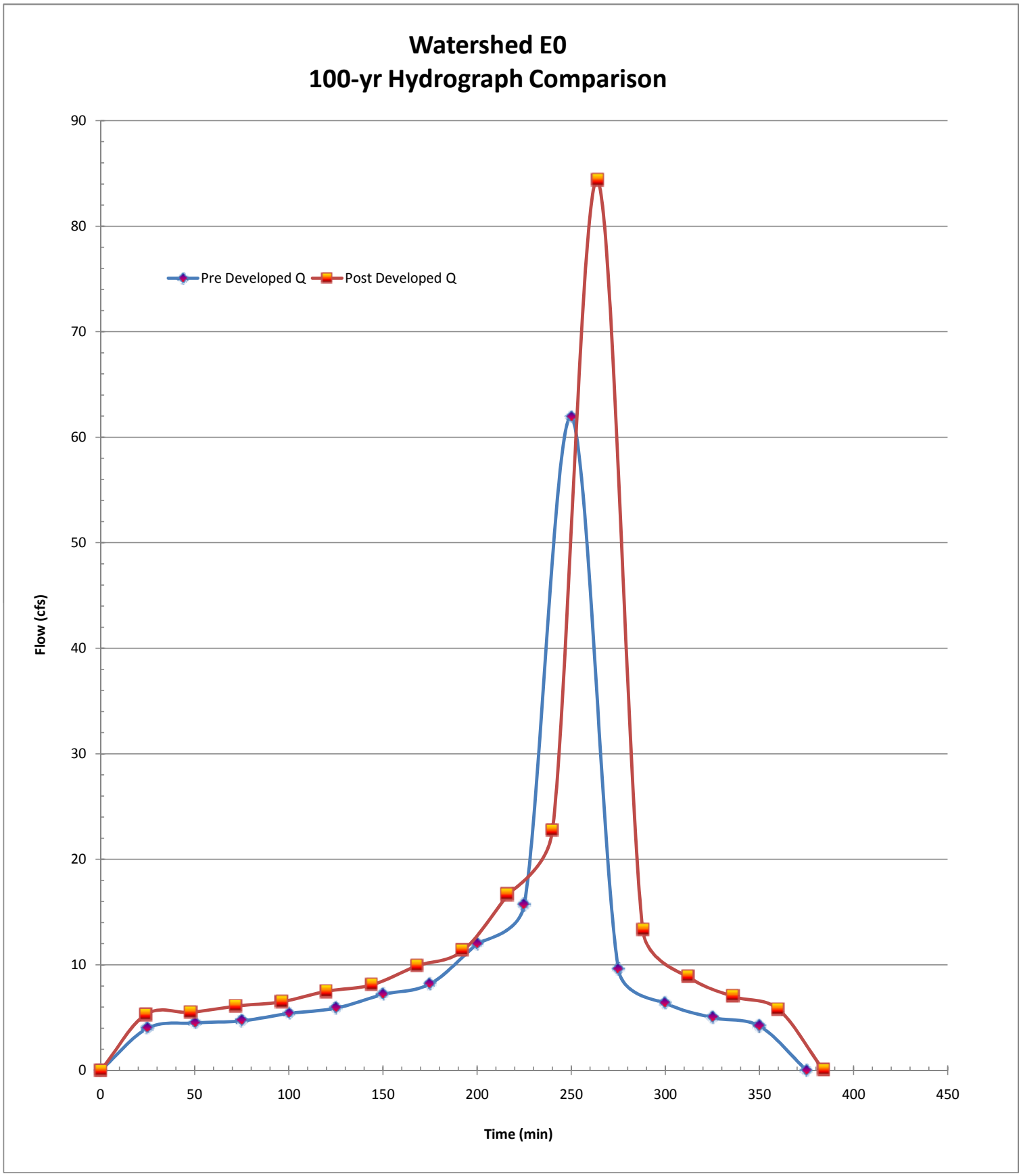
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 346900 | $ft^2$ |
| | A: | 7.96 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 123.85 tons

**Silt Accumulation Basin volume =** **2752** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Watershed E0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200
250
300
350
400
450

# Basin E0 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | E0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 594000 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 13.64 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 42% | AT | 0.90 | 0.374 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 58% | AT | 0.55 | 0.321 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.70 |
| $C_{25}$ = | 0.77 |
| $C_{50}$ = | 0.83 |
| $C_{100}$ = | 0.87 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 HP |
| LOW POINT ELEVATION | 607.8 | ft | |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 117 | ft | to Bioswale |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | AC < = From Table 816.6A |
| $T_t$ (SFF)= | 4.01 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | 0.9% , V FROM FIG 816.6 grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | |
| LOW POINT ELEVATION | 597.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1717 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 0.5% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.86 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 15.39 | minutes | |

# Basin E0 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 592.0 | ft | Proposed onsite pipe (assumed 5' drop to invert) |
| LOW POINT ELEVATION | 585.0 | ft | Proposed Rip Rap Pad in Basin floor |
| ELEVATION DIFF (H) | 7.0 | ft | |
| LENGTH (L) | 194 | ft | |
| SLOPE (S) = (H/L) | 3.6% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.24 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 21.54 | minutes |
| **Minimum Tc =** | 5 | minutes |
| **USE $T_C$ =** | **21.54** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.1 | in/hr | X CA = | |
| $i_{10}$ = | 1.6 | in/hr | X CA = | |
| $i_{25}$ = | 2.1 | in/hr | X CA = | |
| $i_{50}$ = | 2.5 | in/hr | X CA = | |
| $i_{100}$ = | 2.6 | in/hr | X CA = | |

**FLOW RESULTS**

| | cfs |
|---|---|
| **$Q_2$ =** | 10.7 |
| **$Q_{10}$ =** | 15.6 |
| **$Q_{25}$ =** | 21.4 |
| **$Q_{50}$ =** | 28.1 |
| **$Q_{100}$ =** | **30.5** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin E0 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **E0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 30.5 | cfs | $C_{100}$= | 0.87 | |
| Tc= | 21.5 | min | A= | 13.64 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 22 | 396 | 0.3 |
| 44 | 2508 | 1.9 |
| 66 | 2640 | 2 |
| 88 | 2904 | 2.2 |
| 110 | 3036 | 2.3 |
| 132 | 3564 | 2.7 |
| 154 | 3828 | 2.9 |
| 176 | 4752 | 3.6 |
| 198 | 5412 | 4.1 |
| 220 | 7920 | 6 |
| 242 | 10428 | 7.9 |
| 264 | 40260 | 30.5 |
| 286 | 6336 | 4.8 |
| 308 | 4224 | 3.2 |
| 330 | 3300 | 2.5 |
| 352 | 2772 | 2.1 |
| 374 | 0 | 0 |

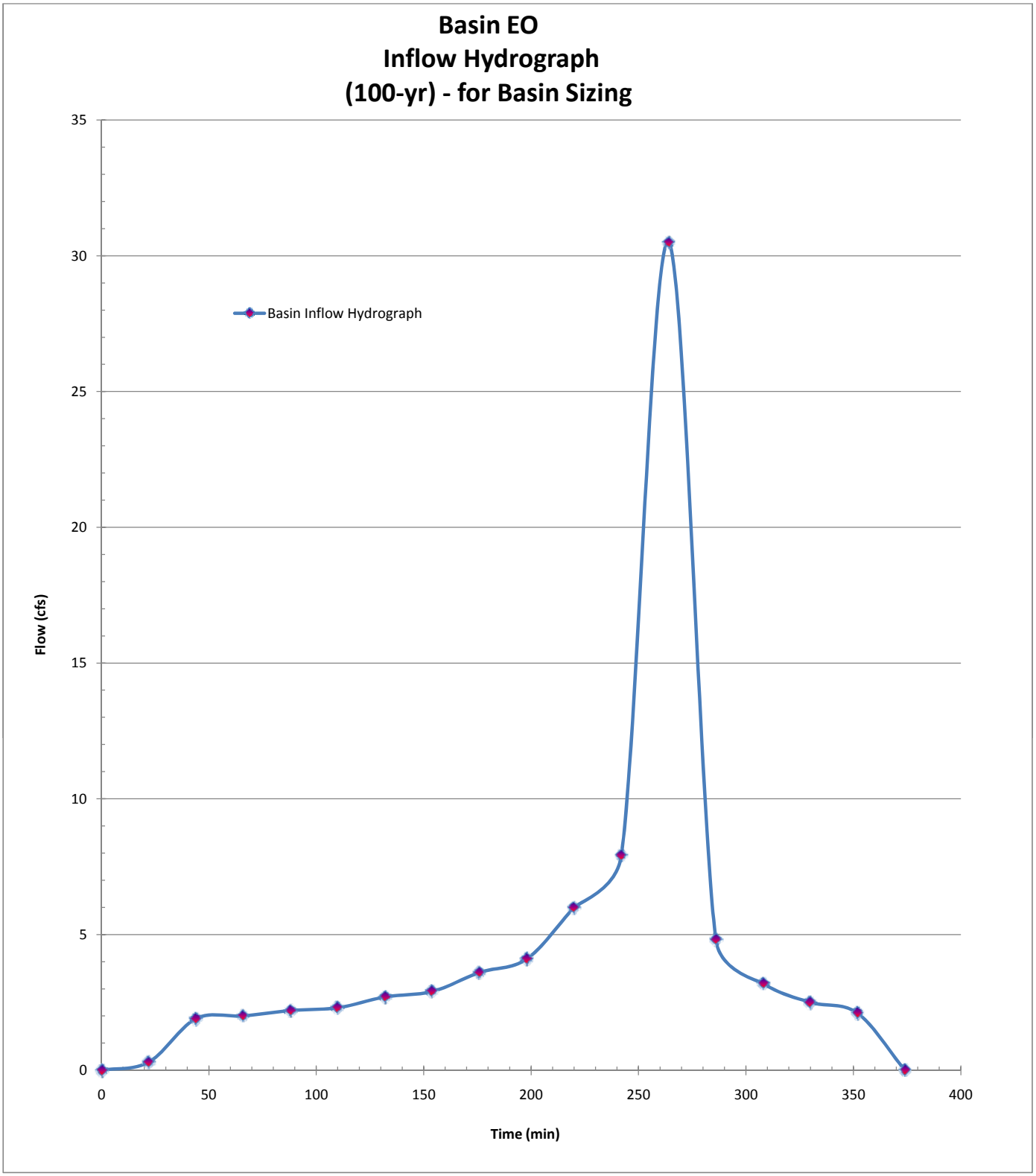
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 104280 $ft^3$**
**2.39 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 2.47 acre-feet
***OK***


Basin EO
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400

# Basin E0 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | SR-11 | | | **DESCRIPTION:** | SR-11 Basin |
| **JOB #:** | 11A1190 | | | **STATION:** | 96+00 |
| **BY:** | M.BRUNING | **DATE:** | 02.19.10 | **WATERSHED:** | E0 |
| **CHK:** | G.DALZIEL | **DATE:** | | **SYSTEM:** | Basin Outlet |

***Notes:***

Required Retention Basin Volume = 85774 $ft^3$

Actual Basin Inflow = 104280 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

Predeveloped Peak 100-year Flow: 61.9 cfs

Post-Developed Peak Flow through Cross Culvert: 36.4 cfs — Includes: E0.3.SL E0.4.SL E0.5.SL E0.6.SL

Flow that does not reach detention basin (bypass per DA table): 0.0 cfs ~ $Q_{100}$ of:

Maximum flow allowed to be released by this detention basin: 25.5 cfs

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

Basin - Top of basin berm elevation = 590.00 ft

Basin flowline elevation = 584.00 ft

Maximum Basin Depth = 6.00 ft

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

Outlet pipe invert from basin floor = 3.60 ft — 587.60 ft

Outlet pipe diameter = 2 ft

***Basin Characteristics***

Base Length (L) 250 ft

Base Width (W) 75 ft

W/L Ratio ® 0.30

Side Slopes (Z) 1: 4

Total Volume (V): 164115 $ft^2$

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 584.00 | 0.00 | 0 | 0 | | 584.00 | 0.00 | | 0.00 |
| 1 | 584.20 | 0.20 | 3802 | 3802 | | 584.20 | 0.00 | | 0.00 |
| 2 | 584.40 | 0.40 | 3907 | 7709 | | 584.40 | 0.00 | | 0.00 |
| 3 | 584.60 | 0.60 | 4013 | 11722 | | 584.60 | 0.00 | | 0.00 |
| 4 | 584.80 | 0.80 | 4120 | 15843 | | 584.80 | 0.00 | | 0.00 |
| 5 | 585.00 | 1.00 | 4228 | 20071 | | 585.00 | 0.00 | | 0.00 |
| 6 | 585.20 | 1.20 | 4338 | 24409 | | 585.20 | 0.00 | | 0.00 |
| 7 | 585.40 | 1.40 | 4448 | 28857 | | 585.40 | 0.00 | | 0.00 |
| 8 | 585.60 | 1.60 | 4560 | 33417 | | 585.60 | 0.00 | | 0.00 |
| 9 | 585.80 | 1.80 | 4672 | 38089 | | 585.80 | 0.00 | | 0.00 |
| 10 | 586.00 | 2.00 | 4786 | 42874 | | 586.00 | 0.00 | | 0.00 |
| 11 | 586.20 | 2.20 | 4900 | 47775 | | 586.20 | 0.00 | | 0.00 |
| 12 | 586.40 | 2.40 | 5016 | 52791 | | 586.40 | 0.00 | | 0.00 |
| 13 | 586.60 | 2.60 | 5133 | 57924 | | 586.60 | 0.00 | | 0.00 |
| 14 | 586.80 | 2.80 | 5251 | 63175 | | 586.80 | 0.00 | | 0.00 |
| 15 | 587.00 | 3.00 | 5370 | 68545 | | 587.00 | 0.00 | 0.00 | 0.00 |
| 16 | 587.20 | 3.20 | 5490 | 74035 | | 587.20 | 0.00 | | 0.00 |
| 17 | 587.40 | 3.40 | 5611 | 79647 | | 587.40 | 0.00 | | 0.00 |
| 18 | 587.60 | 3.60 | 5734 | 85380 | | 587.60 | 0.00 | | 0.00 |
| 19 | 587.80 | 3.80 | 5857 | 91237 | * | 587.80 | 0.00 | | 0.00 |
| 20 | 588.00 | 4.00 | 5981 | 97219 | | 588.00 | 0.15 | | 0.15 |
| 21 | 588.20 | 4.20 | 6107 | 103326 | | 588.20 | 0.59 | | 0.59 |
| 22 | 588.40 | 4.40 | 6234 | 109559 | | 588.40 | 1.30 | | 1.30 |
| 23 | 588.60 | 4.60 | 6361 | 115920 | | 588.60 | 2.25 | | 2.25 |
| 24 | 588.80 | 4.80 | 6490 | 122410 | | 588.80 | 3.42 | | 3.42 |
| 25 | 589.00 | 5.00 | 6620 | 129030 | | 589.00 | 4.79 | | 4.79 |
| 26 | 589.20 | 5.20 | 6751 | 135781 | | 589.20 | 6.32 | | 6.32 |
| 27 | 589.40 | 5.40 | 6883 | 142664 | | 589.40 | 7.99 | | 7.99 |
| 28 | 589.60 | 5.60 | 7016 | 149680 | | 589.60 | 9.77 | | 9.77 |
| 29 | 589.80 | 5.80 | 7150 | 156830 | | 589.80 | 11.63 | | 11.63 |
| 30 | 590.00 | 6.00 | 7285 | 164115 | | 590.00 | 13.53 | | 13.53 |

# Basin E0 Routing

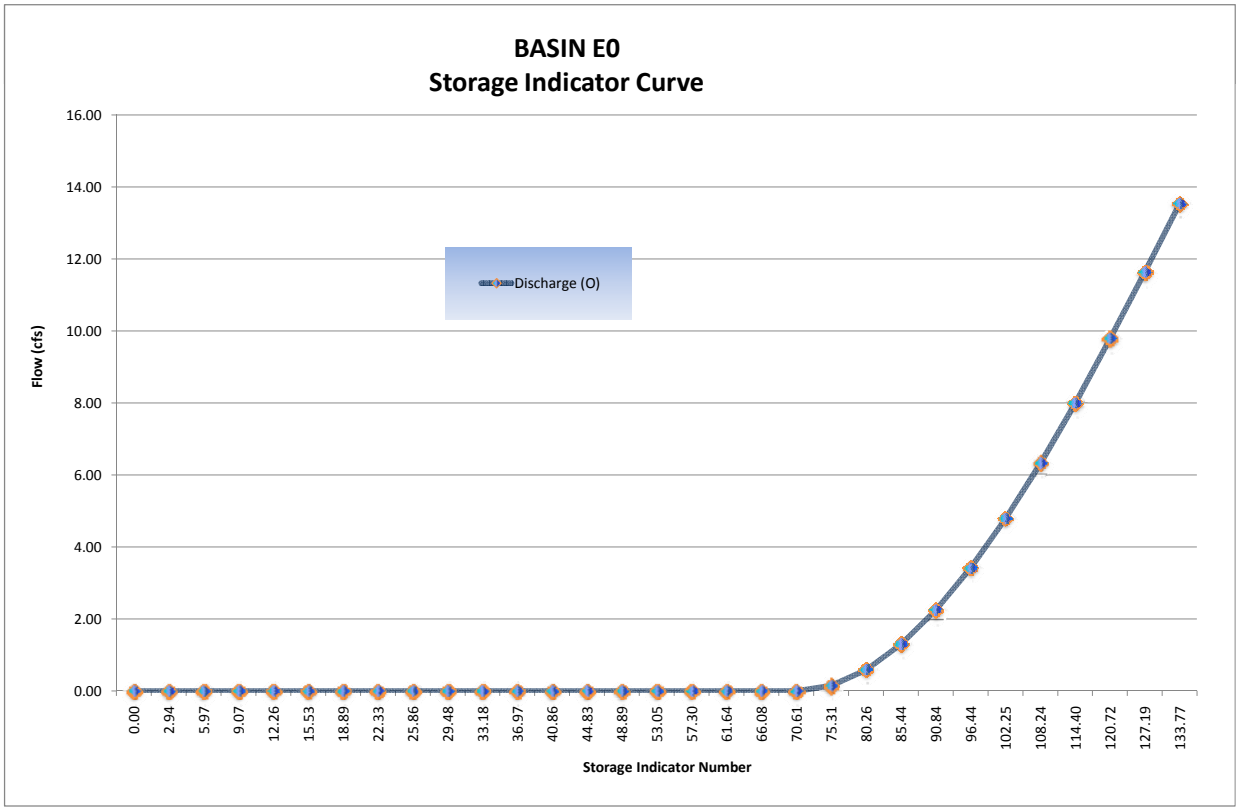
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | E0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin E0 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | Storage Indicator # (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| 584.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 584.20 | 0.00 | 3802 | 0.00 | 2.94 | 2.94 |
| 584.40 | 0.00 | 7709 | 0.00 | 5.97 | 5.97 |
| 584.60 | 0.00 | 11722 | 0.00 | 9.07 | 9.07 |
| 584.80 | 0.00 | 15843 | 0.00 | 12.26 | 12.26 |
| 585.00 | 0.00 | 20071 | 0.00 | 15.53 | 15.53 |
| 585.20 | 0.00 | 24409 | 0.00 | 18.89 | 18.89 |
| 585.40 | 0.00 | 28857 | 0.00 | 22.33 | 22.33 |
| 585.60 | 0.00 | 33417 | 0.00 | 25.86 | 25.86 |
| 585.80 | 0.00 | 38089 | 0.00 | 29.48 | 29.48 |
| 586.00 | 0.00 | 42874 | 0.00 | 33.18 | 33.18 |
| 586.20 | 0.00 | 47775 | 0.00 | 36.97 | 36.97 |
| 586.40 | 0.00 | 52791 | 0.00 | 40.86 | 40.86 |
| 586.60 | 0.00 | 57924 | 0.00 | 44.83 | 44.83 |
| 586.80 | 0.00 | 63175 | 0.00 | 48.89 | 48.89 |
| 587.00 | 0.00 | 68545 | 0.00 | 53.05 | 53.05 |
| 587.20 | 0.00 | 74035 | 0.00 | 57.30 | 57.30 |
| 587.40 | 0.00 | 79647 | 0.00 | 61.64 | 61.64 |
| 587.60 | 0.00 | 85380 | 0.00 | 66.08 | 66.08 |
| 587.80 | 0.00 | 91237 | 0.00 | 70.61 | 70.61 |
| 588.00 | 0.15 | 97219 | 0.08 | 75.24 | 75.31 |
| 588.20 | 0.59 | 103326 | 0.30 | 79.96 | 80.26 |
| 588.40 | 1.30 | 109559 | 0.65 | 84.79 | 85.44 |
| 588.60 | 2.25 | 115920 | 1.13 | 89.71 | 90.84 |
| 588.80 | 3.42 | 122410 | 1.71 | 94.73 | 96.44 |
| 589.00 | 4.79 | 129030 | 2.40 | 99.86 | 102.25 |
| 589.20 | 6.32 | 135781 | 3.16 | 105.08 | 108.24 |
| 589.40 | 7.99 | 142664 | 4.00 | 110.41 | 114.40 |
| 589.60 | 9.77 | 149680 | 4.89 | 115.84 | 120.72 |
| 589.80 | 11.63 | 156830 | 5.82 | 121.37 | 127.19 |
| 590.00 | 13.53 | 164115 | 6.77 | 127.01 | 133.77 |

| | | |
|---|---|---|
| delta t = | 0.36 | hrs |
| delta t = | 22 | min |
| delta t = | 1292.145 | sec |

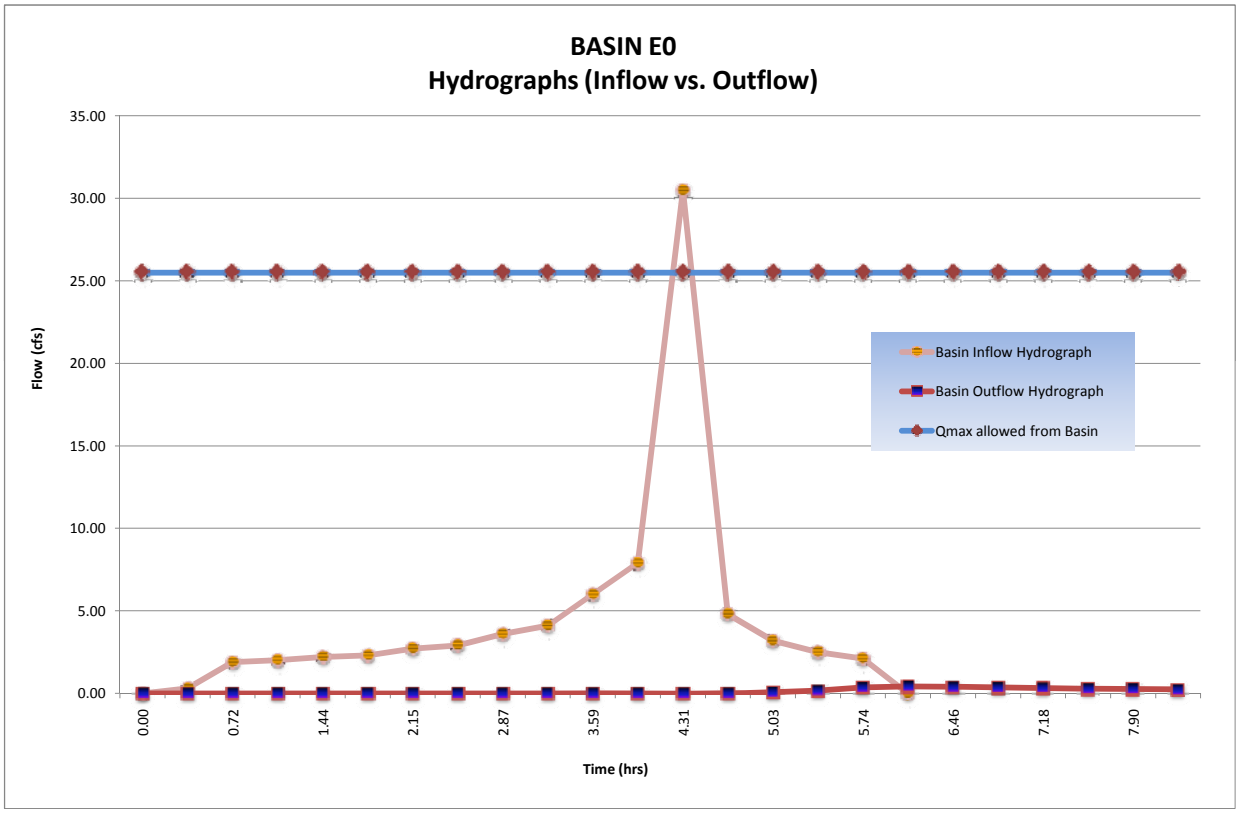


# Basin E0 Routing

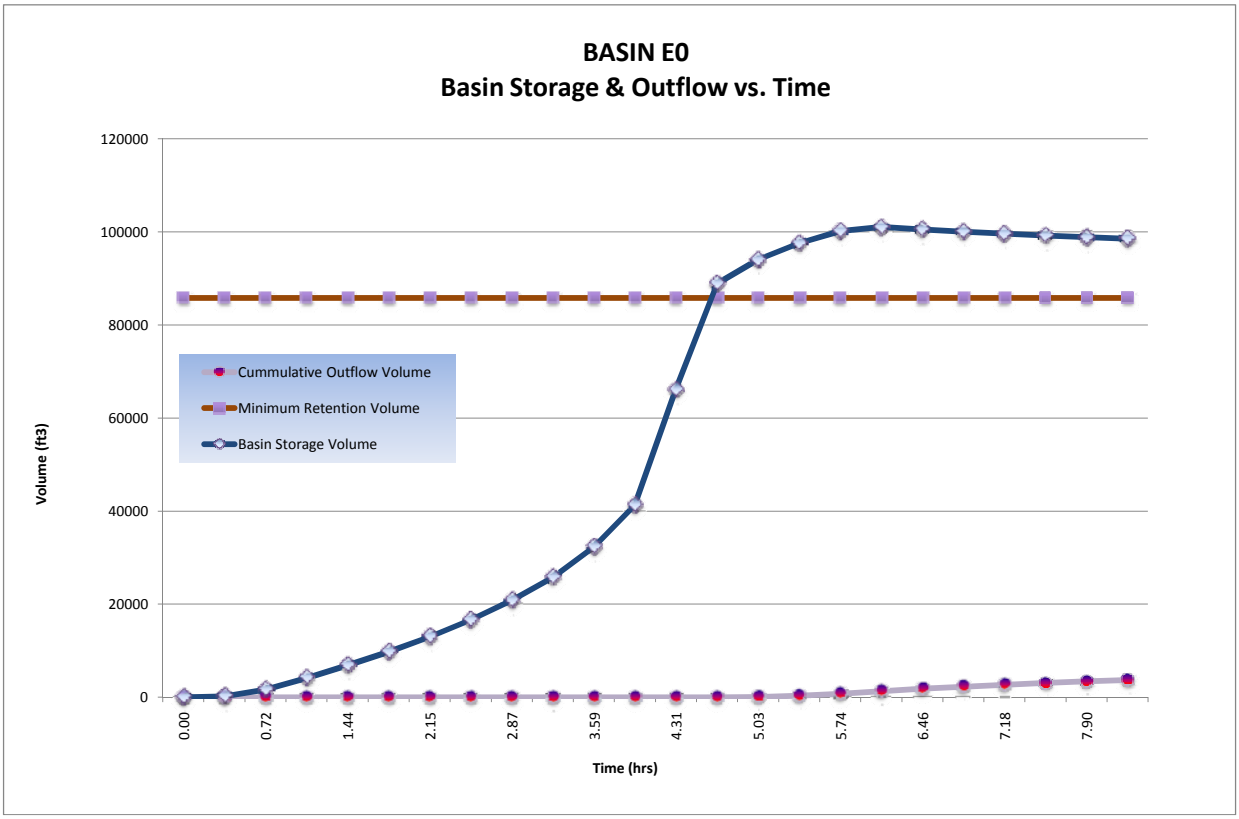
$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} - \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.36 | 0.30 | 0.15 | 0.00 | 0.00 | 0.15 | 0.00 | 194 | 0 | 0 |
| 0.72 | 1.90 | 1.10 | 0.15 | 0.00 | 1.25 | 0.00 | 1615 | 0 | 0 |
| 1.08 | 2.00 | 1.95 | 1.25 | 0.00 | 3.20 | 0.00 | 4135 | 0 | 0 |
| 1.44 | 2.20 | 2.10 | 3.20 | 0.00 | 5.30 | 0.00 | 6848 | 0 | 0 |
| 1.79 | 2.30 | 2.25 | 5.30 | 0.00 | 7.55 | 0.00 | 9756 | 0 | 0 |
| 2.15 | 2.70 | 2.50 | 7.55 | 0.00 | 10.05 | 0.00 | 12986 | 0 | 0 |
| 2.51 | 2.90 | 2.80 | 10.05 | 0.00 | 12.85 | 0.00 | 16604 | 0 | 0 |
| 2.87 | 3.60 | 3.25 | 12.85 | 0.00 | 16.10 | 0.00 | 20804 | 0 | 0 |
| 3.23 | 4.10 | 3.85 | 16.10 | 0.00 | 19.95 | 0.00 | 25778 | 0 | 0 |
| 3.59 | 6.00 | 5.05 | 19.95 | 0.00 | 25.00 | 0.00 | 32304 | 0 | 0 |
| 3.95 | 7.90 | 6.95 | 25.00 | 0.00 | 31.95 | 0.00 | 41284 | 0 | 0 |
| 4.31 | 30.50 | 19.20 | 31.95 | 0.00 | 51.15 | 0.00 | 66093 | 0 | 0 |
| 4.67 | 4.80 | 17.65 | 51.15 | 0.00 | 68.80 | 0.00 | 88900 | 0 | 0 |
| 5.03 | 3.20 | 4.00 | 68.80 | 0.00 | 72.80 | 0.07 | 94023 | 90 | 90 |
| 5.38 | 2.50 | 2.85 | 72.80 | 0.07 | 75.58 | 0.17 | 97551 | 220 | 310 |
| 5.74 | 2.10 | 2.30 | 75.58 | 0.17 | 77.71 | 0.36 | 100180 | 465 | 775 |
| 6.10 | 0.00 | 1.05 | 77.71 | 0.36 | 78.40 | 0.42 | 101033 | 543 | 1318 |
| 6.46 | | 0.00 | 78.40 | 0.42 | 77.98 | 0.39 | 100510 | 504 | 1822 |
| 6.82 | | 0.00 | 77.98 | 0.39 | 77.59 | 0.35 | 100031 | 452 | 2274 |
| 7.18 | | 0.00 | 77.59 | 0.35 | 77.24 | 0.32 | 99599 | 413 | 2688 |
| 7.54 | | 0.00 | 77.24 | 0.32 | 76.92 | 0.29 | 99204 | 375 | 3062 |
| 7.90 | | 0.00 | 76.92 | 0.29 | 76.63 | 0.27 | 98843 | 349 | 3411 |
| 8.26 | | 0.00 | 76.63 | 0.27 | 76.36 | 0.24 | 98513 | 310 | 3721 |



## Basin E0 Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **101,033** | **$ft^3$** | |
| **@ Stage:** | **588.20** | **ft** | |
| **Freeboard** | **1.8** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **164,115** | **$ft^3$** | Basin **E0** |
| **Maximum flow rate released from this basin:** | **0.42** | **cfs** | |

# F0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **92+50 to 116+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **12.31.09** | **WATERSHED:** | **F0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| F0.1.PV | 0.99 | 53800 | 1.2 | 10 | 2.8 | 3.44 | 4.2 | 5.15 | F0.1 | F0.1 | Basin F0 | 101+50 | Lt |
| F0.2.PV | 0.99 | 55600 | 1.3 | 10 | 2.8 | 3.56 | 4.2 | 5.32 | F0.2 | F0.2 | Basin F0 | 101+50 | Rt |
| F0.3.PV | 0.99 | 12800 | 0.3 | 5 | 4.0 | 1.16 | 6.6 | 1.92 | ~ | F0.3 | Basin F0 | 103+35 | Rt |
| F0.4.PV | 0.99 | 56100 | 1.3 | 5 | 4.0 | 5.08 | 6.6 | 8.40 | ~ | F0.4 | Basin F0 | 108+00 | Center |
| F0.5.PV | 0.99 | 35300 | 0.8 | 5 | 4.0 | 3.20 | 6.6 | 5.28 | ~ | F0.5 | Basin F0 | 108+00 | Rt |
| F0.6.PV | 0.99 | 62700 | 1.4 | 5 | 4.0 | 5.68 | 6.6 | 9.39 | ~ | F0.6 | Basin F0 | 116+00 | Center |
| F0.7.PV | 0.99 | 30700 | 0.7 | 5 | 4.0 | 2.78 | 6.6 | 4.60 | ~ | F0.7 | Basin F0 | 112+00 | Rt |
| F0.8.PV | 0.99 | 30000 | 0.7 | 5 | 4.0 | 2.72 | 6.6 | 4.49 | ~ | F0.8 | Basin F0 | 116+00 | Rt |

Σ 337000 *PAVED*

SLOPE

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| F0.1.SL | 0.61 | 43700 | 1.0 | 10 | 2.8 | 1.72 | 4.2 | 2.58 | F0.1 | F0.1 | Basin F0 | 101+50 | Lt |
| F0.2.SL | 0.61 | 19000 | 0.4 | 10 | 2.8 | 0.75 | 4.2 | 1.12 | F0.2 | F0.2 | Basin F0 | 101+50 | Rt |
| F0.9.SL | 0.61 | 69600 | 1.6 | 10 | 2.8 | 2.75 | 4.2 | 4.11 | ~ | Culvert | Culvert | 110+00 | Lt |
| F0.10.SL | 0.61 | 77200 | 1.8 | 10 | 2.8 | 3.05 | 4.2 | 4.55 | ~ | ~ | bypass* | 110+00 | Rt |
| F0.11.SL | 0.61 | 53000 | 1.2 | 10 | 2.8 | 2.09 | 4.2 | 3.13 | ~ | F0.11 | Basin F0 | 113+00 | Rt |

Σ 262500 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 599500 | 13.8 |
| | *SF* | *ac* |

WATERSHED FO
NO INTERCHANGE
ALTERNATIVE
Scale: 1" =450'
"SD11" LINE
"ENFM" LINE
"SD11" LINE
"SD11" LINE
100' SHEET FLOW
667' SHALLOW CONCENTRATED FLOW
318' CHANNEL FLOW
100' STORM DRAIN FLOW
311' CHANNEL FLOW
957' CHANNEL FLOW
3267' STORMDRAIN FLOW
700' CHANNEL FLOW

# F0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 110+50 |
| BY: | M.BRUNING | DATE: | 10.24.09 | WATERSHED: | F0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 5551010 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 127.43 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | NOTES: |
|---|---|---|---|
| RELIEF (.08-.35) | 0.20 | | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.47 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 89% | AT | 0.47 | 0.419 |
| PAVED SURFACE | 6% | AT | 0.90 | 0.055 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 5% | AT | 0.55 | 0.026 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.50 |
| $C_{25}$ = | 0.55 |
| $C_{50}$ = | 0.60 |
| $C_{100}$ = | 0.62 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.4\cdot5}n^{.4\cdot5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.5 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F0 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft | Exist Cross Culvert under berm |
| LOW POINT ELEVATION | 587.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | defined broad channel south of berm (field verified new berm) |
| LOW POINT ELEVATION | 576.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 / ANG-RAD / 0.197 |
| LENGTH (L) | 311 | ft | b = 50 / ANG-DEG / 11.310 |
| SLOPE (S) = (H/L) | 3.5% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.9 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.30 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 555.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 957 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.2% | | d = 1.5 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.74 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 555.0 | ft | Proposed Cross Culvert under SR-11 |
| LOW POINT ELEVATION | 546.0 | ft | Outfall/Rip Rap Pad |
| ELEVATION DIFF (H) | 9.0 | ft | |
| LENGTH (L) | 326 | ft | |
| SLOPE (S) = (H/L) | 2.8% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 4.0 | ft | |
| HYDRAULIC RADIUS R | 1.0 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 19.0 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.29 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 546.0 | ft | channellized - natural |
| LOW POINT ELEVATION | 536.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 10.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 700 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 2 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 1.0 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.58 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.26 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 29.19 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **29.19** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = | |
| $i_{10}$ = | 1.4 | in/hr | X CA = | |
| $i_{25}$ = | 1.7 | in/hr | X CA = | |
| $i_{50}$ = | 2.0 | in/hr | X CA = | |
| $i_{100}$ = | 2.1 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 59.2 |
| $Q_{10}$ = | 86.1 |
| $Q_{25}$ = | 118.3 |
| $Q_{50}$ = | 154.9 |
| $Q_{100}$ = | **168.1** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

CULVERT FO
NO INTERCHANGE
ALTERNATIVE
Scale: 1" =450'
"SD11" LINE
"ENFM" LINE
"AA12" LINE
Culvert FO
667' SHALLOW CONCENTRATED FLOW
100' SHEET FLOW
575' CHANNEL FLOW
100' STORM DRAIN FLOW
311' CHANNEL FLOW
667' CHANNEL FLOW

# Culvert Calculator Report
# F0 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 559.00 | ft | Headwater Depth/Height | 0.98 | |
| Computed Headwater Elevation | 558.91 | ft | Discharge | 63.40 | cfs |
| Inlet Control HW Elev. | 558.60 | ft | Tailwater Elevation | 547.41 | ft |
| Outlet Control HW Elev. | 558.91 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.41 | ft |
| Slope Type | Steep | | Normal Depth | 1.41 | ft |
| Flow Regime | Supercritical | | Critical Depth | 2.40 | ft |
| Velocity Downstream | 16.06 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 558.91 | ft | Upstream Velocity Head | 1.01 | ft |
| Ke | 0.50 | | Entrance Loss | 0.50 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 558.60 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## F0 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 562.00 | ft | Headwater Depth/Height | 1.70 | |
| Computed Headwater Elevation | 561.81 | ft | Discharge | 128.80 | cfs |
| Inlet Control HW Elev. | 561.81 | ft | Tailwater Elevation | 548.11 | ft |
| Outlet Control HW Elev. | 561.38 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 2.11 | ft |
| Slope Type | Steep | | Normal Depth | 2.09 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.40 | ft |
| Velocity Downstream | 19.12 | ft/s | Critical Slope | 0.8 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 561.38 | ft | Upstream Velocity Head | 1.99 | ft |
| Ke | 0.50 | | Entrance Loss | 1.00 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 561.81 | ft | Flow Control | Submerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# F0 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Culvert |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 11.17.09 | WATERSHED: | F0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 4121961 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 94.63 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.20 | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.47 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.47 | 0.465 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.47 |
| $C_{25}$ = | 0.52 |
| $C_{50}$ = | 0.57 |
| $C_{100}$ = | 0.59 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F0 Culvert TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$ $\frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft |
| LOW POINT ELEVATION | 587.0 | ft |
| ELEVATION DIFF (H) | 2.0 | ft |
| LENGTH (L) | 100 | ft |
| SLOPE (S) = (H/L) | 2.0% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.0 | ft |
| HYDRAULIC RADIUS R | 0.8 | ft |
| VELOCITY (STORMDRAIN) | 13.4 | fps |
| $T_C$ (SD)= | 0.12 | minutes |

**NOTES:**

Exist Cross Culvert under berm

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V} = \frac{L}{60\,V}$ $V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft |
| LOW POINT ELEVATION | 576.0 | ft |
| ELEVATION DIFF (H) | 11.0 | ft |
| LENGTH (L) | 311 | ft |
| SLOPE (S) = (H/L) | 3.5% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (CHANNEL) | 3.30 | fps |
| $T_C$ (CH)= | 1.57 | minutes |

**NOTES:**

defined broad channel south of berm (field verified new berm)

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 50 | ANG-DEG | 11.310 |
| d = | 1 | FLOWING FULL ASS'M | |

Natural channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft |
| LOW POINT ELEVATION | 555.0 | ft |
| ELEVATION DIFF (H) | 21.0 | ft |
| LENGTH (L) | 957 | ft |
| SLOPE (S) = (H/L) | 2.2% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.8 | ft |
| VELOCITY (CHANNEL) | 3.74 | fps |
| $T_C$ (CH)= | 4.27 | minutes |

**NOTES:**

channel begins to narrow

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 1.5 | FLOWING FULL ASS'M | |

Natural channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 25.64 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **25.64** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | **FLOW RESULTS:** | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | **$Q_2$ =** | 33.8 |
| $i_{10}$ = | 1.4 | in/hr | X CA = | **$Q_{10}$ =** | 63.4 |
| $i_{25}$ = | 1.8 | in/hr | X CA = | **$Q_{25}$ =** | 87.2 |
| $i_{50}$ = | 2.0 | in/hr | X CA = | **$Q_{50}$ =** | 109.4 |
| $i_{100}$ = | 2.3 | in/hr | X CA = | **$Q_{100}$ =** | **128.8** |

~Use Caltrans 'i' for culvert sizing

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

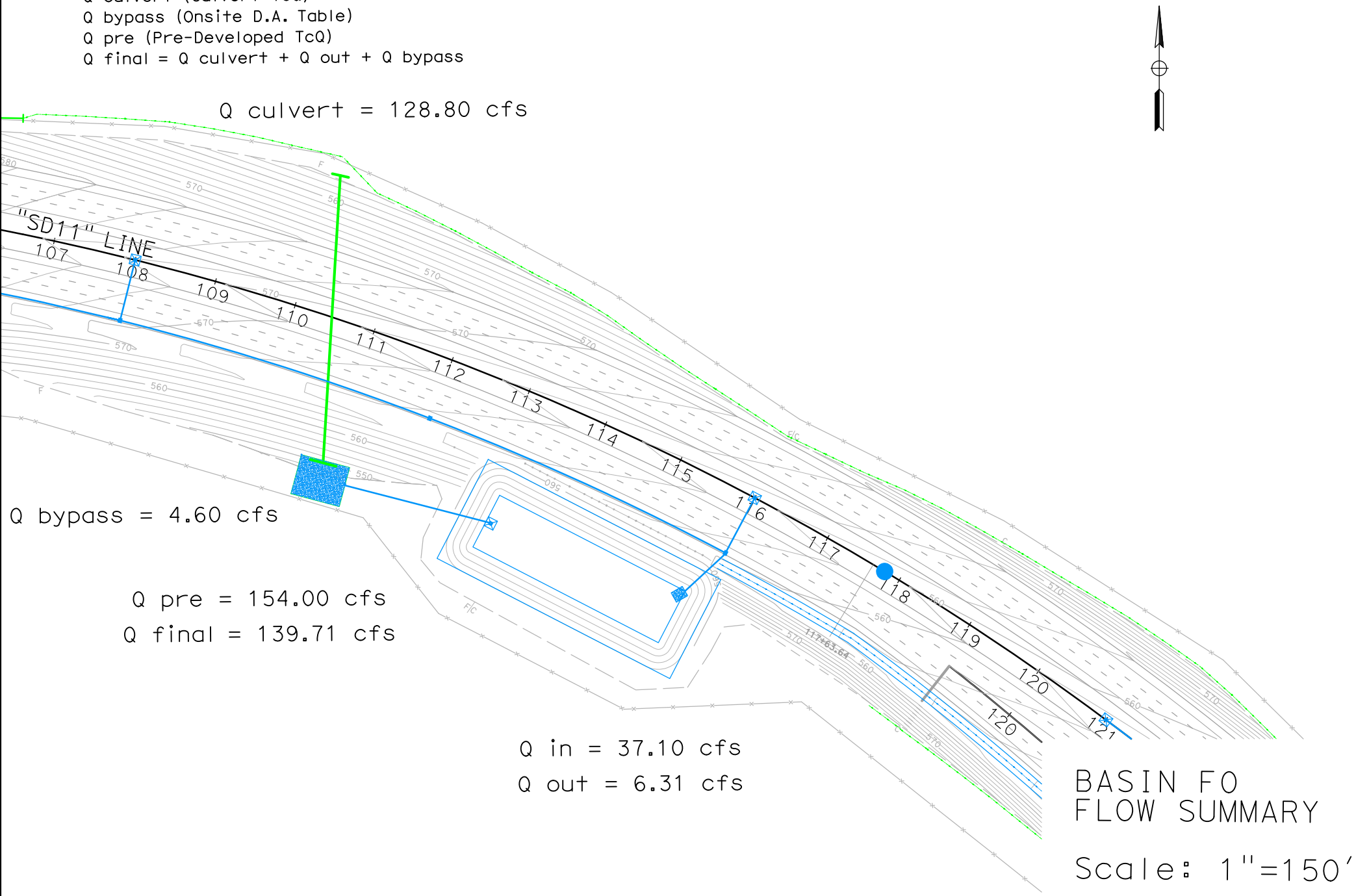
| | | | | **FLOW RESULTS** | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | **$Q_2$ =** | 45.3 |
| $i_{10}$ = | 1.5 | in/hr | X CA = | **$Q_{10}$ =** | 65.9 |
| $i_{25}$ = | 1.8 | in/hr | X CA = | **$Q_{25}$ =** | 90.6 |
| $i_{50}$ = | 2.2 | in/hr | X CA = | **$Q_{50}$ =** | 118.7 |
| $i_{100}$ = | 2.3 | in/hr | X CA = | **$Q_{100}$ =** | **128.8** |

~Use County of SD 'i' for detention basin design

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN FO
FLOW SUMMARY

Scale: 1"=150'

# Basin F0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+50** |
| **BY:** | **M.BRUNING** | **DATE:** | **12.31.09** | **WATERSHED:** | **F0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 154.0 | cfs | | | |
| Tc= | 30.0 | min | C= | 0.59 | |
| $P_{100,6}$= | 2.5 | in | A= | 125.36 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 30 | 20340 | 11.3 |
| 60 | 21600 | 12 |
| 90 | 24660 | 13.7 |
| 120 | 26820 | 14.9 |
| 150 | 32760 | 18.2 |
| 180 | 37260 | 20.7 |
| 210 | 54720 | 30.4 |
| 240 | 75960 | 42.2 |
| 270 | 277200 | 154 |
| 300 | 43920 | 24.4 |
| 330 | 29340 | 16.3 |
| 360 | 23040 | 12.8 |
| 390 | 0 | 0 |

**SUM= 667620 $ft^3$**
**15.33 acre-feet**

Check: $V = C*A*P_6$
V= 15.47 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin F0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 168.1 | cfs | | | |
| Tc= | 29.2 | min | C= | 0.62 | |
| $P_{100,6}$= | 2.5 | in | A= | 127.43 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 29 | 21402 | 12.3 |
| 58 | 22794 | 13.1 |
| 87 | 26100 | 15 |
| 116 | 28188 | 16.2 |
| 145 | 34452 | 19.8 |
| 174 | 39324 | 22.6 |
| 203 | 57768 | 33.2 |
| 232 | 80214 | 46.1 |
| 261 | 292494 | 168.1 |
| 290 | 46284 | 26.6 |
| 319 | 30972 | 17.8 |
| 348 | 24186 | 13.9 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 704178 $ft^3$**
**16.17 acre-feet**

Check: V = C*A*$P_6$
V= 16.59 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **16.17** | *(Post)* | |
| - | **15.33** | *(Pre)* | |
| **Retention volume =** | **0.84** | **acre-feet** | **= 36558 $ft^3$** **Basin Required** |

# Basin F0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 10.39 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **27539** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

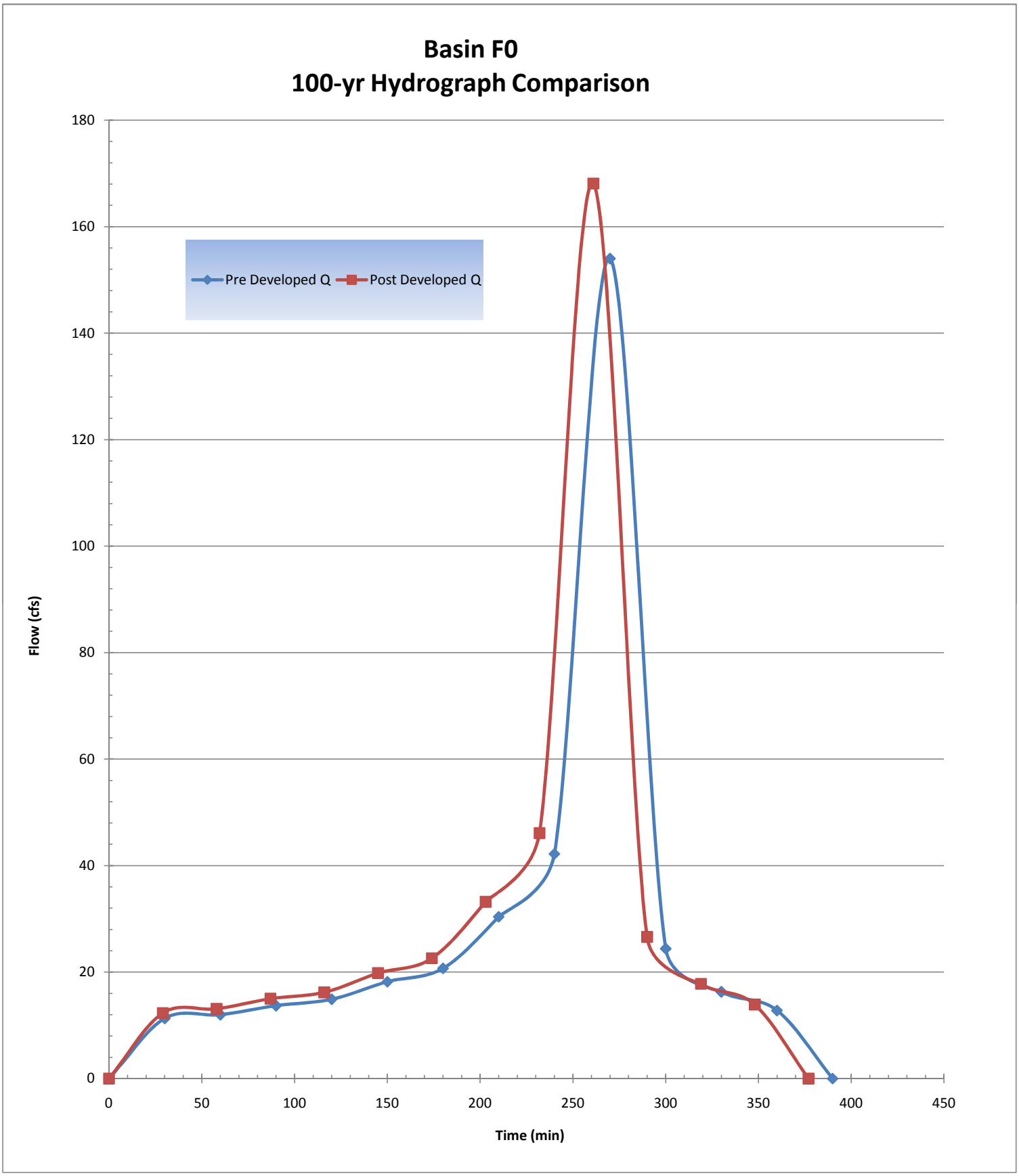
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 115700 | $ft^2$ |
| | A: | 2.66 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 41.31 tons

**Silt Accumulation Basin volume =** **918** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin F0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
180
0
50
100
150
200
250
300
350
400
450

# Basin F0 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 113+00 to 116+00 |
| BY: | M.BRUNING | DATE: | 12.31.09 | WATERSHED: | F0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 452700 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.39 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 74% | AT | 0.90 | 0.670 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 26% | AT | 0.55 | 0.141 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.81 |
| $C_{25}$ = | 0.89 |
| $C_{50}$ = | 0.97 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 599.0 | ft | Median to ES |
| LOW POINT ELEVATION | 597.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 113 | ft | to ES |
| SLOPE (S) = (H/L) | 1.8% | | |
| MANNING'S n | 0.016 | | AC < = From Table 816.6A |
| $T_t$ (SFF)= | 2.52 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 597.0 | ft | Flow in Bioswale |
| LOW POINT ELEVATION | 596.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.0 | fps | 0.5% , V FROM FIG 816.6 grass lined |
| $T_C$ (SH)= | 3.33 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 596.0 | ft | Flow in Bioswale |
| LOW POINT ELEVATION | 585.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 823 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.3% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.97 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.62 | minutes | |

# Basin F0 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 580.0 | ft | Proposed onsite pipe (assumed 5' drop to invert) |
| LOW POINT ELEVATION | 552.0 | ft | Proposed Rip Rap Pad in Basin floor |
| ELEVATION DIFF (H) | 28.0 | ft | |
| LENGTH (L) | 1465 | ft | to basin |
| SLOPE (S) = (H/L) | 1.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 10.0 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 2.45 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.92 | minutes |
| **Minimum Tc =** | 5 | minutes |
| **USE $T_C$ =** | **12.92** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = | $Q_2$ = | 13.2 |
| $i_{10}$ = | 2.3 | in/hr | X CA = | $Q_{10}$ = | 19.2 |
| $i_{25}$ = | 2.9 | in/hr | X CA = | $Q_{25}$ = | 26.5 |
| $i_{50}$ = | 3.4 | in/hr | X CA = | $Q_{50}$ = | 34.6 |
| $i_{100}$ = | 3.6 | in/hr | X CA = | $Q_{100}$ = | **37.1** |

**FLOW RESULTS**

cfs

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin F0 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **116+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **12.31.09** | **WATERSHED:** | **F0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

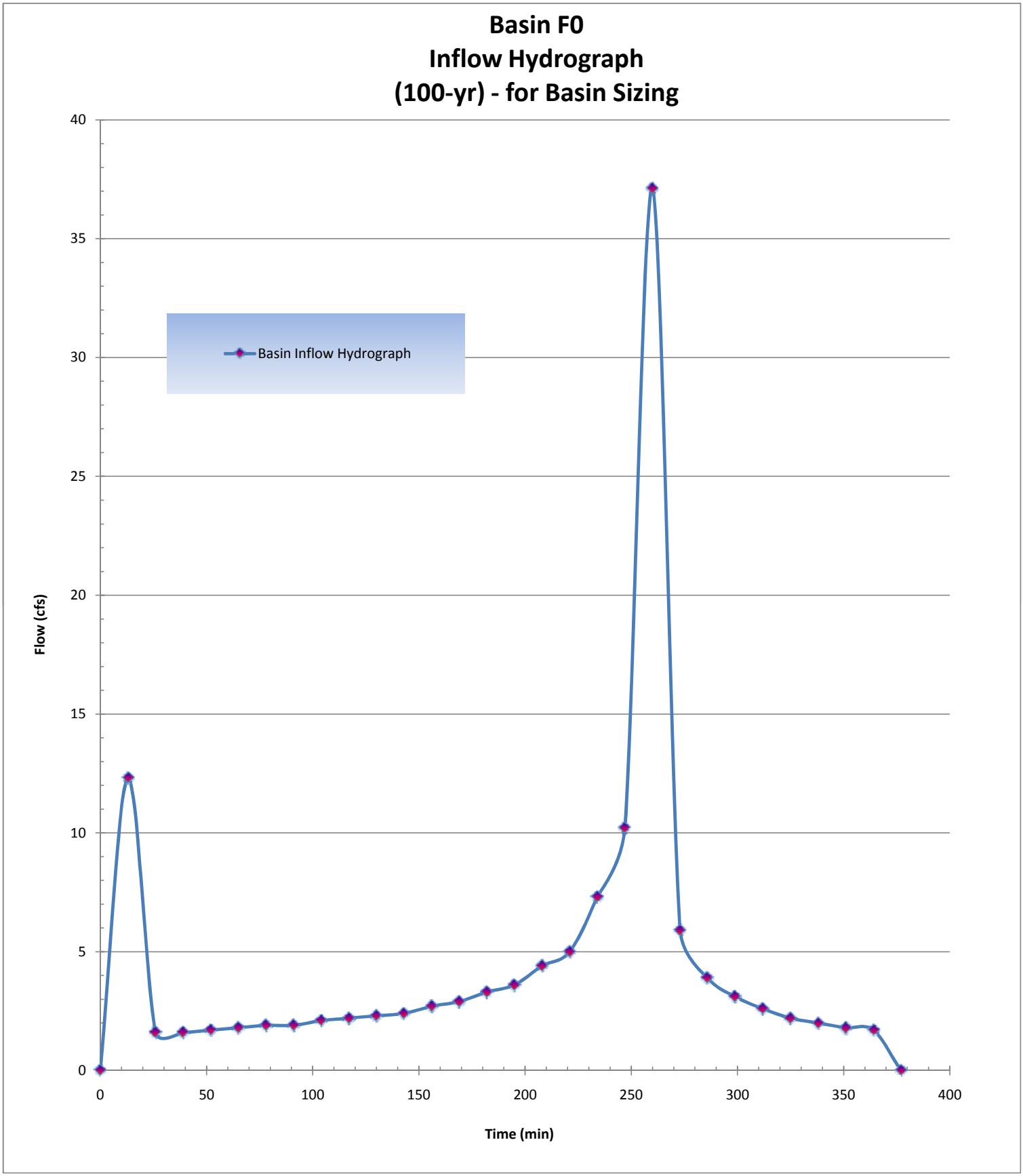
| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 37.1 | cfs | $C_{100}$= | 1.00 | |
| Tc= | 12.9 | min | | | |
| $P_{100,6}$= | 2.5 | in | A= | 10.39 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 9594 | 12.3 |
| 26 | 1248 | 1.6 |
| 39 | 1248 | 1.6 |
| 52 | 1326 | 1.7 |
| 65 | 1404 | 1.8 |
| 78 | 1482 | 1.9 |
| 91 | 1482 | 1.9 |
| 104 | 1638 | 2.1 |
| 117 | 1716 | 2.2 |
| 130 | 1794 | 2.3 |
| 143 | 1872 | 2.4 |
| 156 | 2106 | 2.7 |
| 169 | 2262 | 2.9 |
| 182 | 2574 | 3.3 |
| 195 | 2808 | 3.6 |
| 208 | 3432 | 4.4 |
| 221 | 3900 | 5 |
| 234 | 5694 | 7.3 |
| 247 | 7956 | 10.2 |
| 260 | 28938 | 37.1 |
| 273 | 4602 | 5.9 |
| 286 | 3042 | 3.9 |
| 299 | 2418 | 3.1 |
| 312 | 2028 | 2.6 |
| 325 | 1716 | 2.2 |
| 338 | 1560 | 2 |
| 351 | 1404 | 1.8 |
| 364 | 1326 | 1.7 |
| 377 | 0 | 0 |

Onsite Runoff Volume

**SUM= 102570 $ft^3$**
**2.35 acre-feet**

Check: V = C*A*$P_6$
V= 2.17 acre-feet
***OK***


Basin F0
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400

# Basin F0 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **F0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin Outlet** |

***Notes:***

Required Retention Basin Volume = 37476 $ft^3$

Actual Basin Inflow = 102570 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

| | | | | | |
|---|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 154.0 | cfs | | | |
| Post-Developed Peak Flow through Cross Culvert: | 128.8 | cfs | ~ | Includes: | F0.9.SL |
| Flow that does not reach detention basin (bypass per DA table): | 4.6 | cfs | ~ | $Q_{100}$ from: | F0.10.SL |
| Maximum flow allowed to be released by this detention basin: | 20.7 | cfs | | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 558.00 | ft |
| Basin flowline elevation = | 552.00 | ft |
| Maximum Basin Depth = | 6.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 1.60 | ft | 553.60 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 265 | ft |
| Base Width (W) | 85 | ft |
| W/L Ratio ® | 0.32 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 190229 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 552.00 | 0.00 | 0 | 0 | | 552.00 | 0.00 | | 0.00 |
| 1 | 552.20 | 0.20 | 4561 | 4561 | | 552.20 | 0.00 | | 0.00 |
| 2 | 552.40 | 0.40 | 4674 | 9235 | | 552.40 | 0.00 | | 0.00 |
| 3 | 552.60 | 0.60 | 4788 | 14023 | | 552.60 | 0.00 | | 0.00 |
| 4 | 552.80 | 0.80 | 4903 | 18927 | | 552.80 | 0.00 | | 0.00 |
| 5 | 553.00 | 1.00 | 5019 | 23946 | | 553.00 | 0.00 | | 0.00 |
| 6 | 553.20 | 1.20 | 5137 | 29083 | | 553.20 | 0.00 | | 0.00 |
| 7 | 553.40 | 1.40 | 5255 | 34338 | | 553.40 | 0.00 | | 0.00 |
| 8 | 553.60 | 1.60 | 5374 | 39712 | * | 553.60 | 0.00 | | 0.00 |
| 9 | 553.80 | 1.80 | 5494 | 45206 | | 553.80 | 0.15 | | 0.15 |
| 10 | 554.00 | 2.00 | 5616 | 50822 | | 554.00 | 0.59 | 0.00 | 0.59 |
| 11 | 554.20 | 2.20 | 5738 | 56560 | | 554.20 | 1.30 | | 1.30 |
| 12 | 554.40 | 2.40 | 5862 | 62422 | | 554.40 | 2.25 | | 2.25 |
| 13 | 554.60 | 2.60 | 5986 | 68408 | | 554.60 | 3.42 | | 3.42 |
| 14 | 554.80 | 2.80 | 6112 | 74519 | | 554.80 | 4.79 | | 4.79 |
| 15 | 555.00 | 3.00 | 6238 | 80757 | | 555.00 | 6.32 | | 6.32 |
| 16 | 555.20 | 3.20 | 6366 | 87123 | | 555.20 | 7.99 | | 7.99 |
| 17 | 555.40 | 3.40 | 6494 | 93618 | | 555.40 | 9.77 | | 9.77 |
| 18 | 555.60 | 3.60 | 6624 | 100242 | | 555.60 | 11.63 | | 11.63 |
| 19 | 555.80 | 3.80 | 6755 | 106997 | | 555.80 | 13.56 | | 13.56 |
| 20 | 556.00 | 4.00 | 6887 | 113883 | | 556.00 | 15.46 | | 15.46 |

# Basin F0 Routing

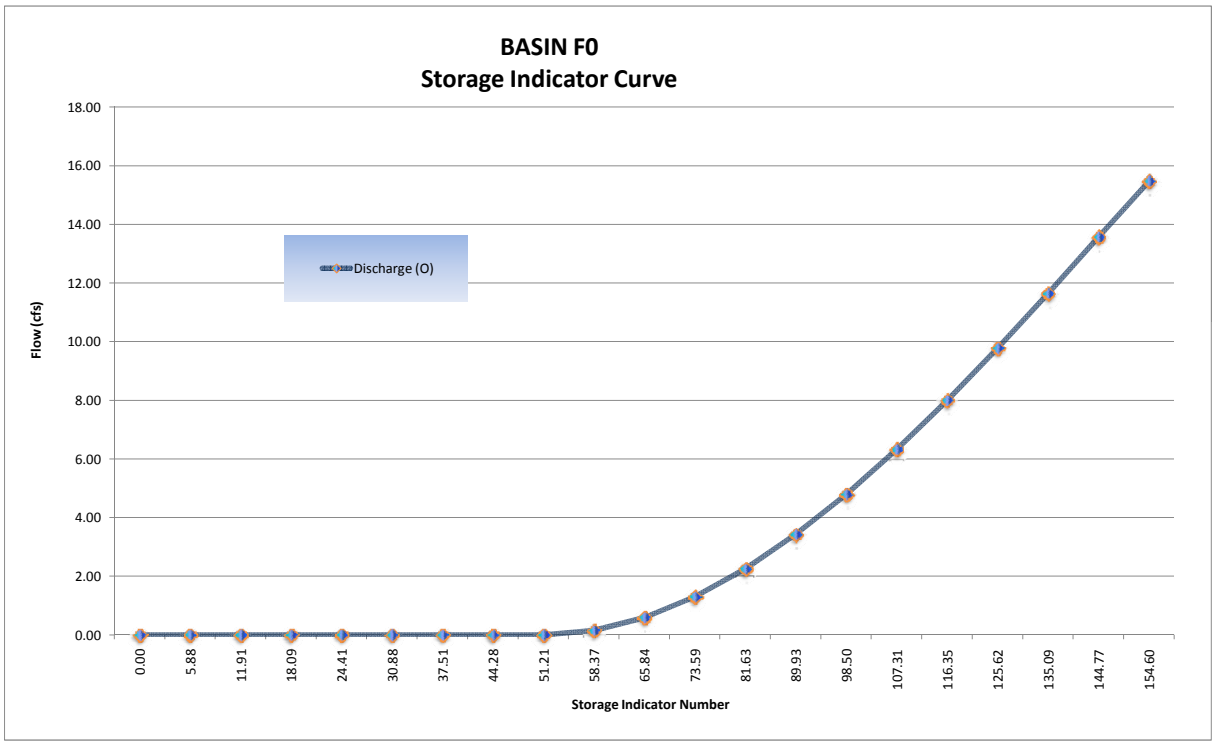
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | F |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin F0 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 552.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 552.20 | 0.00 | 4561 | 0.00 | 5.88 | 5.88 |
| 552.40 | 0.00 | 9235 | 0.00 | 11.91 | 11.91 |
| 552.60 | 0.00 | 14023 | 0.00 | 18.09 | 18.09 |
| 552.80 | 0.00 | 18927 | 0.00 | 24.41 | 24.41 |
| 553.00 | 0.00 | 23946 | 0.00 | 30.88 | 30.88 |
| 553.20 | 0.00 | 29083 | 0.00 | 37.51 | 37.51 |
| 553.40 | 0.00 | 34338 | 0.00 | 44.28 | 44.28 |
| 553.60 | 0.00 | 39712 | 0.00 | 51.21 | 51.21 |
| 553.80 | 0.15 | 45206 | 0.08 | 58.30 | 58.37 |
| 554.00 | 0.59 | 50822 | 0.30 | 65.54 | 65.84 |
| 554.20 | 1.30 | 56560 | 0.65 | 72.94 | 73.59 |
| 554.40 | 2.25 | 62422 | 1.13 | 80.50 | 81.63 |
| 554.60 | 3.42 | 68408 | 1.71 | 88.22 | 89.93 |
| 554.80 | 4.79 | 74519 | 2.40 | 96.10 | 98.50 |
| 555.00 | 6.32 | 80757 | 3.16 | 104.15 | 107.31 |
| 555.20 | 7.99 | 87123 | 4.00 | 112.36 | 116.35 |
| 555.40 | 9.77 | 93618 | 4.89 | 120.73 | 125.62 |
| 555.60 | 11.63 | 100242 | 5.82 | 129.28 | 135.09 |
| 555.80 | 13.56 | 106997 | 6.78 | 137.99 | 144.77 |
| 556.00 | 15.46 | 113883 | 7.73 | 146.87 | 154.60 |

| | | |
|---|---|---|
| delta t = | 0.22 | hrs |
| delta t = | 13 | min |
| delta t = | 775.408 | sec |

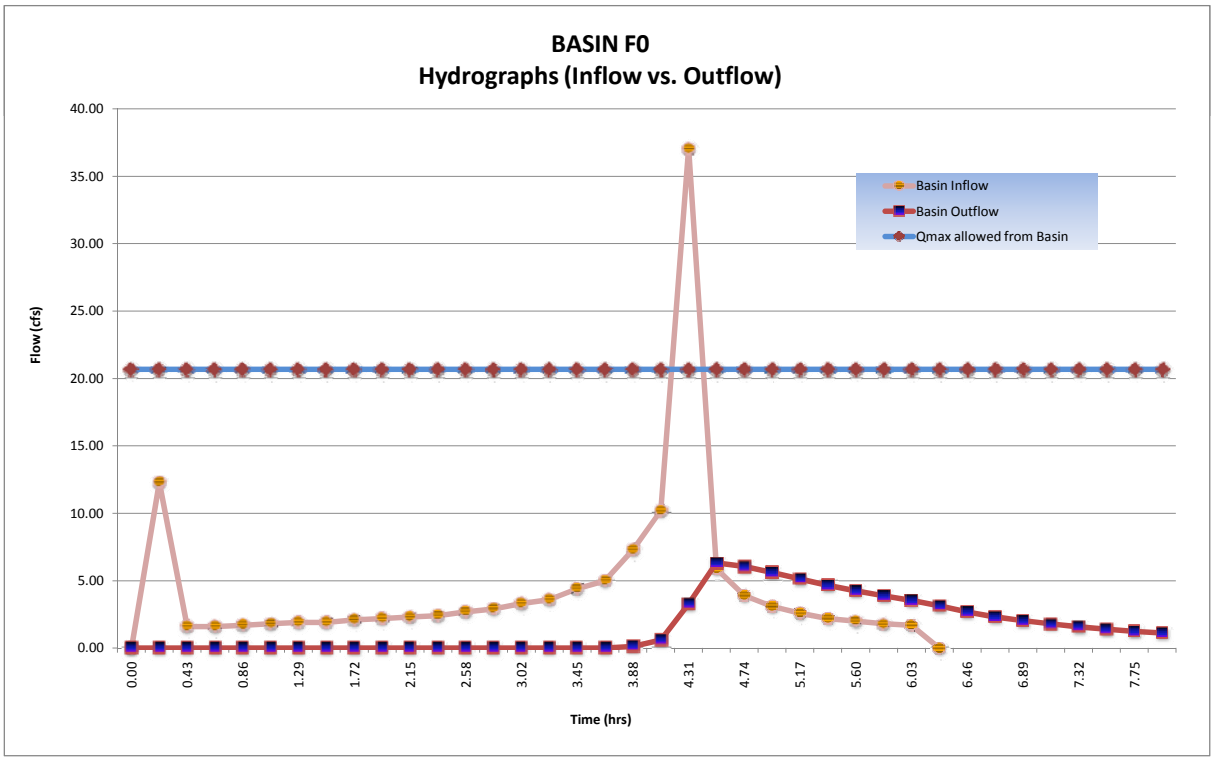


# Basin F0 Routing

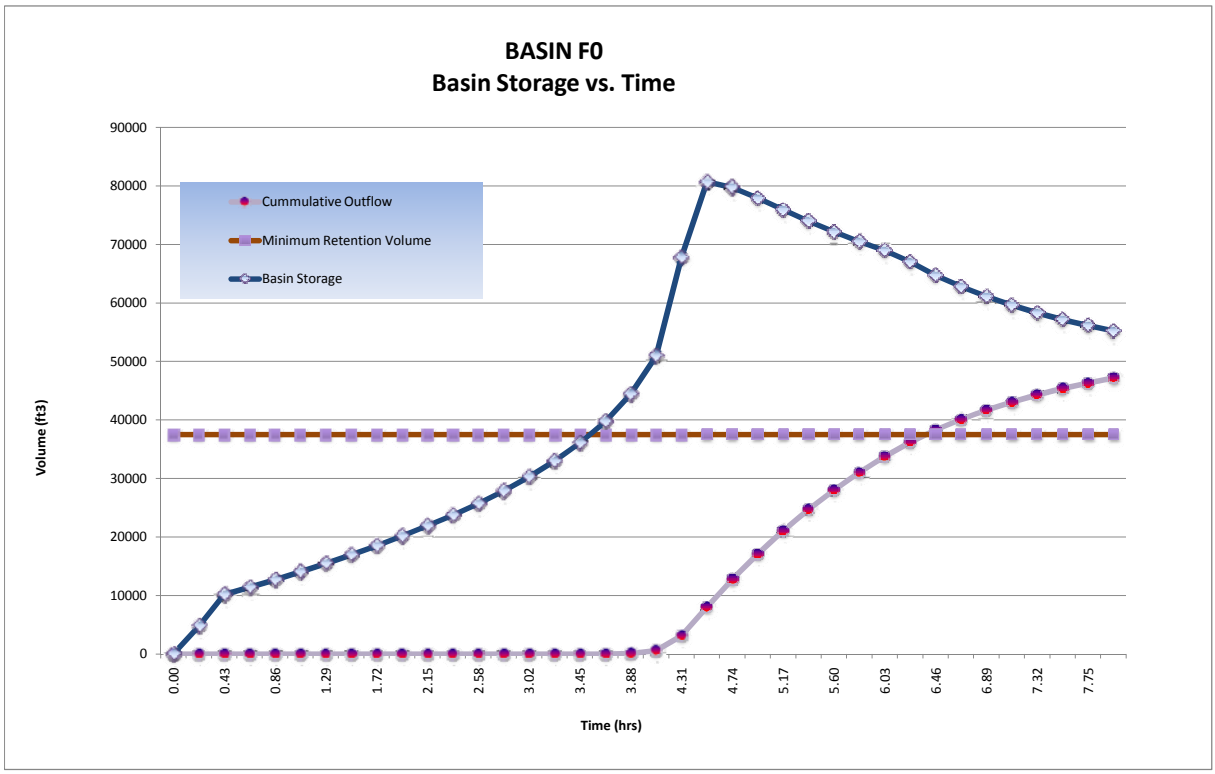
$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) = O_1 + \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.22 | 12.30 | 6.15 | 0.00 | 0.00 | 6.15 | 0.00 | 4769 | 0 | 0 |
| 0.43 | 1.60 | 6.95 | 6.15 | 0.00 | 13.10 | 0.00 | 10158 | 0 | 0 |
| 0.65 | 1.60 | 1.60 | 13.10 | 0.00 | 14.70 | 0.00 | 11398 | 0 | 0 |
| 0.86 | 1.70 | 1.65 | 14.70 | 0.00 | 16.35 | 0.00 | 12678 | 0 | 0 |
| 1.08 | 1.80 | 1.75 | 16.35 | 0.00 | 18.10 | 0.00 | 14035 | 0 | 0 |
| 1.29 | 1.90 | 1.85 | 18.10 | 0.00 | 19.95 | 0.00 | 15469 | 0 | 0 |
| 1.51 | 1.90 | 1.90 | 19.95 | 0.00 | 21.85 | 0.00 | 16943 | 0 | 0 |
| 1.72 | 2.10 | 2.00 | 21.85 | 0.00 | 23.85 | 0.00 | 18493 | 0 | 0 |
| 1.94 | 2.20 | 2.15 | 23.85 | 0.00 | 26.00 | 0.00 | 20161 | 0 | 0 |
| 2.15 | 2.30 | 2.25 | 26.00 | 0.00 | 28.25 | 0.00 | 21905 | 0 | 0 |
| 2.37 | 2.40 | 2.35 | 28.25 | 0.00 | 30.60 | 0.00 | 23727 | 0 | 0 |
| 2.58 | 2.70 | 2.55 | 30.60 | 0.00 | 33.15 | 0.00 | 25705 | 0 | 0 |
| 2.80 | 2.90 | 2.80 | 33.15 | 0.00 | 35.95 | 0.00 | 27876 | 0 | 0 |
| 3.02 | 3.30 | 3.10 | 35.95 | 0.00 | 39.05 | 0.00 | 30280 | 0 | 0 |
| 3.23 | 3.60 | 3.45 | 39.05 | 0.00 | 42.50 | 0.00 | 32955 | 0 | 0 |
| 3.45 | 4.40 | 4.00 | 42.50 | 0.00 | 46.50 | 0.00 | 36056 | 0 | 0 |
| 3.66 | 5.00 | 4.70 | 46.50 | 0.00 | 51.20 | 0.00 | 39701 | 0 | 0 |
| 3.88 | 7.30 | 6.15 | 51.20 | 0.00 | 57.35 | 0.13 | 44419 | 101 | 101 |
| 4.09 | 10.20 | 8.75 | 57.35 | 0.13 | 65.97 | 0.60 | 50921 | 465 | 566 |
| 4.31 | 37.10 | 23.65 | 65.97 | 0.60 | 89.02 | 3.29 | 67751 | 2551 | 3117 |
| 4.52 | 5.90 | 21.50 | 89.02 | 3.29 | 107.23 | 6.31 | 80701 | 4893 | 8010 |
| 4.74 | 3.90 | 4.90 | 107.23 | 6.31 | 105.82 | 6.06 | 79704 | 4699 | 12709 |
| 4.95 | 3.10 | 3.50 | 105.82 | 6.06 | 103.26 | 5.62 | 77890 | 4358 | 17067 |
| 5.17 | 2.60 | 2.85 | 103.26 | 5.62 | 100.49 | 5.14 | 75928 | 3986 | 21052 |
| 5.38 | 2.20 | 2.40 | 100.49 | 5.14 | 97.75 | 4.67 | 73986 | 3621 | 24673 |
| 5.60 | 2.00 | 2.10 | 97.75 | 4.67 | 95.18 | 4.26 | 72152 | 3303 | 27977 |
| 5.82 | 1.80 | 1.90 | 95.18 | 4.26 | 92.82 | 3.88 | 70469 | 3009 | 30985 |
| 6.03 | 1.70 | 1.75 | 92.82 | 3.88 | 90.69 | 3.54 | 68949 | 2745 | 33730 |
| 6.25 | 0.00 | 0.85 | 90.69 | 3.54 | 88.00 | 3.15 | 67015 | 2443 | 36173 |
| 6.46 | | 0.00 | 88.00 | 3.15 | 84.85 | 2.70 | 64747 | 2094 | 38266 |
| 6.68 | | 0.00 | 84.85 | 2.70 | 82.15 | 2.32 | 62800 | 1799 | 40065 |
| 6.89 | | 0.00 | 82.15 | 2.32 | 79.83 | 2.04 | 61110 | 1582 | 41647 |
| 7.11 | | 0.00 | 79.83 | 2.04 | 77.79 | 1.80 | 59621 | 1396 | 43043 |
| 7.32 | | 0.00 | 77.79 | 1.80 | 75.99 | 1.58 | 58311 | 1225 | 44268 |
| 7.54 | | 0.00 | 75.99 | 1.58 | 74.41 | 1.40 | 57155 | 1086 | 45354 |
| 7.75 | | 0.00 | 74.41 | 1.40 | 73.01 | 1.25 | 56128 | 969 | 46323 |
| 7.97 | | 0.00 | 73.01 | 1.25 | 71.76 | 1.13 | 55205 | 876 | 47199 |
| 8.18 | | 0.00 | 71.76 | 1.13 | 70.63 | 1.03 | 54368 | 799 | 47998 |



**Basin F0 Routing**




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **80,701** | **$ft^3$** | |
| **@ Stage:** | **555.00** | **ft** | |
| **Freeboard:** | **3.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **190,229** | **$ft^3$** | Basin **F0** |
| **Maximum flow rate released from this basin:** | **6.31** | **cfs** | |

# G0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **116+00 to 140+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **G0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

PAVED

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| G0.1.PV | 0.99 | 34300 | 0.8 | 5 | 4.0 | 3.12 | 6.6 | 5.13 | ~ | G0.1 | Basin G0-North | 127+00 | Rt |
| G0.2.PV | 0.99 | 39000 | 0.9 | 5 | 4.0 | 3.55 | 6.6 | 5.84 | ~ | G0.2 | Basin G0-North | 121+00 | Center |
| G0.3.PV | 0.99 | 47000 | 1.1 | 5 | 4.0 | 4.27 | 6.6 | 7.04 | ~ | G0.3 | Basin G0-North | 127+00 | Center |
| G0.4.PV | 0.99 | 29100 | 0.7 | 5 | 4.0 | 2.65 | 6.6 | 4.36 | ~ | G0.4 | Basin G0-North | 131+50 | Center |
| G0.5.PV | 0.99 | 60500 | 1.4 | 5 | 4.0 | 5.50 | 6.6 | 9.06 | ~ | G0.5 | Basin G0-South | 139+00 | Lt |
| G0.6.PV | 0.99 | 26900 | 0.6 | 5 | 4.0 | 2.45 | 6.6 | 4.03 | ~ | G0.6 | Basin G0-South | 139+00 | Rt |
| G0.7.PV | 0.99 | 11400 | 0.3 | 5 | 4.0 | 1.04 | 6.6 | 1.71 | ~ | G0.7 | Basin G0-South | 135+00 | Rt |
| G0.8.PV | 0.99 | 80300 | 1.8 | 10 | 2.8 | 5.16 | 4.2 | 7.69 | G0.8 | G0.8 | bypass* | 130+20 | SDR3 |
| G0.9.PV | 0.99 | 40500 | 0.9 | 10 | 2.8 | 2.60 | 4.2 | 3.88 | G0.9 | G0.9 | Basin G0-South | 135+00 | SV2 |
| G0.10.PV | 0.99 | 29200 | 0.7 | 5 | 4.0 | 2.65 | 6.6 | 4.37 | ~ | G0.10 | Basin G0-North | 131+50 | Rt |
| G0.11.PV | 0.99 | 6200 | 0.1 | 5 | 4.0 | 0.56 | 6.6 | 0.93 | ~ | G0.11 | Basin G0-North | 131+50 | SV2 |
| G0.12.PV | 0.99 | 22800 | 0.5 | 5 | 4.0 | 2.07 | 6.6 | 3.41 | ~ | G0.12 | Basin G0-North | 105+00 | SV1 |
| G0.13.PV | 0.99 | 22800 | 0.5 | 5 | 4.0 | 2.07 | 6.6 | 3.41 | ~ | G0.13 | Basin G0-North | 105+00 | SV1 |
| G0.14.PV | 0.99 | 15700 | 0.4 | 5 | 4.0 | 1.43 | 6.6 | 2.35 | ~ | G0.14 | Basin G0-North | 102+00 | SV1 |
| G0.15.PV | 0.99 | 15700 | 0.4 | 5 | 4.0 | 1.43 | 6.6 | 2.35 | ~ | G0.15 | Basin G0-North | 102+00 | SV1 |
| G0.16.PV | 0.99 | 41700 | 1.0 | 5 | 4.0 | 3.79 | 6.6 | 6.24 | ~ | G0.16 | Basin G0-South | 139+00 | SDR3 |
| G0.17.PV | 0.99 | 62300 | 1.4 | 5 | 4.0 | 5.66 | 6.6 | 9.33 | ~ | G0.17 | Basin G0-South | 139+00 | SV2 |
| G0.18.PV | 0.99 | 67700 | 1.6 | 5 | 4.0 | 6.16 | 6.6 | 10.13 | ~ | G0.18 | Basin G0-South | Toll 1 | ~ |
| G0.19.PV | 0.99 | 67200 | 1.5 | 5 | 4.0 | 6.11 | 6.6 | 10.06 | ~ | G0.19 | Basin G0-South | Toll 2 | ~ |
| G0.20.PV | 0.99 | 10200 | 0.2 | 5 | 4.0 | 0.93 | 6.6 | 1.53 | ~ | G0.20 | Basin G0-South | 100+00 | SV1 |
| G0.21.PV | 0.99 | 10200 | 0.2 | 5 | 4.0 | 0.93 | 6.6 | 1.53 | ~ | G0.21 | Basin G0-South | 100+00 | SV1 |
| G0.22.PV | 0.99 | 34200 | 0.8 | 5 | 4.0 | 3.11 | 6.6 | 5.12 | ~ | ~ | bypass* | 96+50 | SV2 |

Σ 774900 *PAVED*

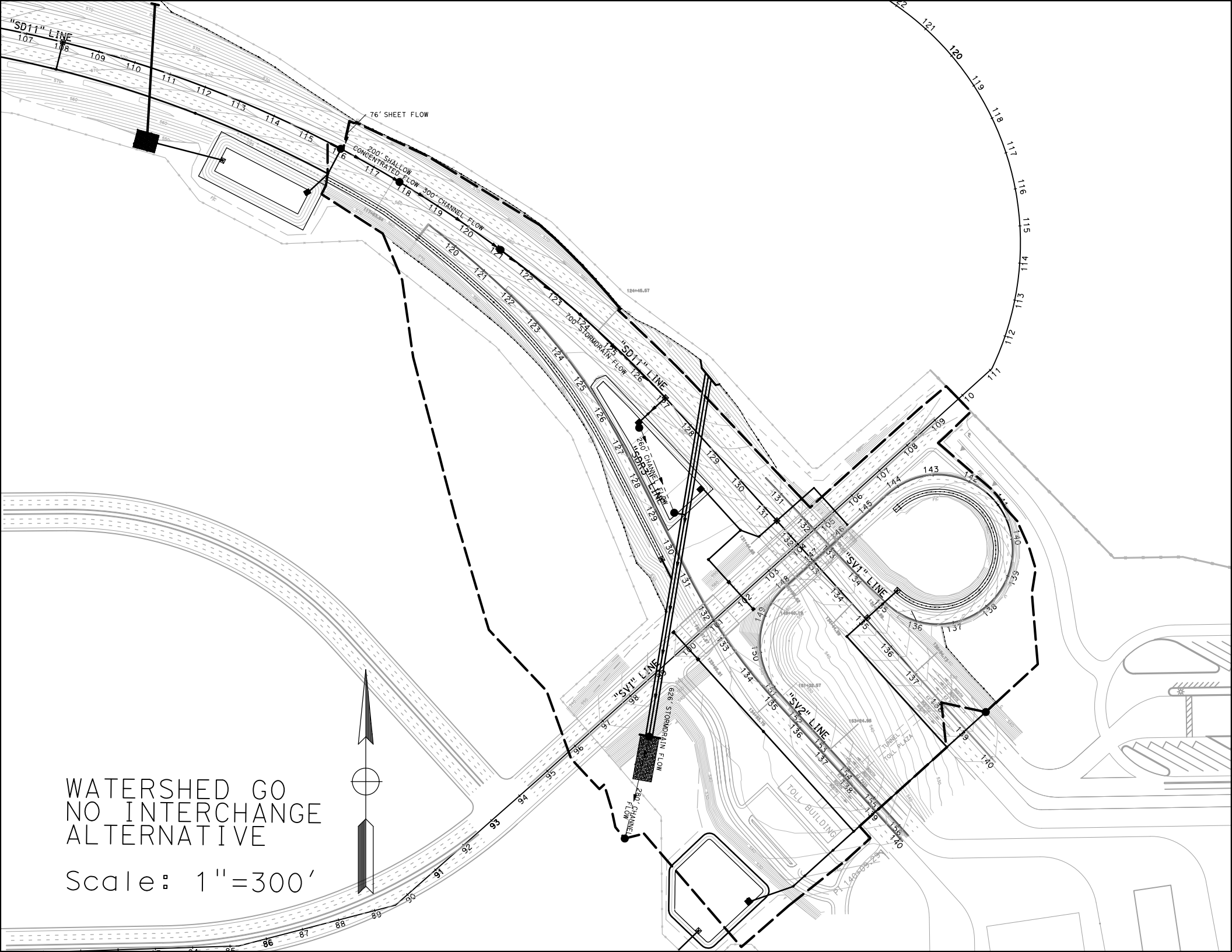
SLOPE

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| G0.5.SL | 0.61 | 13600 | 0.3 | 10 | 2.8 | 0.54 | 4.2 | 0.80 | ~ | G0.5 | Basin G0-South | 139+00 | Lt |
| G0.6.SL | 0.61 | 70500 | 1.6 | 10 | 2.8 | 2.79 | 4.2 | 4.16 | ~ | G0.6 | Basin G0-South | 139+00 | Rt |
| G0.7.SL | 0.61 | 30900 | 0.7 | 10 | 2.8 | 1.22 | 4.2 | 1.82 | ~ | G0.7 | Basin G0-South | 135+00 | Rt |
| G0.8.SL | 0.61 | 59300 | 1.4 | 10 | 2.8 | 2.35 | 4.2 | 3.50 | G0.8 | G0.8 | bypass* | 130+20 | SDR3 |
| G0.9.SL | 0.61 | 95600 | 2.2 | 10 | 2.8 | 3.79 | 4.2 | 5.64 | G0.9 | G0.9 | Basin G0-South | 135+00 | SV1 |
| G0.22.SL | 0.61 | 40900 | 0.9 | 10 | 2.8 | 1.62 | 4.2 | 2.41 | ~ | ~ | bypass* | 96+50 | SV2 |
| G0.23.SL | 0.61 | 101200 | 2.3 | 10 | 2.8 | 4.01 | 4.2 | 5.97 | ~ | G0.23 | Basin G0-South | 135+00 | Rt |
| G0.24.SL | 0.61 | 40800 | 0.9 | 10 | 2.8 | 1.62 | 4.2 | 2.41 | ~ | Culvert | bypass* | 127+00 | Lt |
| G0.25.SL | 0.61 | 19700 | 0.5 | 10 | 2.8 | 0.78 | 4.2 | 1.16 | ~ | ~ | bypass* | 132+00 | Rt |
| G0.26.SL | 0.61 | 57400 | 1.3 | 10 | 2.8 | 2.27 | 4.2 | 3.39 | ~ | G0.26 | Basin G0-South | 139+00 | Lt |
| G0.27.SL | 0.61 | 100900 | 2.3 | 10 | 2.8 | 4.00 | 4.2 | 5.95 | ~ | G0.27 | Basin G0-North | 139+01 | Lt |

Σ 630800 *SLOPE*

* flow that does not reach the basin

| | | |
|---|---|---|
| Total : | 1405700 | 32.3 |
| | *SF* | *ac* |




WATERSHED GO
NO INTERCHANGE
ALTERNATIVE

Scale: 1"=300'

# G0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | G0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | No Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1846084 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 42.38 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | NOTES: |
|---|---|---|---|
| RELIEF (.08-.35) | 0.12 | | Relatively Flat ~ 4% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.39 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 24% | AT | 0.39 | 0.093 |
| PAVED SURFACE | 42% | AT | 0.90 | 0.378 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 34% | AT | 0.55 | 0.188 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.66 |
| $C_{25}$ = | 0.72 |
| $C_{50}$ = | 0.79 |
| $C_{100}$ = | 0.82 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 567.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 563.0 | ft | |
| ELEVATION DIFF (H) | 4.0 | ft | |
| LENGTH (L) | 76 | ft | |
| SLOPE (S) = (H/L) | 5.3% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.19 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 560.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 200 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 2.67 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 560.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 3.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.0% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.84 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.72 | minutes | |

# G0 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft | Proposed storm drain through median (elev at pipe invert) |
| LOW POINT ELEVATION | 545.0 | ft | Sta 127+00 - basin G0-1 |
| ELEVATION DIFF (H) | 7.0 | ft | |
| LENGTH (L) | 700 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 7.2 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.62 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 545.0 | ft | Detention basin (low flow channel) |
| LOW POINT ELEVATION | 542.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 3.0 | ft | Z= 4 / ANG-RAD / 0.245 |
| LENGTH (L) | 260 | ft | b = 2 / ANG-DEG / 14.036 |
| SLOPE (S) = (H/L) | 1.2% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.6 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.24 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.93 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft | Proposed RCB |
| LOW POINT ELEVATION | 523.0 | ft | Outlet |
| ELEVATION DIFF (H) | 9.0 | ft | |
| LENGTH (L) | 626 | ft | |
| SLOPE (S) = (H/L) | 1.4% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 4.0 | ft | |
| HYDRAULIC RADIUS R | 1.0 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.76 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 523.0 | ft | RCP to confluence point |
| LOW POINT ELEVATION | 515.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 8.0 | ft | Z= 4 / ANG-RAD / 0.245 |
| LENGTH (L) | 280 | ft | b = 2 / ANG-DEG / 14.036 |
| SLOPE (S) = (H/L) | 2.9% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.055 | | HDM Table 864.3A, Depressed Median - Earth (with growth) and RCP |
| HYDRAULIC RADIUS R | 0.6 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.21 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.46 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.34 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **12.34** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

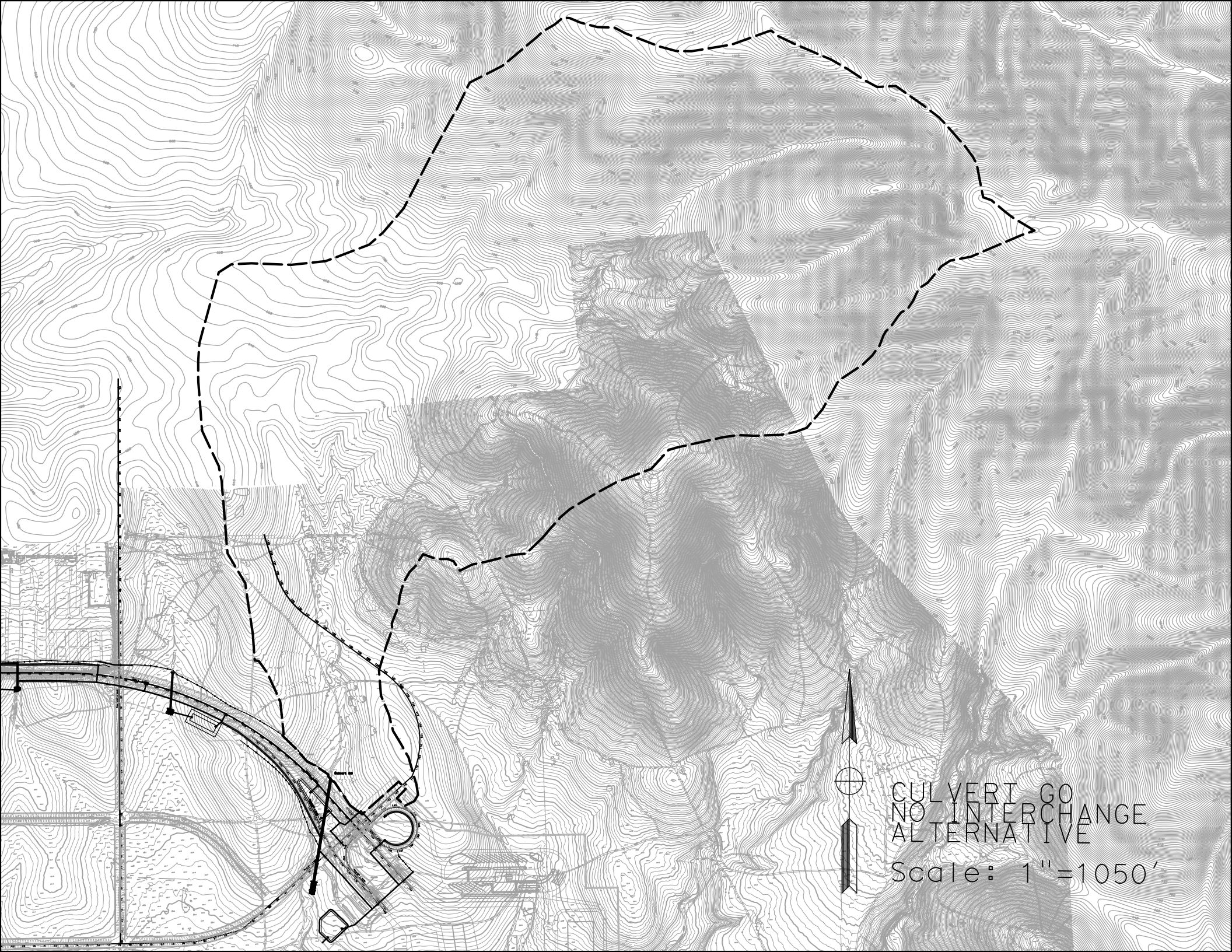
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = | |
| $i_{10}$ = | 2.4 | in/hr | X CA = | |
| $i_{25}$ = | 2.9 | in/hr | X CA = | |
| $i_{50}$ = | 3.5 | in/hr | X CA = | |
| $i_{100}$ = | 3.7 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 45.2 |
| **$Q_{10}$ =** | 65.7 |
| **$Q_{25}$ =** | 90.4 |
| **$Q_{50}$ =** | 118.3 |
| **$Q_{100}$ =** | **128.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


CULVERT GO
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=1050'

# Culvert Calculator Report
# G0 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 548.00 | ft | Headwater Depth/Height | 1.85 | |
| Computed Headwater Elevation | 547.39 | ft | Discharge | 658.00 | cfs |
| Inlet Control HW Elev. | 547.39 | ft | Tailwater Elevation | 518.04 | ft |
| Outlet Control HW Elev. | 546.56 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 540.00 | ft | Downstream Invert | 516.00 | ft |
| Length | 1,150.00 | ft | Constructed Slope | 2.1 | % |

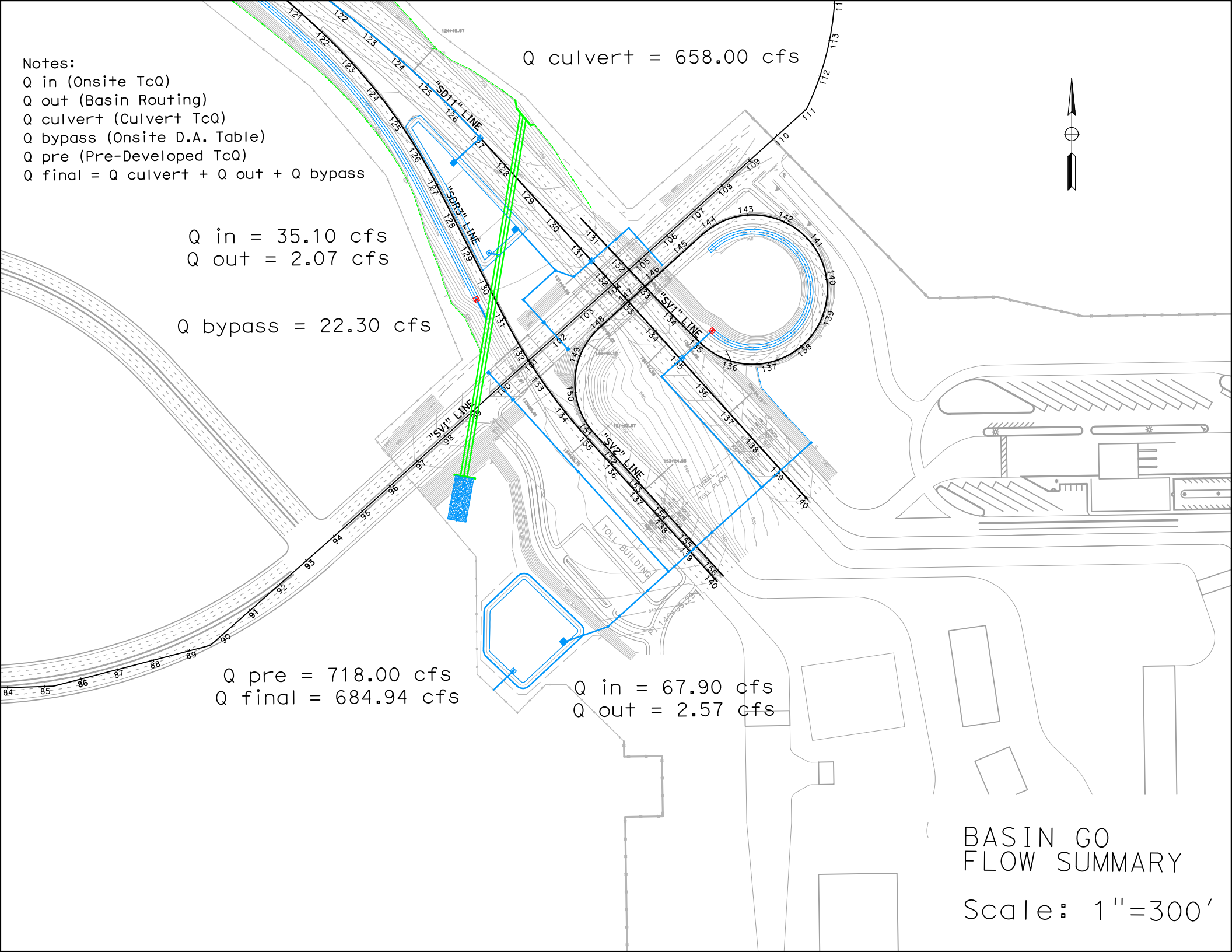
| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 2.04 | ft |
| Slope Type | Steep | | Normal Depth | 2.04 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.75 | ft |
| Velocity Downstream | 20.17 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Box | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 8.00 | ft |
| Section Size | 8 x 4 ft | | Rise | 4.00 | ft |
| Number Sections | 2 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 546.56 | ft | Upstream Velocity Head | 1.87 | ft |
| Ke | 0.50 | | Entrance Loss | 0.94 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 547.39 | ft | Flow Control | Submerged | |
| Inlet Type | 90 and 15° wingwall flares | | Area Full | 64.0 | $ft^2$ |
| K | 0.06100 | | HDS 5 Chart | 8 | |
| M | 0.75000 | | HDS 5 Scale | 2 | |
| C | 0.04000 | | Equation Form | 1 | |
| Y | 0.80000 | | | | |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN GO
FLOW SUMMARY

Scale: 1"=300'

# Basin G0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **G0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 60.0 | cfs | | | |
| Tc= | 17.0 | min | C= | 0.49 | |
| $P_{100,6}$= | 2.5 | in | A= | 41.08 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 17 | 3060 | 3 |
| 34 | 3162 | 3.1 |
| 51 | 3468 | 3.4 |
| 68 | 3570 | 3.5 |
| 85 | 3876 | 3.8 |
| 102 | 4080 | 4 |
| 119 | 4488 | 4.4 |
| 136 | 4794 | 4.7 |
| 153 | 5508 | 5.4 |
| 170 | 5916 | 5.8 |
| 187 | 7242 | 7.1 |
| 204 | 8262 | 8.1 |
| 221 | 12138 | 11.9 |
| 238 | 17340 | 17 |
| 255 | 61200 | 60 |
| 272 | 9792 | 9.6 |
| 289 | 6528 | 6.4 |
| 306 | 5100 | 5 |
| 323 | 4284 | 4.2 |
| 340 | 3672 | 3.6 |
| 357 | 3366 | 3.3 |
| 374 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 180846 $ft^3$**
**4.15 acre-feet**

Check: V = C*A*$P_6$
V= 4.17 acre-feet
***OK***

# Basin G0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 128.4 | cfs | | | |
| Tc= | 12.3 | min | C= | 0.82 | |
| $P_{100,6}$= | 2.5 | in | A= | 42.38 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 12 | 3744 | 5.2 |
| 24 | 3816 | 5.3 |
| 36 | 4032 | 5.6 |
| 48 | 4104 | 5.7 |
| 60 | 4320 | 6 |
| 72 | 4464 | 6.2 |
| 84 | 4752 | 6.6 |
| 96 | 4896 | 6.8 |
| 108 | 5256 | 7.3 |
| 120 | 5472 | 7.6 |
| 132 | 5904 | 8.2 |
| 144 | 6192 | 8.6 |
| 156 | 6912 | 9.6 |
| 168 | 7272 | 10.1 |
| 180 | 8352 | 11.6 |
| 192 | 9072 | 12.6 |
| 204 | 11088 | 15.4 |
| 216 | 12600 | 17.5 |
| 228 | 18576 | 25.8 |
| 240 | 27360 | 38 |
| 252 | 92448 | 128.4 |
| 264 | 14904 | 20.7 |
| 276 | 9936 | 13.8 |
| 288 | 7776 | 10.8 |
| 300 | 6552 | 9.1 |
| 312 | 5688 | 7.9 |
| 324 | 5040 | 7 |
| 336 | 4608 | 6.4 |
| 348 | 4248 | 5.9 |
| 360 | 3888 | 5.4 |
| 372 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 313272 $ft^3$**
**7.19 acre-feet**

Check: V = C*A*$P_6$
V= 7.27 acre-feet
***OK***

**Retention volume = 7.19**
**- 4.15**
**= 3.04 acre-feet = 132426 $ft^3$ Basin Required**

# Basin G0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 25.95 acres

$WQ_{72}$: 0.73 in/area

| |
|---|
| Max C from North/South Onsite |
| Sum of North/South Onsite Area |

**Water Quality Volume (WQV) =** **68772** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**If the WQV is less than retention requirement, do not add volume since WQ is addressed in Retention**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 511000 $ft^2$
A: 11.73 acres
10.00 years
where: R= 30.00
K= 0.24
Ls= 18.00
C= 0.012
P= 1.00
As 1.56 tons/yr.Ac

Volume for 10-year Silt Accumulation = 182.44 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

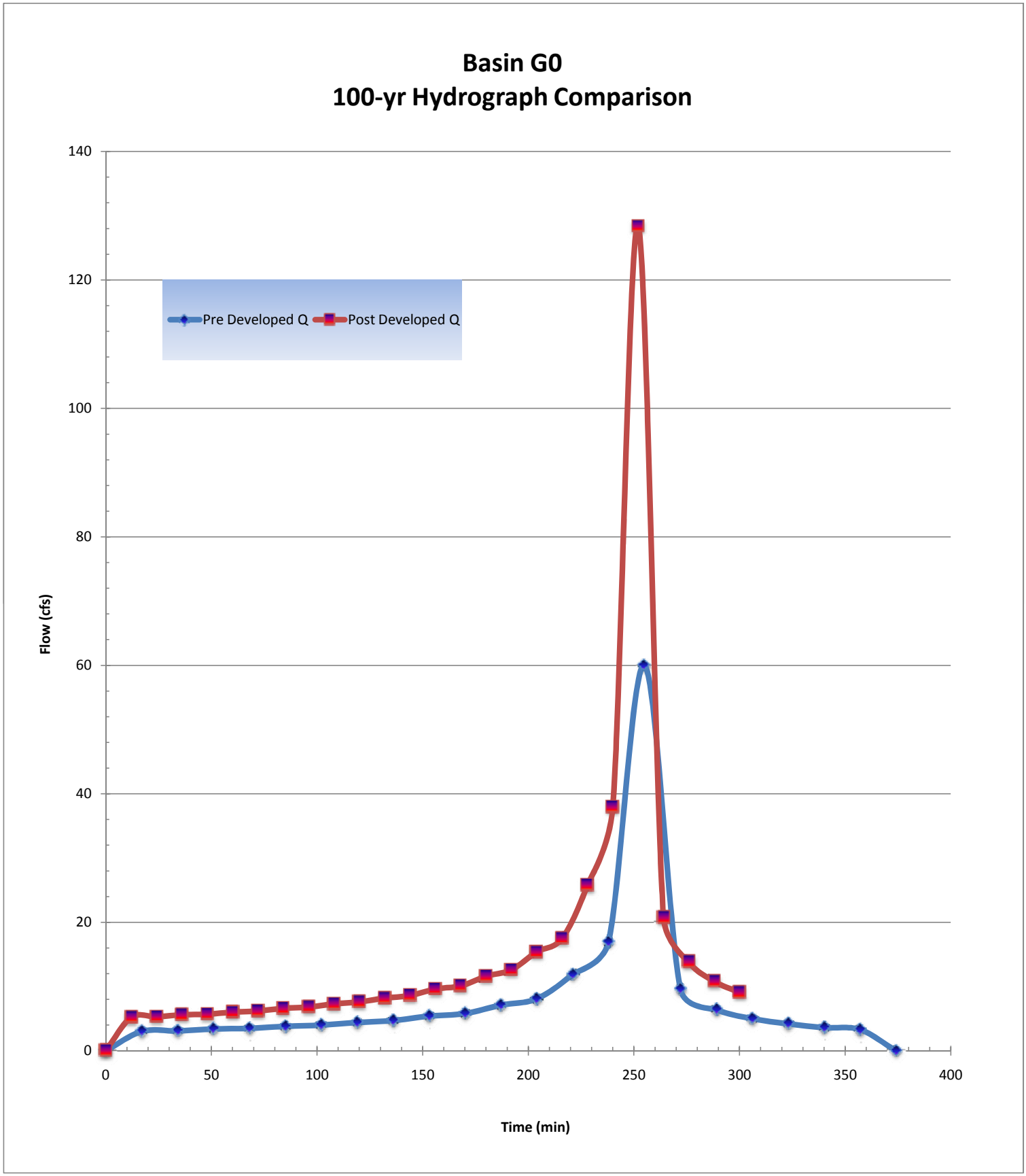
$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **4054** **$ft^3$** **Add this volume to Basin**

**Add this volume to Basin volume due to silts from cut slopes**


Basin G0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
0
50
100
150
200
250
300
350
400

# Basin G0-North Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 125+50 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | G0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G0-North |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 362700 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 8.33 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | |
|---|---|
| RELIEF (.08-.35) | 0.00 |
| INFILTRATION (.04-.16) | 0.00 |
| VEGETATION (.04-.16) | 0.00 |
| STORAGE (.04-.12) | 0.00 |
| TOTAL C = | 0.00 |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 72% | AT | 0.90 | 0.650 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 28% | AT | 0.55 | 0.153 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.80 |
| $C_{25}$ = | 0.88 |
| $C_{50}$ = | 0.96 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 565.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 563.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 76 | ft | |
| SLOPE (S) = (H/L) | 2.6% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.57 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 561.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 200 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 2.67 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 561.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 4.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.3% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.12 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.35 | minutes | |

# Basin G0-North Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft | Proposed storm drain through median (elev at pipe invert) |
| LOW POINT ELEVATION | 546.0 | ft | Sta 127+00 - basin G0-1 |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 700 | ft | |
| SLOPE (S) = (H/L) | 0.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 6.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.75 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.33 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | $Q_2$ = | 12.4 |
| $i_{10}$ = | 2.7 | in/hr | X CA = | $Q_{10}$ = | 18.0 |
| $i_{25}$ = | 3.4 | in/hr | X CA = | $Q_{25}$ = | 24.8 |
| $i_{50}$ = | 4.0 | in/hr | X CA = | $Q_{50}$ = | 32.4 |
| $i_{100}$ = | 4.2 | in/hr | X CA = | $Q_{100}$ = | **35.1** |

**FLOW RESULTS:** cfs

**COUNTY $P_6$** inches

| | |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G0North Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125+50 - 129+50** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **G0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 35.1 | cfs | $C_{100}$= | 1.00 | |
| Tc= | 10.0 | min | A= | 8.33 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 720 | 1.2 |
| 20 | 780 | 1.3 |
| 30 | 780 | 1.3 |
| 40 | 780 | 1.3 |
| 50 | 840 | 1.4 |
| 60 | 840 | 1.4 |
| 70 | 900 | 1.5 |
| 80 | 900 | 1.5 |
| 90 | 960 | 1.6 |
| 100 | 1020 | 1.7 |
| 110 | 1080 | 1.8 |
| 120 | 1080 | 1.8 |
| 130 | 1200 | 2 |
| 140 | 1200 | 2 |
| 150 | 1320 | 2.2 |
| 160 | 1380 | 2.3 |
| 170 | 1560 | 2.6 |
| 180 | 1620 | 2.7 |
| 190 | 1860 | 3.1 |
| 200 | 2040 | 3.4 |
| 210 | 2520 | 4.2 |
| 220 | 2820 | 4.7 |
| 230 | 4140 | 6.9 |
| 240 | 5880 | 9.8 |
| 250 | 21060 | 35.1 |
| 260 | 3360 | 5.6 |
| 270 | 2220 | 3.7 |
| 280 | 1740 | 2.9 |
| 290 | 1440 | 2.4 |
| 300 | 1260 | 2.1 |
| 310 | 1140 | 1.9 |
| 320 | 1020 | 1.7 |
| 330 | 960 | 1.6 |
| 340 | 900 | 1.5 |
| 350 | 840 | 1.4 |
| 360 | 780 | 1.3 |
| 370 | 0 | 0 |

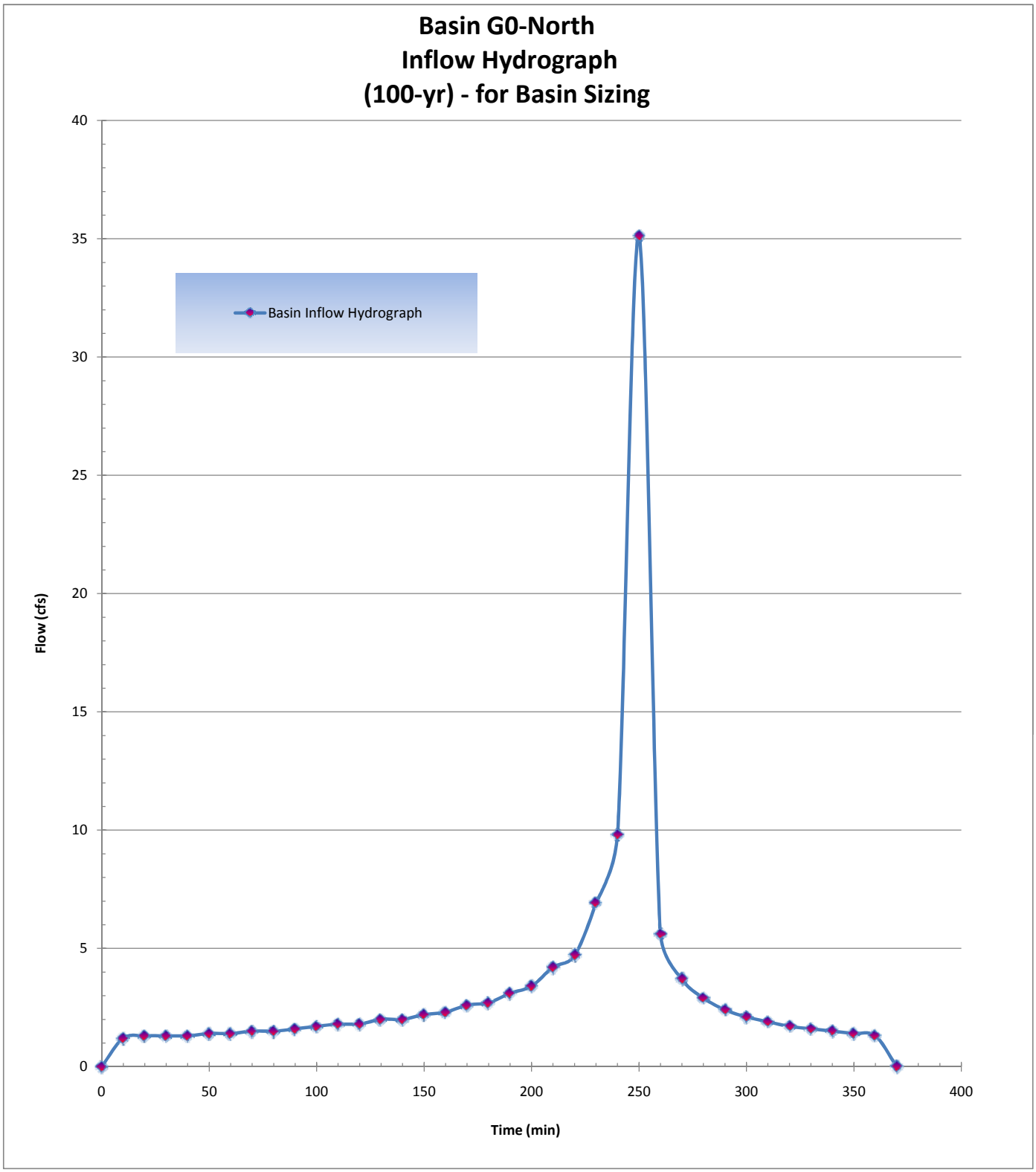
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 74940 $ft^3$**
**1.72 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 1.73 acre-feet
***OK***


Basin G0-North
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400

# Basin G0-North Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **129+50** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G0-North** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 136480 | $ft^3$ | from G0-ALL |
| Retention volume from this basin = | 46802 | | at 2.6' depth, see G0-South for remainder of storage |
| Actual Basin Inflow = | 74940 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G0-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G0 |
| Flow that does not reach detention basin (bypass per DA table): | 22.3 | cfs | $Q_{100}$ from: G0.8.PVG0.22.PVG0.8.SLG0.22.SLG0.24.SLG0.25.SL |
| Maximum flow allowed to be released by this detention basin: | 12.9 | cfs | *34%* of G0-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 546.40 | ft |
| Basin flowline elevation = | 542.00 | ft |
| Maximum Basin Depth = | 4.40 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.60 | ft | 544.60 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | 200 | ft | L/2 due to sloped floor |
| Base Width (W) | 75 | ft | average width |
| W/L Ratio ® | 0.38 | | |
| Side Slopes (Z) | 1: 4 | | |
| Total Volume (V): | 89047 | $ft^2$ | |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 ~ *assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 542.00 | 0.00 | 0 | 0 | | 542.00 | 0.00 | 0.00 | 0.00 |
| 1 | 542.20 | 0.20 | 3044 | 3044 | | 542.20 | 0.00 | | 0.00 |
| 2 | 542.40 | 0.40 | 3133 | 6178 | | 542.40 | 0.00 | | 0.00 |
| 3 | 542.60 | 0.60 | 3223 | 9401 | | 542.60 | 0.00 | | 0.00 |
| 4 | 542.80 | 0.80 | 3314 | 12715 | | 542.80 | 0.00 | | 0.00 |
| 5 | 543.00 | 1.00 | 3406 | 16122 | | 543.00 | 0.00 | | 0.00 |
| 6 | 543.20 | 1.20 | 3499 | 19621 | | 543.20 | 0.00 | | 0.00 |
| 7 | 543.40 | 1.40 | 3593 | 23215 | | 543.40 | 0.00 | | 0.00 |
| 8 | 543.60 | 1.60 | 3688 | 26903 | | 543.60 | 0.00 | | 0.00 |
| 9 | 543.80 | 1.80 | 3784 | 30687 | | 543.80 | 0.00 | | 0.00 |
| 10 | 544.00 | 2.00 | 3881 | 34568 | | 544.00 | 0.00 | | 0.00 |
| 11 | 544.20 | 2.20 | 3979 | 38547 | | 544.20 | 0.00 | 0.00 | 0.00 |
| 12 | 544.40 | 2.40 | 4078 | 42625 | | 544.40 | 0.00 | | 0.00 |
| 13 | 544.60 | 2.60 | 4177 | 46802 | * | 544.60 | 0.00 | | 0.00 |
| 14 | 544.80 | 2.80 | 4278 | 51080 | | 544.80 | 0.15 | | 0.15 |
| 15 | 545.00 | 3.00 | 4380 | 55460 | | 545.00 | 0.59 | | 0.59 |
| 16 | 545.20 | 3.20 | 4482 | 59943 | | 545.20 | 1.30 | | 1.30 |
| 17 | 545.40 | 3.40 | 4586 | 64529 | | 545.40 | 2.25 | | 2.25 |
| 18 | 545.60 | 3.60 | 4691 | 69219 | | 545.60 | 3.42 | | 3.42 |
| 19 | 545.80 | 3.80 | 4796 | 74016 | | 545.80 | 4.79 | | 4.79 |
| 20 | 546.00 | 4.00 | 4903 | 78918 | | 546.00 | 6.32 | | 6.32 |
| 21 | 546.20 | 4.20 | 5010 | 83929 | | 546.20 | 7.99 | | 7.99 |
| 22 | 546.40 | 4.40 | 5119 | 89047 | | 546.40 | 9.77 | | 9.77 |

# Basin G0-North Routing

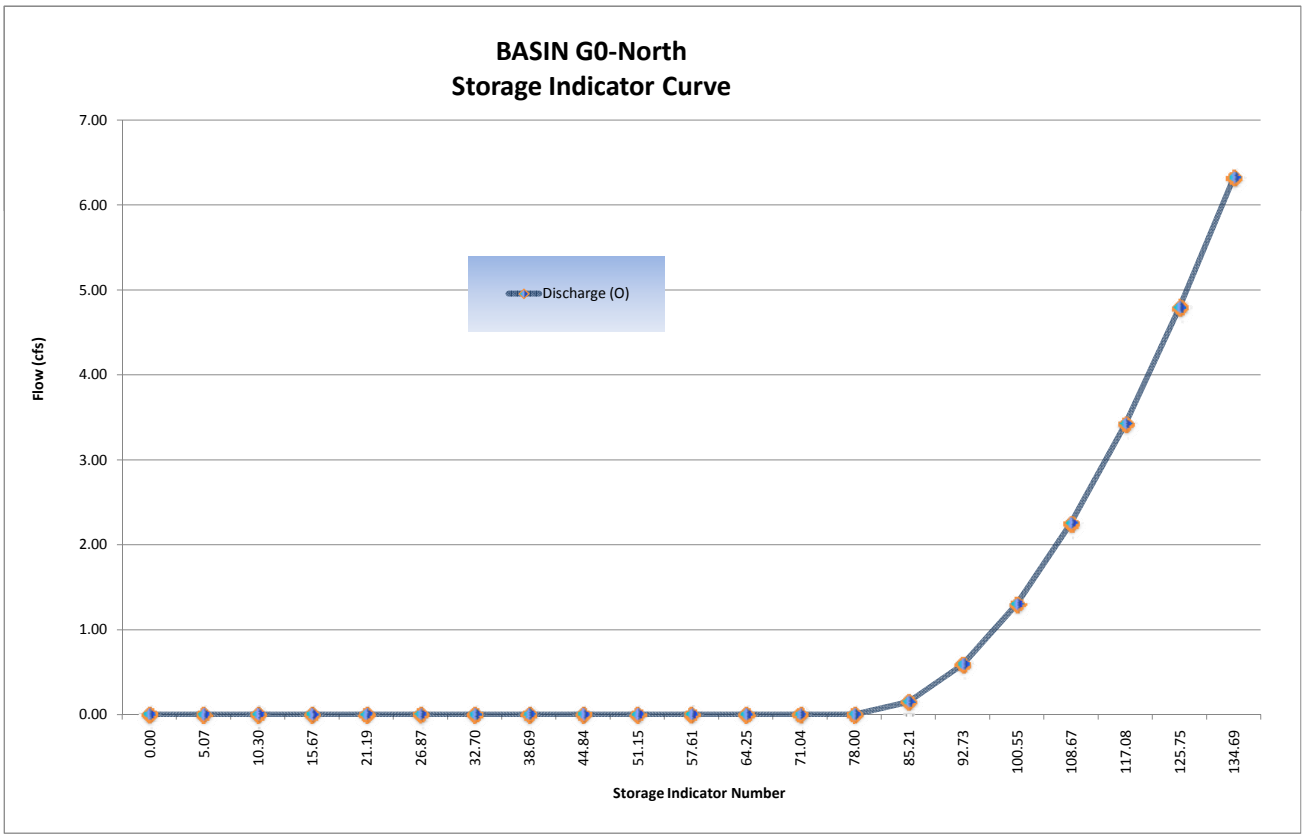
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 129+50 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G0-North |

user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 542.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 542.20 | 0.00 | 3044 | 0.00 | 5.07 | 5.07 |
| 542.40 | 0.00 | 6178 | 0.00 | 10.30 | 10.30 |
| 542.60 | 0.00 | 9401 | 0.00 | 15.67 | 15.67 |
| 542.80 | 0.00 | 12715 | 0.00 | 21.19 | 21.19 |
| 543.00 | 0.00 | 16122 | 0.00 | 26.87 | 26.87 |
| 543.20 | 0.00 | 19621 | 0.00 | 32.70 | 32.70 |
| 543.40 | 0.00 | 23215 | 0.00 | 38.69 | 38.69 |
| 543.60 | 0.00 | 26903 | 0.00 | 44.84 | 44.84 |
| 543.80 | 0.00 | 30687 | 0.00 | 51.15 | 51.15 |
| 544.00 | 0.00 | 34568 | 0.00 | 57.61 | 57.61 |
| 544.20 | 0.00 | 38547 | 0.00 | 64.25 | 64.25 |
| 544.40 | 0.00 | 42625 | 0.00 | 71.04 | 71.04 |
| 544.60 | 0.00 | 46802 | 0.00 | 78.00 | 78.00 |
| 544.80 | 0.15 | 51080 | 0.08 | 85.13 | 85.21 |
| 545.00 | 0.59 | 55460 | 0.30 | 92.43 | 92.73 |
| 545.20 | 1.30 | 59943 | 0.65 | 99.90 | 100.55 |
| 545.40 | 2.25 | 64529 | 1.13 | 107.55 | 108.67 |
| 545.60 | 3.42 | 69219 | 1.71 | 115.37 | 117.08 |
| 545.80 | 4.79 | 74016 | 2.40 | 123.36 | 125.75 |
| 546.00 | 6.32 | 78918 | 3.16 | 131.53 | 134.69 |
| 546.20 | 7.99 | 83929 | 4.00 | 139.88 | 143.88 |
| 546.40 | 9.77 | 89047 | 4.89 | 148.41 | 153.30 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



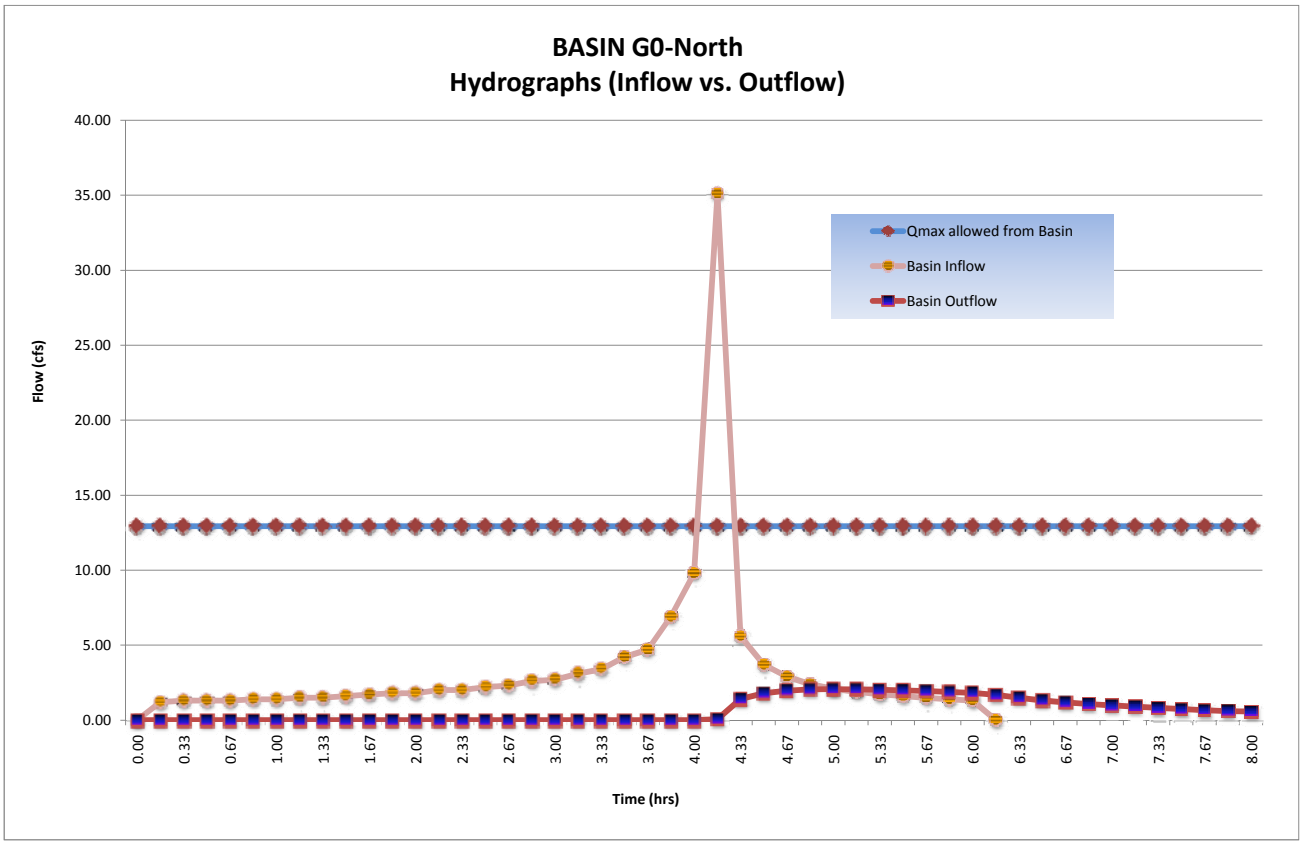
# Basin G0-North Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

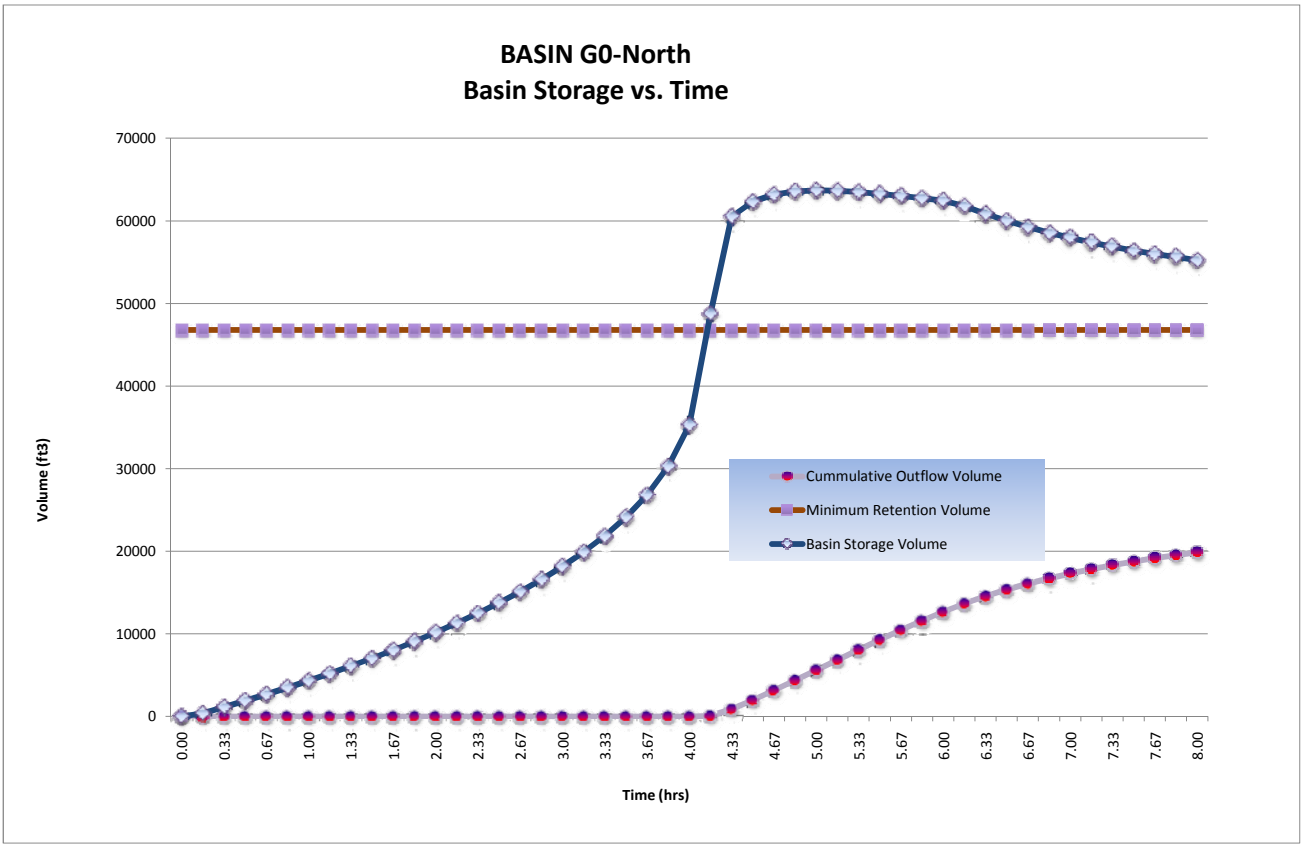
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 1.20 | 0.60 | 0.00 | 0.00 | 0.60 | 0.00 | 360 | 0 | 0 |
| 0.33 | 1.30 | 1.25 | 0.60 | 0.00 | 1.85 | 0.00 | 1110 | 0 | 0 |
| 0.50 | 1.30 | 1.30 | 1.85 | 0.00 | 3.15 | 0.00 | 1890 | 0 | 0 |
| 0.67 | 1.30 | 1.30 | 3.15 | 0.00 | 4.45 | 0.00 | 2670 | 0 | 0 |
| 0.83 | 1.40 | 1.35 | 4.45 | 0.00 | 5.80 | 0.00 | 3480 | 0 | 0 |
| 1.00 | 1.40 | 1.40 | 5.80 | 0.00 | 7.20 | 0.00 | 4320 | 0 | 0 |
| 1.17 | 1.50 | 1.45 | 7.20 | 0.00 | 8.65 | 0.00 | 5190 | 0 | 0 |
| 1.33 | 1.50 | 1.50 | 8.65 | 0.00 | 10.15 | 0.00 | 6090 | 0 | 0 |
| 1.50 | 1.60 | 1.55 | 10.15 | 0.00 | 11.70 | 0.00 | 7020 | 0 | 0 |
| 1.67 | 1.70 | 1.65 | 11.70 | 0.00 | 13.35 | 0.00 | 8010 | 0 | 0 |
| 1.83 | 1.80 | 1.75 | 13.35 | 0.00 | 15.10 | 0.00 | 9060 | 0 | 0 |
| 2.00 | 1.80 | 1.80 | 15.10 | 0.00 | 16.90 | 0.00 | 10140 | 0 | 0 |
| 2.17 | 2.00 | 1.90 | 16.90 | 0.00 | 18.80 | 0.00 | 11280 | 0 | 0 |
| 2.33 | 2.00 | 2.00 | 18.80 | 0.00 | 20.80 | 0.00 | 12480 | 0 | 0 |
| 2.50 | 2.20 | 2.10 | 20.80 | 0.00 | 22.90 | 0.00 | 13740 | 0 | 0 |
| 2.67 | 2.30 | 2.25 | 22.90 | 0.00 | 25.15 | 0.00 | 15090 | 0 | 0 |
| 2.83 | 2.60 | 2.45 | 25.15 | 0.00 | 27.60 | 0.00 | 16560 | 0 | 0 |
| 3.00 | 2.70 | 2.65 | 27.60 | 0.00 | 30.25 | 0.00 | 18150 | 0 | 0 |
| 3.17 | 3.10 | 2.90 | 30.25 | 0.00 | 33.15 | 0.00 | 19890 | 0 | 0 |
| 3.33 | 3.40 | 3.25 | 33.15 | 0.00 | 36.40 | 0.00 | 21840 | 0 | 0 |
| 3.50 | 4.20 | 3.80 | 36.40 | 0.00 | 40.20 | 0.00 | 24120 | 0 | 0 |
| 3.67 | 4.70 | 4.45 | 40.20 | 0.00 | 44.65 | 0.00 | 26790 | 0 | 0 |
| 3.83 | 6.90 | 5.80 | 44.65 | 0.00 | 50.45 | 0.00 | 30270 | 0 | 0 |
| 4.00 | 9.80 | 8.35 | 50.45 | 0.00 | 58.80 | 0.00 | 35280 | 0 | 0 |
| 4.17 | 35.10 | 22.45 | 58.80 | 0.00 | 81.25 | 0.07 | 48729 | 42 | 42 |
| 4.33 | 5.60 | 20.35 | 81.25 | 0.07 | 101.53 | 1.41 | 60495 | 846 | 888 |
| 4.50 | 3.70 | 4.65 | 101.53 | 1.41 | 104.77 | 1.79 | 62325 | 1074 | 1962 |
| 4.67 | 2.90 | 3.30 | 104.77 | 1.79 | 106.28 | 1.97 | 63177 | 1182 | 3144 |
| 4.83 | 2.40 | 2.65 | 106.28 | 1.97 | 106.96 | 2.05 | 63561 | 1230 | 4374 |
| 5.00 | 2.10 | 2.25 | 106.96 | 2.05 | 107.16 | 2.07 | 63675 | 1242 | 5616 |
| 5.17 | 1.90 | 2.00 | 107.16 | 2.07 | 107.09 | 2.06 | 63636 | 1236 | 6852 |
| 5.33 | 1.70 | 1.80 | 107.09 | 2.06 | 106.83 | 2.03 | 63489 | 1218 | 8070 |
| 5.50 | 1.60 | 1.65 | 106.83 | 2.03 | 106.45 | 1.99 | 63273 | 1194 | 9264 |
| 5.67 | 1.50 | 1.55 | 106.45 | 1.99 | 106.01 | 1.94 | 63024 | 1164 | 10428 |
| 5.83 | 1.40 | 1.45 | 106.01 | 1.94 | 105.52 | 1.88 | 62748 | 1128 | 11556 |
| 6.00 | 1.30 | 1.35 | 105.52 | 1.88 | 104.99 | 1.82 | 62448 | 1092 | 12648 |
| 6.17 | 0.00 | 0.65 | 104.99 | 1.82 | 103.82 | 1.68 | 61788 | 1008 | 13656 |
| 6.33 | | 0.00 | 103.82 | 1.68 | 102.14 | 1.49 | 60837 | 894 | 14550 |
| 6.50 | | 0.00 | 102.14 | 1.49 | 100.65 | 1.31 | 59997 | 786 | 15336 |
| 6.67 | | 0.00 | 100.65 | 1.31 | 99.34 | 1.19 | 59247 | 714 | 16050 |
| 6.83 | | 0.00 | 99.34 | 1.19 | 98.15 | 1.08 | 58566 | 648 | 16698 |
| 7.00 | | 0.00 | 98.15 | 1.08 | 97.07 | 0.98 | 57948 | 588 | 17286 |
| 7.17 | | 0.00 | 97.07 | 0.98 | 96.09 | 0.89 | 57387 | 534 | 17820 |
| 7.33 | | 0.00 | 96.09 | 0.89 | 95.20 | 0.81 | 56877 | 486 | 18306 |
| 7.50 | | 0.00 | 95.20 | 0.81 | 94.39 | 0.74 | 56412 | 444 | 18750 |
| 7.67 | | 0.00 | 94.39 | 0.74 | 93.65 | 0.67 | 55989 | 402 | 19152 |
| 7.83 | | 0.00 | 93.65 | 0.67 | 92.98 | 0.61 | 55605 | 366 | 19518 |
| 8.00 | | 0.00 | 92.98 | 0.61 | 92.37 | 0.57 | 55251 | 342 | 19860 |

## Basin G0-North Routing



## Basin G0-North Routing




| | | | |
|---|---|---|---|
| **Detention / Retention Basin Volume Required:** | **63,675** | **$ft^3$** | |
| **@ Stage:** | **545.40** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **89,047** | **$ft^3$** | Basin **G0-North** |
| **Maximum flow rate released from this basin:** | **2.07** | **cfs** | |

# Basin G0-South Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 01.05.10 | WATERSHED: | G0 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G0-South |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 767800 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 17.63 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 52% | AT | 0.90 | 0.467 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 48% | AT | 0.55 | 0.264 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.73 |
| $C_{25}$ = | 0.80 |
| $C_{50}$ = | 0.88 |
| $C_{100}$ = | 0.91 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 544.0 | ft | From median, north of SV Line |
| LOW POINT ELEVATION | 542.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 60 | ft | |
| SLOPE (S) = (H/L) | 3.3% | | |
| MANNING'S n | 0.050 | | < = FROM TABLE 816.6A Fallow |
| $T_t$ (SFF)= | 2.94 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 542.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 539.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 183 | ft | |
| SLOPE (S) = (H/L) | 1.6% | | |
| VELOCITY (SCF) | 0.8 | fps | <=V FROM FIG 816.5 short grass |
| $T_C$ (SH)= | 3.81 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 539.0 | ft | median ditch |
| LOW POINT ELEVATION | 537.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 2.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 112 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.46 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.76 | minutes | |

# Basin G0-South Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft | |
| LOW POINT ELEVATION | 525.0 | ft | |
| ELEVATION DIFF (H) | 7.0 | ft | |
| LENGTH (L) | 472 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 11.5 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.68 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 525.0 | ft | Proposed storm to basin |
| LOW POINT ELEVATION | 512.0 | ft | |
| ELEVATION DIFF (H) | 13.0 | ft | |
| LENGTH (L) | 680 | ft | |
| SLOPE (S) = (H/L) | 1.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.1 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.87 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 9.06 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 23.9 |
| **$Q_{10}$ =** | 34.8 |
| **$Q_{25}$ =** | 47.8 |
| **$Q_{50}$ =** | 62.6 |
| **$Q_{100}$ =** | **67.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G0South Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **137+00 - 139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.05.10** | **WATERSHED:** | **G0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G0-South** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 67.9 | cfs | $C_{100}$= | 0.91 | |
| Tc= | 10.0 | min | A= | 17.63 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1440 | 2.4 |
| 20 | 1440 | 2.4 |
| 30 | 1500 | 2.5 |
| 40 | 1560 | 2.6 |
| 50 | 1620 | 2.7 |
| 60 | 1680 | 2.8 |
| 70 | 1740 | 2.9 |
| 80 | 1800 | 3 |
| 90 | 1860 | 3.1 |
| 100 | 1920 | 3.2 |
| 110 | 2040 | 3.4 |
| 120 | 2100 | 3.5 |
| 130 | 2280 | 3.8 |
| 140 | 2340 | 3.9 |
| 150 | 2580 | 4.3 |
| 160 | 2700 | 4.5 |
| 170 | 3000 | 5 |
| 180 | 3180 | 5.3 |
| 190 | 3600 | 6 |
| 200 | 3900 | 6.5 |
| 210 | 4800 | 8 |
| 220 | 5460 | 9.1 |
| 230 | 8040 | 13.4 |
| 240 | 11100 | 18.5 |
| 250 | 40740 | 67.9 |
| 260 | 6420 | 10.7 |
| 270 | 4320 | 7.2 |
| 280 | 3360 | 5.6 |
| 290 | 2820 | 4.7 |
| 300 | 2460 | 4.1 |
| 310 | 2220 | 3.7 |
| 320 | 1980 | 3.3 |
| 330 | 1800 | 3 |
| 340 | 1680 | 2.8 |
| 350 | 1560 | 2.6 |
| 360 | 1500 | 2.5 |
| 370 | 0 | 0 |

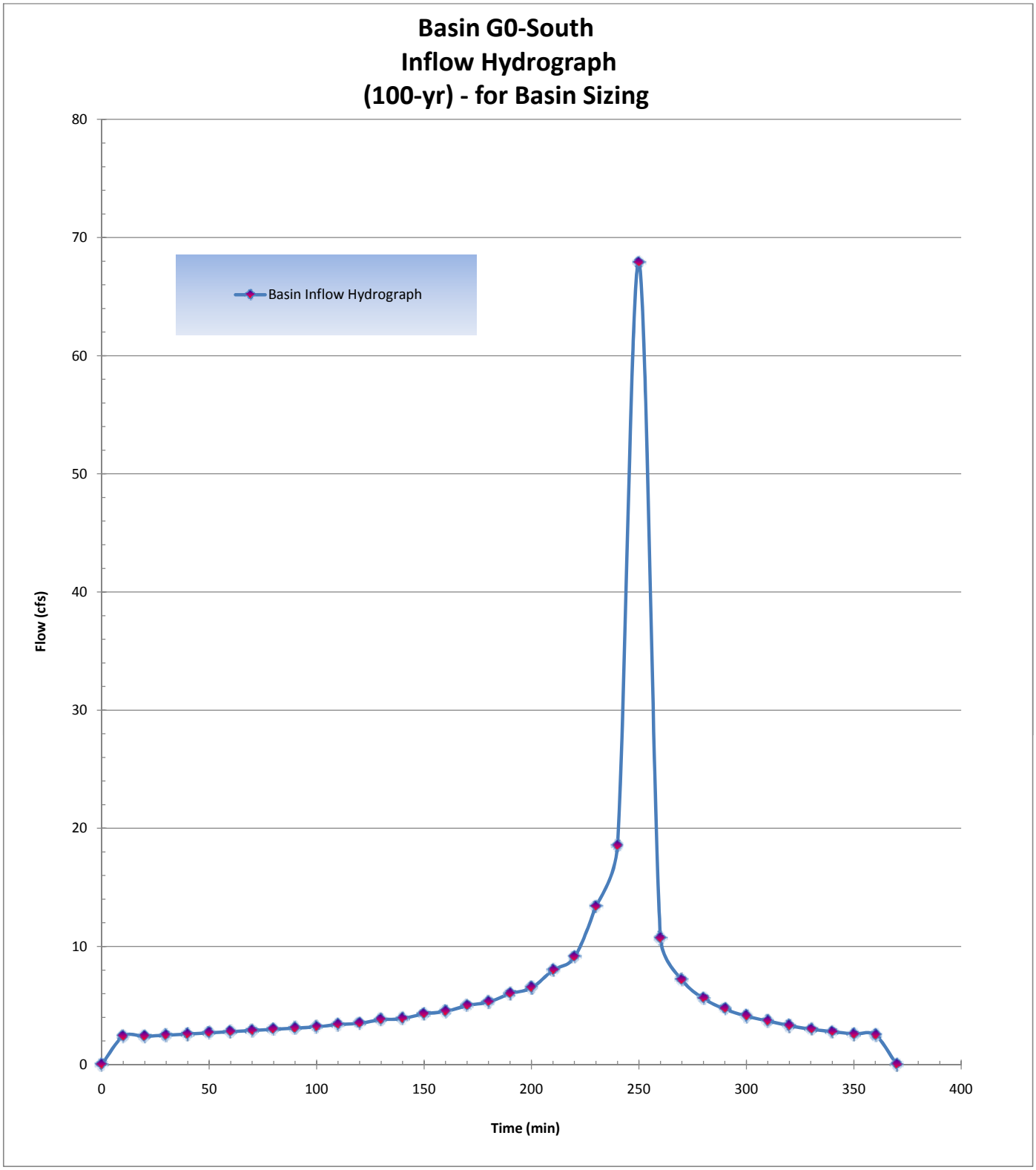
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 144540 $ft^3$**
**3.32 acre-feet**

Onsite Runoff Volume

Check: $V = C*A*P_6$
V= 3.36 acre-feet
***OK***


Basin G0-South
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
350
400

# Basin G0-South Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **137+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G0-South** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G0-South** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 136480 | $ft^3$ | from G0-ALL |
| Retention volume from G0-North Basin = | 46802 | $ft^4$ | |
| Minimum Retention volume from this basin = | 89678 | | balance of required retention for G0-ALL |
| Actual Basin Inflow = | 144540 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G0-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G0 |
| Flow that does not reach detention basin (bypass per DA table): | 22.3 | cfs | $Q_{100}$ from: G0.8.PVG0.22.PVG0.8.SLG0.22.SLG0.24.SLG0.25.SL |
| Maximum flow to be released by G0-1 basin: | 12.9 | cfs | *34%* of G0-ALL (per retention ratios) |
| Maximum flow allowed to be released by this detention basin: | 16.3 | cfs | *66%* of G0-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 516.60 | ft |
| Basin flowline elevation = | 512.00 | ft |
| Maximum Basin Depth = | 4.60 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.60 | ft | 514.60 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | 180 | ft | L/2 due to sloped floor |
| Base Width (W) | 180 | ft | average |
| W/L Ratio ® | 1.00 | | |
| Side Slopes (Z) | 1: 4 | | |
| Total Volume (V): | 181518 | $ft^2$ | |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 ~ *assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 512.00 | 0.00 | 0 | 0 | | 512.00 | 0.00 | 0.00 | 0.00 |
| 1 | 512.20 | 0.20 | 6539 | 6539 | | 512.20 | 0.00 | | 0.00 |
| 2 | 512.40 | 0.40 | 6656 | 13195 | | 512.40 | 0.00 | | 0.00 |
| 3 | 512.60 | 0.60 | 6775 | 19970 | | 512.60 | 0.00 | | 0.00 |
| 4 | 512.80 | 0.80 | 6894 | 26863 | | 512.80 | 0.00 | | 0.00 |
| 5 | 513.00 | 1.00 | 7014 | 33877 | | 513.00 | 0.00 | | 0.00 |
| 6 | 513.20 | 1.20 | 7135 | 41012 | | 513.20 | 0.00 | | 0.00 |
| 7 | 513.40 | 1.40 | 7256 | 48268 | | 513.40 | 0.00 | | 0.00 |
| 8 | 513.60 | 1.60 | 7378 | 55646 | | 513.60 | 0.00 | | 0.00 |
| 9 | 513.80 | 1.80 | 7501 | 63148 | | 513.80 | 0.00 | | 0.00 |
| 10 | 514.00 | 2.00 | 7625 | 70773 | | 514.00 | 0.00 | | 0.00 |
| 11 | 514.20 | 2.20 | 7750 | 78523 | | 514.20 | 0.00 | | 0.00 |
| 12 | 514.40 | 2.40 | 7875 | 86398 | | 514.40 | 0.00 | 0.00 | 0.00 |
| 13 | 514.60 | 2.60 | 8001 | 94399 | * | 514.60 | 0.00 | | 0.00 |
| 14 | 514.80 | 2.80 | 8128 | 102528 | | 514.80 | 0.15 | | 0.15 |
| 15 | 515.00 | 3.00 | 8256 | 110784 | | 515.00 | 0.59 | | 0.59 |
| 16 | 515.20 | 3.20 | 8384 | 119168 | | 515.20 | 1.30 | | 1.30 |
| 17 | 515.40 | 3.40 | 8513 | 127681 | | 515.40 | 2.25 | | 2.25 |
| 18 | 515.60 | 3.60 | 8643 | 136325 | | 515.60 | 3.42 | | 3.42 |
| 19 | 515.80 | 3.80 | 8774 | 145099 | | 515.80 | 4.79 | | 4.79 |
| 20 | 516.00 | 4.00 | 8906 | 154004 | | 516.00 | 6.32 | | 6.32 |
| 21 | 516.20 | 4.20 | 9038 | 163042 | | 516.20 | 7.99 | | 7.99 |
| 22 | 516.40 | 4.40 | 9171 | 172213 | | 516.40 | 9.77 | | 9.77 |
| 23 | 516.60 | 4.60 | 9305 | 181518 | | 516.60 | 11.63 | | 11.63 |

# Basin G0-South Routing

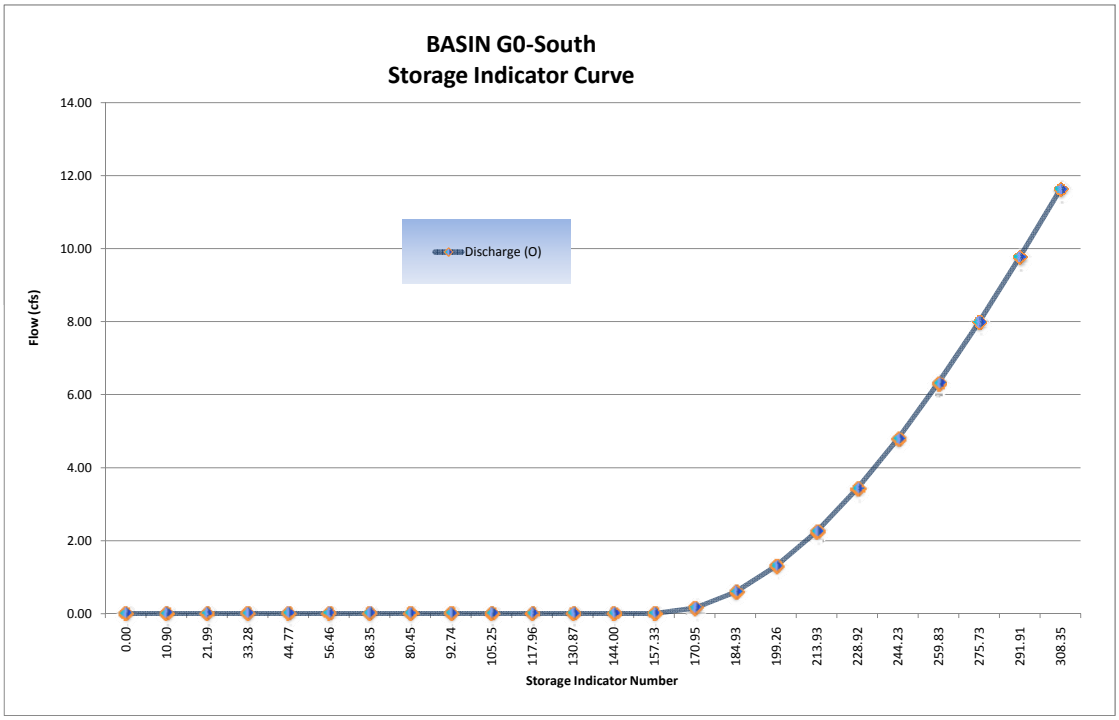
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 137+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G0-South |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G0-South |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 512.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 512.20 | 0.00 | 6539 | 0.00 | 10.90 | 10.90 |
| 512.40 | 0.00 | 13195 | 0.00 | 21.99 | 21.99 |
| 512.60 | 0.00 | 19970 | 0.00 | 33.28 | 33.28 |
| 512.80 | 0.00 | 26863 | 0.00 | 44.77 | 44.77 |
| 513.00 | 0.00 | 33877 | 0.00 | 56.46 | 56.46 |
| 513.20 | 0.00 | 41012 | 0.00 | 68.35 | 68.35 |
| 513.40 | 0.00 | 48268 | 0.00 | 80.45 | 80.45 |
| 513.60 | 0.00 | 55646 | 0.00 | 92.74 | 92.74 |
| 513.80 | 0.00 | 63148 | 0.00 | 105.25 | 105.25 |
| 514.00 | 0.00 | 70773 | 0.00 | 117.96 | 117.96 |
| 514.20 | 0.00 | 78523 | 0.00 | 130.87 | 130.87 |
| 514.40 | 0.00 | 86398 | 0.00 | 144.00 | 144.00 |
| 514.60 | 0.00 | 94399 | 0.00 | 157.33 | 157.33 |
| 514.80 | 0.15 | 102528 | 0.08 | 170.88 | 170.95 |
| 515.00 | 0.59 | 110784 | 0.30 | 184.64 | 184.93 |
| 515.20 | 1.30 | 119168 | 0.65 | 198.61 | 199.26 |
| 515.40 | 2.25 | 127681 | 1.13 | 212.80 | 213.93 |
| 515.60 | 3.42 | 136325 | 1.71 | 227.21 | 228.92 |
| 515.80 | 4.79 | 145099 | 2.40 | 241.83 | 244.23 |
| 516.00 | 6.32 | 154004 | 3.16 | 256.67 | 259.83 |
| 516.20 | 7.99 | 163042 | 4.00 | 271.74 | 275.73 |
| 516.40 | 9.77 | 172213 | 4.89 | 287.02 | 291.91 |
| 516.60 | 11.63 | 181518 | 5.82 | 302.53 | 308.35 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |

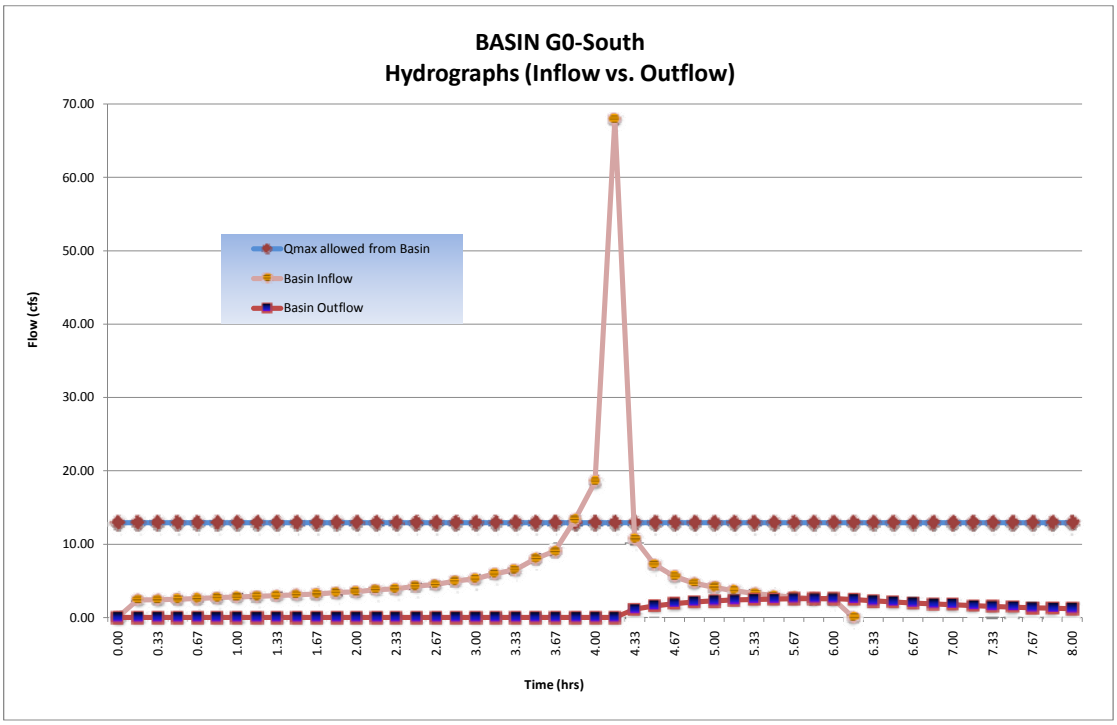


# Basin G0-South Routing

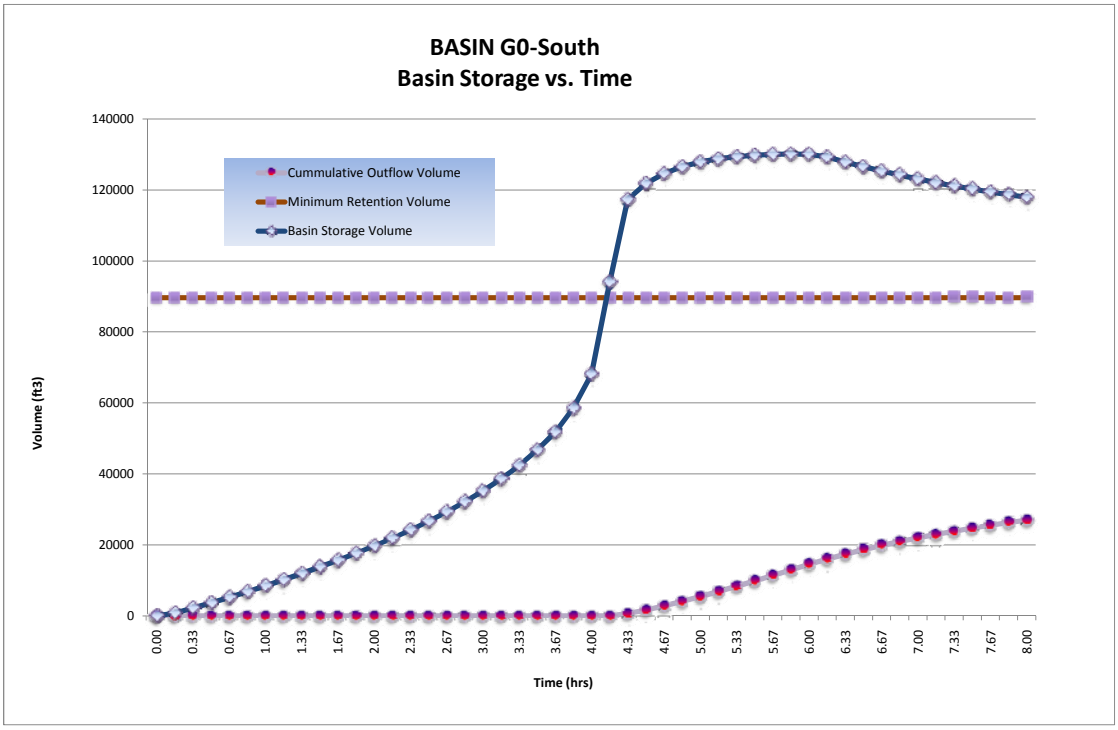
$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) = O_1 + \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 2.40 | 1.20 | 0.00 | 0.00 | 1.20 | 0.00 | 720 | 0 | 0 |
| 0.33 | 2.40 | 2.40 | 1.20 | 0.00 | 3.60 | 0.00 | 2160 | 0 | 0 |
| 0.50 | 2.50 | 2.45 | 3.60 | 0.00 | 6.05 | 0.00 | 3630 | 0 | 0 |
| 0.67 | 2.60 | 2.55 | 6.05 | 0.00 | 8.60 | 0.00 | 5160 | 0 | 0 |
| 0.83 | 2.70 | 2.65 | 8.60 | 0.00 | 11.25 | 0.00 | 6750 | 0 | 0 |
| 1.00 | 2.80 | 2.75 | 11.25 | 0.00 | 14.00 | 0.00 | 8400 | 0 | 0 |
| 1.17 | 2.90 | 2.85 | 14.00 | 0.00 | 16.85 | 0.00 | 10110 | 0 | 0 |
| 1.33 | 3.00 | 2.95 | 16.85 | 0.00 | 19.80 | 0.00 | 11880 | 0 | 0 |
| 1.50 | 3.10 | 3.05 | 19.80 | 0.00 | 22.85 | 0.00 | 13710 | 0 | 0 |
| 1.67 | 3.20 | 3.15 | 22.85 | 0.00 | 26.00 | 0.00 | 15600 | 0 | 0 |
| 1.83 | 3.40 | 3.30 | 26.00 | 0.00 | 29.30 | 0.00 | 17580 | 0 | 0 |
| 2.00 | 3.50 | 3.45 | 29.30 | 0.00 | 32.75 | 0.00 | 19650 | 0 | 0 |
| 2.17 | 3.80 | 3.65 | 32.75 | 0.00 | 36.40 | 0.00 | 21840 | 0 | 0 |
| 2.33 | 3.90 | 3.85 | 36.40 | 0.00 | 40.25 | 0.00 | 24150 | 0 | 0 |
| 2.50 | 4.30 | 4.10 | 40.25 | 0.00 | 44.35 | 0.00 | 26610 | 0 | 0 |
| 2.67 | 4.50 | 4.40 | 44.35 | 0.00 | 48.75 | 0.00 | 29250 | 0 | 0 |
| 2.83 | 5.00 | 4.75 | 48.75 | 0.00 | 53.50 | 0.00 | 32100 | 0 | 0 |
| 3.00 | 5.30 | 5.15 | 53.50 | 0.00 | 58.65 | 0.00 | 35190 | 0 | 0 |
| 3.17 | 6.00 | 5.65 | 58.65 | 0.00 | 64.30 | 0.00 | 38580 | 0 | 0 |
| 3.33 | 6.50 | 6.25 | 64.30 | 0.00 | 70.55 | 0.00 | 42330 | 0 | 0 |
| 3.50 | 8.00 | 7.25 | 70.55 | 0.00 | 77.80 | 0.00 | 46680 | 0 | 0 |
| 3.67 | 9.10 | 8.55 | 77.80 | 0.00 | 86.35 | 0.00 | 51810 | 0 | 0 |
| 3.83 | 13.40 | 11.25 | 86.35 | 0.00 | 97.60 | 0.00 | 58560 | 0 | 0 |
| 4.00 | 18.50 | 15.95 | 97.60 | 0.00 | 113.55 | 0.00 | 68130 | 0 | 0 |
| 4.17 | 67.90 | 43.20 | 113.55 | 0.00 | 156.75 | 0.00 | 94050 | 0 | 0 |
| 4.33 | 10.70 | 39.30 | 156.75 | 0.00 | 196.05 | 1.14 | 117288 | 684 | 684 |
| 4.50 | 7.20 | 8.95 | 196.05 | 1.14 | 203.86 | 1.60 | 121836 | 960 | 1644 |
| 4.67 | 5.60 | 6.40 | 203.86 | 1.60 | 208.66 | 1.91 | 124623 | 1146 | 2790 |
| 4.83 | 4.70 | 5.15 | 208.66 | 1.91 | 211.90 | 2.12 | 126504 | 1272 | 4062 |
| 5.00 | 4.10 | 4.40 | 211.90 | 2.12 | 214.18 | 2.27 | 127827 | 1362 | 5424 |
| 5.17 | 3.70 | 3.90 | 214.18 | 2.27 | 215.81 | 2.40 | 128766 | 1440 | 6864 |
| 5.33 | 3.30 | 3.50 | 215.81 | 2.40 | 216.91 | 2.48 | 129402 | 1488 | 8352 |
| 5.50 | 3.00 | 3.15 | 216.91 | 2.48 | 217.58 | 2.54 | 129786 | 1524 | 9876 |
| 5.67 | 2.80 | 2.90 | 217.58 | 2.54 | 217.94 | 2.56 | 129996 | 1536 | 11412 |
| 5.83 | 2.60 | 2.70 | 217.94 | 2.56 | 218.08 | 2.57 | 130077 | 1542 | 12954 |
| 6.00 | 2.50 | 2.55 | 218.08 | 2.57 | 218.06 | 2.57 | 130065 | 1542 | 14496 |
| 6.17 | 0.00 | 1.25 | 218.06 | 2.57 | 216.74 | 2.47 | 129303 | 1482 | 15978 |
| 6.33 | | 0.00 | 216.74 | 2.47 | 214.27 | 2.28 | 127878 | 1368 | 17346 |
| 6.50 | | 0.00 | 214.27 | 2.28 | 211.99 | 2.12 | 126558 | 1272 | 18618 |
| 6.67 | | 0.00 | 211.99 | 2.12 | 209.87 | 1.99 | 125325 | 1194 | 19812 |
| 6.83 | | 0.00 | 209.87 | 1.99 | 207.88 | 1.86 | 124170 | 1116 | 20928 |
| 7.00 | | 0.00 | 207.88 | 1.86 | 206.02 | 1.74 | 123090 | 1044 | 21972 |
| 7.17 | | 0.00 | 206.02 | 1.74 | 204.28 | 1.63 | 122079 | 978 | 22950 |
| 7.33 | | 0.00 | 204.28 | 1.63 | 202.65 | 1.52 | 121134 | 912 | 23862 |
| 7.50 | | 0.00 | 202.65 | 1.52 | 201.13 | 1.42 | 120252 | 852 | 24714 |
| 7.67 | | 0.00 | 201.13 | 1.42 | 199.71 | 1.33 | 119427 | 798 | 25512 |
| 7.83 | | 0.00 | 199.71 | 1.33 | 198.38 | 1.26 | 118650 | 756 | 26268 |
| 8.00 | | 0.00 | 198.38 | 1.26 | 197.12 | 1.19 | 117915 | 714 | 26982 |



**Basin G0-South Routing**




| | | | |
|---|---|---|---|
| **Detention / Retention Basin Volume Required:** | **130,077** | **ft$^3$** | |
| **@ Stage:** | **515.60** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **181,518** | **ft$^3$** | Basin **G0-South** |
| **Maximum flow rate released from this basin:** | **2.57** | **cfs** | |

# X0 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.25.10** | **WATERSHED:** | **X** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | X0.1.PV | 0.99 | 2100 | 0.0 | 5 | 4.0 | 0.19 | 6.6 | 0.31 | ~ | X0.1 | bypass* | 40+00 | Rt |
| | X0.2.PV | 0.99 | 64500 | 1.5 | 5 | 4.0 | 5.84 | 6.6 | 9.66 | ~ | X0.2 | bypass* | 40+50 | Rt |
| | X0.3.PV | 0.99 | 2300 | 0.1 | 5 | 4.0 | 0.21 | 6.6 | 0.34 | ~ | X0.3 | bypass* | 40+00 | Lt |
| | X0.4.PV | 0.99 | 66500 | 1.5 | 5 | 4.0 | 6.02 | 6.6 | 9.96 | ~ | X0.4 | bypass* | 40+50 | Lt |

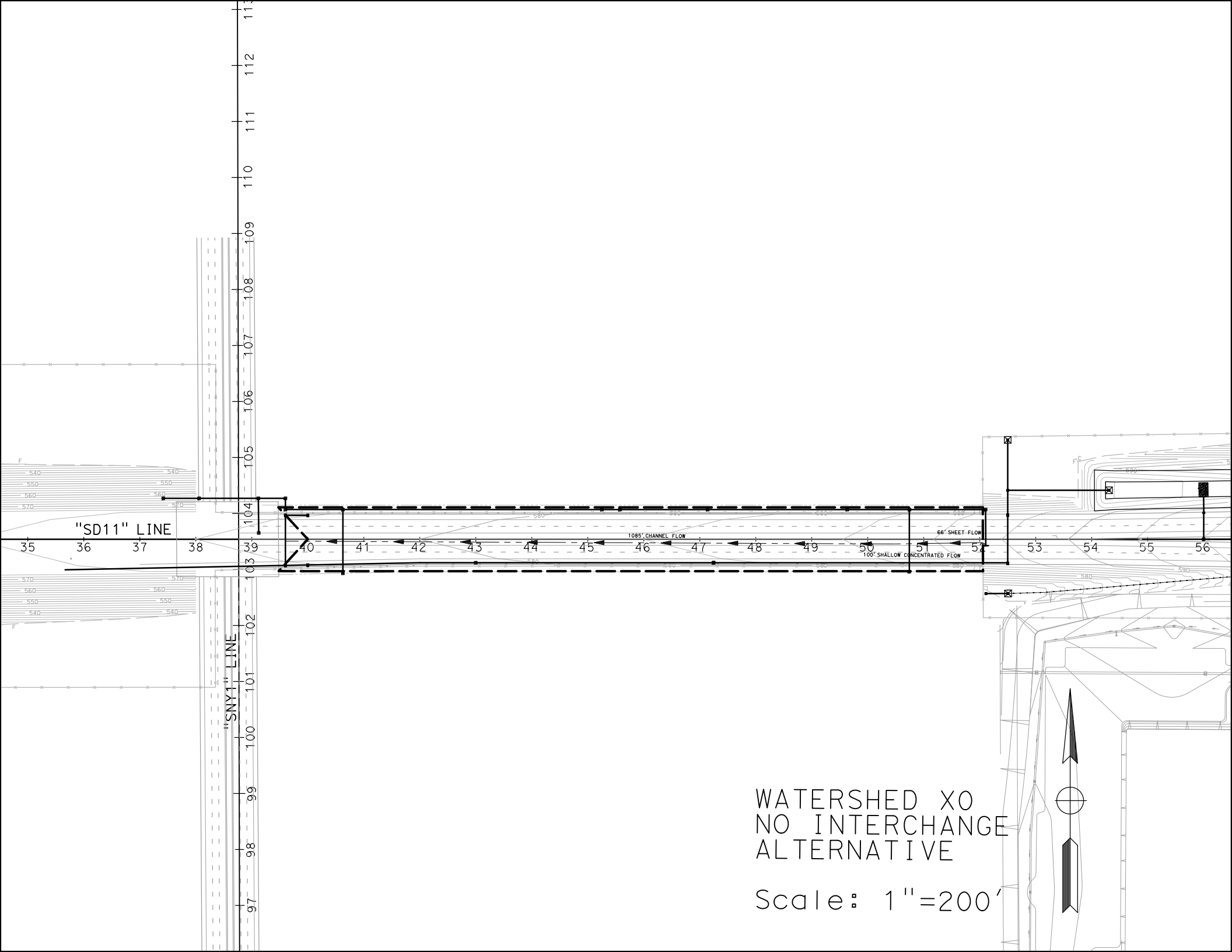
Σ 135400 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | X0.5.SL | 0.61 | 5033 | 0.1 | 10 | 2.8 | 0.20 | 4.2 | 0.30 | ~ | X0.5 | bypass* | 40+00 | ~ |

Σ 5033 *SLOPE*

*flow that does not reach the basin

| | | |
|---|---|---|
| Total : | 140433 | 3.2 |
| | *SF* | *ac* |


"SD11" LINE
"SNY1" LINE
1085' CHANNEL FLOW
66' SHEET FLOW
100' SHALLOW CONCENTRATED FLOW
35
36
37
38
39
40
41
42
43
44
45
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48
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97
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100
101
102
103
104
105
106
107
108
109
110
111
112
WATERSHED X0
NO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# X0 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Post-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.25.10** | **WATERSHED:** | **X0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X0** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **140433** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **3.22** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.22 | Hilly Slopes ~ 15% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.49 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 17% | AT | 0.49 | 0.084 |
| PAVED SURFACE | 83% | AT | 0.90 | 0.746 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.83 |
| $C_{25}$ = | 0.91 |
| $C_{50}$ = | 1.00 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{.4\,5} n^{.4\,5}}{P_2^{.1/2} s^{.2\,5}}$

**NOTES:** $P_{2,24}$ **(in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | SR-11 at Sta 52 CL |
| LOW POINT ELEVATION | 586.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 66 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| MANNING'S n | 0.016 | | < = from Table 816.6A HMA |
| $T_t$ (SFF)= | 1.75 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 586.0 | ft | assumed not channelized yet |
| LOW POINT ELEVATION | 584.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| VELOCITY (SCF) | 4.0 | fps | <=V FROM FIG 816.6 HMA |
| $T_C$ (SH)= | 0.42 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft | channelizes in shoulder of structure |
| LOW POINT ELEVATION | 578.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 6.0 | ft | Z= 20 ANG-RAD 0.050 |
| LENGTH (L) | 1085 | ft | b = 10 ANG-DEG 2.862 |
| SLOPE (S) = (H/L) | 0.6% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.016 | | HMA |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.33 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.43 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 7.60 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 5.0 |
| $Q_{10}$ = | 7.2 |
| $Q_{25}$ = | 9.9 |
| $Q_{50}$ = | 13.0 |
| $Q_{100}$ = | **13.6** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin X0 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **11.18.09** | **WATERSHED:** | **X0** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X** |

***Notes:***

* The difference between pre-developed and post-developed values gives the approximate volume to detain.
Stage-Storage calculations will determine accurate volume

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 10.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.76 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 240 | 0.4 |
| 20 | 240 | 0.4 |
| 30 | 240 | 0.4 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 300 | 0.5 |
| 90 | 300 | 0.5 |
| 100 | 300 | 0.5 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 360 | 0.6 |
| 140 | 360 | 0.6 |
| 150 | 420 | 0.7 |
| 160 | 420 | 0.7 |
| 170 | 480 | 0.8 |
| 180 | 480 | 0.8 |
| 190 | 540 | 0.9 |
| 200 | 600 | 1 |
| 210 | 720 | 1.2 |
| 220 | 840 | 1.4 |
| 230 | 1200 | 2 |
| 240 | 1680 | 2.8 |
| 250 | 6240 | 10.4 |
| 260 | 960 | 1.6 |
| 270 | 660 | 1.1 |
| 280 | 540 | 0.9 |
| 290 | 420 | 0.7 |
| 300 | 360 | 0.6 |
| 310 | 360 | 0.6 |
| 320 | 300 | 0.5 |
| 330 | 300 | 0.5 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 240 | 0.4 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 22140 $ft^3$**
**0.51 acre-feet**

Check: $V = C*A*P_6$
V= 0.51 acre-feet
***OK***

# Basin X0 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 13.6 | cfs | | | |
| Tc= | 10.0 | min | C= | 1.00 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 300 | 0.5 |
| 20 | 300 | 0.5 |
| 30 | 300 | 0.5 |
| 40 | 300 | 0.5 |
| 50 | 300 | 0.5 |
| 60 | 360 | 0.6 |
| 70 | 360 | 0.6 |
| 80 | 360 | 0.6 |
| 90 | 360 | 0.6 |
| 100 | 360 | 0.6 |
| 110 | 420 | 0.7 |
| 120 | 420 | 0.7 |
| 130 | 480 | 0.8 |
| 140 | 480 | 0.8 |
| 150 | 540 | 0.9 |
| 160 | 540 | 0.9 |
| 170 | 600 | 1 |
| 180 | 660 | 1.1 |
| 190 | 720 | 1.2 |
| 200 | 780 | 1.3 |
| 210 | 960 | 1.6 |
| 220 | 1080 | 1.8 |
| 230 | 1620 | 2.7 |
| 240 | 2220 | 3.7 |
| 250 | 8160 | 13.6 |
| 260 | 1320 | 2.2 |
| 270 | 840 | 1.4 |
| 280 | 660 | 1.1 |
| 290 | 540 | 0.9 |
| 300 | 480 | 0.8 |
| 310 | 420 | 0.7 |
| 320 | 420 | 0.7 |
| 330 | 360 | 0.6 |
| 340 | 360 | 0.6 |
| 350 | 300 | 0.5 |
| 360 | 300 | 0.5 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 28980 $ft^3$**
**0.67 acre-feet**

Check: V = C*A*$P_6$
V= 0.67 acre-feet
***OK***

**0.67**
**- 0.51**

**Attenuation volume = 0.16 acre-feet = 6840 $ft^3$**

**Basin Required**
**REFER TO BASIN Y**

# Basin X0 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 3.22 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **8543** **$ft^3$**

**WQV to be added to retention volume =** **1703** **$ft^3$** **Add this Volume to Basin**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

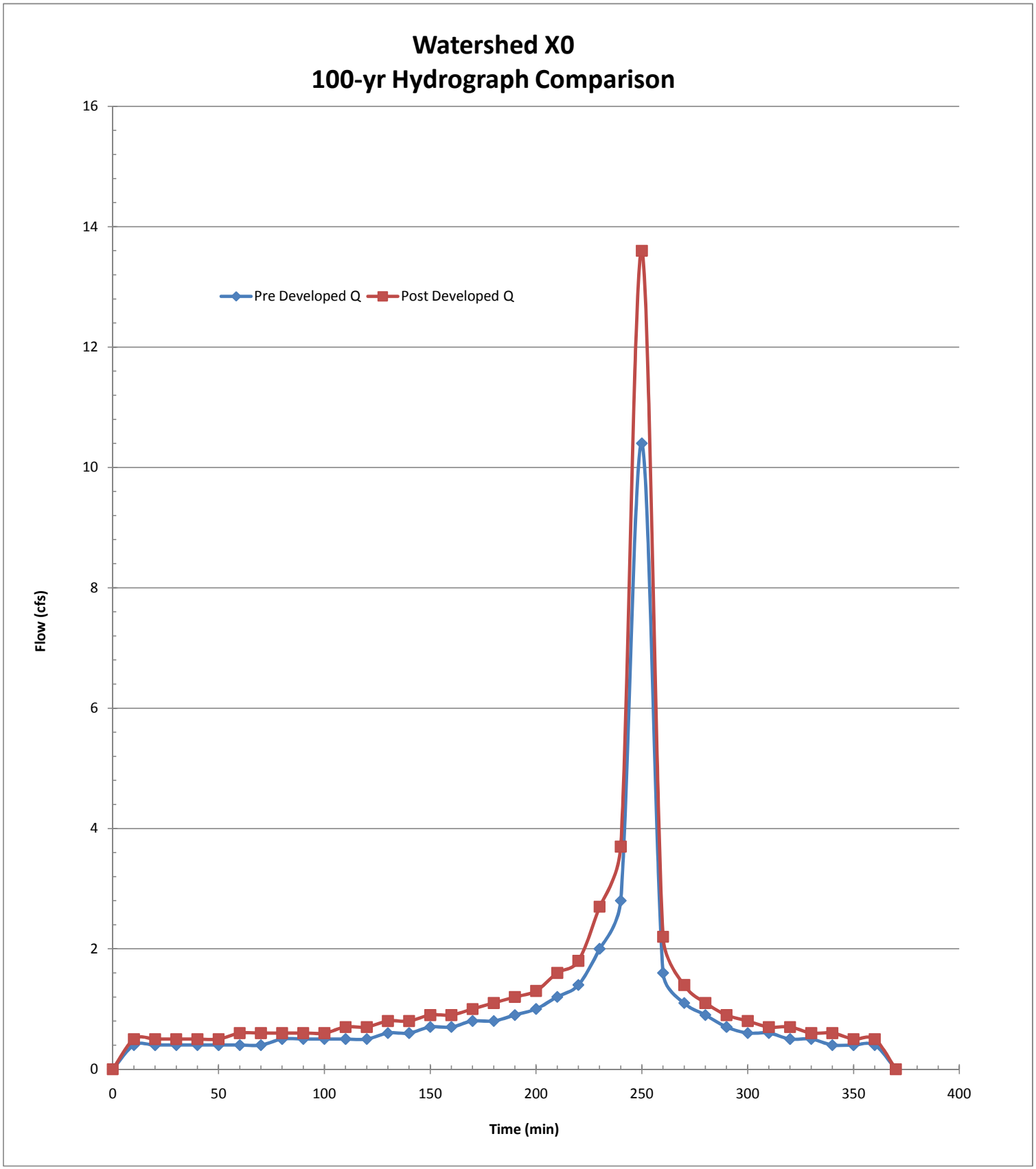
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 5033 | $ft^2$ |
| | A: | 0.12 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 1.80 tons

**Silt Accumulation Basin volume =** **40** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Watershed X0
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
250
300
350
400

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## Detention/Retention Basin Flows and Sizes – Zero Interchange Alternative

| Watershed | Location | Flow | | | Runoff Volume | | | Basin Volume - Breakdown | | | Basin Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Developed | Post-Developed | Increase | Pre-Developed | Post-Developed | Increase | Retention Provided | Detention | 1' Freeboard (minimum) | Final Volume | Length | Width | Depth | Free-board | Name |
| Name | (Sta) | (cfs) | (cfs) | (cfs) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | (ft) | (ft) | (ft) | (ft) | |
| X | 40+00 | 10.38 | 13.58 | 3.20 | 22,140 | 28,980 | 6,840 | ~ | ~ | ~ | Routed to Basin Y-EAST | ~ | ~ | ~ | ~ | ~ |
| A | 53+00 | 23.50 | 40.19 | 16.69 | 50,220 | 101,712 | 51,492 | 55,300 | 14,456 | 33,367 | 103,123 | 350 | 30 | 5.2 | 1.0 | A0 |
| B | 69+00 | 30.80 | 27.75 | (3.06) | 124,488 | 104,250 | (20,238) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| C | 78+00 | 16.38 | 9.05 | (7.33) | 35,100 | 19,380 | (15,720) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| D | 80+00 | 18.54 | 10.28 | (8.25) | 42,636 | 22,260 | (20,376) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| E | 96+00 | 61.90 | 84.35 | 22.45 | 232,050 | 315,072 | 83,022 | 91,237 | 9,795 | 63,082 | 164,115 | 250 | 75 | 6.0 | 1.8 | E0 |
| F | 110+00 | 154.03 | 168.09 | 14.06 | 667,620 | 704,178 | 36,558 | 39,712 | 40,989 | 109,528 | 190,229 | 265 | 85 | 6.0 | 3.0 | F0 |
| G | 127+00 | 59.99 | 128.37 | 68.38 | 180,846 | 313,272 | 132,426 | 46,802 | 16,873 | 25,372 | 89,047 | 200 | 75 | 4.4 | 1.0 | G0-North |
| | 139+00 | | | | | | | 94,399 | 35,678 | 51,441 | 181,518 | 180 | 180 | 4.6 | 1.0 | G0-South |

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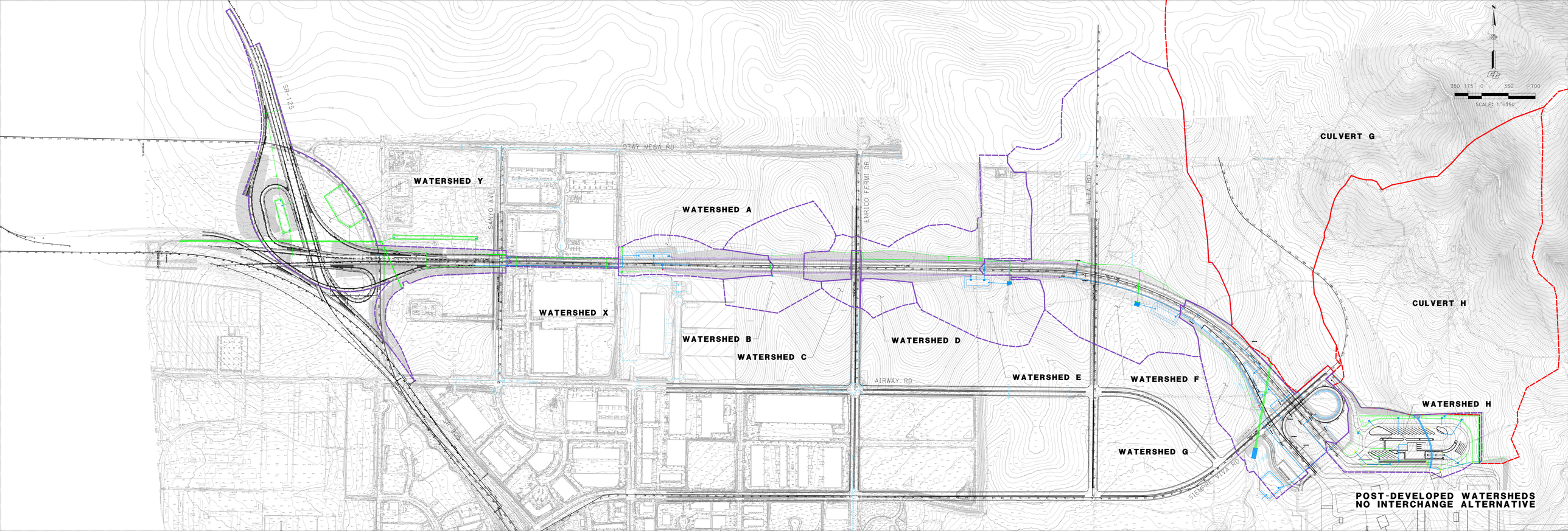
SR-125
OTAY MESA RD
SANYO AVE
ENRICO FERMI DR
ALTA RD
AIRWAY RD
SIEMPRE VIVA RD
SR-905
WATERSHED Y
WATERSHED X
WATERSHED A
WATERSHED B
WATERSHED C
WATERSHED D
WATERSHED E
WATERSHED F
WATERSHED G
WATERSHED H
CULVERT G
CULVERT H
350 175 0 350 700
SCALE: 1" = 350'
POST-DEVELOPED WATERSHEDS
NO INTERCHANGE ALTERNATIVE

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# *Appendix C*

ONE-Interchange Alternative

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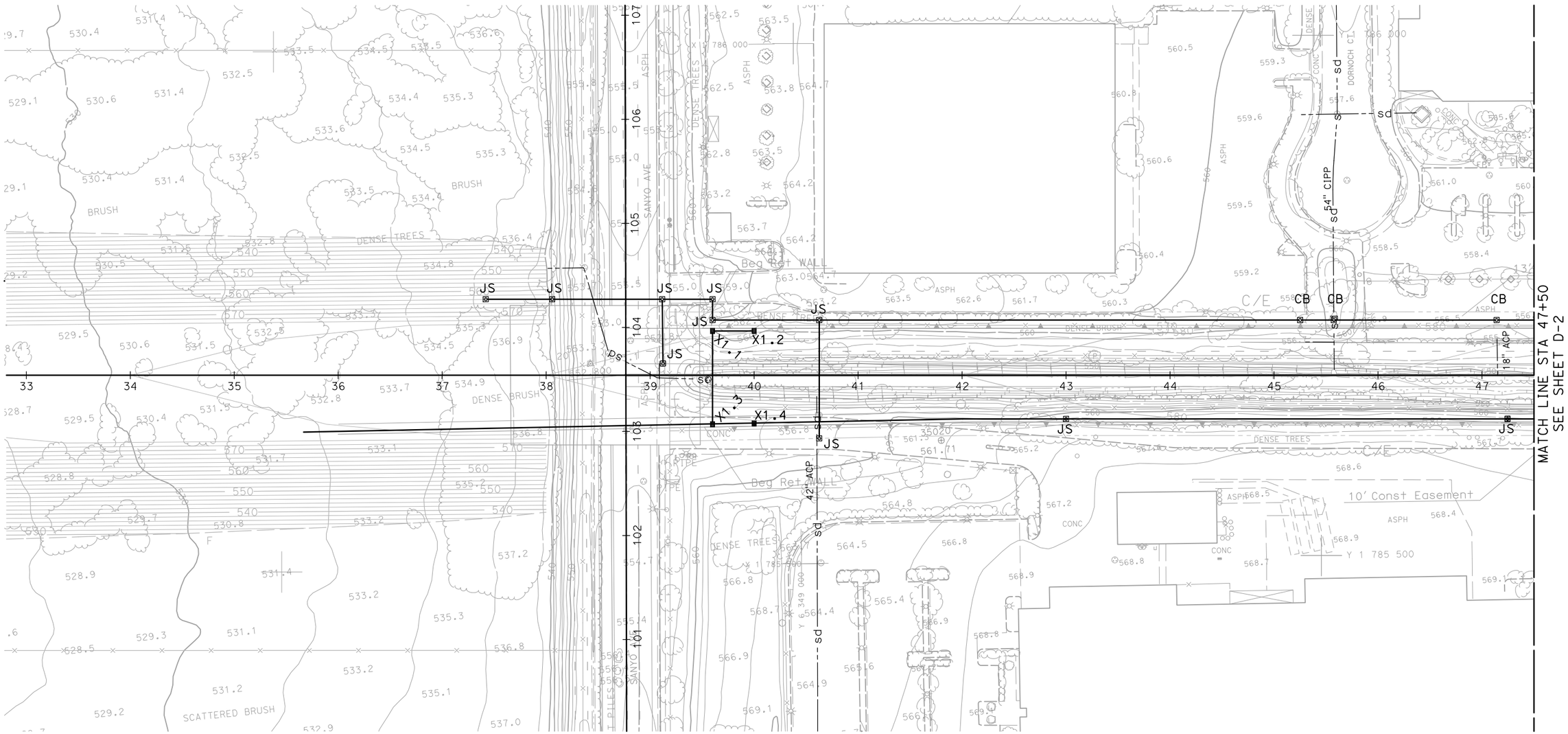
LEGEND:

- JS
- PIPE
- INLET W/APRON
- RSP
- HEADWALL
- --sd-- EXISTING STORMDRAIN




# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

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**D-1**

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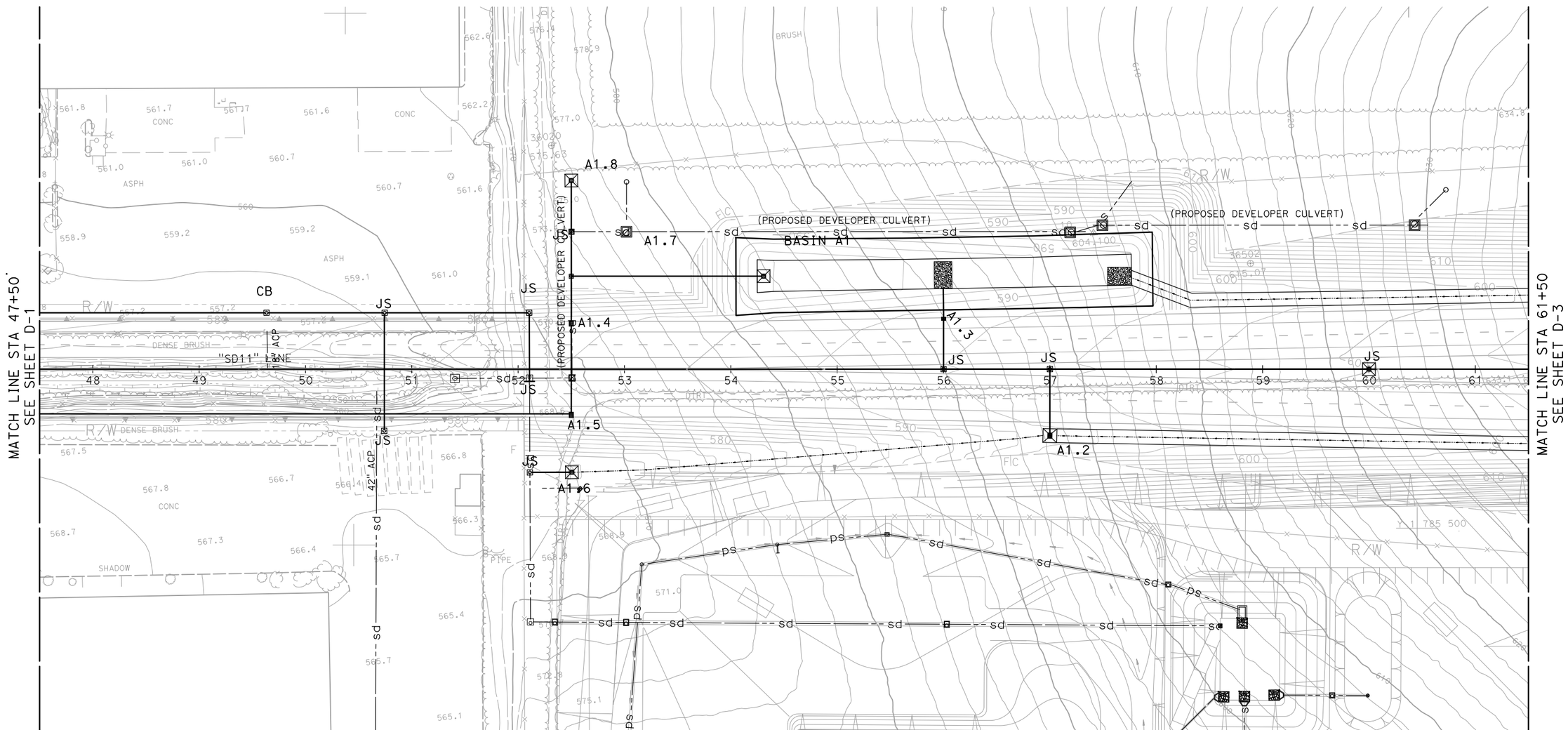


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SCALE 1"=50'

# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

**D-2**

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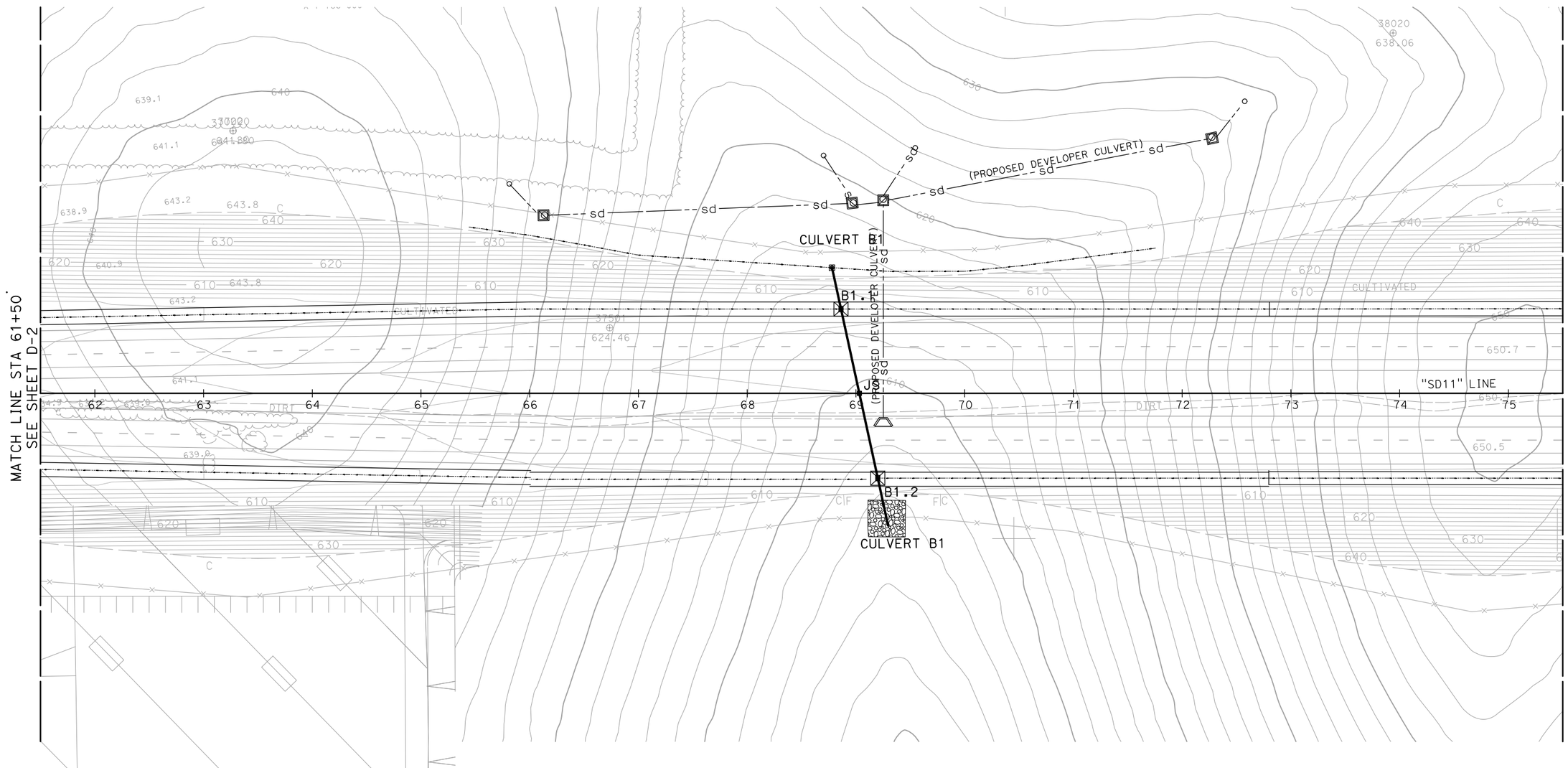


**ONE INTERCHANGE ALTERNATIVE**

**DRAINAGE PLAN**

SCALE 1"=50'

**D-3**

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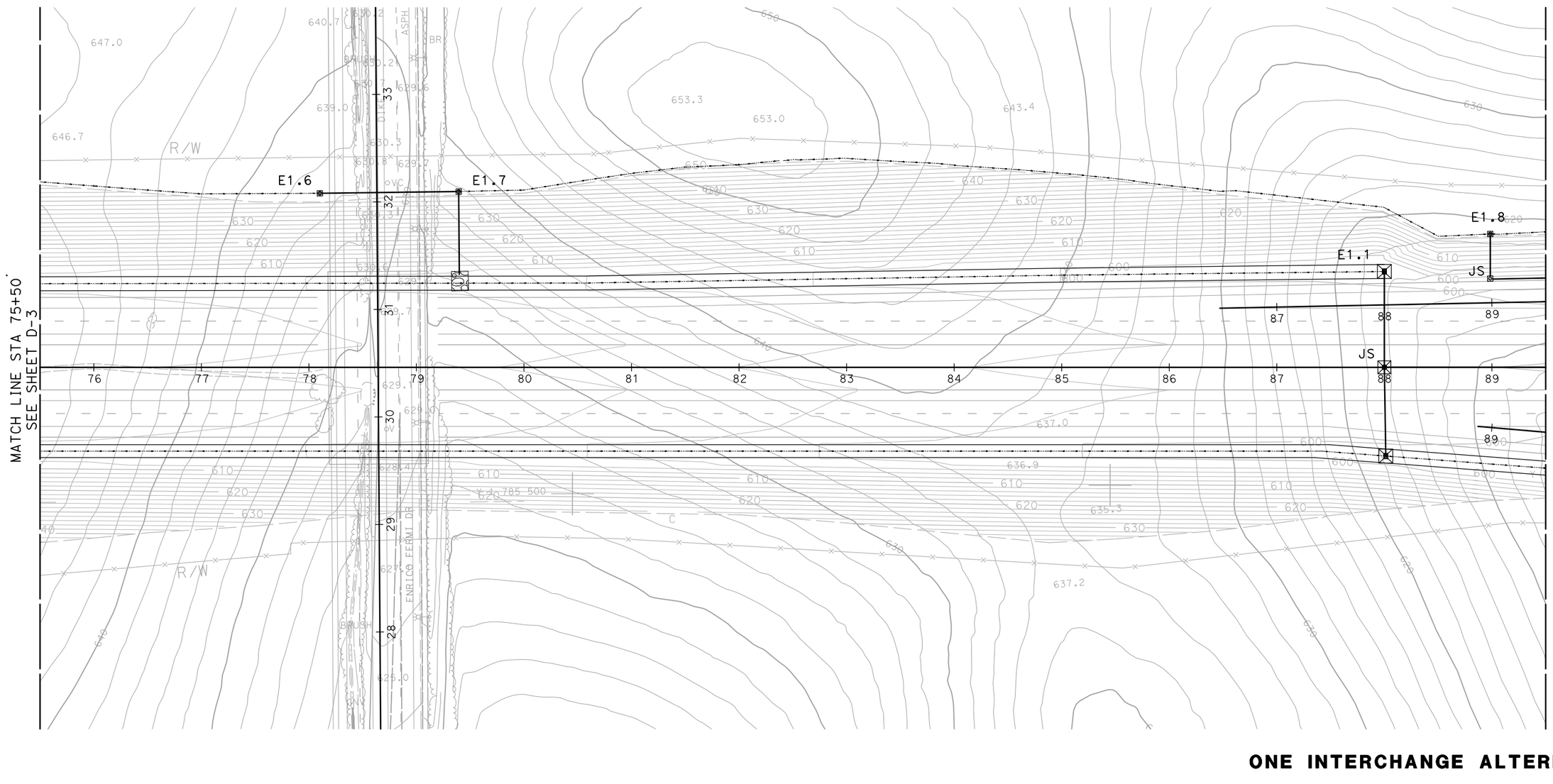


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

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**D-4**

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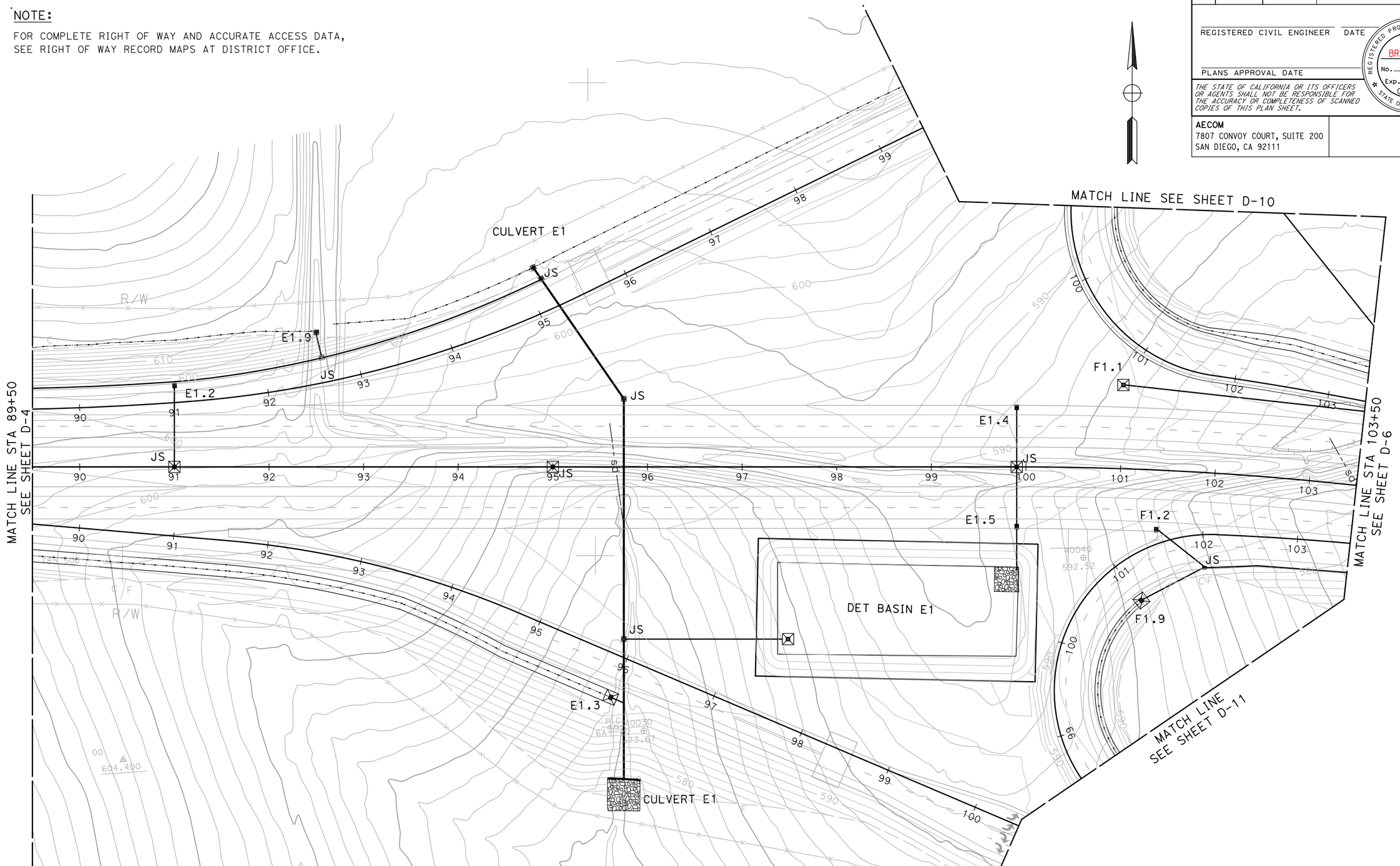


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-5**

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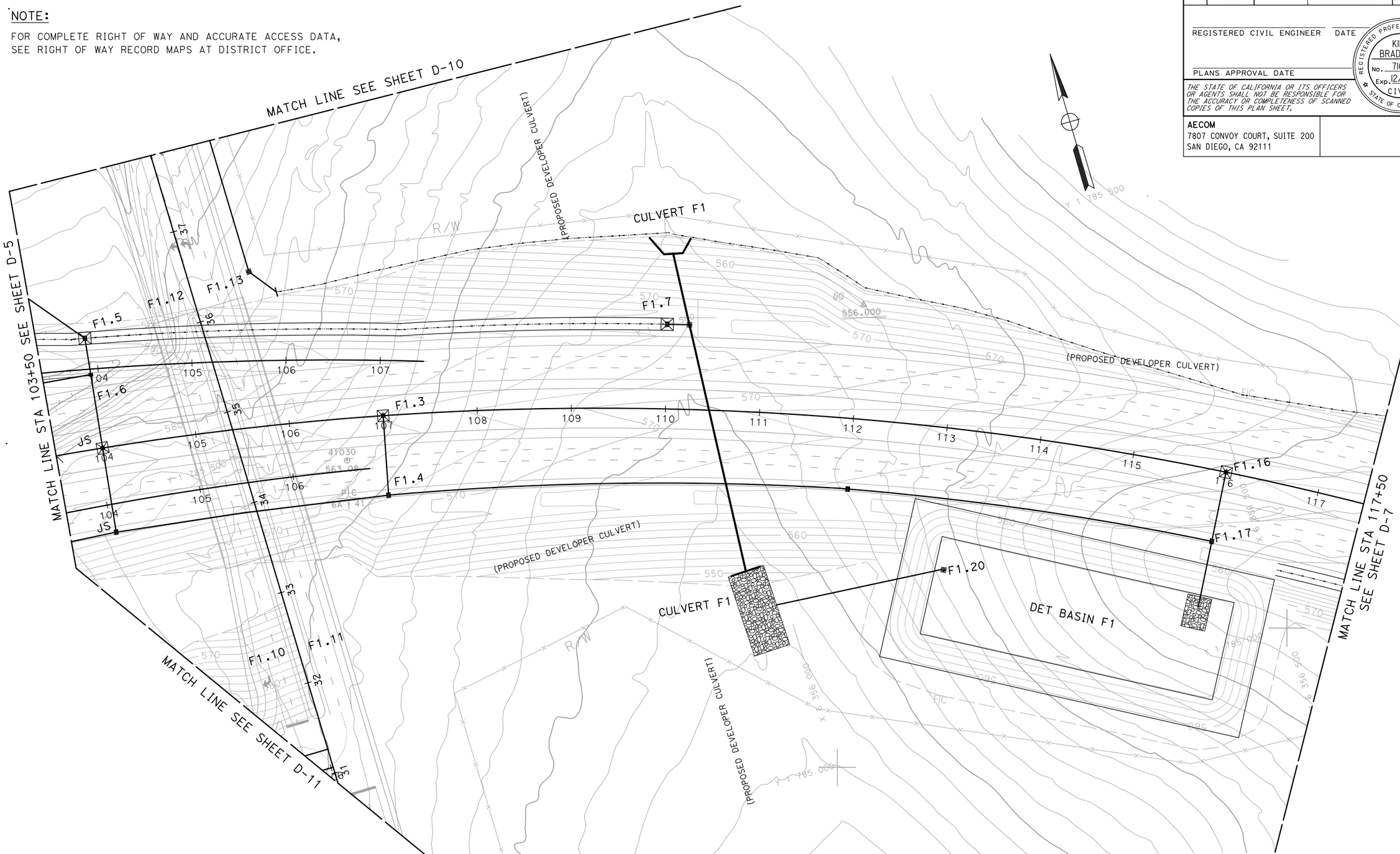


# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-6**

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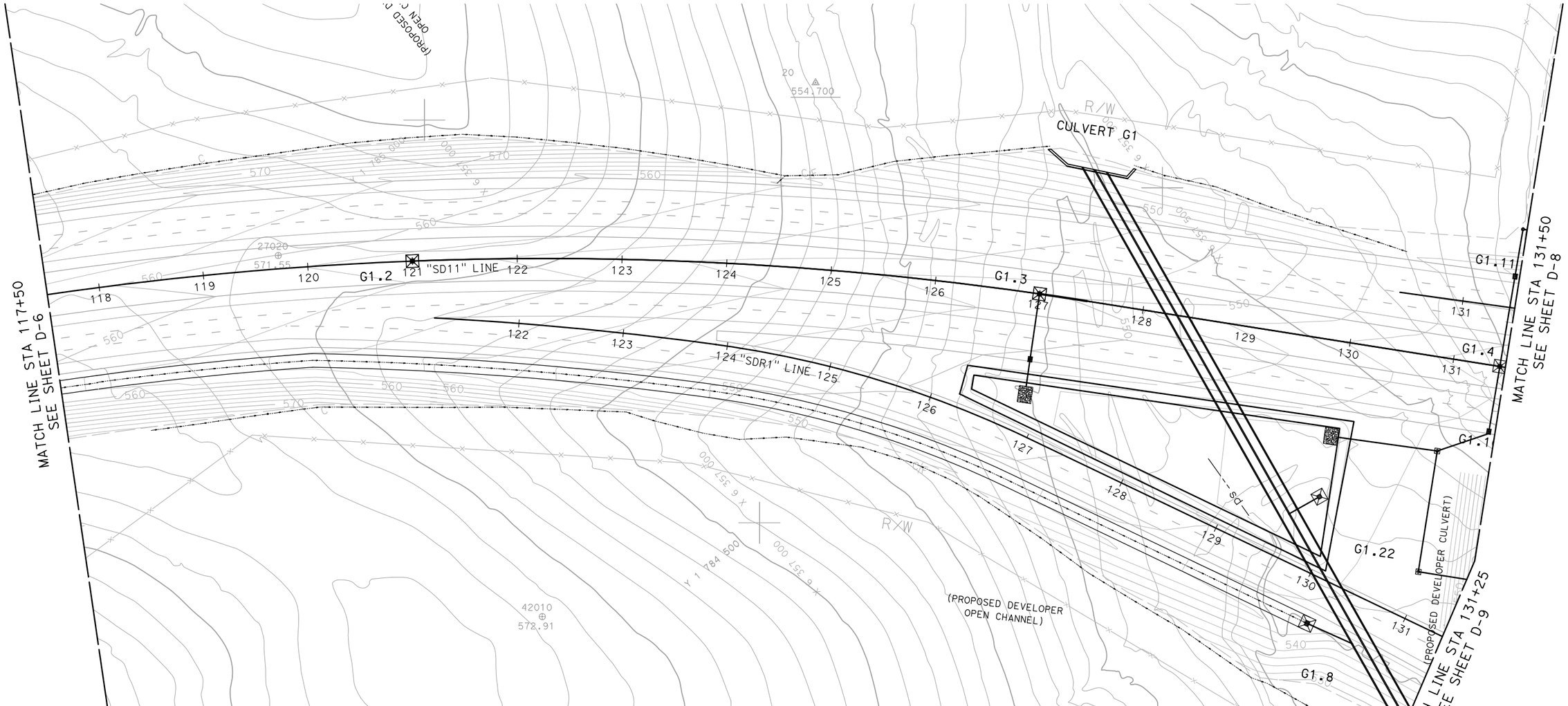


# ONE INTERCHANGE ALTERNATIVE

# DRAINAGE PLAN

SCALE 1"=50'

**D-7**

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| GERARD DALZIEL | |

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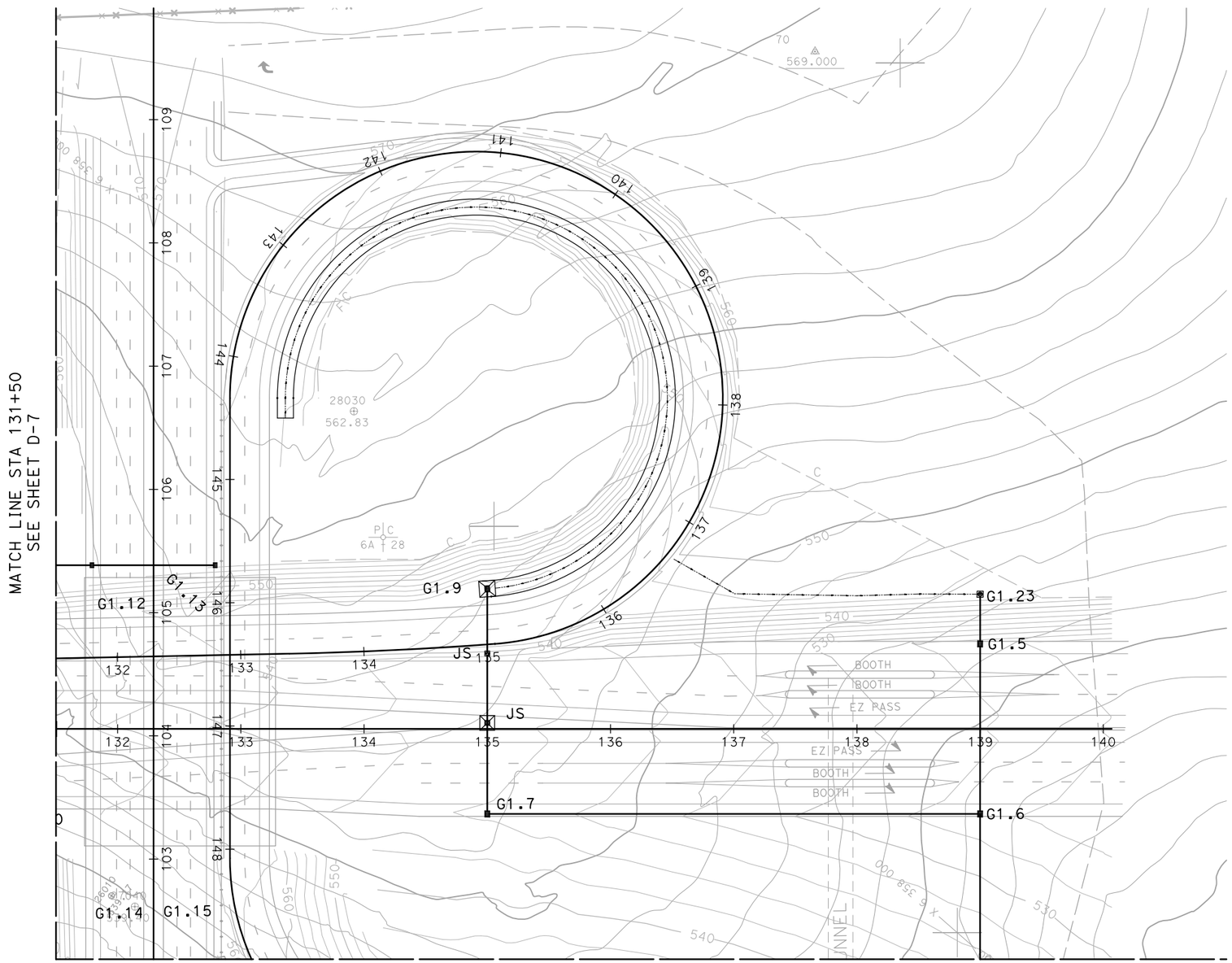


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-8**

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2/3/2010 5:52:08 PM YamanakaG h:\caltrans\2208300\cad\planset\b056300ia008_1.dgn
BORDER LAST REVISED 4/11/2008

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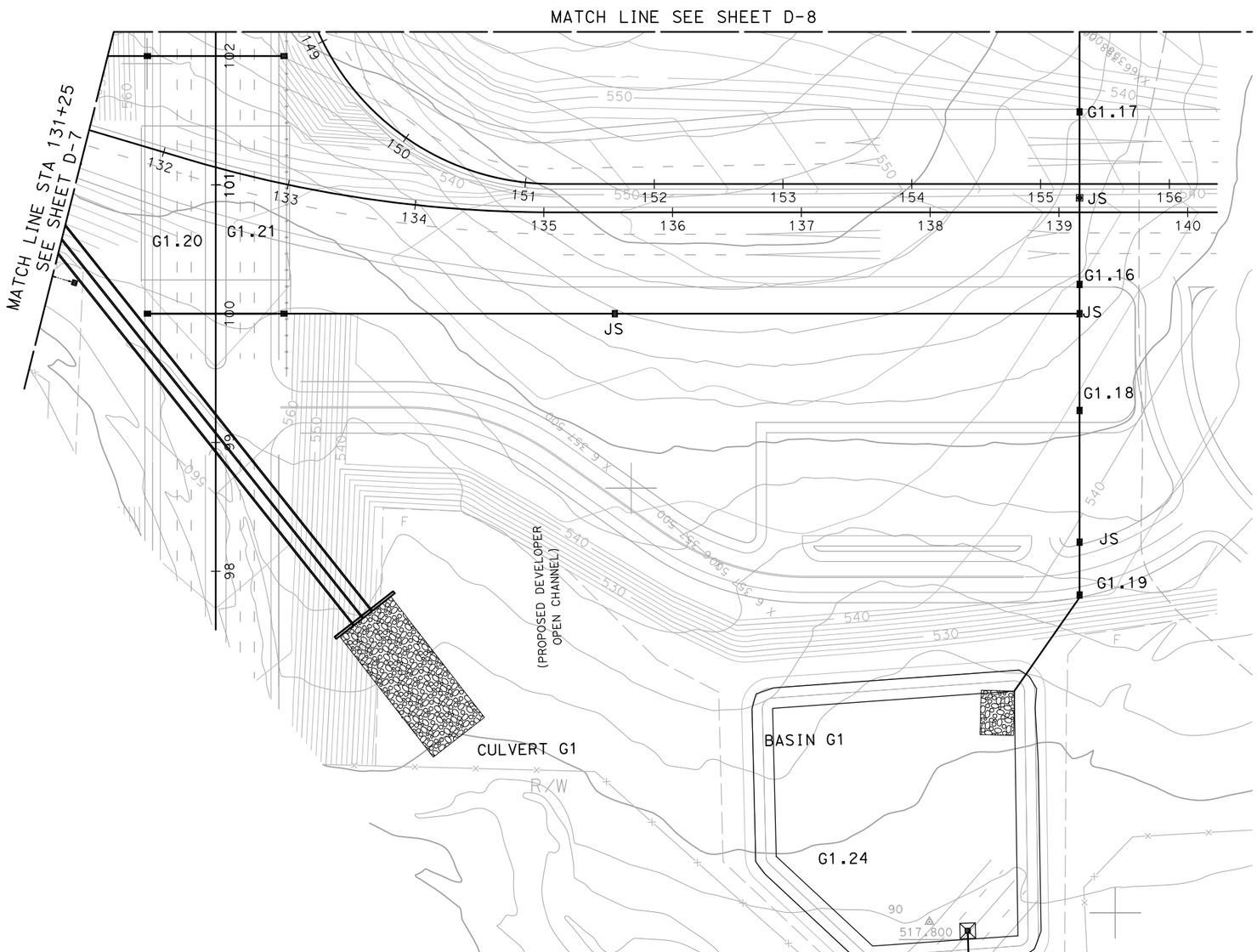


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-9**

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# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE PLAN

SCALE 1"=50'

**D-10**

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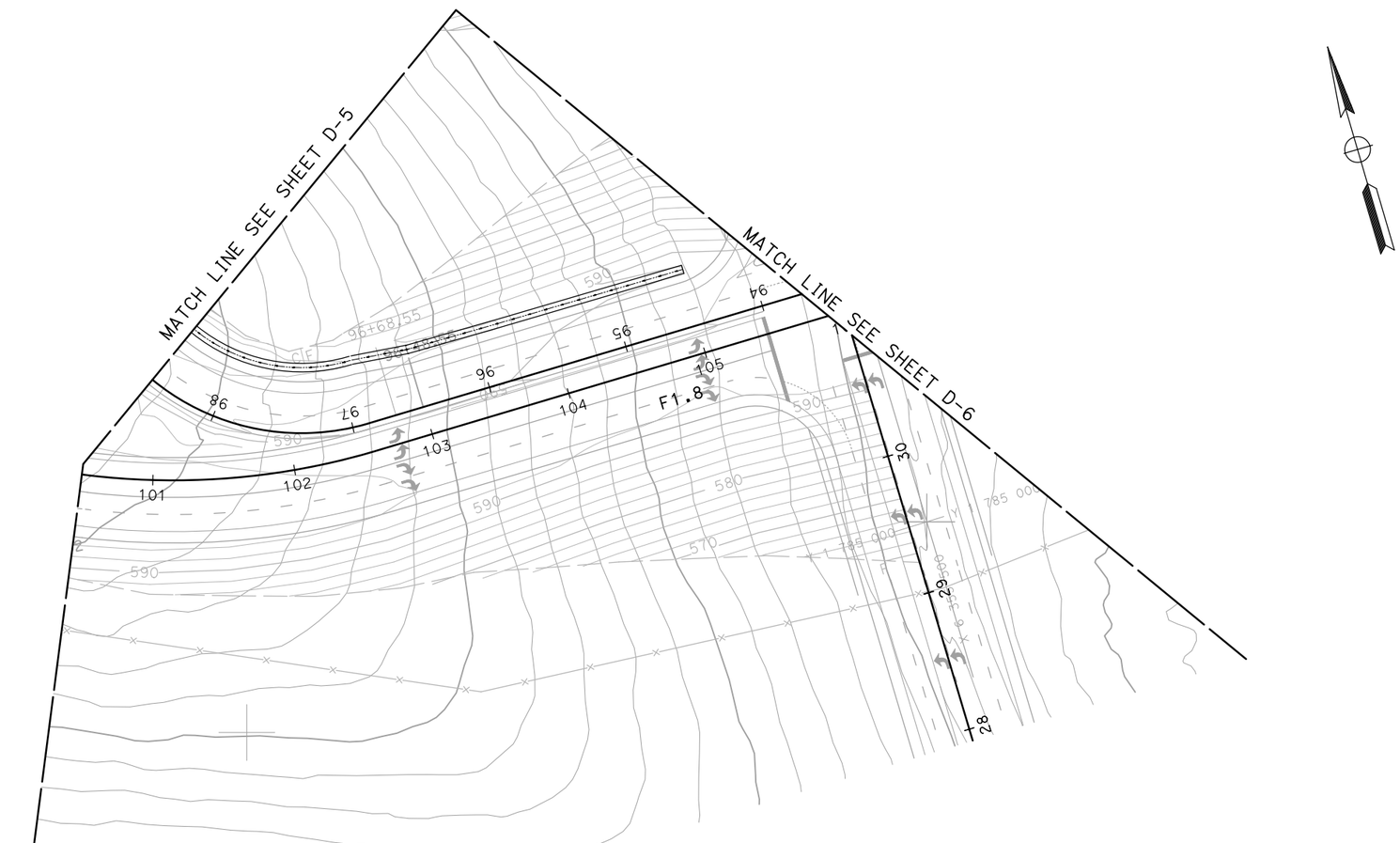


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# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE PLAN

SCALE 1"=50'

**D-11**

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LEGEND:

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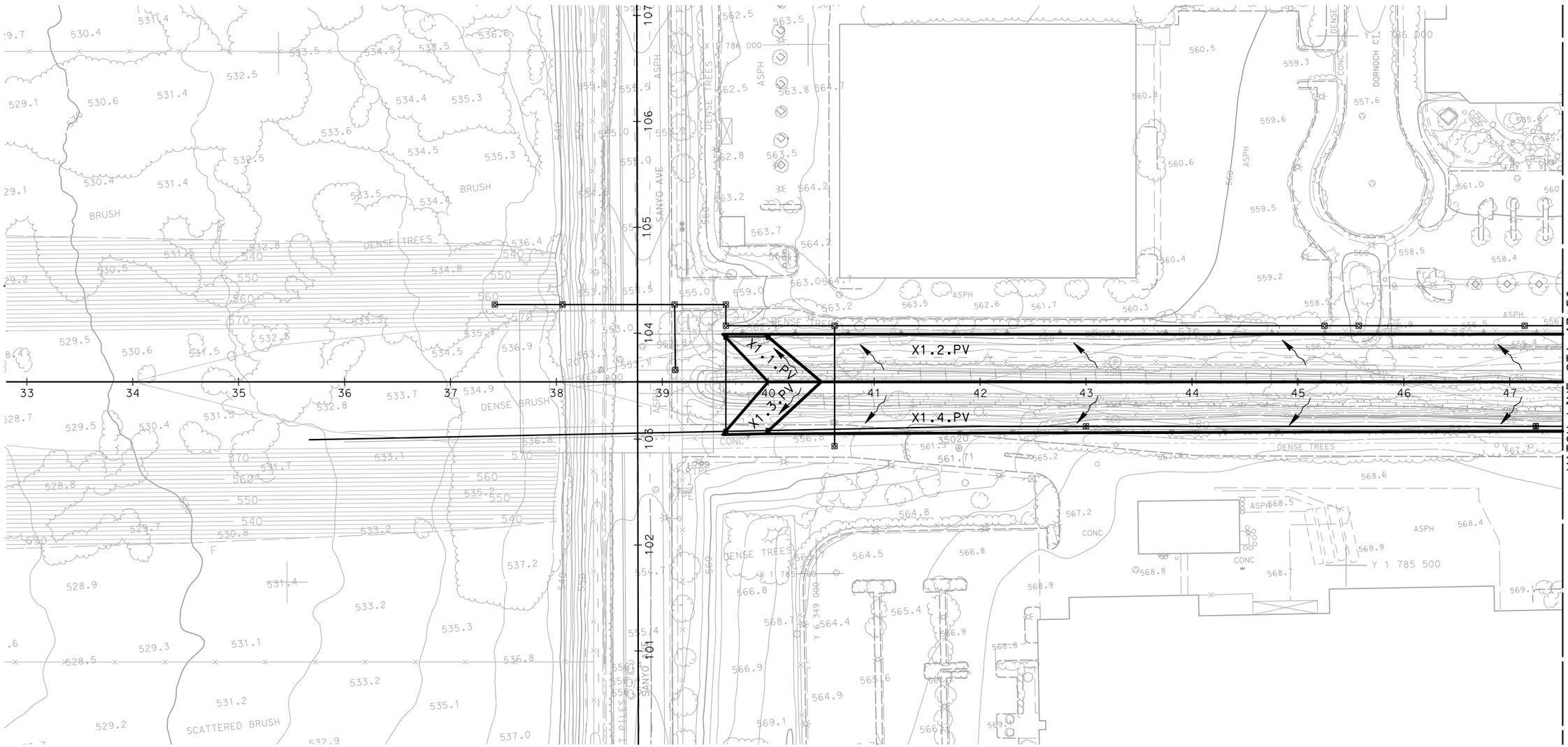
- PIPE
- INLET W/APRON
- RSP
- HEADWALL
- --sd— EXISTING STORMDRAIN




# ONE INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-1**

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BORDER LAST REVISED 4/11/2008

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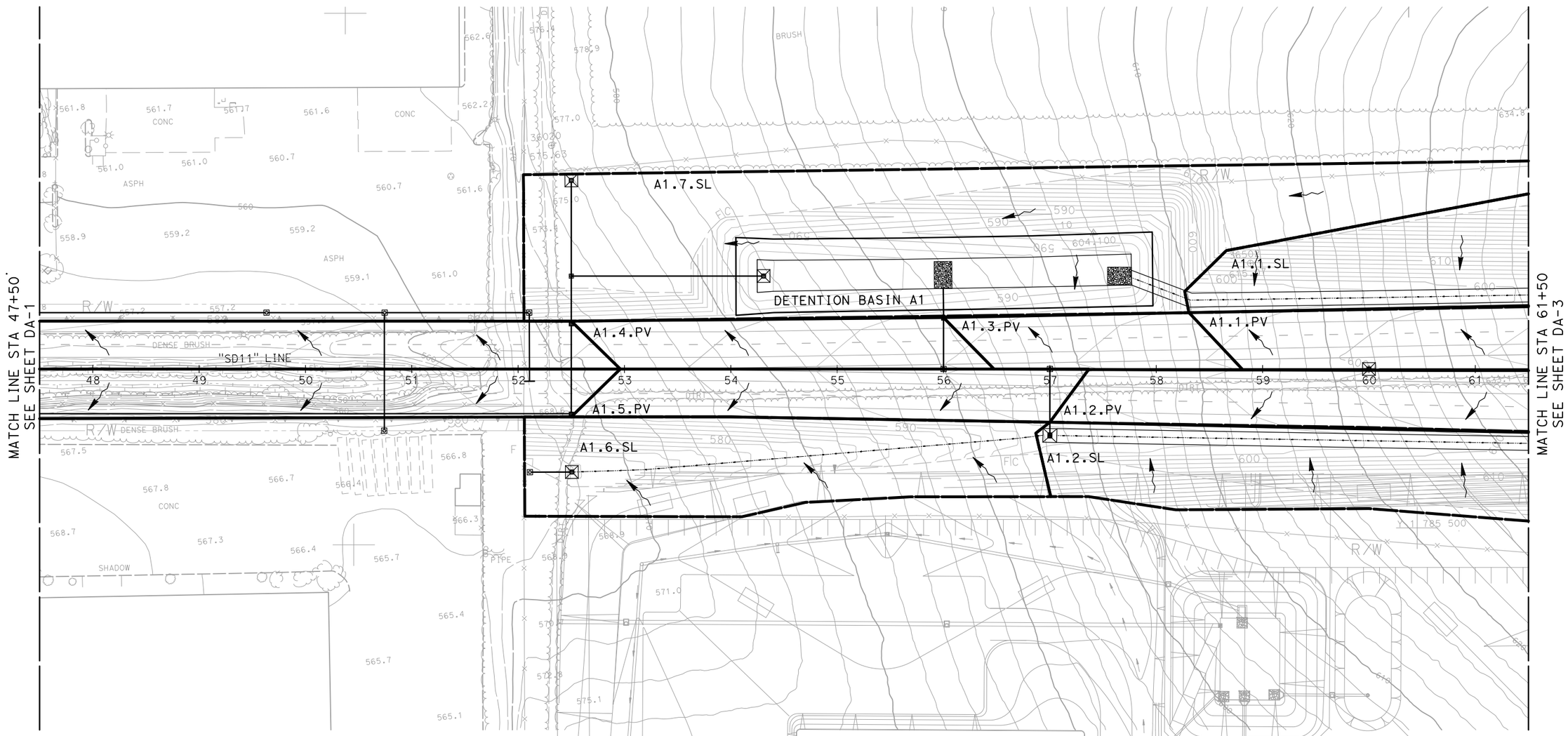


# ONE INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-2**

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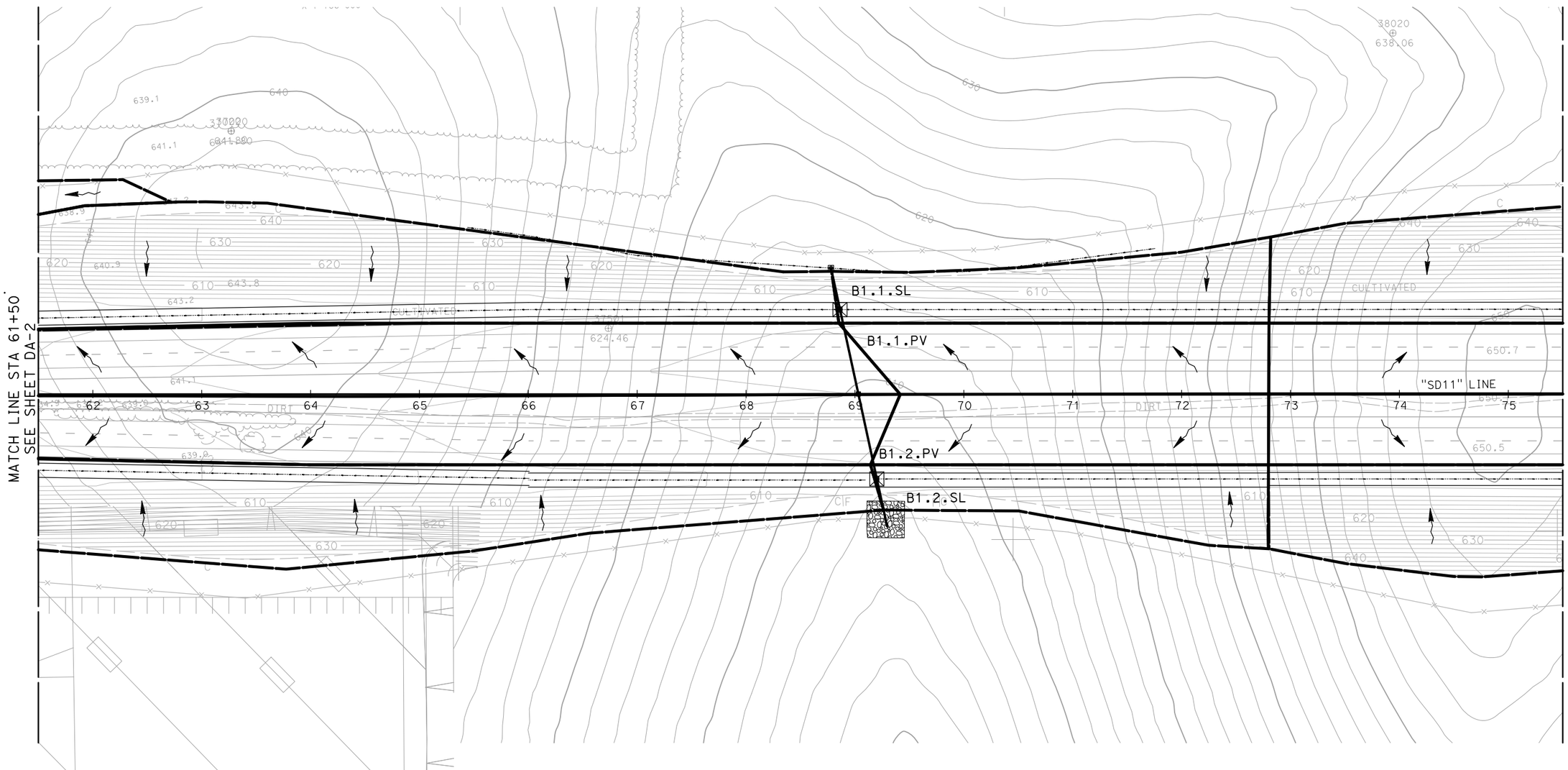


# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-3**

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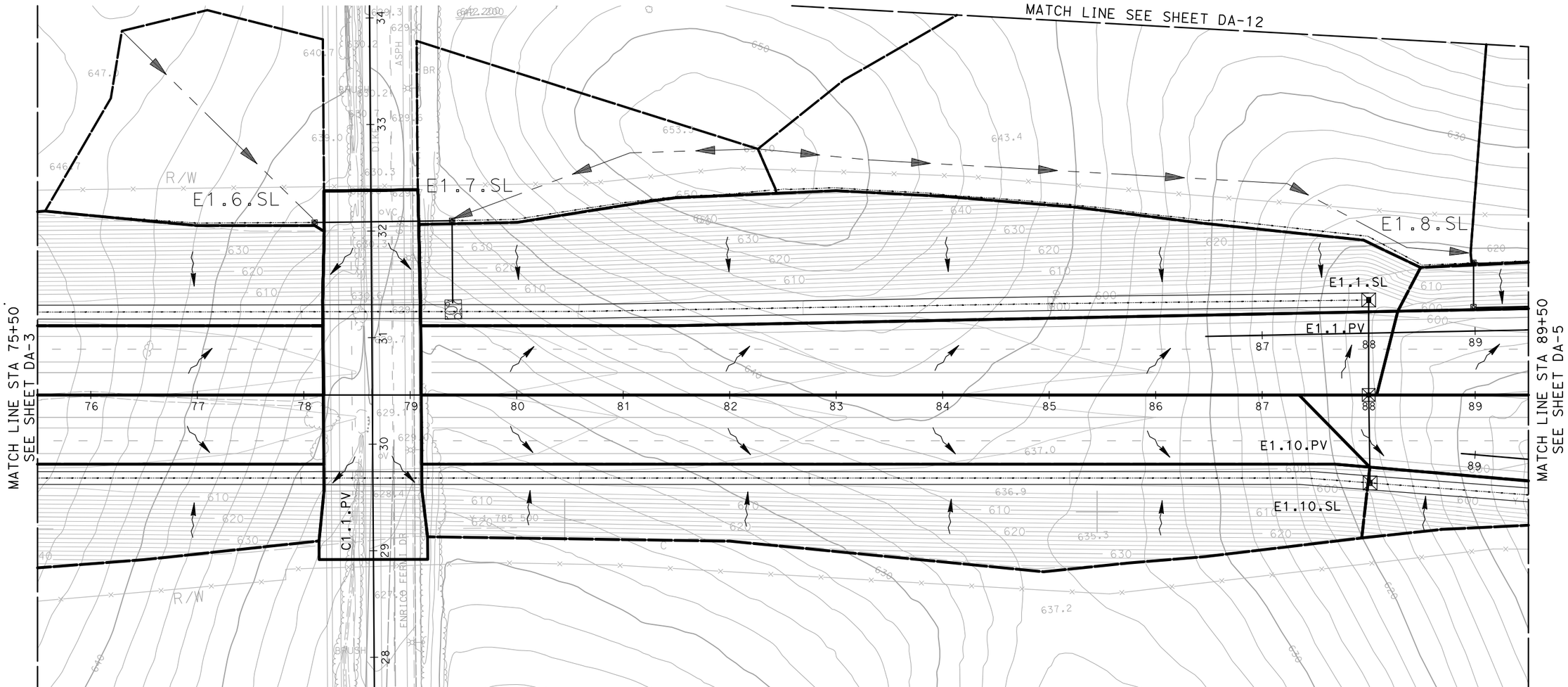


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-4**

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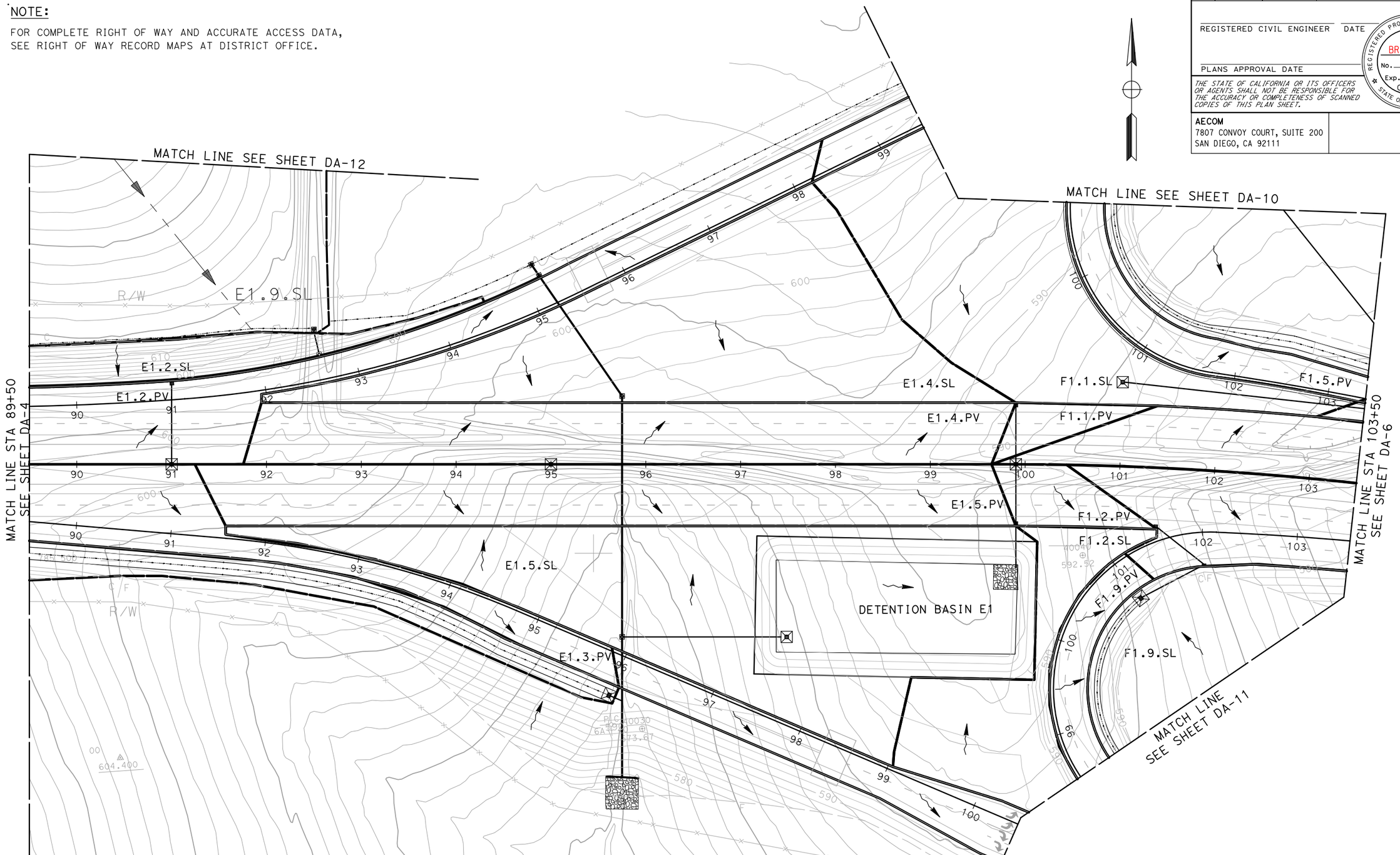


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-5**

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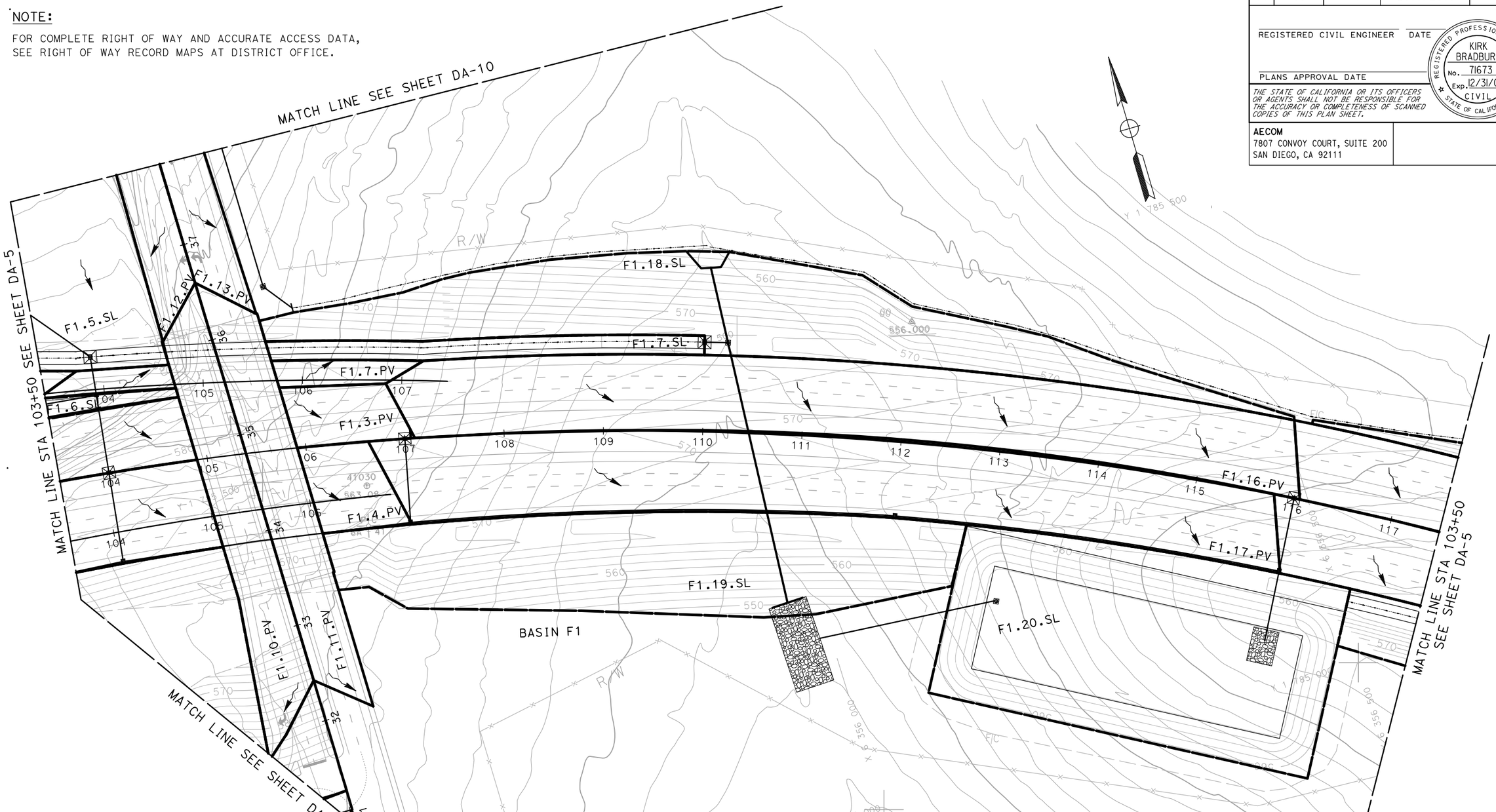


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# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-6**

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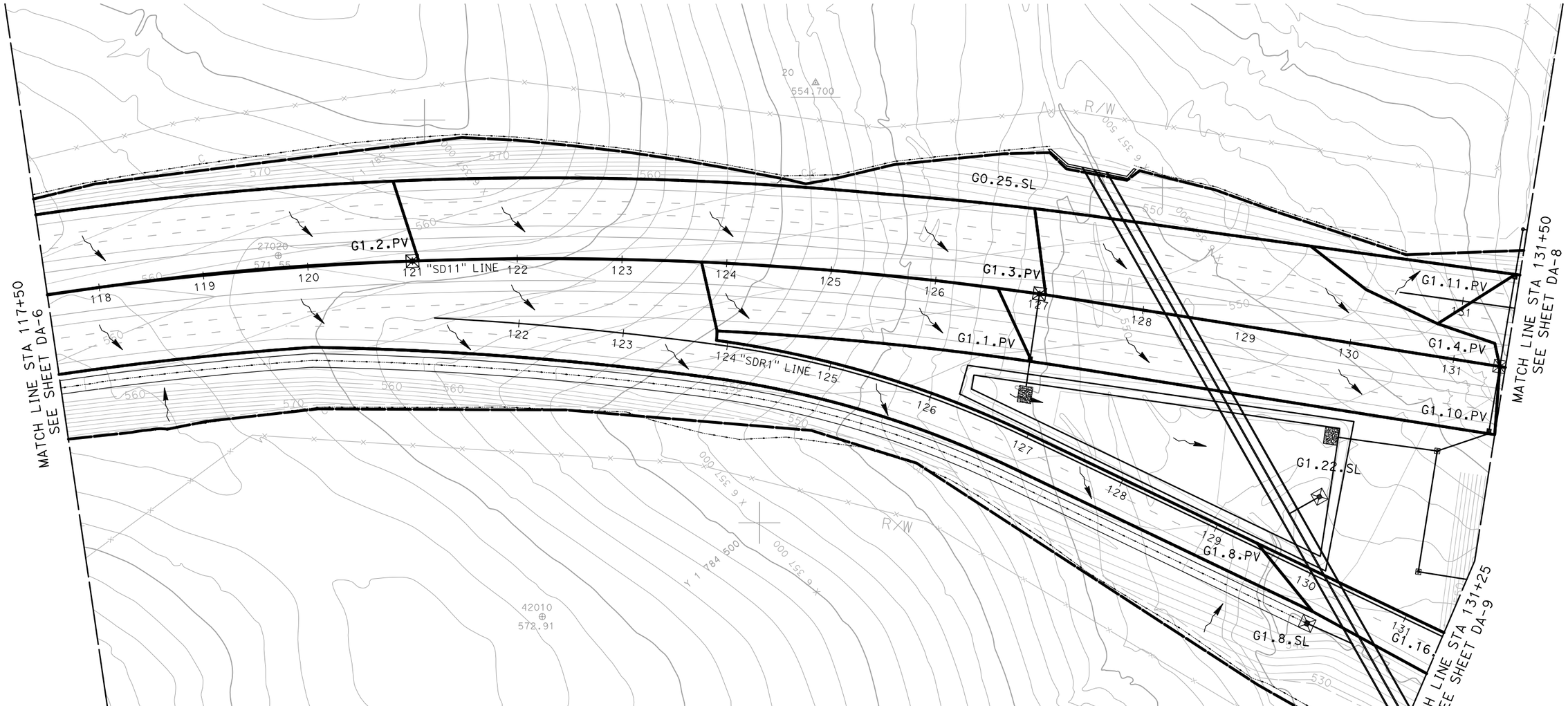


# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-7**

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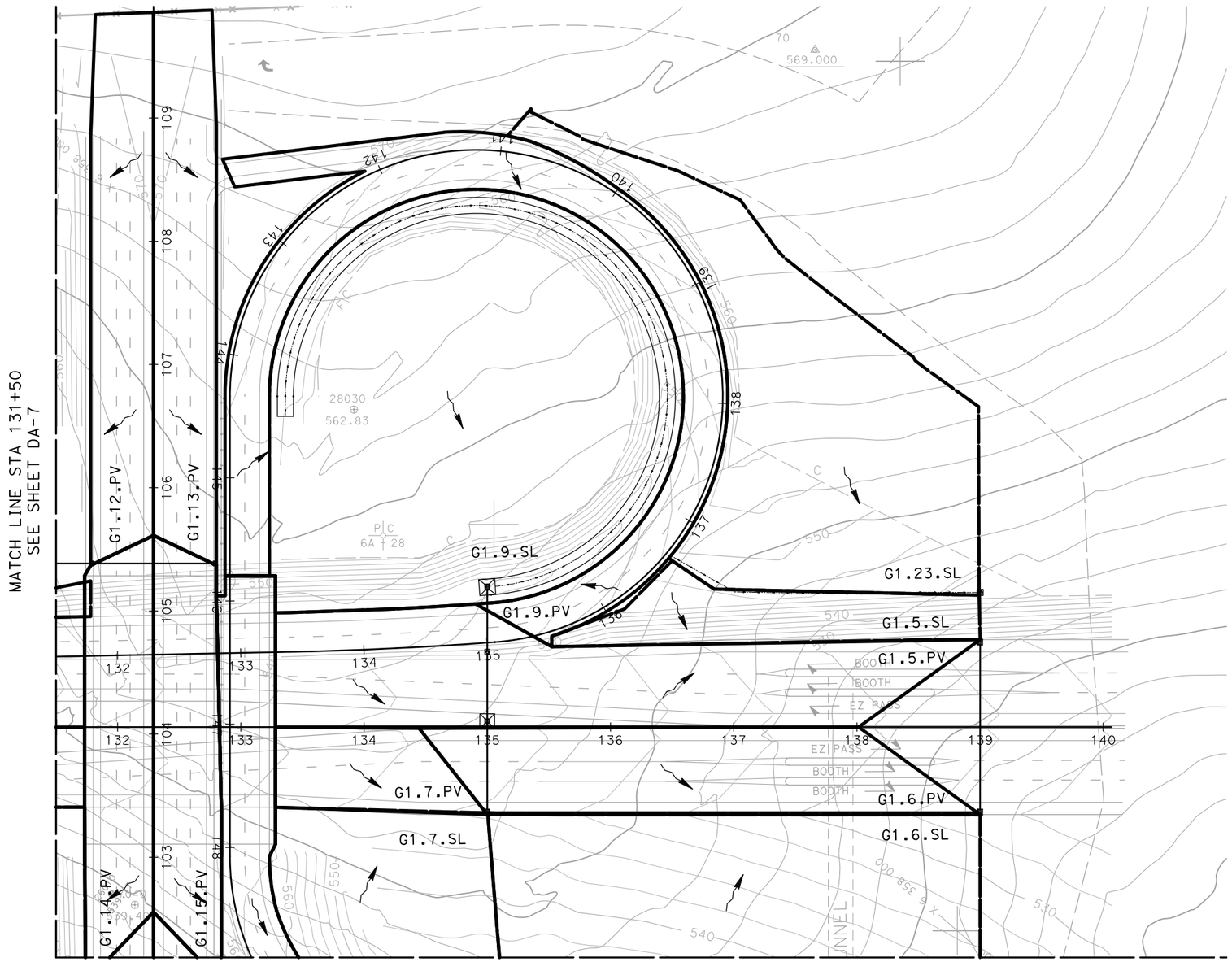


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# ONE INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-8**

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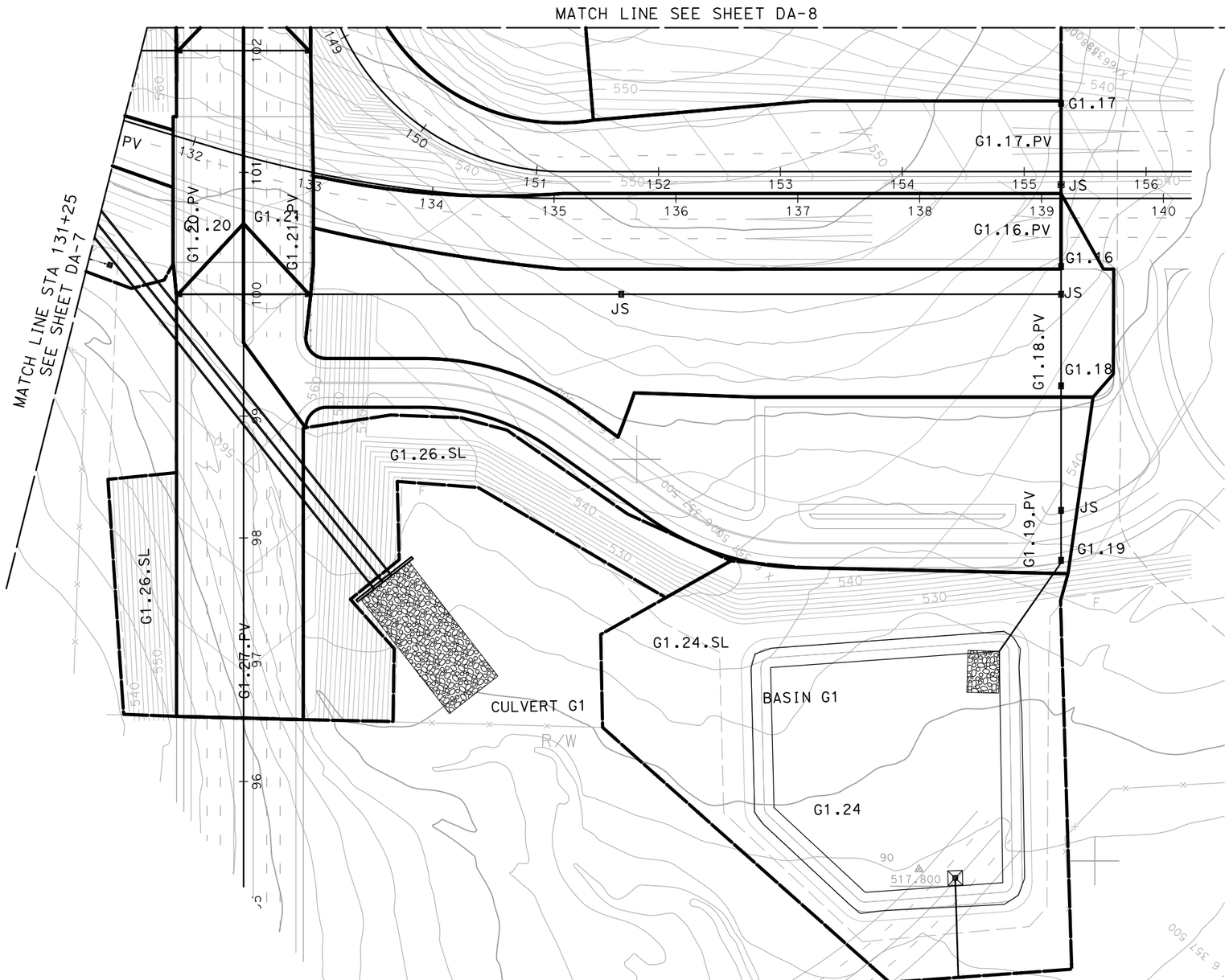


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# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-9**

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NOTE:

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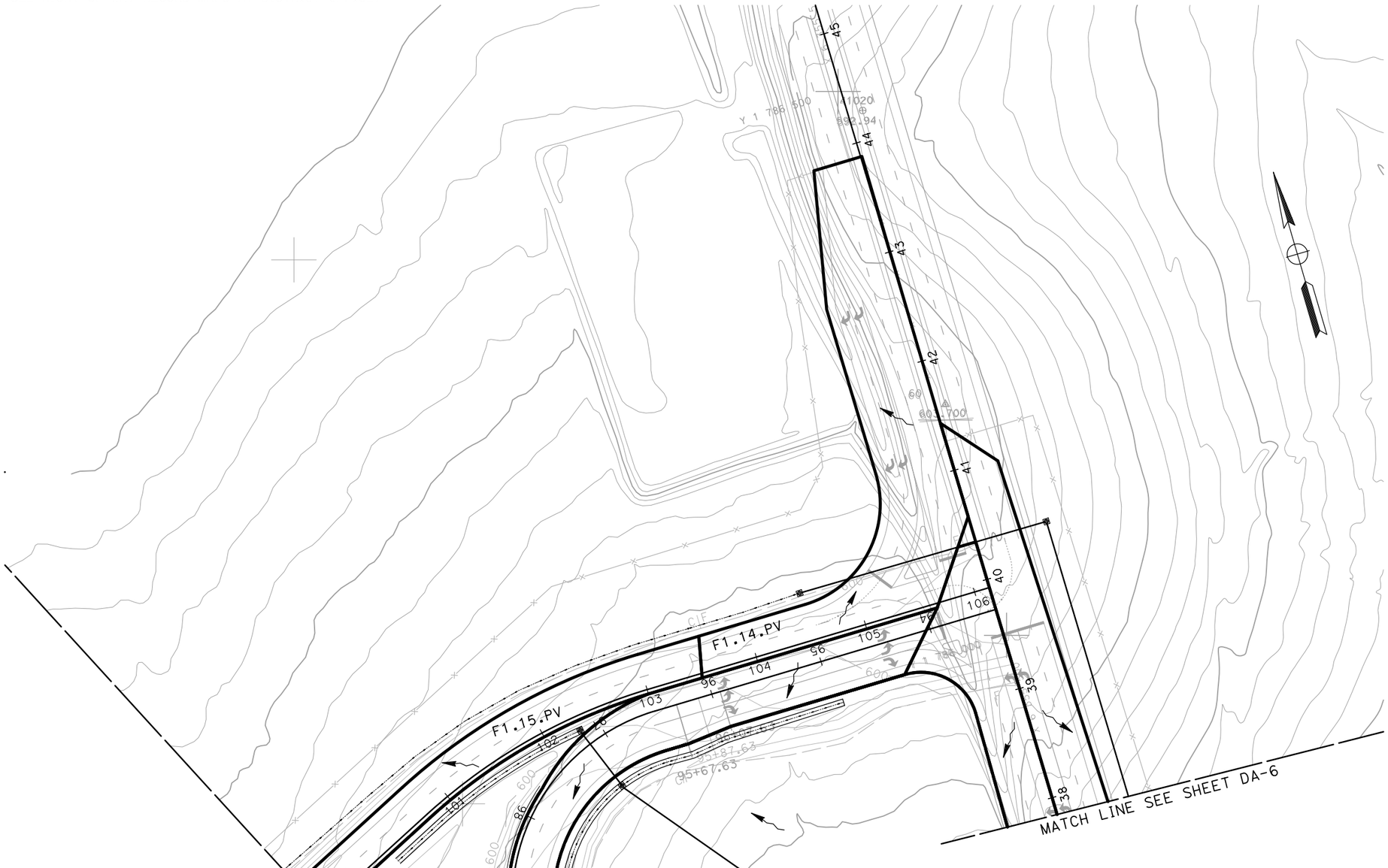



THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-10**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

DATE REVISED

LAST REVISION 11-13-09

DATE PLOTTED => 2/3/2010
TIME PLOTTED => 5:52:54 PM

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

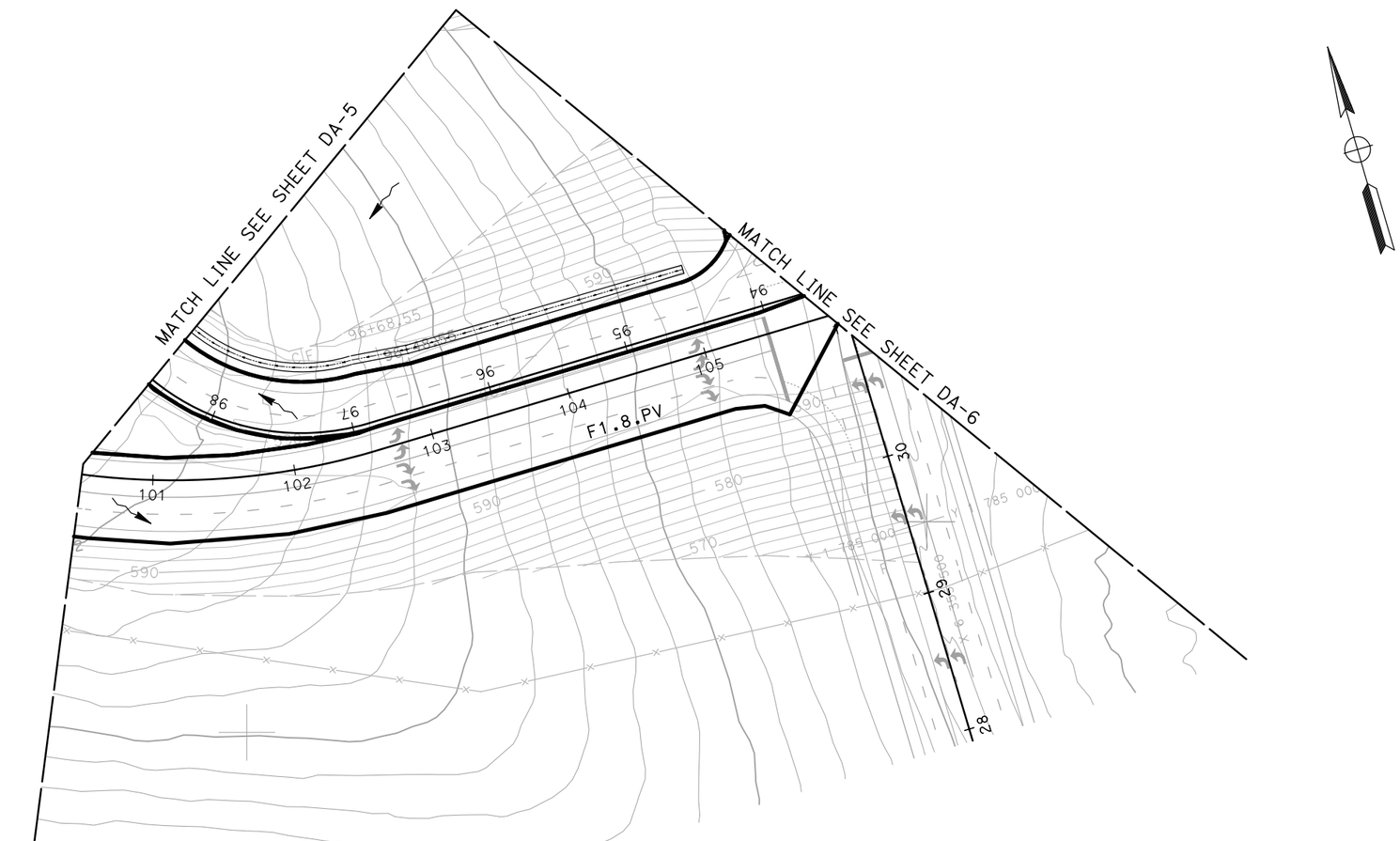
REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

*THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.*


**AECOM**
7807 CONVOY COURT, SUITE 200
SAN DIEGO, CA 92111


NOTE:

FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.




THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-11**

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

| CALCULATED-DESIGNED BY | CHECKED BY |
|---|---|

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

A00298859

LAST REVISION 11-13-09 | DATE PLOTTED => 2/3/2010 TIME PLOTTED => 5:53:15 PM

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

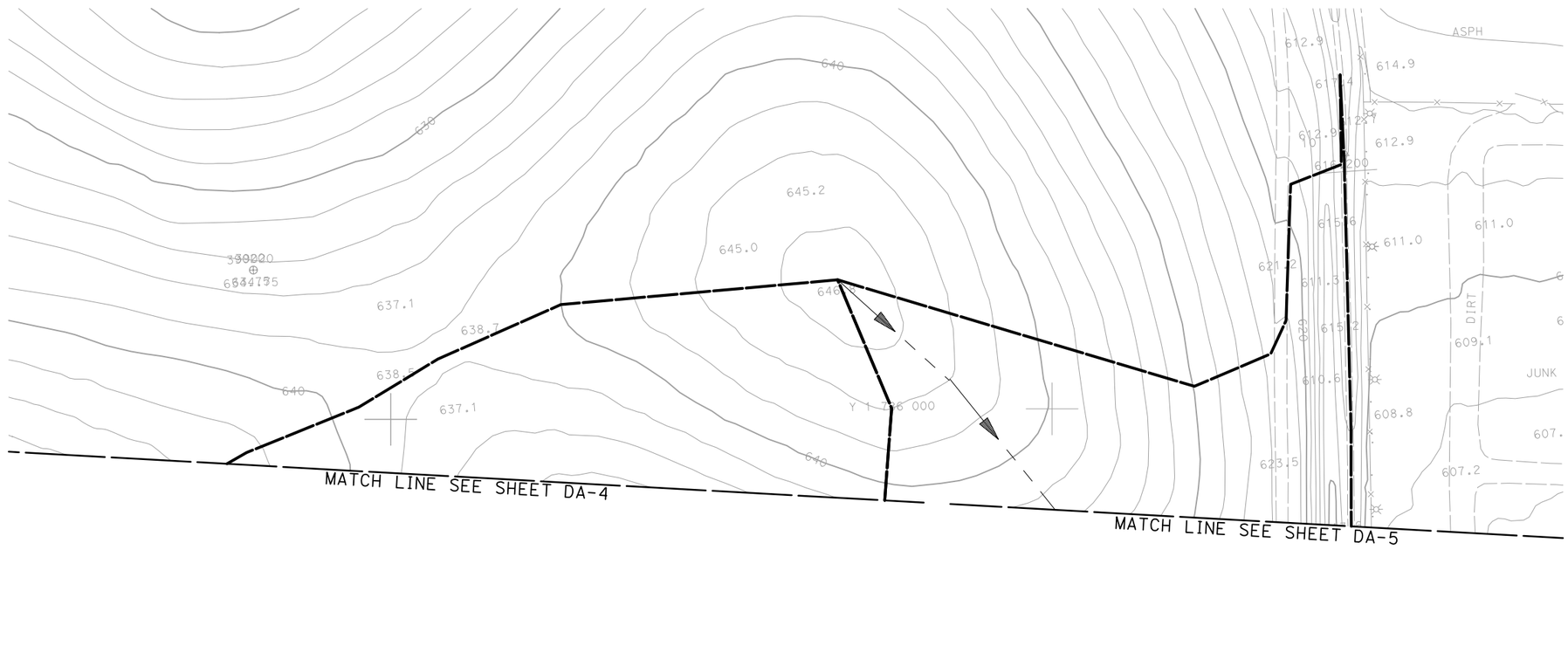
REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

*THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.*


**AECOM**
7807 CONVOY COURT, SUITE 200
SAN DIEGO, CA 92111


NOTE:

FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.




THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

# ONE INTERCHANGE ALTERNATIVE
# DRAINAGE AREA PLAN

**DA-12**

| REVISED BY | DATE REVISED |
|---|---|
| | |
| | |
| | |
| | |

CALCULATED-DESIGNED BY: MIKE BRUNING
CHECKED BY: GERARD DALZIEL
CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 11-13-09
DATE PLOTTED => 2/3/2010
TIME PLOTTED => 5:53:21 PM

# A1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | A1.1.PV | 0.99 | 67100 | 1.5 | 10 | 2.8 | 4.31 | 4.2 | 6.42 | A1.1 | ~ | Basin A1 | 57+75 | Lt |
| | A1.2.PV | 0.99 | 72100 | 1.7 | 10 | 2.8 | 4.64 | 4.2 | 6.90 | A1.2 | A1.2 | Basin A1 | 57+00 | Rt |
| | A1.3.PV | 0.99 | 12000 | 0.3 | 5 | 4.0 | 1.09 | 6.6 | 1.80 | ~ | A1.3 | Basin A1 | 56+00 | Lt |
| | A1.4.PV | 0.99 | 16500 | 0.4 | 5 | 4.0 | 1.50 | 6.6 | 2.47 | ~ | A1.4 | *bypass** | 52+50 | Lt |
| | A1.5.PV | 0.99 | 20900 | 0.5 | 5 | 4.0 | 1.90 | 6.6 | 3.13 | ~ | A1.5 | *bypass** | 52+50 | Rt |

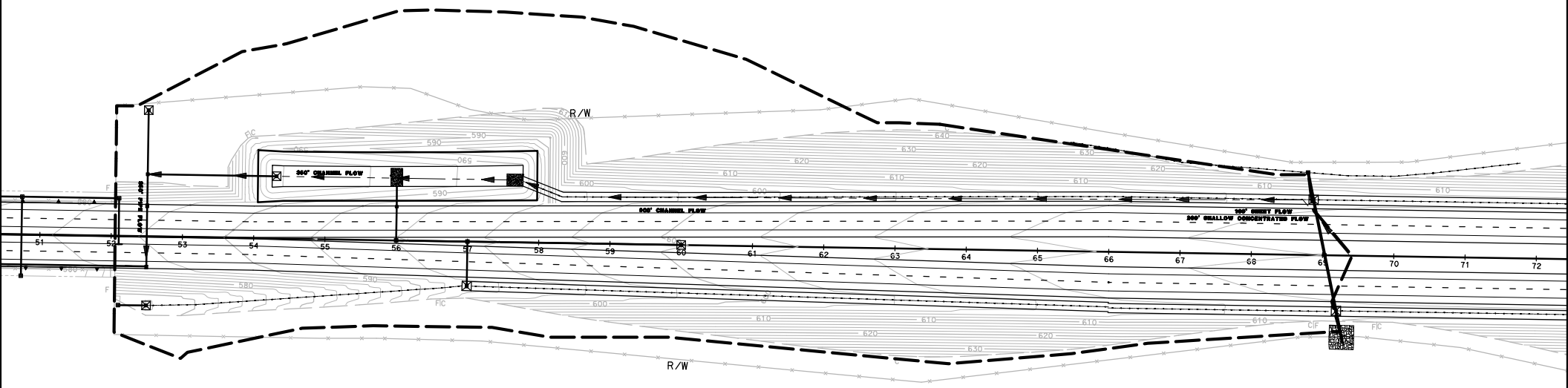
Σ 188600 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | A1.1.SL | 0.61 | 88300 | 2.0 | 10 | 2.8 | 3.50 | 4.2 | 5.21 | A1.1 | ~ | Basin A1 | 57+75 | Lt |
| | A1.2.SL | 0.61 | 92400 | 2.1 | 10 | 2.8 | 3.66 | 4.2 | 5.45 | A1.2 | A1.2 | Basin A1 | 57+00 | Rt |
| | A1.6.SL | 0.61 | 40800 | 0.9 | 10 | 2.8 | 1.62 | 4.2 | 2.41 | ~ | A1.6 | *bypass** | 52+50 | Rt |
| | A1.7.SL | 0.61 | 108200 | 2.5 | 10 | 2.8 | 4.29 | 4.2 | 6.38 | ~ | A1.7 | Basin A1 | 54+25 | Lt |

Σ 329700 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 518300 | 11.9 |
| | *SF* | *ac* |




WATERSHED A1
ONE INTERCHANGE
ALTERNATIVE

Scale: 1"=200'

# A1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 52+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 615812 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 14.14 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 16% | AT | 0.42 | 0.067 |
| PAVED SURFACE | 31% | AT | 0.90 | 0.276 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 54% | AT | 0.55 | 0.294 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.64 |
| $C_{25}$ = | 0.70 |
| $C_{50}$ = | 0.76 |
| $C_{100}$ = | 0.80 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 607.8 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 100 | ft | to Bioswale |
| SLOPE (S) = (H/L) | 0.7% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.32 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 16.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 900 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.42 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.38 | minutes | |

# A1 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 590.0 | ft |
| LOW POINT ELEVATION | 584.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 350 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 3.36 | fps |
| $T_C$ (CH)= | 1.73 | minutes |

**NOTES:**

assume basin floor has same dimensions of bioswale

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft |
| LOW POINT ELEVATION | 583.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 350 | ft |
| SLOPE (S) = (H/L) | 0.3% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 3.9 | fps |
| $T_C$ (SD)= | 1.51 | minutes |

**NOTES:**

proposed basin outlet pipe

discharge at watershed end (Sta 52+00)

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.85 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **12.85** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = |
| $i_{10}$ = | 2.3 | in/hr | X CA = |
| $i_{25}$ = | 2.9 | in/hr | X CA = |
| $i_{50}$ = | 3.4 | in/hr | X CA = |
| $i_{100}$ = | 3.6 | in/hr | X CA = |

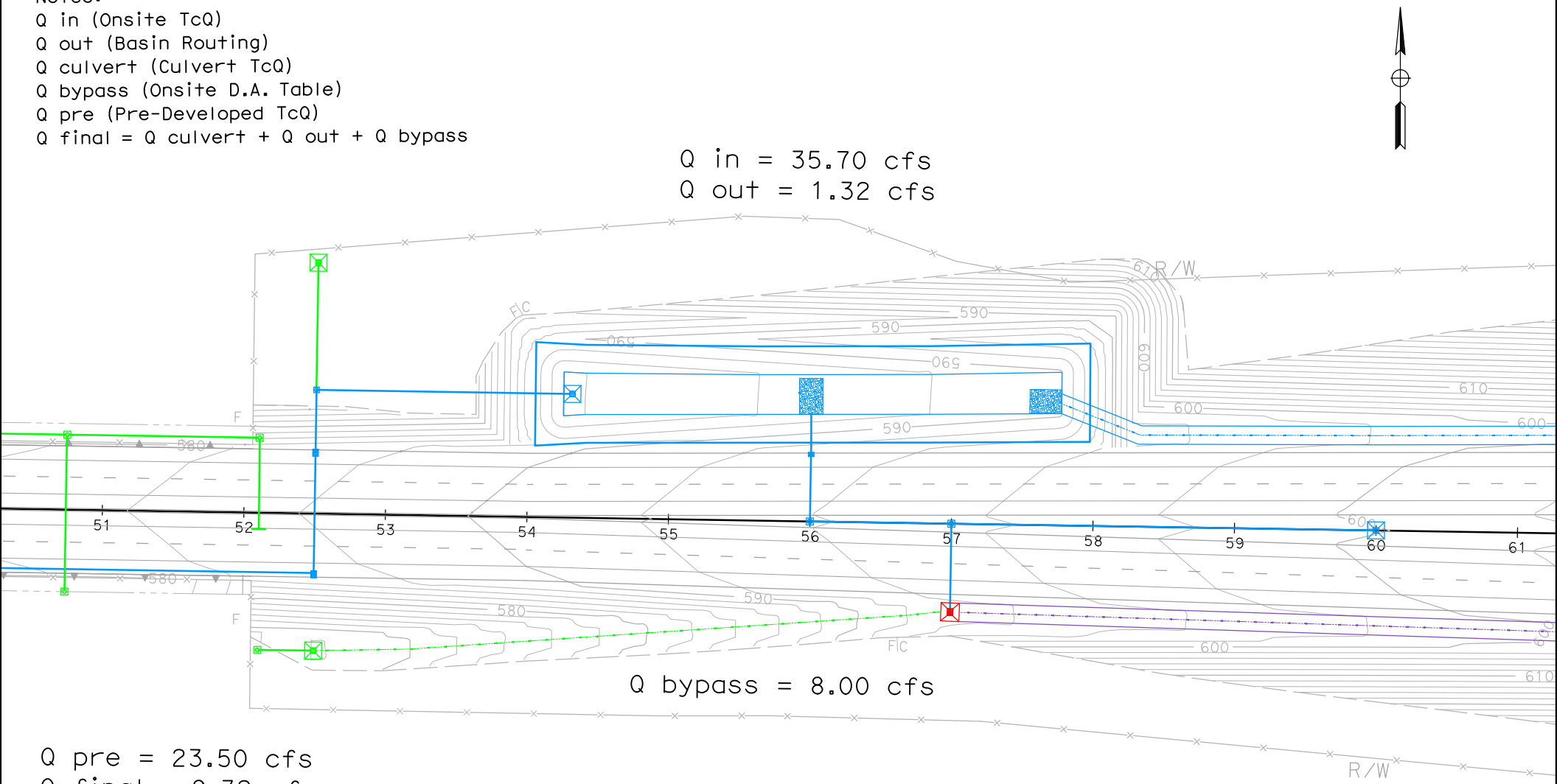
**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 14.2 |
| **$Q_{10}$ =** | 20.6 |
| **$Q_{25}$ =** | 28.4 |
| **$Q_{50}$ =** | 37.2 |
| **$Q_{100}$ =** | **40.3** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




Q pre = 23.50 cfs
Q final = 9.32 cfs

BASIN A1
FLOW SUMMARY

Scale: 1"=100'

# Basin A1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 57+75** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 23.5 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 10.51 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 480 | 0.8 |
| 20 | 480 | 0.8 |
| 30 | 540 | 0.9 |
| 40 | 540 | 0.9 |
| 50 | 540 | 0.9 |
| 60 | 600 | 1 |
| 70 | 600 | 1 |
| 80 | 600 | 1 |
| 90 | 660 | 1.1 |
| 100 | 660 | 1.1 |
| 110 | 720 | 1.2 |
| 120 | 720 | 1.2 |
| 130 | 780 | 1.3 |
| 140 | 840 | 1.4 |
| 150 | 900 | 1.5 |
| 160 | 960 | 1.6 |
| 170 | 1020 | 1.7 |
| 180 | 1080 | 1.8 |
| 190 | 1260 | 2.1 |
| 200 | 1380 | 2.3 |
| 210 | 1680 | 2.8 |
| 220 | 1920 | 3.2 |
| 230 | 2760 | 4.6 |
| 240 | 3900 | 6.5 |
| 250 | 14100 | 23.5 |
| 260 | 2220 | 3.7 |
| 270 | 1500 | 2.5 |
| 280 | 1140 | 1.9 |
| 290 | 960 | 1.6 |
| 300 | 840 | 1.4 |
| 310 | 780 | 1.3 |
| 320 | 720 | 1.2 |
| 330 | 660 | 1.1 |
| 340 | 600 | 1 |
| 350 | 540 | 0.9 |
| 360 | 540 | 0.9 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 50220 $ft^3$**
**1.15 acre-feet**

Check: V = C*A*$P_6$
V= 1.16 acre-feet
***OK***

# Basin A1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 40.3 | cfs | | | |
| Tc= | 12.8 | min | C= | 0.80 | |
| $P_{100,6}$= | 2.5 | in | A= | 14.14 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 1092 | 1.4 |
| 26 | 1326 | 1.7 |
| 39 | 1404 | 1.8 |
| 52 | 1482 | 1.9 |
| 65 | 1482 | 1.9 |
| 78 | 1560 | 2 |
| 91 | 1638 | 2.1 |
| 104 | 1794 | 2.3 |
| 117 | 1794 | 2.3 |
| 130 | 1950 | 2.5 |
| 143 | 2106 | 2.7 |
| 156 | 2340 | 3 |
| 169 | 2418 | 3.1 |
| 182 | 2808 | 3.6 |
| 195 | 3042 | 3.9 |
| 208 | 3744 | 4.8 |
| 221 | 4212 | 5.4 |
| 234 | 6240 | 8 |
| 247 | 8736 | 11.2 |
| 260 | 31434 | 40.3 |
| 273 | 4992 | 6.4 |
| 286 | 3354 | 4.3 |
| 299 | 2574 | 3.3 |
| 312 | 2184 | 2.8 |
| 325 | 1872 | 2.4 |
| 338 | 1716 | 2.2 |
| 351 | 1560 | 2 |
| 364 | 1404 | 1.8 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 102258 $ft^3$**
**2.35 acre-feet**

Check: $V = C*A*P_6$
V= 2.34 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **2.35** | *(Post)* | |
| - | **1.15** | *(Pre)* | |
| **Retention volume =** | **1.19** | **acre-feet** | **= 52038 $ft^3$** **Basin Required** |

# Basin A1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.84
A= 10.10 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **24206** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

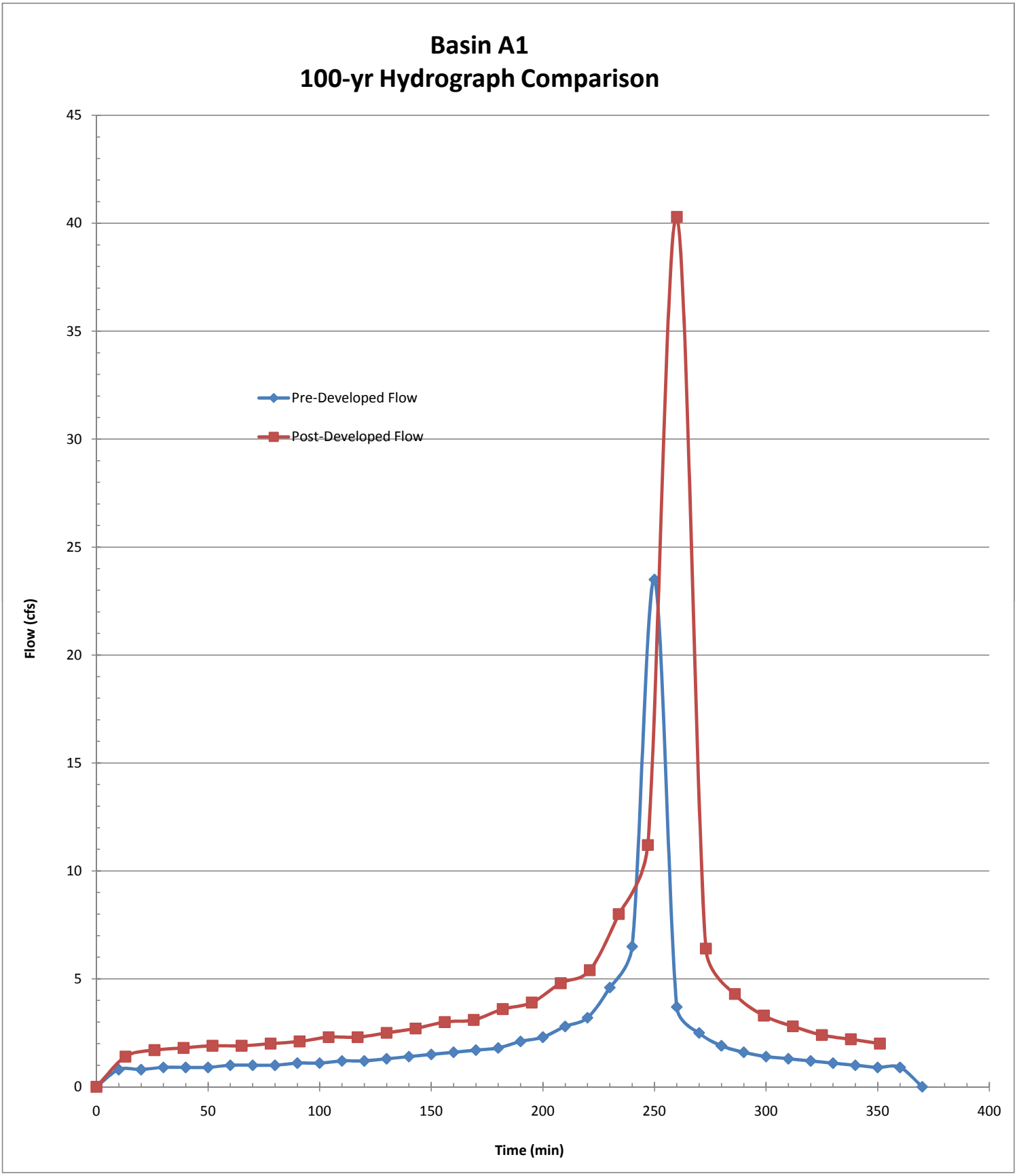
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 288900 | $ft^2$ |
| | A: | 6.63 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 103.14 tons

**Silt Accumulation Basin volume =** **2292** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**

.


Basin A1
100-yr Hydrograph Comparison
Pre-Developed Flow
Post-Developed Flow
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
45
0
50
100
150
200
250
300
350
400

# Basin A1 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 57+75 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 440100 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.10 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 34% | AT | 0.90 | 0.309 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 66% | AT | 0.55 | 0.361 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.67 |
| $C_{25}$ = | 0.74 |
| $C_{50}$ = | 0.80 |
| $C_{100}$ = | 0.84 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 607.8 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 100 | ft | to Bioswale |
| SLOPE (S) = (H/L) | 0.7% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.32 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 16.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 900 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.42 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.38 | minutes | |

# Basin A1 Inflow TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 9.60 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 12.6 |
| **$Q_{10}$ =** | 18.3 |
| **$Q_{25}$ =** | 25.1 |
| **$Q_{50}$ =** | 32.9 |
| **$Q_{100}$ =** | **35.7** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin A1 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 57+75** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 35.7 | cfs | $C_{100}$= | 0.84 | |
| Tc= | 10.0 | min | A= | 10.10 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 780 | 1.3 |
| 20 | 780 | 1.3 |
| 30 | 780 | 1.3 |
| 40 | 840 | 1.4 |
| 50 | 840 | 1.4 |
| 60 | 900 | 1.5 |
| 70 | 900 | 1.5 |
| 80 | 960 | 1.6 |
| 90 | 1020 | 1.7 |
| 100 | 1020 | 1.7 |
| 110 | 1080 | 1.8 |
| 120 | 1140 | 1.9 |
| 130 | 1200 | 2 |
| 140 | 1260 | 2.1 |
| 150 | 1380 | 2.3 |
| 160 | 1440 | 2.4 |
| 170 | 1560 | 2.6 |
| 180 | 1680 | 2.8 |
| 190 | 1920 | 3.2 |
| 200 | 2100 | 3.5 |
| 210 | 2520 | 4.2 |
| 220 | 2880 | 4.8 |
| 230 | 4260 | 7.1 |
| 240 | 6060 | 10.1 |
| 250 | 21420 | 35.7 |
| 260 | 3420 | 5.7 |
| 270 | 2280 | 3.8 |
| 280 | 1800 | 3 |
| 290 | 1500 | 2.5 |
| 300 | 1320 | 2.2 |
| 310 | 1140 | 1.9 |
| 320 | 1080 | 1.8 |
| 330 | 960 | 1.6 |
| 340 | 900 | 1.5 |
| 350 | 840 | 1.4 |
| 360 | 780 | 1.3 |
| 370 | 0 | 0 |

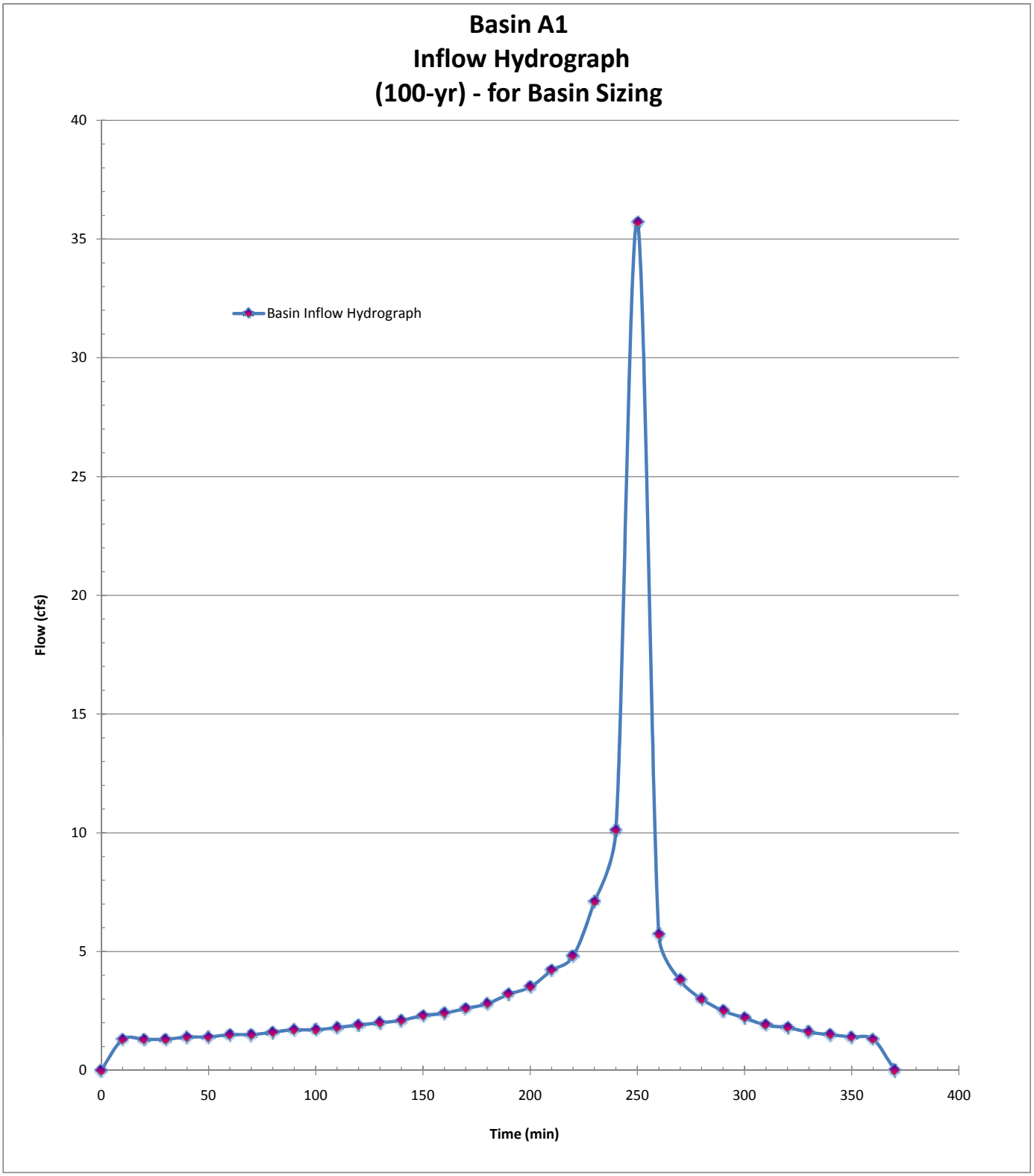
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 76740 $ft^3$**
**1.76 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 1.76 acre-feet
***OK***


Basin A1
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400

# Basin A1 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **A1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

Required Retention Basin Volume = 54330 $ft^3$

Actual Basin Inflow = 76740 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

Predeveloped Peak 100-year Flow: 23.5 cfs

Post-Developed Peak Flow through Cross Culvert: 0.0 cfs

Flow that does not reach detention basin (bypass per DA table): 8.0 cfs ~ $Q_{100}$ of: A1.4.PVA1.5.PVA1.6.SL

Maximum flow allowed to be released by this detention basin: 15.5 cfs

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

Basin - Top of basin berm elevation = 589.20 ft

Basin flowline elevation = 584.00 ft

Maximum Basin Depth = 5.20 ft

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

Outlet pipe invert from basin floor = 3.40 ft 587.40 ft

Outlet pipe diameter = 2 ft

***Basin Characteristics***

Base Length (L) 350 ft

Base Width (W) 30 ft

W/L Ratio ® 0.09

Side Slopes (Z) 1: 4

Total Volume (V): 103123 $ft^2$

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 584.00 | 0.00 | 0 | 0 | | 584.00 | 0.00 | | 0.00 |
| 1 | 584.20 | 0.20 | 2161 | 2161 | | 584.20 | 0.00 | | 0.00 |
| 2 | 584.40 | 0.40 | 2284 | 4445 | | 584.40 | 0.00 | | 0.00 |
| 3 | 584.60 | 0.60 | 2410 | 6855 | | 584.60 | 0.00 | | 0.00 |
| 4 | 584.80 | 0.80 | 2539 | 9394 | | 584.80 | 0.00 | | 0.00 |
| 5 | 585.00 | 1.00 | 2670 | 12063 | | 585.00 | 0.00 | | 0.00 |
| 6 | 585.20 | 1.20 | 2804 | 14867 | | 585.20 | 0.00 | | 0.00 |
| 7 | 585.40 | 1.40 | 2940 | 17808 | | 585.40 | 0.00 | | 0.00 |
| 8 | 585.60 | 1.60 | 3079 | 20887 | | 585.60 | 0.00 | | 0.00 |
| 9 | 585.80 | 1.80 | 3221 | 24108 | | 585.80 | 0.00 | | 0.00 |
| 10 | 586.00 | 2.00 | 3366 | 27474 | | 586.00 | 0.00 | | 0.00 |
| 11 | 586.20 | 2.20 | 3513 | 30987 | | 586.20 | 0.00 | | 0.00 |
| 12 | 586.40 | 2.40 | 3662 | 34649 | | 586.40 | 0.00 | | 0.00 |
| 13 | 586.60 | 2.60 | 3815 | 38464 | | 586.60 | 0.00 | 0.00 | 0.00 |
| 14 | 586.80 | 2.80 | 3970 | 42434 | | 586.80 | 0.00 | | 0.00 |
| 15 | 587.00 | 3.00 | 4127 | 46561 | | 587.00 | 0.00 | | 0.00 |
| 16 | 587.20 | 3.20 | 4288 | 50849 | | 587.20 | 0.00 | | 0.00 |
| 17 | 587.40 | 3.40 | 4451 | 55300 | * | 587.40 | 0.00 | | 0.00 |
| 18 | 587.60 | 3.60 | 4616 | 59916 | | 587.60 | 0.15 | | 0.15 |
| 19 | 587.80 | 3.80 | 4784 | 64700 | | 587.80 | 0.59 | | 0.59 |
| 20 | 588.00 | 4.00 | 4955 | 69656 | | 588.00 | 1.30 | | 1.30 |
| 21 | 588.20 | 4.20 | 5129 | 74785 | | 588.20 | 2.25 | | 2.25 |
| 22 | 588.40 | 4.40 | 5305 | 80090 | | 588.40 | 3.42 | | 3.42 |
| 23 | 588.60 | 4.60 | 5484 | 85573 | | 588.60 | 4.79 | | 4.79 |
| 24 | 588.80 | 4.80 | 5665 | 91238 | | 588.80 | 6.32 | | 6.32 |
| 25 | 589.00 | 5.00 | 5849 | 97087 | | 589.00 | 7.99 | | 7.99 |
| 26 | 589.20 | 5.20 | 6036 | 103123 | | 589.20 | 9.77 | | 9.77 |

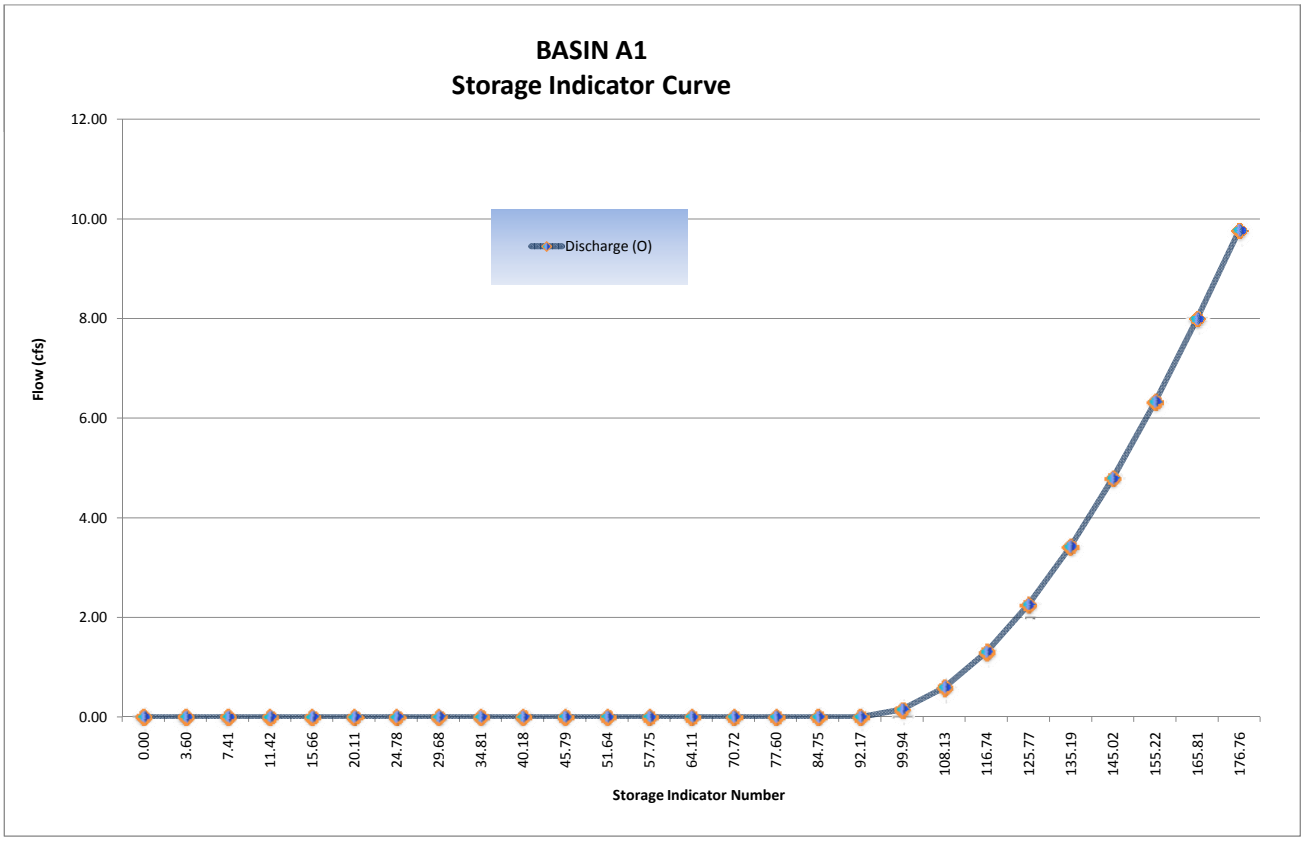
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 53+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | A |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin A1 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 584.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 584.20 | 0.00 | 2161 | 0.00 | 3.60 | 3.60 |
| 584.40 | 0.00 | 4445 | 0.00 | 7.41 | 7.41 |
| 584.60 | 0.00 | 6855 | 0.00 | 11.42 | 11.42 |
| 584.80 | 0.00 | 9394 | 0.00 | 15.66 | 15.66 |
| 585.00 | 0.00 | 12063 | 0.00 | 20.11 | 20.11 |
| 585.20 | 0.00 | 14867 | 0.00 | 24.78 | 24.78 |
| 585.40 | 0.00 | 17808 | 0.00 | 29.68 | 29.68 |
| 585.60 | 0.00 | 20887 | 0.00 | 34.81 | 34.81 |
| 585.80 | 0.00 | 24108 | 0.00 | 40.18 | 40.18 |
| 586.00 | 0.00 | 27474 | 0.00 | 45.79 | 45.79 |
| 586.20 | 0.00 | 30987 | 0.00 | 51.64 | 51.64 |
| 586.40 | 0.00 | 34649 | 0.00 | 57.75 | 57.75 |
| 586.60 | 0.00 | 38464 | 0.00 | 64.11 | 64.11 |
| 586.80 | 0.00 | 42434 | 0.00 | 70.72 | 70.72 |
| 587.00 | 0.00 | 46561 | 0.00 | 77.60 | 77.60 |
| 587.20 | 0.00 | 50849 | 0.00 | 84.75 | 84.75 |
| 587.40 | 0.00 | 55300 | 0.00 | 92.17 | 92.17 |
| 587.60 | 0.15 | 59916 | 0.08 | 99.86 | 99.94 |
| 587.80 | 0.59 | 64700 | 0.30 | 107.83 | 108.13 |
| 588.00 | 1.30 | 69656 | 0.65 | 116.09 | 116.74 |
| 588.20 | 2.25 | 74785 | 1.13 | 124.64 | 125.77 |
| 588.40 | 3.42 | 80090 | 1.71 | 133.48 | 135.19 |
| 588.60 | 4.79 | 85573 | 2.40 | 142.62 | 145.02 |
| 588.80 | 6.32 | 91238 | 3.16 | 152.06 | 155.22 |
| 589.00 | 7.99 | 97087 | 4.00 | 161.81 | 165.81 |
| 589.20 | 9.77 | 103123 | 4.89 | 171.87 | 176.76 |

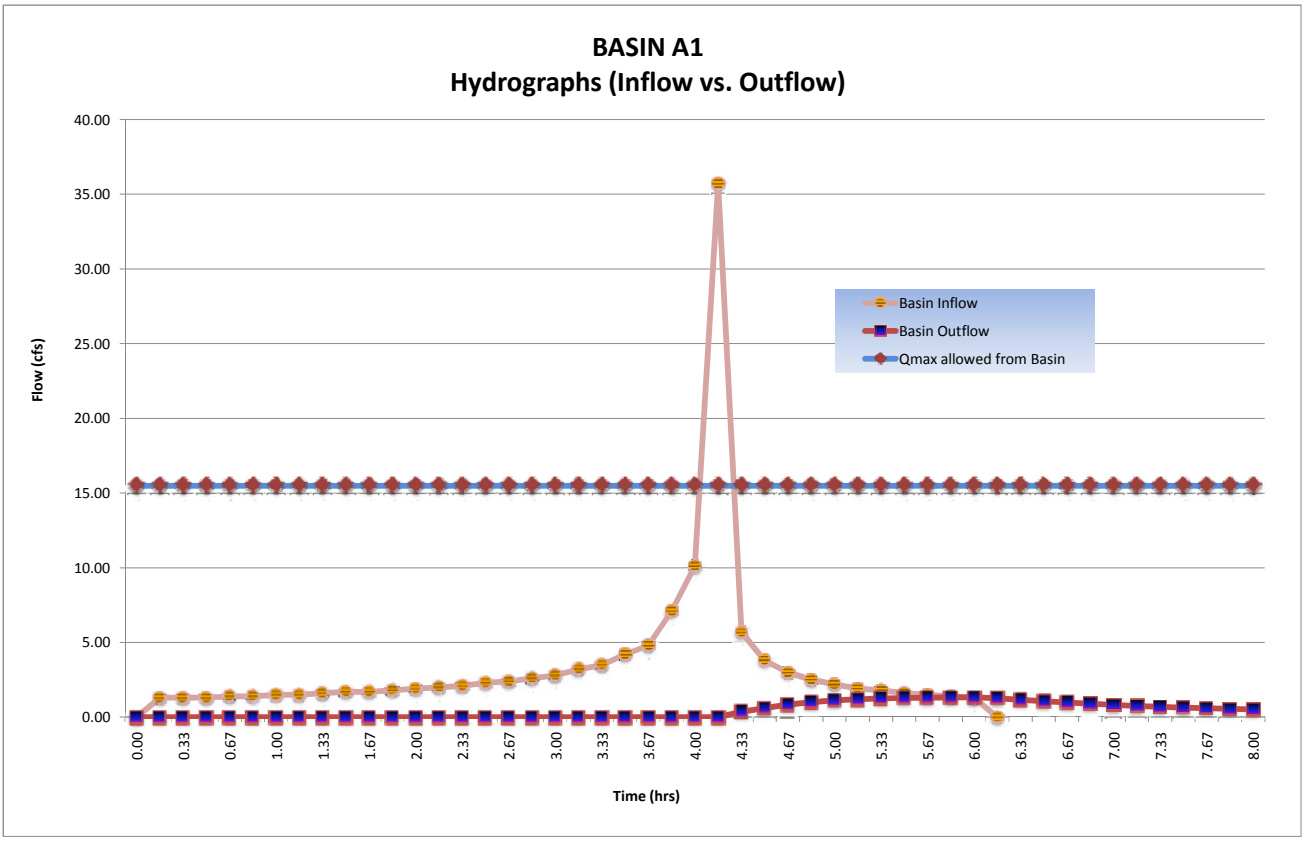
| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |

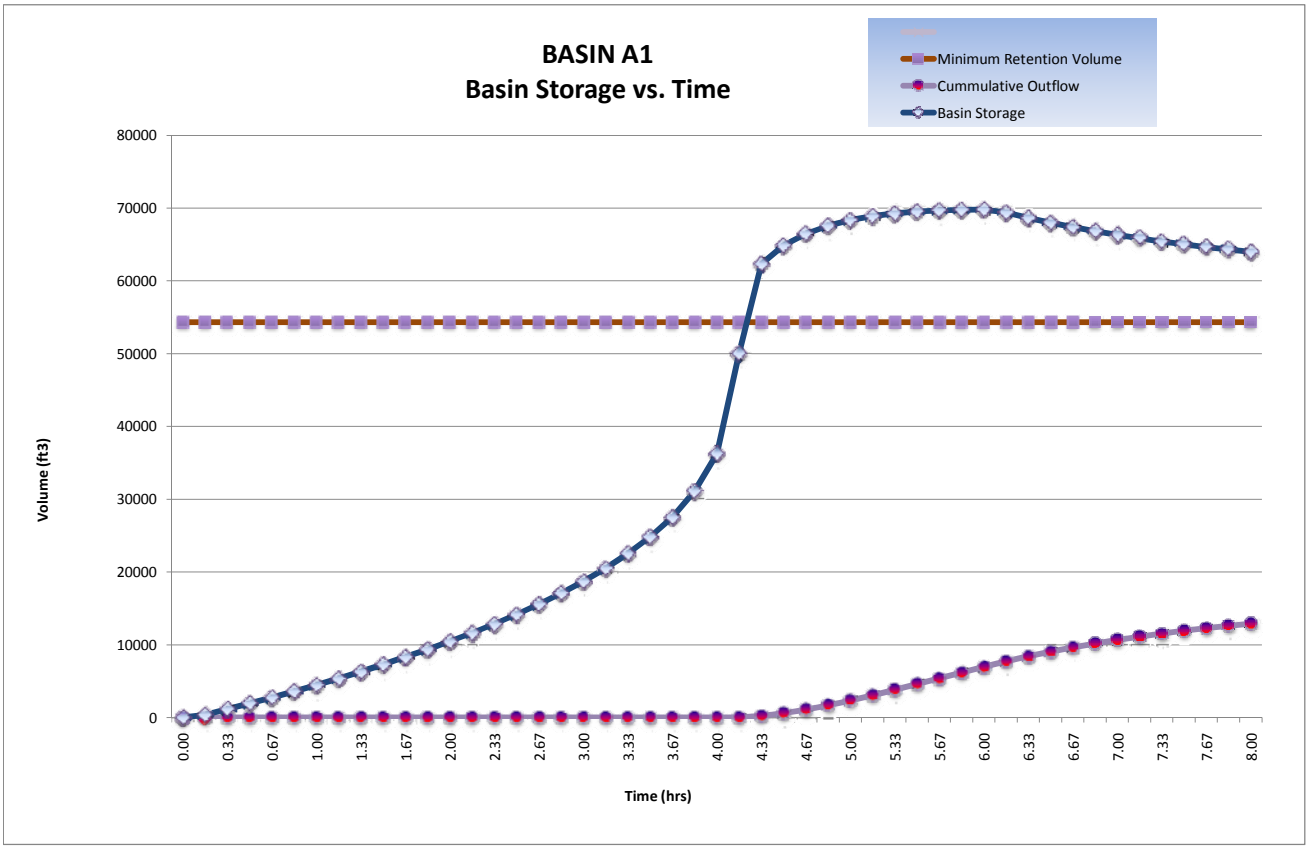


$$\frac{I_1 - I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) = O_1 + \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 1.30 | 0.65 | 0.00 | 0.00 | 0.65 | 0.00 | 390 | 0 | 0 |
| 0.33 | 1.30 | 1.30 | 0.65 | 0.00 | 1.95 | 0.00 | 1170 | 0 | 0 |
| 0.50 | 1.30 | 1.30 | 1.95 | 0.00 | 3.25 | 0.00 | 1950 | 0 | 0 |
| 0.67 | 1.40 | 1.35 | 3.25 | 0.00 | 4.60 | 0.00 | 2760 | 0 | 0 |
| 0.83 | 1.40 | 1.40 | 4.60 | 0.00 | 6.00 | 0.00 | 3600 | 0 | 0 |
| 1.00 | 1.50 | 1.45 | 6.00 | 0.00 | 7.45 | 0.00 | 4470 | 0 | 0 |
| 1.17 | 1.50 | 1.50 | 7.45 | 0.00 | 8.95 | 0.00 | 5370 | 0 | 0 |
| 1.33 | 1.60 | 1.55 | 8.95 | 0.00 | 10.50 | 0.00 | 6300 | 0 | 0 |
| 1.50 | 1.70 | 1.65 | 10.50 | 0.00 | 12.15 | 0.00 | 7290 | 0 | 0 |
| 1.67 | 1.70 | 1.70 | 12.15 | 0.00 | 13.85 | 0.00 | 8310 | 0 | 0 |
| 1.83 | 1.80 | 1.75 | 13.85 | 0.00 | 15.60 | 0.00 | 9360 | 0 | 0 |
| 2.00 | 1.90 | 1.85 | 15.60 | 0.00 | 17.45 | 0.00 | 10470 | 0 | 0 |
| 2.17 | 2.00 | 1.95 | 17.45 | 0.00 | 19.40 | 0.00 | 11640 | 0 | 0 |
| 2.33 | 2.10 | 2.05 | 19.40 | 0.00 | 21.45 | 0.00 | 12870 | 0 | 0 |
| 2.50 | 2.30 | 2.20 | 21.45 | 0.00 | 23.65 | 0.00 | 14190 | 0 | 0 |
| 2.67 | 2.40 | 2.35 | 23.65 | 0.00 | 26.00 | 0.00 | 15600 | 0 | 0 |
| 2.83 | 2.60 | 2.50 | 26.00 | 0.00 | 28.50 | 0.00 | 17100 | 0 | 0 |
| 3.00 | 2.80 | 2.70 | 28.50 | 0.00 | 31.20 | 0.00 | 18720 | 0 | 0 |
| 3.17 | 3.20 | 3.00 | 31.20 | 0.00 | 34.20 | 0.00 | 20520 | 0 | 0 |
| 3.33 | 3.50 | 3.35 | 34.20 | 0.00 | 37.55 | 0.00 | 22530 | 0 | 0 |
| 3.50 | 4.20 | 3.85 | 37.55 | 0.00 | 41.40 | 0.00 | 24840 | 0 | 0 |
| 3.67 | 4.80 | 4.50 | 41.40 | 0.00 | 45.90 | 0.00 | 27540 | 0 | 0 |
| 3.83 | 7.10 | 5.95 | 45.90 | 0.00 | 51.85 | 0.00 | 31110 | 0 | 0 |
| 4.00 | 10.10 | 8.60 | 51.85 | 0.00 | 60.45 | 0.00 | 36270 | 0 | 0 |
| 4.17 | 35.70 | 22.90 | 60.45 | 0.00 | 83.35 | 0.00 | 50010 | 0 | 0 |
| 4.33 | 5.70 | 20.70 | 83.35 | 0.00 | 104.05 | 0.37 | 62319 | 222 | 222 |
| 4.50 | 3.80 | 4.75 | 104.05 | 0.37 | 108.43 | 0.61 | 64875 | 366 | 588 |
| 4.67 | 3.00 | 3.40 | 108.43 | 0.61 | 111.22 | 0.84 | 66480 | 504 | 1092 |
| 4.83 | 2.50 | 2.75 | 111.22 | 0.84 | 113.13 | 1.00 | 67578 | 600 | 1692 |
| 5.00 | 2.20 | 2.35 | 113.13 | 1.00 | 114.48 | 1.11 | 68355 | 666 | 2358 |
| 5.17 | 1.90 | 2.05 | 114.48 | 1.11 | 115.42 | 1.19 | 68895 | 714 | 3072 |
| 5.33 | 1.80 | 1.85 | 115.42 | 1.19 | 116.08 | 1.25 | 69273 | 750 | 3822 |
| 5.50 | 1.60 | 1.70 | 116.08 | 1.25 | 116.53 | 1.28 | 69534 | 768 | 4590 |
| 5.67 | 1.50 | 1.55 | 116.53 | 1.28 | 116.80 | 1.31 | 69687 | 786 | 5376 |
| 5.83 | 1.40 | 1.45 | 116.80 | 1.31 | 116.94 | 1.32 | 69768 | 792 | 6168 |
| 6.00 | 1.30 | 1.35 | 116.94 | 1.32 | 116.97 | 1.32 | 69786 | 792 | 6960 |
| 6.17 | 0.00 | 0.65 | 116.97 | 1.32 | 116.30 | 1.26 | 69402 | 756 | 7716 |
| 6.33 | | 0.00 | 116.30 | 1.26 | 115.04 | 1.16 | 68676 | 696 | 8412 |
| 6.50 | | 0.00 | 115.04 | 1.16 | 113.88 | 1.06 | 68010 | 636 | 9048 |
| 6.67 | | 0.00 | 113.88 | 1.06 | 112.82 | 0.98 | 67398 | 588 | 9636 |
| 6.83 | | 0.00 | 112.82 | 0.98 | 111.84 | 0.90 | 66834 | 540 | 10176 |
| 7.00 | | 0.00 | 111.84 | 0.90 | 110.94 | 0.82 | 66318 | 492 | 10668 |
| 7.17 | | 0.00 | 110.94 | 0.82 | 110.12 | 0.75 | 65847 | 450 | 11118 |
| 7.33 | | 0.00 | 110.12 | 0.75 | 109.37 | 0.69 | 65415 | 414 | 11532 |
| 7.50 | | 0.00 | 109.37 | 0.69 | 108.68 | 0.64 | 65016 | 384 | 11916 |
| 7.67 | | 0.00 | 108.68 | 0.64 | 108.04 | 0.59 | 64647 | 354 | 12270 |
| 7.83 | | 0.00 | 108.04 | 0.59 | 107.45 | 0.55 | 64305 | 330 | 12600 |
| 8.00 | | 0.00 | 107.45 | 0.55 | 106.90 | 0.52 | 63984 | 312 | 12912 |


BASIN A1
Hydrographs (Inflow vs. Outflow)
Flow (cfs)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Basin Inflow
Basin Outflow
Qmax allowed from Basin
0.00
0.33
0.67
1.00
1.33
1.67
2.00
2.33
2.67
3.00
3.33
3.67
4.00
4.33
4.67
5.00
5.33
5.67
6.00
6.33
6.67
7.00
7.33
7.67
8.00
Time (hrs)




| | | | |
|---|---|---|---|
| **Detention / Retention Basin Volume Required:** | **69,786** | **$ft^3$** | |
| **@ Stage:** | **588.20** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | Incl. >1' Freeboard |
| **Final Total Basin Volume Provided:** | **103,123** | **$ft^3$** | Basin **A1** |
| **Maximum flow rate released from this basin:** | **1.32** | **cfs** | |

# B1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| B1.1.PV | 0.99 | 23900 | 0.5 | 10 | 2.8 | 1.54 | 4.2 | 2.29 | B1.1 | B1.1 | *bypass** | 69+00 | Lt |
| B1.2.PV | 0.99 | 22900 | 0.5 | 10 | 2.8 | 1.47 | 4.2 | 2.19 | B1.2 | B1.2 | *bypass** | 69+00 | Rt |

Σ 46800 *PAVED*

SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| B1.1.SL | 0.61 | 22700 | 0.5 | 10 | 2.8 | 0.90 | 4.2 | 1.34 | B1.1 | B1.1 | *bypass** | 69+00 | Lt |
| B1.2.SL | 0.61 | 19800 | 0.5 | 10 | 2.8 | 0.78 | 4.2 | 1.17 | B1.2 | B1.2 | *bypass** | 69+00 | Rt |

Σ 42500 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 89300 | 2.1 |
| | *SF* | *ac* |

WATERSHED B1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=200'
SHEET FLOW
SHALLOW CONCENTRATED FLOW
CHANNEL FLOW
STORM DRAIN FLOW
R/W
CULTIVATED
BRUSH
DIRT
GROUND COVER
ENRICO FERMI DR.

# B1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 910258 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 20.90 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 90% | AT | 0.42 | 0.379 |
| PAVED SURFACE | 5% | AT | 0.90 | 0.046 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 5% | AT | 0.55 | 0.026 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.45 |
| $C_{25}$ = | 0.50 |
| $C_{50}$ = | 0.54 |
| $C_{100}$ = | 0.56 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass - prairie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 654.0 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 39.0 | ft | |
| LENGTH (L) | 828 | ft | |
| SLOPE (S) = (H/L) | 4.7% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_C$ (SH)= | 9.20 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 37 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.78 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.11 | minutes | |

# B1 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 614.5 | ft |
| LOW POINT ELEVATION | 606.0 | ft |
| ELEVATION DIFF (H) | 8.5 | ft |
| LENGTH (L) | 226 | ft |
| SLOPE (S) = (H/L) | 3.8% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.0 | ft |
| HYDRAULIC RADIUS R | 0.8 | ft |
| VELOCITY (STORMDRAIN) | 18.3 | fps |
| $T_C$ (SD)= | 0.21 | minutes |

**NOTES:**

Cross Culvert

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft |
| LOW POINT ELEVATION | 594.0 | ft |
| ELEVATION DIFF (H) | 12.0 | ft |
| LENGTH (L) | 430 | ft |
| SLOPE (S) = (H/L) | 2.8% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 0.4 | ft |
| VELOCITY (CHANNEL) | 1.73 | fps |
| $T_C$ (CH)= | 4.15 | minutes |

**NOTES:**

Begins to form natural channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 10 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 24.62 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **24.62** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

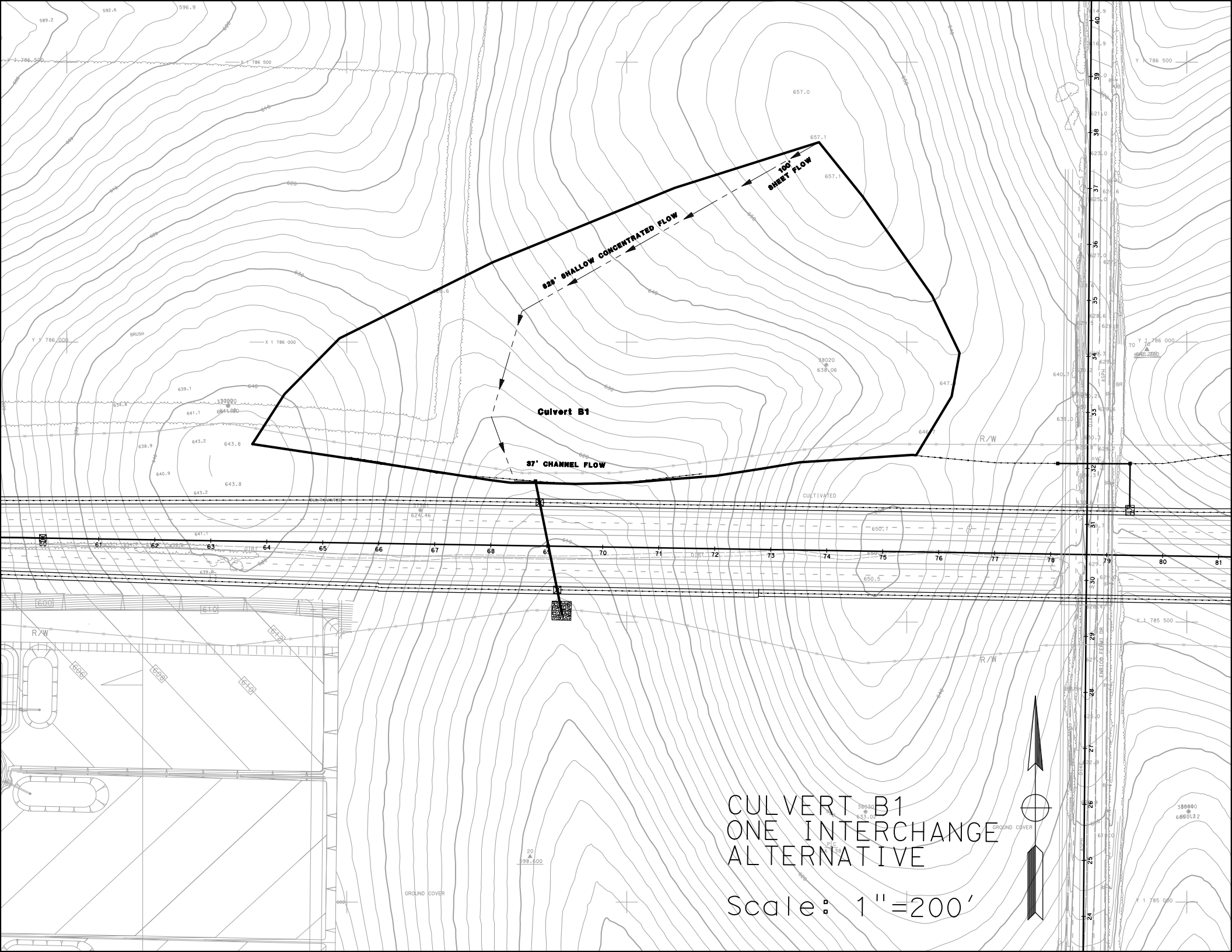
| | | | |
|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = |
| $i_{10}$ = | 1.5 | in/hr | X CA = |
| $i_{25}$ = | 1.9 | in/hr | X CA = |
| $i_{50}$ = | 2.3 | in/hr | X CA = |
| $i_{100}$ = | 2.4 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 9.8 |
| **$Q_{10}$ =** | 14.2 |
| **$Q_{25}$ =** | 19.5 |
| **$Q_{50}$ =** | 25.6 |
| **$Q_{100}$ =** | **27.7** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


100' SHEET FLOW
828' SHALLOW CONCENTRATED FLOW
Culvert B1
37' CHANNEL FLOW
CULTIVATED
R/W
GROUND COVER
CULVERT B1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# Culvert Calculator Report
## B1 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 616.50 | ft | Headwater Depth/Height | 0.77 | |
| Computed Headwater Elevation | 616.03 | ft | Discharge | 7.40 | cfs |
| Inlet Control HW Elev. | 615.86 | ft | Tailwater Elevation | 606.56 | ft |
| Outlet Control HW Elev. | 616.03 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 606.00 | ft |
| Length | 226.00 | ft | Constructed Slope | 3.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.56 | ft |
| Slope Type | Steep | | Normal Depth | 0.56 | ft |
| Flow Regime | Supercritical | | Critical Depth | 0.97 | ft |
| Velocity Downstream | 10.39 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 616.03 | ft | Upstream Velocity Head | 0.38 | ft |
| Ke | 0.50 | | Entrance Loss | 0.19 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 615.86 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
# B1 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 617.00 | ft | Headwater Depth/Height | 1.18 | |
| Computed Headwater Elevation | 616.85 | ft | Discharge | 15.00 | cfs |
| Inlet Control HW Elev. | 616.72 | ft | Tailwater Elevation | 606.81 | ft |
| Outlet Control HW Elev. | 616.85 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 606.00 | ft |
| Length | 226.00 | ft | Constructed Slope | 3.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.81 | ft |
| Slope Type | Steep | | Normal Depth | 0.81 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.40 | ft |
| Velocity Downstream | 12.65 | ft/s | Critical Slope | 0.6 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 616.85 | ft | Upstream Velocity Head | 0.64 | ft |
| Ke | 0.50 | | Entrance Loss | 0.32 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 616.72 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# B1 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B1 Culvert |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | B1 Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 483334 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 11.10 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | $C_{2,10}$ = | 0.42 |
| | (100%) | | $C_{25}$ = | 0.46 |
| | | | $C_{50}$ = | 0.50 |
| | | | $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass prarie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 42.1 | ft | |
| LENGTH (L) | 828 | ft | |
| SLOPE (S) = (H/L) | 5.1% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_C$ (SH)= | 9.20 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 37 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.78 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.11 | minutes | |

# B1 Culvert TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 20.27 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **20.27** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | **$Q_2$ =** | 3.9 |
| $i_{10}$ = | 1.6 | in/hr | X CA = | **$Q_{10}$ =** | 7.4 |
| $i_{25}$ = | 2.0 | in/hr | X CA = | **$Q_{25}$ =** | 10.2 |
| $i_{50}$ = | 2.3 | in/hr | X CA = | **$Q_{50}$ =** | 12.8 |
| $i_{100}$ = | 2.6 | in/hr | X CA = | **$Q_{100}$ =** | **15.0** |

**FLOW RESULTS**

**cfs**

**COUNTY $P_6$**

| | **inches** |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin B1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **69+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 30.8 | cfs | | | |
| Tc= | 26.2 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 25.94 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 26 | 3276 | 2.1 |
| 52 | 3588 | 2.3 |
| 78 | 3744 | 2.4 |
| 104 | 4368 | 2.8 |
| 130 | 4680 | 3 |
| 156 | 5772 | 3.7 |
| 182 | 6552 | 4.2 |
| 208 | 9672 | 6.2 |
| 234 | 14352 | 9.2 |
| 260 | 48048 | 30.8 |
| 286 | 7800 | 5 |
| 312 | 5148 | 3.3 |
| 338 | 4056 | 2.6 |
| 364 | 3432 | 2.2 |
| 390 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 124488 $ft^3$**
**2.86 acre-feet**

Check: $V = C*A*P_6$
V= 2.84 acre-feet
***OK***

# Basin B1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 27.7 | cfs | | | |
| Tc= | 24.6 | min | C= | 0.56 | |
| $P_{100,6}$= | 2.5 | in | A= | 20.90 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 25 | 2700 | 1.8 |
| 50 | 3000 | 2 |
| 75 | 3150 | 2.1 |
| 100 | 3600 | 2.4 |
| 125 | 3900 | 2.6 |
| 150 | 4800 | 3.2 |
| 175 | 5550 | 3.7 |
| 200 | 8100 | 5.4 |
| 225 | 10800 | 7.2 |
| 250 | 41550 | 27.7 |
| 275 | 6450 | 4.3 |
| 300 | 4350 | 2.9 |
| 325 | 3450 | 2.3 |
| 350 | 2850 | 1.9 |
| 375 | 0 | 0 |

*

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 104250 $ft^3$**
**2.39 acre-feet**

Check: $V = C*A*P_6$
V= 2.45 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **2.39** | *(Post)* | |
| - | **2.86** | *(Pre)* | |
| **Retention volume =** | **-0.46** | **acre-feet** | **= -20238 $ft^3$** **No Basin Required** |

# Basin B1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

| | | |
|---|---|---|
| $C_{100}$= | 0.99 | |
| A= | 1.07 | acres |
| $WQ_{72}$: | 0.73 | in/area |

**Water Quality Volume (WQV) =** **2847** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 42500 | $ft^2$ |
| | A: | 0.98 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 15.17 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

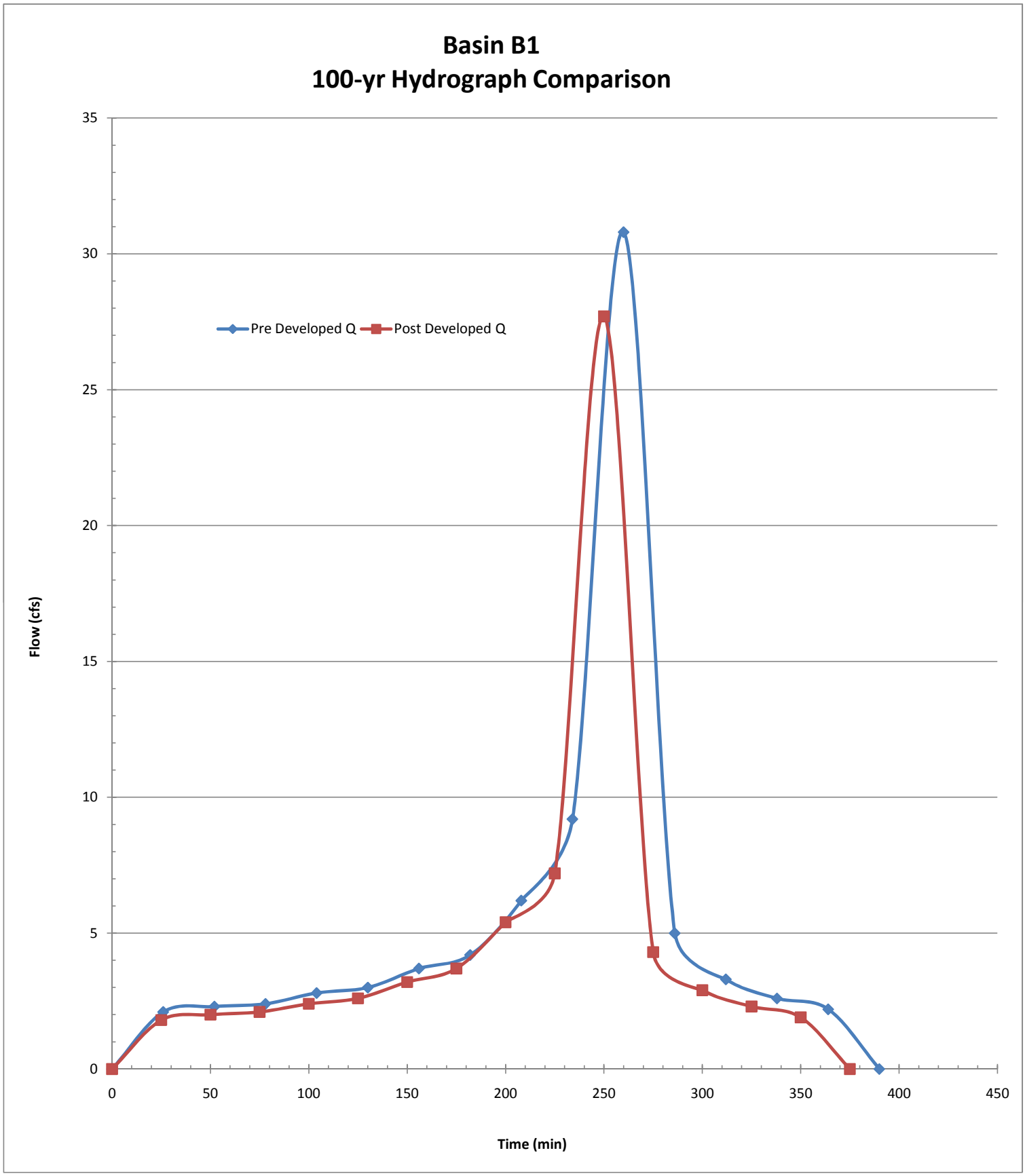
where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **337** **$ft^3$**

**Silt extracted within biofiltration swale**

.


Basin B1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400
450

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# C1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C1.1.PV | 0.99 | 32100 | 0.7 | 10 | 2.8 | 2.06 | 4.2 | 3.07 | ~ | C1.1 | *bypass** | 29+00 | ENF |

Σ 32100 *PAVED*

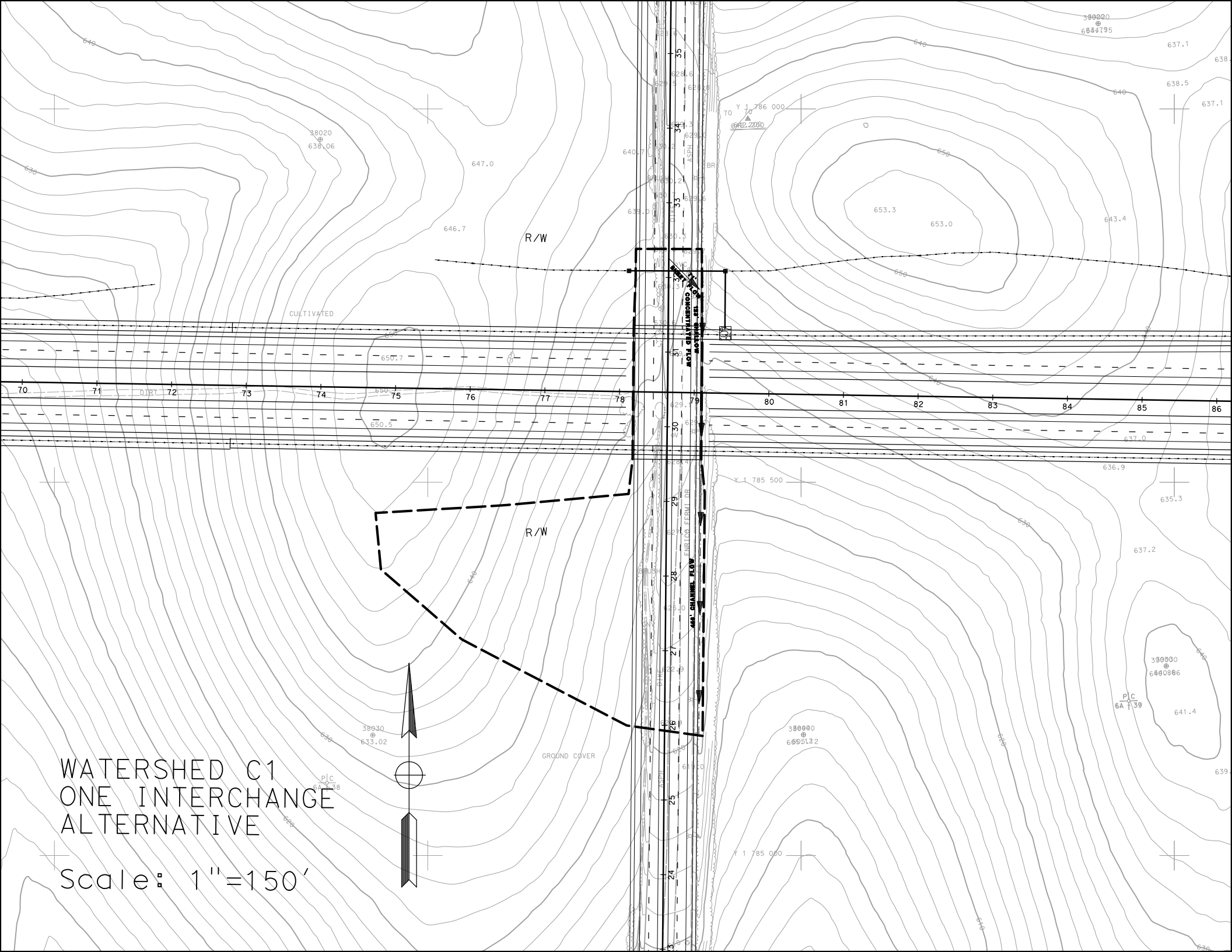
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C1.1.SL | 0.61 | 98400 | 2.3 | 10 | 2.8 | 3.90 | 4.2 | 5.80 | ~ | C1.1 | *bypass** | 26+00 | ENF |

Σ 98400 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 130500 | 3.00 |
| | *SF* | *ac* |




WATERSHED C1
ONE INTERCHANGE
ALTERNATIVE

Scale: 1"=150'

# C1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 78+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | C1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 130500 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 3.00 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 75% | AT | 0.42 | 0.317 |
| PAVED SURFACE | 25% | AT | 0.90 | 0.221 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.54 |
| $C_{25}$ = | 0.59 |
| $C_{50}$ = | 0.65 |
| $C_{100}$ = | 0.67 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.8 | ft | High Point on Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 630.0 | ft | |
| ELEVATION DIFF (H) | 0.8 | ft | |
| LENGTH (L) | 71 | ft | |
| SLOPE (S) = (H/L) | 1.2% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.05 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Eastern Gutter of Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 629.0 | ft | Caltrans ROW |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 123 | ft | |
| SLOPE (S) = (H/L) | 0.8% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 1.37 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | Enrico Fermi Gutter - east |
| LOW POINT ELEVATION | 620.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 12 ANG-RAD 0.083 |
| LENGTH (L) | 456 | ft | b = 2 ANG-DEG 4.764 |
| SLOPE (S) = (H/L) | 2.0% | | d = 0.25 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Gutter |
| HYDRAULIC RADIUS R | 0.16 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 4.04 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.88 | minutes | |

# C1 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 5.29 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\ P_6\ D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.0 |
| **$Q_{10}$ =** | 4.3 |
| **$Q_{25}$ =** | 6.0 |
| **$Q_{50}$ =** | 7.8 |
| **$Q_{100}$ =** | **8.5** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin C1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **78+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 16.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.60 | |
| $P_{100,6}$= | 2.5 | in | A= | 6.49 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 360 | 0.6 |
| 20 | 360 | 0.6 |
| 30 | 360 | 0.6 |
| 40 | 360 | 0.6 |
| 50 | 420 | 0.7 |
| 60 | 420 | 0.7 |
| 70 | 420 | 0.7 |
| 80 | 420 | 0.7 |
| 90 | 480 | 0.8 |
| 100 | 480 | 0.8 |
| 110 | 480 | 0.8 |
| 120 | 540 | 0.9 |
| 130 | 540 | 0.9 |
| 140 | 600 | 1 |
| 150 | 600 | 1 |
| 160 | 660 | 1.1 |
| 170 | 720 | 1.2 |
| 180 | 780 | 1.3 |
| 190 | 900 | 1.5 |
| 200 | 960 | 1.6 |
| 210 | 1140 | 1.9 |
| 220 | 1320 | 2.2 |
| 230 | 1920 | 3.2 |
| 240 | 2760 | 4.6 |
| 250 | 9840 | 16.4 |
| 260 | 1560 | 2.6 |
| 270 | 1020 | 1.7 |
| 280 | 840 | 1.4 |
| 290 | 660 | 1.1 |
| 300 | 600 | 1 |
| 310 | 540 | 0.9 |
| 320 | 480 | 0.8 |
| 330 | 420 | 0.7 |
| 340 | 420 | 0.7 |
| 350 | 360 | 0.6 |
| 360 | 360 | 0.6 |
| 370 | 0 | 0 |

**SUM= 35100 $ft^3$**
**0.81 acre-feet**

Check: V = C*A*$P_6$
V= 0.81 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin C1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 8.5 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.67 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.00 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 180 | 0.3 |
| 20 | 180 | 0.3 |
| 30 | 180 | 0.3 |
| 40 | 180 | 0.3 |
| 50 | 180 | 0.3 |
| 60 | 180 | 0.3 |
| 70 | 240 | 0.4 |
| 80 | 240 | 0.4 |
| 90 | 240 | 0.4 |
| 100 | 240 | 0.4 |
| 110 | 240 | 0.4 |
| 120 | 240 | 0.4 |
| 130 | 300 | 0.5 |
| 140 | 300 | 0.5 |
| 150 | 300 | 0.5 |
| 160 | 360 | 0.6 |
| 170 | 360 | 0.6 |
| 180 | 420 | 0.7 |
| 190 | 480 | 0.8 |
| 200 | 480 | 0.8 |
| 210 | 600 | 1 |
| 220 | 660 | 1.1 |
| 230 | 1020 | 1.7 |
| 240 | 1380 | 2.3 |
| 250 | 5100 | 8.5 |
| 260 | 780 | 1.3 |
| 270 | 540 | 0.9 |
| 280 | 420 | 0.7 |
| 290 | 360 | 0.6 |
| 300 | 300 | 0.5 |
| 310 | 300 | 0.5 |
| 320 | 240 | 0.4 |
| 330 | 240 | 0.4 |
| 340 | 240 | 0.4 |
| 350 | 180 | 0.3 |
| 360 | 180 | 0.3 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 18060 $ft^3$**
**0.41 acre-feet**

Check: V = C*A*$P_6$
V= 0.42 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **0.41** | *(Post)* | |
| - | **0.81** | *(Pre)* | |
| **Retention volume =** | **-0.39** | **acre-feet** | **= -17040 $ft^3$** **No Basin Required** |

# Basin C1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 0.74 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **1953** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 98400 $ft^2$
A: 2.26 acres
10.00 years
where: R= 30.00
K= 0.24
Ls= 18.00
C= 0.012
P= 1.00
As 1.56 tons/yr*Ac

Volume for 10-year Silt Accumulation = 35.13 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

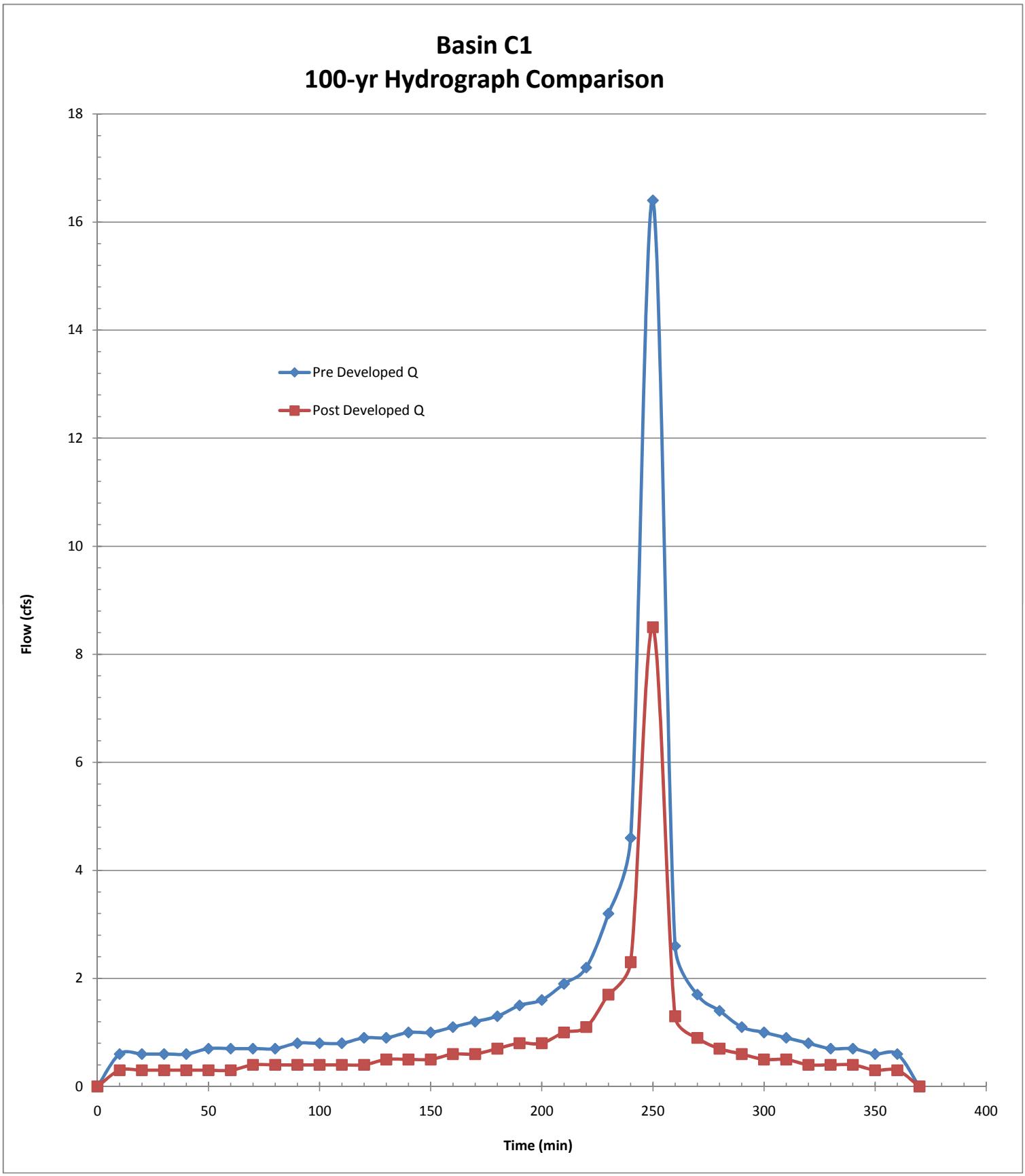
$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **781** **$ft^3$**

**Silt extracted within biofiltration swale**


Basin C1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
300
350
400

# D1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| ~ | 0.99 | 0 | 0.0 | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ |

Σ 0 *PAVED*

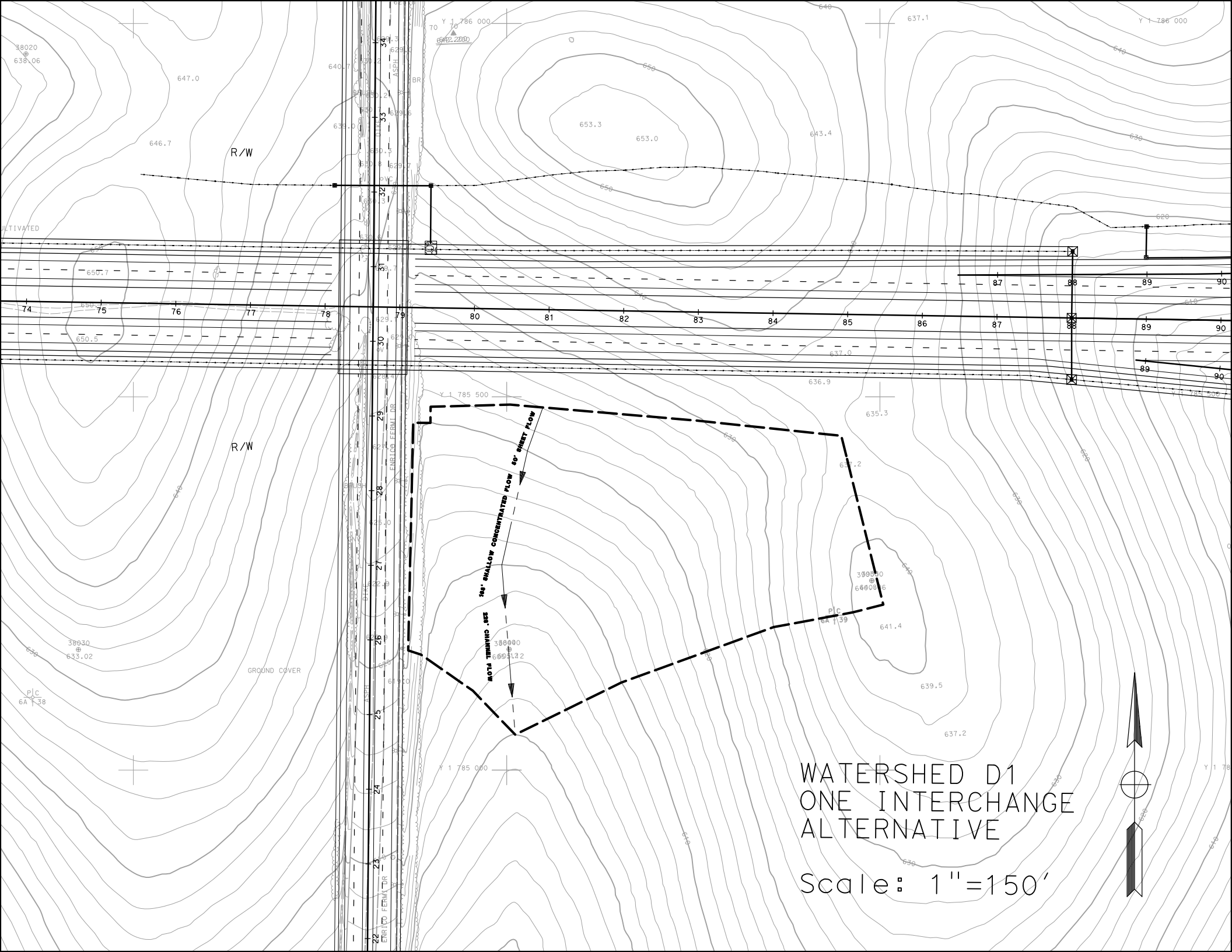
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| D1.1.SL | 0.61 | 202600 | 4.7 | 10 | 2.8 | 7.99 | 4.2 | 11.95 | ~ | D1.1 | **bypass* | 26+00 | ENF |

Σ 202600 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 202600 | 4.7 |
| | *SF* | *ac* |


R/W
R/W
ENRICO FERMI DR
GROUND COVER
160' SHALLOW CONCENTRATED FLOW
60' SHEET FLOW
225' CHANNEL FLOW
WATERSHED D1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=150'

# D1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 81+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | D1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 202600 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 4.65 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 624.0 | ft | High Point in Watershed, south of SR-11 |
| LOW POINT ELEVATION | 621.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 6.0% | | |
| MANNING'S n | 0.100 | | < = From Table 816.6A nearly bare ground |
| $T_t$ (SFF)= | 3.50 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 621.0 | ft | |
| LOW POINT ELEVATION | 612.0 | ft | |
| ELEVATION DIFF (H) | 9.0 | ft | |
| LENGTH (L) | 168 | ft | |
| SLOPE (S) = (H/L) | 5.4% | | |
| VELOCITY (SCF) | 2.4 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 1.17 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft | begins to channelize |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 12.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 228 | ft | b = 2 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 5.3% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.150 | | short prairie grass |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.06 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.59 | minutes | |

# D1 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.25 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.6 |
| **$Q_{10}$ =** | 5.3 |
| **$Q_{25}$ =** | 7.2 |
| **$Q_{50}$ =** | 9.5 |
| **$Q_{100}$ =** | **10.3** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin D1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **81+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 18.5 | cfs | | | |
| Tc= | 11.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 8.89 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 11 | 462 | 0.7 |
| 22 | 462 | 0.7 |
| 33 | 462 | 0.7 |
| 44 | 528 | 0.8 |
| 55 | 528 | 0.8 |
| 66 | 528 | 0.8 |
| 77 | 594 | 0.9 |
| 88 | 594 | 0.9 |
| 99 | 594 | 0.9 |
| 110 | 660 | 1 |
| 121 | 660 | 1 |
| 132 | 726 | 1.1 |
| 143 | 792 | 1.2 |
| 154 | 792 | 1.2 |
| 165 | 924 | 1.4 |
| 176 | 990 | 1.5 |
| 187 | 1122 | 1.7 |
| 198 | 1188 | 1.8 |
| 209 | 1452 | 2.2 |
| 220 | 1650 | 2.5 |
| 231 | 2442 | 3.7 |
| 242 | 3564 | 5.4 |
| 253 | 12210 | 18.5 |
| 264 | 1980 | 3 |
| 275 | 1320 | 2 |
| 286 | 1056 | 1.6 |
| 297 | 858 | 1.3 |
| 308 | 726 | 1.1 |
| 319 | 660 | 1 |
| 330 | 594 | 0.9 |
| 341 | 528 | 0.8 |
| 352 | 528 | 0.8 |
| 363 | 462 | 0.7 |
| 374 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **42636** | **$ft^3$** |
| | **0.98** | **acre-feet** |

Check: $V = C*A*P_6$

V= 0.97 acre-feet

***OK***

# Basin D1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 10.3 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 4.65 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 240 | 0.4 |
| 20 | 240 | 0.4 |
| 30 | 240 | 0.4 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 300 | 0.5 |
| 90 | 300 | 0.5 |
| 100 | 300 | 0.5 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 360 | 0.6 |
| 140 | 360 | 0.6 |
| 150 | 420 | 0.7 |
| 160 | 420 | 0.7 |
| 170 | 480 | 0.8 |
| 180 | 480 | 0.8 |
| 190 | 540 | 0.9 |
| 200 | 600 | 1 |
| 210 | 720 | 1.2 |
| 220 | 840 | 1.4 |
| 230 | 1260 | 2.1 |
| 240 | 1800 | 3 |
| 250 | 6180 | 10.3 |
| 260 | 960 | 1.6 |
| 270 | 660 | 1.1 |
| 280 | 540 | 0.9 |
| 290 | 420 | 0.7 |
| 300 | 360 | 0.6 |
| 310 | 360 | 0.6 |
| 320 | 300 | 0.5 |
| 330 | 300 | 0.5 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 240 | 0.4 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 22260 $ft^3$**
**0.51 acre-feet**

Check: V = C*A*$P_6$
V= 0.51 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **0.51** | *(Post)* | | |
| | - | **0.98** | *(Pre)* | | |
| **Retention volume =** | | **-0.47** | **acre-feet** | **=** | **-20376 $ft^3$** | **No Basin Required** |

# Basin D1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 0.00 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **0** **$ft^3$**

**No pavement areas proposed in this watershed**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

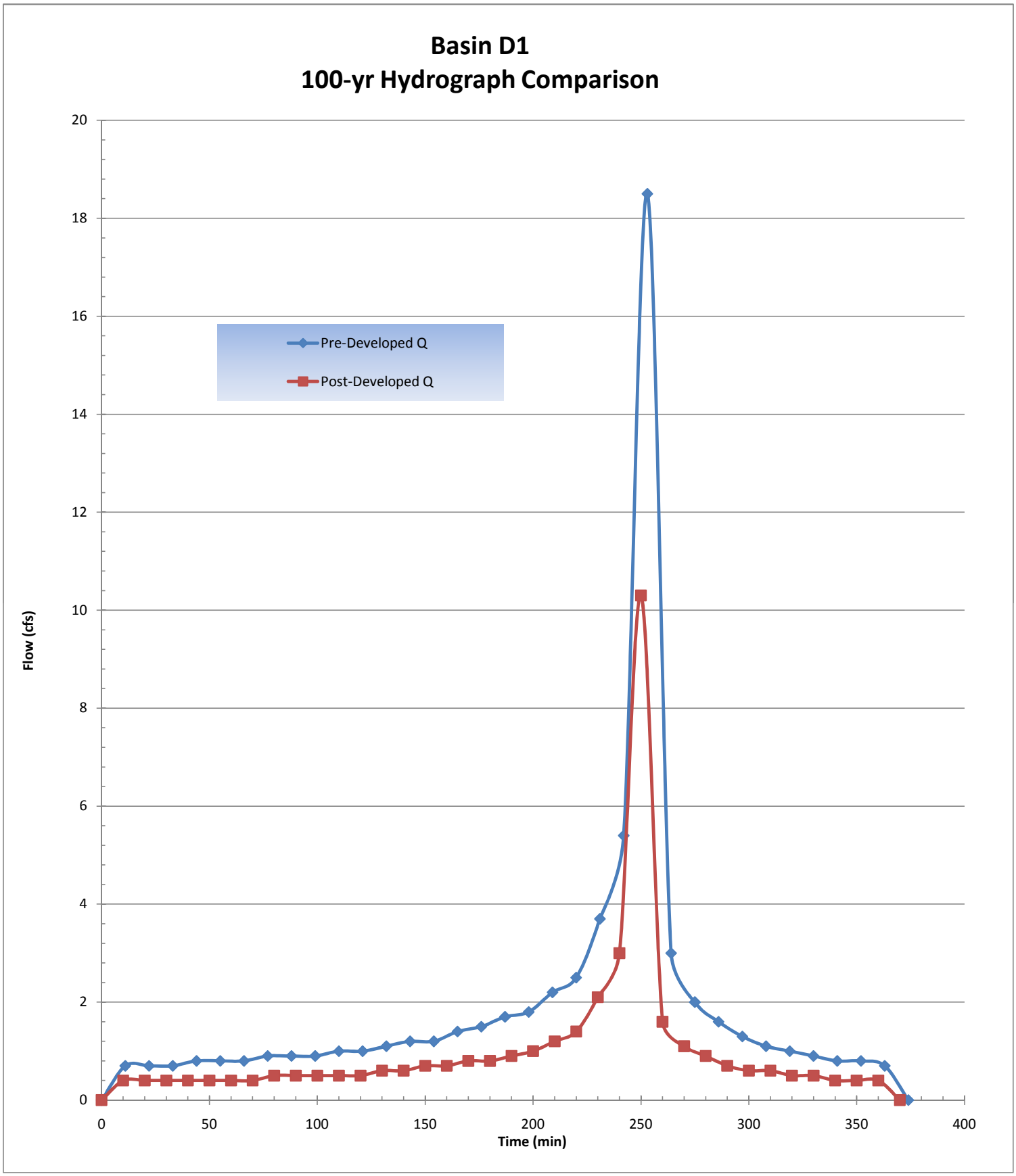
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 202600 | $ft^2$ |
| | A: | 4.65 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 72.33 tons

**Silt Accumulation Basin volume =** **1607** **$ft^3$**

**These are existing Sloped Areas to remain**

.


Basin D1
100-yr Hydrograph Comparison
Pre-Developed Q
Post-Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
20
0
50
100
150
200
250
300
350
400

# E1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| E1.1.PV | 0.99 | 98500 | 2.3 | 10 | 2.8 | 6.33 | 4.2 | 9.43 | E1.1 | E1.1 | Basin E1 | 88+00 | Lt |
| E1.2.PV | 0.99 | 52500 | 1.2 | 5 | 4.0 | 4.77 | 6.6 | 7.86 | ~ | E1.2 | Basin E1 | 91+00 | Lt |
| E1.3.PV | 0.99 | 43300 | 1.0 | 10 | 2.8 | 2.78 | 4.2 | 4.15 | E1.3 | E1.3 | bypass* | 96+00 | Rt |
| E1.4.PV | 0.99 | 51500 | 1.2 | 5 | 4.0 | 4.68 | 6.6 | 7.71 | ~ | E1.4 | Basin E1 | 100+00 | Lt |
| E1.5.PV | 0.99 | 54400 | 1.2 | 5 | 4.0 | 4.95 | 6.6 | 8.14 | ~ | E1.5 | Basin E1 | 100+00 | Rt |
| E1.10.PV | 0.99 | 90700 | 2.1 | 6 | 3.7 | 7.53 | 5.9 | 12.07 | E1.10 | E1.10 | Basin E1 | 88+00 | Rt |

Σ 390900 *PAVED*

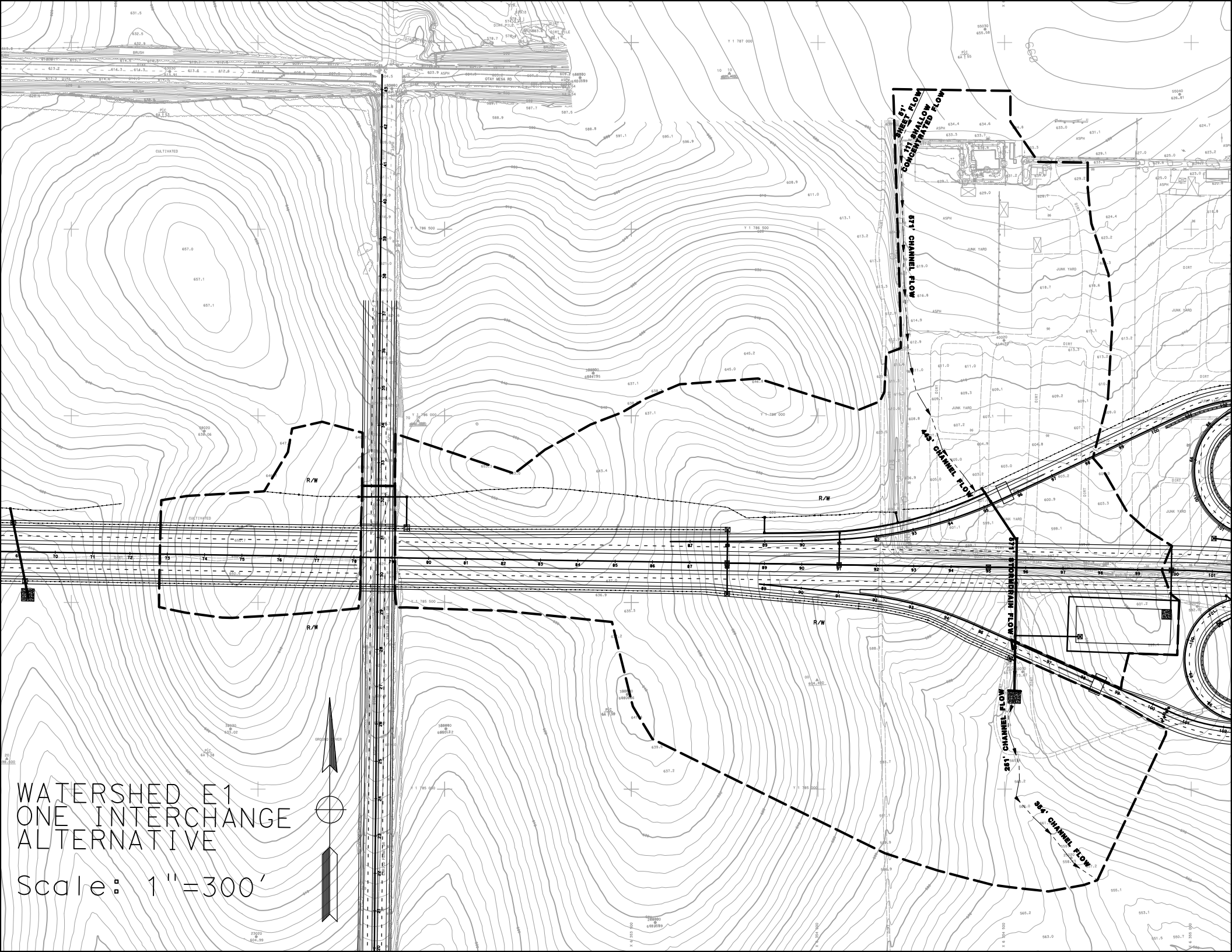
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| E1.1.SL | 0.61 | 146500 | 3.4 | 10 | 2.8 | 5.80 | 4.2 | 8.64 | E1.1 | E1.1 | Basin E1 | 88+00 | Lt |
| E1.2.SL | 0.61 | 19600 | 0.4 | 5 | 4.0 | 1.10 | 6.6 | 1.81 | ~ | E1.2 | Basin E1 | 91+00 | Lt |
| E1.3.SL | 0.61 | 25700 | 0.6 | 10 | 2.8 | 1.02 | 4.2 | 1.52 | E1.3 | E1.3 | bypass* | 96+00 | Rt |
| E1.4.SL | 0.61 | 79900 | 1.8 | 5 | 4.0 | 4.48 | 6.6 | 7.37 | ~ | E1.4 | Basin E1 | 100+00 | Lt |
| E1.5.SL | 0.61 | 104100 | 2.4 | 5 | 4.0 | 5.83 | 6.6 | 9.60 | ~ | E1.5 | Basin E1 | 100+00 | Rt |
| E1.6.SL | 0.60 | 40800 | 0.9 | 10 | 3.3 | 1.82 | 4.2 | 2.35 | E1.1 | E1.6 | Basin E1 | 78+00 | Lt |
| E1.7.SL | 0.60 | 35000 | 0.8 | 10 | 3.3 | 1.56 | 4.2 | 2.02 | E1.1 | E1.7 | Basin E1 | 79+50 | Lt |
| E1.8.SL | 0.60 | 163800 | 3.8 | 10 | 3.3 | 7.30 | 4.2 | 9.45 | ~ | E1.8 | Culvert | 88+00 | Lt |
| E1.9.SL | 0.60 | 119300 | 2.7 | 10 | 3.3 | 5.31 | 4.2 | 6.88 | ~ | E1.9 | Culvert | 92+50 | Lt |
| E1.10.SL | 0.65 | 71500 | 1.6 | 11 | 3.1 | 3.31 | 4.0 | 4.23 | E1.10 | E1.10 | Basin E1 | 88+00 | Rt |

Σ 806200 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 1197100 | 27.5 |
| | *SF* | *ac* |


SHEET FLOW
171' SHALLOW CONCENTRATED FLOW
574' CHANNEL FLOW
443' CHANNEL FLOW
STORM WATER FLOW
251' CHANNEL FLOW
354' CHANNEL FLOW
R/W
R/W
R/W
R/W
CULTIVATED
CULTIVATED
JUNK YARD
JUNK YARD
JUNK YARD
JUNK YARD
DIRT
ASPH
OTAY MESA RD
BRUSH
DIRT PILE
GROUND WATER
WATERSHED E1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=300'

# E1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | E1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 2495864 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 57.30 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 52% | AT | 0.43 | 0.224 |
| PAVED SURFACE | 16% | AT | 0.90 | 0.141 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 32% | AT | 0.55 | 0.178 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.54 |
| $C_{25}$ = | 0.60 |
| $C_{50}$ = | 0.65 |
| $C_{100}$ = | 0.68 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 51 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 1.28 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 634.0 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 111 | ft | |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.23 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 571 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.64 | minutes | |

# E1 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 602.0 | ft |
| ELEVATION DIFF (H) | 10.0 | ft |
| LENGTH (L) | 443 | ft |
| SLOPE (S) = (H/L) | 2.3% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 0.97 | fps |
| $T_C$ (CH)= | 7.58 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 596.0 | ft |
| LOW POINT ELEVATION | 570.0 | ft |
| ELEVATION DIFF (H) | 26.0 | ft |
| LENGTH (L) | 571 | ft |
| SLOPE (S) = (H/L) | 4.6% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.5 | ft |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (STORMDRAIN) | 22.4 | fps |
| $T_C$ (SD)= | 0.43 | minutes |

**NOTES:**

Proposed Cross Culvert (assumed 6' drop to invert)

Proposed Rip Rap Pad

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 570.0 | ft |
| LOW POINT ELEVATION | 565.2 | ft |
| ELEVATION DIFF (H) | 4.8 | ft |
| LENGTH (L) | 251 | ft |
| SLOPE (S) = (H/L) | 1.9% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 1.50 | fps |
| $T_C$ (CH)= | 2.80 | minutes |

**NOTES:**

Natural Channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 2 | ANG-DEG | 26.565 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 565.2 | ft |
| LOW POINT ELEVATION | 556.0 | ft |
| ELEVATION DIFF (H) | 9.2 | ft |
| LENGTH (L) | 354 | ft |
| SLOPE (S) = (H/L) | 2.6% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.7 | ft |
| VELOCITY (CHANNEL) | 1.81 | fps |
| $T_C$ (CH)= | 3.26 | minutes |

**NOTES:**

Begins to broaden

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 4 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 20.23 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **20.23** | minutes |

Total Length of Run (ft) = 2352

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

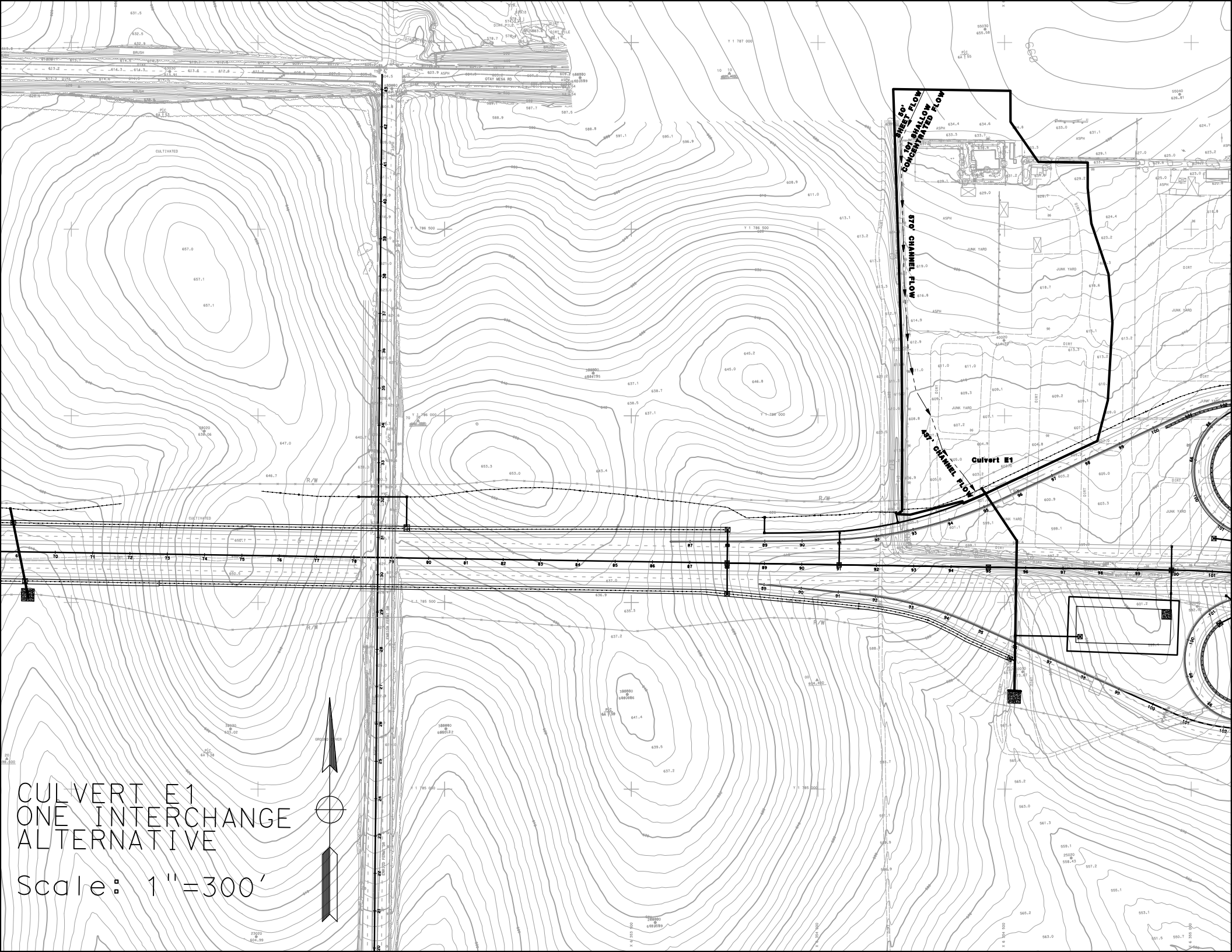
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.2 | in/hr | X CA = | |
| $i_{10}$ = | 1.7 | in/hr | X CA = | |
| $i_{25}$ = | 2.1 | in/hr | X CA = | |
| $i_{50}$ = | 2.6 | in/hr | X CA = | |
| $i_{100}$ = | 2.7 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 36.6 |
| **$Q_{10}$ =** | 53.2 |
| **$Q_{25}$ =** | 73.1 |
| **$Q_{50}$ =** | 95.7 |
| **$Q_{100}$ =** | **103.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


SHEET FLOW
10'
1ST SHALLOW CONCENTRATED FLOW
870' CHANNEL FLOW
457' CHANNEL FLOW
Culvert E1
OTAY MESA RD
JUNK YARD
CULTIVATED
R/W
CULVERT E1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=300'

# Culvert Calculator Report
## E1 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 599.00 | ft | Headwater Depth/Height | 0.65 | |
| Computed Headwater Elevation | 597.96 | ft | Discharge | 15.40 | cfs |
| Inlet Control HW Elev. | 597.70 | ft | Tailwater Elevation | 570.67 | ft |
| Outlet Control HW Elev. | 597.96 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 596.00 | ft | Downstream Invert | 570.00 | ft |
| Length | 571.00 | ft | Constructed Slope | 4.6 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.67 | ft |
| Slope Type | Steep | | Normal Depth | 0.67 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.25 | ft |
| Velocity Downstream | 13.17 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 597.96 | ft | Upstream Velocity Head | 0.47 | ft |
| Ke | 0.50 | | Entrance Loss | 0.24 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 597.70 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
# E1 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 600.00 | ft | Headwater Depth/Height | 0.99 | |
| Computed Headwater Elevation | 598.96 | ft | Discharge | 31.30 | cfs |
| Inlet Control HW Elev. | 598.70 | ft | Tailwater Elevation | 570.96 | ft |
| Outlet Control HW Elev. | 598.96 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 596.00 | ft | Downstream Invert | 570.00 | ft |
| Length | 571.00 | ft | Constructed Slope | 4.6 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.96 | ft |
| Slope Type | Steep | | Normal Depth | 0.96 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.81 | ft |
| Velocity Downstream | 16.15 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 598.96 | ft | Upstream Velocity Head | 0.76 | ft |
| Ke | 0.50 | | Entrance Loss | 0.38 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 598.70 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# E1 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Culvert |
| JOB #: | 11A1190 | | | STATION: | 95+50 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | E1.Culvert |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Culvert E1 |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 813298 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 18.67 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.43 | 0.426 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| DENSE RESIDENTIAL | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.43 |
| $C_{25}$ = | 0.48 |
| $C_{50}$ = | 0.52 |
| $C_{100}$ = | 0.54 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E1 Culvert TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 602.0 | ft |
| ELEVATION DIFF (H) | 10.0 | ft |
| LENGTH (L) | 437 | ft |
| SLOPE (S) = (H/L) | 2.3% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 0.98 | fps |
| $T_C$ (CH)= | 7.43 | minutes |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 14.21 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **14.21** | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**INTENSITY CHART:** Caltrans IDF2000

**FLOW RESULTS**

| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | $Q_2$ = | 8.2 |
| $i_{10}$ = | 1.9 | in/hr | X CA = | $Q_{10}$ = | 15.4 |
| $i_{25}$ = | 2.4 | in/hr | X CA = | $Q_{25}$ = | 21.2 |
| $i_{50}$ = | 2.7 | in/hr | X CA = | $Q_{50}$ = | 26.6 |
| $i_{100}$ = | 3.1 | in/hr | X CA = | $Q_{100}$ = | **31.3** |

~Use Caltrans 'i' for culvert sizing

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

**FLOW RESULTS**

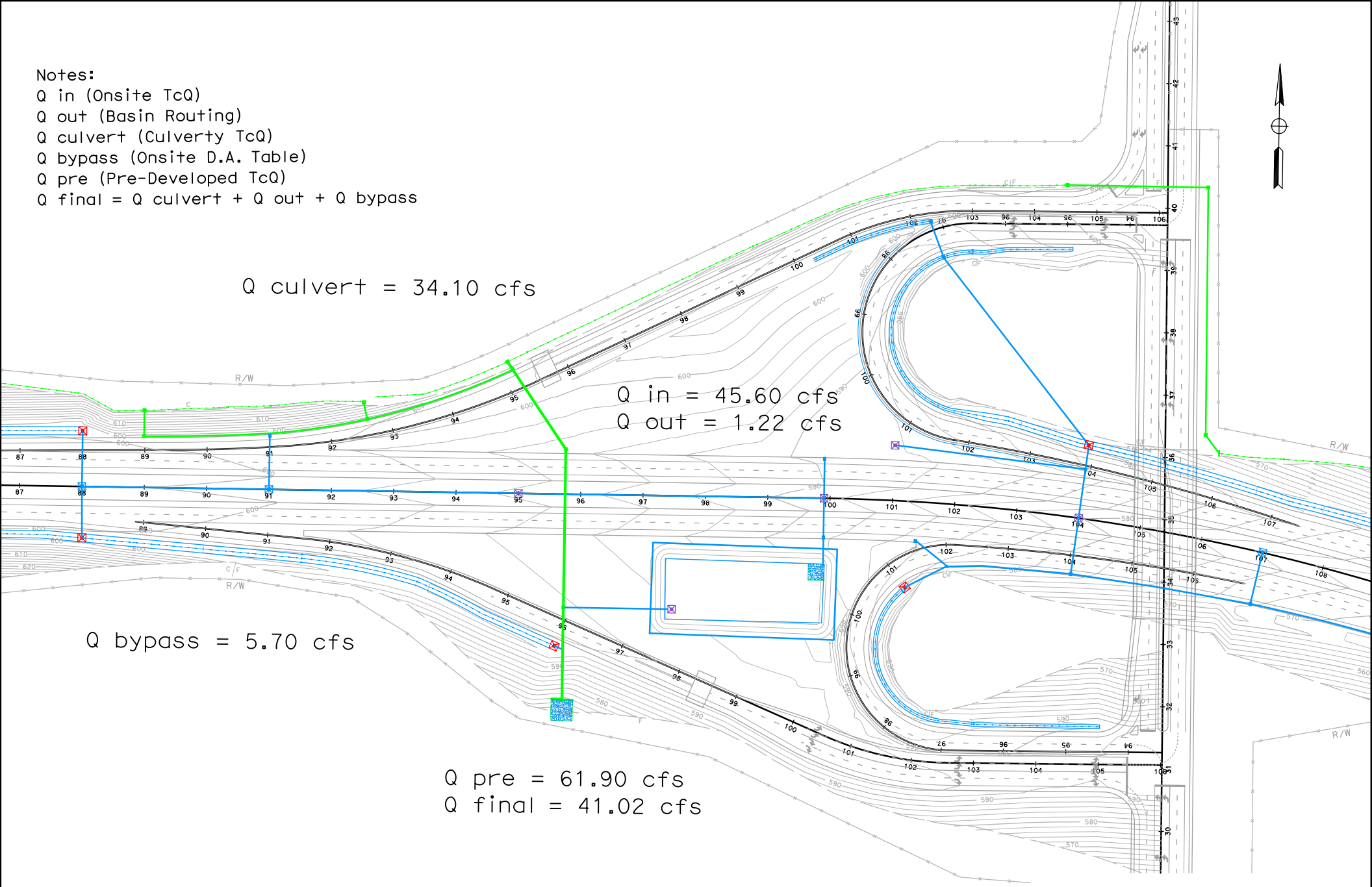
| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.5 | in/hr | X CA = | $Q_2$ = | 12.0 |
| $i_{10}$ = | 2.1 | in/hr | X CA = | $Q_{10}$ = | 17.4 |
| $i_{25}$ = | 2.7 | in/hr | X CA = | $Q_{25}$ = | 24.0 |
| $i_{50}$ = | 3.2 | in/hr | X CA = | $Q_{50}$ = | 31.4 |
| $i_{100}$ = | 3.4 | in/hr | X CA = | $Q_{100}$ = | **34.1** |

~Use County of SD 'i' for detention basin design

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culverty TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN E1
FLOW SUMMARY

Scale: 1"=200'

# Basin E1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin E1** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 61.9 | cfs | | | |
| Tc= | 24.5 | min | C= | 0.54 | |
| $P_{100,6}$= | 2.5 | in | A= | 48.15 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 25 | 6000 | 4 |
| 50 | 6750 | 4.5 |
| 75 | 7050 | 4.7 |
| 100 | 8100 | 5.4 |
| 125 | 8850 | 5.9 |
| 150 | 10800 | 7.2 |
| 175 | 12300 | 8.2 |
| 200 | 18000 | 12 |
| 225 | 23550 | 15.7 |
| 250 | 92850 | 61.9 |
| 275 | 14400 | 9.6 |
| 300 | 9600 | 6.4 |
| 325 | 7500 | 5 |
| 350 | 6300 | 4.2 |
| 375 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 232050 $ft^3$**
**5.33 acre-feet**

Check: $V = C*A*P_6$
V= 5.45 acre-feet
***OK***

# Basin E1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 103.9 | cfs | | | |
| Tc= | 20.2 | min | C= | 0.68 | |
| $P_{100,6}$= | 2.5 | in | A= | 57.30 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 20 | 7080 | 5.9 |
| 40 | 7320 | 6.1 |
| 60 | 7920 | 6.6 |
| 80 | 8400 | 7 |
| 100 | 9240 | 7.7 |
| 120 | 9840 | 8.2 |
| 140 | 11280 | 9.4 |
| 160 | 12240 | 10.2 |
| 180 | 14880 | 12.4 |
| 200 | 17040 | 14.2 |
| 220 | 24960 | 20.8 |
| 240 | 36360 | 30.3 |
| 260 | 124680 | 103.9 |
| 280 | 20040 | 16.7 |
| 300 | 13440 | 11.2 |
| 320 | 10440 | 8.7 |
| 340 | 8760 | 7.3 |
| 360 | 7680 | 6.4 |
| 380 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 351600 $ft^3$**
**8.07 acre-feet**

Check: $V = C*A*P_6$
V= 8.09 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **8.07** | *(Post)* | |
| - | **5.33** | *(Pre)* | |
| **Retention volume =** | **2.74** | **acre-feet** | **= 119550 $ft^3$** **Basin Required** |

# Basin E1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.87
A= 19.40 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **46475** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

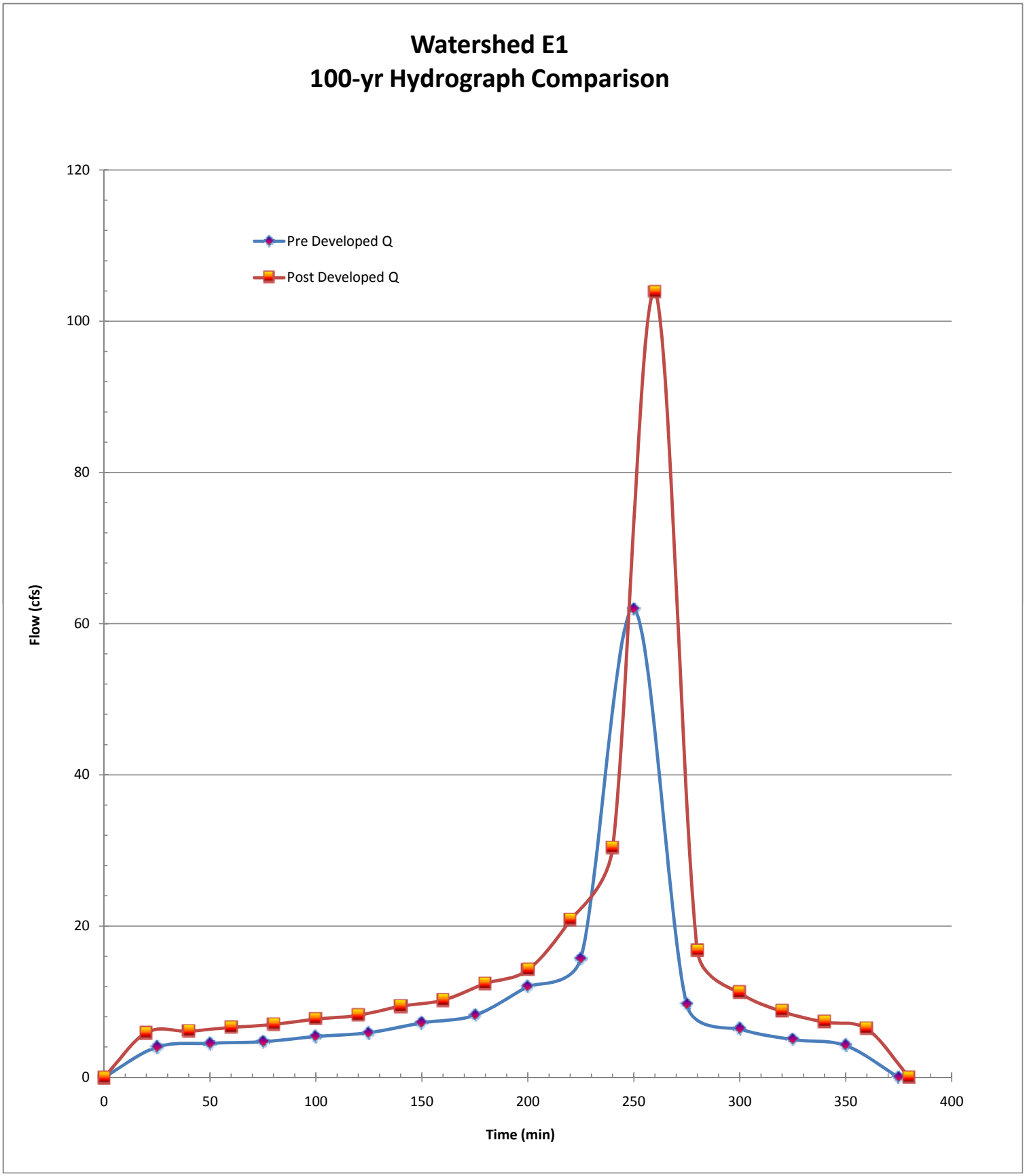
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 497400 | $ft^2$ |
| | A: | 11.42 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 177.58 tons

**Silt Accumulation Basin volume =** **3946** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Watershed E1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
0
50
100
150
200
250
300
350
400

# Basin E1 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | E1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 845000 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 19.40 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 41% | AT | 0.90 | 0.370 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 59% | AT | 0.55 | 0.324 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.69 |
| $C_{25}$ = | 0.76 |
| $C_{50}$ = | 0.83 |
| $C_{100}$ = | 0.87 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | SR-11 HP |
| LOW POINT ELEVATION | 607.8 | ft | |
| ELEVATION DIFF (H) | 0.7 | ft | |
| LENGTH (L) | 117 | ft | to Bioswale |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | AC < = From Table 816.6A |
| $T_t$ (SFF)= | 4.01 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 607.8 | ft | origin of Bioswale |
| LOW POINT ELEVATION | 606.0 | ft | |
| ELEVATION DIFF (H) | 1.8 | ft | |
| LENGTH (L) | 200 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 0.9% | | |
| VELOCITY (SCF) | 1.8 | fps | 0.9% , V FROM FIG 816.6 grassed waterway |
| $T_C$ (SH)= | 1.90 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 606.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 6.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1212 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 0.5% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.81 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 11.18 | minutes | |

# Basin E1 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 596.0 | ft | Proposed onsite pipe (assumed 4' drop to invert) |
| LOW POINT ELEVATION | 595.5 | ft | |
| ELEVATION DIFF (H) | 0.5 | ft | |
| LENGTH (L) | 87 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 5.5 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.26 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 595.5 | ft | |
| LOW POINT ELEVATION | 584.0 | ft | Proposed Rip Rap Pad in Basin floor |
| ELEVATION DIFF (H) | 11.5 | ft | |
| LENGTH (L) | 1300 | ft | |
| SLOPE (S) = (H/L) | 0.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 8.9 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 2.43 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 19.79 | minutes |
| **Minimum Tc =** | 5 | minutes |
| **USE $T_C$ =** | **19.79** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.2 | in/hr | X CA = | $Q_2$ = | 16.1 |
| $i_{10}$ = | 1.7 | in/hr | X CA = | $Q_{10}$ = | 23.4 |
| $i_{25}$ = | 2.2 | in/hr | X CA = | $Q_{25}$ = | 32.1 |
| $i_{50}$ = | 2.6 | in/hr | X CA = | $Q_{50}$ = | 42.1 |
| $i_{100}$ = | 2.7 | in/hr | X CA = | $Q_{100}$ = | **45.6** |

**FLOW RESULTS**

cfs

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin E1 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin E1** |

***Notes:***
This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 45.6 | cfs | $C_{100}$= | 0.87 | |
| Tc= | 19.8 | min | | | |
| $P_{100,6}$= | 2.5 | in | A= | 19.40 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 20 | 3000 | 2.5 |
| 40 | 3120 | 2.6 |
| 60 | 3480 | 2.9 |
| 80 | 3600 | 3 |
| 100 | 3960 | 3.3 |
| 120 | 4200 | 3.5 |
| 140 | 4920 | 4.1 |
| 160 | 5280 | 4.4 |
| 180 | 6480 | 5.4 |
| 200 | 7320 | 6.1 |
| 220 | 10800 | 9 |
| 240 | 15000 | 12.5 |
| 260 | 54720 | 45.6 |
| 280 | 8640 | 7.2 |
| 300 | 5760 | 4.8 |
| 320 | 4560 | 3.8 |
| 340 | 3840 | 3.2 |
| 360 | 3360 | 2.8 |
| 380 | 0 | 0 |

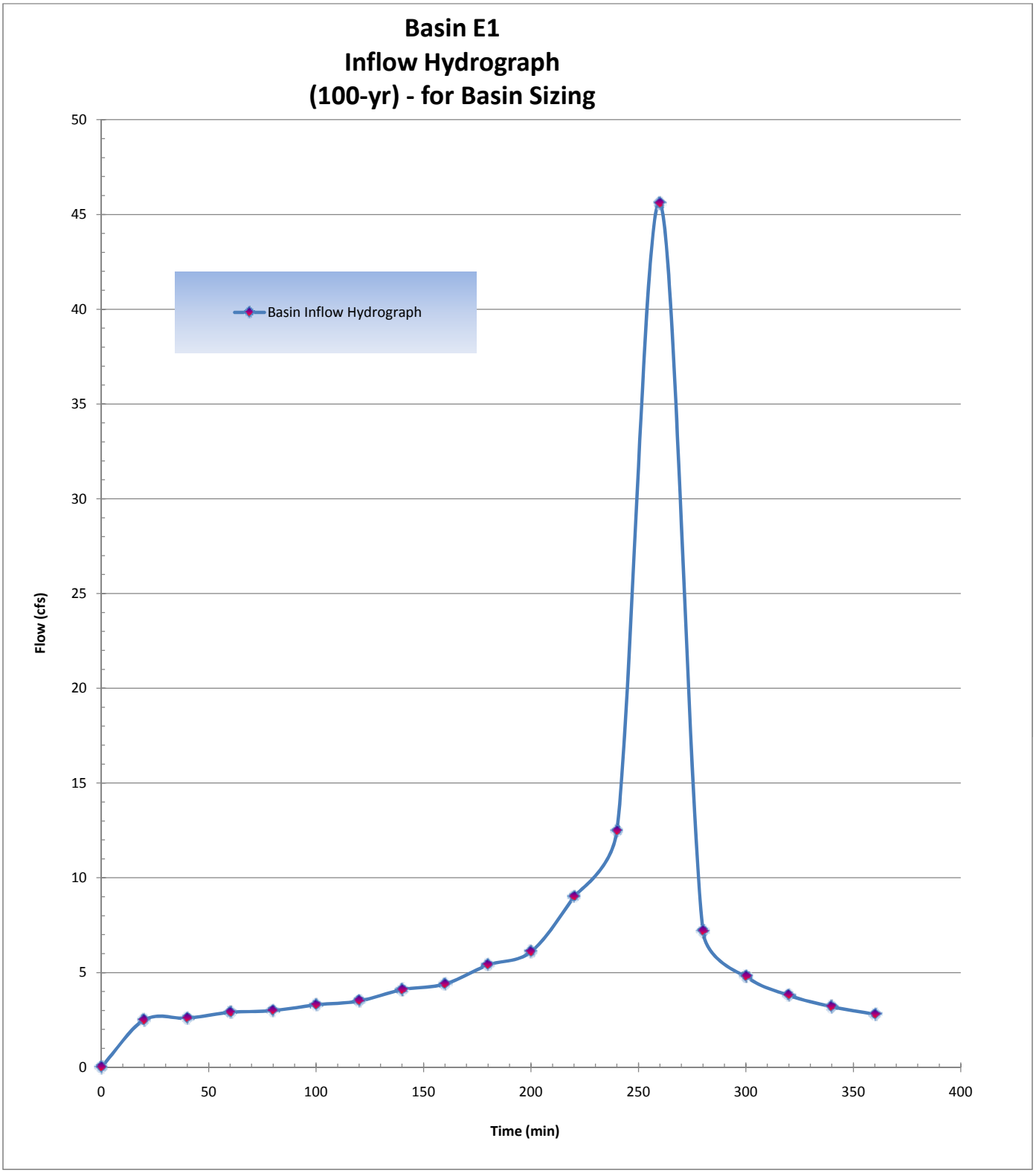
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 152040 $ft^3$**
**3.49 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 3.51 acre-feet
***OK***


Basin E1
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
300
350
400

# Basin E1 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | SR-11 | | | **DESCRIPTION:** | SR-11 Basin |
| **JOB #:** | 11A1190 | | | **STATION:** | 96+00 |
| **BY:** | M.BRUNING | **DATE:** | 02.19.10 | **WATERSHED:** | E1 |
| **CHK:** | G.DALZIEL | **DATE:** | | **SYSTEM:** | Basin E1 |

***Notes:***

Required Retention Basin Volume = 123496 $ft^3$

Actual Basin Inflow = 152040 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

| | | | | | |
|---|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 61.9 | cfs | | | |
| Post-Developed Peak Flow through Cross Culvert: | 34.1 | cfs | | Includes: | E1.8.SL E1.9.SL |
| Flow that does not reach detention basin (bypass per DA table): | 5.7 | cfs | ~ | $Q_{100}$ of: | E1.3.PV E1.3.SL |
| Maximum flow allowed to be released by this detention basin: | 22.2 | cfs | | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 590.00 | ft |
| Basin flowline elevation = | 584.00 | ft |
| Maximum Basin Depth = | 6.00 | ft |

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 4.00 | ft | 588.00 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 250 | ft |
| Base Width (W) | 100 | ft |
| W/L Ratio ® | 0.40 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 204733 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 584.00 | 0.00 | 0 | 0 | | 584.00 | 0.00 | | 0.00 |
| 1 | 584.20 | 0.20 | 5056 | 5056 | | 584.20 | 0.00 | | 0.00 |
| 2 | 584.40 | 0.40 | 5169 | 10226 | | 584.40 | 0.00 | | 0.00 |
| 3 | 584.60 | 0.60 | 5284 | 15509 | | 584.60 | 0.00 | | 0.00 |
| 4 | 584.80 | 0.80 | 5399 | 20908 | | 584.80 | 0.00 | | 0.00 |
| 5 | 585.00 | 1.00 | 5515 | 26422 | | 585.00 | 0.00 | | 0.00 |
| 6 | 585.20 | 1.20 | 5631 | 32054 | | 585.20 | 0.00 | | 0.00 |
| 7 | 585.40 | 1.40 | 5749 | 37803 | | 585.40 | 0.00 | | 0.00 |
| 8 | 585.60 | 1.60 | 5868 | 43671 | | 585.60 | 0.00 | | 0.00 |
| 9 | 585.80 | 1.80 | 5988 | 49659 | | 585.80 | 0.00 | | 0.00 |
| 10 | 586.00 | 2.00 | 6109 | 55768 | | 586.00 | 0.00 | | 0.00 |
| 11 | 586.20 | 2.20 | 6230 | 61998 | | 586.20 | 0.00 | | 0.00 |
| 12 | 586.40 | 2.40 | 6353 | 68351 | | 586.40 | 0.00 | | 0.00 |
| 13 | 586.60 | 2.60 | 6476 | 74827 | | 586.60 | 0.00 | | 0.00 |
| 14 | 586.80 | 2.80 | 6601 | 81428 | | 586.80 | 0.00 | | 0.00 |
| 15 | 587.00 | 3.00 | 6726 | 88154 | | 587.00 | 0.00 | 0.00 | 0.00 |
| 16 | 587.20 | 3.20 | 6852 | 95006 | | 587.20 | 0.00 | | 0.00 |
| 17 | 587.40 | 3.40 | 6980 | 101986 | | 587.40 | 0.00 | | 0.00 |
| 18 | 587.60 | 3.60 | 7108 | 109094 | | 587.60 | 0.00 | | 0.00 |
| 19 | 587.80 | 3.80 | 7237 | 116331 | | 587.80 | 0.00 | | 0.00 |
| 20 | 588.00 | 4.00 | 7367 | 123698 | * | 588.00 | 0.00 | | 0.00 |
| 21 | 588.20 | 4.20 | 7498 | 131197 | | 588.20 | 0.15 | | 0.15 |
| 22 | 588.40 | 4.40 | 7630 | 138827 | | 588.40 | 0.59 | | 0.59 |
| 23 | 588.60 | 4.60 | 7763 | 146590 | | 588.60 | 1.30 | | 1.30 |
| 24 | 588.80 | 4.80 | 7897 | 154487 | | 588.80 | 2.25 | | 2.25 |
| 25 | 589.00 | 5.00 | 8032 | 162519 | | 589.00 | 3.42 | | 3.42 |
| 26 | 589.20 | 5.20 | 8168 | 170686 | | 589.20 | 4.79 | | 4.79 |
| 27 | 589.40 | 5.40 | 8304 | 178991 | | 589.40 | 6.32 | | 6.32 |
| 28 | 589.60 | 5.60 | 8442 | 187432 | | 589.60 | 7.99 | | 7.99 |
| 29 | 589.80 | 5.80 | 8580 | 196013 | | 589.80 | 9.77 | | 9.77 |
| 30 | 590.00 | 6.00 | 8720 | 204733 | | 590.00 | 11.63 | | 11.63 |

# Basin E1 Routing

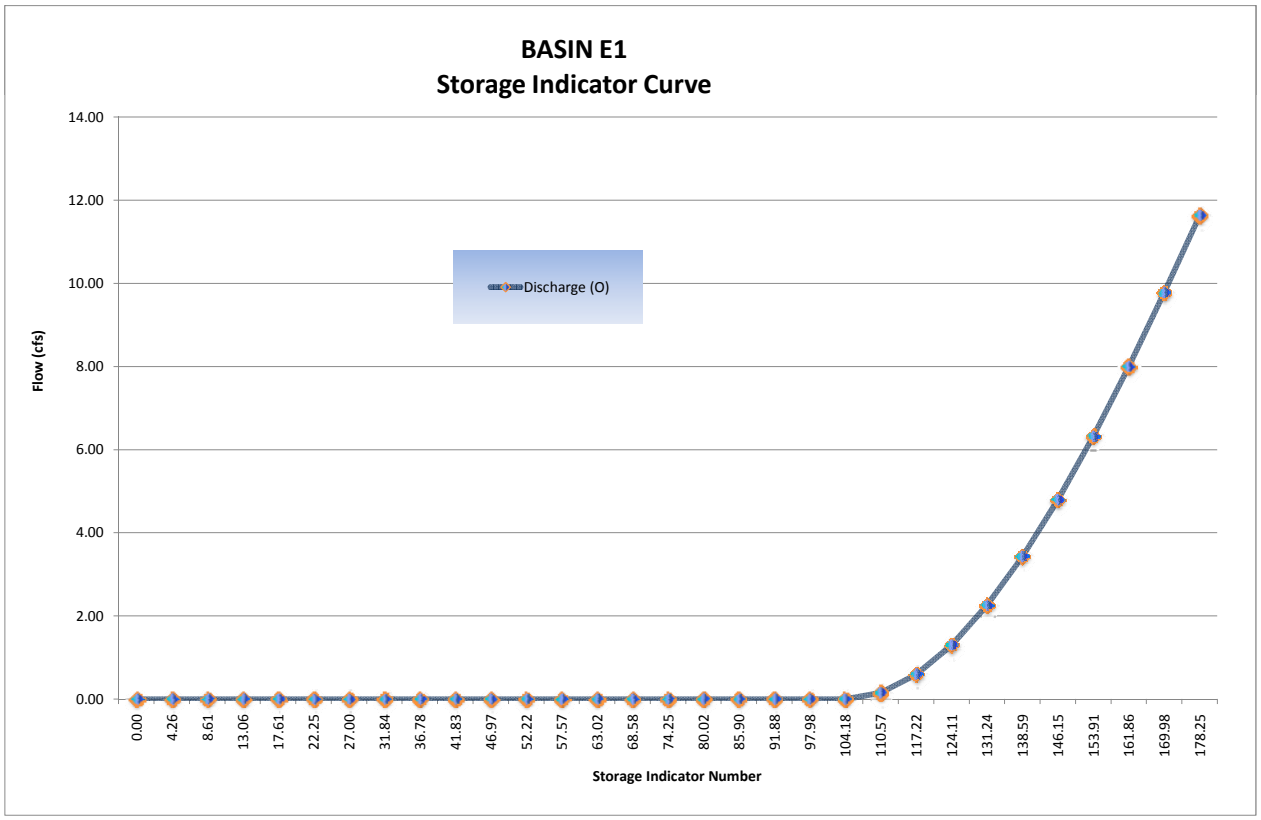
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | E |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin E1 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 584.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 584.20 | 0.00 | 5056 | 0.00 | 4.26 | 4.26 |
| 584.40 | 0.00 | 10226 | 0.00 | 8.61 | 8.61 |
| 584.60 | 0.00 | 15509 | 0.00 | 13.06 | 13.06 |
| 584.80 | 0.00 | 20908 | 0.00 | 17.61 | 17.61 |
| 585.00 | 0.00 | 26422 | 0.00 | 22.25 | 22.25 |
| 585.20 | 0.00 | 32054 | 0.00 | 27.00 | 27.00 |
| 585.40 | 0.00 | 37803 | 0.00 | 31.84 | 31.84 |
| 585.60 | 0.00 | 43671 | 0.00 | 36.78 | 36.78 |
| 585.80 | 0.00 | 49659 | 0.00 | 41.83 | 41.83 |
| 586.00 | 0.00 | 55768 | 0.00 | 46.97 | 46.97 |
| 586.20 | 0.00 | 61998 | 0.00 | 52.22 | 52.22 |
| 586.40 | 0.00 | 68351 | 0.00 | 57.57 | 57.57 |
| 586.60 | 0.00 | 74827 | 0.00 | 63.02 | 63.02 |
| 586.80 | 0.00 | 81428 | 0.00 | 68.58 | 68.58 |
| 587.00 | 0.00 | 88154 | 0.00 | 74.25 | 74.25 |
| 587.20 | 0.00 | 95006 | 0.00 | 80.02 | 80.02 |
| 587.40 | 0.00 | 101986 | 0.00 | 85.90 | 85.90 |
| 587.60 | 0.00 | 109094 | 0.00 | 91.88 | 91.88 |
| 587.80 | 0.00 | 116331 | 0.00 | 97.98 | 97.98 |
| 588.00 | 0.00 | 123698 | 0.00 | 104.18 | 104.18 |
| 588.20 | 0.15 | 131197 | 0.08 | 110.50 | 110.57 |
| 588.40 | 0.59 | 138827 | 0.30 | 116.93 | 117.22 |
| 588.60 | 1.30 | 146590 | 0.65 | 123.46 | 124.11 |
| 588.80 | 2.25 | 154487 | 1.13 | 130.12 | 131.24 |
| 589.00 | 3.42 | 162519 | 1.71 | 136.88 | 138.59 |
| 589.20 | 4.79 | 170686 | 2.40 | 143.76 | 146.15 |
| 589.40 | 6.32 | 178991 | 3.16 | 150.75 | 153.91 |
| 589.60 | 7.99 | 187432 | 4.00 | 157.86 | 161.86 |
| 589.80 | 9.77 | 196013 | 4.89 | 165.09 | 169.98 |
| 590.00 | 11.63 | 204733 | 5.82 | 172.44 | 178.25 |

| | | |
|---|---|---|
| delta t = | 0.33 | hrs |
| delta t = | 20 | min |
| delta t = | 1187.302 | sec |

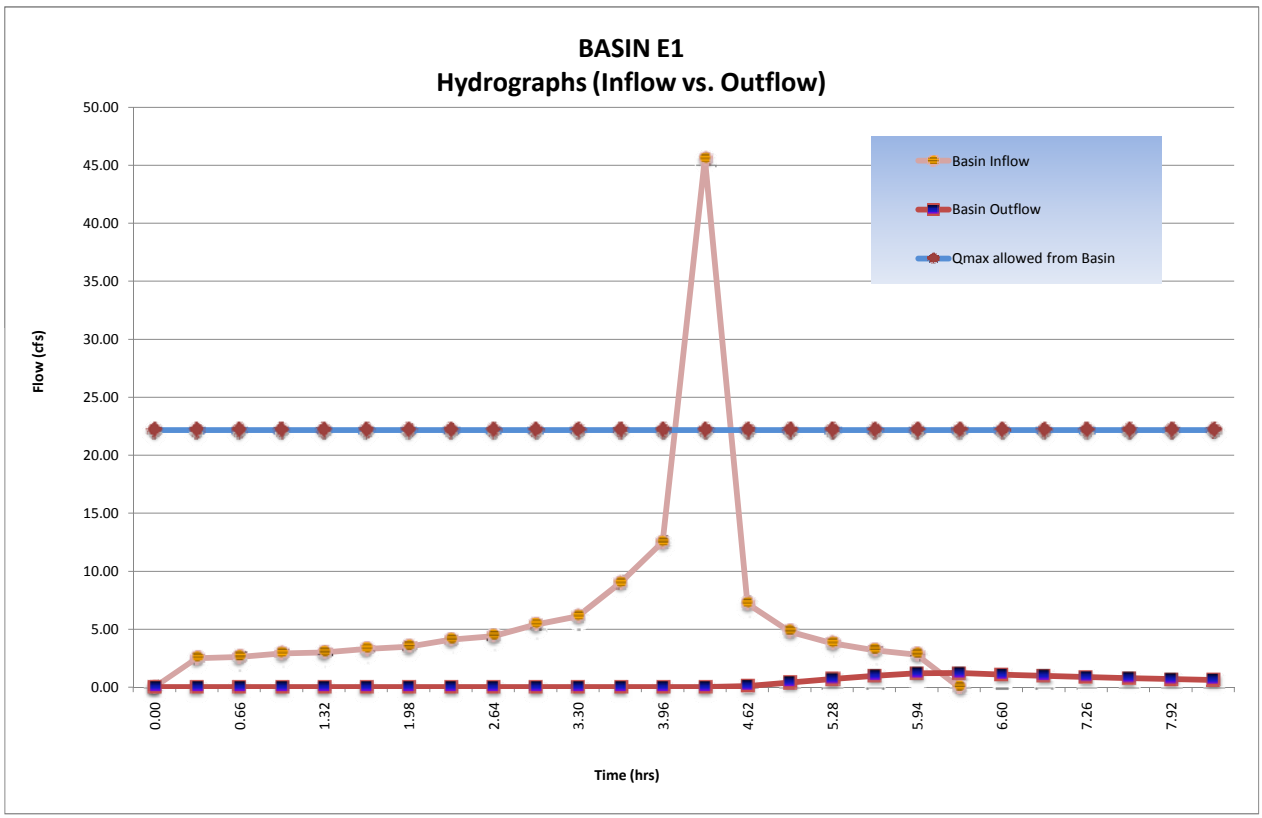


# Basin E1 Routing

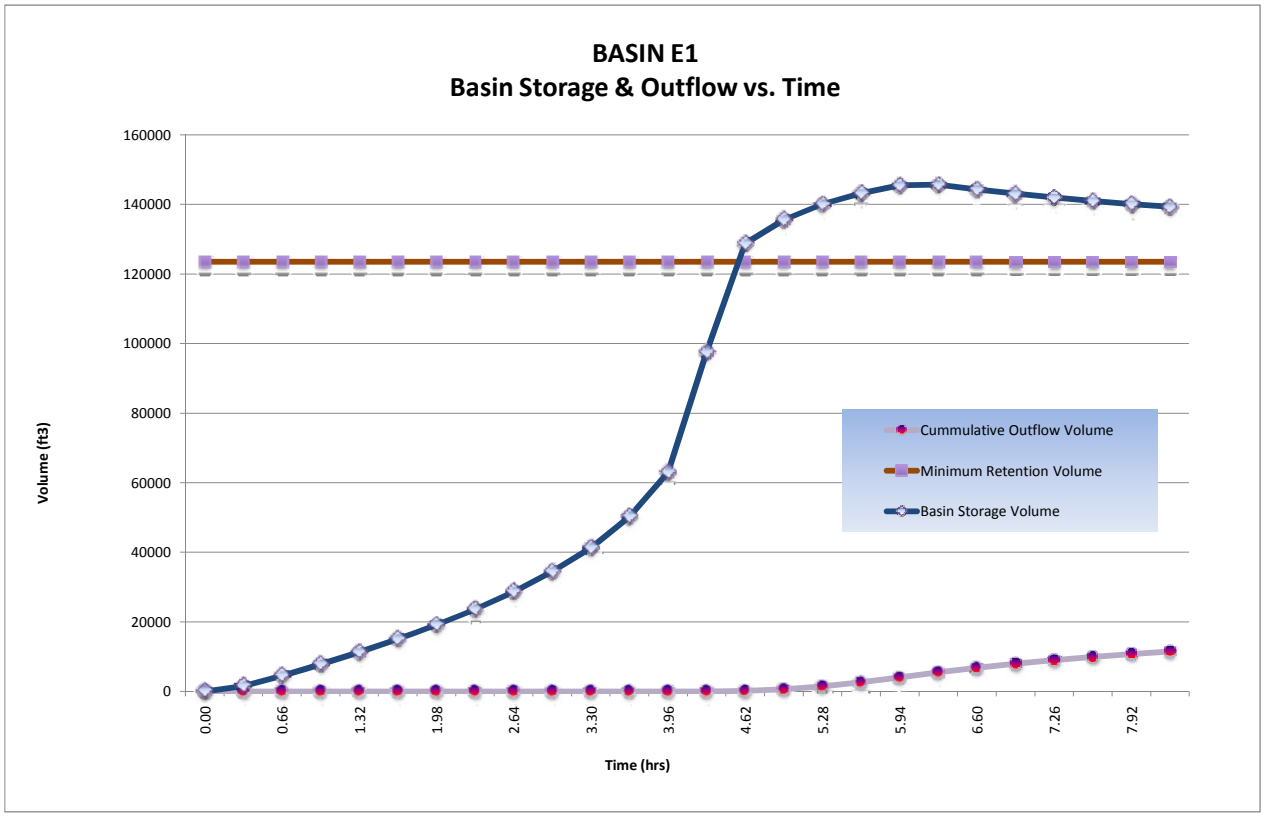
$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) = O_1 + \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.33 | 2.50 | 1.25 | 0.00 | 0.00 | 1.25 | 0.00 | 1484 | 0 | 0 |
| 0.66 | 2.60 | 2.55 | 1.25 | 0.00 | 3.80 | 0.00 | 4512 | 0 | 0 |
| 0.99 | 2.90 | 2.75 | 3.80 | 0.00 | 6.55 | 0.00 | 7777 | 0 | 0 |
| 1.32 | 3.00 | 2.95 | 6.55 | 0.00 | 9.50 | 0.00 | 11279 | 0 | 0 |
| 1.65 | 3.30 | 3.15 | 9.50 | 0.00 | 12.65 | 0.00 | 15019 | 0 | 0 |
| 1.98 | 3.50 | 3.40 | 12.65 | 0.00 | 16.05 | 0.00 | 19056 | 0 | 0 |
| 2.31 | 4.10 | 3.80 | 16.05 | 0.00 | 19.85 | 0.00 | 23568 | 0 | 0 |
| 2.64 | 4.40 | 4.25 | 19.85 | 0.00 | 24.10 | 0.00 | 28614 | 0 | 0 |
| 2.97 | 5.40 | 4.90 | 24.10 | 0.00 | 29.00 | 0.00 | 34432 | 0 | 0 |
| 3.30 | 6.10 | 5.75 | 29.00 | 0.00 | 34.75 | 0.00 | 41259 | 0 | 0 |
| 3.63 | 9.00 | 7.55 | 34.75 | 0.00 | 42.30 | 0.00 | 50223 | 0 | 0 |
| 3.96 | 12.50 | 10.75 | 42.30 | 0.00 | 53.05 | 0.00 | 62986 | 0 | 0 |
| 4.29 | 45.60 | 29.05 | 53.05 | 0.00 | 82.10 | 0.00 | 97477 | 0 | 0 |
| 4.62 | 7.20 | 26.40 | 82.10 | 0.00 | 108.50 | 0.10 | 128763 | 119 | 119 |
| 4.95 | 4.80 | 6.00 | 108.50 | 0.10 | 114.40 | 0.40 | 135590 | 475 | 594 |
| 5.28 | 3.80 | 4.30 | 114.40 | 0.40 | 118.30 | 0.70 | 140042 | 831 | 1425 |
| 5.61 | 3.20 | 3.50 | 118.30 | 0.70 | 121.10 | 0.99 | 143195 | 1175 | 2600 |
| 5.94 | 2.80 | 3.00 | 121.10 | 0.99 | 123.11 | 1.20 | 145456 | 1425 | 4025 |
| 6.27 | 0.00 | 1.40 | 123.11 | 1.20 | 123.31 | 1.22 | 145682 | 1449 | 5473 |
| 6.60 | | 0.00 | 123.31 | 1.22 | 122.09 | 1.09 | 144311 | 1294 | 6768 |
| 6.93 | | 0.00 | 122.09 | 1.09 | 121.00 | 0.98 | 143082 | 1164 | 7931 |
| 7.26 | | 0.00 | 121.00 | 0.98 | 120.02 | 0.88 | 141978 | 1045 | 8976 |
| 7.59 | | 0.00 | 120.02 | 0.88 | 119.14 | 0.79 | 140986 | 938 | 9914 |
| 7.92 | | 0.00 | 119.14 | 0.79 | 118.35 | 0.71 | 140096 | 843 | 10757 |
| 8.25 | | 0.00 | 118.35 | 0.71 | 117.64 | 0.63 | 139300 | 748 | 11505 |



**Basin E1 Routing**




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **145,682** | **$ft^3$** | |
| **@ Stage:** | **588.60** | **ft** | |
| **Freeboard** | **1.4** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **204,733** | **$ft^3$** | Basin **E1** |
| **Maximum flow rate released from this basin:** | **1.22** | **cfs** | |

# F1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.03.10** | **WATERSHED:** | **F1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

PAVED

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| F1.1.PV | 0.99 | 5000 | 0.1 | 5 | 4.0 | 0.45 | 6.6 | 0.75 | ~ | F1.1 | Basin F1 | 101+00 | Lt |
| F1.2.PV | 0.99 | 7400 | 0.2 | 5 | 4.0 | 0.67 | 6.6 | 1.11 | ~ | F1.2 | Basin F1 | 101+50 | Rt |
| F1.3.PV | 0.99 | 35100 | 0.8 | 5 | 4.0 | 3.18 | 6.6 | 5.25 | ~ | F1.3 | Basin F1 | 107+00 | Center |
| F1.4.PV | 0.99 | 44700 | 1.0 | 5 | 4.0 | 4.05 | 6.6 | 6.69 | ~ | F1.4 | Basin F1 | 107+00 | Rt |
| F1.5.PV | 0.99 | 37600 | 0.9 | 10 | 2.8 | 2.41 | 4.2 | 3.60 | F1.5 | F1.5 | Basin F1 | 104+00 | Lt |
| F1.7.PV | 0.99 | 6100 | 0.1 | 10 | 2.8 | 0.39 | 4.2 | 0.58 | F1.7 | F1.7 | bypass* | 107+00 | Lt |
| F1.8.PV | 0.99 | 51300 | 1.2 | 5 | 4.0 | 4.64 | 6.6 | 7.68 | ~ | F1.8 | Basin F1 | 105+00 | AL3A1 |
| F1.9.PV | 0.99 | 31500 | 0.7 | 10 | 2.8 | 2.02 | 4.2 | 3.02 | F1.9 | F1.9 | Basin F1 | 101+00 | AL3B1 |
| F1.10.PV | 0.99 | 21800 | 0.5 | 10 | 2.8 | 1.40 | 4.2 | 2.09 | ~ | F1.10 | bypass* | 32+00 | ALTA |
| F1.11.PV | 0.99 | 21100 | 0.5 | 10 | 2.8 | 1.35 | 4.2 | 2.02 | ~ | F1.11 | bypass* | 32+00 | ALTA |
| F1.12.PV | 0.99 | 19200 | 0.4 | 10 | 2.8 | 1.23 | 4.2 | 1.84 | ~ | F1.12 | bypass* | 36+00 | ALTA |
| F1.13.PV | 0.99 | 21300 | 0.5 | 10 | 2.8 | 1.36 | 4.2 | 2.04 | ~ | F1.13 | bypass* | 36+00 | ALTA |
| F1.14.PV | 0.99 | 32500 | 0.7 | 5 | 4.0 | 2.94 | 6.6 | 4.87 | ~ | F1.14 | Basin F1 | 103+50 | AL4A1 |
| F1.15.PV | 0.99 | 19000 | 0.4 | 10 | 2.8 | 1.22 | 4.2 | 1.82 | ~ | F1.15 | Basin F1 | 102+25 | AL4A1 |
| F1.16.PV | 0.99 | 68700 | 1.6 | 5 | 4.0 | 6.22 | 6.6 | 10.28 | ~ | F1.16 | Basin F1 | 116+00 | Lt |
| F1.17.PV | 0.99 | 71700 | 1.6 | 5 | 4.0 | 6.49 | 6.6 | 10.73 | ~ | F1.17 | Basin F1 | 116+00 | Rt |

$\Sigma$ 494000 *PAVED*

SLOPE

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| F1.1.SL | 0.61 | 80900 | 1.9 | 10 | 2.8 | 3.19 | 4.2 | 4.77 | ~ | F1.1 | Basin F1 | 101+00 | Lt |
| F1.2.SL | 0.61 | 32000 | 0.7 | 10 | 2.8 | 1.26 | 4.2 | 1.89 | ~ | F1.2 | Basin F1 | 101+50 | Rt |
| F1.5.SL | 0.61 | 115100 | 2.6 | 10 | 2.8 | 4.54 | 4.2 | 6.79 | F1.5 | F1.5 | Basin F1 | 104+00 | Lt |
| F1.6.SL | 0.61 | 2600 | 0.1 | 10 | 2.8 | 0.10 | 4.2 | 0.15 | ~ | F1.6 | Basin F1 | 104+00 | Lt |
| F1.7.SL | 0.61 | 8600 | 0.2 | 10 | 2.8 | 0.34 | 4.2 | 0.51 | F1.7 | F1.7 | bypass* | 107+00 | Lt |
| F1.9.SL | 0.61 | 98900 | 2.3 | 10 | 2.8 | 3.90 | 4.2 | 5.83 | F1.9 | F1.9 | Basin F1 | 101+00 | AL3B1 |
| F1.18.SL | 0.61 | 58800 | 1.3 | 10 | 2.8 | 2.32 | 4.2 | 3.47 | ~ | Culvert | Culvert | 110+00 | Lt |
| F1.19.SL | 0.61 | 57200 | 1.3 | 10 | 2.8 | 2.26 | 4.2 | 3.37 | ~ | ~ | bypass* | 110+00 | Rt |
| F1.20.SL | 0.61 | 74800 | 1.7 | 10 | 2.8 | 2.95 | 4.2 | 4.41 | ~ | F1.20 | Basin F1 | 113+00 | Rt |

$\Sigma$ 528900 *SLOPE*

** flow that does not reach the basin*

| Total : | 1022900 | 23.5 |
|---|---|---|
| | *SF* | *ac* |

WATERSHED F1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1" =450'

# F1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 01.03.10 | WATERSHED: | F1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 5443181 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 124.96 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.20 | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.47 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 81% | AT | 0.47 | 0.382 |
| PAVED SURFACE | 9% | AT | 0.90 | 0.082 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 10% | AT | 0.55 | 0.053 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.52 |
| $C_{25}$ = | 0.57 |
| $C_{50}$ = | 0.62 |
| $C_{100}$ = | 0.65 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.4\cdot5}n^{.4\cdot5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F1 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft | Exist Cross Culvert under berm |
| LOW POINT ELEVATION | 587.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | |
| $T_C$ (SD)= | 0.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$ $V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | defined broad channel south of berm (field verified new berm) |
| LOW POINT ELEVATION | 576.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 / ANG-RAD / 0.197 |
| LENGTH (L) | 311 | ft | b = 50 / ANG-DEG / 11.310 |
| SLOPE (S) = (H/L) | 3.5% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.9 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.30 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 555.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 957 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.2% | | d = 1.5 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.74 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 555.0 | ft | Proposed Cross Culvert under SR-11 |
| LOW POINT ELEVATION | 546.0 | ft | Outfall/Rip Rap Pad |
| ELEVATION DIFF (H) | 9.0 | ft | |
| LENGTH (L) | 326 | ft | |
| SLOPE (S) = (H/L) | 2.8% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 4.0 | ft | |
| HYDRAULIC RADIUS R | 1.0 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 19.0 | fps | |
| $T_C$ (SD)= | 0.29 | minutes | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 546.0 | ft | channellized - natural |
| LOW POINT ELEVATION | 536.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 10.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 700 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 1.4% | | d = 2 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 1.0 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.58 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.26 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 29.19 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **29.19** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = | $Q_2$ = | 60.0 |
| $i_{10}$ = | 1.4 | in/hr | X CA = | $Q_{10}$ = | 87.2 |
| $i_{25}$ = | 1.7 | in/hr | X CA = | $Q_{25}$ = | 120.0 |
| $i_{50}$ = | 2.0 | in/hr | X CA = | $Q_{50}$ = | 157.0 |
| $i_{100}$ = | 2.1 | in/hr | X CA = | $Q_{100}$ = | **170.4** |

**FLOW RESULTS:** cfs

**COUNTY $P_6$** inches

| | |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

CULVERT F1
ONE INTERCHANGE
ALTERNATIVE

Scale: 1" =450'

# Culvert Calculator Report
# F1 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 559.00 | ft | Headwater Depth/Height | 0.92 | |
| Computed Headwater Elevation | 558.67 | ft | Discharge | 57.20 | cfs |
| Inlet Control HW Elev. | 558.36 | ft | Tailwater Elevation | 547.33 | ft |
| Outlet Control HW Elev. | 558.67 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.33 | ft |
| Slope Type | Steep | | Normal Depth | 1.33 | ft |
| Flow Regime | Supercritical | | Critical Depth | 2.28 | ft |
| Velocity Downstream | 15.60 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 558.67 | ft | Upstream Velocity Head | 0.93 | ft |
| Ke | 0.50 | | Entrance Loss | 0.47 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 558.36 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## F1 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 562.00 | ft | Headwater Depth/Height | 1.51 | |
| Computed Headwater Elevation | 561.02 | ft | Discharge | 116.10 | cfs |
| Inlet Control HW Elev. | 561.02 | ft | Tailwater Elevation | 547.98 | ft |
| Outlet Control HW Elev. | 560.88 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.98 | ft |
| Slope Type | Steep | | Normal Depth | 1.97 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.25 | ft |
| Velocity Downstream | 18.72 | ft/s | Critical Slope | 0.7 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 560.88 | ft | Upstream Velocity Head | 1.75 | ft |
| Ke | 0.50 | | Entrance Loss | 0.88 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 561.02 | ft | Flow Control | Submerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# F1 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Culvert |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 11.17.09 | WATERSHED: | F1.Culvert |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Culvert F1 |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 3796682 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 87.16 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.20 | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.06 | Normal |
| TOTAL C = | 0.46 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.46 | 0.455 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.46 |
| $C_{25}$ = | 0.51 |
| $C_{50}$ = | 0.56 |
| $C_{100}$ = | 0.58 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.4\cdot5}n^{.4\cdot5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F1 Culvert TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft | Exist Cross Culvert under berm |
| LOW POINT ELEVATION | 587.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | |
| $T_C$ (SD)= | 0.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | defined broad channel south of berm (field verified new berm) |
| LOW POINT ELEVATION | 576.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 / ANG-RAD / 0.197 |
| LENGTH (L) | 311 | ft | b = 50 / ANG-DEG / 11.310 |
| SLOPE (S) = (H/L) | 3.5% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural channel |
| HYDRAULIC RADIUS R | 0.9 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.30 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 555.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 957 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.2% | | d = 1.5 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.74 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 25.64 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **25.64** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | **FLOW RESULTS:** | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | $Q_2$ = | 30.4 |
| $i_{10}$ = | 1.4 | in/hr | X CA = | $Q_{10}$ = | 57.2 |
| $i_{25}$ = | 1.8 | in/hr | X CA = | $Q_{25}$ = | 78.7 |
| $i_{50}$ = | 2.0 | in/hr | X CA = | $Q_{50}$ = | 98.7 |
| $i_{100}$ = | 2.3 | in/hr | X CA = | $Q_{100}$ = | **116.1** |

~Use Caltrans 'i' for culvert sizing

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

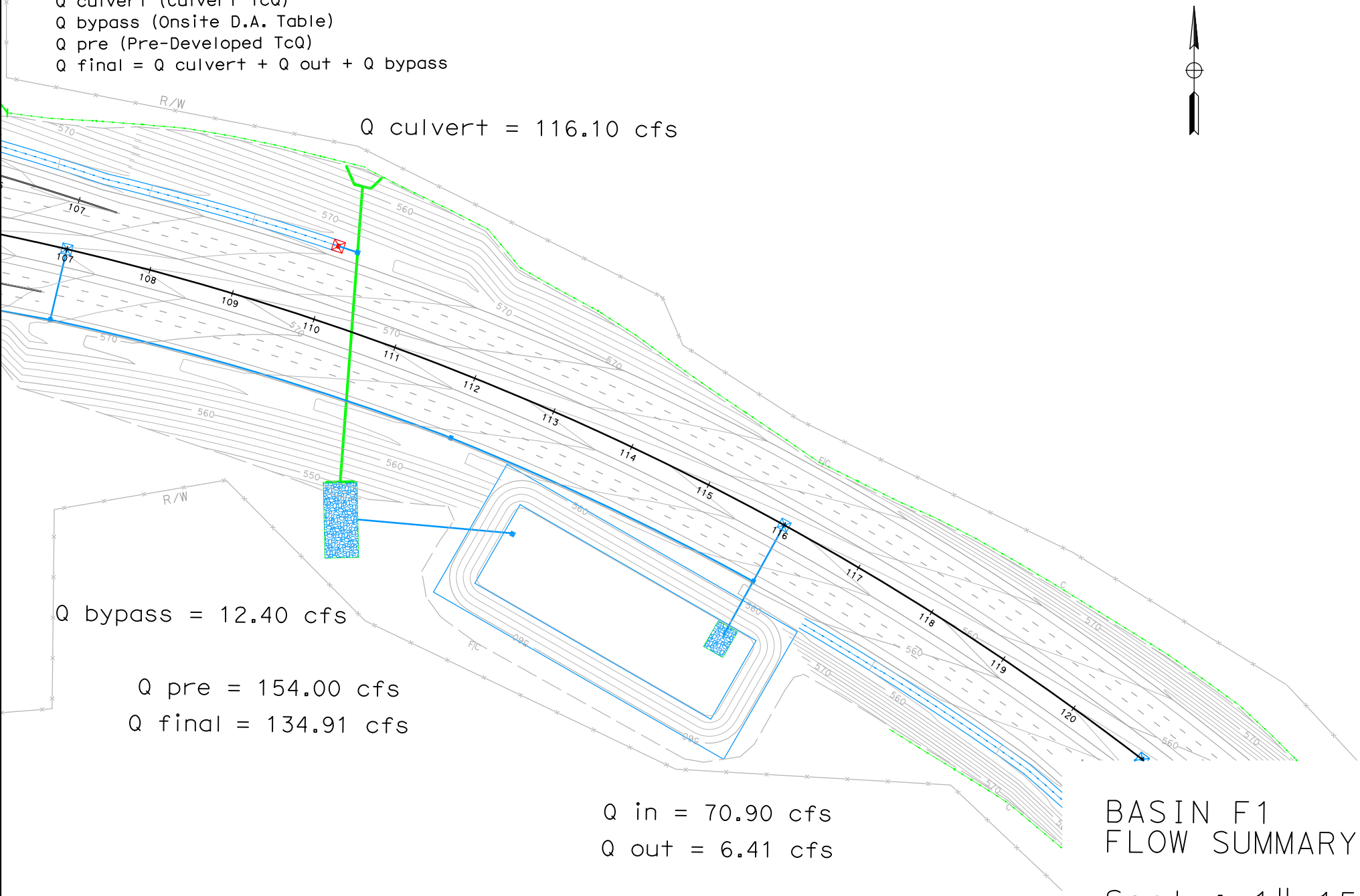
| | | | | **FLOW RESULTS** | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | $Q_2$ = | 40.9 |
| $i_{10}$ = | 1.5 | in/hr | X CA = | $Q_{10}$ = | 59.5 |
| $i_{25}$ = | 1.8 | in/hr | X CA = | $Q_{25}$ = | 81.7 |
| $i_{50}$ = | 2.2 | in/hr | X CA = | $Q_{50}$ = | 107.0 |
| $i_{100}$ = | 2.3 | in/hr | X CA = | $Q_{100}$ = | **116.1** |

~Use County of SD 'i' for detention basin design

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN F1
FLOW SUMMARY

Scale: 1"=150'

# Basin F1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **10.13.09** | **WATERSHED:** | **F1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 154.0 | cfs | | | |
| Tc= | 30.0 | min | C= | 0.59 | |
| $P_{100,6}$= | 2.5 | in | A= | 125.36 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 30 | 20340 | 11.3 |
| 60 | 21600 | 12 |
| 90 | 24660 | 13.7 |
| 120 | 26820 | 14.9 |
| 150 | 32760 | 18.2 |
| 180 | 37260 | 20.7 |
| 210 | 54720 | 30.4 |
| 240 | 75960 | 42.2 |
| 270 | 277200 | 154 |
| 300 | 43920 | 24.4 |
| 330 | 29340 | 16.3 |
| 360 | 23040 | 12.8 |
| 390 | 0 | 0 |

**SUM= 667620 $ft^3$**
**15.33 acre-feet**

Check: V = C*A*$P_6$
V= 15.47 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin F1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 170.4 | cfs | | | |
| Tc= | 29.2 | min | C= | 0.65 | |
| $P_{100,6}$= | 2.5 | in | A= | 124.96 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 29 | 22098 | 12.7 |
| 58 | 23316 | 13.4 |
| 87 | 26796 | 15.4 |
| 116 | 29058 | 16.7 |
| 145 | 35496 | 20.4 |
| 174 | 40368 | 23.2 |
| 203 | 59334 | 34.1 |
| 232 | 86652 | 49.8 |
| 261 | 296496 | 170.4 |
| 290 | 47502 | 27.3 |
| 319 | 31842 | 18.3 |
| 348 | 24882 | 14.3 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 723840 $ft^3$**
**16.62 acre-feet**

Check: V = C*A*$P_6$
V= 16.82 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **16.62** | *(Post)* | | |
| | **-** | **15.33** | *(Pre)* | | |
| **Retention volume =** | | **1.29** | **acre-feet** | **=** | **56220 $ft^3$** **Basin Required** |

# Basin F1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.91
A= 18.57 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **49202** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

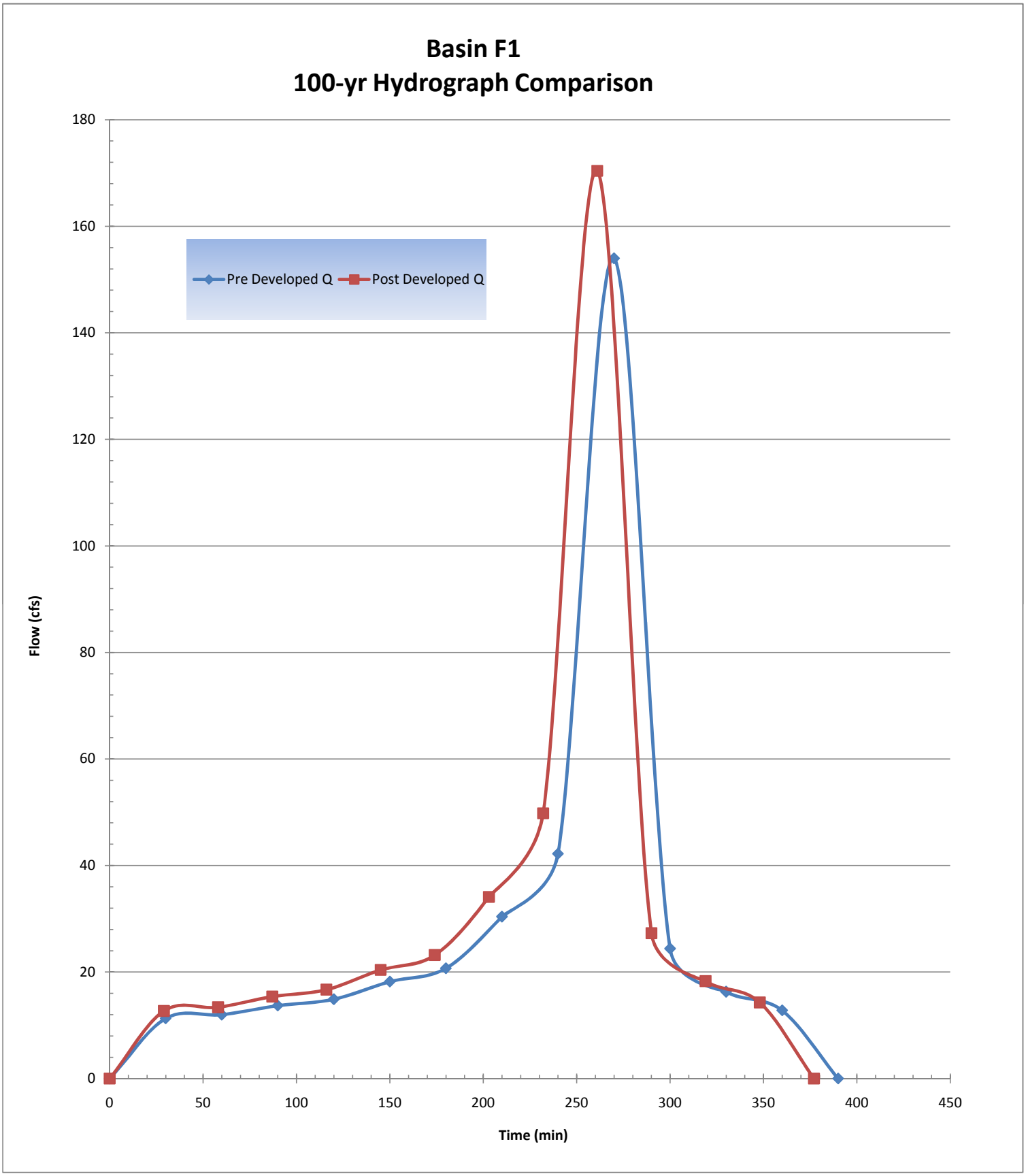
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 404300 | $ft^2$ |
| | A: | 9.28 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 144.35 tons

**Silt Accumulation Basin volume =** **3208** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin F1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
180
0
50
100
150
200
250
300
350
400
450

# Basin F1 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 01.03.10 | WATERSHED: | F1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 808800 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 18.57 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | |
|---|---|
| RELIEF (.08-.35) | 0.00 |
| INFILTRATION (.04-.16) | 0.00 |
| VEGETATION (.04-.16) | 0.00 |
| STORAGE (.04-.12) | 0.00 |
| TOTAL C = | 0.00 |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 50% | AT | 0.90 | 0.450 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 50% | AT | 0.55 | 0.275 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.73 |
| $C_{25}$ = | 0.80 |
| $C_{50}$ = | 0.87 |
| $C_{100}$ = | 0.91 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 604.0 | ft | Alta Ramp AL4A1, Sta 98+50 |
| LOW POINT ELEVATION | 603.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | to ES |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.016 | | AC < = From Table 816.6A |
| $T_t$ (SFF)= | 2.88 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 603.0 | ft | flow in side road ditch - per grading |
| LOW POINT ELEVATION | 602.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 86 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 1.2% | | |
| VELOCITY (SCF) | 1.1 | fps | 1.2% , V FROM FIG 816.6 Nearly Bare Ground |
| $T_C$ (SH)= | 1.30 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 602.0 | ft | flow in side road ditch - per grading |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 2.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 196 | ft | b = 6 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.0% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.40 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.62 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.02 | minutes | |

# Basin F1 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 595.0 | ft | Proposed onsite pipe (assumed 5' drop to invert) |
| LOW POINT ELEVATION | 550.0 | ft | Proposed Rip Rap Pad in Basin floor |
| ELEVATION DIFF (H) | 45.0 | ft | |
| LENGTH (L) | 1891 | ft | |
| SLOPE (S) = (H/L) | 2.4% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 14.6 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 2.16 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.35 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | $Q_2$ = | 25.0 |
| $i_{10}$ = | 2.7 | in/hr | X CA = | $Q_{10}$ = | 36.3 |
| $i_{25}$ = | 3.4 | in/hr | X CA = | $Q_{25}$ = | 49.9 |
| $i_{50}$ = | 4.0 | in/hr | X CA = | $Q_{50}$ = | 65.3 |
| $i_{100}$ = | 4.2 | in/hr | X CA = | $Q_{100}$ = | **70.9** |

**FLOW RESULTS**

cfs

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin F1 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **11.17.09** | **WATERSHED:** | **F1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 70.9 | cfs | $C_{100}$= | 0.91 | |
| Tc= | 10.0 | min | | | |
| $P_{100,6}$= | 2.5 | in | A= | 18.57 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1500 | 2.5 |
| 20 | 1560 | 2.6 |
| 30 | 1620 | 2.7 |
| 40 | 1620 | 2.7 |
| 50 | 1680 | 2.8 |
| 60 | 1740 | 2.9 |
| 70 | 1860 | 3.1 |
| 80 | 1860 | 3.1 |
| 90 | 1980 | 3.3 |
| 100 | 2040 | 3.4 |
| 110 | 2160 | 3.6 |
| 120 | 2220 | 3.7 |
| 130 | 2400 | 4 |
| 140 | 2460 | 4.1 |
| 150 | 2700 | 4.5 |
| 160 | 2820 | 4.7 |
| 170 | 3120 | 5.2 |
| 180 | 3300 | 5.5 |
| 190 | 3840 | 6.4 |
| 200 | 4140 | 6.9 |
| 210 | 5040 | 8.4 |
| 220 | 5760 | 9.6 |
| 230 | 8460 | 14.1 |
| 240 | 12060 | 20.1 |
| 250 | 42540 | 70.9 |
| 260 | 6780 | 11.3 |
| 270 | 4560 | 7.6 |
| 280 | 3540 | 5.9 |
| 290 | 3000 | 5 |
| 300 | 2580 | 4.3 |
| 310 | 2280 | 3.8 |
| 320 | 2100 | 3.5 |
| 330 | 1920 | 3.2 |
| 340 | 1800 | 3 |
| 350 | 1680 | 2.8 |
| 360 | 1560 | 2.6 |
| 370 | 0 | 0 |

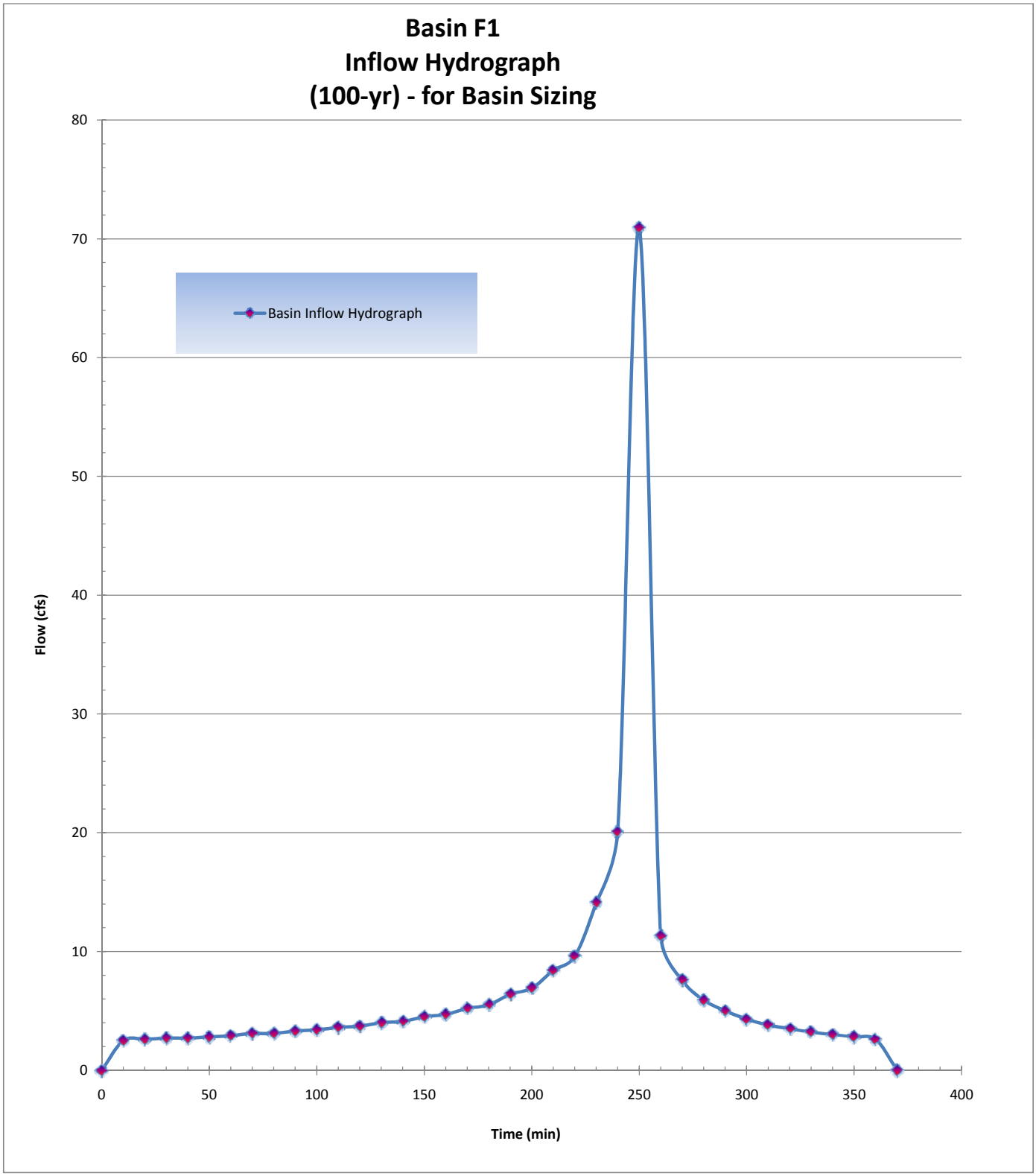
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 152280 $ft^3$**
**3.50 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 3.51 acre-feet
***OK***


Basin F1
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
350
400

# Basin F1 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **F1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin Outlet** |

***Notes:***

Required Retention Basin Volume = 59428 $ft^3$

Actual Basin Inflow = 152280 $ft^3$ *OK*

***Flow Balance - determine maximum flow from basin***

| | | | | | |
|---|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 154.0 | cfs | | | |
| Post-Developed Peak Flow through Cross Culvert: | 116.1 | cfs | | Includes: | F1.18.SL |
| Flow that does not reach detention basin (bypass per DA table): | 12.4 | cfs | ~ | $Q_{100}$ from: | Alta Road (County) |
| Maximum flow allowed to be released by this detention basin: | 25.4 | cfs | | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 558.00 | ft |
| Basin flowline elevation = | 552.00 | ft |
| Maximum Basin Depth = | 6.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 1.80 | ft | 553.80 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 325 | ft |
| Base Width (W) | 100 | ft |
| W/L Ratio ® | 0.31 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 260961 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 552.00 | 0.00 | 0 | 0 | | 552.00 | 0.00 | | 0.00 |
| 1 | 552.20 | 0.20 | 6568 | 6568 | | 552.20 | 0.00 | | 0.00 |
| 2 | 552.40 | 0.40 | 6705 | 13273 | | 552.40 | 0.00 | | 0.00 |
| 3 | 552.60 | 0.60 | 6843 | 20116 | | 552.60 | 0.00 | | 0.00 |
| 4 | 552.80 | 0.80 | 6982 | 27099 | | 552.80 | 0.00 | | 0.00 |
| 5 | 553.00 | 1.00 | 7122 | 34221 | | 553.00 | 0.00 | | 0.00 |
| 6 | 553.20 | 1.20 | 7264 | 41485 | | 553.20 | 0.00 | | 0.00 |
| 7 | 553.40 | 1.40 | 7406 | 48891 | | 553.40 | 0.00 | | 0.00 |
| 8 | 553.60 | 1.60 | 7549 | 56440 | | 553.60 | 0.00 | | 0.00 |
| 9 | 553.80 | 1.80 | 7694 | 64134 | * | 553.80 | 0.00 | | 0.00 |
| 10 | 554.00 | 2.00 | 7839 | 71973 | | 554.00 | 0.15 | 0.00 | 0.15 |
| 11 | 554.20 | 2.20 | 7986 | 79959 | | 554.20 | 0.59 | | 0.59 |
| 12 | 554.40 | 2.40 | 8134 | 88093 | | 554.40 | 1.30 | | 1.30 |
| 13 | 554.60 | 2.60 | 8282 | 96375 | | 554.60 | 2.25 | | 2.25 |
| 14 | 554.80 | 2.80 | 8432 | 104807 | | 554.80 | 3.42 | | 3.42 |
| 15 | 555.00 | 3.00 | 8583 | 113390 | | 555.00 | 4.79 | | 4.79 |
| 16 | 555.20 | 3.20 | 8735 | 122125 | | 555.20 | 6.32 | | 6.32 |
| 17 | 555.40 | 3.40 | 8888 | 131013 | | 555.40 | 7.99 | | 7.99 |
| 18 | 555.60 | 3.60 | 9042 | 140055 | | 555.60 | 9.77 | | 9.77 |
| 19 | 555.80 | 3.80 | 9197 | 149252 | | 555.80 | 11.63 | | 11.63 |
| 20 | 556.00 | 4.00 | 9353 | 158605 | | 556.00 | 13.53 | | 13.53 |

# Basin F1 Routing

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | F |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin F1 |

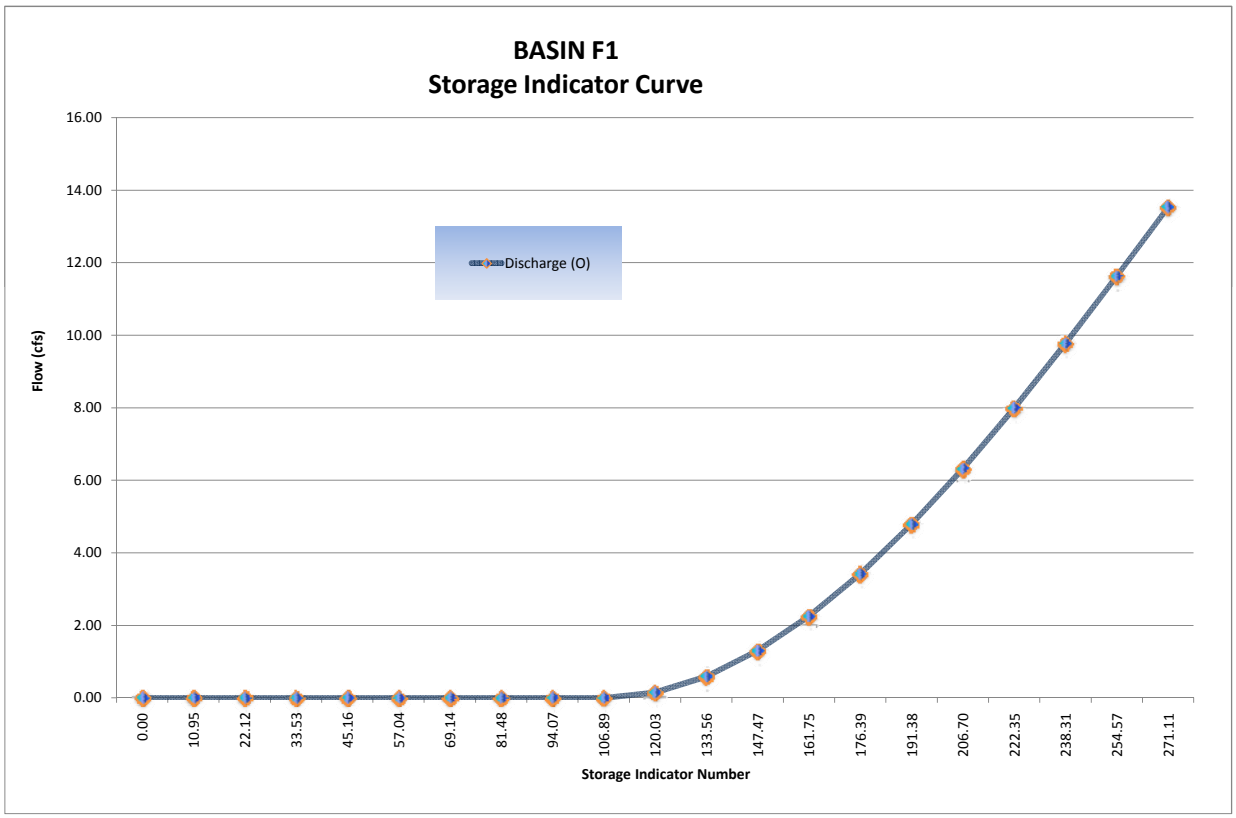
user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

59428

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 552.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 552.20 | 0.00 | 6568 | 0.00 | 10.95 | 10.95 |
| 552.40 | 0.00 | 13273 | 0.00 | 22.12 | 22.12 |
| 552.60 | 0.00 | 20116 | 0.00 | 33.53 | 33.53 |
| 552.80 | 0.00 | 27099 | 0.00 | 45.16 | 45.16 |
| 553.00 | 0.00 | 34221 | 0.00 | 57.04 | 57.04 |
| 553.20 | 0.00 | 41485 | 0.00 | 69.14 | 69.14 |
| 553.40 | 0.00 | 48891 | 0.00 | 81.48 | 81.48 |
| 553.60 | 0.00 | 56440 | 0.00 | 94.07 | 94.07 |
| 553.80 | 0.00 | 64134 | 0.00 | 106.89 | 106.89 |
| 554.00 | 0.15 | 71973 | 0.08 | 119.96 | 120.03 |
| 554.20 | 0.59 | 79959 | 0.30 | 133.27 | 133.56 |
| 554.40 | 1.30 | 88093 | 0.65 | 146.82 | 147.47 |
| 554.60 | 2.25 | 96375 | 1.13 | 160.63 | 161.75 |
| 554.80 | 3.42 | 104807 | 1.71 | 174.68 | 176.39 |
| 555.00 | 4.79 | 113390 | 2.40 | 188.98 | 191.38 |
| 555.20 | 6.32 | 122125 | 3.16 | 203.54 | 206.70 |
| 555.40 | 7.99 | 131013 | 4.00 | 218.35 | 222.35 |
| 555.60 | 9.77 | 140055 | 4.89 | 233.42 | 238.31 |
| 555.80 | 11.63 | 149252 | 5.82 | 248.75 | 254.57 |
| 556.00 | 13.53 | 158605 | 6.77 | 264.34 | 271.11 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



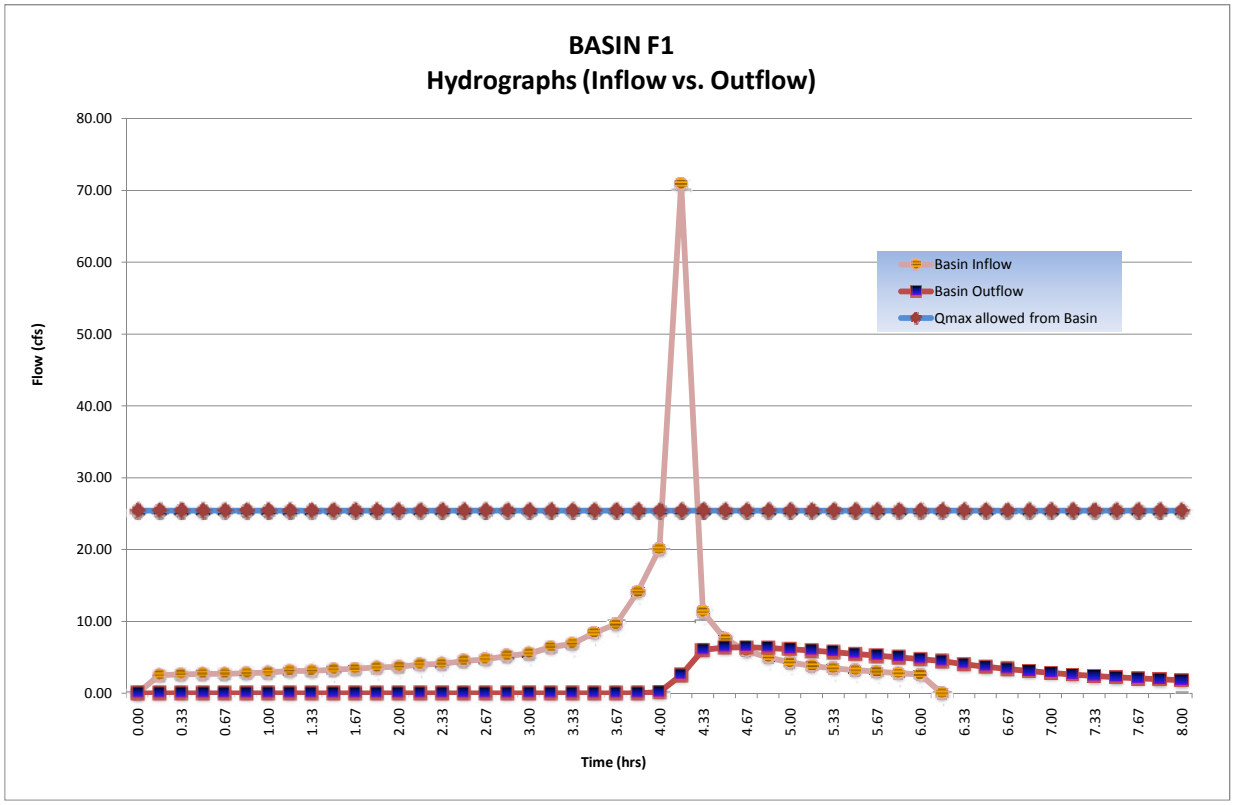
# Basin F1 Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

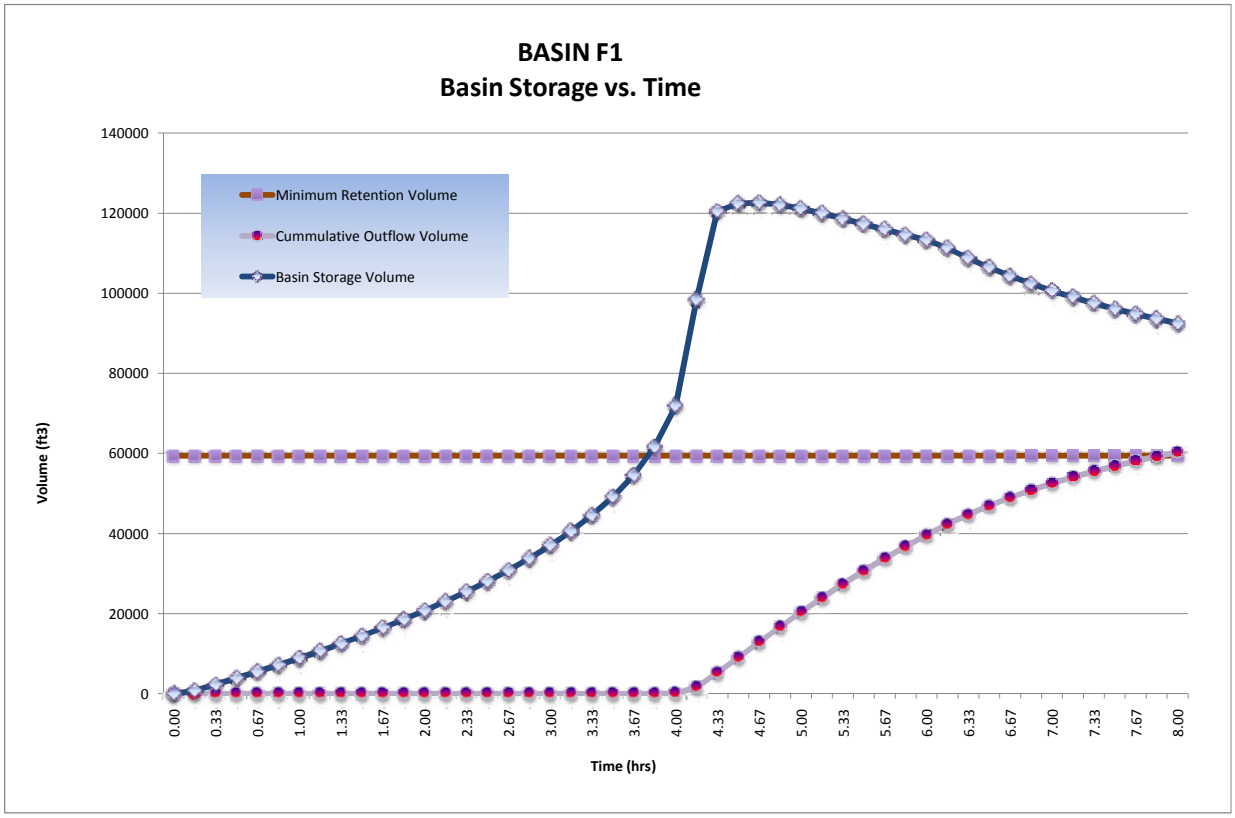
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 2.50 | 1.25 | 0.00 | 0.00 | 1.25 | 0.00 | 750 | 0 | 0 |
| 0.33 | 2.60 | 2.55 | 1.25 | 0.00 | 3.80 | 0.00 | 2280 | 0 | 0 |
| 0.50 | 2.70 | 2.65 | 3.80 | 0.00 | 6.45 | 0.00 | 3870 | 0 | 0 |
| 0.67 | 2.70 | 2.70 | 6.45 | 0.00 | 9.15 | 0.00 | 5490 | 0 | 0 |
| 0.83 | 2.80 | 2.75 | 9.15 | 0.00 | 11.90 | 0.00 | 7140 | 0 | 0 |
| 1.00 | 2.90 | 2.85 | 11.90 | 0.00 | 14.75 | 0.00 | 8850 | 0 | 0 |
| 1.17 | 3.10 | 3.00 | 14.75 | 0.00 | 17.75 | 0.00 | 10650 | 0 | 0 |
| 1.33 | 3.10 | 3.10 | 17.75 | 0.00 | 20.85 | 0.00 | 12510 | 0 | 0 |
| 1.50 | 3.30 | 3.20 | 20.85 | 0.00 | 24.05 | 0.00 | 14430 | 0 | 0 |
| 1.67 | 3.40 | 3.35 | 24.05 | 0.00 | 27.40 | 0.00 | 16440 | 0 | 0 |
| 1.83 | 3.60 | 3.50 | 27.40 | 0.00 | 30.90 | 0.00 | 18540 | 0 | 0 |
| 2.00 | 3.70 | 3.65 | 30.90 | 0.00 | 34.55 | 0.00 | 20730 | 0 | 0 |
| 2.17 | 4.00 | 3.85 | 34.55 | 0.00 | 38.40 | 0.00 | 23040 | 0 | 0 |
| 2.33 | 4.10 | 4.05 | 38.40 | 0.00 | 42.45 | 0.00 | 25470 | 0 | 0 |
| 2.50 | 4.50 | 4.30 | 42.45 | 0.00 | 46.75 | 0.00 | 28050 | 0 | 0 |
| 2.67 | 4.70 | 4.60 | 46.75 | 0.00 | 51.35 | 0.00 | 30810 | 0 | 0 |
| 2.83 | 5.20 | 4.95 | 51.35 | 0.00 | 56.30 | 0.00 | 33780 | 0 | 0 |
| 3.00 | 5.50 | 5.35 | 56.30 | 0.00 | 61.65 | 0.00 | 36990 | 0 | 0 |
| 3.17 | 6.40 | 5.95 | 61.65 | 0.00 | 67.60 | 0.00 | 40560 | 0 | 0 |
| 3.33 | 6.90 | 6.65 | 67.60 | 0.00 | 74.25 | 0.00 | 44550 | 0 | 0 |
| 3.50 | 8.40 | 7.65 | 74.25 | 0.00 | 81.90 | 0.00 | 49139 | 2 | 2 |
| 3.67 | 9.60 | 9.00 | 81.90 | 0.00 | 90.90 | 0.00 | 54537 | 2 | 4 |
| 3.83 | 14.10 | 11.85 | 90.90 | 0.00 | 102.74 | 0.00 | 61646 | 2 | 5 |
| 4.00 | 20.10 | 17.10 | 102.74 | 0.00 | 119.84 | 0.15 | 71860 | 90 | 95 |
| 4.17 | 70.90 | 45.50 | 119.84 | 0.15 | 165.19 | 2.53 | 98356 | 1518 | 1613 |
| 4.33 | 11.30 | 41.10 | 165.19 | 2.53 | 203.76 | 6.03 | 120448 | 3618 | 5231 |
| 4.50 | 7.60 | 9.45 | 203.76 | 6.03 | 207.18 | 6.37 | 122398 | 3822 | 9053 |
| 4.67 | 5.90 | 6.75 | 207.18 | 6.37 | 207.56 | 6.41 | 122614 | 3846 | 12899 |
| 4.83 | 5.00 | 5.45 | 207.56 | 6.41 | 206.60 | 6.31 | 122068 | 3786 | 16685 |
| 5.00 | 4.30 | 4.65 | 206.60 | 6.31 | 204.94 | 6.14 | 121123 | 3684 | 20369 |
| 5.17 | 3.80 | 4.05 | 204.94 | 6.14 | 202.85 | 5.94 | 119929 | 3564 | 23933 |
| 5.33 | 3.50 | 3.65 | 202.85 | 5.94 | 200.56 | 5.71 | 118624 | 3426 | 27359 |
| 5.50 | 3.20 | 3.35 | 200.56 | 5.71 | 198.20 | 5.47 | 117280 | 3282 | 30641 |
| 5.67 | 3.00 | 3.10 | 198.20 | 5.47 | 195.83 | 5.23 | 115930 | 3138 | 33779 |
| 5.83 | 2.80 | 2.90 | 195.83 | 5.23 | 193.50 | 5.00 | 114601 | 3000 | 36779 |
| 6.00 | 2.60 | 2.70 | 193.50 | 5.00 | 191.20 | 4.77 | 113290 | 2862 | 39641 |
| 6.17 | 0.00 | 1.30 | 191.20 | 4.77 | 187.73 | 4.46 | 111301 | 2676 | 42317 |
| 6.33 | | 0.00 | 187.73 | 4.46 | 183.27 | 4.05 | 108748 | 2430 | 44747 |
| 6.50 | | 0.00 | 183.27 | 4.05 | 179.22 | 3.68 | 106429 | 2208 | 46955 |
| 6.67 | | 0.00 | 179.22 | 3.68 | 175.54 | 3.35 | 104320 | 2010 | 48965 |
| 6.83 | | 0.00 | 175.54 | 3.35 | 172.19 | 3.08 | 102391 | 1848 | 50813 |
| 7.00 | | 0.00 | 172.19 | 3.08 | 169.11 | 2.84 | 100615 | 1704 | 52517 |
| 7.17 | | 0.00 | 169.11 | 2.84 | 166.27 | 2.61 | 98980 | 1566 | 54083 |
| 7.33 | | 0.00 | 166.27 | 2.61 | 163.66 | 2.40 | 97477 | 1440 | 55523 |
| 7.50 | | 0.00 | 163.66 | 2.40 | 161.26 | 2.22 | 96091 | 1332 | 56855 |
| 7.67 | | 0.00 | 161.26 | 2.22 | 159.04 | 2.07 | 94804 | 1242 | 58097 |
| 7.83 | | 0.00 | 159.04 | 2.07 | 156.97 | 1.93 | 93604 | 1158 | 59255 |
| 8.00 | | 0.00 | 156.97 | 1.93 | 155.04 | 1.80 | 92485 | 1080 | 60335 |

**Basin F1 Routing**



## Basin F1 Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **122,614** | **$ft^3$** | |
| **@ Stage:** | **555.40** | **ft** | |
| **Freeboard:** | **2.6** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **260,961** | **$ft^3$** | Basin **F1** |
| **Maximum flow rate released from this basin:** | **6.41** | **cfs** | |

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# G1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | On-site Drainage Areas (D.A.) |
| JOB #: | 11A1190 | | | STATION: | ~ |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | G1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

PAVED

| Name | C | Area SF | Area Acres | Tc min | Caltrans $i_{25}$ in/hr | Caltrans $Q_{25}$ cfs | County $i_{100}$ in/hr | County $Q_{100}$ cfs | Drains to: Bioswale | Drains to: Inlet | Drains to: Destination | @ Station | Offset |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G1.1.PV | 0.99 | 19000 | 0.4 | 5 | 4.0 | 1.73 | 6.6 | 2.84 | ~ | G1.1 | Basin G1-North | 127+00 | Rt |
| G1.2.PV | 0.99 | 39000 | 0.9 | 5 | 4.0 | 3.55 | 6.6 | 5.84 | ~ | G1.2 | Basin G1-North | 121+00 | Center |
| G1.3.PV | 0.99 | 47000 | 1.1 | 5 | 4.0 | 4.27 | 6.6 | 7.04 | ~ | G1.3 | Basin G1-North | 127+00 | Center |
| G1.4.PV | 0.99 | 29700 | 0.7 | 5 | 4.0 | 2.70 | 6.6 | 4.45 | ~ | G1.4 | Basin G1-North | 131+50 | Center |
| G1.5.PV | 0.99 | 45800 | 1.1 | 5 | 4.0 | 4.16 | 6.6 | 6.86 | ~ | G1.5 | Basin G1-South | 139+00 | Lt |
| G1.6.PV | 0.99 | 26800 | 0.6 | 5 | 4.0 | 2.44 | 6.6 | 4.01 | ~ | G1.6 | Basin G1-South | 139+00 | Rt |
| G1.7.PV | 0.99 | 11400 | 0.3 | 5 | 4.0 | 1.04 | 6.6 | 1.71 | ~ | G1.7 | Basin G1-South | 135+00 | Rt |
| G1.8.PV | 0.99 | 88200 | 2.0 | 10 | 2.8 | 5.67 | 4.2 | 8.44 | G1.8 | G1.8 | bypass* | 130+20 | SDR1 |
| G1.9.PV | 0.99 | 40500 | 0.9 | 10 | 2.8 | 2.60 | 4.2 | 3.88 | G1.9 | G1.9 | Basin G1-South | 135+00 | SV1 |
| G1.10.PV | 0.99 | 30300 | 0.7 | 5 | 4.0 | 2.76 | 6.6 | 4.54 | ~ | G1.10 | Basin G1-North | 131+50 | Rt |
| G1.11.PV | 0.99 | 6200 | 0.1 | 5 | 4.0 | 0.56 | 6.6 | 0.93 | ~ | G1.11 | Basin G1-North | 131+50 | Lt |
| G1.12.PV | 0.99 | 22100 | 0.5 | 5 | 4.0 | 2.01 | 6.6 | 3.31 | ~ | G1.12 | Basin G1-North | 105+50 | SVI1 |
| G1.13.PV | 0.99 | 22200 | 0.5 | 5 | 4.0 | 2.02 | 6.6 | 3.32 | ~ | G1.13 | Basin G1-North | 105+50 | SVI1 |
| G1.14.PV | 0.99 | 18000 | 0.4 | 5 | 4.0 | 1.64 | 6.6 | 2.69 | ~ | G1.14 | Basin G1-North | 102+00 | SVI1 |
| G1.15.PV | 0.99 | 17300 | 0.4 | 5 | 4.0 | 1.57 | 6.6 | 2.59 | ~ | G1.15 | Basin G1-North | 102+00 | SVI1 |
| G1.16.PV | 0.99 | 43800 | 1.0 | 5 | 4.0 | 3.98 | 6.6 | 6.56 | ~ | G1.16 | Basin G1-South | 155+00 | SDR1 |
| G1.17.PV | 0.99 | 62900 | 1.4 | 5 | 4.0 | 5.72 | 6.6 | 9.42 | ~ | G1.17 | Basin G1-South | 155+00 | SV1 |
| G1.18.PV | 0.99 | 68700 | 1.6 | 5 | 4.0 | 6.25 | 6.6 | 10.28 | ~ | G1.18 | Basin G1-South | Toll 1 | ~ |
| G1.19.PV | 0.99 | 67300 | 1.5 | 5 | 4.0 | 6.12 | 6.6 | 10.07 | ~ | G1.19 | Basin G1-South | Toll 2 | ~ |
| G1.20.PV | 0.99 | 11400 | 0.3 | 5 | 4.0 | 1.04 | 6.6 | 1.71 | ~ | G1.20 | Basin G1-South | 100+00 | SVI1 |
| G1.21.PV | 0.99 | 11300 | 0.3 | 5 | 4.0 | 1.03 | 6.6 | 1.69 | ~ | G1.21 | Basin G1-South | 100+00 | SVI1 |
| G1.27.PV | 0.99 | 34200 | 0.8 | 5 | 4.0 | 3.11 | 6.6 | 5.12 | ~ | ~ | bypass* | 96+50 | SVI |

Σ 763100 *PAVED*

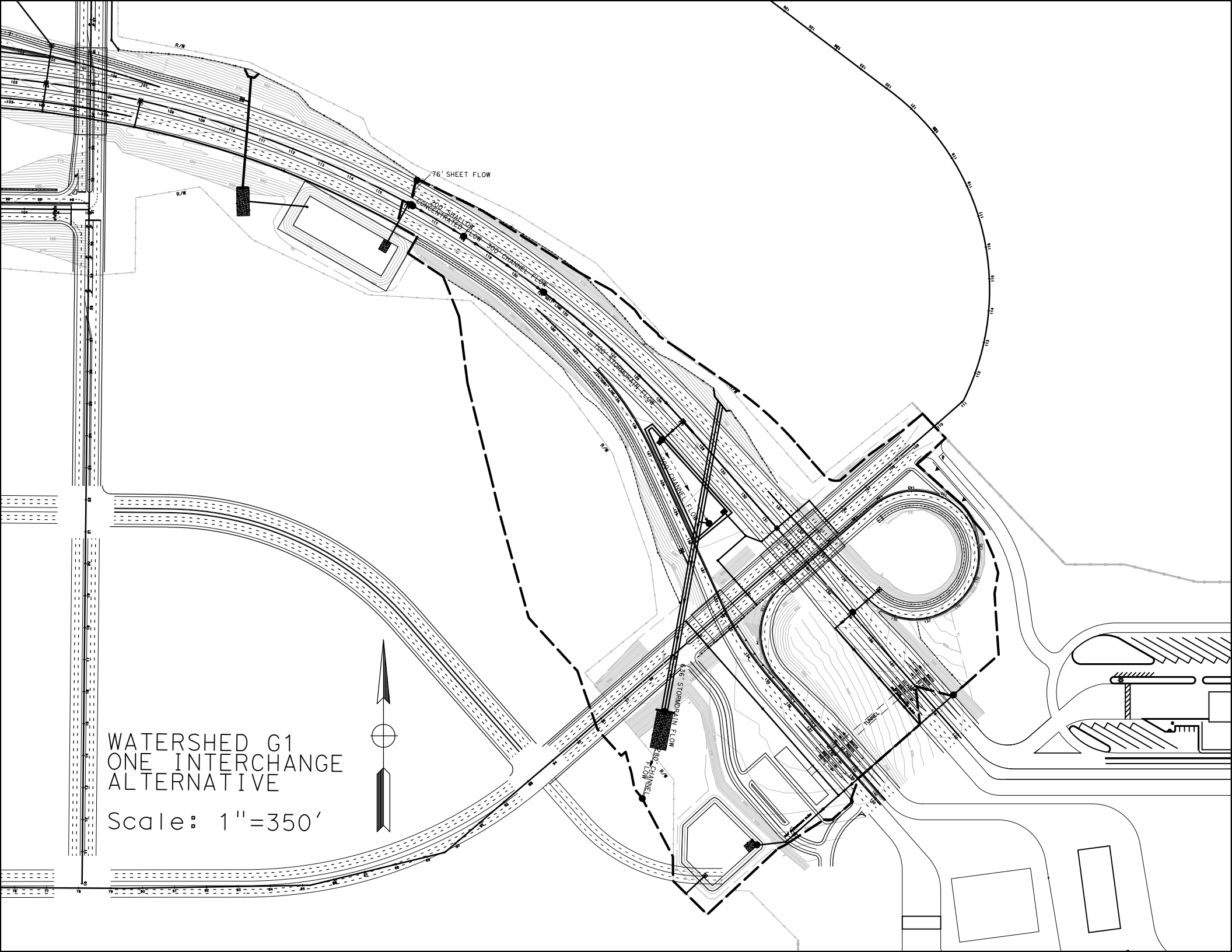
SLOPE

| Name | C | Area SF | Area Acres | Tc min | Caltrans $i_{25}$ in/hr | Caltrans $Q_{25}$ cfs | County $i_{100}$ in/hr | County $Q_{100}$ cfs | Drains to: Bioswale | Drains to: Inlet | Drains to: Destination | @ Station | Offset |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G1.5.SL | 0.61 | 13600 | 0.3 | 10 | 2.8 | 0.54 | 4.2 | 0.80 | ~ | G1.5 | Basin G1-South | 139+00 | Lt |
| G1.6.SL | 0.61 | 70500 | 1.6 | 10 | 2.8 | 2.79 | 4.2 | 4.16 | ~ | G1.6 | Basin G1-South | 139+00 | Rt |
| G1.7.SL | 0.61 | 30700 | 0.7 | 10 | 2.8 | 1.22 | 4.2 | 1.81 | ~ | G1.7 | Basin G1-South | 135+00 | Rt |
| G1.8.SL | 0.61 | 87000 | 2.0 | 10 | 2.8 | 3.45 | 4.2 | 5.13 | G1.8 | G1.8 | bypass* | 130+20 | SDR1 |
| G1.9.SL | 0.61 | 95400 | 2.2 | 10 | 2.8 | 3.78 | 4.2 | 5.63 | G1.9 | G1.8 | Basin G1-South | 135+00 | SV1 |
| G1.22.SL | 0.61 | 74000 | 1.7 | 10 | 2.8 | 2.93 | 4.2 | 4.37 | ~ | G1.22 | Basin G1-North | 130+00 | SDR1 |
| G1.23.SL | 0.61 | 57400 | 1.3 | 10 | 2.8 | 2.27 | 4.2 | 3.39 | ~ | G1.23 | Basin G1-South | 139+00 | Lt |
| G1.24.SL | 0.61 | 101200 | 2.3 | 10 | 2.8 | 4.01 | 4.2 | 5.97 | ~ | G1.24 | Basin G1-South | 135+00 | Rt |
| G1.25.SL | 0.61 | 40800 | 0.9 | 10 | 2.8 | 1.62 | 4.2 | 2.41 | ~ | Culvert | bypass* | 127+00 | Lt |
| G1.27.SL | 0.61 | 40900 | 0.9 | 10 | 2.8 | 1.62 | 4.2 | 2.41 | ~ | ~ | bypass* | 135+02 | Rt |

Σ 611500 *SLOPE*

* flow that does not reach the basin

| Total : | 1374600 | 31.6 |
|---|---|---|
| | *SF* | *ac* |


76' SHEET FLOW
200' TRAP FLOW
CONCENTRATED FLOW
300' CHANNEL FLOW
700' 18" STORMDRAIN FLOW
300' CHANNEL FLOW
636' STORMDRAIN FLOW
380' CHANNEL FLOW
TUNNEL
R/W
WATERSHED G1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=350'

# G1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | G1-ALL |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | One Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1969019 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 45.20 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | NOTES: |
|---|---|---|---|
| RELIEF (.08-.35) | 0.12 | | Relatively Flat ~ 4% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.39 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 30% | AT | 0.39 | 0.118 |
| PAVED SURFACE | 39% | AT | 0.90 | 0.349 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 31% | AT | 0.55 | 0.171 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.64 |
| $C_{25}$ = | 0.70 |
| $C_{50}$ = | 0.76 |
| $C_{100}$ = | 0.80 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 567.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 563.0 | ft | |
| ELEVATION DIFF (H) | 4.0 | ft | |
| LENGTH (L) | 76 | ft | |
| SLOPE (S) = (H/L) | 5.3% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.19 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 560.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 200 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 2.67 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 560.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 3.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.0% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.84 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.72 | minutes | |

# G1 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft |
| LOW POINT ELEVATION | 545.0 | ft |
| ELEVATION DIFF (H) | 7.0 | ft |
| LENGTH (L) | 700 | ft |
| SLOPE (S) = (H/L) | 1.0% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 7.2 | fps |
| $T_C$ (SD)= | 1.62 | minutes |

**NOTES:**

Proposed storm drain through median (elev at pipe invert)
Sta 127+00 - basin G0-1

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 545.0 | ft |
| LOW POINT ELEVATION | 542.0 | ft |
| ELEVATION DIFF (H) | 3.0 | ft |
| LENGTH (L) | 300 | ft |
| SLOPE (S) = (H/L) | 1.0% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 2.09 | fps |
| $T_C$ (CH)= | 2.40 | minutes |

**NOTES:**

Detention basin (low flow channel)

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 2 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)
R=(bdsinA+d^2cosA)/(bsinA+2d)
From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft |
| LOW POINT ELEVATION | 523.0 | ft |
| ELEVATION DIFF (H) | 9.0 | ft |
| LENGTH (L) | 636 | ft |
| SLOPE (S) = (H/L) | 1.4% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 4.0 | ft |
| HYDRAULIC RADIUS R | 1.0 | ft |
| VELOCITY (STORMDRAIN) | 13.6 | fps |
| $T_C$ (SD)= | 0.78 | minutes |

**NOTES:**

Proposed RCB
Outlet

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 523.0 | ft |
| LOW POINT ELEVATION | 515.0 | ft |
| ELEVATION DIFF (H) | 8.0 | ft |
| LENGTH (L) | 280 | ft |
| SLOPE (S) = (H/L) | 2.9% | |
| MANNING'S n | 0.055 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 3.21 | fps |
| $T_C$ (CH)= | 1.46 | minutes |

**NOTES:**

RCP to confluence point

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 2 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth) and RCP
R=(bdsinA+d^2cosA)/(bsinA+2d)
From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.82 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **12.82** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

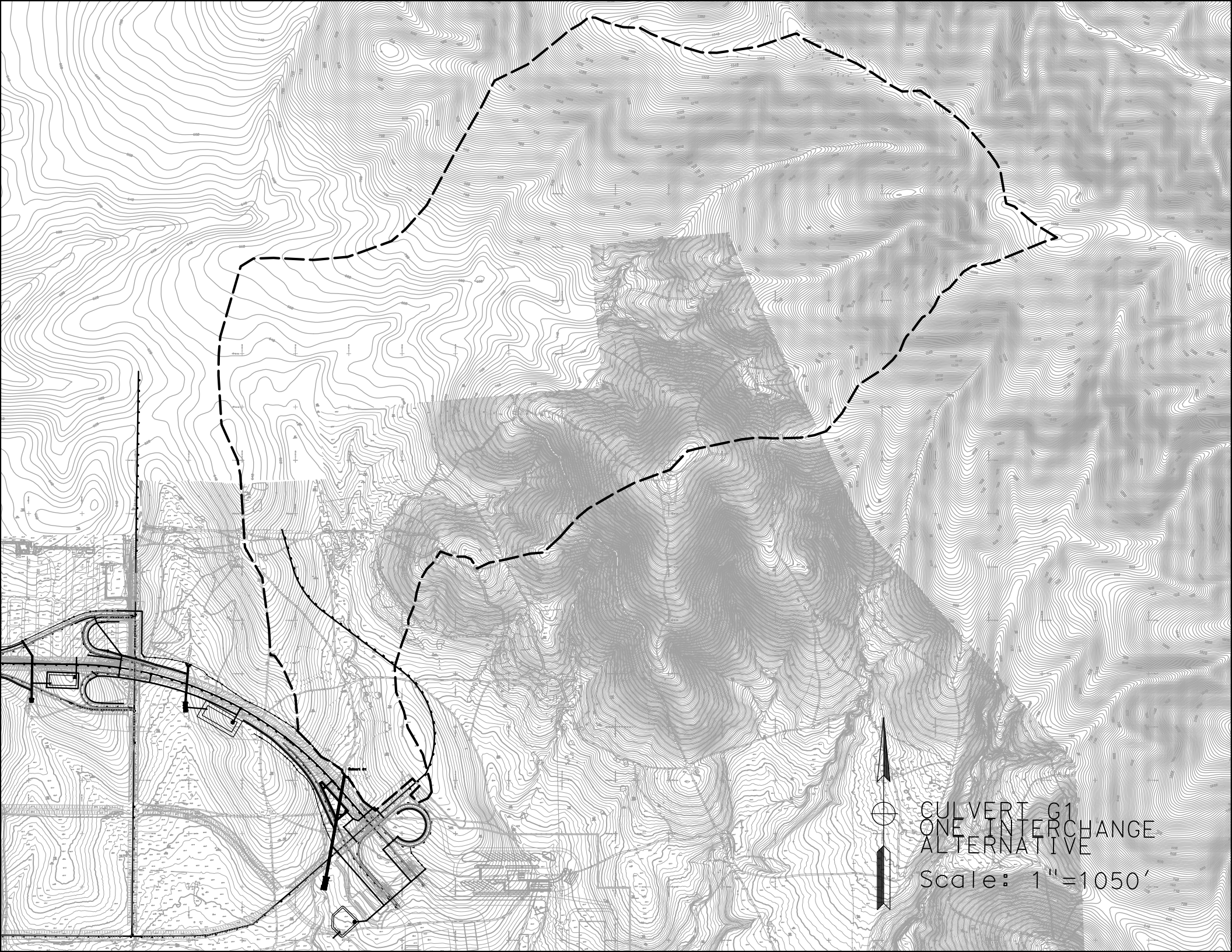
| | | | |
|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = |
| $i_{10}$ = | 2.3 | in/hr | X CA = |
| $i_{25}$ = | 2.9 | in/hr | X CA = |
| $i_{50}$ = | 3.4 | in/hr | X CA = |
| $i_{100}$ = | 3.6 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 45.5 |
| **$Q_{10}$ =** | 66.2 |
| **$Q_{25}$ =** | 91.0 |
| **$Q_{50}$ =** | 119.1 |
| **$Q_{100}$ =** | **129.2** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


CULVERT G1
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=1050'

# Culvert Calculator Report
# G1 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 548.00 | ft | Headwater Depth/Height | 1.85 | |
| Computed Headwater Elevation | 547.39 | ft | Discharge | 658.00 | cfs |
| Inlet Control HW Elev. | 547.39 | ft | Tailwater Elevation | 518.04 | ft |
| Outlet Control HW Elev. | 546.56 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 540.00 | ft | Downstream Invert | 516.00 | ft |
| Length | 1,150.00 | ft | Constructed Slope | 2.1 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 2.04 | ft |
| Slope Type | Steep | | Normal Depth | 2.04 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.75 | ft |
| Velocity Downstream | 20.17 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Box | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 8.00 | ft |
| Section Size | 8 x 4 ft | | Rise | 4.00 | ft |
| Number Sections | 2 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 546.56 | ft | Upstream Velocity Head | 1.87 | ft |
| Ke | 0.50 | | Entrance Loss | 0.94 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 547.39 | ft | Flow Control | Submerged | |
| Inlet Type | 90 and 15° wingwall flares | | Area Full | 64.0 | $ft^2$ |
| K | 0.06100 | | HDS 5 Chart | 8 | |
| M | 0.75000 | | HDS 5 Scale | 2 | |
| C | 0.04000 | | Equation Form | 1 | |
| Y | 0.80000 | | | | |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass

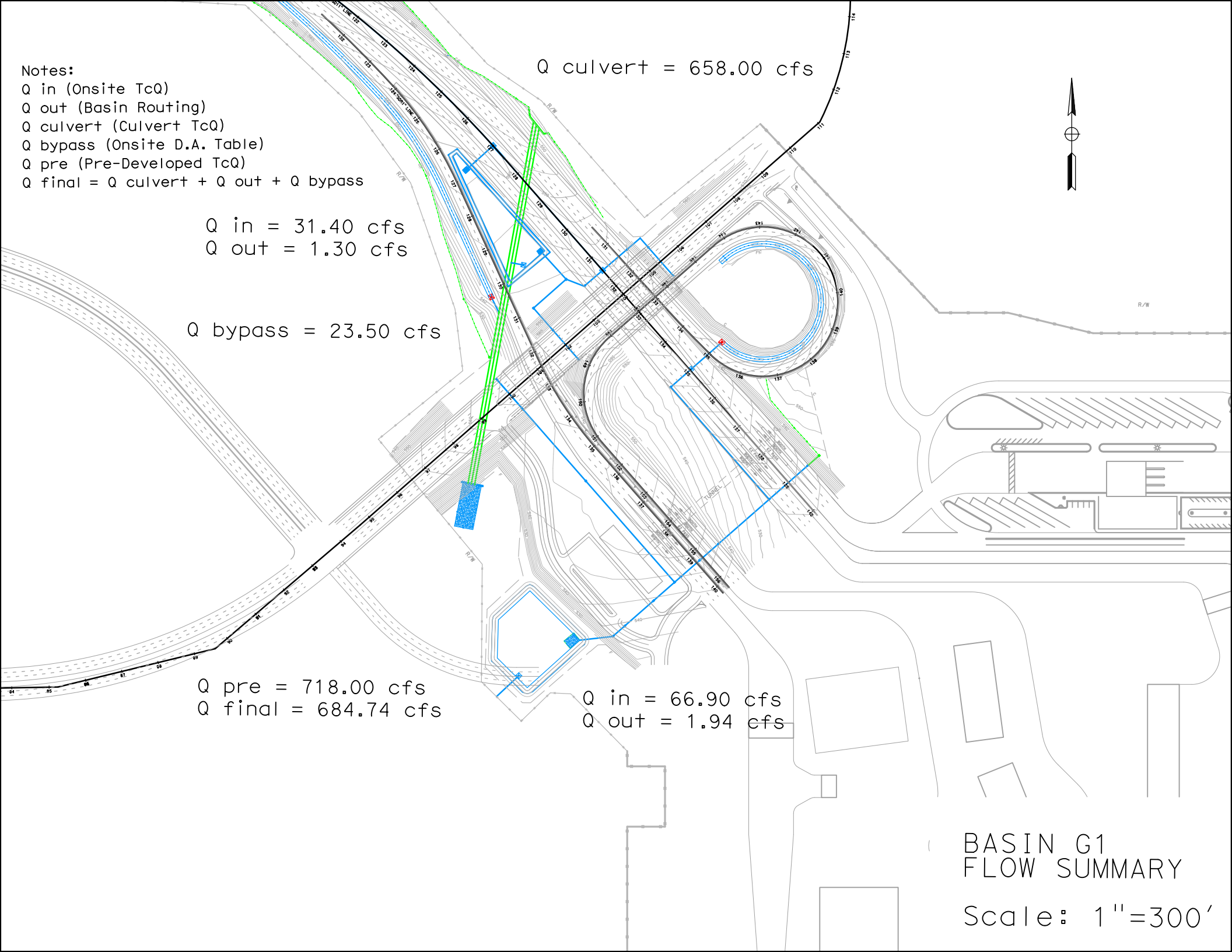
Q culvert = 658.00 cfs

Q in = 31.40 cfs
Q out = 1.30 cfs

Q bypass = 23.50 cfs

Q pre = 718.00 cfs
Q final = 684.74 cfs

Q in = 66.90 cfs
Q out = 1.94 cfs



BASIN G1
FLOW SUMMARY

Scale: 1"=300'

# Basin G1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **G1-ALL** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **One Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 60.0 | cfs | | | |
| Tc= | 17.0 | min | C= | 0.49 | |
| $P_{100,6}$= | 2.5 | in | A= | 41.08 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 17 | 3060 | 3 |
| 34 | 3162 | 3.1 |
| 51 | 3468 | 3.4 |
| 68 | 3570 | 3.5 |
| 85 | 3876 | 3.8 |
| 102 | 4080 | 4 |
| 119 | 4488 | 4.4 |
| 136 | 4794 | 4.7 |
| 153 | 5508 | 5.4 |
| 170 | 5916 | 5.8 |
| 187 | 7242 | 7.1 |
| 204 | 8262 | 8.1 |
| 221 | 12138 | 11.9 |
| 238 | 17340 | 17 |
| 255 | 61200 | 60 |
| 272 | 9792 | 9.6 |
| 289 | 6528 | 6.4 |
| 306 | 5100 | 5 |
| 323 | 4284 | 4.2 |
| 340 | 3672 | 3.6 |
| 357 | 3366 | 3.3 |
| 374 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 180846 $ft^3$**
**4.15 acre-feet**

Check: V = C*A*$P_6$
V= 4.17 acre-feet
***OK***

# Basin G1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 129.2 | cfs | | | |
| Tc= | 12.8 | min | C= | 0.80 | |
| $P_{100,6}$= | 2.5 | in | A= | 45.20 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 1872 | 2.4 |
| 26 | 4290 | 5.5 |
| 39 | 4446 | 5.7 |
| 52 | 4680 | 6 |
| 65 | 4758 | 6.1 |
| 78 | 5070 | 6.5 |
| 91 | 5226 | 6.7 |
| 104 | 5616 | 7.2 |
| 117 | 5850 | 7.5 |
| 130 | 6318 | 8.1 |
| 143 | 6630 | 8.5 |
| 156 | 7410 | 9.5 |
| 169 | 7800 | 10 |
| 182 | 8970 | 11.5 |
| 195 | 9750 | 12.5 |
| 208 | 11856 | 15.2 |
| 221 | 13494 | 17.3 |
| 234 | 19890 | 25.5 |
| 247 | 27534 | 35.3 |
| 260 | 100776 | 129.2 |
| 273 | 15912 | 20.4 |
| 286 | 10686 | 13.7 |
| 299 | 8346 | 10.7 |
| 312 | 7020 | 9 |
| 325 | 6084 | 7.8 |
| 338 | 5460 | 7 |
| 351 | 4914 | 6.3 |
| 364 | 4524 | 5.8 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 325182 $ft^3$**
**7.47 acre-feet**

Check: $V = C*A*P_6$
V= 7.50 acre-feet
***OK***

**Retention volume = 7.47**
**- 4.15**
**= 3.31 acre-feet = 144336 $ft^3$ Basin Required**

# Basin G1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00 — Max C from North/South Onsite
A= 24.87 acres — Sum of North/South Onsite Area

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **65913** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**If the WQV is less than retention requirement, do not add volume since WQ is addressed in Retention**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

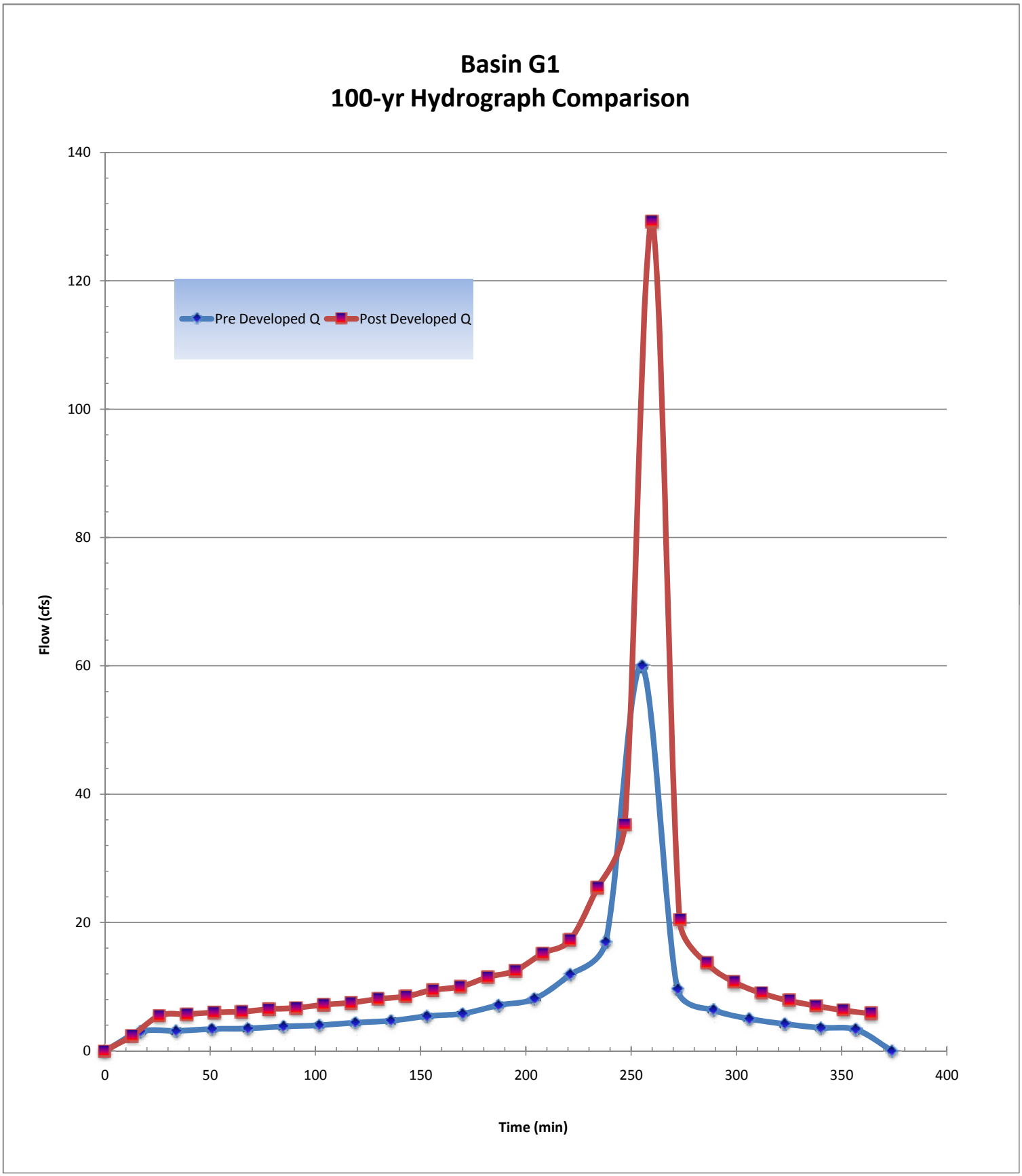
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 442800 | $ft^2$ |
| | A: | 10.17 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 158.09 tons

**Silt Accumulation Basin volume =** **3513** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin G1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
0
50
100
150
200
250
300
350
400

# Basin G1-North Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **127+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **G1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G1-North** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **324800** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **7.46** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 77% | AT | 0.90 | 0.695 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 23% | AT | 0.55 | 0.125 |
| TOTAL | 100% | | $C_{2,10}$ = | 0.82 |
| | (100%) | | $C_{25}$ = | 0.90 |
| | | | $C_{50}$ = | 0.98 |
| | | | $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 567.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 563.0 | ft | |
| ELEVATION DIFF (H) | 4.0 | ft | |
| LENGTH (L) | 76 | ft | |
| SLOPE (S) = (H/L) | 5.3% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.19 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 563.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 560.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 200 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 2.67 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 560.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 3.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.0% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.84 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.72 | minutes | |

# Basin G1-North Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft | Proposed storm drain through median (elev at pipe invert) |
| LOW POINT ELEVATION | 546.0 | ft | Sta 127+00 - basin G1-North |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 700 | ft | |
| SLOPE (S) = (H/L) | 0.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 6.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.75 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.32 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 11.3 |
| **$Q_{10}$ =** | 16.5 |
| **$Q_{25}$ =** | 22.7 |
| **$Q_{50}$ =** | 29.7 |
| **$Q_{100}$ =** | **31.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G1North Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **126+50 - 130+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **G1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **No Interchange Option** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 31.4 | cfs | $C_{100}$= | 1.00 | |
| Tc= | 10.0 | min | A= | 7.46 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 660 | 1.1 |
| 20 | 660 | 1.1 |
| 30 | 720 | 1.2 |
| 40 | 720 | 1.2 |
| 50 | 780 | 1.3 |
| 60 | 780 | 1.3 |
| 70 | 780 | 1.3 |
| 80 | 840 | 1.4 |
| 90 | 900 | 1.5 |
| 100 | 900 | 1.5 |
| 110 | 960 | 1.6 |
| 120 | 960 | 1.6 |
| 130 | 1080 | 1.8 |
| 140 | 1080 | 1.8 |
| 150 | 1200 | 2 |
| 160 | 1260 | 2.1 |
| 170 | 1380 | 2.3 |
| 180 | 1440 | 2.4 |
| 190 | 1680 | 2.8 |
| 200 | 1800 | 3 |
| 210 | 2220 | 3.7 |
| 220 | 2520 | 4.2 |
| 230 | 3720 | 6.2 |
| 240 | 5280 | 8.8 |
| 250 | 18840 | 31.4 |
| 260 | 3000 | 5 |
| 270 | 1980 | 3.3 |
| 280 | 1560 | 2.6 |
| 290 | 1320 | 2.2 |
| 300 | 1140 | 1.9 |
| 310 | 1020 | 1.7 |
| 320 | 900 | 1.5 |
| 330 | 840 | 1.4 |
| 340 | 780 | 1.3 |
| 350 | 720 | 1.2 |
| 360 | 720 | 1.2 |
| 370 | 0 | 0 |

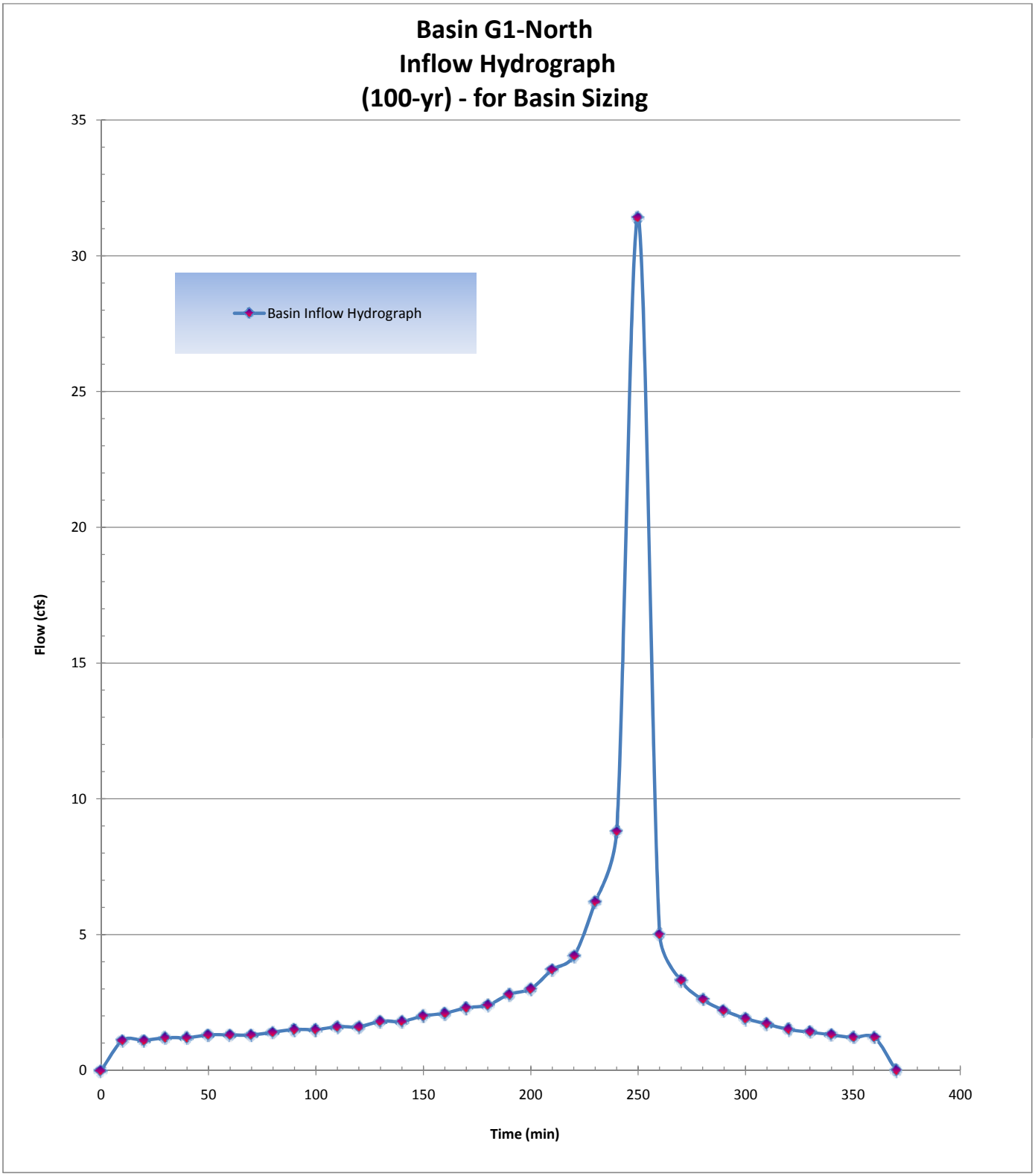
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 67140 $ft^3$**
**1.54 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 1.55 acre-feet
***OK***


Basin G1-North
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400

# Basin G1-North Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **130+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G1-North** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G1-North** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 147849 | $ft^3$ | from G1-ALL |
| Retention volume from this basin = | 46802 | | at 2.6' depth, see G1-South for remainder of storage |
| Actual Basin Inflow = | 67140 | $ft^3$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G1-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G1 |
| Flow that does not reach detention basin (bypass per DA table): | 23.5 | cfs | $Q_{100}$ from: G1.8.PVG1.27.PVG1.8.SLG1.25.SLG1.27.SL |
| Maximum flow allowed to be released by this detention basin: | 11.5 | cfs | *32%* of G1-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 546.20 | ft |
| Basin flowline elevation = | 542.00 | ft |
| Maximum Basin Depth = | 4.20 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.60 | ft | 544.60 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | 200 | ft | L/2 due to sloped floor |
| Base Width (W) | 75 | ft | average |
| W/L Ratio ® | 0.38 | | |
| Side Slopes (Z) | 1: 4 | | |
| Total Volume (V): | 83929 | $ft^2$ | |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 542.00 | 0.00 | 0 | 0 | | 542.00 | 0.00 | 0.00 | 0.00 |
| 1 | 542.20 | 0.20 | 3044 | 3044 | | 542.20 | 0.00 | | 0.00 |
| 2 | 542.40 | 0.40 | 3133 | 6178 | | 542.40 | 0.00 | | 0.00 |
| 3 | 542.60 | 0.60 | 3223 | 9401 | | 542.60 | 0.00 | | 0.00 |
| 4 | 542.80 | 0.80 | 3314 | 12715 | | 542.80 | 0.00 | | 0.00 |
| 5 | 543.00 | 1.00 | 3406 | 16122 | | 543.00 | 0.00 | | 0.00 |
| 6 | 543.20 | 1.20 | 3499 | 19621 | | 543.20 | 0.00 | | 0.00 |
| 7 | 543.40 | 1.40 | 3593 | 23215 | | 543.40 | 0.00 | | 0.00 |
| 8 | 543.60 | 1.60 | 3688 | 26903 | | 543.60 | 0.00 | | 0.00 |
| 9 | 543.80 | 1.80 | 3784 | 30687 | | 543.80 | 0.00 | | 0.00 |
| 10 | 544.00 | 2.00 | 3881 | 34568 | | 544.00 | 0.00 | | 0.00 |
| 11 | 544.20 | 2.20 | 3979 | 38547 | | 544.20 | 0.00 | | 0.00 |
| 12 | 544.40 | 2.40 | 4078 | 42625 | | 544.40 | 0.00 | | 0.00 |
| 13 | 544.60 | 2.60 | 4177 | 46802 | * | 544.60 | 0.00 | 0.00 | 0.00 |
| 14 | 544.80 | 2.80 | 4278 | 51080 | | 544.80 | 0.15 | | 0.15 |
| 15 | 545.00 | 3.00 | 4380 | 55460 | | 545.00 | 0.59 | | 0.59 |
| 16 | 545.20 | 3.20 | 4482 | 59943 | | 545.20 | 1.30 | | 1.30 |
| 17 | 545.40 | 3.40 | 4586 | 64529 | | 545.40 | 2.25 | | 2.25 |
| 18 | 545.60 | 3.60 | 4691 | 69219 | | 545.60 | 3.42 | | 3.42 |
| 19 | 545.80 | 3.80 | 4796 | 74016 | | 545.80 | 4.79 | | 4.79 |
| 20 | 546.00 | 4.00 | 4903 | 78918 | | 546.00 | 6.32 | | 6.32 |
| 21 | 546.20 | 4.20 | 5010 | 83929 | | 546.20 | 7.99 | | 7.99 |
| 22 | 546.40 | 4.40 | 5119 | 89047 | | 546.40 | 9.77 | | 9.77 |
| 23 | 546.60 | 4.60 | 5228 | 94276 | | 546.60 | 11.63 | | 11.63 |
| 24 | 546.80 | 4.80 | 5339 | 99614 | | 546.80 | 13.53 | | 13.53 |
| 25 | 547.00 | 5.00 | 5450 | 105064 | | 547.00 | 15.46 | | 15.46 |

# Basin G1-North Routing

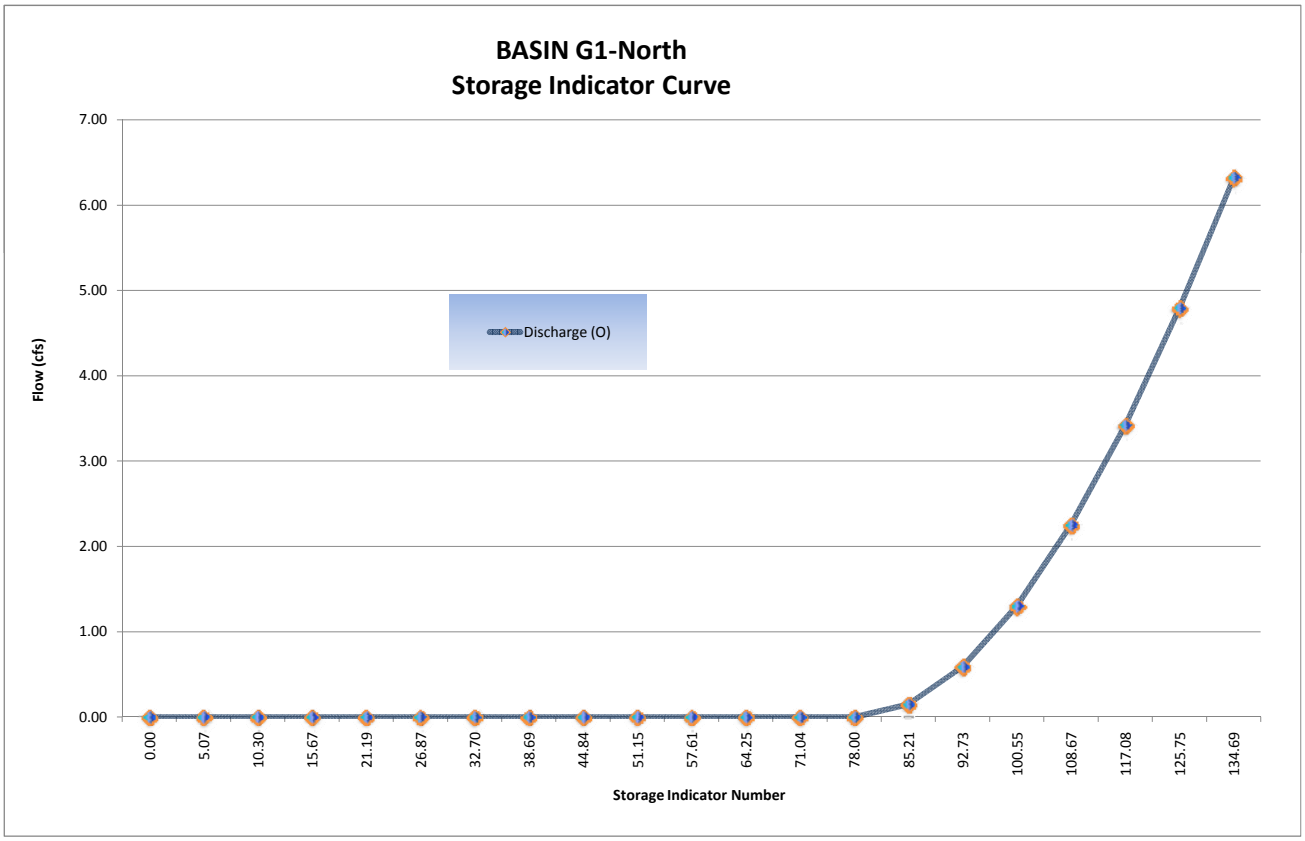
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 130+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G1-North |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G1-North |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 542.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 542.20 | 0.00 | 3044 | 0.00 | 5.07 | 5.07 |
| 542.40 | 0.00 | 6178 | 0.00 | 10.30 | 10.30 |
| 542.60 | 0.00 | 9401 | 0.00 | 15.67 | 15.67 |
| 542.80 | 0.00 | 12715 | 0.00 | 21.19 | 21.19 |
| 543.00 | 0.00 | 16122 | 0.00 | 26.87 | 26.87 |
| 543.20 | 0.00 | 19621 | 0.00 | 32.70 | 32.70 |
| 543.40 | 0.00 | 23215 | 0.00 | 38.69 | 38.69 |
| 543.60 | 0.00 | 26903 | 0.00 | 44.84 | 44.84 |
| 543.80 | 0.00 | 30687 | 0.00 | 51.15 | 51.15 |
| 544.00 | 0.00 | 34568 | 0.00 | 57.61 | 57.61 |
| 544.20 | 0.00 | 38547 | 0.00 | 64.25 | 64.25 |
| 544.40 | 0.00 | 42625 | 0.00 | 71.04 | 71.04 |
| 544.60 | 0.00 | 46802 | 0.00 | 78.00 | 78.00 |
| 544.80 | 0.15 | 51080 | 0.08 | 85.13 | 85.21 |
| 545.00 | 0.59 | 55460 | 0.30 | 92.43 | 92.73 |
| 545.20 | 1.30 | 59943 | 0.65 | 99.90 | 100.55 |
| 545.40 | 2.25 | 64529 | 1.13 | 107.55 | 108.67 |
| 545.60 | 3.42 | 69219 | 1.71 | 115.37 | 117.08 |
| 545.80 | 4.79 | 74016 | 2.40 | 123.36 | 125.75 |
| 546.00 | 6.32 | 78918 | 3.16 | 131.53 | 134.69 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



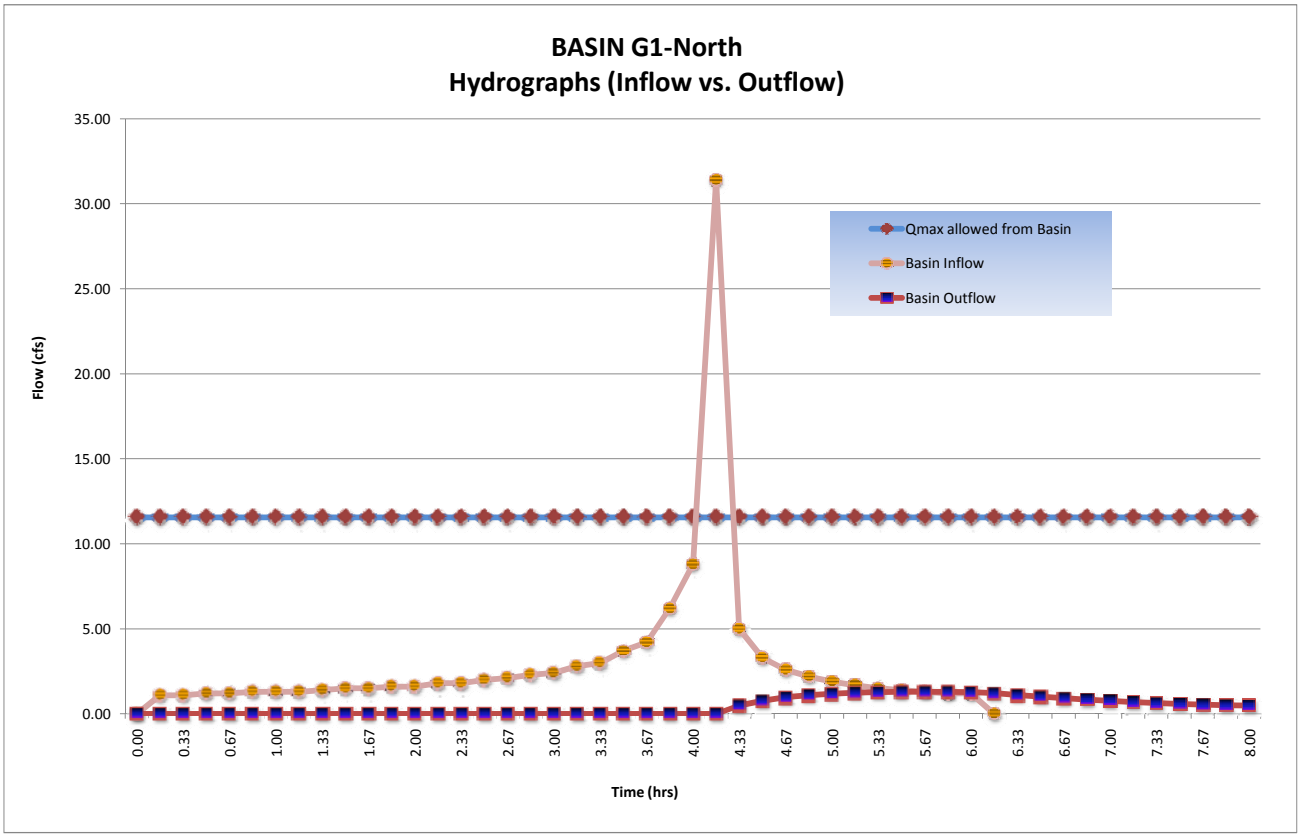
# Basin G1-North Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

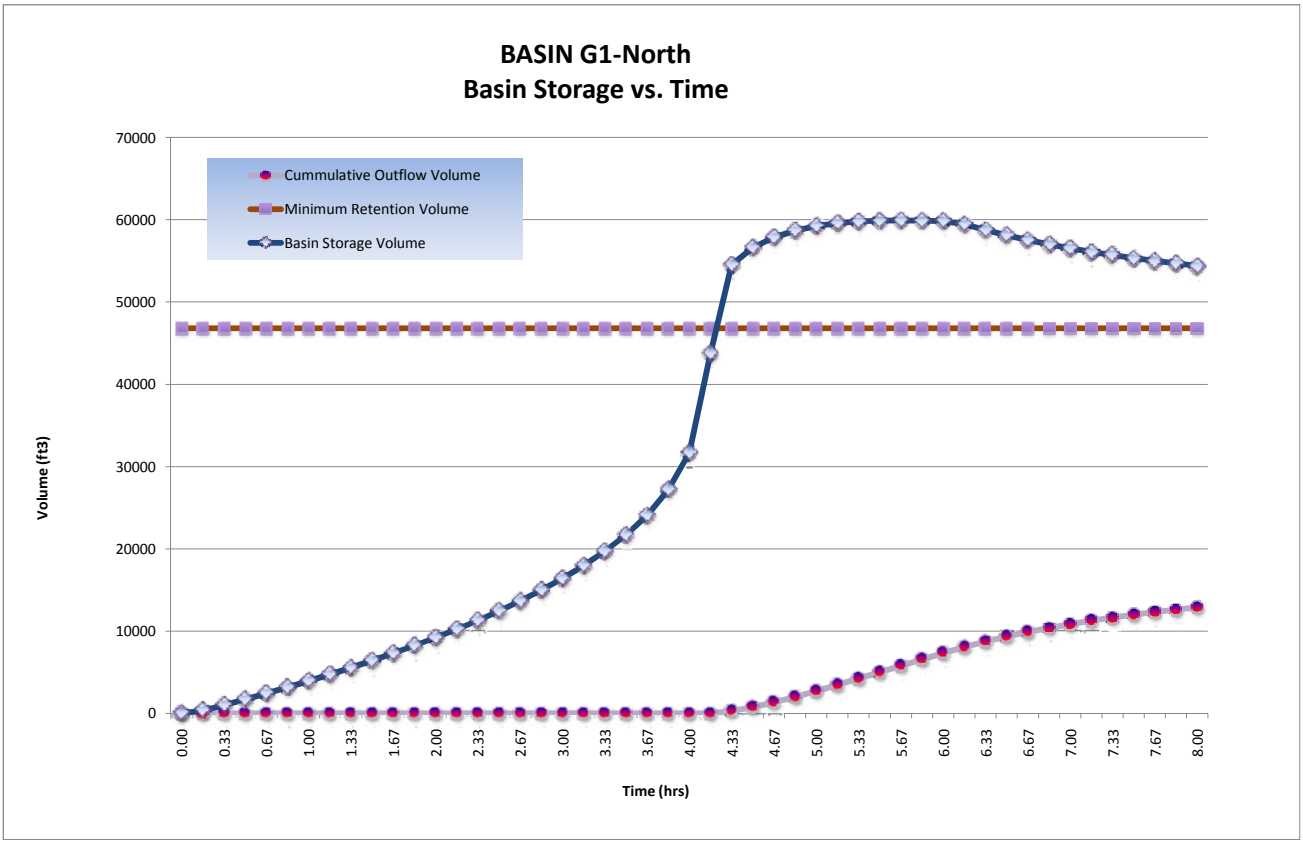
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 1.10 | 0.55 | 0.00 | 0.00 | 0.55 | 0.00 | 330 | 0 | 0 |
| 0.33 | 1.10 | 1.10 | 0.55 | 0.00 | 1.65 | 0.00 | 990 | 0 | 0 |
| 0.50 | 1.20 | 1.15 | 1.65 | 0.00 | 2.80 | 0.00 | 1680 | 0 | 0 |
| 0.67 | 1.20 | 1.20 | 2.80 | 0.00 | 4.00 | 0.00 | 2400 | 0 | 0 |
| 0.83 | 1.30 | 1.25 | 4.00 | 0.00 | 5.25 | 0.00 | 3150 | 0 | 0 |
| 1.00 | 1.30 | 1.30 | 5.25 | 0.00 | 6.55 | 0.00 | 3930 | 0 | 0 |
| 1.17 | 1.30 | 1.30 | 6.55 | 0.00 | 7.85 | 0.00 | 4710 | 0 | 0 |
| 1.33 | 1.40 | 1.35 | 7.85 | 0.00 | 9.20 | 0.00 | 5520 | 0 | 0 |
| 1.50 | 1.50 | 1.45 | 9.20 | 0.00 | 10.65 | 0.00 | 6390 | 0 | 0 |
| 1.67 | 1.50 | 1.50 | 10.65 | 0.00 | 12.15 | 0.00 | 7290 | 0 | 0 |
| 1.83 | 1.60 | 1.55 | 12.15 | 0.00 | 13.70 | 0.00 | 8220 | 0 | 0 |
| 2.00 | 1.60 | 1.60 | 13.70 | 0.00 | 15.30 | 0.00 | 9180 | 0 | 0 |
| 2.17 | 1.80 | 1.70 | 15.30 | 0.00 | 17.00 | 0.00 | 10200 | 0 | 0 |
| 2.33 | 1.80 | 1.80 | 17.00 | 0.00 | 18.80 | 0.00 | 11280 | 0 | 0 |
| 2.50 | 2.00 | 1.90 | 18.80 | 0.00 | 20.70 | 0.00 | 12420 | 0 | 0 |
| 2.67 | 2.10 | 2.05 | 20.70 | 0.00 | 22.75 | 0.00 | 13650 | 0 | 0 |
| 2.83 | 2.30 | 2.20 | 22.75 | 0.00 | 24.95 | 0.00 | 14970 | 0 | 0 |
| 3.00 | 2.40 | 2.35 | 24.95 | 0.00 | 27.30 | 0.00 | 16380 | 0 | 0 |
| 3.17 | 2.80 | 2.60 | 27.30 | 0.00 | 29.90 | 0.00 | 17940 | 0 | 0 |
| 3.33 | 3.00 | 2.90 | 29.90 | 0.00 | 32.80 | 0.00 | 19680 | 0 | 0 |
| 3.50 | 3.70 | 3.35 | 32.80 | 0.00 | 36.15 | 0.00 | 21690 | 0 | 0 |
| 3.67 | 4.20 | 3.95 | 36.15 | 0.00 | 40.10 | 0.00 | 24060 | 0 | 0 |
| 3.83 | 6.20 | 5.20 | 40.10 | 0.00 | 45.30 | 0.00 | 27180 | 0 | 0 |
| 4.00 | 8.80 | 7.50 | 45.30 | 0.00 | 52.80 | 0.00 | 31680 | 0 | 0 |
| 4.17 | 31.40 | 20.10 | 52.80 | 0.00 | 72.90 | 0.00 | 43740 | 0 | 0 |
| 4.33 | 5.00 | 18.20 | 72.90 | 0.00 | 91.10 | 0.49 | 54513 | 294 | 294 |
| 4.50 | 3.30 | 4.15 | 91.10 | 0.49 | 94.76 | 0.77 | 56625 | 462 | 756 |
| 4.67 | 2.60 | 2.95 | 94.76 | 0.77 | 96.94 | 0.97 | 57873 | 582 | 1338 |
| 4.83 | 2.20 | 2.40 | 96.94 | 0.97 | 98.37 | 1.10 | 58692 | 660 | 1998 |
| 5.00 | 1.90 | 2.05 | 98.37 | 1.10 | 99.32 | 1.19 | 59235 | 714 | 2712 |
| 5.17 | 1.70 | 1.80 | 99.32 | 1.19 | 99.93 | 1.24 | 59586 | 744 | 3456 |
| 5.33 | 1.50 | 1.60 | 99.93 | 1.24 | 100.29 | 1.28 | 59790 | 768 | 4224 |
| 5.50 | 1.40 | 1.45 | 100.29 | 1.28 | 100.46 | 1.29 | 59889 | 774 | 4998 |
| 5.67 | 1.30 | 1.35 | 100.46 | 1.29 | 100.52 | 1.30 | 59922 | 780 | 5778 |
| 5.83 | 1.20 | 1.25 | 100.52 | 1.30 | 100.47 | 1.29 | 59895 | 774 | 6552 |
| 6.00 | 1.20 | 1.20 | 100.47 | 1.29 | 100.38 | 1.28 | 59844 | 768 | 7320 |
| 6.17 | 0.00 | 0.60 | 100.38 | 1.28 | 99.70 | 1.22 | 59454 | 732 | 8052 |
| 6.33 | | 0.00 | 99.70 | 1.22 | 98.48 | 1.11 | 58755 | 666 | 8718 |
| 6.50 | | 0.00 | 98.48 | 1.11 | 97.37 | 1.01 | 58119 | 606 | 9324 |
| 6.67 | | 0.00 | 97.37 | 1.01 | 96.36 | 0.92 | 57540 | 552 | 9876 |
| 6.83 | | 0.00 | 96.36 | 0.92 | 95.44 | 0.84 | 57012 | 504 | 10380 |
| 7.00 | | 0.00 | 95.44 | 0.84 | 94.60 | 0.76 | 56532 | 456 | 10836 |
| 7.17 | | 0.00 | 94.60 | 0.76 | 93.84 | 0.69 | 56097 | 414 | 11250 |
| 7.33 | | 0.00 | 93.84 | 0.69 | 93.15 | 0.63 | 55701 | 378 | 11628 |
| 7.50 | | 0.00 | 93.15 | 0.63 | 92.52 | 0.58 | 55338 | 348 | 11976 |
| 7.67 | | 0.00 | 92.52 | 0.58 | 91.94 | 0.54 | 55002 | 324 | 12300 |
| 7.83 | | 0.00 | 91.94 | 0.54 | 91.40 | 0.51 | 54687 | 306 | 12606 |
| 8.00 | | 0.00 | 91.40 | 0.51 | 90.89 | 0.48 | 54390 | 288 | 12894 |

## Basin G1-North Routing



## Basin G1-North Routing




| | | |
|---|---|---|
| **Detention / Retention Basin Volume Required:** | **59,922** | **$ft^3$** |
| **@ Stage:** | **545.20** | **ft** |
| **Freeboard:** | **1.0** | **ft** |
| **Final Total Basin Volume Provided:** | **83,929** | **$ft^3$** |
| **Maximum flow rate released from this basin:** | **1.30** | **cfs** |

> 1' Freeboard

Basin **G1-North**

# Basin G1-South Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | G1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G1-South |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 758700 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 17.42 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | |
|---|---|
| RELIEF (.08-.35) | 0.00 |
| INFILTRATION (.04-.16) | 0.00 |
| VEGETATION (.04-.16) | 0.00 |
| STORAGE (.04-.12) | 0.00 |
| TOTAL C = | 0.00 |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 51% | AT | 0.90 | 0.463 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 49% | AT | 0.55 | 0.267 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.73 |
| $C_{25}$ = | 0.80 |
| $C_{50}$ = | 0.88 |
| $C_{100}$ = | 0.91 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | |
|---|---|---|
| HIGH PT ELEVATION | 568.0 | ft |
| LOW POINT ELEVATION | 567.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 60 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.016 | |
| $T_t$ (SFF)= | 1.56 | minutes |

SVI Line to bioswale

< = FROM TABLE 816.6A AC

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | |
|---|---|---|
| HIGH PT ELEVATION | 567.0 | ft |
| LOW POINT ELEVATION | 565.0 | ft |
| ELEVATION DIFF (H) | 2.0 | ft |
| LENGTH (L) | 116 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| VELOCITY (SCF) | 0.8 | fps |
| $T_C$ (SH)= | 2.42 | minutes |

Flow in Bioswale

assumed SCF and not channelized or flowing full yet

<=V FROM FIG 816.5 short grass

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | |
|---|---|---|
| HIGH PT ELEVATION | 565.0 | ft |
| LOW POINT ELEVATION | 541.0 | ft |
| ELEVATION DIFF (H) | 24.0 | ft |
| LENGTH (L) | 611 | ft |
| SLOPE (S) = (H/L) | 3.9% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (CHANNEL) | 3.65 | fps |
| $T_C$ (CH)= | 2.79 | minutes |

biofiltration swale

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 0 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

# Basin G1-South Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 536.0 | ft | Proposed stormdrain - upper segment |
| LOW POINT ELEVATION | 525.0 | ft | |
| ELEVATION DIFF (H) | 11.0 | ft | |
| LENGTH (L) | 579 | ft | |
| SLOPE (S) = (H/L) | 1.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 10.0 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.97 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 525.0 | ft | Proposed stormdrain -lower segment to basin |
| LOW POINT ELEVATION | 512.0 | ft | Basin G1-South |
| ELEVATION DIFF (H) | 13.0 | ft | |
| LENGTH (L) | 645 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.80 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.54 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | **FLOW RESULTS:** | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | $Q_2$ = | 23.6 |
| $i_{10}$ = | 2.7 | in/hr | X CA = | $Q_{10}$ = | 34.3 |
| $i_{25}$ = | 3.4 | in/hr | X CA = | $Q_{25}$ = | 47.1 |
| $i_{50}$ = | 4.0 | in/hr | X CA = | $Q_{50}$ = | 61.7 |
| $i_{100}$ = | 4.2 | in/hr | X CA = | $Q_{100}$ = | **66.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G1South Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **137+00 - 139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **G1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G1-South** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 66.9 | cfs | $C_{100}$= | 0.91 | |
| Tc= | 10.0 | min | A= | 17.42 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1440 | 2.4 |
| 20 | 1440 | 2.4 |
| 30 | 1500 | 2.5 |
| 40 | 1560 | 2.6 |
| 50 | 1620 | 2.7 |
| 60 | 1620 | 2.7 |
| 70 | 1740 | 2.9 |
| 80 | 1740 | 2.9 |
| 90 | 1860 | 3.1 |
| 100 | 1920 | 3.2 |
| 110 | 2040 | 3.4 |
| 120 | 2100 | 3.5 |
| 130 | 2220 | 3.7 |
| 140 | 2340 | 3.9 |
| 150 | 2520 | 4.2 |
| 160 | 2640 | 4.4 |
| 170 | 2940 | 4.9 |
| 180 | 3120 | 5.2 |
| 190 | 3600 | 6 |
| 200 | 3900 | 6.5 |
| 210 | 4740 | 7.9 |
| 220 | 5400 | 9 |
| 230 | 7920 | 13.2 |
| 240 | 11100 | 18.5 |
| 250 | 40140 | 66.9 |
| 260 | 6360 | 10.6 |
| 270 | 4260 | 7.1 |
| 280 | 3360 | 5.6 |
| 290 | 2760 | 4.6 |
| 300 | 2400 | 4 |
| 310 | 2160 | 3.6 |
| 320 | 1980 | 3.3 |
| 330 | 1800 | 3 |
| 340 | 1680 | 2.8 |
| 350 | 1560 | 2.6 |
| 360 | 1500 | 2.5 |
| 370 | 0 | 0 |

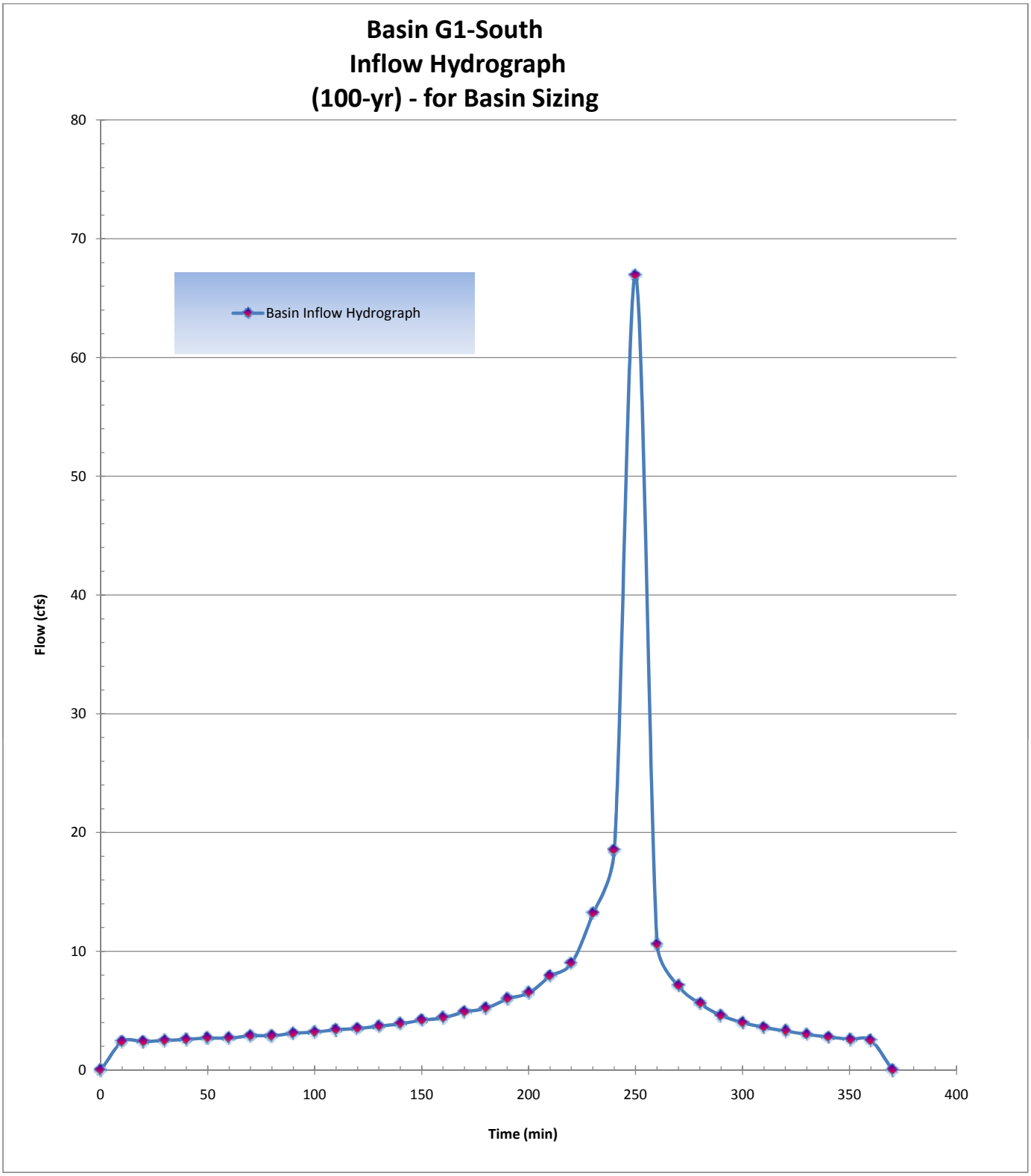
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 142980 $ft^3$**
**3.28 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 3.31 acre-feet
***OK***


Basin G1-South
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
350
400

# Basin G1-South Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G1-South** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G1-South** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 147849 | $ft^3$ | from G1-ALL |
| Retention volume from G1-North Basin = | 46802 | $ft^4$ | |
| Minimum Retention volume from this basin = | 101047 | | balance of required retention for G1-ALL |
| Actual Basin Inflow = | 142980 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G1-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G1 |
| Flow that does not reach detention basin (bypass per DA table): | 23.5 | cfs | $Q_{100}$ from: G1.8.PVG1.27.PVG1.8.SLG1.25.SLG1.27.SL |
| Maximum flow to be released by G1-North basin: | 11.5 | cfs | *32%* of G1-ALL (per retention ratios) |
| Maximum flow allowed to be released by this detention basin: | 17.0 | cfs | *68%* of G1-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 516.60 | ft |
| Basin flowline elevation = | 512.00 | ft |
| Maximum Basin Depth = | 4.60 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.80 | ft | 514.80 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 180 | ft |
| Base Width (W) | 180 | ft |
| W/L Ratio ® | 1.00 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 181518 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 512.00 | 0.00 | 0 | 0 | | 512.00 | 0.00 | 0.00 | 0.00 |
| 1 | 512.20 | 0.20 | 6539 | 6539 | | 512.20 | 0.00 | | 0.00 |
| 2 | 512.40 | 0.40 | 6656 | 13195 | | 512.40 | 0.00 | | 0.00 |
| 3 | 512.60 | 0.60 | 6775 | 19970 | | 512.60 | 0.00 | | 0.00 |
| 4 | 512.80 | 0.80 | 6894 | 26863 | | 512.80 | 0.00 | | 0.00 |
| 5 | 513.00 | 1.00 | 7014 | 33877 | | 513.00 | 0.00 | | 0.00 |
| 6 | 513.20 | 1.20 | 7135 | 41012 | | 513.20 | 0.00 | | 0.00 |
| 7 | 513.40 | 1.40 | 7256 | 48268 | | 513.40 | 0.00 | | 0.00 |
| 8 | 513.60 | 1.60 | 7378 | 55646 | | 513.60 | 0.00 | | 0.00 |
| 9 | 513.80 | 1.80 | 7501 | 63148 | | 513.80 | 0.00 | | 0.00 |
| 10 | 514.00 | 2.00 | 7625 | 70773 | | 514.00 | 0.00 | | 0.00 |
| 11 | 514.20 | 2.20 | 7750 | 78523 | | 514.20 | 0.00 | | 0.00 |
| 12 | 514.40 | 2.40 | 7875 | 86398 | | 514.40 | 0.00 | 0.00 | 0.00 |
| 13 | 514.60 | 2.60 | 8001 | 94399 | | 514.60 | 0.00 | | 0.00 |
| 14 | 514.80 | 2.80 | 8128 | 102528 | * | 514.80 | 0.00 | | 0.00 |
| 15 | 515.00 | 3.00 | 8256 | 110784 | | 515.00 | 0.15 | | 0.15 |
| 16 | 515.20 | 3.20 | 8384 | 119168 | | 515.20 | 0.59 | | 0.59 |
| 17 | 515.40 | 3.40 | 8513 | 127681 | | 515.40 | 1.30 | | 1.30 |
| 18 | 515.60 | 3.60 | 8643 | 136325 | | 515.60 | 2.25 | | 2.25 |
| 19 | 515.80 | 3.80 | 8774 | 145099 | | 515.80 | 3.42 | | 3.42 |
| 20 | 516.00 | 4.00 | 8906 | 154004 | | 516.00 | 4.79 | | 4.79 |
| 21 | 516.20 | 4.20 | 9038 | 163042 | | 516.20 | 6.32 | | 6.32 |
| 22 | 516.40 | 4.40 | 9171 | 172213 | | 516.40 | 7.99 | | 7.99 |
| 23 | 516.60 | 4.60 | 9305 | 181518 | | 516.60 | 9.77 | | 9.77 |

# Basin G1-South Routing

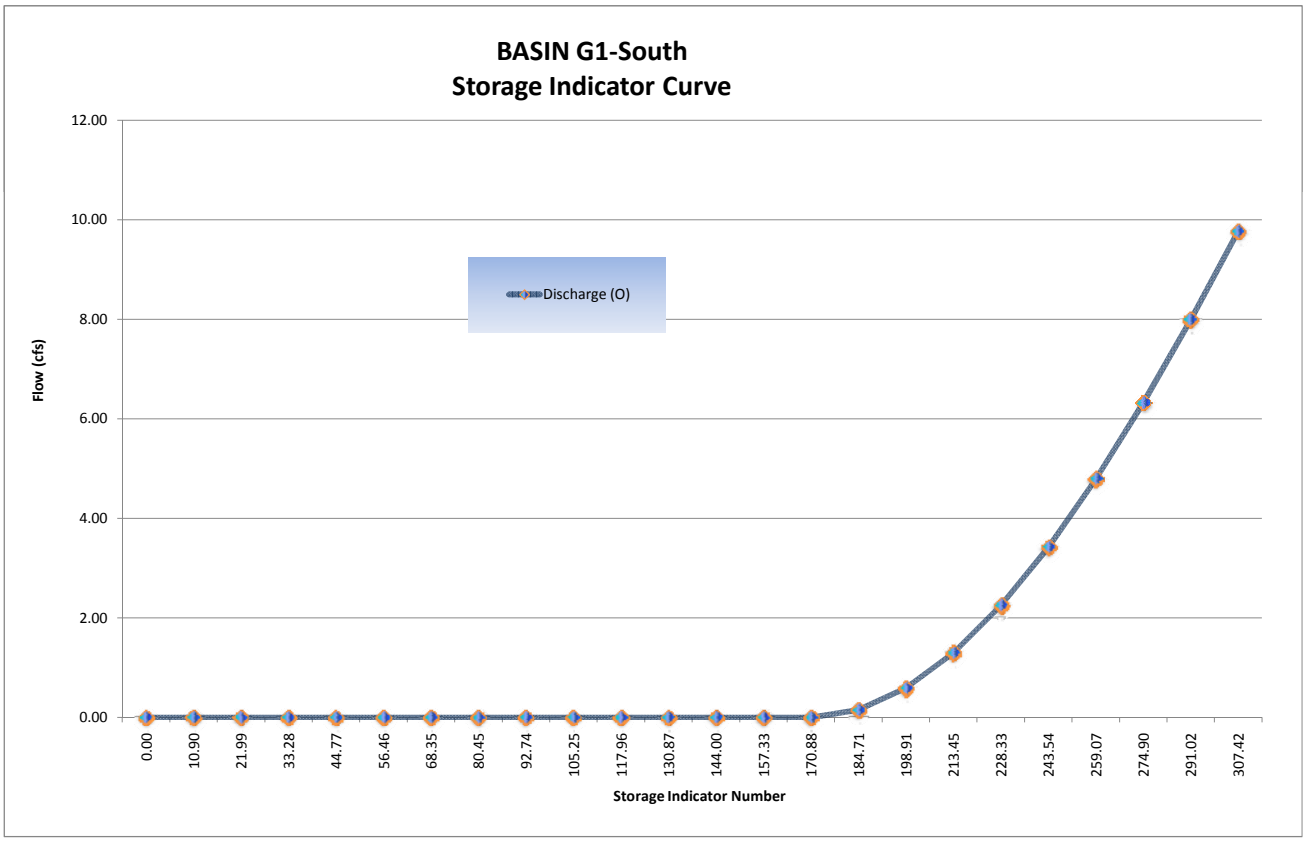
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G1-South |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G1-South |

user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 512.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 512.20 | 0.00 | 6539 | 0.00 | 10.90 | 10.90 |
| 512.40 | 0.00 | 13195 | 0.00 | 21.99 | 21.99 |
| 512.60 | 0.00 | 19970 | 0.00 | 33.28 | 33.28 |
| 512.80 | 0.00 | 26863 | 0.00 | 44.77 | 44.77 |
| 513.00 | 0.00 | 33877 | 0.00 | 56.46 | 56.46 |
| 513.20 | 0.00 | 41012 | 0.00 | 68.35 | 68.35 |
| 513.40 | 0.00 | 48268 | 0.00 | 80.45 | 80.45 |
| 513.60 | 0.00 | 55646 | 0.00 | 92.74 | 92.74 |
| 513.80 | 0.00 | 63148 | 0.00 | 105.25 | 105.25 |
| 514.00 | 0.00 | 70773 | 0.00 | 117.96 | 117.96 |
| 514.20 | 0.00 | 78523 | 0.00 | 130.87 | 130.87 |
| 514.40 | 0.00 | 86398 | 0.00 | 144.00 | 144.00 |
| 514.60 | 0.00 | 94399 | 0.00 | 157.33 | 157.33 |
| 514.80 | 0.00 | 102528 | 0.00 | 170.88 | 170.88 |
| 515.00 | 0.15 | 110784 | 0.08 | 184.64 | 184.71 |
| 515.20 | 0.59 | 119168 | 0.30 | 198.61 | 198.91 |
| 515.40 | 1.30 | 127681 | 0.65 | 212.80 | 213.45 |
| 515.60 | 2.25 | 136325 | 1.13 | 227.21 | 228.33 |
| 515.80 | 3.42 | 145099 | 1.71 | 241.83 | 243.54 |
| 516.00 | 4.79 | 154004 | 2.40 | 256.67 | 259.07 |
| 516.20 | 6.32 | 163042 | 3.16 | 271.74 | 274.90 |
| 516.40 | 7.99 | 172213 | 4.00 | 287.02 | 291.02 |
| 516.60 | 9.77 | 181518 | 4.89 | 302.53 | 307.42 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



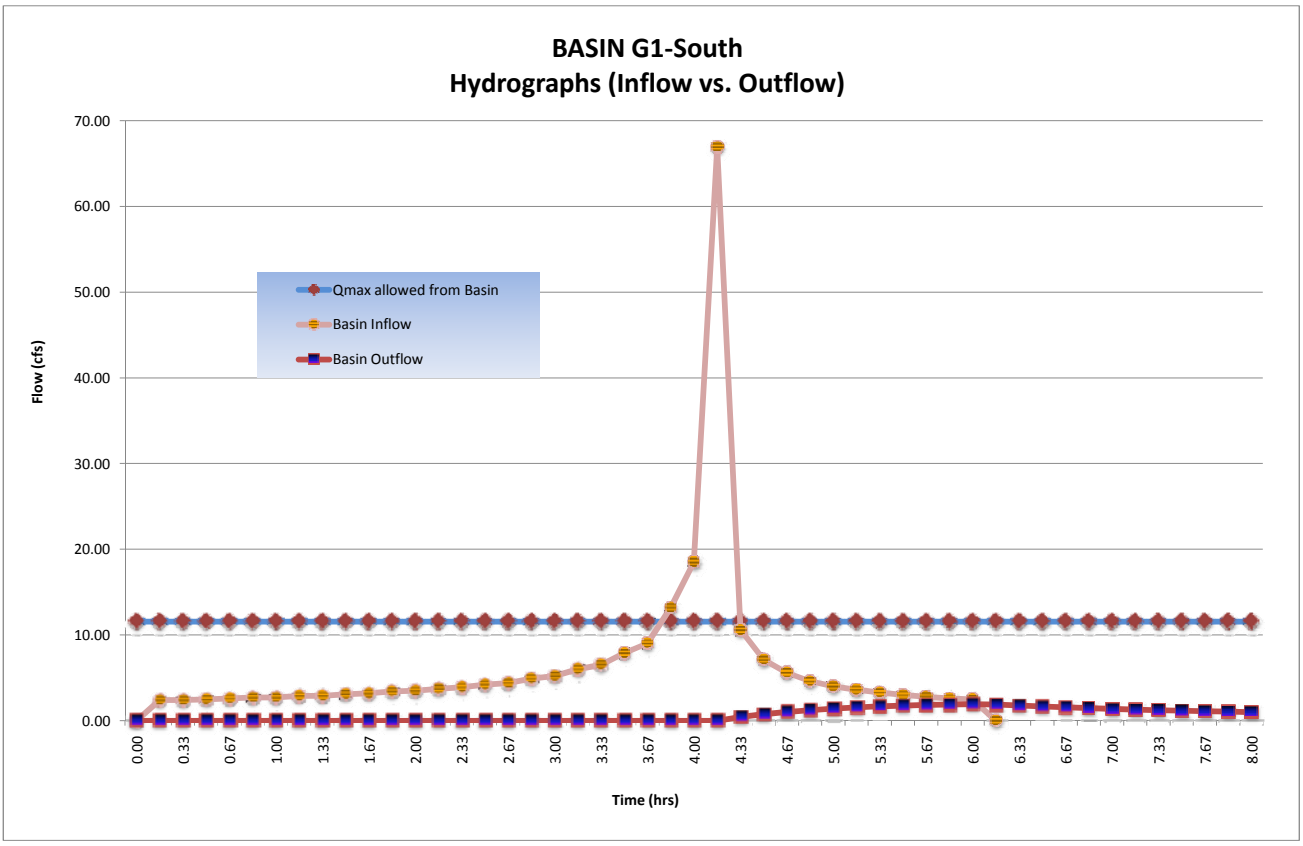
# Basin G1-South Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

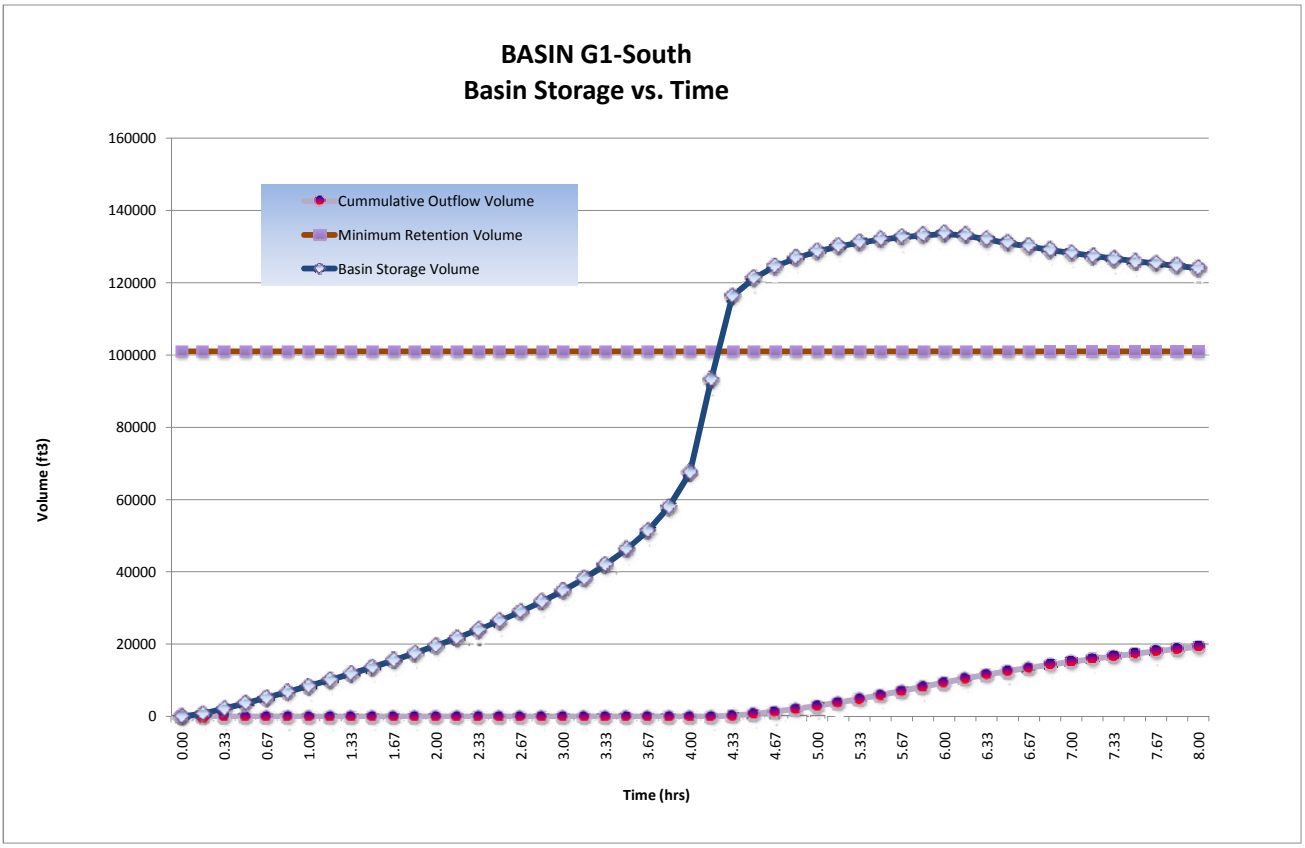
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 2.40 | 1.20 | 0.00 | 0.00 | 1.20 | 0.00 | 720 | 0 | 0 |
| 0.33 | 2.40 | 2.40 | 1.20 | 0.00 | 3.60 | 0.00 | 2160 | 0 | 0 |
| 0.50 | 2.50 | 2.45 | 3.60 | 0.00 | 6.05 | 0.00 | 3630 | 0 | 0 |
| 0.67 | 2.60 | 2.55 | 6.05 | 0.00 | 8.60 | 0.00 | 5160 | 0 | 0 |
| 0.83 | 2.70 | 2.65 | 8.60 | 0.00 | 11.25 | 0.00 | 6750 | 0 | 0 |
| 1.00 | 2.70 | 2.70 | 11.25 | 0.00 | 13.95 | 0.00 | 8370 | 0 | 0 |
| 1.17 | 2.90 | 2.80 | 13.95 | 0.00 | 16.75 | 0.00 | 10050 | 0 | 0 |
| 1.33 | 2.90 | 2.90 | 16.75 | 0.00 | 19.65 | 0.00 | 11790 | 0 | 0 |
| 1.50 | 3.10 | 3.00 | 19.65 | 0.00 | 22.65 | 0.00 | 13590 | 0 | 0 |
| 1.67 | 3.20 | 3.15 | 22.65 | 0.00 | 25.80 | 0.00 | 15480 | 0 | 0 |
| 1.83 | 3.40 | 3.30 | 25.80 | 0.00 | 29.10 | 0.00 | 17460 | 0 | 0 |
| 2.00 | 3.50 | 3.45 | 29.10 | 0.00 | 32.55 | 0.00 | 19530 | 0 | 0 |
| 2.17 | 3.70 | 3.60 | 32.55 | 0.00 | 36.15 | 0.00 | 21690 | 0 | 0 |
| 2.33 | 3.90 | 3.80 | 36.15 | 0.00 | 39.95 | 0.00 | 23970 | 0 | 0 |
| 2.50 | 4.20 | 4.05 | 39.95 | 0.00 | 44.00 | 0.00 | 26400 | 0 | 0 |
| 2.67 | 4.40 | 4.30 | 44.00 | 0.00 | 48.30 | 0.00 | 28980 | 0 | 0 |
| 2.83 | 4.90 | 4.65 | 48.30 | 0.00 | 52.95 | 0.00 | 31770 | 0 | 0 |
| 3.00 | 5.20 | 5.05 | 52.95 | 0.00 | 58.00 | 0.00 | 34800 | 0 | 0 |
| 3.17 | 6.00 | 5.60 | 58.00 | 0.00 | 63.60 | 0.00 | 38160 | 0 | 0 |
| 3.33 | 6.50 | 6.25 | 63.60 | 0.00 | 69.85 | 0.00 | 41910 | 0 | 0 |
| 3.50 | 7.90 | 7.20 | 69.85 | 0.00 | 77.05 | 0.00 | 46230 | 0 | 0 |
| 3.67 | 9.00 | 8.45 | 77.05 | 0.00 | 85.50 | 0.00 | 51300 | 0 | 0 |
| 3.83 | 13.20 | 11.10 | 85.50 | 0.00 | 96.60 | 0.00 | 57960 | 0 | 0 |
| 4.00 | 18.50 | 15.85 | 96.60 | 0.00 | 112.45 | 0.00 | 67470 | 0 | 0 |
| 4.17 | 66.90 | 42.70 | 112.45 | 0.00 | 155.15 | 0.00 | 93090 | 0 | 0 |
| 4.33 | 10.60 | 38.75 | 155.15 | 0.00 | 193.90 | 0.43 | 116211 | 258 | 258 |
| 4.50 | 7.10 | 8.85 | 193.90 | 0.43 | 202.32 | 0.76 | 121164 | 456 | 714 |
| 4.67 | 5.60 | 6.35 | 202.32 | 0.76 | 207.91 | 1.03 | 124437 | 618 | 1332 |
| 4.83 | 4.60 | 5.10 | 207.91 | 1.03 | 211.98 | 1.23 | 126819 | 738 | 2070 |
| 5.00 | 4.00 | 4.30 | 211.98 | 1.23 | 215.05 | 1.40 | 128610 | 840 | 2910 |
| 5.17 | 3.60 | 3.80 | 215.05 | 1.40 | 217.45 | 1.56 | 130002 | 936 | 3846 |
| 5.33 | 3.30 | 3.45 | 217.45 | 1.56 | 219.34 | 1.68 | 131100 | 1008 | 4854 |
| 5.50 | 3.00 | 3.15 | 219.34 | 1.68 | 220.81 | 1.77 | 131955 | 1062 | 5916 |
| 5.67 | 2.80 | 2.90 | 220.81 | 1.77 | 221.94 | 1.84 | 132612 | 1104 | 7020 |
| 5.83 | 2.60 | 2.70 | 221.94 | 1.84 | 222.80 | 1.90 | 133110 | 1140 | 8160 |
| 6.00 | 2.50 | 2.55 | 222.80 | 1.90 | 223.45 | 1.94 | 133488 | 1164 | 9324 |
| 6.17 | 0.00 | 1.25 | 223.45 | 1.94 | 222.76 | 1.89 | 133089 | 1134 | 10458 |
| 6.33 | | 0.00 | 222.76 | 1.89 | 220.87 | 1.77 | 131991 | 1062 | 11520 |
| 6.50 | | 0.00 | 220.87 | 1.77 | 219.10 | 1.66 | 130962 | 996 | 12516 |
| 6.67 | | 0.00 | 219.10 | 1.66 | 217.44 | 1.55 | 129999 | 930 | 13446 |
| 6.83 | | 0.00 | 217.44 | 1.55 | 215.89 | 1.46 | 129096 | 876 | 14322 |
| 7.00 | | 0.00 | 215.89 | 1.46 | 214.43 | 1.36 | 128250 | 816 | 15138 |
| 7.17 | | 0.00 | 214.43 | 1.36 | 213.07 | 1.28 | 127458 | 768 | 15906 |
| 7.33 | | 0.00 | 213.07 | 1.28 | 211.79 | 1.22 | 126708 | 732 | 16638 |
| 7.50 | | 0.00 | 211.79 | 1.22 | 210.57 | 1.16 | 125994 | 696 | 17334 |
| 7.67 | | 0.00 | 210.57 | 1.16 | 209.41 | 1.10 | 125316 | 660 | 17994 |
| 7.83 | | 0.00 | 209.41 | 1.10 | 208.31 | 1.05 | 124671 | 630 | 18624 |
| 8.00 | | 0.00 | 208.31 | 1.05 | 207.26 | 1.00 | 124056 | 600 | 19224 |

## Basin G1-South Routing



## Basin G1-South Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **133,488** | **$ft^3$** | |
| **@ Stage:** | **515.60** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **181,518** | **$ft^3$** | Basin **G1-South** |
| **Maximum flow rate released from this basin:** | **1.94** | **cfs** | |

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# X1 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.27.10** | **WATERSHED:** | **X** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | X1.1.PV | 0.99 | 2000 | 0.0 | 5 | 4.0 | 0.18 | 6.6 | 0.30 | ~ | X1.1 | bypass* | 40+00 | Rt |
| | X1.2.PV | 0.99 | 64000 | 1.5 | 5 | 4.0 | 5.79 | 6.6 | 9.58 | ~ | X1.2 | bypass* | 40+50 | Rt |
| | X1.3.PV | 0.99 | 2200 | 0.1 | 5 | 4.0 | 0.20 | 6.6 | 0.33 | ~ | X1.3 | bypass* | 40+00 | Lt |
| | X1.4.PV | 0.99 | 66500 | 1.5 | 5 | 4.0 | 6.02 | 6.6 | 9.96 | ~ | X1.4 | bypass* | 40+50 | Lt |

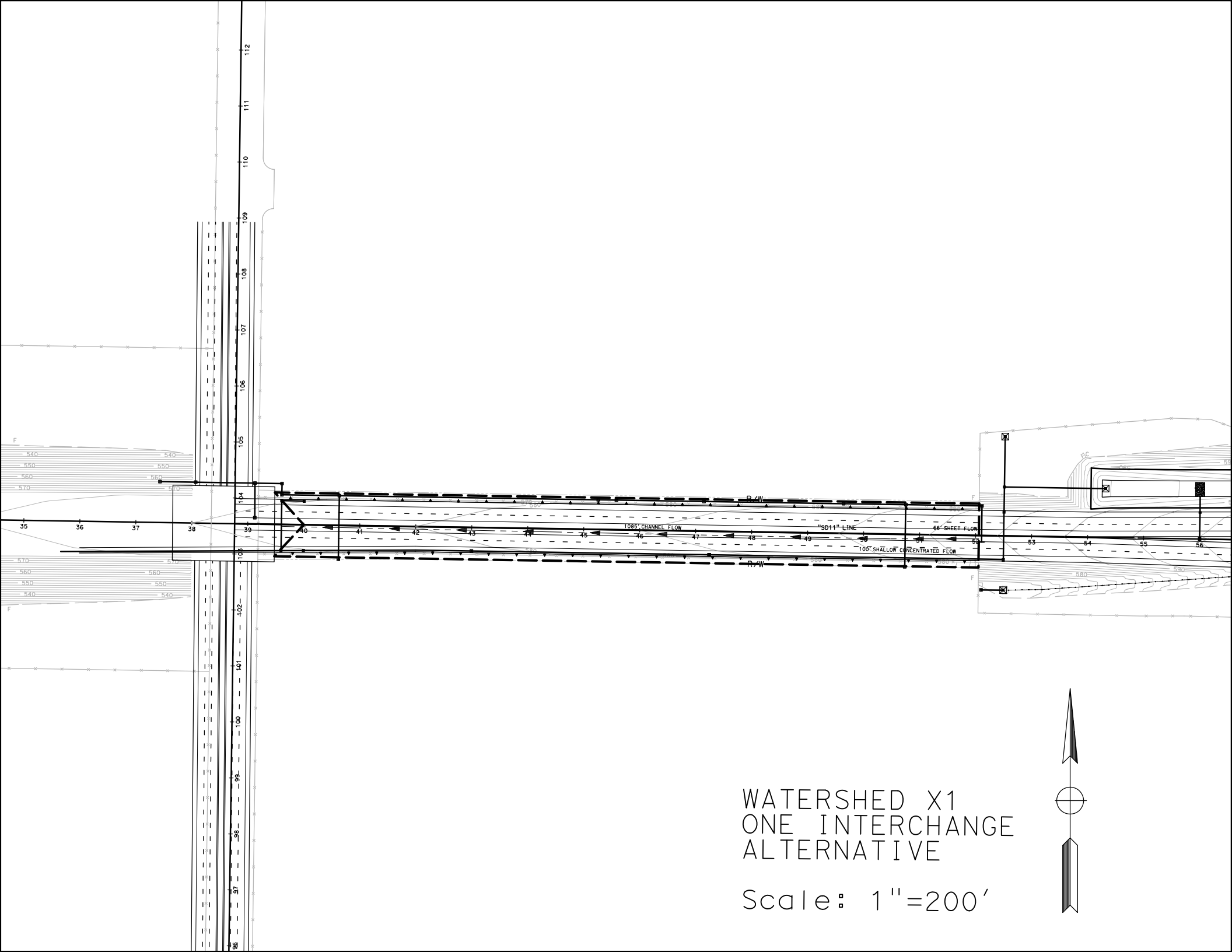
Σ 134700 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | X1.5.SL | 0.61 | 5733 | 0.1 | 10 | 2.8 | 0.23 | 4.2 | 0.34 | ~ | X1.5 | bypass* | 40+00 | ~ |

Σ 5733 *SLOPE*

*flow that does not reach the basin

| | | |
|---|---|---|
| Total : | 140433 | 3.2 |
| | *SF* | *ac* |




WATERSHED X1
ONE INTERCHANGE
ALTERNATIVE

Scale: 1"=200'

# X1 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 40+00 |
| BY: | M.BRUNING | DATE: | 01.27.10 | WATERSHED: | X1 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | X1 |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 140433 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 3.22 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.22 | Hilly Slopes ~ 15% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.49 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 15% | AT | 0.49 | 0.071 |
| PAVED SURFACE | 85% | AT | 0.90 | 0.769 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.84 |
| $C_{25}$ = | 0.92 |
| $C_{50}$ = | 1.00 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{.4\,5} n^{.4\,5}}{P_2^{.1/2} s^{.2\,5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | SR-11 at Sta 52 CL |
| LOW POINT ELEVATION | 586.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 66 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A HMA |
| $T_t$ (SFF)= | 1.75 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 586.0 | ft | assumed not channelized yet |
| LOW POINT ELEVATION | 584.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| VELOCITY (SCF) | 4.0 | fps | <=V FROM FIG 816.6 HMA |
| $T_C$ (SH)= | 0.42 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft | channelizes in shoulder of structure |
| LOW POINT ELEVATION | 578.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 6.0 | ft | Z= 20 ANG-RAD 0.050 |
| LENGTH (L) | 1085 | ft | b = 10 ANG-DEG 2.862 |
| SLOPE (S) = (H/L) | 0.6% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.016 | | HMA |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.33 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.43 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 7.60 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 5.0 |
| $Q_{10}$ = | 7.3 |
| $Q_{25}$ = | 10.0 |
| $Q_{50}$ = | 13.0 |
| $Q_{100}$ = | **13.6** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin X1 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.27.10** | **WATERSHED:** | **X1** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X1** |

***Notes:***

* The difference between pre-developed and post-developed values gives the approximate volume to detain.
Stage-Storage calculations will determine accurate volume

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 10.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.76 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 240 | 0.4 |
| 20 | 240 | 0.4 |
| 30 | 240 | 0.4 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 300 | 0.5 |
| 90 | 300 | 0.5 |
| 100 | 300 | 0.5 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 360 | 0.6 |
| 140 | 360 | 0.6 |
| 150 | 420 | 0.7 |
| 160 | 420 | 0.7 |
| 170 | 480 | 0.8 |
| 180 | 480 | 0.8 |
| 190 | 540 | 0.9 |
| 200 | 600 | 1 |
| 210 | 720 | 1.2 |
| 220 | 840 | 1.4 |
| 230 | 1200 | 2 |
| 240 | 1680 | 2.8 |
| 250 | 6240 | 10.4 |
| 260 | 960 | 1.6 |
| 270 | 660 | 1.1 |
| 280 | 540 | 0.9 |
| 290 | 420 | 0.7 |
| 300 | 360 | 0.6 |
| 310 | 360 | 0.6 |
| 320 | 300 | 0.5 |
| 330 | 300 | 0.5 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 240 | 0.4 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **22140** | **$ft^3$** |
| | **0.51** | **acre-feet** |

Check: V = C*A*$P_6$

V= 0.51 acre-feet

***OK***

# Basin X1 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 13.6 | cfs | | | |
| Tc= | 10.0 | min | C= | 1.00 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 300 | 0.5 |
| 20 | 300 | 0.5 |
| 30 | 300 | 0.5 |
| 40 | 300 | 0.5 |
| 50 | 300 | 0.5 |
| 60 | 360 | 0.6 |
| 70 | 360 | 0.6 |
| 80 | 360 | 0.6 |
| 90 | 360 | 0.6 |
| 100 | 360 | 0.6 |
| 110 | 420 | 0.7 |
| 120 | 420 | 0.7 |
| 130 | 480 | 0.8 |
| 140 | 480 | 0.8 |
| 150 | 540 | 0.9 |
| 160 | 540 | 0.9 |
| 170 | 600 | 1 |
| 180 | 660 | 1.1 |
| 190 | 720 | 1.2 |
| 200 | 780 | 1.3 |
| 210 | 960 | 1.6 |
| 220 | 1080 | 1.8 |
| 230 | 1620 | 2.7 |
| 240 | 2220 | 3.7 |
| 250 | 8160 | 13.6 |
| 260 | 1320 | 2.2 |
| 270 | 840 | 1.4 |
| 280 | 660 | 1.1 |
| 290 | 540 | 0.9 |
| 300 | 480 | 0.8 |
| 310 | 420 | 0.7 |
| 320 | 420 | 0.7 |
| 330 | 360 | 0.6 |
| 340 | 360 | 0.6 |
| 350 | 300 | 0.5 |
| 360 | 300 | 0.5 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 28980 $ft^3$**
**0.67 acre-feet**

Check: V = C*A*$P_6$
V= 0.67 acre-feet
***OK***

| | | | | |
|---|---|---|---|---|
| | | **0.67** | | |
| | - | **0.51** | | |
| **Attenuation volume =** | | **0.16** | **acre-feet** | **=** **6840 $ft^3$** |

**Basin Required**
**REFER TO BASIN Y**

# Basin X1 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 3.22 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **8543** **$ft^3$**

**WQV to be added to retention volume =** **1703** **$ft^3$** **Add this Volume to Basin**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 5733 $ft^2$
A: 0.13 acres
10.00 years
where: R= 30.00
K= 0.24
Ls= 18.00
C= 0.012
P= 1.00
As 1.56 tons/yr.Ac

Volume for 10-year Silt Accumulation = 2.05 tons

**Silt Accumulation Basin volume =** **45** **$ft^3$**

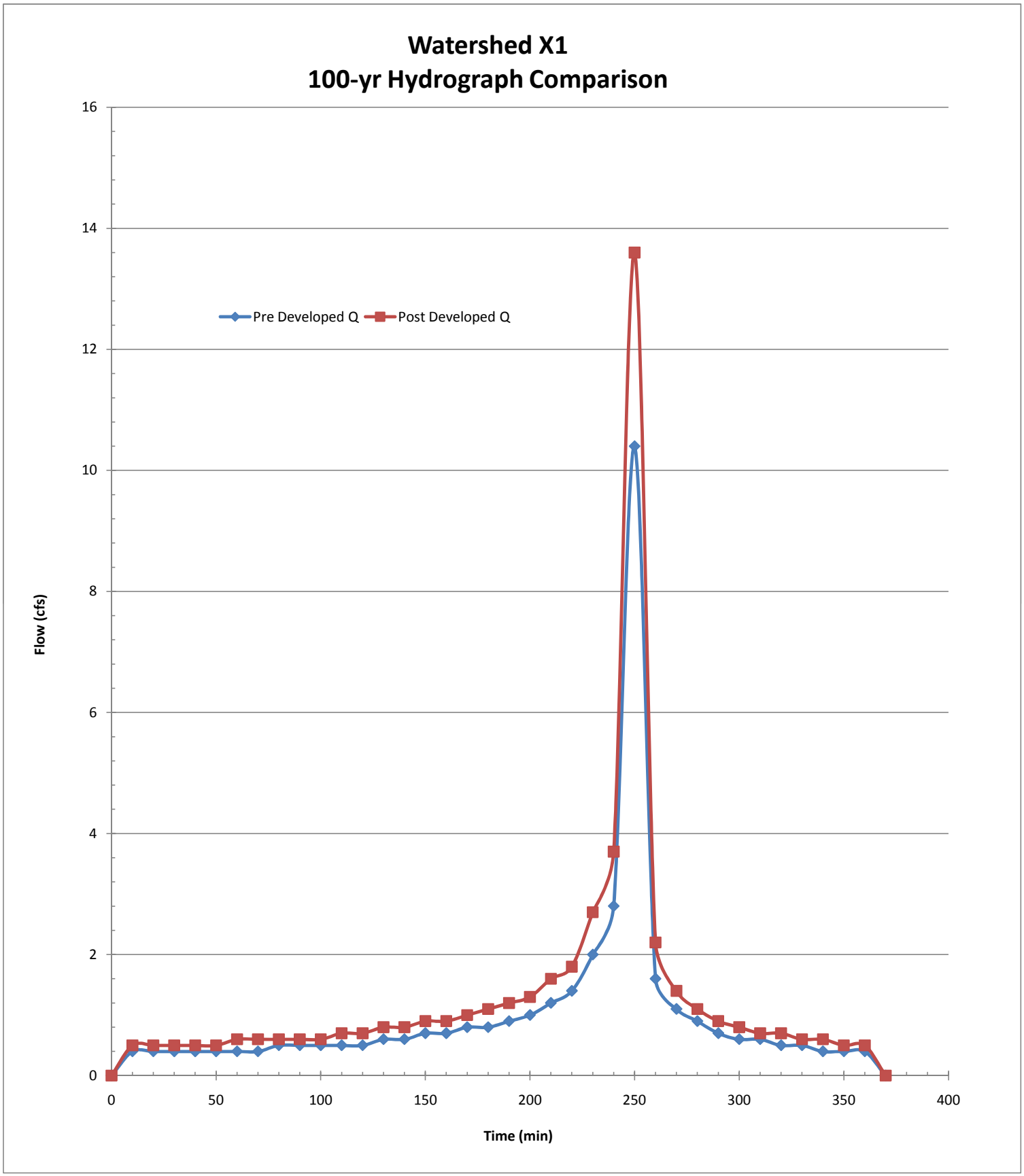
Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Add this volume to Basin volume due to silts from cut slopes**


Watershed X1
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
250
300
350
400

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## Detention/Retention Basin Flows and Sizes – One Interchange Alternative

| Watershed | Location | Flow | | | Runoff Volume | | | Basin Volume - Breakdown | | | Basin Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Developed | Post-Developed | Increase | Pre-Developed | Post-Developed | Increase | Retention Provided | Detention | 1' Freeboard (minimum) | Final Volume | Length | Width | Depth | Free-board | Name |
| Name | (Sta) | (cfs) | (cfs) | (cfs) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | (ft) | (ft) | (ft) | (ft) | |
| X | 40+00 | 10.38 | 13.58 | 3.20 | 22,140 | 28,980 | 6,840 | ~ | ~ | ~ | Routed to Basin Y-EAST | ~ | ~ | ~ | ~ | ~ |
| A | 53+00 | 23.50 | 40.31 | 16.81 | 50,220 | 102,258 | 52,038 | 55,300 | 14,486 | 33,337 | 103,123 | 350 | 30 | 5.2 | 1.0 | A1 |
| B | 69+00 | 30.80 | 27.73 | (3.07) | 124,488 | 104,250 | (20,238) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| C | 78+00 | 16.38 | 8.49 | (7.90) | 35,100 | 18,060 | (17,040) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| D | 80+00 | 18.54 | 10.29 | (8.25) | 42,636 | 22,260 | (20,376) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| E | 101+00 | 61.90 | 103.88 | 41.98 | 232,050 | 351,600 | 119,550 | 123,698 | 21,983 | 59,051 | 204,733 | 250 | 100 | 6.0 | 1.4 | E1 |
| F | 110+00 | 154.03 | 170.40 | 16.37 | 667,620 | 723,840 | 56,220 | 64,134 | 58,480 | 138,348 | 260,961 | 325 | 100 | 6.0 | 2.6 | F1 |
| G | 127+00 | 59.99 | 129.24 | 69.25 | 180,846 | 325,182 | 144,336 | 46,802 | 13,120 | 24,007 | 83,929 | 200 | 75 | 4.2 | 1.0 | G1-North |
| | 139+00 | | | | | | | 102,528 | 30,960 | 48,030 | 181,518 | 180 | 180 | 4.6 | 1.0 | G1-South |

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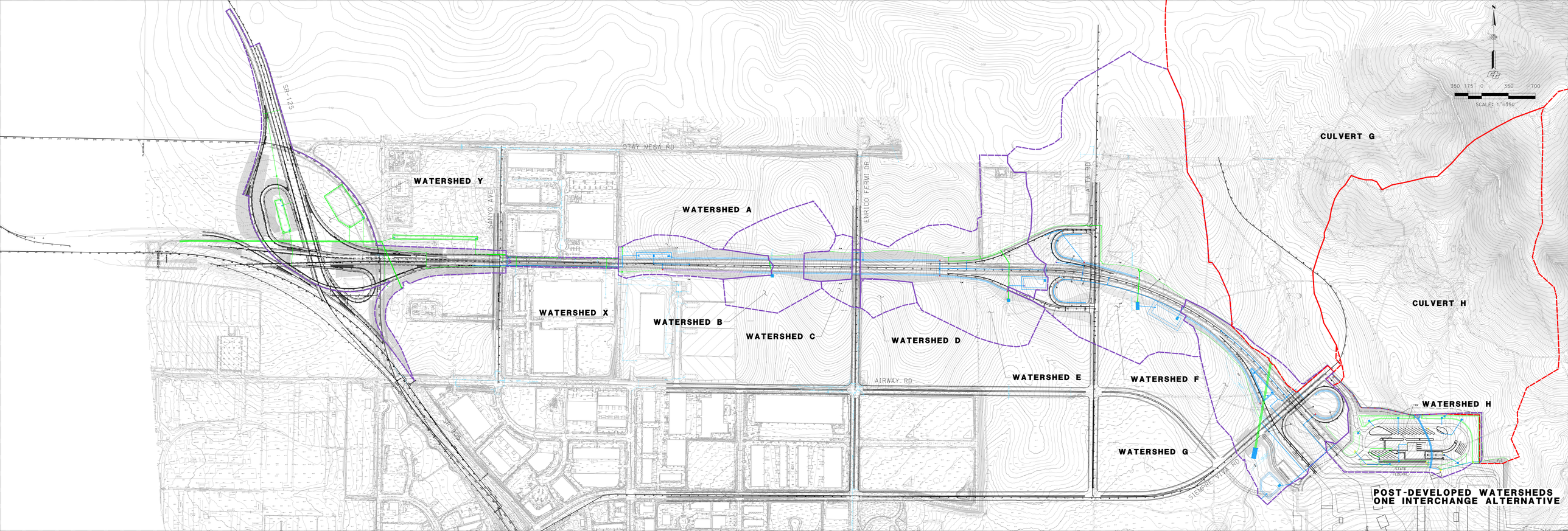


POST-DEVELOPED WATERSHEDS
ONE INTERCHANGE ALTERNATIVE

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# *Appendix D*

TWO-Interchange Alternative

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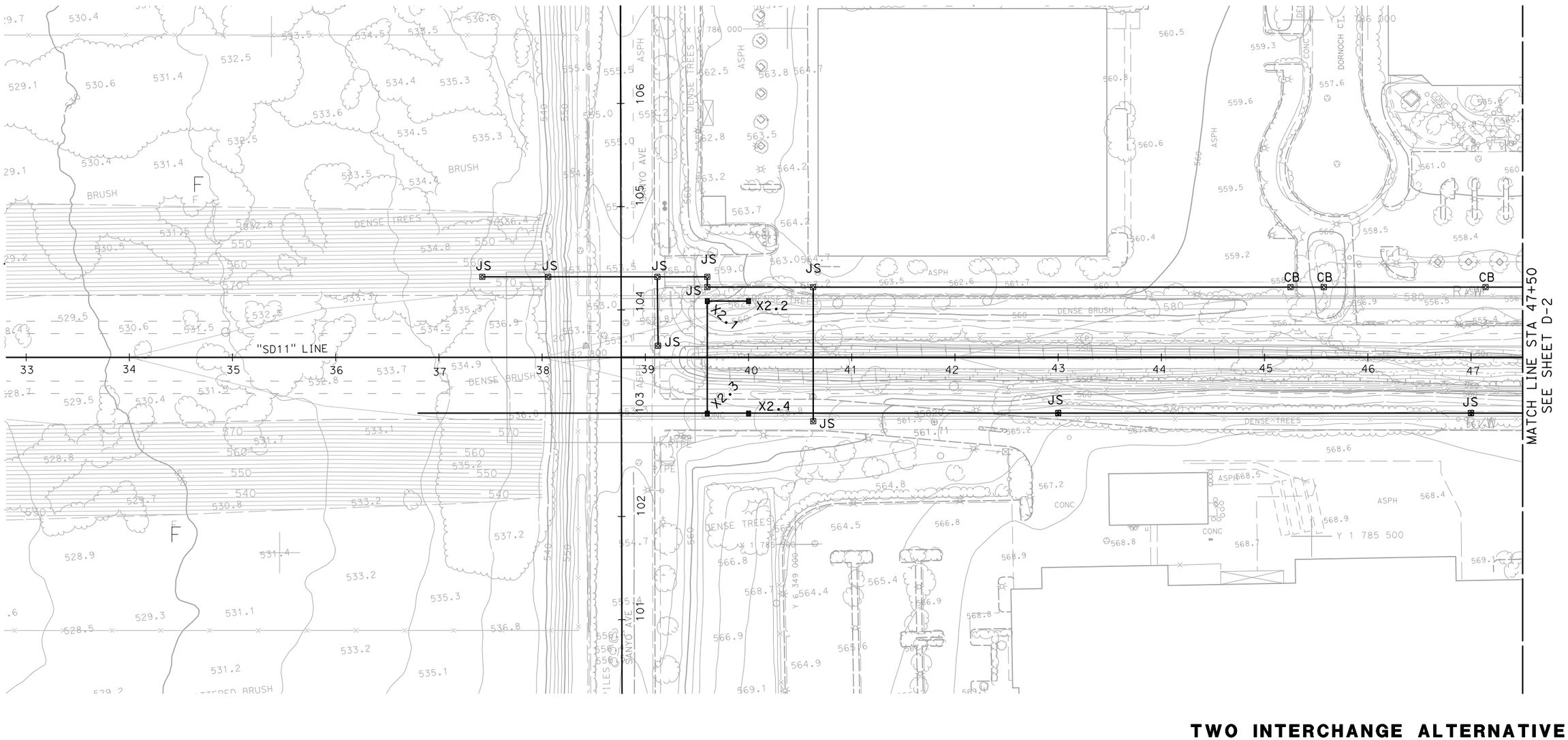
LEGEND:

- JS
- PIPE
- INLET W/APRON
- RSP
- HEADWALL
- --sd-- EXISTING STORMDRAIN

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# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-1**

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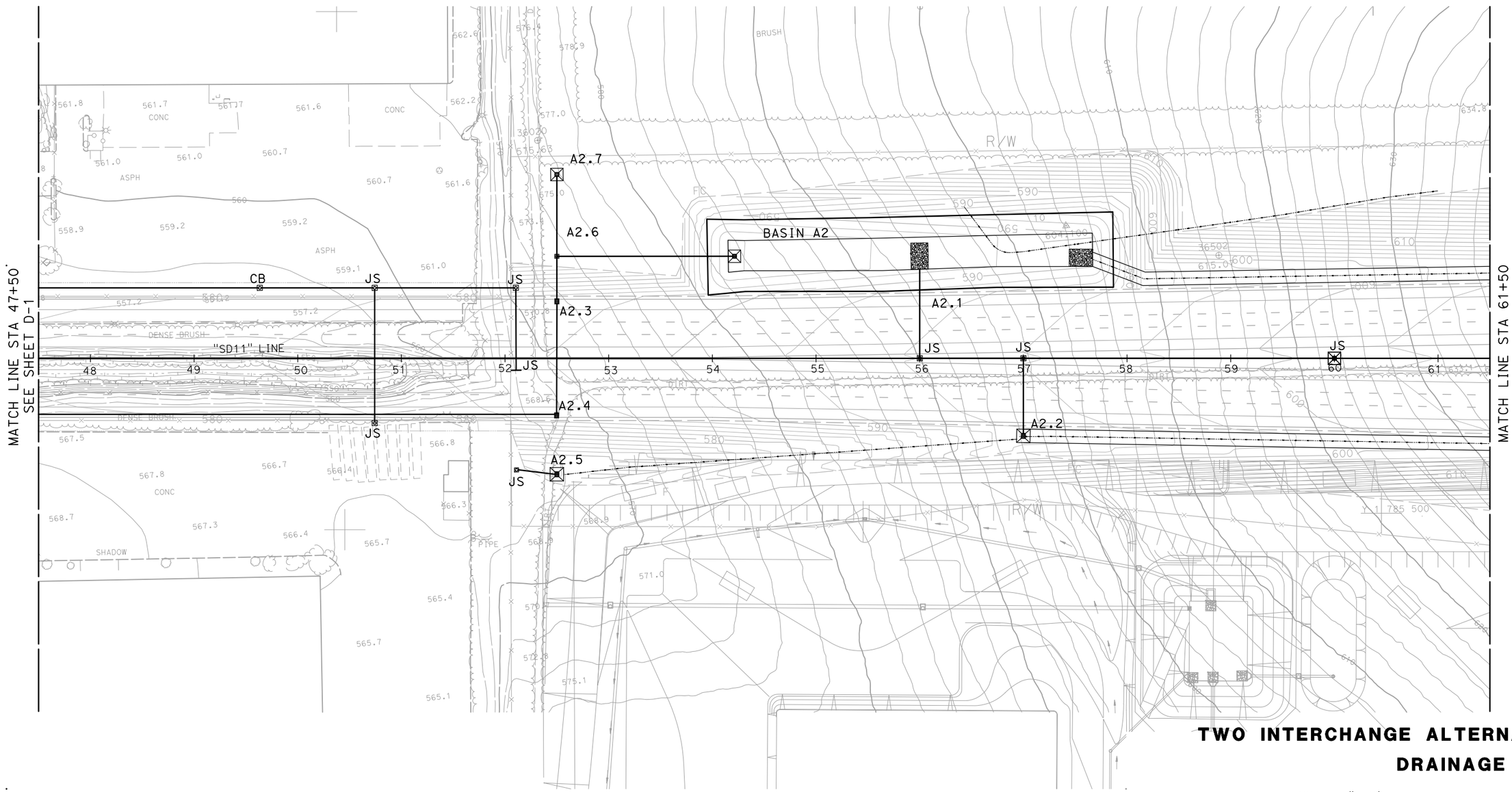


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

**D-2**

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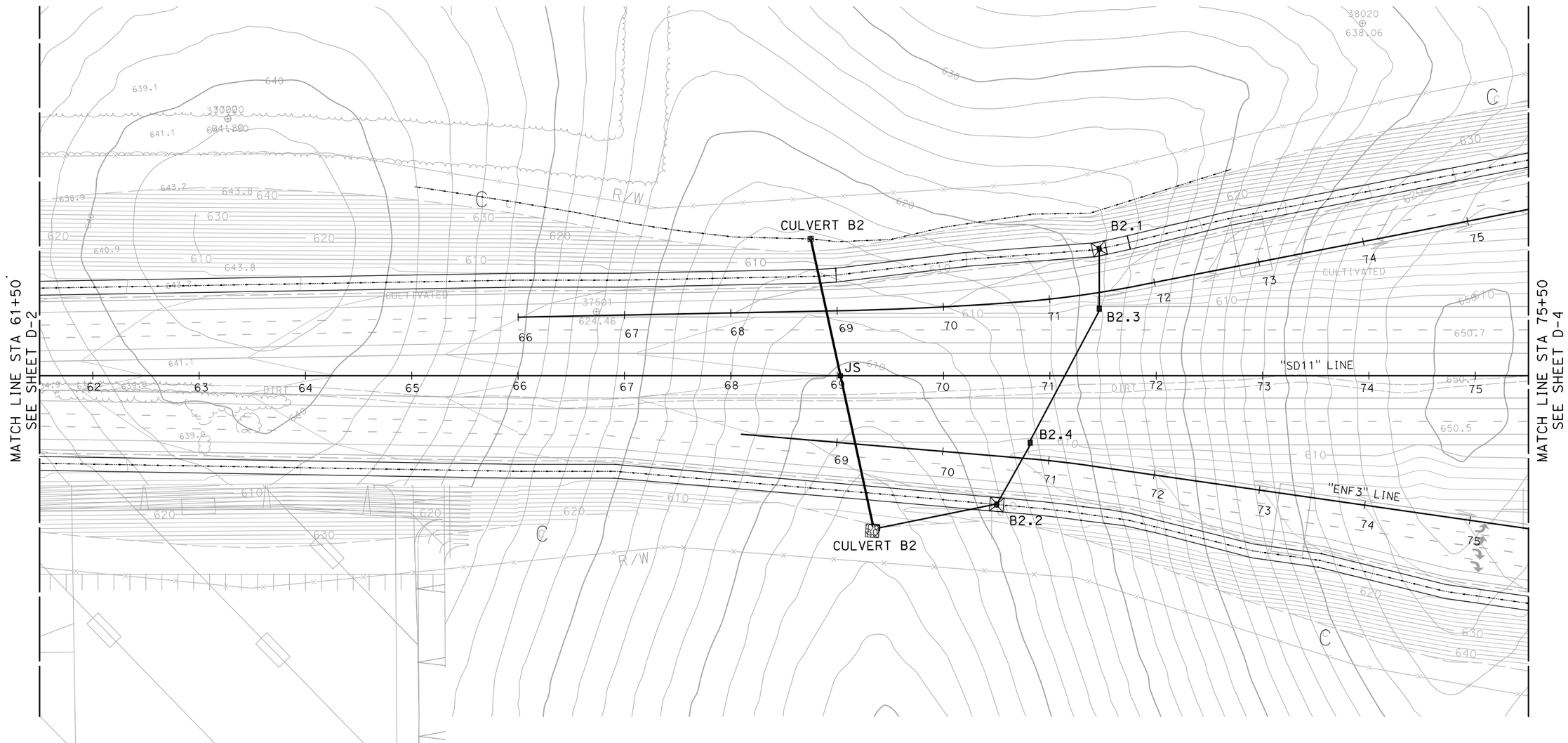


**TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN**

SCALE 1"=50'

**D-3**

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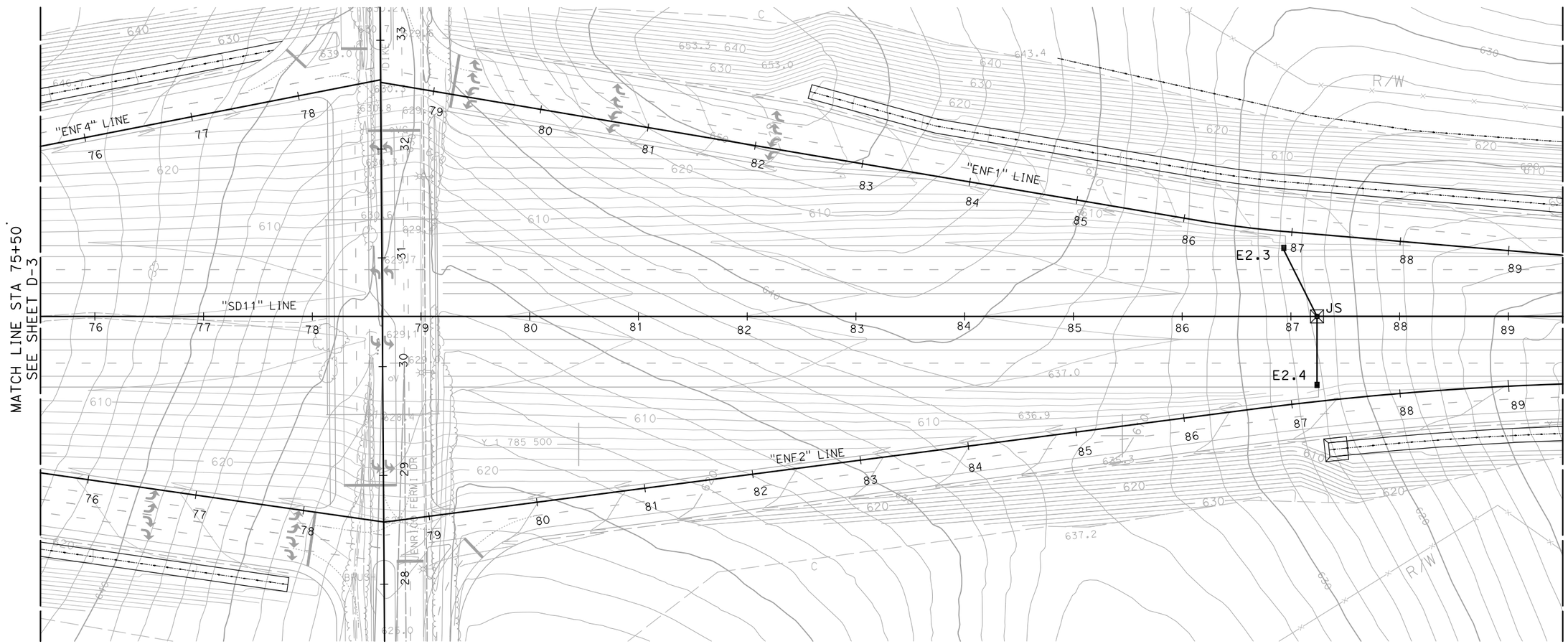


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**D-4**

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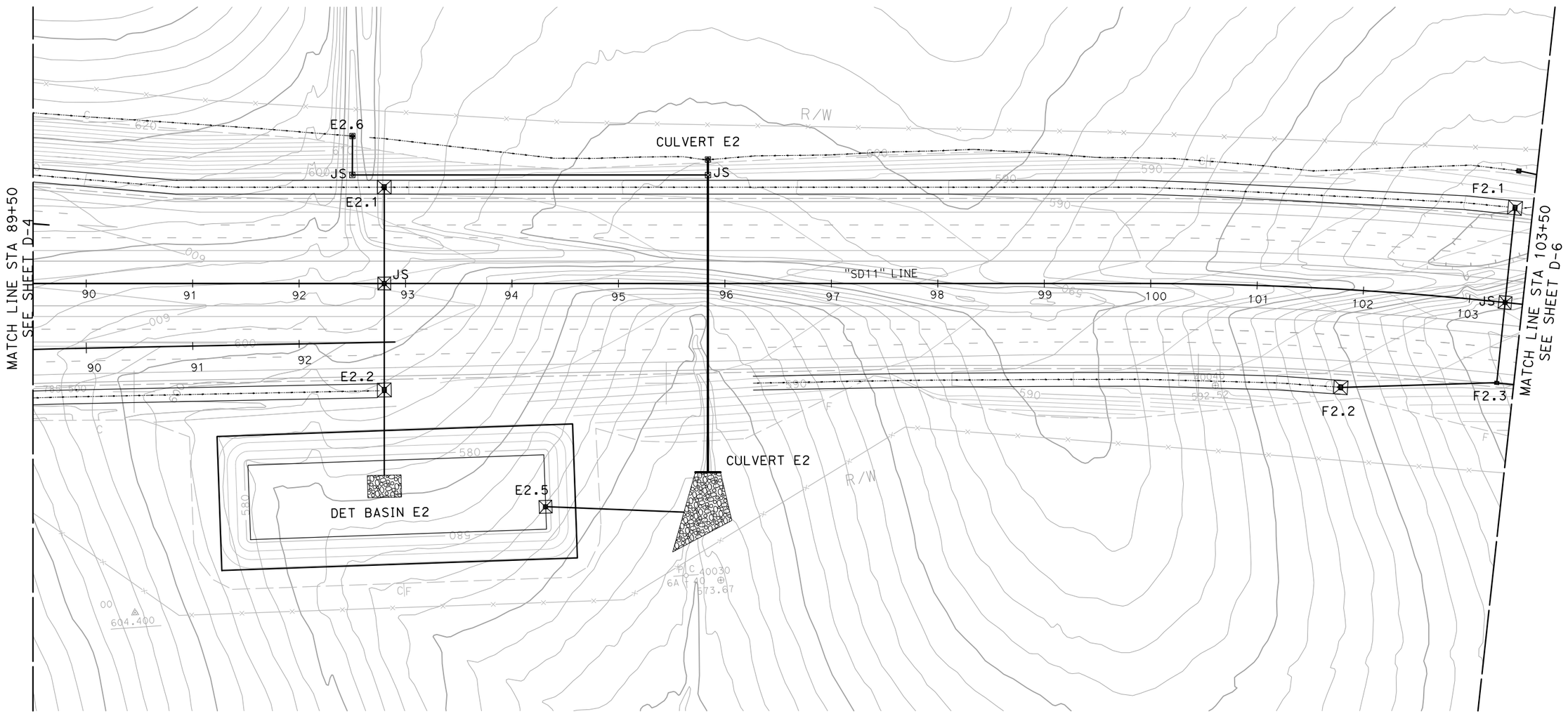


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SCALE 1"=50'

**D-5**

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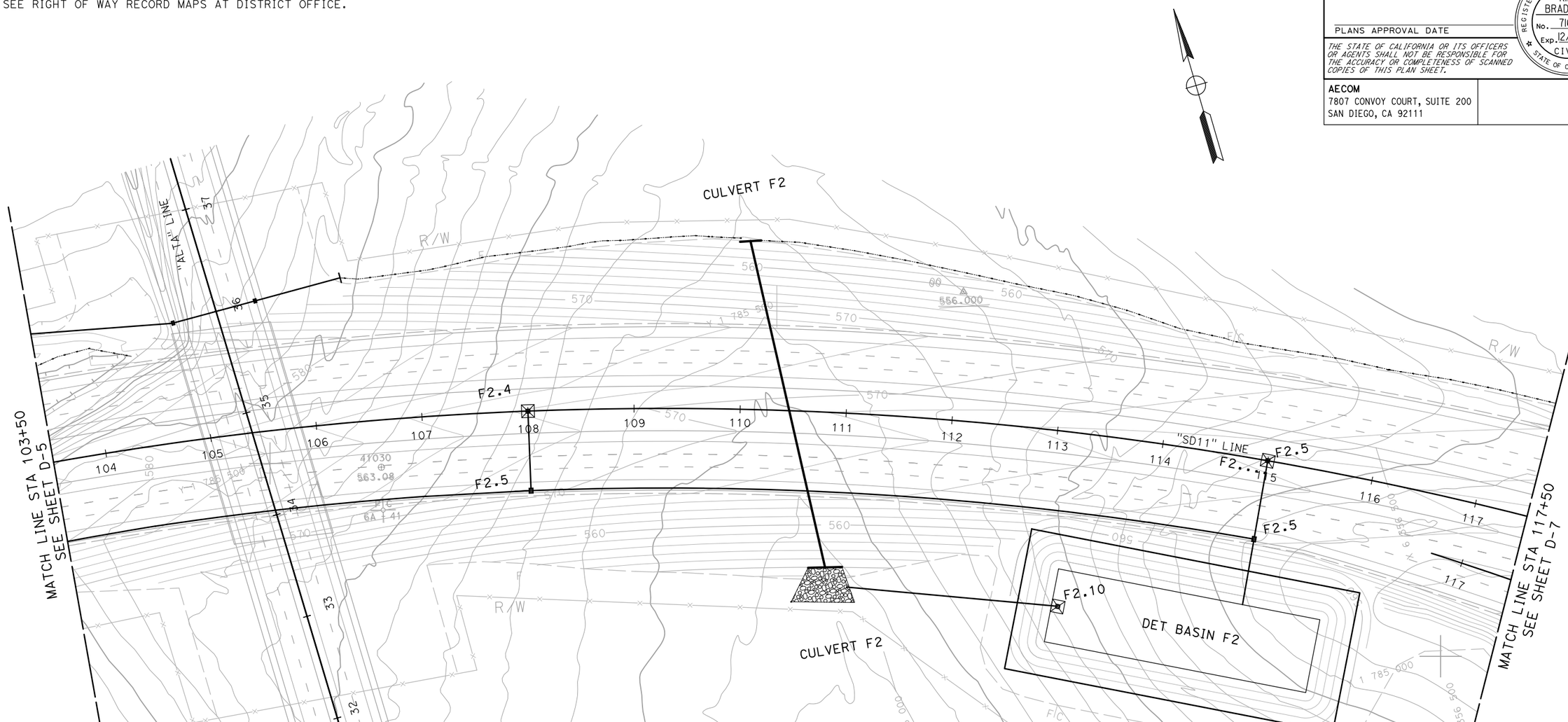


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

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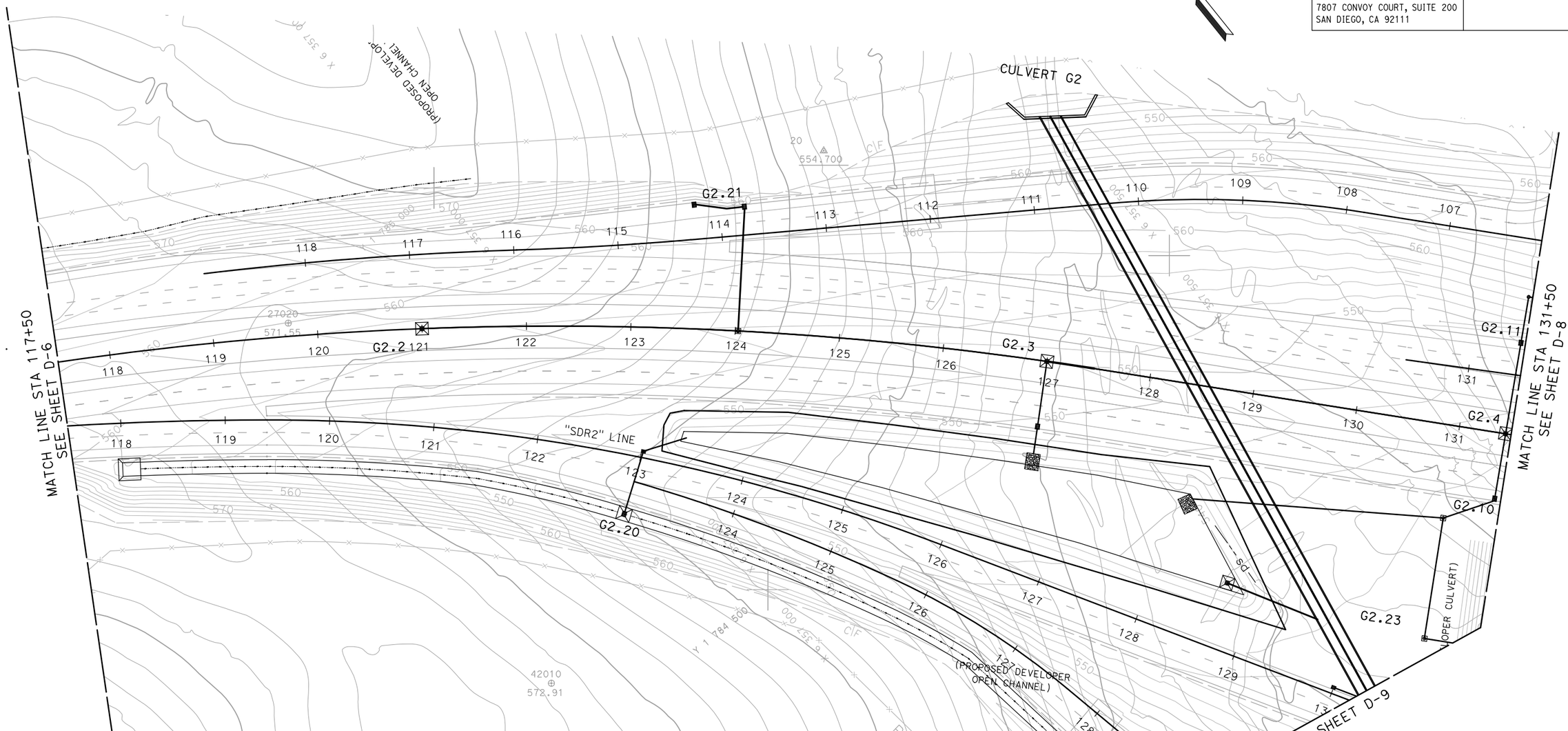


# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-7**

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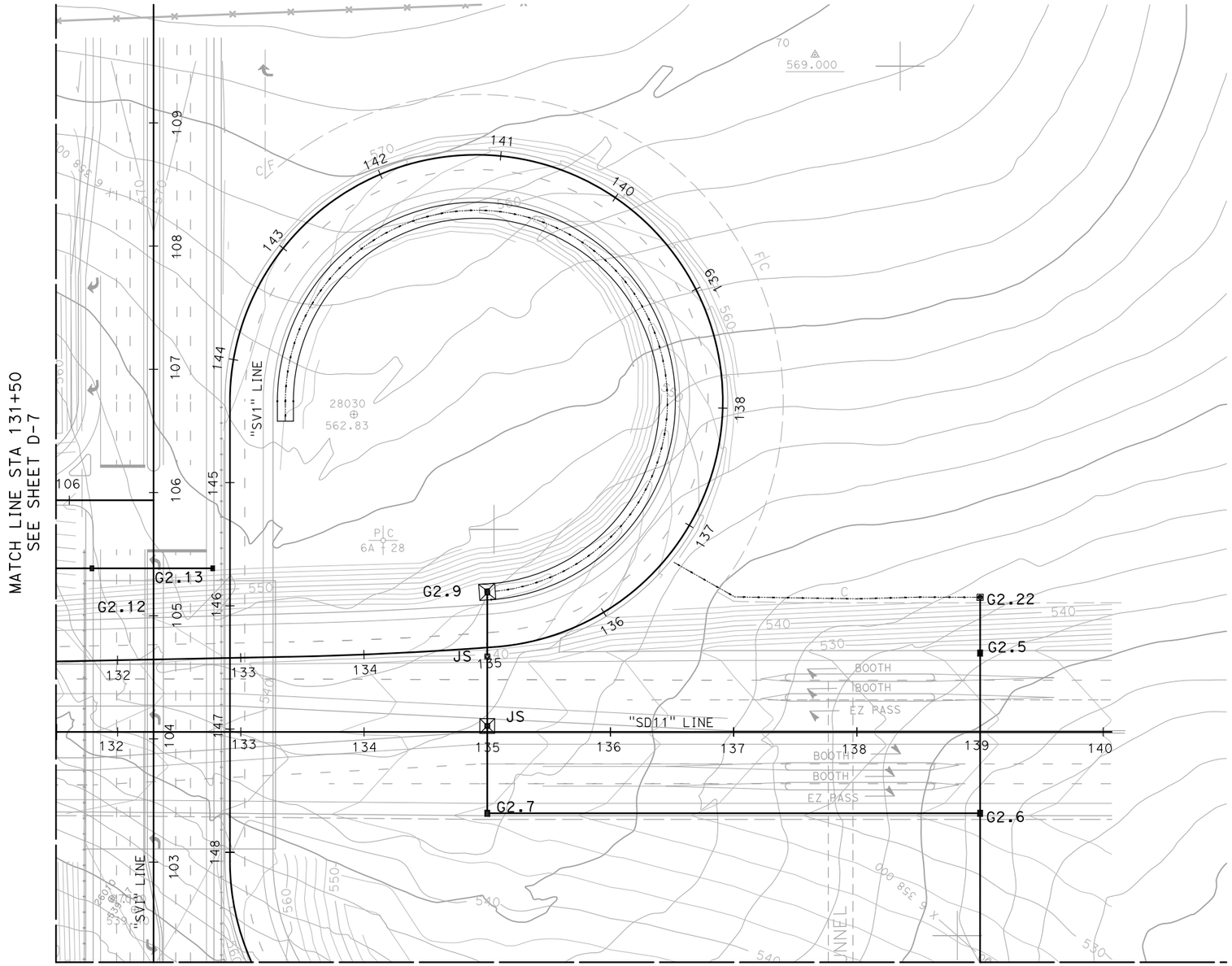


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-8**

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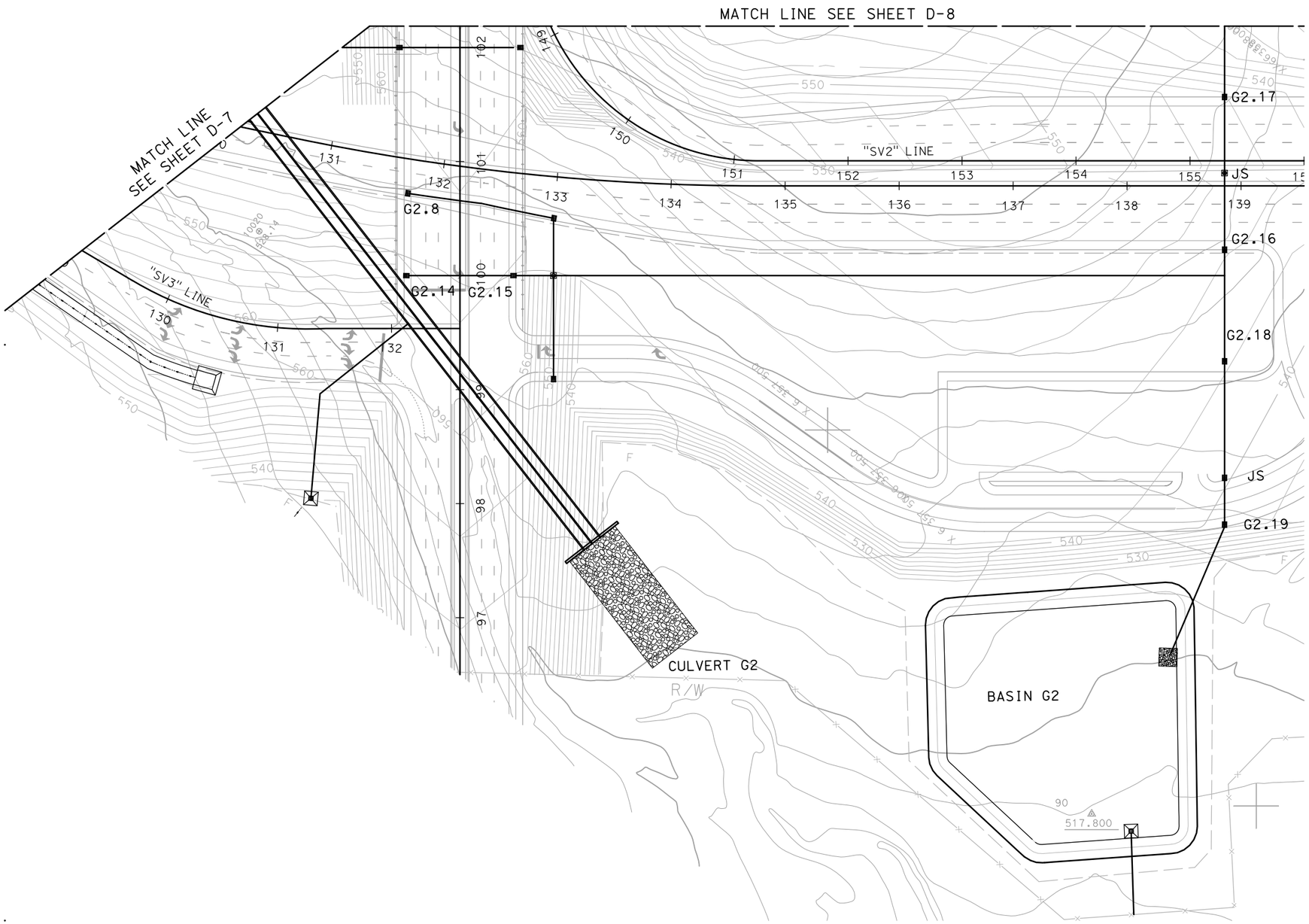


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE PLAN

SCALE 1"=50'

**D-9**

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LEGEND:

- JS
- PIPE
- INLET W/APRON
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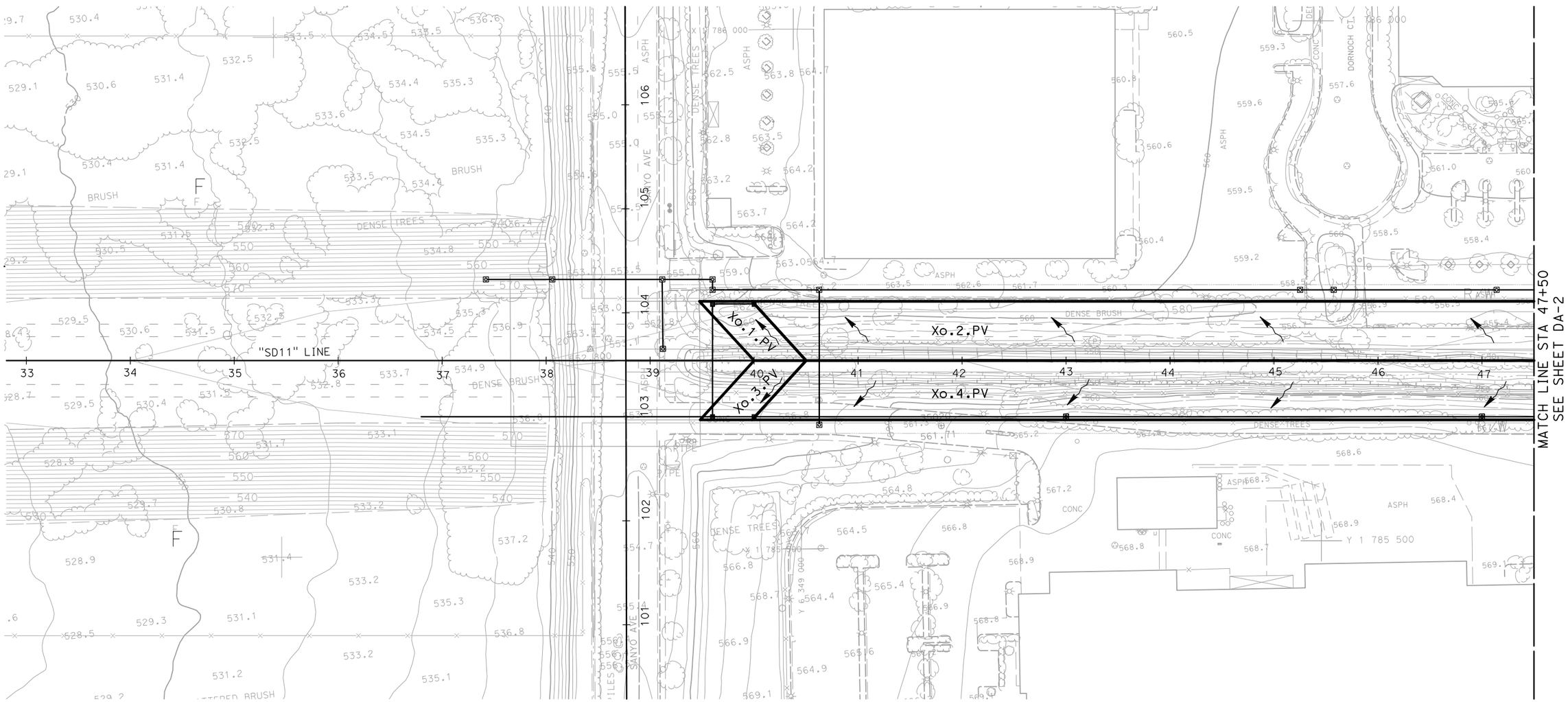
- HEADWALL
- --sd-- EXISTING STORMDRAIN

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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-1**

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REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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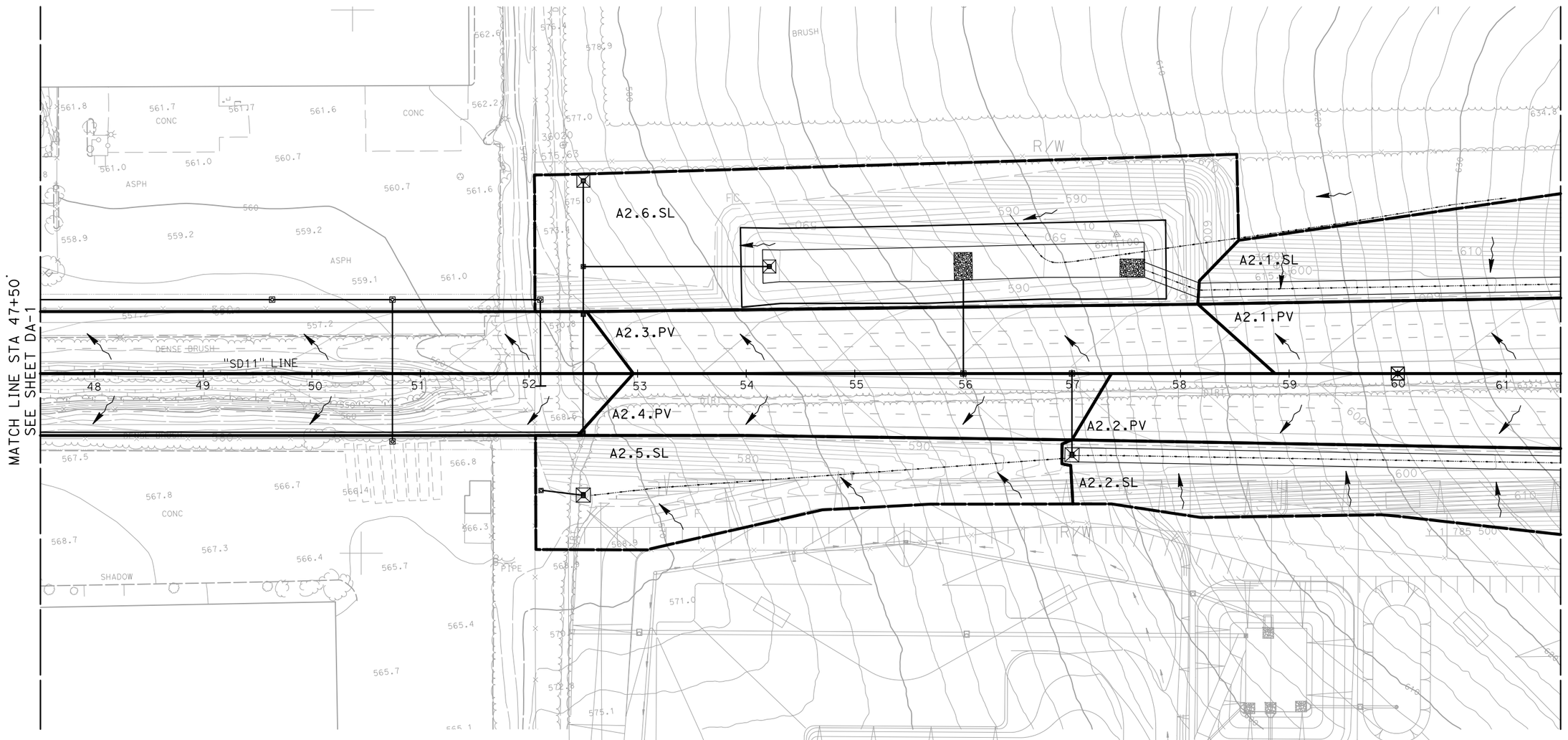


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

**DA-2**

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

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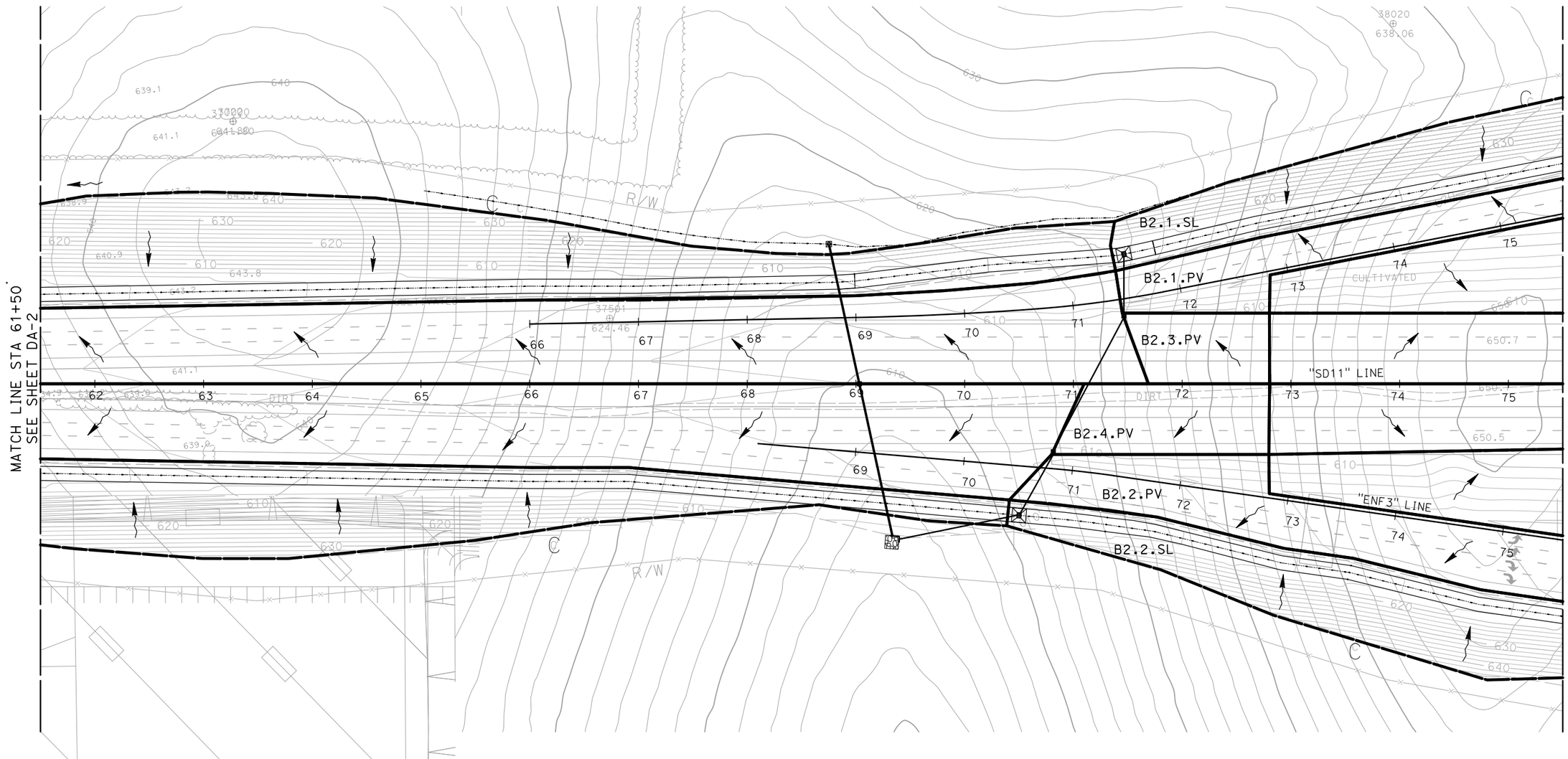


# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-3**

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|---|---|
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| GERARD DALZIEL | |

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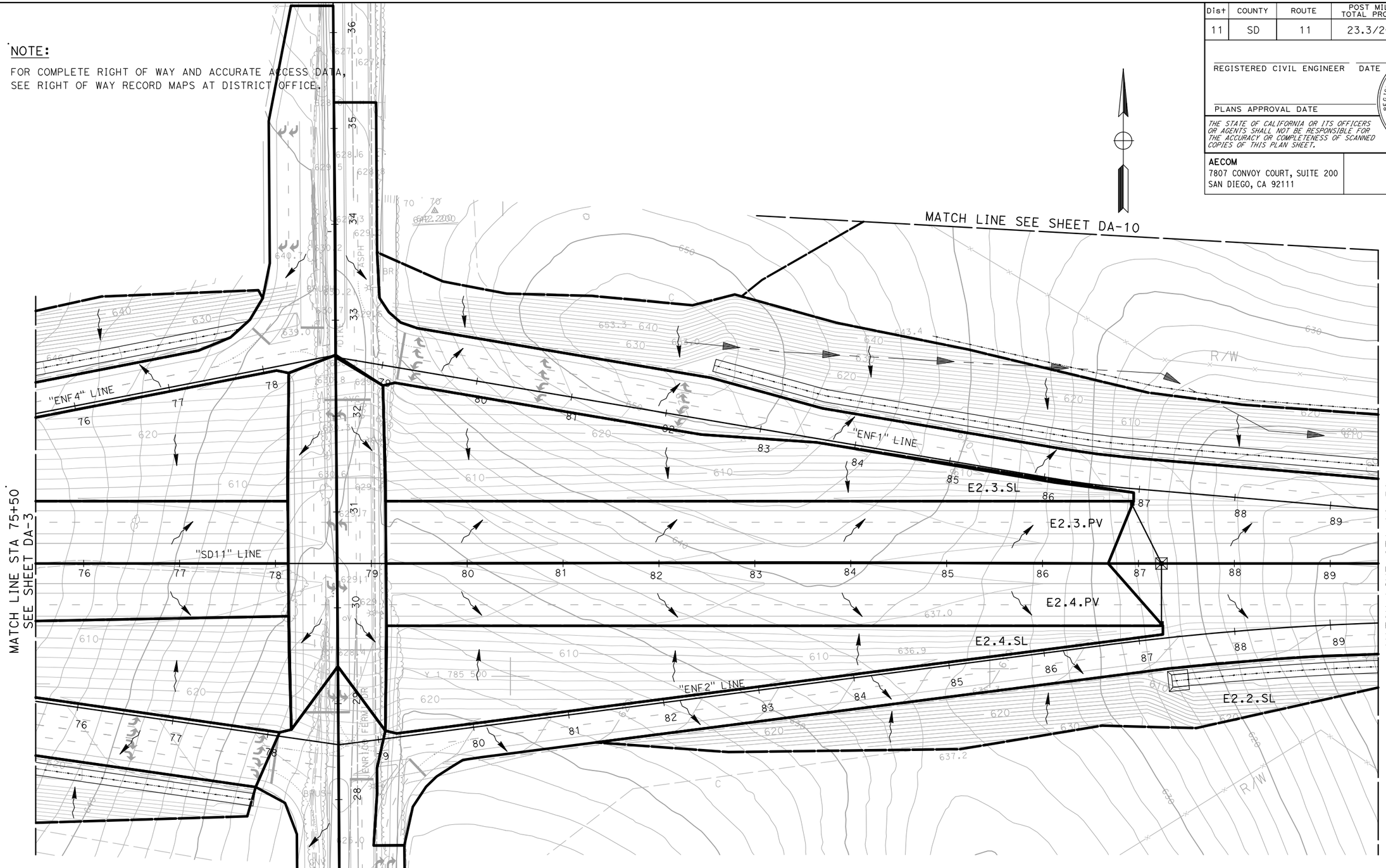


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-4**

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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

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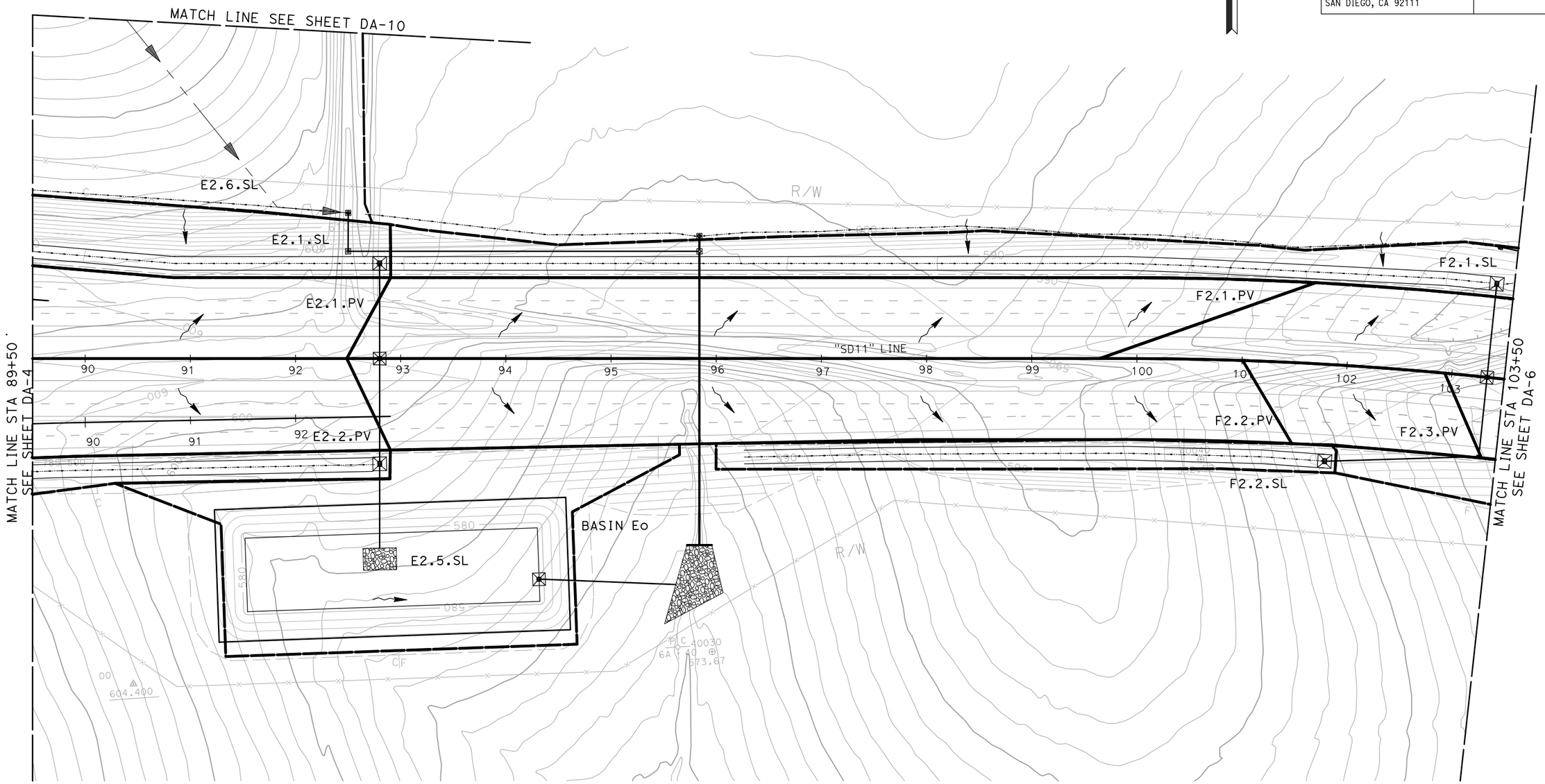


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-5**

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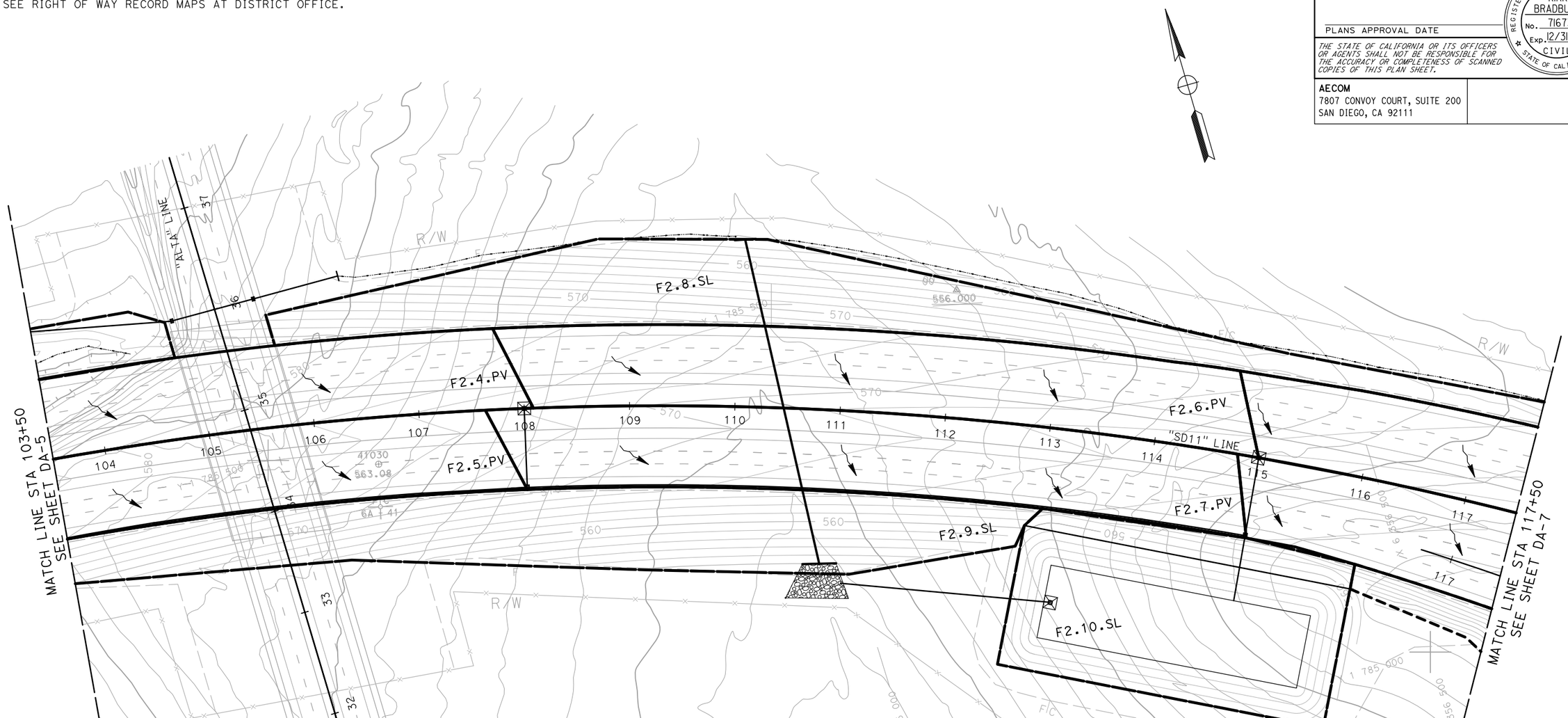


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-6**

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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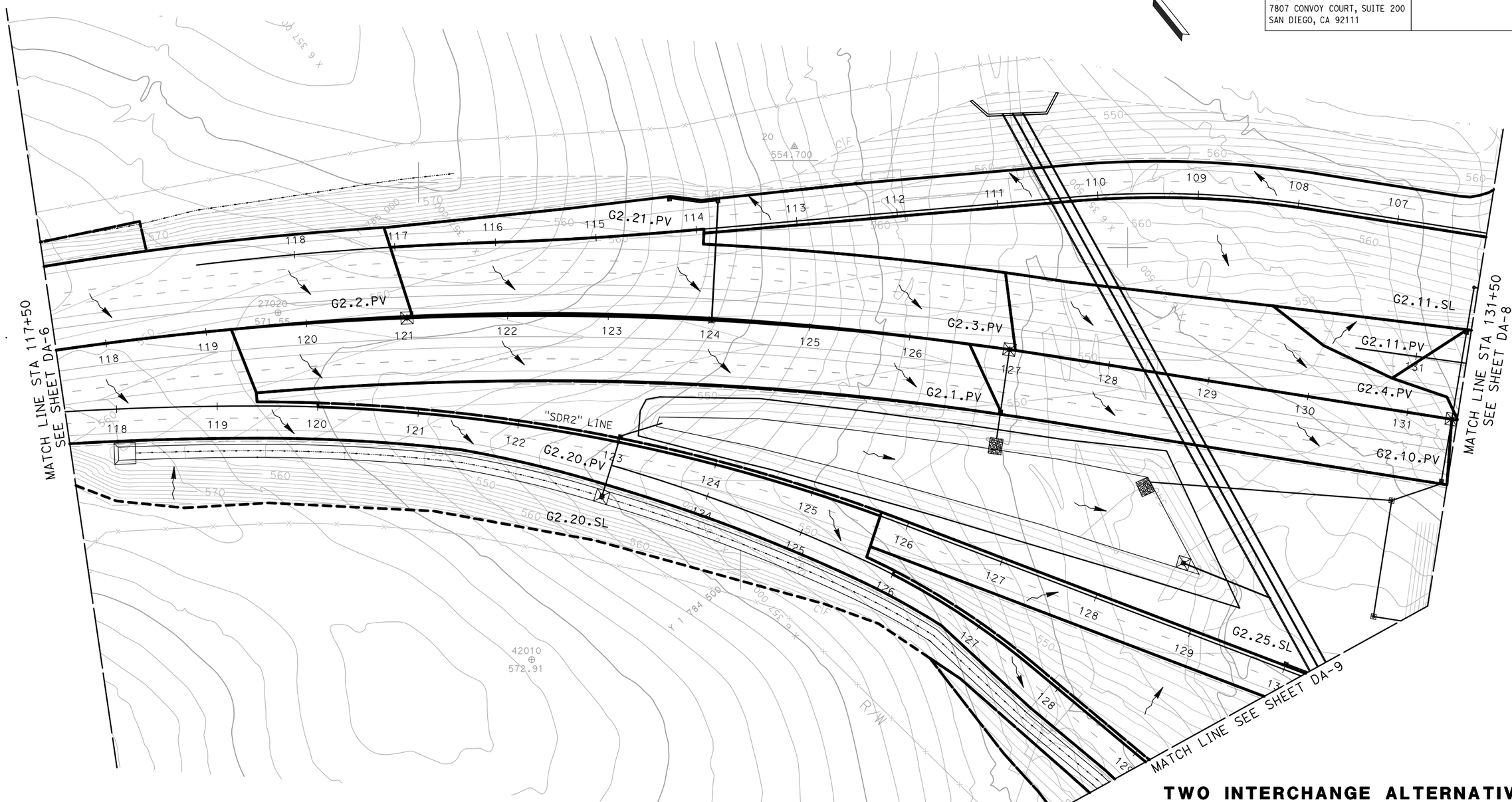


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SCALE 1"=50'

# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

**DA-7**

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|---|---|---|---|---|---|
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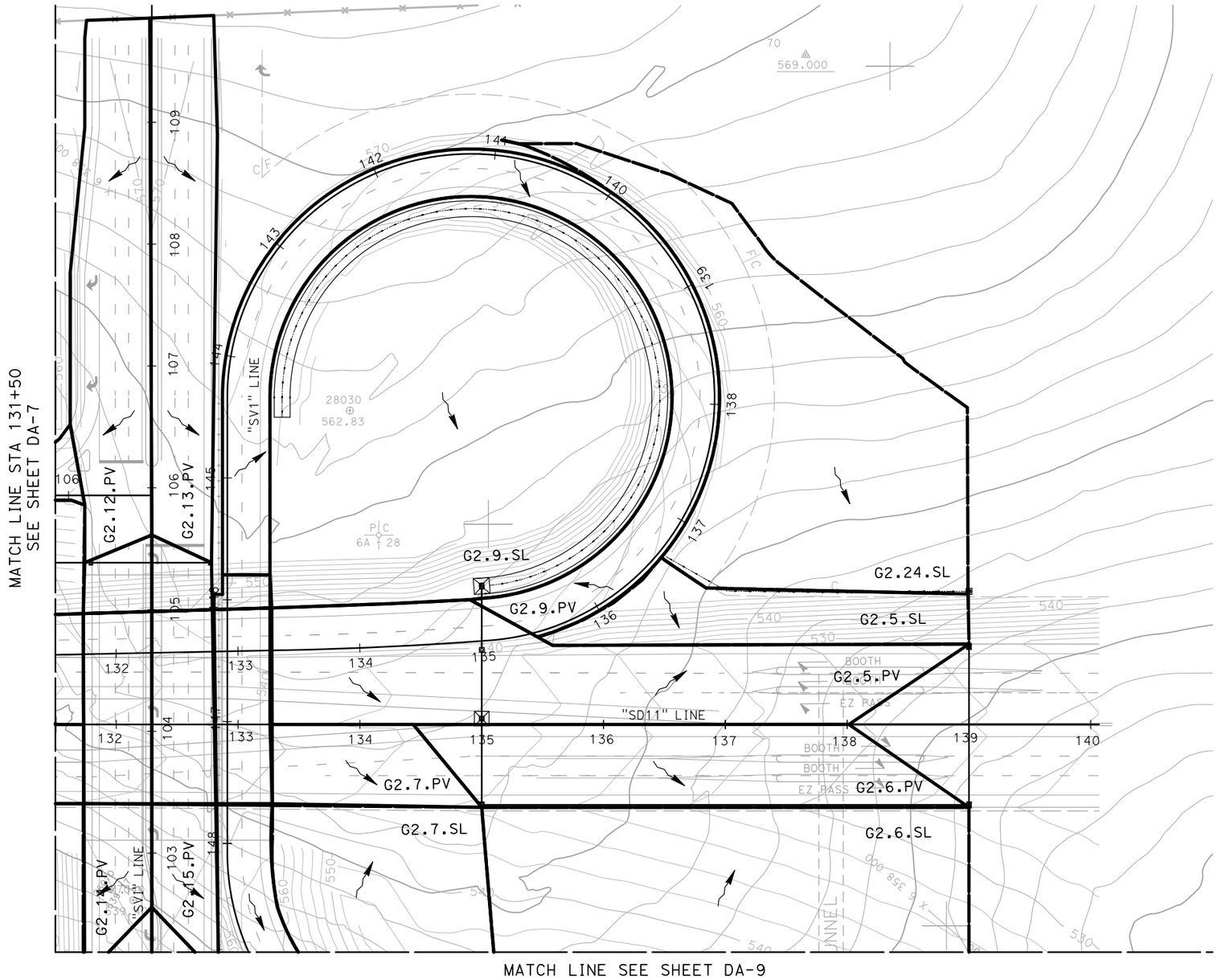


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-8**

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2/3/2010 5:52:22 PM YamanakaG hs\caltrans\2208300\cad\planset\b056300ia008_2da.dgn

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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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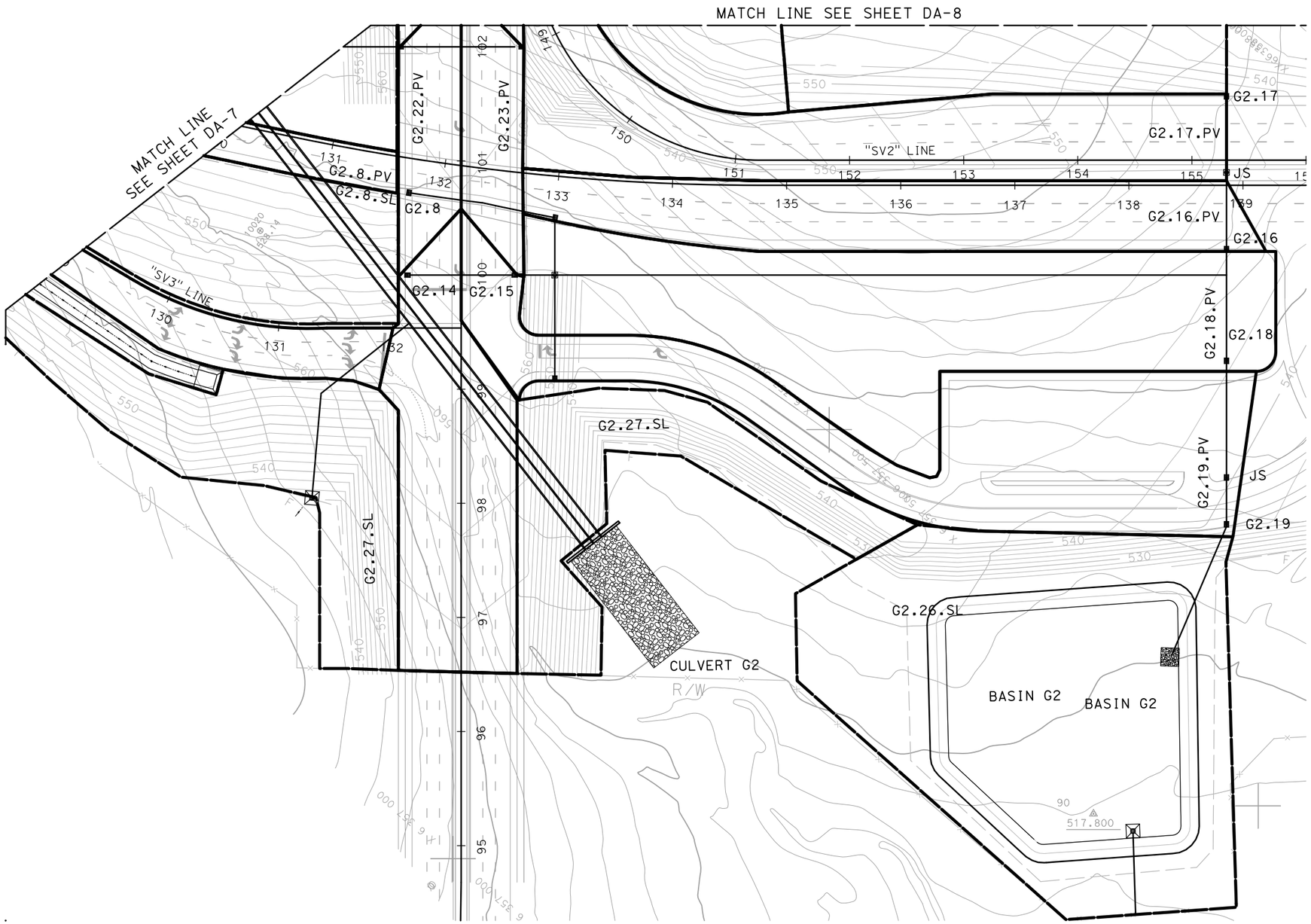


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-9**

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EA 06002

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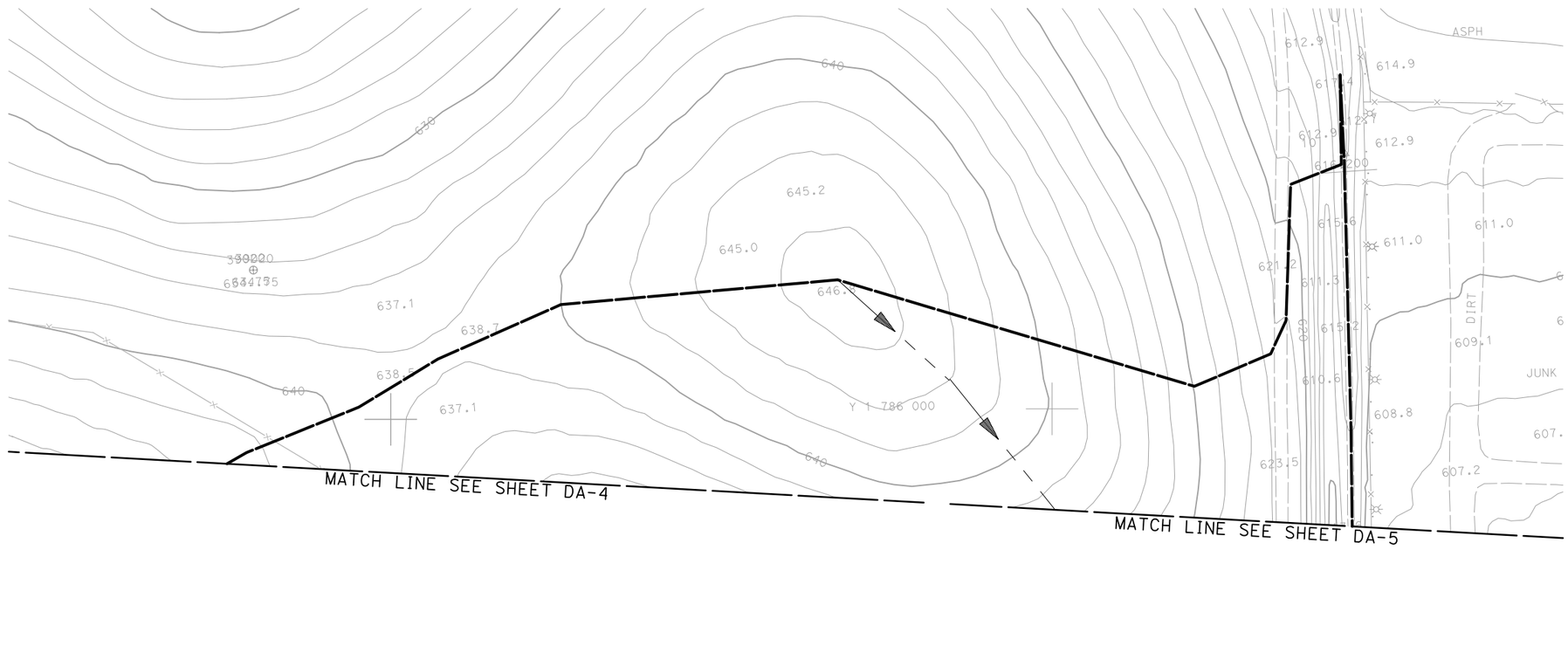


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# TWO INTERCHANGE ALTERNATIVE DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-10**

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# A2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| A2.1.PV | 0.99 | 99500 | 2.3 | 10 | 2.8 | 6.40 | 4.2 | 9.53 | A2.1 | ~ | Basin A2 | 57+75 | Lt |
| A2.2.PV | 0.99 | 104500 | 2.4 | 10 | 2.8 | 6.72 | 4.2 | 10.00 | A2.2 | A2.2 | Basin A2 | 57+00 | Rt |
| A2.3.PV | 0.99 | 35100 | 0.8 | 5 | 4.0 | 3.19 | 6.6 | 5.25 | ~ | A2.3 | *bypass** | 52+50 | Lt |
| A2.4.PV | 0.99 | 26200 | 0.6 | 5 | 4.0 | 2.38 | 6.6 | 3.92 | ~ | A2.4 | *bypass** | 52+50 | Rt |

Σ 265300 *PAVED*

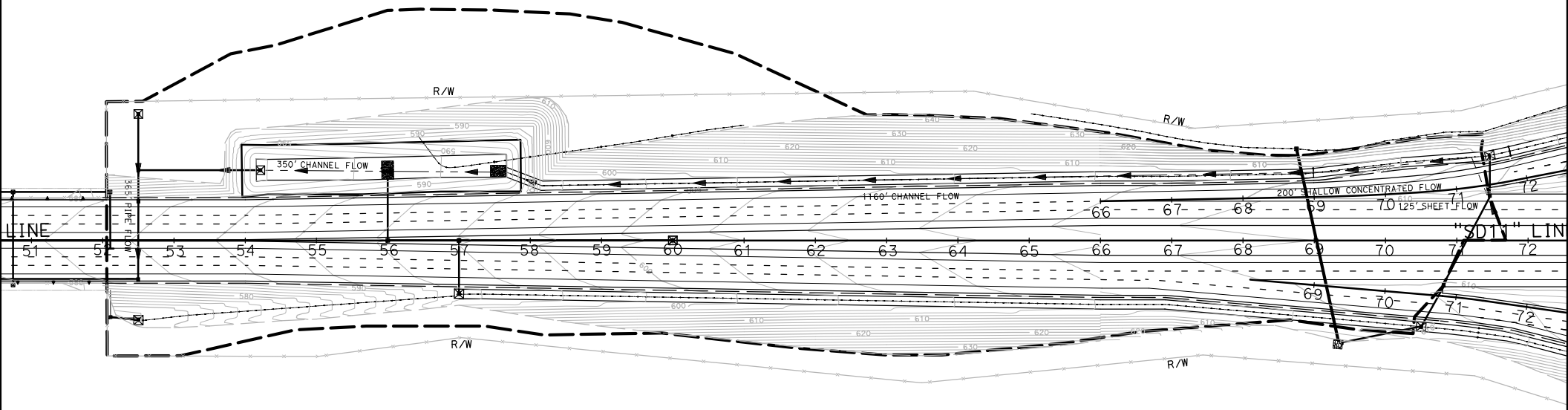
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Basin: | @ Station | Offset |
| A2.1.SL | 0.61 | 94700 | 2.2 | 10 | 2.8 | 3.75 | 4.2 | 5.59 | A2.1 | ~ | Basin A2 | 56+00 | Lt |
| A2.2.SL | 0.61 | 81400 | 1.9 | 10 | 2.8 | 3.22 | 4.2 | 4.80 | A2.2 | A2.5 | Basin A2 | 57+00 | Rt |
| A2.5.SL | 0.61 | 38800 | 0.9 | 10 | 2.8 | 1.54 | 4.2 | 2.29 | ~ | A2.5 | *bypass** | 52+50 | Rt |
| A2.6.SL | 0.61 | 83900 | 1.9 | 10 | 2.8 | 3.32 | 4.2 | 4.95 | ~ | A2.6 | Basin A2 | 53+00 | Lt |

Σ 298800 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 564100 | 12.9 |
| | *SF* | *ac* |




WATERSHED A2
TWO INTERCHANGE
ALTERNATIVE

Scale: 1"=200'

# A2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Post-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **52+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **675608** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **15.51** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 17% | AT | 0.42 | 0.069 |
| PAVED SURFACE | 39% | AT | 0.90 | 0.353 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 44% | AT | 0.55 | 0.243 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.67 |
| $C_{25}$ = | 0.73 |
| $C_{50}$ = | 0.80 |
| $C_{100}$ = | 0.83 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 611.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 610.0 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 1.5 | ft | |
| LENGTH (L) | 125 | ft | To Bioswale |
| SLOPE (S) = (H/L) | 1.2% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.20 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | Origin of Bioswale |
| LOW POINT ELEVATION | 609.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | Assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 grassed waterway |
| $T_C$ (SH)= | 1.85 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 609.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 19.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1160 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.6% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.29 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.88 | minutes | |

# A2 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = T_t = \frac{L}{60\,V}$

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 590.0 | ft |
| LOW POINT ELEVATION | 584.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 350 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 3.36 | fps |
| $T_C$ (CH)= | 1.73 | minutes |

assume basin floor has same dimensions of bioswale

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft |
| LOW POINT ELEVATION | 581.0 | ft |
| ELEVATION DIFF (H) | 3.0 | ft |
| LENGTH (L) | 365 | ft |
| SLOPE (S) = (H/L) | 0.8% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 6.5 | fps |
| $T_C$ (SD)= | 0.93 | minutes |

**NOTES:**

proposed basin outlet pipe

discharge at watershed end (Sta 52+00)

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 13.59 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **13.59** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.5 | in/hr | X CA = |
| $i_{10}$ = | 2.2 | in/hr | X CA = |
| $i_{25}$ = | 2.8 | in/hr | X CA = |
| $i_{50}$ = | 3.3 | in/hr | X CA = |
| $i_{100}$ = | 3.5 | in/hr | X CA = |

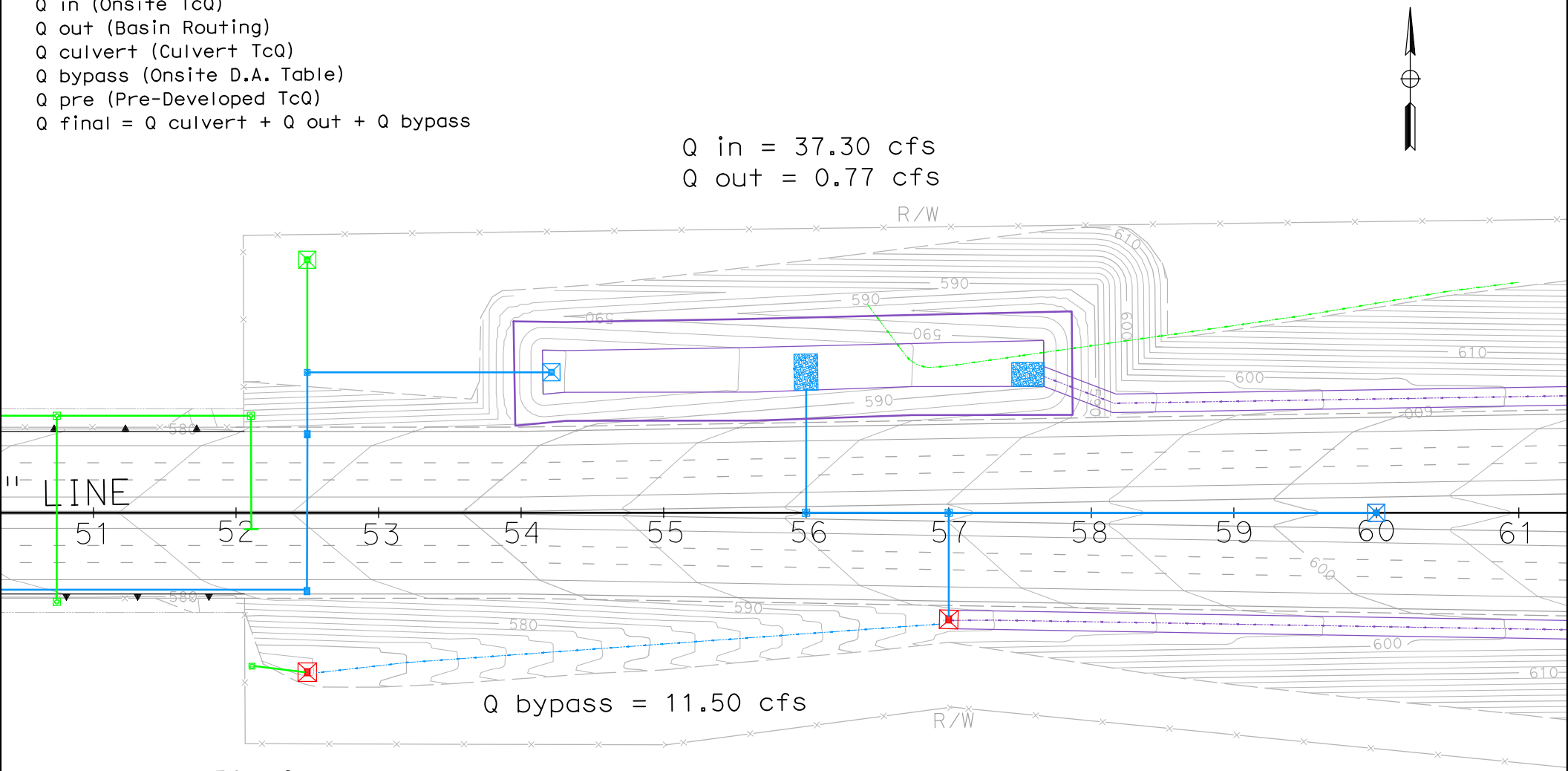
**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 15.7 |
| **$Q_{10}$ =** | 22.8 |
| **$Q_{25}$ =** | 31.4 |
| **$Q_{50}$ =** | 41.1 |
| **$Q_{100}$ =** | **44.6** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




Q pre = 23.50 cfs
Q final = 12.27 cfs

BASIN A2
FLOW SUMMARY

Scale: 1"=100'

# Basin A2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 57+75** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 23.5 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 10.51 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 480 | 0.8 |
| 20 | 480 | 0.8 |
| 30 | 540 | 0.9 |
| 40 | 540 | 0.9 |
| 50 | 540 | 0.9 |
| 60 | 600 | 1 |
| 70 | 600 | 1 |
| 80 | 600 | 1 |
| 90 | 660 | 1.1 |
| 100 | 660 | 1.1 |
| 110 | 720 | 1.2 |
| 120 | 720 | 1.2 |
| 130 | 780 | 1.3 |
| 140 | 840 | 1.4 |
| 150 | 900 | 1.5 |
| 160 | 960 | 1.6 |
| 170 | 1020 | 1.7 |
| 180 | 1080 | 1.8 |
| 190 | 1260 | 2.1 |
| 200 | 1380 | 2.3 |
| 210 | 1680 | 2.8 |
| 220 | 1920 | 3.2 |
| 230 | 2760 | 4.6 |
| 240 | 3900 | 6.5 |
| 250 | 14100 | 23.5 |
| 260 | 2220 | 3.7 |
| 270 | 1500 | 2.5 |
| 280 | 1140 | 1.9 |
| 290 | 960 | 1.6 |
| 300 | 840 | 1.4 |
| 310 | 780 | 1.3 |
| 320 | 720 | 1.2 |
| 330 | 660 | 1.1 |
| 340 | 600 | 1 |
| 350 | 540 | 0.9 |
| 360 | 540 | 0.9 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **50220** | **$ft^3$** |
| | **1.15** | **acre-feet** |

Check: $V = C*A*P_6$

V= 1.16 acre-feet

***OK***

# Basin A2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 44.6 | cfs | | | |
| Tc= | 13.6 | min | C= | 0.83 | |
| $P_{100,6}$= | 2.5 | in | A= | 15.51 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1596 | 1.9 |
| 28 | 1680 | 2 |
| 42 | 1764 | 2.1 |
| 56 | 1848 | 2.2 |
| 70 | 1932 | 2.3 |
| 84 | 2016 | 2.4 |
| 98 | 2100 | 2.5 |
| 112 | 2352 | 2.8 |
| 126 | 2436 | 2.9 |
| 140 | 2688 | 3.2 |
| 154 | 2856 | 3.4 |
| 168 | 3276 | 3.9 |
| 182 | 3528 | 4.2 |
| 196 | 4368 | 5.2 |
| 210 | 4956 | 5.9 |
| 224 | 7224 | 8.6 |
| 238 | 9408 | 11.2 |
| 252 | 37464 | 44.6 |
| 266 | 5796 | 6.9 |
| 280 | 3864 | 4.6 |
| 294 | 3024 | 3.6 |
| 308 | 2520 | 3 |
| 322 | 2184 | 2.6 |
| 336 | 2016 | 2.4 |
| 350 | 1764 | 2.1 |
| 364 | 1680 | 2 |
| 378 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 116340 $ft^3$**
**2.67 acre-feet**

Check: $V = C*A*P_6$
V= 2.69 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **2.67** | *(Post)* | | |
| | - | **1.15** | *(Pre)* | | |
| **Retention volume =** | | **1.52** | **acre-feet** | **=** | **66120 $ft^3$** **Basin Required** |

# Basin A2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.88
A= 10.65 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **25520** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

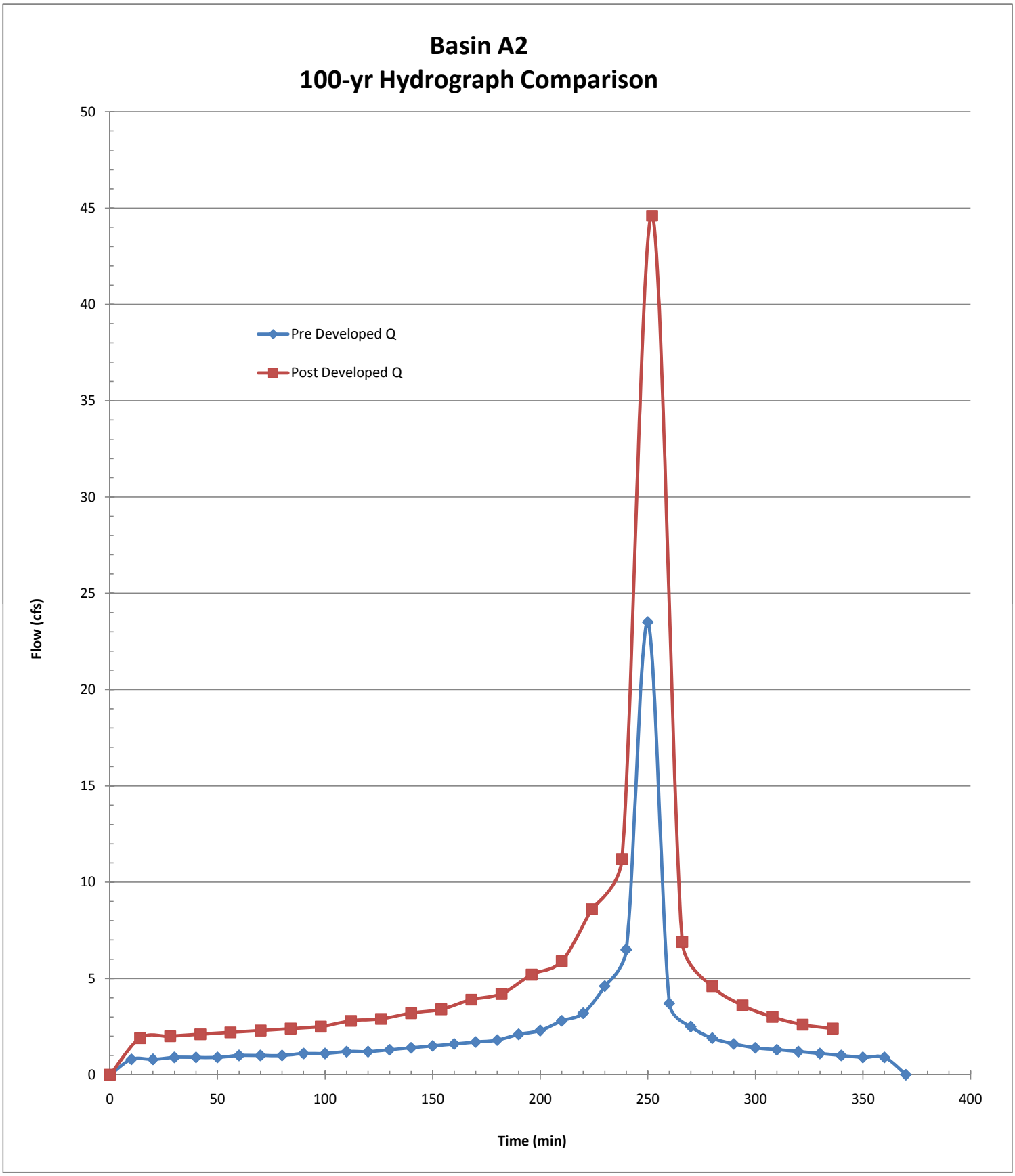
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 260000 | $ft^2$ |
| | A: | 5.97 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 92.83 tons

**Silt Accumulation Basin volume =** **2063** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin A2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
300
350
400

# Basin A2 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 57+75 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | A2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 464000 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.65 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 44% | AT | 0.90 | 0.396 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 56% | AT | 0.55 | 0.308 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.70 |
| $C_{25}$ = | 0.77 |
| $C_{50}$ = | 0.84 |
| $C_{100}$ = | 0.88 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 611.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 610.0 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 1.5 | ft | |
| LENGTH (L) | 125 | ft | to Bioswale |
| SLOPE (S) = (H/L) | 1.2% | | |
| MANNING'S n | 0.016 | | <=n from Table 816.6A AC |
| $T_t$ (SFF)= | 3.20 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | origin of Bioswale |
| LOW POINT ELEVATION | 609.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.8 | fps | <=V from Figure 816.6 grassed waterway |
| $T_C$ (SH)= | 1.85 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 609.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 19.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1160 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.6% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.29 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.88 | minutes | |

# Basin A2 Inflow TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 10.93 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.93** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.8 | in/hr | X CA = |
| $i_{10}$ = | 2.5 | in/hr | X CA = |
| $i_{25}$ = | 3.2 | in/hr | X CA = |
| $i_{50}$ = | 3.8 | in/hr | X CA = |
| $i_{100}$ = | 4.0 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 13.1 |
| **$Q_{10}$ =** | 19.1 |
| **$Q_{25}$ =** | 26.2 |
| **$Q_{50}$ =** | 34.4 |
| **$Q_{100}$ =** | **37.3** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin A2 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25 - 57+75** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **A2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 37.3 | cfs | $C_{100}$= | 0.88 | |
| Tc= | 10.9 | min | A= | 10.65 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 11 | 924 | 1.4 |
| 22 | 924 | 1.4 |
| 33 | 990 | 1.5 |
| 44 | 990 | 1.5 |
| 55 | 1056 | 1.6 |
| 66 | 1056 | 1.6 |
| 77 | 1122 | 1.7 |
| 88 | 1188 | 1.8 |
| 99 | 1254 | 1.9 |
| 110 | 1254 | 1.9 |
| 121 | 1386 | 2.1 |
| 132 | 1452 | 2.2 |
| 143 | 1518 | 2.3 |
| 154 | 1650 | 2.5 |
| 165 | 1782 | 2.7 |
| 176 | 1914 | 2.9 |
| 187 | 2178 | 3.3 |
| 198 | 2376 | 3.6 |
| 209 | 2904 | 4.4 |
| 220 | 3300 | 5 |
| 231 | 4884 | 7.4 |
| 242 | 6732 | 10.2 |
| 253 | 24618 | 37.3 |
| 264 | 3894 | 5.9 |
| 275 | 2574 | 3.9 |
| 286 | 2046 | 3.1 |
| 297 | 1716 | 2.6 |
| 308 | 1518 | 2.3 |
| 319 | 1320 | 2 |
| 330 | 1188 | 1.8 |
| 341 | 1122 | 1.7 |
| 352 | 1056 | 1.6 |
| 363 | 990 | 1.5 |
| 374 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

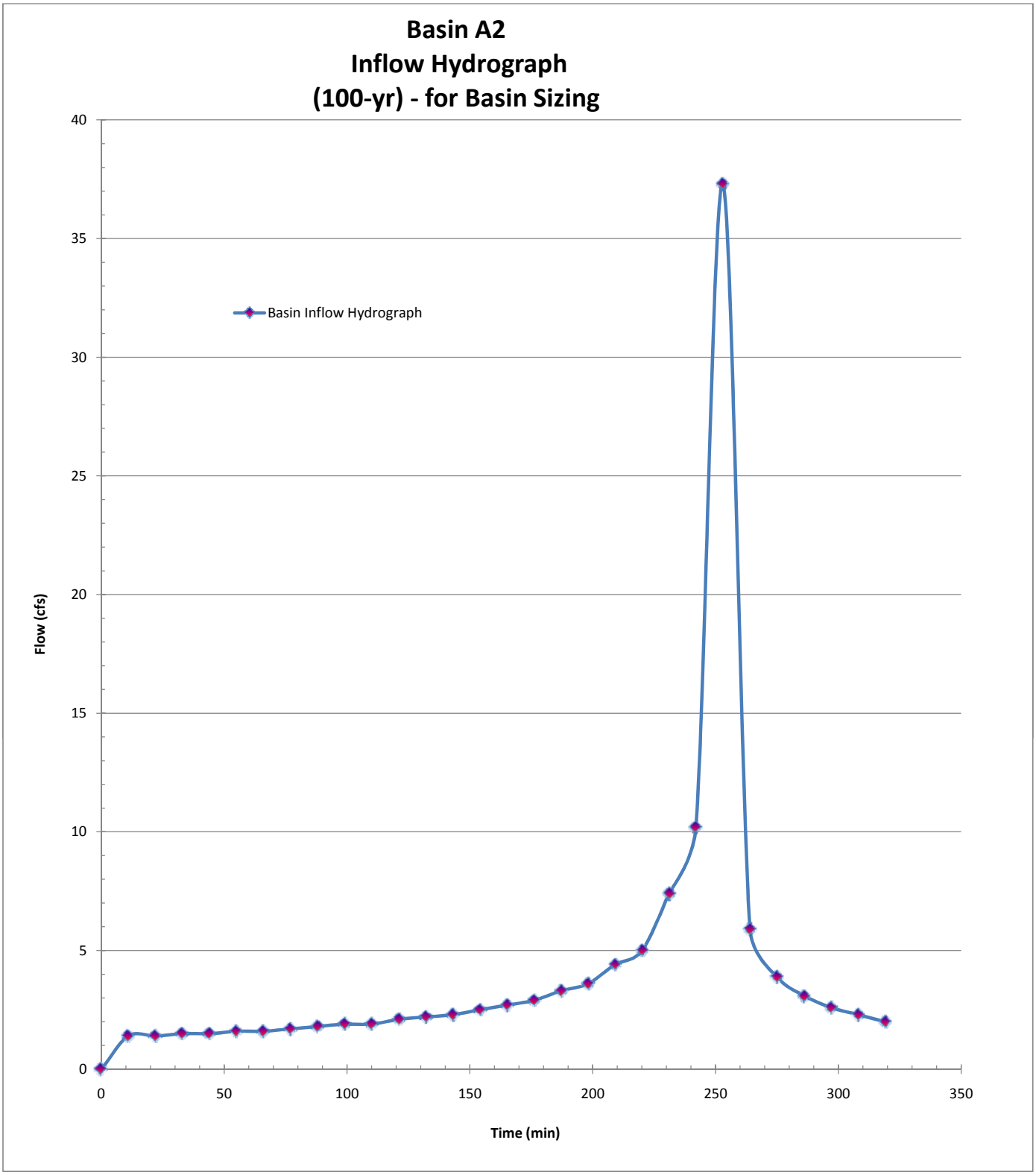
| | | |
|---|---|---|
| **SUM=** | **84876** | **$ft^3$** |
| | **1.95** | **acre-feet** |

Onsite Runoff Volume

Check: V = C*A*$P_6$

V= 1.95 acre-feet

***OK***


Basin A2
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350

# Basin A2 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **54+25** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **A2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

Required Retention Basin Volume = 68183 $ft^3$

Actual Basin Inflow = 84876 $ft^4$ *OK*

***Flow Balance - determine maximum flow from basin***

| | | | | |
|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 23.5 | cfs | | |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | | |
| Flow that does not reach detention basin (bypass per DA table): | 11.5 | cfs | ~ | $Q_{100}$ of: A2.3.PVA2.4.PVA2.5.SL |
| Maximum flow allowed to be released by this detention basin: | 12.0 | cfs | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 589.60 | ft |
| Basin flowline elevation = | 584.00 | ft |
| Maximum Basin Depth = | 5.60 | ft |

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 4.00 | ft | 588.00 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 350 | ft |
| Base Width (W) | 30 | ft |
| W/L Ratio ® | 0.09 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 115766 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 584.00 | 0.00 | 0 | 0 | | 584.00 | 0.00 | | 0.00 |
| 1 | 584.20 | 0.20 | 2161 | 2161 | | 584.20 | 0.00 | | 0.00 |
| 2 | 584.40 | 0.40 | 2284 | 4445 | | 584.40 | 0.00 | | 0.00 |
| 3 | 584.60 | 0.60 | 2410 | 6855 | | 584.60 | 0.00 | | 0.00 |
| 4 | 584.80 | 0.80 | 2539 | 9394 | | 584.80 | 0.00 | | 0.00 |
| 5 | 585.00 | 1.00 | 2670 | 12063 | | 585.00 | 0.00 | | 0.00 |
| 6 | 585.20 | 1.20 | 2804 | 14867 | | 585.20 | 0.00 | | 0.00 |
| 7 | 585.40 | 1.40 | 2940 | 17808 | | 585.40 | 0.00 | | 0.00 |
| 8 | 585.60 | 1.60 | 3079 | 20887 | | 585.60 | 0.00 | | 0.00 |
| 9 | 585.80 | 1.80 | 3221 | 24108 | | 585.80 | 0.00 | | 0.00 |
| 10 | 586.00 | 2.00 | 3366 | 27474 | | 586.00 | 0.00 | | 0.00 |
| 11 | 586.20 | 2.20 | 3513 | 30987 | | 586.20 | 0.00 | | 0.00 |
| 12 | 586.40 | 2.40 | 3662 | 34649 | | 586.40 | 0.00 | | 0.00 |
| 13 | 586.60 | 2.60 | 3815 | 38464 | | 586.60 | 0.00 | | 0.00 |
| 14 | 586.80 | 2.80 | 3970 | 42434 | | 586.80 | 0.00 | 0.00 | 0.00 |
| 15 | 587.00 | 3.00 | 4127 | 46561 | | 587.00 | 0.00 | | 0.00 |
| 16 | 587.20 | 3.20 | 4288 | 50849 | | 587.20 | 0.00 | | 0.00 |
| 17 | 587.40 | 3.40 | 4451 | 55300 | | 587.40 | 0.00 | | 0.00 |
| 18 | 587.60 | 3.60 | 4616 | 59916 | | 587.60 | 0.00 | | 0.00 |
| 19 | 587.80 | 3.80 | 4784 | 64700 | | 587.80 | 0.00 | | 0.00 |
| 20 | 588.00 | 4.00 | 4955 | 69656 | * | 588.00 | 0.00 | | 0.00 |
| 21 | 588.20 | 4.20 | 5129 | 74785 | | 588.20 | 0.15 | | 0.15 |
| 22 | 588.40 | 4.40 | 5305 | 80090 | | 588.40 | 0.59 | | 0.59 |
| 23 | 588.60 | 4.60 | 5484 | 85573 | | 588.60 | 1.30 | | 1.30 |
| 24 | 588.80 | 4.80 | 5665 | 91238 | | 588.80 | 2.25 | | 2.25 |
| 25 | 589.00 | 5.00 | 5849 | 97087 | | 589.00 | 3.42 | | 3.42 |
| 26 | 589.20 | 5.20 | 6036 | 103123 | | 589.20 | 4.79 | | 4.79 |
| 27 | 589.40 | 5.40 | 6225 | 109348 | | 589.40 | 6.32 | | 6.32 |
| 28 | 589.60 | 5.60 | 6417 | 115766 | | 589.60 | 7.99 | | 7.99 |

# Basin A2 Routing

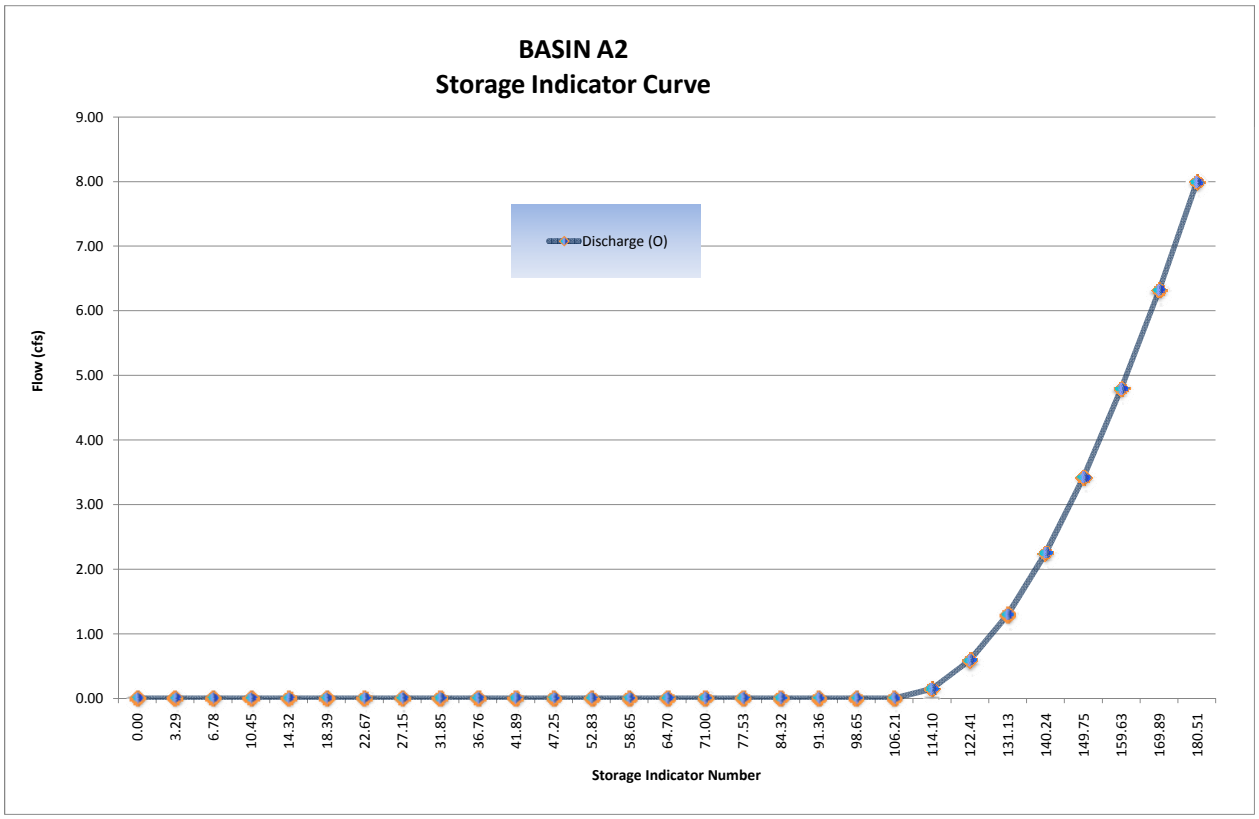
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 54+75 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | A |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin A2 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | Storage Indicator # (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| 584.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 584.20 | 0.00 | 2161 | 0.00 | 3.29 | 3.29 |
| 584.40 | 0.00 | 4445 | 0.00 | 6.78 | 6.78 |
| 584.60 | 0.00 | 6855 | 0.00 | 10.45 | 10.45 |
| 584.80 | 0.00 | 9394 | 0.00 | 14.32 | 14.32 |
| 585.00 | 0.00 | 12063 | 0.00 | 18.39 | 18.39 |
| 585.20 | 0.00 | 14867 | 0.00 | 22.67 | 22.67 |
| 585.40 | 0.00 | 17808 | 0.00 | 27.15 | 27.15 |
| 585.60 | 0.00 | 20887 | 0.00 | 31.85 | 31.85 |
| 585.80 | 0.00 | 24108 | 0.00 | 36.76 | 36.76 |
| 586.00 | 0.00 | 27474 | 0.00 | 41.89 | 41.89 |
| 586.20 | 0.00 | 30987 | 0.00 | 47.25 | 47.25 |
| 586.40 | 0.00 | 34649 | 0.00 | 52.83 | 52.83 |
| 586.60 | 0.00 | 38464 | 0.00 | 58.65 | 58.65 |
| 586.80 | 0.00 | 42434 | 0.00 | 64.70 | 64.70 |
| 587.00 | 0.00 | 46561 | 0.00 | 71.00 | 71.00 |
| 587.20 | 0.00 | 50849 | 0.00 | 77.53 | 77.53 |
| 587.40 | 0.00 | 55300 | 0.00 | 84.32 | 84.32 |
| 587.60 | 0.00 | 59916 | 0.00 | 91.36 | 91.36 |
| 587.80 | 0.00 | 64700 | 0.00 | 98.65 | 98.65 |
| 588.00 | 0.00 | 69656 | 0.00 | 106.21 | 106.21 |
| 588.20 | 0.15 | 74785 | 0.08 | 114.03 | 114.10 |
| 588.40 | 0.59 | 80090 | 0.30 | 122.12 | 122.41 |
| 588.60 | 1.30 | 85573 | 0.65 | 130.48 | 131.13 |
| 588.80 | 2.25 | 91238 | 1.13 | 139.12 | 140.24 |
| 589.00 | 3.42 | 97087 | 1.71 | 148.04 | 149.75 |
| 589.20 | 4.79 | 103123 | 2.40 | 157.24 | 159.63 |
| 589.40 | 6.32 | 109348 | 3.16 | 166.73 | 169.89 |
| 589.60 | 7.99 | 115766 | 4.00 | 176.52 | 180.51 |

| | | |
|---|---|---|
| delta t = | 0.18 | hrs |
| delta t = | 11 | min |
| delta t = | 655.8389 | sec |



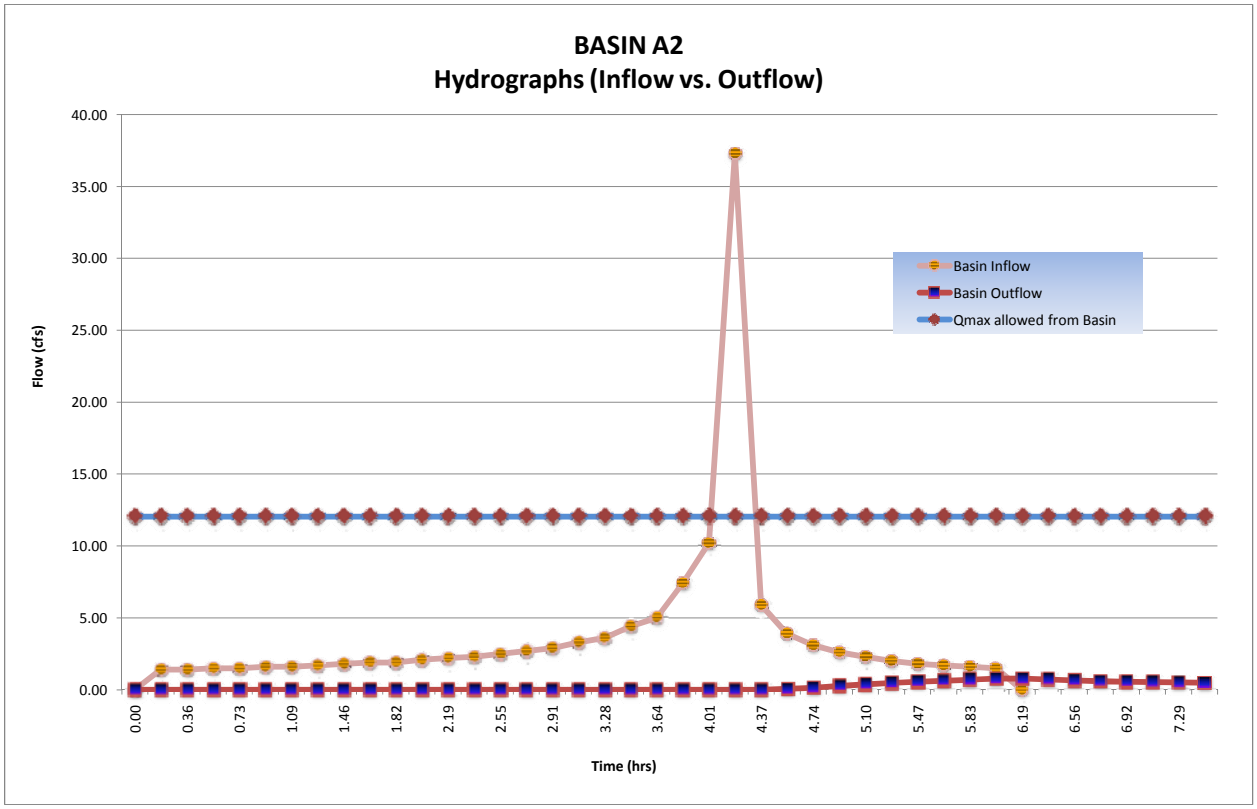
# Basin A2 Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

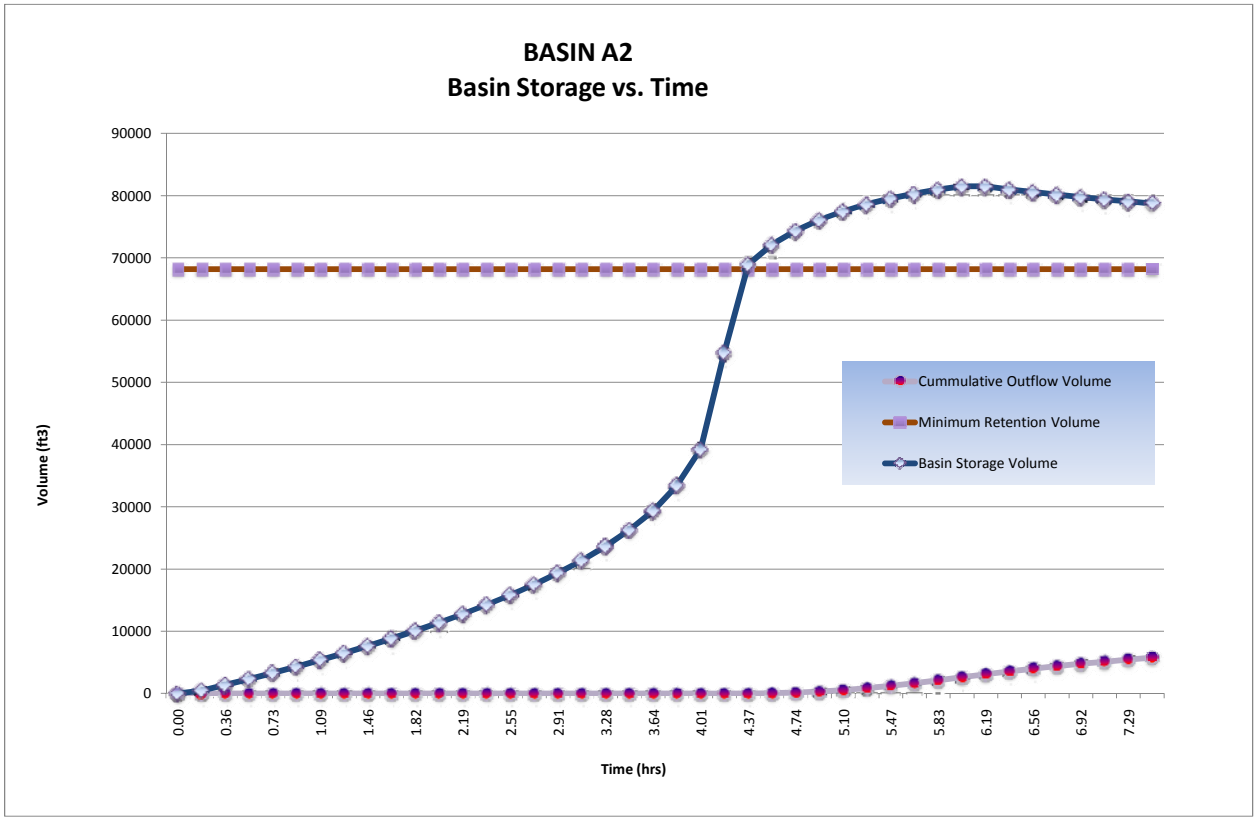
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.18 | 1.40 | 0.70 | 0.00 | 0.00 | 0.70 | 0.00 | 459 | 0 | 0 |
| 0.36 | 1.40 | 1.40 | 0.70 | 0.00 | 2.10 | 0.00 | 1377 | 0 | 0 |
| 0.55 | 1.50 | 1.45 | 2.10 | 0.00 | 3.55 | 0.00 | 2328 | 0 | 0 |
| 0.73 | 1.50 | 1.50 | 3.55 | 0.00 | 5.05 | 0.00 | 3312 | 0 | 0 |
| 0.91 | 1.60 | 1.55 | 5.05 | 0.00 | 6.60 | 0.00 | 4329 | 0 | 0 |
| 1.09 | 1.60 | 1.60 | 6.60 | 0.00 | 8.20 | 0.00 | 5378 | 0 | 0 |
| 1.28 | 1.70 | 1.65 | 8.20 | 0.00 | 9.85 | 0.00 | 6460 | 0 | 0 |
| 1.46 | 1.80 | 1.75 | 9.85 | 0.00 | 11.60 | 0.00 | 7608 | 0 | 0 |
| 1.64 | 1.90 | 1.85 | 11.60 | 0.00 | 13.45 | 0.00 | 8821 | 0 | 0 |
| 1.82 | 1.90 | 1.90 | 13.45 | 0.00 | 15.35 | 0.00 | 10067 | 0 | 0 |
| 2.00 | 2.10 | 2.00 | 15.35 | 0.00 | 17.35 | 0.00 | 11379 | 0 | 0 |
| 2.19 | 2.20 | 2.15 | 17.35 | 0.00 | 19.50 | 0.00 | 12789 | 0 | 0 |
| 2.37 | 2.30 | 2.25 | 19.50 | 0.00 | 21.75 | 0.00 | 14264 | 0 | 0 |
| 2.55 | 2.50 | 2.40 | 21.75 | 0.00 | 24.15 | 0.00 | 15839 | 0 | 0 |
| 2.73 | 2.70 | 2.60 | 24.15 | 0.00 | 26.75 | 0.00 | 17544 | 0 | 0 |
| 2.91 | 2.90 | 2.80 | 26.75 | 0.00 | 29.55 | 0.00 | 19380 | 0 | 0 |
| 3.10 | 3.30 | 3.10 | 29.55 | 0.00 | 32.65 | 0.00 | 21413 | 0 | 0 |
| 3.28 | 3.60 | 3.45 | 32.65 | 0.00 | 36.10 | 0.00 | 23676 | 0 | 0 |
| 3.46 | 4.40 | 4.00 | 36.10 | 0.00 | 40.10 | 0.00 | 26299 | 0 | 0 |
| 3.64 | 5.00 | 4.70 | 40.10 | 0.00 | 44.80 | 0.00 | 29382 | 0 | 0 |
| 3.83 | 7.40 | 6.20 | 44.80 | 0.00 | 51.00 | 0.00 | 33448 | 0 | 0 |
| 4.01 | 10.20 | 8.80 | 51.00 | 0.00 | 59.80 | 0.00 | 39219 | 0 | 0 |
| 4.19 | 37.30 | 23.75 | 59.80 | 0.00 | 83.55 | 0.00 | 54795 | 0 | 0 |
| 4.37 | 5.90 | 21.60 | 83.55 | 0.00 | 105.15 | 0.00 | 68961 | 0 | 0 |
| 4.55 | 3.90 | 4.90 | 105.15 | 0.00 | 110.05 | 0.07 | 72152 | 46 | 46 |
| 4.74 | 3.10 | 3.50 | 110.05 | 0.07 | 113.48 | 0.14 | 74379 | 92 | 138 |
| 4.92 | 2.60 | 2.85 | 113.48 | 0.14 | 116.19 | 0.26 | 76117 | 171 | 308 |
| 5.10 | 2.30 | 2.45 | 116.19 | 0.26 | 118.38 | 0.38 | 77514 | 249 | 557 |
| 5.28 | 2.00 | 2.15 | 118.38 | 0.38 | 120.15 | 0.47 | 78645 | 308 | 866 |
| 5.47 | 1.80 | 1.90 | 120.15 | 0.47 | 121.58 | 0.55 | 79557 | 361 | 1226 |
| 5.65 | 1.70 | 1.75 | 121.58 | 0.55 | 122.78 | 0.62 | 80321 | 407 | 1633 |
| 5.83 | 1.60 | 1.65 | 122.78 | 0.62 | 123.81 | 0.70 | 80970 | 459 | 2092 |
| 6.01 | 1.50 | 1.55 | 123.81 | 0.70 | 124.66 | 0.77 | 81504 | 505 | 2597 |
| 6.19 | 0.00 | 0.75 | 124.66 | 0.77 | 124.64 | 0.77 | 81491 | 505 | 3102 |
| 6.38 | | 0.00 | 124.64 | 0.77 | 123.87 | 0.71 | 81006 | 466 | 3568 |
| 6.56 | | 0.00 | 123.87 | 0.71 | 123.16 | 0.65 | 80560 | 426 | 3994 |
| 6.74 | | 0.00 | 123.16 | 0.65 | 122.51 | 0.60 | 80150 | 394 | 4388 |
| 6.92 | | 0.00 | 122.51 | 0.60 | 121.91 | 0.56 | 79770 | 367 | 4755 |
| 7.10 | | 0.00 | 121.91 | 0.56 | 121.35 | 0.53 | 79412 | 348 | 5102 |
| 7.29 | | 0.00 | 121.35 | 0.53 | 120.82 | 0.51 | 79071 | 334 | 5437 |
| 7.47 | | 0.00 | 120.82 | 0.51 | 120.31 | 0.48 | 78747 | 315 | 5752 |
| 7.65 | | 0.00 | 120.31 | 0.48 | 119.83 | 0.45 | 78442 | 295 | 6047 |
| 7.83 | | 0.00 | 119.83 | 0.45 | 119.38 | 0.43 | 78153 | 282 | 6329 |
| 8.02 | | 0.00 | 119.38 | 0.43 | 118.95 | 0.41 | 77878 | 269 | 6598 |

## Basin A2 Routing



**Basin A2 Routing**




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **81,504** | **ft$^3$** | |
| **@ Stage:** | **588.60** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | Incl. >1' Freeboard |
| **Final Total Basin Volume Provided:** | **115,766** | **ft$^3$** | Basin **A2** |
| **Maximum flow rate released from this basin:** | **0.77** | **cfs** | |

# B2 Onsite D.A. Table

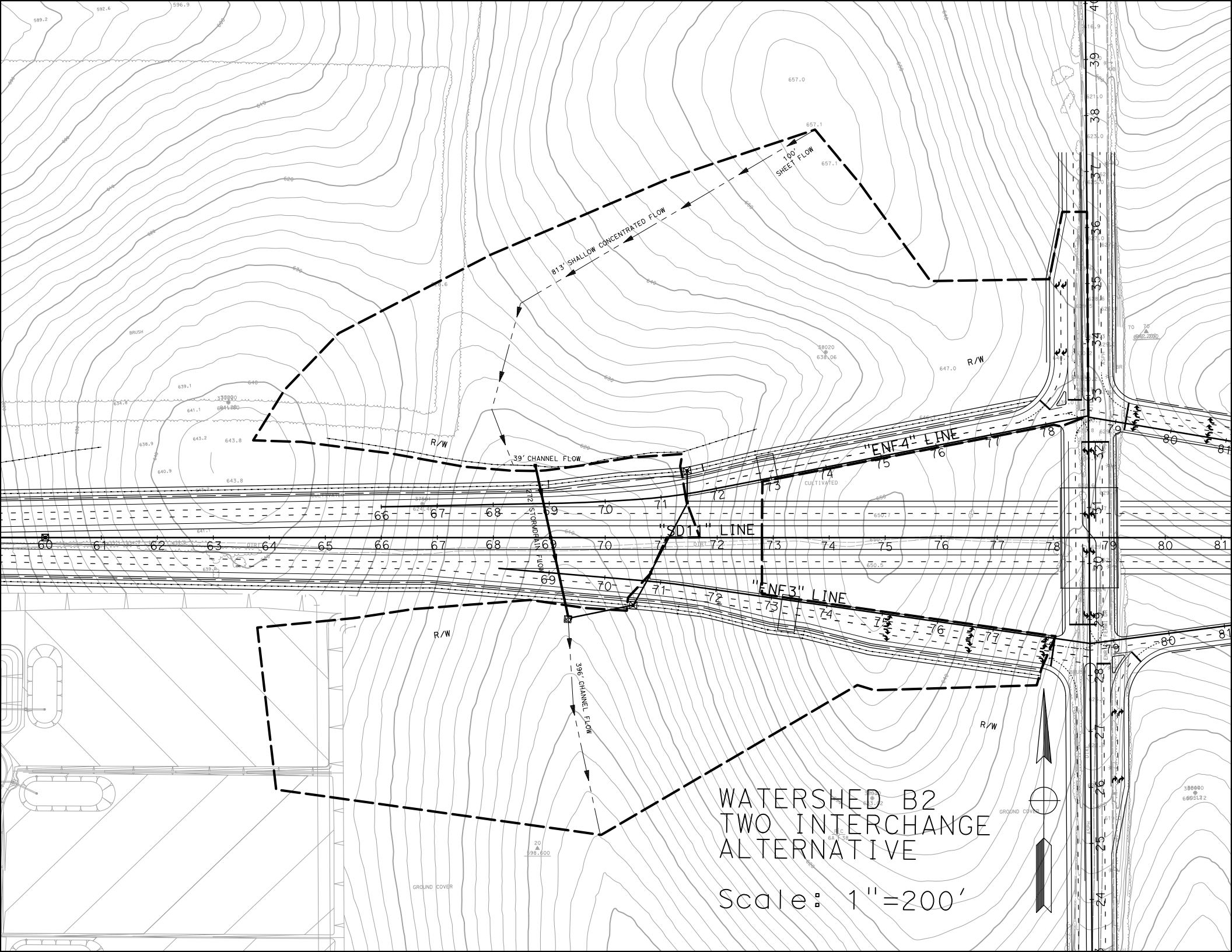
| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | B2.1.PV | 0.99 | 5200 | 0.1 | 10 | 2.8 | 0.33 | 4.2 | 0.50 | B2.1 | B2.1 | *bypass** | 71+50 | ENF4 |
| | B2.2.PV | 0.99 | 42500 | 1.0 | 10 | 2.8 | 2.73 | 4.2 | 4.07 | B2.2 | B2.2 | *bypass** | 70+50 | ENF3 |
| | B2.3.PV | 0.99 | 8100 | 0.2 | 5 | 4.0 | 0.74 | 6.6 | 1.21 | ~ | B2.2 | *bypass** | 71+50 | Lt |
| | B2.4.PV | 0.99 | 12100 | 0.3 | 5 | 4.0 | 1.10 | 6.6 | 1.81 | ~ | B2.2 | *bypass** | 71+00 | Rt |
| | | Σ | 67900 | *PAVED* | | | | | | | | | | |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | B2.1.SL | 0.61 | 41200 | 0.9 | 10 | 2.8 | 1.63 | 4.2 | 2.43 | B2.1 | B2.1 | *bypass** | 71+50 | ENF4 |
| | B2.2.SL | 0.61 | 42300 | 1.0 | 10 | 2.8 | 1.68 | 4.2 | 2.50 | B2.2 | B2.2 | *bypass** | 70+50 | ENF3 |
| | | Σ | 83500 | *SLOPE* | | | | | | | | | | |

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 151400 | 3.5 |
| | *SF* | *ac* |


100' SHEET FLOW
813' SHALLOW CONCENTRATED FLOW
39' CHANNEL FLOW
822' STORMDRAIN FLOW
396' CHANNEL FLOW
"ENF4" LINE
"SD11" LINE
"ENF3" LINE
R/W
BRUSH
CULTIVATED
GROUND COVER
WATERSHED B2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# B2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 984937 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 22.61 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 85% | AT | 0.42 | 0.355 |
| PAVED SURFACE | 7% | AT | 0.90 | 0.062 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 8% | AT | 0.55 | 0.047 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.46 |
| $C_{25}$ = | 0.51 |
| $C_{50}$ = | 0.56 |
| $C_{100}$ = | 0.58 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass prarie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 654.0 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 39.0 | ft | |
| LENGTH (L) | 813 | ft | to slope ditch |
| SLOPE (S) = (H/L) | 4.8% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_C$ (SH)= | 9.03 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 39 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.3% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.63 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.12 | minutes | |

# B2 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 614.5 | ft | Cross Culvert |
| LOW POINT ELEVATION | 605.0 | ft | |
| ELEVATION DIFF (H) | 9.5 | ft | |
| LENGTH (L) | 272 | ft | |
| SLOPE (S) = (H/L) | 3.5% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 17.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 605.0 | ft | Begins to form natural channel |
| LOW POINT ELEVATION | 594.0 | ft | CHANNEL DATA — TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 — ANG-RAD — 0.197 |
| LENGTH (L) | 396 | ft | b = 10 — ANG-DEG — 11.310 |
| SLOPE (S) = (H/L) | 2.8% | | d = 0.5 — FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | grass |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.72 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.83 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 24.20 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **24.20** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

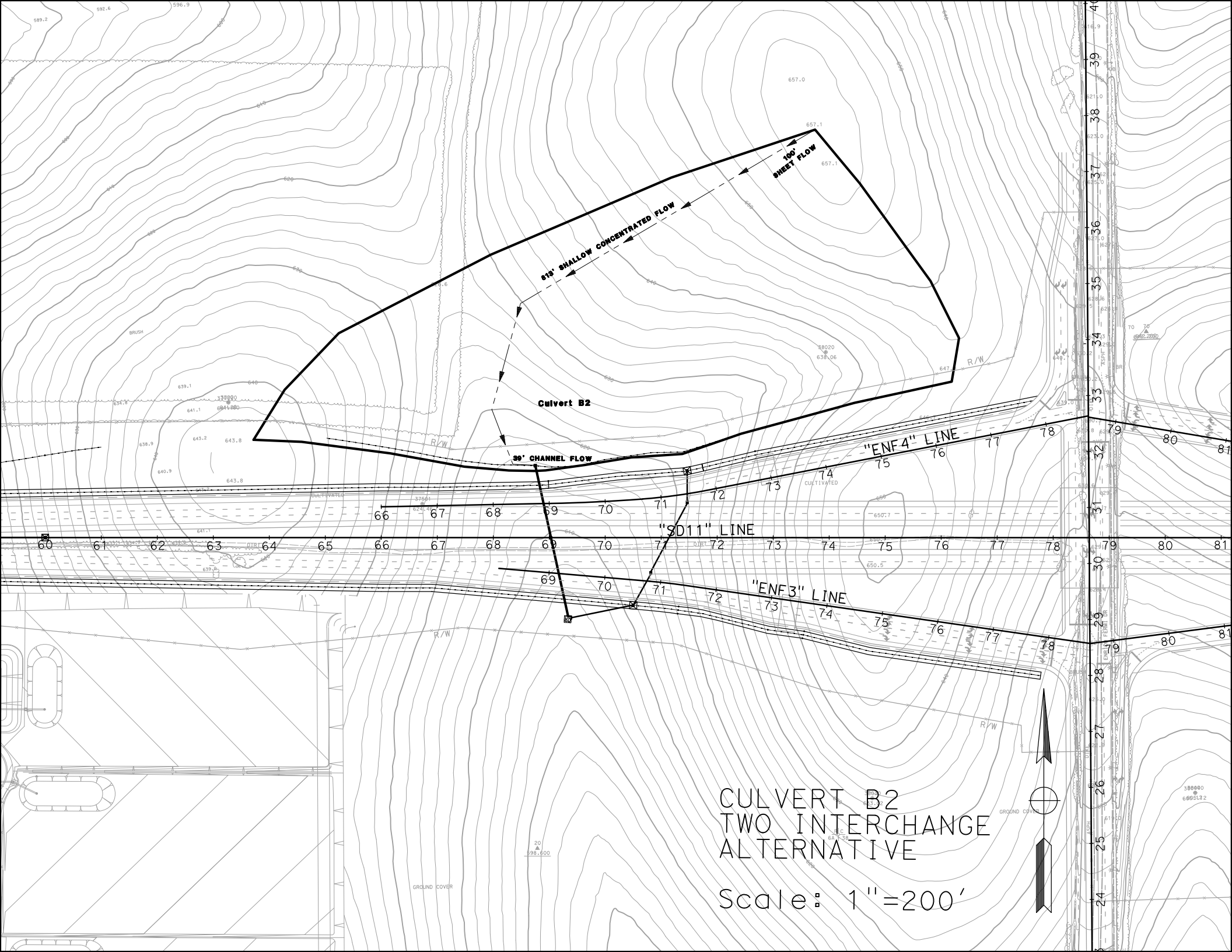
| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | |
| $i_{10}$ = | 1.5 | in/hr | X CA = | |
| $i_{25}$ = | 1.9 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.4 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 11.0 |
| **$Q_{10}$ =** | 16.0 |
| **$Q_{25}$ =** | 22.0 |
| **$Q_{50}$ =** | 28.8 |
| **$Q_{100}$ =** | **31.2** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


100' SHEET FLOW
613' SHALLOW CONCENTRATED FLOW
Culvert B2
39' CHANNEL FLOW
"ENF4" LINE
"SD11" LINE
"ENF3" LINE
R/W
CULTIVATED
BRUSH
GROUND COVER
CULVERT B2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# Culvert Calculator Report
## B2 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 616.50 | ft | Headwater Depth/Height | 0.74 | |
| Computed Headwater Elevation | 615.97 | ft | Discharge | 6.90 | cfs |
| Inlet Control HW Elev. | 615.80 | ft | Tailwater Elevation | 605.55 | ft |
| Outlet Control HW Elev. | 615.97 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 605.00 | ft |
| Length | 272.00 | ft | Constructed Slope | 3.5 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.55 | ft |
| Slope Type | Steep | | Normal Depth | 0.55 | ft |
| Flow Regime | Supercritical | | Critical Depth | 0.93 | ft |
| Velocity Downstream | 9.92 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 615.97 | ft | Upstream Velocity Head | 0.36 | ft |
| Ke | 0.50 | | Entrance Loss | 0.18 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 615.80 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## B2 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 617.00 | ft | Headwater Depth/Height | 1.12 | |
| Computed Headwater Elevation | 616.74 | ft | Discharge | 13.90 | cfs |
| Inlet Control HW Elev. | 616.60 | ft | Tailwater Elevation | 605.79 | ft |
| Outlet Control HW Elev. | 616.74 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 614.50 | ft | Downstream Invert | 605.00 | ft |
| Length | 272.00 | ft | Constructed Slope | 3.5 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.79 | ft |
| Slope Type | Steep | | Normal Depth | 0.79 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.34 | ft |
| Velocity Downstream | 12.06 | ft/s | Critical Slope | 0.6 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 616.74 | ft | Upstream Velocity Head | 0.60 | ft |
| Ke | 0.50 | | Entrance Loss | 0.30 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 616.60 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 3.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# B2 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 69+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | B2 Culvert |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | B2 Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 446229 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.24 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 657.1 | ft | northern peak |
| LOW POINT ELEVATION | 654.0 | ft | |
| ELEVATION DIFF (H) | 3.1 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 3.1% | | |
| MANNING'S n | 0.150 | | < = FROM TABLE 816.6A short grass prarie |
| $T_t$ (SFF)= | 10.96 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 654.0 | ft | northern peak |
| LOW POINT ELEVATION | 615.0 | ft | |
| ELEVATION DIFF (H) | 39.0 | ft | |
| LENGTH (L) | 813 | ft | |
| SLOPE (S) = (H/L) | 4.8% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 short grass |
| $T_C$ (SH)= | 9.03 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 615.0 | ft | Slope Ditch |
| LOW POINT ELEVATION | 614.5 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 0.5 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 39 | ft | b = 2 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 1.3% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Concrete-rough |
| HYDRAULIC RADIUS R | 0.35 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 5.63 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.12 | minutes | |

# B2 Culvert TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 20.11 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **20.11** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | |
| $i_{10}$ = | 1.6 | in/hr | X CA = | |
| $i_{25}$ = | 2.0 | in/hr | X CA = | |
| $i_{50}$ = | 2.3 | in/hr | X CA = | |
| $i_{100}$ = | 2.6 | in/hr | X CA = | |

**FLOW RESULTS**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.7 |
| **$Q_{10}$ =** | 6.9 |
| **$Q_{25}$ =** | 9.4 |
| **$Q_{50}$ =** | 11.8 |
| **$Q_{100}$ =** | **13.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin B2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **69+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **B2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 30.8 | cfs | | | |
| Tc= | 26.2 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 25.94 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 26 | 3276 | 2.1 |
| 52 | 3588 | 2.3 |
| 78 | 3744 | 2.4 |
| 104 | 4368 | 2.8 |
| 130 | 4680 | 3 |
| 156 | 5772 | 3.7 |
| 182 | 6552 | 4.2 |
| 208 | 9672 | 6.2 |
| 234 | 14352 | 9.2 |
| 260 | 48048 | 30.8 |
| 286 | 7800 | 5 |
| 312 | 5148 | 3.3 |
| 338 | 4056 | 2.6 |
| 364 | 3432 | 2.2 |
| 390 | 0 | 0 |

**SUM= 124488 $ft^3$**
**2.86 acre-feet**

Check: $V = C*A*P_6$
V= 2.84 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin B2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 31.2 | cfs | | | |
| Tc= | 24.2 | min | C= | 0.58 | |
| $P_{100,6}$= | 2.5 | in | A= | 22.61 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 24 | 2880 | 2 |
| 48 | 3024 | 2.1 |
| 72 | 3312 | 2.3 |
| 96 | 3456 | 2.4 |
| 120 | 4032 | 2.8 |
| 144 | 4320 | 3 |
| 168 | 5328 | 3.7 |
| 192 | 6048 | 4.2 |
| 216 | 8928 | 6.2 |
| 240 | 12960 | 9 |
| 264 | 44928 | 31.2 |
| 288 | 7200 | 5 |
| 312 | 4752 | 3.3 |
| 336 | 3744 | 2.6 |
| 360 | 3168 | 2.2 |
| 384 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 118080 $ft^3$**
**2.71 acre-feet**

Check: V = C*A*$P_6$
V= 2.73 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **2.71** | *(Post)* | | |
| | **-** | **2.86** | *(Pre)* | | |
| **Retention volume =** | | **-0.15** | **acre-feet** | **=** | **-6408 $ft^3$** |

**No Basin Required**

# Basin B2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 1.56 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **4131** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

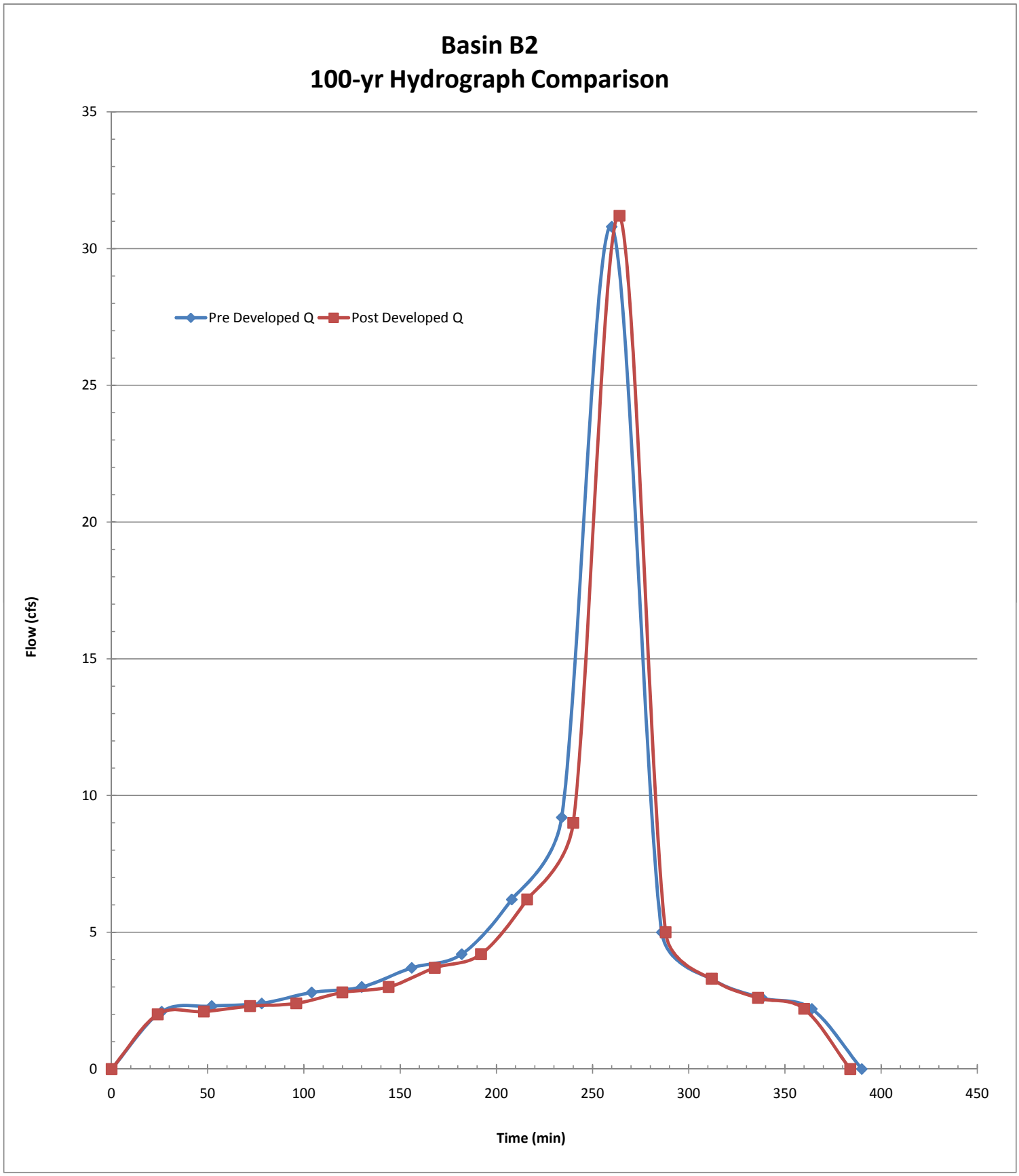
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 83500 | $ft^2$ |
| | A: | 1.92 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 29.81 tons

**Silt Accumulation Basin volume =** **662** **$ft^3$**

**Silt extracted within biofiltration swale**

.


Basin B2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
300
350
400
450

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# C2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C2.1.PV | 0.99 | 34100 | 0.8 | 5 | 4.0 | 3.10 | 6.6 | 5.10 | ~ | C2.1 | *bypass** | 26+00 | ENF |
| C2.2.PV | 0.99 | 35100 | 0.8 | 5 | 4.0 | 3.19 | 6.6 | 5.25 | ~ | C2.2 | *bypass** | 26+00 | ENF |

Σ 69200 *PAVED*

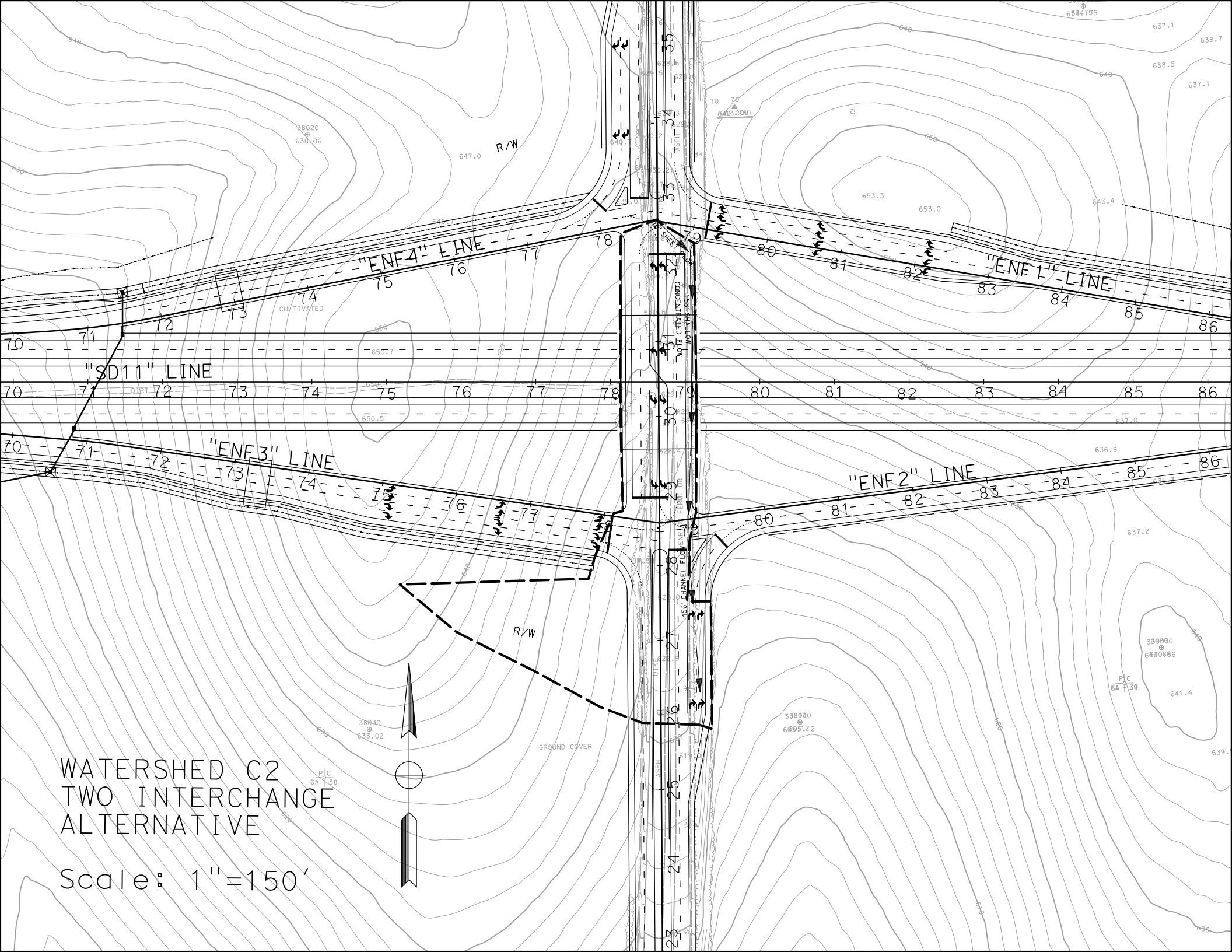
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| C2.1.SL | 0.61 | 32600 | 0.7 | 5 | 4.0 | 1.83 | 6.6 | 3.01 | ~ | C2.1 | *bypass** | 26+00 | ENF |

Σ 32600 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 101800 | 2.3 |
| | *SF* | *ac* |


"ENF4" LINE
"ENF1" LINE
"SD11" LINE
"ENF3" LINE
"ENF2" LINE
R/W
CULTIVATED
DIRT
GROUND COVER
CONCENTRATED FLOW
158' SHALLOW
456' CHANNEL FLOW
FERMT DR
SHEET FLOW
ASPH
DITCH
WATERSHED C2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=150'

# C2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 78+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | C2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 101800 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 2.34 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 32% | AT | 0.42 | 0.134 |
| PAVED SURFACE | 68% | AT | 0.90 | 0.612 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.75 |
| $C_{25}$ = | 0.82 |
| $C_{50}$ = | 0.90 |
| $C_{100}$ = | 0.93 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 632.0 | ft | High Point on Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 631.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 70 | ft | |
| SLOPE (S) = (H/L) | 1.4% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 1.88 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 631.0 | ft | Eastern Gutter of Enrico Fermi, north of SR-11 |
| LOW POINT ELEVATION | 629.0 | ft | Caltrans ROW |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 158 | ft | |
| SLOPE (S) = (H/L) | 1.3% | | |
| VELOCITY (SCF) | 1.5 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 1.76 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | Enrico Fermi Gutter - east |
| LOW POINT ELEVATION | 620.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 9.0 | ft | Z= 12 ANG-RAD 0.083 |
| LENGTH (L) | 456 | ft | b = 2 ANG-DEG 4.764 |
| SLOPE (S) = (H/L) | 2.0% | | d = 0.25 FLOWING FULL ASS'M |
| MANNING'S n | 0.015 | | Gutter |
| HYDRAULIC RADIUS R | 0.16 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 4.04 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.88 | minutes | |

# C2 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 5.51 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\ P_6\ D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.2 |
| **$Q_{10}$ =** | 4.7 |
| **$Q_{25}$ =** | 6.5 |
| **$Q_{50}$ =** | 8.5 |
| **$Q_{100}$ =** | **9.2** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin C2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **78+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **C2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 16.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.60 | |
| $P_{100,6}$= | 2.5 | in | A= | 6.49 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 360 | 0.6 |
| 20 | 360 | 0.6 |
| 30 | 360 | 0.6 |
| 40 | 360 | 0.6 |
| 50 | 420 | 0.7 |
| 60 | 420 | 0.7 |
| 70 | 420 | 0.7 |
| 80 | 420 | 0.7 |
| 90 | 480 | 0.8 |
| 100 | 480 | 0.8 |
| 110 | 480 | 0.8 |
| 120 | 540 | 0.9 |
| 130 | 540 | 0.9 |
| 140 | 600 | 1 |
| 150 | 600 | 1 |
| 160 | 660 | 1.1 |
| 170 | 720 | 1.2 |
| 180 | 780 | 1.3 |
| 190 | 900 | 1.5 |
| 200 | 960 | 1.6 |
| 210 | 1140 | 1.9 |
| 220 | 1320 | 2.2 |
| 230 | 1920 | 3.2 |
| 240 | 2760 | 4.6 |
| 250 | 9840 | 16.4 |
| 260 | 1560 | 2.6 |
| 270 | 1020 | 1.7 |
| 280 | 840 | 1.4 |
| 290 | 660 | 1.1 |
| 300 | 600 | 1 |
| 310 | 540 | 0.9 |
| 320 | 480 | 0.8 |
| 330 | 420 | 0.7 |
| 340 | 420 | 0.7 |
| 350 | 360 | 0.6 |
| 360 | 360 | 0.6 |
| 370 | 0 | 0 |

**SUM= 35100 $ft^3$**
**0.81 acre-feet**

Check: V = C*A*$P_6$
V= 0.81 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

# Basin C2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 9.2 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.93 | |
| $P_{100,6}$= | 2.5 | in | A= | 2.34 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 180 | 0.3 |
| 20 | 180 | 0.3 |
| 30 | 180 | 0.3 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 240 | 0.4 |
| 90 | 240 | 0.4 |
| 100 | 240 | 0.4 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 300 | 0.5 |
| 140 | 300 | 0.5 |
| 150 | 360 | 0.6 |
| 160 | 360 | 0.6 |
| 170 | 420 | 0.7 |
| 180 | 420 | 0.7 |
| 190 | 480 | 0.8 |
| 200 | 540 | 0.9 |
| 210 | 660 | 1.1 |
| 220 | 720 | 1.2 |
| 230 | 1080 | 1.8 |
| 240 | 1500 | 2.5 |
| 250 | 5520 | 9.2 |
| 260 | 900 | 1.5 |
| 270 | 600 | 1 |
| 280 | 480 | 0.8 |
| 290 | 360 | 0.6 |
| 300 | 360 | 0.6 |
| 310 | 300 | 0.5 |
| 320 | 240 | 0.4 |
| 330 | 240 | 0.4 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 180 | 0.3 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 19620 $ft^3$**
**0.45 acre-feet**

Check: $V = C*A*P_6$
V= 0.45 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **0.45** | *(Post)* | |
| - | **0.81** | *(Pre)* | |
| **Retention volume =** | **-0.36** | **acre-feet** | **= -15480 $ft^3$** **No Basin Required** |

# Basin C2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 1.59 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **4210** **$ft^3$**

**Treatment within biofiltration swales**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

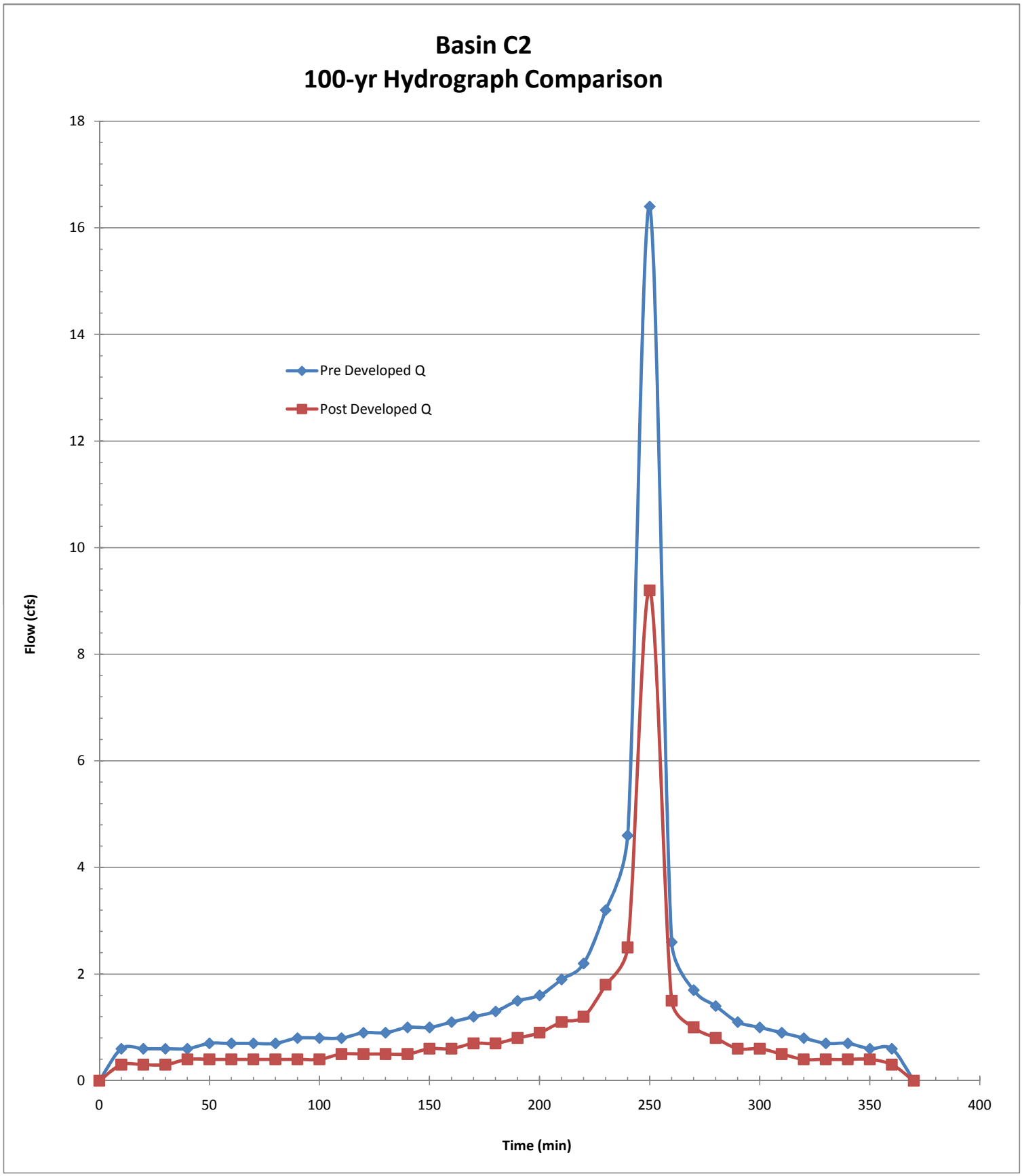
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 32600 | $ft^2$ |
| | A: | 0.75 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 11.64 tons

**Silt Accumulation Basin volume =** **259** **$ft^3$**

**Silt extracted within biofiltration swale**

.


Basin C2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
300
350
400

# D2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| ~ | 0.99 | 0 | 0.0 | 0 | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ |

Σ 0 *PAVED*

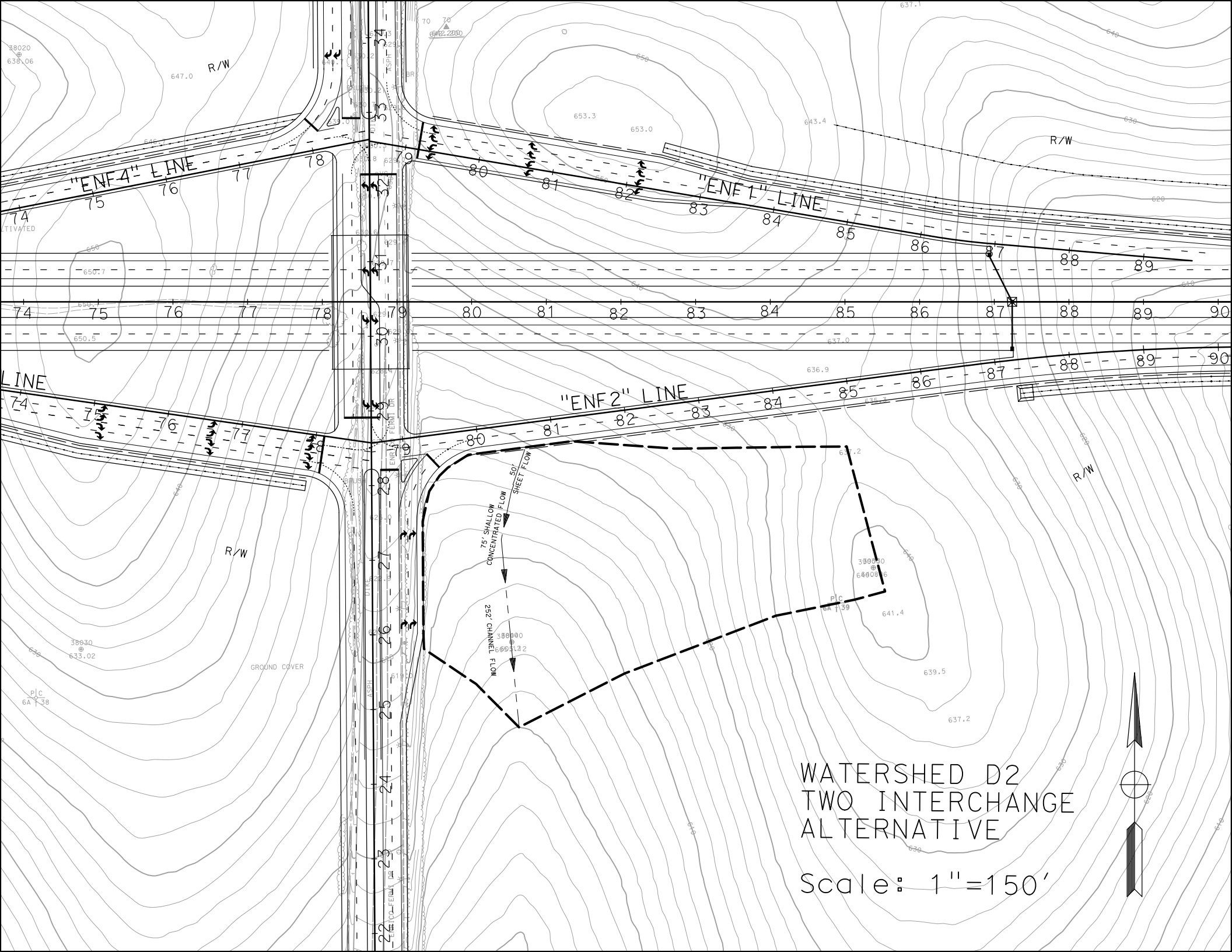
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | @ Station | Offset |
| | | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | | |
| D2.1.SL | 0.61 | 166100 | 3.8 | 10 | 2.8 | 6.55 | 4.2 | 9.80 | ~ | D2.1 | **bypass* | 26+00 | ENF |

Σ 166100 *SLOPE*

**flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 166100 | 3.8 |
| | *SF* | *ac* |


"ENF4" LINE
"ENF1" LINE
"ENF2" LINE
R/W
GROUND COVER
75' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW
252' CHANNEL FLOW
WATERSHED D2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=150'

# D2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Post-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **81+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **166100** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **3.81** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.14 | Rolling Slopes ~ 5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.42 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.42 | 0.420 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.42 |
| $C_{25}$ = | 0.46 |
| $C_{50}$ = | 0.50 |
| $C_{100}$ = | 0.53 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ **(in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 620.0 | ft | High Point in Watershed, south of SR-11 |
| LOW POINT ELEVATION | 618.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 4.0% | | |
| MANNING'S n | 0.100 | | < = From Table 816.6A nearly bare ground |
| $T_t$ (SFF)= | 4.11 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 618.0 | ft | |
| LOW POINT ELEVATION | 612.0 | ft | |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 75 | ft | |
| SLOPE (S) = (H/L) | 8.0% | | |
| VELOCITY (SCF) | 2.8 | fps | V FROM FIG 816.6 nearly bare ground |
| $T_C$ (SH)= | 0.45 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft | begins to channelize |
| LOW POINT ELEVATION | 600.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 12.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 252 | ft | b = 2 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 4.8% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.150 | | short prairie grass |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.01 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.17 | minutes | |

# D2 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.73 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 3.0 |
| **$Q_{10}$ =** | 4.3 |
| **$Q_{25}$ =** | 5.9 |
| **$Q_{50}$ =** | 7.8 |
| **$Q_{100}$ =** | **8.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin D2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **81+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **D2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

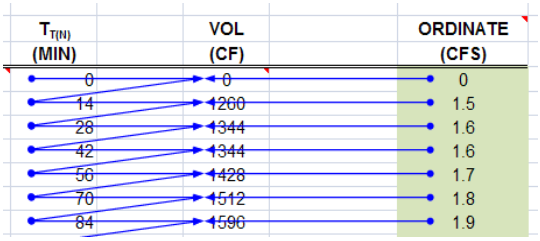
100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 18.5 | cfs | | | |
| Tc= | 11.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 8.89 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 11 | 462 | 0.7 |
| 22 | 462 | 0.7 |
| 33 | 462 | 0.7 |
| 44 | 528 | 0.8 |
| 55 | 528 | 0.8 |
| 66 | 528 | 0.8 |
| 77 | 594 | 0.9 |
| 88 | 594 | 0.9 |
| 99 | 594 | 0.9 |
| 110 | 660 | 1 |
| 121 | 660 | 1 |
| 132 | 726 | 1.1 |
| 143 | 792 | 1.2 |
| 154 | 792 | 1.2 |
| 165 | 924 | 1.4 |
| 176 | 990 | 1.5 |
| 187 | 1122 | 1.7 |
| 198 | 1188 | 1.8 |
| 209 | 1452 | 2.2 |
| 220 | 1650 | 2.5 |
| 231 | 2442 | 3.7 |
| 242 | 3564 | 5.4 |
| 253 | 12210 | 18.5 |
| 264 | 1980 | 3 |
| 275 | 1320 | 2 |
| 286 | 1056 | 1.6 |
| 297 | 858 | 1.3 |
| 308 | 726 | 1.1 |
| 319 | 660 | 1 |
| 330 | 594 | 0.9 |
| 341 | 528 | 0.8 |
| 352 | 528 | 0.8 |
| 363 | 462 | 0.7 |
| 374 | 0 | 0 |

Example of Steps:



| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 42636 $ft^3$**
**0.98 acre-feet**

Check: $V = C*A*P_6$
V= 0.97 acre-feet
***OK***

# Basin D2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 8.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.53 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.81 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 180 | 0.3 |
| 20 | 180 | 0.3 |
| 30 | 180 | 0.3 |
| 40 | 180 | 0.3 |
| 50 | 180 | 0.3 |
| 60 | 180 | 0.3 |
| 70 | 240 | 0.4 |
| 80 | 240 | 0.4 |
| 90 | 240 | 0.4 |
| 100 | 240 | 0.4 |
| 110 | 240 | 0.4 |
| 120 | 240 | 0.4 |
| 130 | 300 | 0.5 |
| 140 | 300 | 0.5 |
| 150 | 300 | 0.5 |
| 160 | 360 | 0.6 |
| 170 | 360 | 0.6 |
| 180 | 420 | 0.7 |
| 190 | 480 | 0.8 |
| 200 | 480 | 0.8 |
| 210 | 600 | 1 |
| 220 | 660 | 1.1 |
| 230 | 1020 | 1.7 |
| 240 | 1500 | 2.5 |
| 250 | 5040 | 8.4 |
| 260 | 780 | 1.3 |
| 270 | 540 | 0.9 |
| 280 | 420 | 0.7 |
| 290 | 360 | 0.6 |
| 300 | 300 | 0.5 |
| 310 | 300 | 0.5 |
| 320 | 240 | 0.4 |
| 330 | 240 | 0.4 |
| 340 | 240 | 0.4 |
| 350 | 180 | 0.3 |
| 360 | 180 | 0.3 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 18120 $ft^3$**
**0.42 acre-feet**

Check: $V = C*A*P_6$
V= 0.42 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **0.42** | *(Post)* | |
| - | **0.98** | *(Pre)* | |
| **Retention volume =** | **-0.56** | **acre-feet** | **= -24516 $ft^3$** **No Basin Required** |

# Basin D2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.99
A= 0.00 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **0** **$ft^3$**

**No pavement areas proposed in this watershed**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

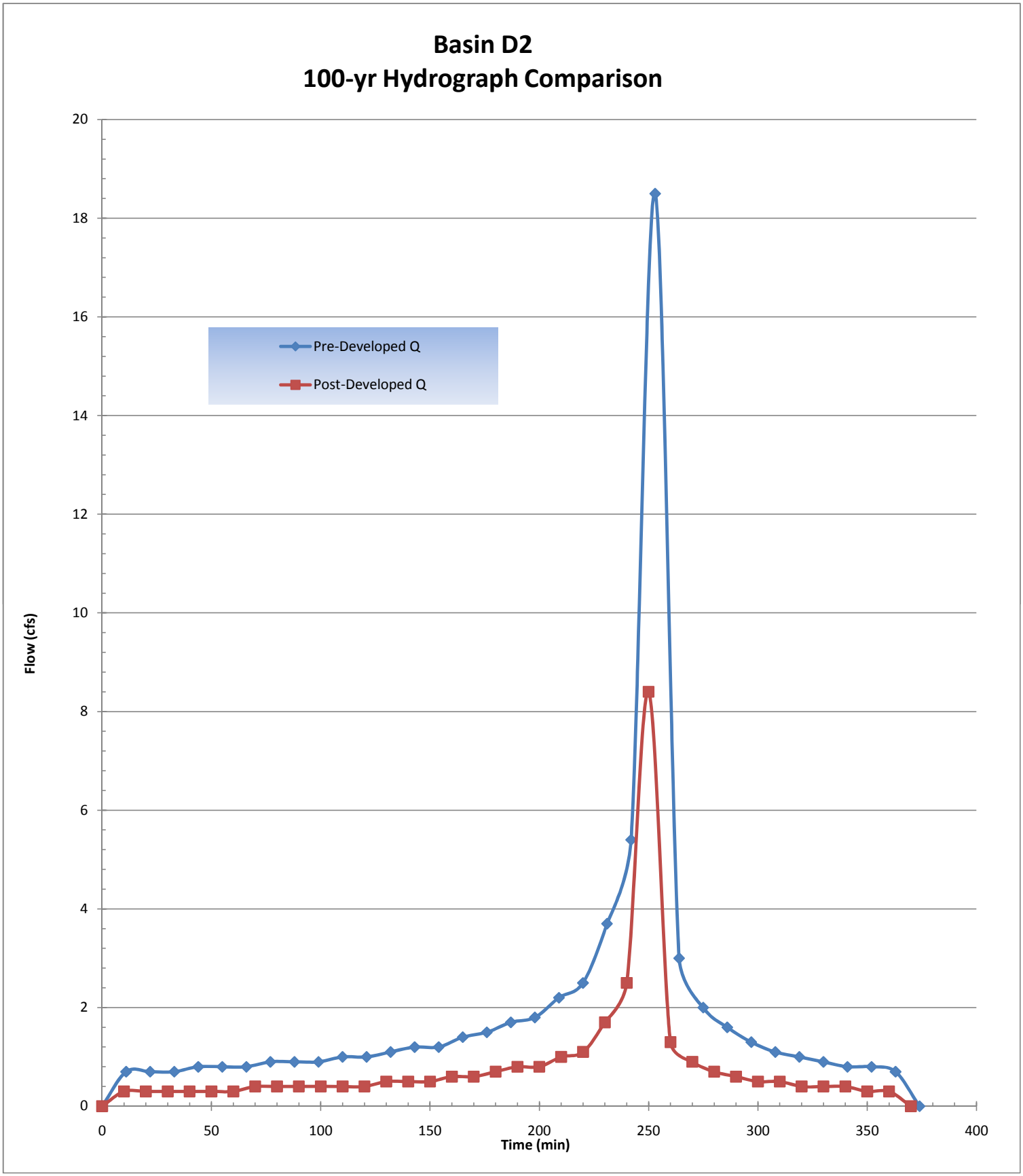
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 166100 | $ft^2$ |
| | A: | 3.81 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 59.30 tons

**Silt Accumulation Basin volume =** **1318** **$ft^3$**

**These are existing Sloped Areas to remain**

.


Basin D2
100-yr Hydrograph Comparison
Pre-Developed Q
Post-Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
18
20
0
50
100
150
200
250
300
350
400

# E2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

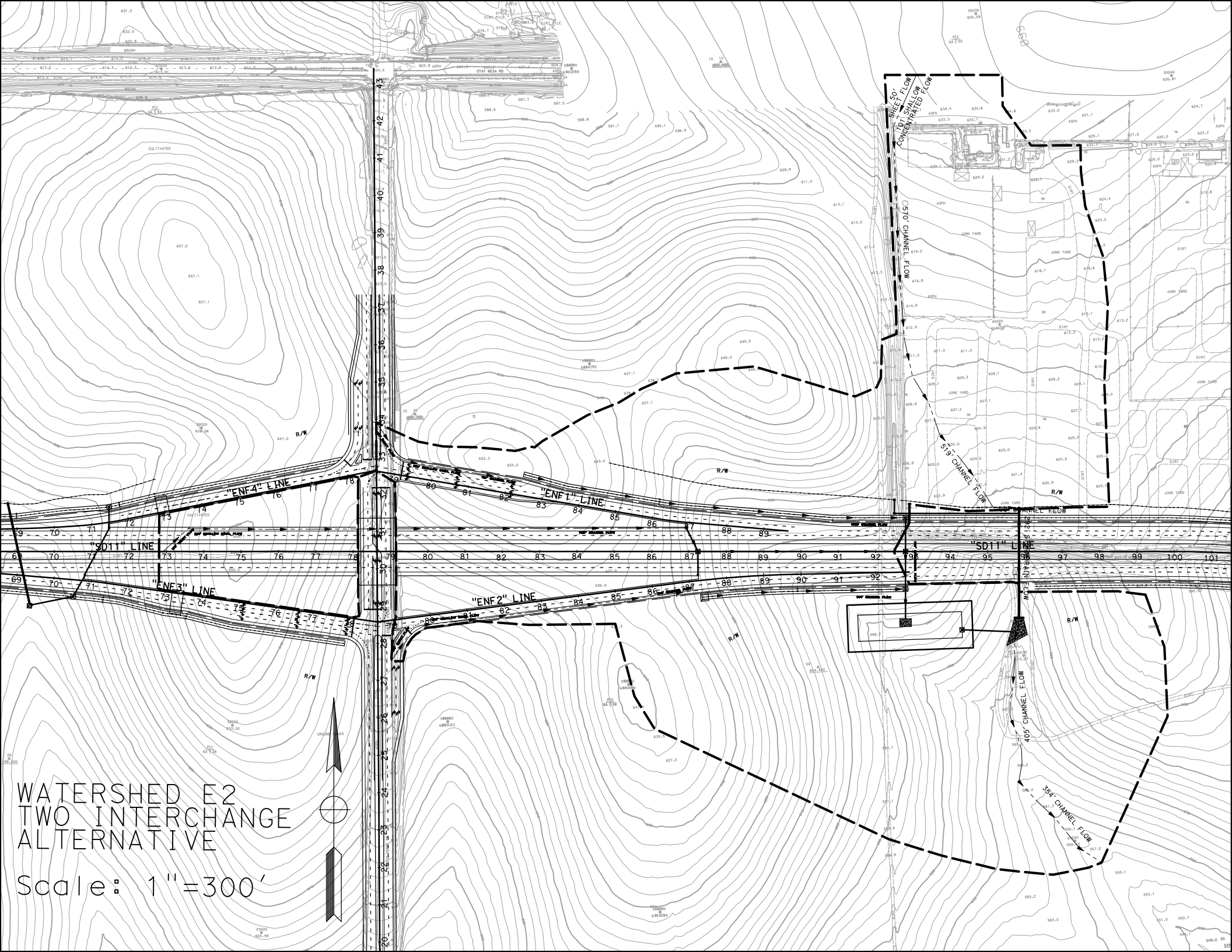
| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | E2.1.PV | 0.99 | 102800 | 2.4 | 10 | 2.8 | 6.61 | 4.2 | 9.84 | E2.1 | E2.1 | Basin E2 | 93+00 | Lt |
| | E2.2.PV | 0.99 | 86900 | 2.0 | 10 | 2.8 | 5.59 | 4.2 | 8.32 | E2.2 | E2.2 | Basin E2 | 96+00 | Rt |
| | E2.3.PV | 0.99 | 84100 | 1.9 | 10 | 2.8 | 5.41 | 4.2 | 8.05 | ~ | E2.3 | Basin E2 | 87+00 | Lt |
| | E2.4.PV | 0.99 | 83200 | 1.9 | 10 | 2.8 | 5.35 | 4.2 | 7.96 | ~ | E2.4 | Basin E2 | 87+00 | Rt |

Σ 357000 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | E2.1.SL | 0.61 | 98100 | 2.3 | 10 | 2.8 | 3.89 | 4.2 | 5.79 | E2.1 | E2.1 | Basin E2 | 93+00 | Lt |
| | E2.2.SL | 0.61 | 44800 | 1.0 | 10 | 2.8 | 1.77 | 4.2 | 2.64 | E2.2 | E2.2 | Basin E2 | 93+00 | Rt |
| | E2.3.SL | 0.61 | 97800 | 2.2 | 10 | 2.8 | 3.87 | 4.2 | 5.77 | ~ | E2.3 | Basin E2 | 87+00 | Lt |
| | E2.4.SL | 0.61 | 92100 | 2.1 | 10 | 2.8 | 3.65 | 4.2 | 5.43 | ~ | E2.4 | Basin E2 | 87+00 | Rt |
| | E2.5.SL | 0.61 | 65200 | 1.5 | 5 | 4.0 | 3.65 | 6.6 | 6.01 | ~ | E2.5 | Basin E2 | 93+00 | Rt |
| | E2.6.SL | 0.61 | 247500 | 5.7 | 10 | 3.3 | 11.27 | 4.2 | 14.60 | ~ | E2.6 | Culvert | 92+50 | Lt |

Watershed Σ 645500 *SLOPE*

| | | |
|---|---|---|
| Total : | 1002500 | 23.0 |
| | *SF* | *ac* |


WATERSHED E2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=300'
"ENF4" LINE
"ENF1" LINE
"SD11" LINE
"ENF3" LINE
"ENF2" LINE
"SD11" LINE
SHEET FLOW
50'
761' SHALLOW CONCENTRATED FLOW
570' CHANNEL FLOW
519' CHANNEL FLOW
292' CHANNEL FLOW
405' CHANNEL FLOW
354' CHANNEL FLOW
R/W
OTAY MESA RD
CULTIVATED
JUNK YARD
DIRT
ASPH

# E2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Post-Developed** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **2354540** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **54.05** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 57% | AT | 0.43 | 0.247 |
| PAVED SURFACE | 15% | AT | 0.90 | 0.136 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 27% | AT | 0.55 | 0.151 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.53 |
| $C_{25}$ = | 0.59 |
| $C_{50}$ = | 0.64 |
| $C_{100}$ = | 0.67 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = From Table 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E2 Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 599.0 | ft |
| ELEVATION DIFF (H) | 13.0 | ft |
| LENGTH (L) | 519 | ft |
| SLOPE (S) = (H/L) | 2.5% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 1.03 | fps |
| $T_C$ (CH)= | 8.43 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 599.0 | ft |
| LOW POINT ELEVATION | 598.0 | ft |
| ELEVATION DIFF (H) | 1.0 | ft |
| LENGTH (L) | 68 | ft |
| SLOPE (S) = (H/L) | 1.5% | |
| MANNING'S n | 0.015 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 5.51 | fps |
| $T_C$ (CH)= | 0.21 | minutes |

**NOTES:**

Proposed Slope Ditch

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 0.5 | FLOWING FULL ASS'M | |

concrete - rough

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 592.0 | ft |
| LOW POINT ELEVATION | 573.0 | ft |
| ELEVATION DIFF (H) | 19.0 | ft |
| LENGTH (L) | 292 | ft |
| SLOPE (S) = (H/L) | 6.5% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.5 | ft |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (STORMDRAIN) | 26.7 | fps |
| $T_C$ (SD)= | 0.18 | minutes |

**NOTES:**

Proposed Cross Culvert

Proposed Rip Rap Pad

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 573.0 | ft |
| LOW POINT ELEVATION | 565.2 | ft |
| ELEVATION DIFF (H) | 7.8 | ft |
| LENGTH (L) | 405 | ft |
| SLOPE (S) = (H/L) | 1.9% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.6 | ft |
| VELOCITY (CHANNEL) | 1.50 | fps |
| $T_C$ (CH)= | 4.50 | minutes |

**NOTES:**

Natural Channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 2 | ANG-DEG | 26.565 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 565.2 | ft |
| LOW POINT ELEVATION | 556.0 | ft |
| ELEVATION DIFF (H) | 9.2 | ft |
| LENGTH (L) | 354 | ft |
| SLOPE (S) = (H/L) | 2.6% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.7 | ft |
| VELOCITY (CHANNEL) | 1.81 | fps |
| $T_C$ (CH)= | 3.26 | minutes |

**NOTES:**

Begins to broaden

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 4 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

grass

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 23.36 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **23.36** | minutes |

Total Length of Run (ft) = 2359

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

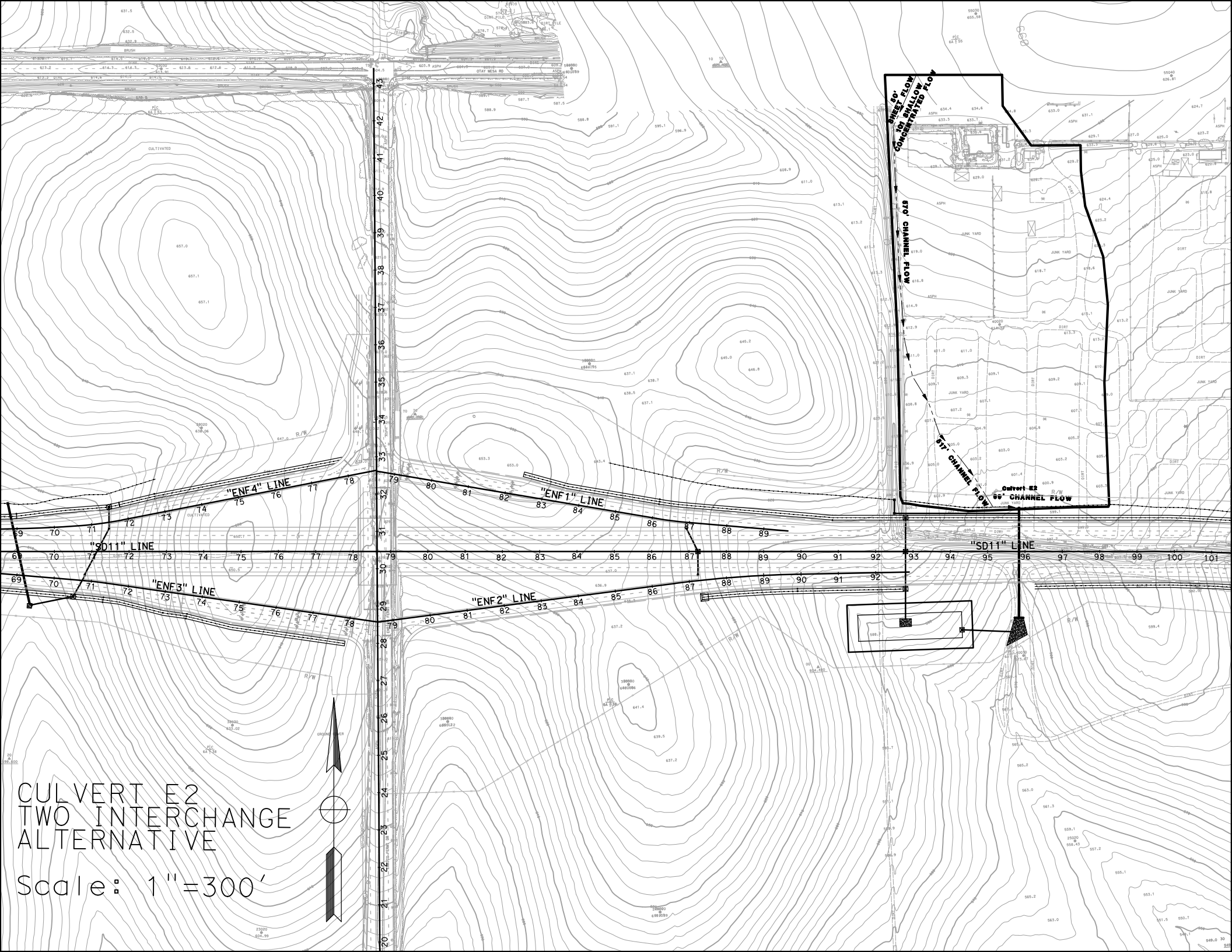
| | | | |
|---|---|---|---|
| $i_2$ = | 1.1 | in/hr | X CA = |
| $i_{10}$ = | 1.6 | in/hr | X CA = |
| $i_{25}$ = | 1.9 | in/hr | X CA = |
| $i_{50}$ = | 2.3 | in/hr | X CA = |
| $i_{100}$ = | 2.4 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 31.0 |
| **$Q_{10}$ =** | 45.0 |
| **$Q_{25}$ =** | 61.9 |
| **$Q_{50}$ =** | 81.0 |
| **$Q_{100}$ =** | **87.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


50' SHEET FLOW
101' SHALLOW CONCENTRATED FLOW
570' CHANNEL FLOW
317' CHANNEL FLOW
Culvert E2
99' CHANNEL FLOW
"ENF4" LINE
"ENF1" LINE
"SD11" LINE
"SD11" LINE
"ENF3" LINE
"ENF2" LINE
OTAY MESA RD
JUNK YARD
CULTIVATED
BRUSH
DIRT
ASPH
R/W
CULVERT E2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=300'

# Culvert Calculator Report
## E2 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 595.00 | ft | Headwater Depth/Height | 0.64 | |
| Computed Headwater Elevation | 593.92 | ft | Discharge | 14.80 | cfs |
| Inlet Control HW Elev. | 593.63 | ft | Tailwater Elevation | 573.60 | ft |
| Outlet Control HW Elev. | 593.92 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 592.00 | ft | Downstream Invert | 573.00 | ft |
| Length | 292.00 | ft | Constructed Slope | 6.5 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.60 | ft |
| Slope Type | Steep | | Normal Depth | 0.60 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.23 | ft |
| Velocity Downstream | 14.77 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 593.92 | ft | Upstream Velocity Head | 0.46 | ft |
| Ke | 0.50 | | Entrance Loss | 0.23 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 593.63 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## E2 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 596.00 | ft | Headwater Depth/Height | 0.96 | |
| Computed Headwater Elevation | 594.89 | ft | Discharge | 30.10 | cfs |
| Inlet Control HW Elev. | 594.60 | ft | Tailwater Elevation | 573.85 | ft |
| Outlet Control HW Elev. | 594.89 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 592.00 | ft | Downstream Invert | 573.00 | ft |
| Length | 292.00 | ft | Constructed Slope | 6.5 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 0.85 | ft |
| Slope Type | Steep | | Normal Depth | 0.85 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.78 | ft |
| Velocity Downstream | 18.15 | ft/s | Critical Slope | 0.5 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 594.89 | ft | Upstream Velocity Head | 0.74 | ft |
| Ke | 0.50 | | Entrance Loss | 0.37 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 594.60 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 7.1 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# E2 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Culvert** |
| **JOB #:** | **11A1190** | | | **STATION:** | **95+90** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E2.Culvert** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Culvert E2** |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| **A =** | **843184** | **ft^2** | **SOURCE:** | **MICROSTATION/USGS** |
| | **19.36** | **acres** | | **(SCALE = 1:1)** |

**COEFFICIENT OF RUNOFF:**

**KEY:** User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | **NOTES:** |
|---|---|---|
| RELIEF (.08-.35) | 0.15 | Rolling Slopes ~ 7.5% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.08 | Low |
| TOTAL C = | 0.43 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.43 | 0.426 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.43 |
| $C_{25}$ = | 0.48 |
| $C_{50}$ = | 0.52 |
| $C_{100}$ = | 0.54 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.4\,5}n^{.4\,5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** **$P_{2,24}$ (in) = 1.80**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 635.0 | ft | South of Otay Mesa Road - Driveway Area |
| LOW POINT ELEVATION | 634.7 | ft | |
| ELEVATION DIFF (H) | 0.3 | ft | |
| LENGTH (L) | 50 | ft | |
| SLOPE (S) = (H/L) | 0.6% | | |
| MANNING'S n | 0.016 | | < = FROM FIG 816.6A Asphalt |
| $T_t$ (SFF)= | 2.03 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 634.7 | ft | Mid-driveway |
| LOW POINT ELEVATION | 633.0 | ft | North end of Junk Yard |
| ELEVATION DIFF (H) | 1.7 | ft | |
| LENGTH (L) | 101 | ft | |
| SLOPE (S) = (H/L) | 1.7% | | |
| VELOCITY (SCF) | 1.5 | fps | <=V FROM FIG 816.6 Asphalt |
| $T_C$ (SH)= | 1.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 633.0 | ft | channel along western side of junk yard |
| LOW POINT ELEVATION | 612.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 570 | ft | b = 1 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 3.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | earthen/dirt |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.61 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.63 | minutes | |

# E2 Culvert TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 612.0 | ft |
| LOW POINT ELEVATION | 602.0 | ft |
| ELEVATION DIFF (H) | 10.0 | ft |
| LENGTH (L) | 517 | ft |
| SLOPE (S) = (H/L) | 1.9% | |
| MANNING'S n | 0.100 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 0.90 | fps |
| $T_C$ (CH)= | 9.56 | minutes |

**NOTES:**

Begins to broaden across junk yard

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 1 | ANG-DEG | 11.310 |
| d = | 0.5 | FLOWING FULL ASS'M | |

dirt with junk yard obstructions

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 602.0 | ft |
| LOW POINT ELEVATION | 598.0 | ft |
| ELEVATION DIFF (H) | 4.0 | ft |
| LENGTH (L) | 69 | ft |
| SLOPE (S) = (H/L) | 5.8% | |
| MANNING'S n | 0.015 | |
| HYDRAULIC RADIUS R | 0.3 | ft |
| VELOCITY (CHANNEL) | 10.93 | fps |
| $T_C$ (CH)= | 0.11 | minutes |

**NOTES:**

Proposed Slope Ditch

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 0.5 | FLOWING FULL ASS'M | |

concrete - rough

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 16.45 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **16.45** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

**FLOW RESULTS**

| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = | $Q_2$ = | 7.9 |
| $i_{10}$ = | 1.8 | in/hr | X CA = | $Q_{10}$ = | 14.8 |
| $i_{25}$ = | 2.2 | in/hr | X CA = | $Q_{25}$ = | 20.4 |
| $i_{50}$ = | 2.5 | in/hr | X CA = | $Q_{50}$ = | 25.6 |
| $i_{100}$ = | 2.9 | in/hr | X CA = | $Q_{100}$ = | **30.1** |

~Use Caltrans 'i' for culvert sizing

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

**FLOW RESULTS**

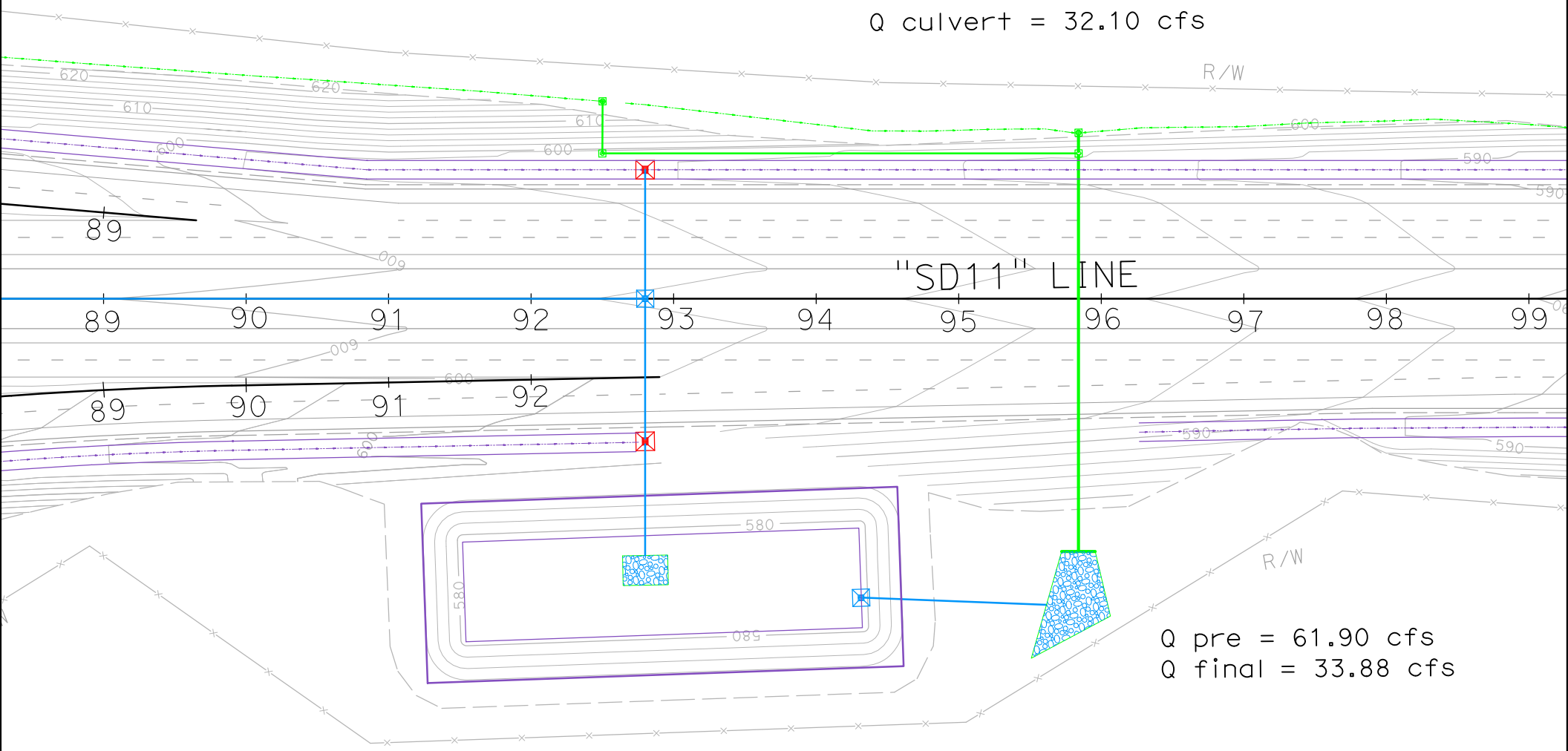
| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.3 | in/hr | X CA = | $Q_2$ = | 11.3 |
| $i_{10}$ = | 2.0 | in/hr | X CA = | $Q_{10}$ = | 16.5 |
| $i_{25}$ = | 2.4 | in/hr | X CA = | $Q_{25}$ = | 22.6 |
| $i_{50}$ = | 2.9 | in/hr | X CA = | $Q_{50}$ = | 29.6 |
| $i_{100}$ = | 3.1 | in/hr | X CA = | $Q_{100}$ = | **32.1** |

~Use County of SD 'i' for detention basin design

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN E2
FLOW SUMMARY

Scale: 1"=100'

# Basin E2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **96+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin E2** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 61.9 | cfs | | | |
| Tc= | 24.5 | min | C= | 0.54 | |
| $P_{100,6}$= | 2.5 | in | A= | 48.15 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 25 | 6000 | 4 |
| 50 | 6750 | 4.5 |
| 75 | 7050 | 4.7 |
| 100 | 8100 | 5.4 |
| 125 | 8850 | 5.9 |
| 150 | 10800 | 7.2 |
| 175 | 12300 | 8.2 |
| 200 | 18000 | 12 |
| 225 | 23550 | 15.7 |
| 250 | 92850 | 61.9 |
| 275 | 14400 | 9.6 |
| 300 | 9600 | 6.4 |
| 325 | 7500 | 5 |
| 350 | 6300 | 4.2 |
| 375 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 232050 $ft^3$**
**5.33 acre-feet**

Check: V = C*A*$P_6$
V= 5.45 acre-feet
***OK***

# Basin E2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 87.9 | cfs | | | |
| Tc= | 23.4 | min | C= | 0.67 | |
| $P_{100,6}$= | 2.5 | in | A= | 54.05 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 23 | 3450 | 2.5 |
| 46 | 7728 | 5.6 |
| 69 | 8142 | 5.9 |
| 92 | 9108 | 6.6 |
| 115 | 9522 | 6.9 |
| 138 | 11040 | 8 |
| 161 | 11868 | 8.6 |
| 184 | 14628 | 10.6 |
| 207 | 16560 | 12 |
| 230 | 24426 | 17.7 |
| 253 | 36018 | 26.1 |
| 276 | 121302 | 87.9 |
| 299 | 19596 | 14.2 |
| 322 | 13110 | 9.5 |
| 345 | 10212 | 7.4 |
| 368 | 8556 | 6.2 |
| 391 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 325266 $ft^3$**
**7.47 acre-feet**

Check: V = C*A*$P_6$
V= 7.52 acre-feet
***OK***

| | | | |
|---|---|---|---|
| | **7.47** | *(Post)* | |
| - | **5.33** | *(Pre)* | |
| **Retention volume =** | **2.14** | **acre-feet** | **= 93216 $ft^3$** **Basin Required** |

# Basin E2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.89
A= 17.33 acres

$WQ_{72}$: 0.66 in/area

**Water Quality Volume (WQV) =** **41525** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

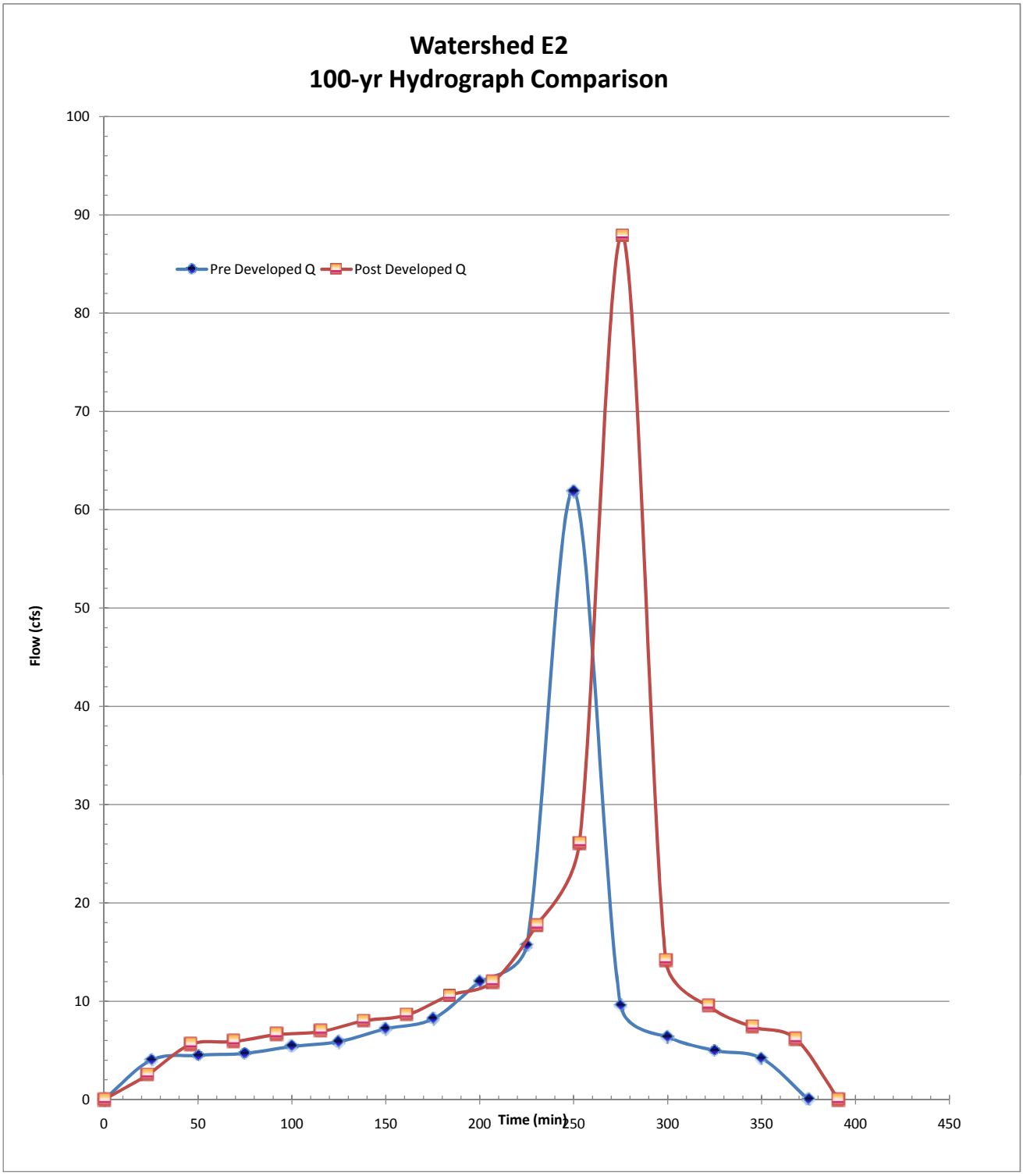
| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 398000 | $ft^2$ |
| | A: | 9.14 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 142.10 tons

**Silt Accumulation Basin volume =** **3158** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**

## Basin E2 Retention



# Basin E2 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 93+00 |
| BY: | M.BRUNING | DATE: | 01.06.10 | WATERSHED: | E2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 755000 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 17.33 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | |
|---|---|
| RELIEF (.08-.35) | 0.00 |
| INFILTRATION (.04-.16) | 0.00 |
| VEGETATION (.04-.16) | 0.00 |
| STORAGE (.04-.12) | 0.00 |
| TOTAL C = | 0.00 |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 47% | AT | 0.90 | 0.426 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 53% | AT | 0.55 | 0.290 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.72 |
| $C_{25}$ = | 0.79 |
| $C_{50}$ = | 0.86 |
| $C_{100}$ = | 0.89 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{.5}n^{.4.5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.5 | ft | SR-11 HP |
| LOW POINT ELEVATION | 610.0 | ft | |
| ELEVATION DIFF (H) | 0.5 | ft | |
| LENGTH (L) | 100 | ft | to ES |
| SLOPE (S) = (H/L) | 0.5% | | |
| MANNING'S n | 0.016 | | AC < = From Table 816.6A |
| $T_t$ (SFF)= | 3.80 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | Flow in gutter (SCF) |
| LOW POINT ELEVATION | 608.5 | ft | |
| ELEVATION DIFF (H) | 1.5 | ft | |
| LENGTH (L) | 200 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 0.8% | | |
| VELOCITY (SCF) | 2.5 | fps | 0.8% , V FROM FIG 816.6 AC |
| $T_C$ (SH)= | 1.33 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 608.5 | ft | along HMA dike |
| LOW POINT ELEVATION | 603.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 5.5 | ft | Z= 20 ANG-RAD 0.050 |
| LENGTH (L) | 1127 | ft | b = 10 ANG-DEG 2.862 |
| SLOPE (S) = (H/L) | 0.5% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.016 | | HMA |
| HYDRAULIC RADIUS R | 0.33 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.13 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 6.01 | minutes | |

# Basin E2 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 598.0 | ft |
| LOW POINT ELEVATION | 580.0 | ft |
| ELEVATION DIFF (H) | 18.0 | ft |
| LENGTH (L) | 808 | ft |
| SLOPE (S) = (H/L) | 2.2% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 10.8 | fps |
| $T_C$ (SD)= | 1.25 | minutes |

**NOTES:**

| |
|---|
| Proposed onsite pipe (assumed 5' drop to invert) |
| Proposed Rip Rap Pad in Basin floor |
| |
| |
| |
| RCP |
| |
| R=D/4, Assume: flowing full |
| $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.39 | minutes |
| **Minimum Tc =** | 5 | minutes |
| **USE $T_C$ =** | **12.39** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = |
| $i_{10}$ = | 2.3 | in/hr | X CA = |
| $i_{25}$ = | 2.9 | in/hr | X CA = |
| $i_{50}$ = | 3.5 | in/hr | X CA = |
| $i_{100}$ = | 3.7 | in/hr | X CA = |

**FLOW RESULTS**

| | cfs |
|---|---|
| **$Q_2$ =** | 20.0 |
| **$Q_{10}$ =** | 29.1 |
| **$Q_{25}$ =** | 40.0 |
| **$Q_{50}$ =** | 52.4 |
| **$Q_{100}$ =** | **56.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin E2 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **93+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.06.10** | **WATERSHED:** | **E2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin E2** |

***Notes:***

This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 56.9 | cfs | | | |
| Tc= | 12.4 | min | $C_{100}$= | 0.89 | |
| $P_{100,6}$= | 2.5 | in | A= | 17.33 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 12 | 1656 | 2.3 |
| 24 | 1728 | 2.4 |
| 36 | 1800 | 2.5 |
| 48 | 1800 | 2.5 |
| 60 | 1944 | 2.7 |
| 72 | 2016 | 2.8 |
| 84 | 2088 | 2.9 |
| 96 | 2160 | 3 |
| 108 | 2304 | 3.2 |
| 120 | 2448 | 3.4 |
| 132 | 2664 | 3.7 |
| 144 | 2736 | 3.8 |
| 156 | 3024 | 4.2 |
| 168 | 3240 | 4.5 |
| 180 | 3744 | 5.2 |
| 192 | 4032 | 5.6 |
| 204 | 4896 | 6.8 |
| 216 | 5616 | 7.8 |
| 228 | 8208 | 11.4 |
| 240 | 12240 | 17 |
| 252 | 40968 | 56.9 |
| 264 | 6624 | 9.2 |
| 276 | 4392 | 6.1 |
| 288 | 3456 | 4.8 |
| 300 | 2880 | 4 |
| 312 | 2520 | 3.5 |
| 324 | 2232 | 3.1 |
| 336 | 2016 | 2.8 |
| 348 | 1872 | 2.6 |
| 360 | 1728 | 2.4 |
| 372 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 139032 $ft^3$**
**3.19 acre-feet**

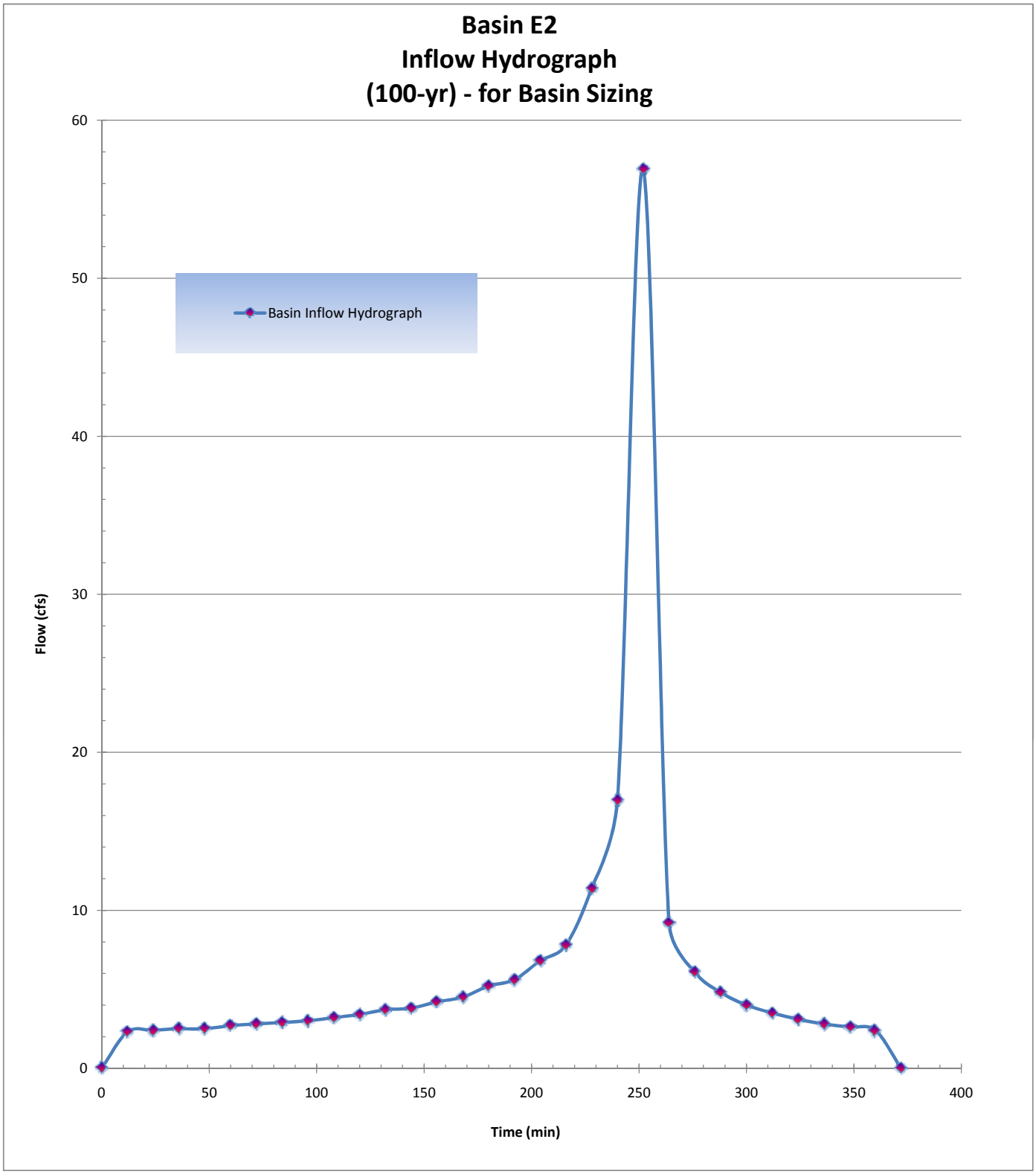
Onsite Runoff Volume

Check: V = C*A*$P_6$

V= 3.23 acre-feet

***OK***

## Basin E2 Inflow Hydrograph



# Basin E2 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **93+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **E2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin E2** |

***Notes:***

| | | | | | |
|---|---|---|---|---|---|
| Required Retention Basin Volume = | 96374 | $ft^3$ | | | |
| Actual Basin Inflow = | 139032 | $ft^4$ | *OK* | | |

***Flow Balance - determine maximum flow from basin***

| | | | | | |
|---|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 61.9 | cfs | | | |
| Post-Developed Peak Flow through Cross Culvert: | 32.1 | cfs | | Includes: | E2.6.SL |
| Flow that does not reach detention basin (bypass per DA table): | 0.0 | cfs | ~ | $Q_{100}$ of: | ~ |
| Maximum flow allowed to be released by this detention basin: | 29.8 | cfs | | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 586.00 | ft |
| Basin flowline elevation = | 580.00 | ft |
| Maximum Basin Depth = | 6.00 | ft |

***Outlet Pipe***

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 4.00 | ft | 584.00 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | | 285 | ft |
| Base Width (W) | | 75 | ft |
| W/L Ratio ® | | 0.26 | |
| Side Slopes (Z) | 1: | 4 | |
| Total Volume (V): | | 185217 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 580.00 | 0.00 | 0 | 0 | | 580.00 | 0.00 | | 0.00 |
| 1 | 580.20 | 0.20 | 4333 | 4333 | | 580.20 | 0.00 | | 0.00 |
| 2 | 580.40 | 0.40 | 4449 | 8781 | | 580.40 | 0.00 | | 0.00 |
| 3 | 580.60 | 0.60 | 4566 | 13348 | | 580.60 | 0.00 | | 0.00 |
| 4 | 580.80 | 0.80 | 4685 | 18032 | | 580.80 | 0.00 | | 0.00 |
| 5 | 581.00 | 1.00 | 4804 | 22836 | | 581.00 | 0.00 | | 0.00 |
| 6 | 581.20 | 1.20 | 4925 | 27761 | | 581.20 | 0.00 | | 0.00 |
| 7 | 581.40 | 1.40 | 5047 | 32808 | | 581.40 | 0.00 | | 0.00 |
| 8 | 581.60 | 1.60 | 5170 | 37978 | | 581.60 | 0.00 | | 0.00 |
| 9 | 581.80 | 1.80 | 5294 | 43272 | | 581.80 | 0.00 | | 0.00 |
| 10 | 582.00 | 2.00 | 5420 | 48692 | | 582.00 | 0.00 | | 0.00 |
| 11 | 582.20 | 2.20 | 5546 | 54238 | | 582.20 | 0.00 | | 0.00 |
| 12 | 582.40 | 2.40 | 5674 | 59912 | | 582.40 | 0.00 | | 0.00 |
| 13 | 582.60 | 2.60 | 5803 | 65715 | | 582.60 | 0.00 | | 0.00 |
| 14 | 582.80 | 2.80 | 5933 | 71648 | | 582.80 | 0.00 | | 0.00 |
| 15 | 583.00 | 3.00 | 6064 | 77712 | | 583.00 | 0.00 | 0.00 | 0.00 |
| 16 | 583.20 | 3.20 | 6197 | 83909 | | 583.20 | 0.00 | | 0.00 |
| 17 | 583.40 | 3.40 | 6330 | 90239 | | 583.40 | 0.00 | | 0.00 |
| 18 | 583.60 | 3.60 | 6465 | 96704 | | 583.60 | 0.00 | | 0.00 |
| 19 | 583.80 | 3.80 | 6601 | 103305 | | 583.80 | 0.00 | | 0.00 |
| 20 | 584.00 | 4.00 | 6738 | 110043 | * | 584.00 | 0.00 | | 0.00 |
| 21 | 584.20 | 4.20 | 6876 | 116919 | | 584.20 | 0.15 | | 0.15 |
| 22 | 584.40 | 4.40 | 7016 | 123935 | | 584.40 | 0.59 | | 0.59 |
| 23 | 584.60 | 4.60 | 7156 | 131091 | | 584.60 | 1.30 | | 1.30 |
| 24 | 584.80 | 4.80 | 7298 | 138389 | | 584.80 | 2.25 | | 2.25 |
| 25 | 585.00 | 5.00 | 7441 | 145829 | | 585.00 | 3.42 | | 3.42 |
| 26 | 585.20 | 5.20 | 7585 | 153414 | | 585.20 | 4.79 | | 4.79 |
| 27 | 585.40 | 5.40 | 7730 | 161144 | | 585.40 | 6.32 | | 6.32 |
| 28 | 585.60 | 5.60 | 7876 | 169021 | | 585.60 | 7.99 | | 7.99 |
| 29 | 585.80 | 5.80 | 8024 | 177045 | | 585.80 | 9.77 | | 9.77 |
| 30 | 586.00 | 6.00 | 8173 | 185217 | | 586.00 | 11.63 | | 11.63 |

# Basin E2 Routing

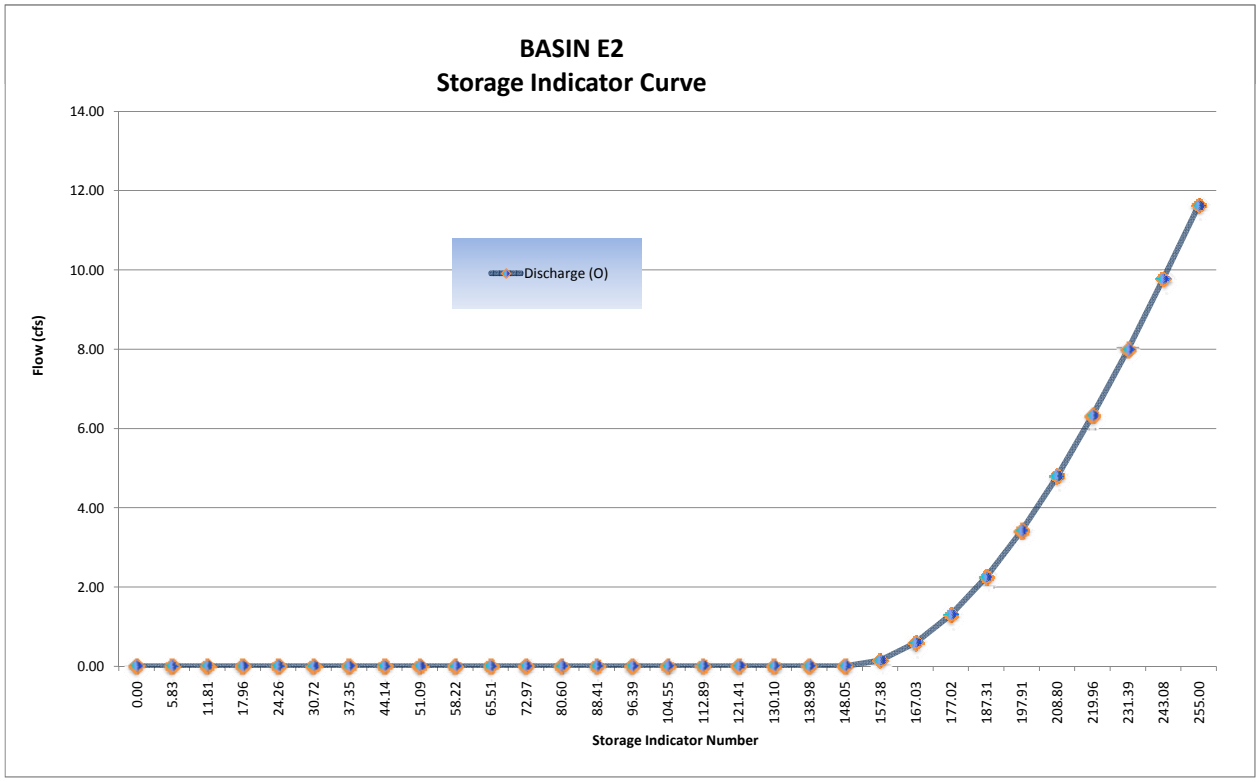
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 96+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | E |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin E2 |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 580.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 580.20 | 0.00 | 4333 | 0.00 | 5.83 | 5.83 |
| 580.40 | 0.00 | 8781 | 0.00 | 11.81 | 11.81 |
| 580.60 | 0.00 | 13348 | 0.00 | 17.96 | 17.96 |
| 580.80 | 0.00 | 18032 | 0.00 | 24.26 | 24.26 |
| 581.00 | 0.00 | 22836 | 0.00 | 30.72 | 30.72 |
| 581.20 | 0.00 | 27761 | 0.00 | 37.35 | 37.35 |
| 581.40 | 0.00 | 32808 | 0.00 | 44.14 | 44.14 |
| 581.60 | 0.00 | 37978 | 0.00 | 51.09 | 51.09 |
| 581.80 | 0.00 | 43272 | 0.00 | 58.22 | 58.22 |
| 582.00 | 0.00 | 48692 | 0.00 | 65.51 | 65.51 |
| 582.20 | 0.00 | 54238 | 0.00 | 72.97 | 72.97 |
| 582.40 | 0.00 | 59912 | 0.00 | 80.60 | 80.60 |
| 582.60 | 0.00 | 65715 | 0.00 | 88.41 | 88.41 |
| 582.80 | 0.00 | 71648 | 0.00 | 96.39 | 96.39 |
| 583.00 | 0.00 | 77712 | 0.00 | 104.55 | 104.55 |
| 583.20 | 0.00 | 83909 | 0.00 | 112.89 | 112.89 |
| 583.40 | 0.00 | 90239 | 0.00 | 121.41 | 121.41 |
| 583.60 | 0.00 | 96704 | 0.00 | 130.10 | 130.10 |
| 583.80 | 0.00 | 103305 | 0.00 | 138.98 | 138.98 |
| 584.00 | 0.00 | 110043 | 0.00 | 148.05 | 148.05 |
| 584.20 | 0.15 | 116919 | 0.08 | 157.30 | 157.38 |
| 584.40 | 0.59 | 123935 | 0.30 | 166.74 | 167.03 |
| 584.60 | 1.30 | 131091 | 0.65 | 176.37 | 177.02 |
| 584.80 | 2.25 | 138389 | 1.13 | 186.19 | 187.31 |
| 585.00 | 3.42 | 145829 | 1.71 | 196.20 | 197.91 |
| 585.20 | 4.79 | 153414 | 2.40 | 206.40 | 208.80 |
| 585.40 | 6.32 | 161144 | 3.16 | 216.80 | 219.96 |
| 585.60 | 7.99 | 169021 | 4.00 | 227.40 | 231.39 |
| 585.80 | 9.77 | 177045 | 4.89 | 238.19 | 243.08 |
| 586.00 | 11.63 | 185217 | 5.82 | 249.19 | 255.00 |

| | | |
|---|---|---|
| delta t = | 0.21 | hrs |
| delta t = | 12 | min |
| delta t = | 743.2807 | sec |

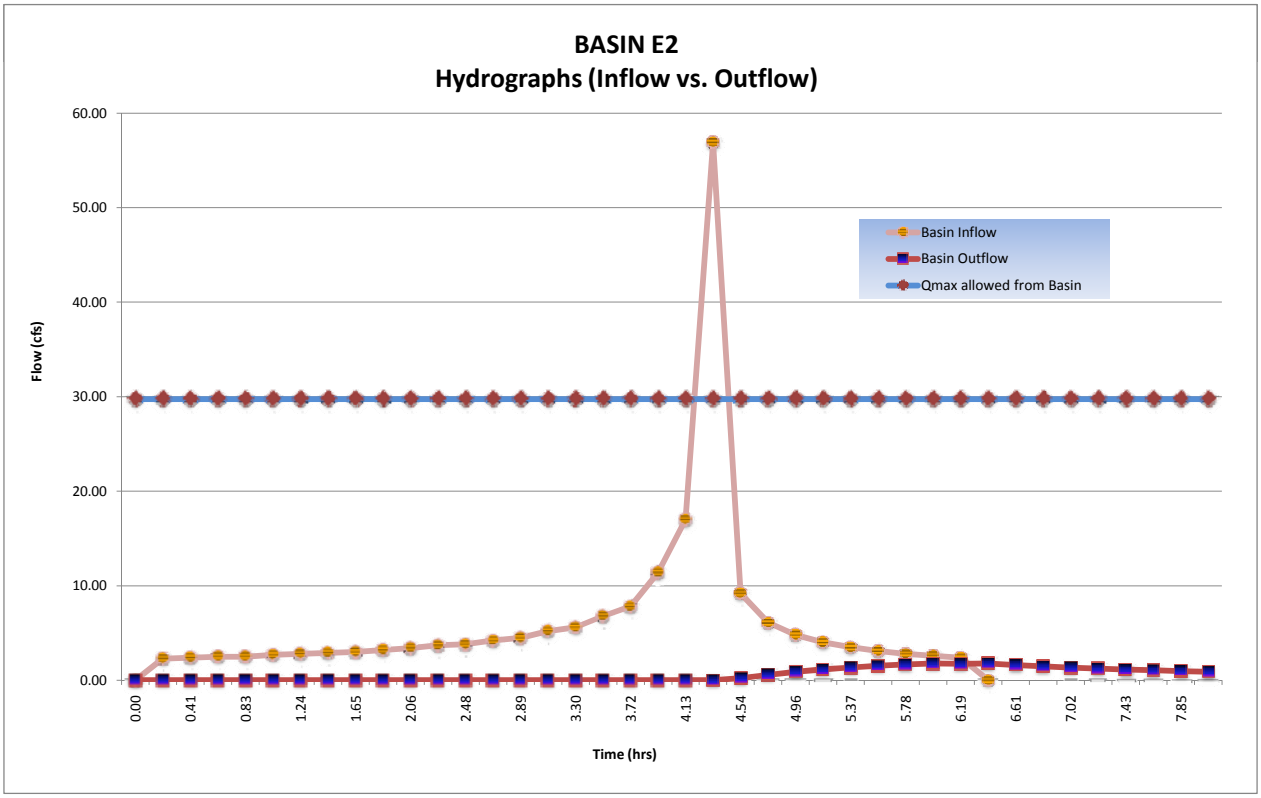


# Basin E2 Routing

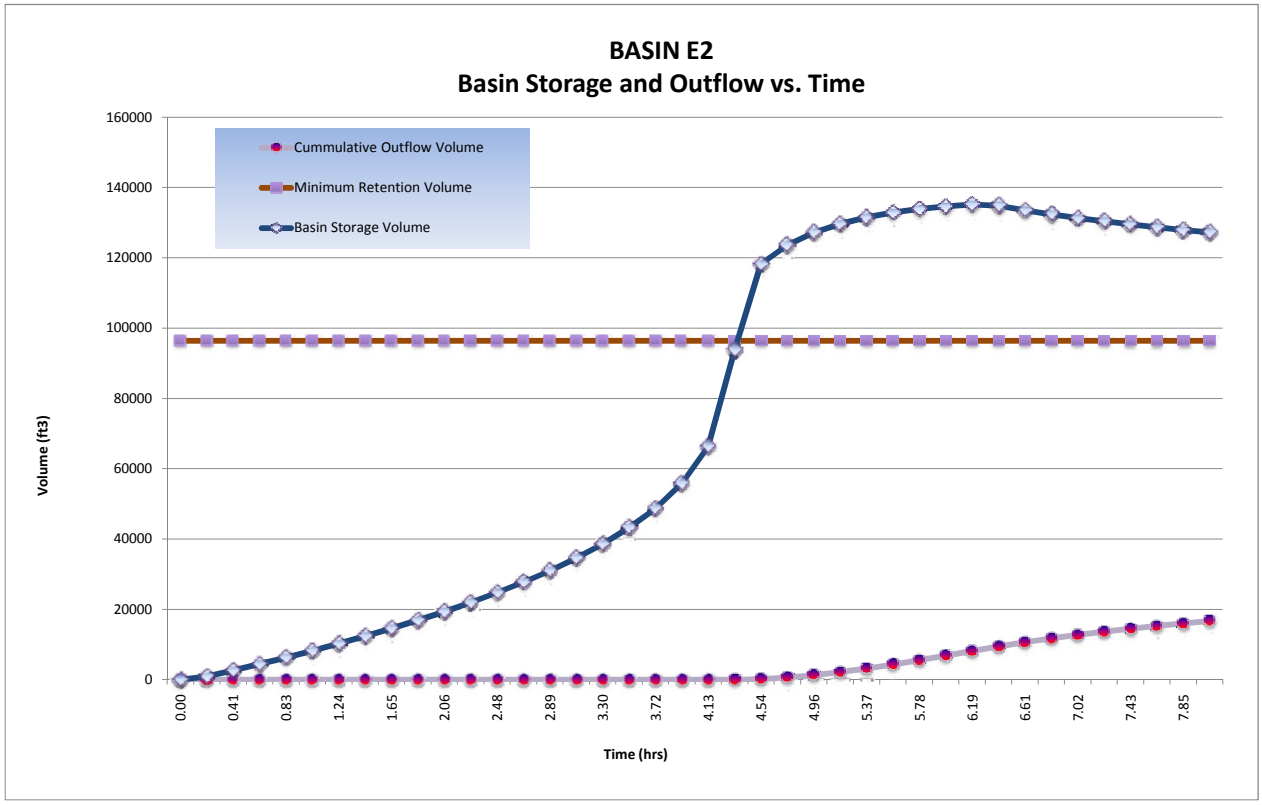
$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.21 | 2.30 | 1.15 | 0.00 | 0.00 | 1.15 | 0.00 | 855 | 0 | 0 |
| 0.41 | 2.40 | 2.35 | 1.15 | 0.00 | 3.50 | 0.00 | 2601 | 0 | 0 |
| 0.62 | 2.50 | 2.45 | 3.50 | 0.00 | 5.95 | 0.00 | 4423 | 0 | 0 |
| 0.83 | 2.50 | 2.50 | 5.95 | 0.00 | 8.45 | 0.00 | 6281 | 0 | 0 |
| 1.03 | 2.70 | 2.60 | 8.45 | 0.00 | 11.05 | 0.00 | 8213 | 0 | 0 |
| 1.24 | 2.80 | 2.75 | 11.05 | 0.00 | 13.80 | 0.00 | 10257 | 0 | 0 |
| 1.45 | 2.90 | 2.85 | 13.80 | 0.00 | 16.65 | 0.00 | 12376 | 0 | 0 |
| 1.65 | 3.00 | 2.95 | 16.65 | 0.00 | 19.60 | 0.00 | 14568 | 0 | 0 |
| 1.86 | 3.20 | 3.10 | 19.60 | 0.00 | 22.70 | 0.00 | 16872 | 0 | 0 |
| 2.06 | 3.40 | 3.30 | 22.70 | 0.00 | 26.00 | 0.00 | 19325 | 0 | 0 |
| 2.27 | 3.70 | 3.55 | 26.00 | 0.00 | 29.55 | 0.00 | 21964 | 0 | 0 |
| 2.48 | 3.80 | 3.75 | 29.55 | 0.00 | 33.30 | 0.00 | 24751 | 0 | 0 |
| 2.68 | 4.20 | 4.00 | 33.30 | 0.00 | 37.30 | 0.00 | 27724 | 0 | 0 |
| 2.89 | 4.50 | 4.35 | 37.30 | 0.00 | 41.65 | 0.00 | 30958 | 0 | 0 |
| 3.10 | 5.20 | 4.85 | 41.65 | 0.00 | 46.50 | 0.00 | 34563 | 0 | 0 |
| 3.30 | 5.60 | 5.40 | 46.50 | 0.00 | 51.90 | 0.00 | 38576 | 0 | 0 |
| 3.51 | 6.80 | 6.20 | 51.90 | 0.00 | 58.10 | 0.00 | 43185 | 0 | 0 |
| 3.72 | 7.80 | 7.30 | 58.10 | 0.00 | 65.40 | 0.00 | 48611 | 0 | 0 |
| 3.92 | 11.40 | 9.60 | 65.40 | 0.00 | 75.00 | 0.00 | 55746 | 0 | 0 |
| 4.13 | 17.00 | 14.20 | 75.00 | 0.00 | 89.20 | 0.00 | 66301 | 0 | 0 |
| 4.34 | 56.90 | 36.95 | 89.20 | 0.00 | 126.15 | 0.00 | 93765 | 0 | 0 |
| 4.54 | 9.20 | 33.05 | 126.15 | 0.00 | 159.20 | 0.23 | 118245 | 171 | 171 |
| 4.75 | 6.10 | 7.65 | 159.20 | 0.23 | 166.62 | 0.57 | 123634 | 424 | 595 |
| 4.96 | 4.80 | 5.45 | 166.62 | 0.57 | 171.50 | 0.91 | 127134 | 676 | 1271 |
| 5.16 | 4.00 | 4.40 | 171.50 | 0.91 | 174.99 | 1.16 | 129636 | 862 | 2133 |
| 5.37 | 3.50 | 3.75 | 174.99 | 1.16 | 177.58 | 1.35 | 131490 | 1003 | 3137 |
| 5.57 | 3.10 | 3.30 | 177.58 | 1.35 | 179.53 | 1.53 | 132873 | 1137 | 4274 |
| 5.78 | 2.80 | 2.95 | 179.53 | 1.53 | 180.95 | 1.66 | 133880 | 1234 | 5508 |
| 5.99 | 2.60 | 2.70 | 180.95 | 1.66 | 181.99 | 1.76 | 134616 | 1308 | 6816 |
| 6.19 | 2.40 | 2.50 | 181.99 | 1.76 | 182.73 | 1.73 | 135177 | 1286 | 8102 |
| 6.40 | 0.00 | 1.20 | 182.73 | 1.73 | 182.20 | 1.78 | 134764 | 1323 | 9425 |
| 6.61 | | 0.00 | 182.20 | 1.78 | 180.42 | 1.61 | 133504 | 1197 | 10621 |
| 6.81 | | 0.00 | 180.42 | 1.61 | 178.81 | 1.47 | 132360 | 1093 | 11714 |
| 7.02 | | 0.00 | 178.81 | 1.47 | 177.34 | 1.33 | 131319 | 989 | 12703 |
| 7.23 | | 0.00 | 177.34 | 1.33 | 176.01 | 1.23 | 130368 | 914 | 13617 |
| 7.43 | | 0.00 | 176.01 | 1.23 | 174.78 | 1.14 | 129487 | 847 | 14464 |
| 7.64 | | 0.00 | 174.78 | 1.14 | 173.64 | 1.06 | 128669 | 788 | 15252 |
| 7.85 | | 0.00 | 173.64 | 1.06 | 172.58 | 0.98 | 127911 | 728 | 15981 |
| 8.05 | | 0.00 | 172.58 | 0.98 | 171.60 | 0.91 | 127209 | 676 | 16657 |



## Basin E2 Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **135,177** | **$ft^3$** | |
| **@ Stage:** | **584.80** | **ft** | |
| **Freeboard:** | **1.2** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **185,217** | **$ft^3$** | Basin **E2** |
| **Maximum flow rate released from this basin:** | **1.78** | **cfs** | |

# F2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **F2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | F2.1.PV | 0.99 | 61700 | 1.4 | 10.28 | 2.8 | 3.90 | 4.1 | 5.80 | F2.1 | F2.1 | Basin F2 | 101+00 | Lt |
| | F2.2.PV | 0.99 | 68500 | 1.6 | 10 | 2.8 | 4.39 | 4.2 | 6.56 | F2.2 | F2.2 | Basin F2 | 101+50 | Rt |
| | F2.3.PV | 0.99 | 14400 | 0.3 | 5 | 4.0 | 1.30 | 6.6 | 2.16 | ~ | F2.3 | Basin F2 | 103+35 | Rt |
| | F2.4.PV | 0.99 | 56300 | 1.3 | 5 | 4.0 | 5.10 | 6.6 | 8.43 | ~ | F2.4 | Basin F2 | 108+00 | Center |
| | F2.5.PV | 0.99 | 35600 | 0.8 | 5 | 4.0 | 3.22 | 6.6 | 5.33 | ~ | F2.5 | Basin F2 | 108+00 | Rt |
| | F2.6.PV | 0.99 | 54100 | 1.2 | 5 | 4.0 | 4.90 | 6.6 | 8.10 | ~ | F2.6 | Basin F2 | 115+00 | Lt |
| | F2.7.PV | 0.99 | 54000 | 1.2 | 5 | 4.0 | 4.89 | 6.6 | 8.08 | ~ | F2.7 | Basin F2 | 115+00 | Rt |

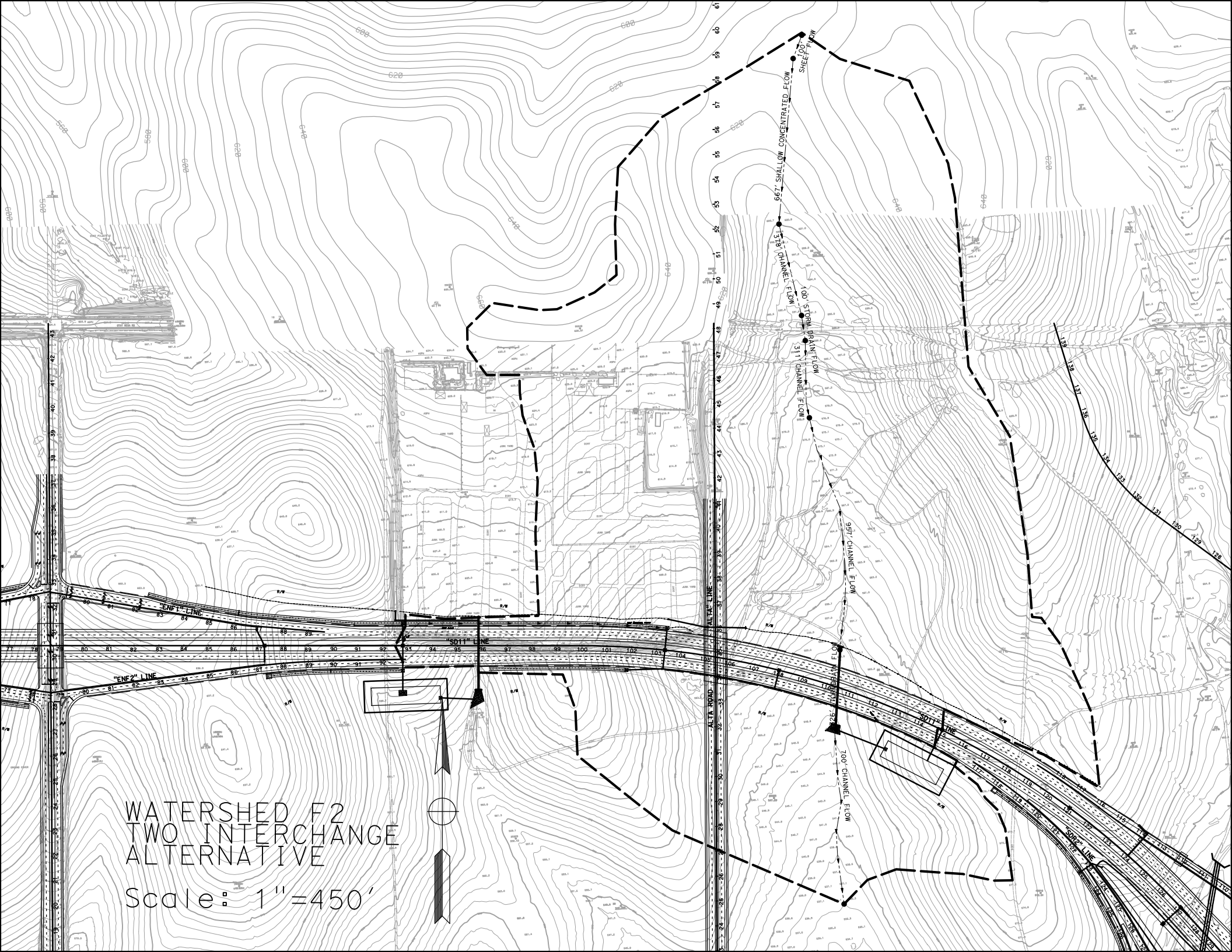
Σ 344600 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| | **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | F2.1.SL | 0.61 | 47700 | 1.1 | 10.28 | 2.8 | 1.86 | 4.1 | 2.76 | F2.1 | F2.1 | Basin F2 | 103+35 | Lt |
| | F2.2.SL | 0.61 | 15500 | 0.4 | 10 | 2.8 | 0.61 | 4.2 | 0.91 | F2.2 | F2.2 | Basin F2 | 101+90 | Rt |
| | F2.8.SL | 0.61 | 61700 | 1.4 | 10 | 2.8 | 2.43 | 4.2 | 3.64 | ~ | Culvert | Culvert | 110+50 | Lt |
| | F2.9.SL | 0.61 | 63300 | 1.5 | 10 | 2.8 | 2.50 | 4.2 | 3.73 | ~ | ~ | bypass* | 110+50 | Rt |
| | F2.10.SL | 0.61 | 49800 | 1.1 | 10 | 2.8 | 1.96 | 4.2 | 2.94 | ~ | F2.10 | Basin F2 | 114+00 | Rt |

Σ 238000 *SLOPE*

** flow that does not reach the basin*

| | | |
|---|---|---|
| Total : | 582600 | 13.4 |
| | *SF* | *ac* |


WATERSHED F2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=450'
100' SHEET FLOW
657' SHALLOW CONCENTRATED FLOW
318' CHANNEL FLOW
100' STORM DRAIN FLOW
311' CHANNEL FLOW
957' CHANNEL FLOW
700' CHANNEL FLOW
"ENF1" LINE
"ENF2" LINE
"SD11" LINE
"SD12" LINE
"SD13" LINE
ALTA ROAD

# F2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 01.04.10 | WATERSHED: | F2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 5547848 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 127.36 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | | NOTES: |
|---|---|---|---|
| RELIEF (.08-.35) | 0.20 | | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | | Normal |
| TOTAL C = | 0.47 | | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 89% | AT | 0.47 | 0.421 |
| PAVED SURFACE | 6% | AT | 0.90 | 0.056 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 4% | AT | 0.55 | 0.024 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.50 |
| $C_{25}$ = | 0.55 |
| $C_{50}$ = | 0.60 |
| $C_{100}$ = | 0.63 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_C$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural Channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 3.25 | minutes | |

# F2 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft |
| LOW POINT ELEVATION | 587.0 | ft |
| ELEVATION DIFF (H) | 2.0 | ft |
| LENGTH (L) | 100 | ft |
| SLOPE (S) = (H/L) | 2.0% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 3.0 | ft |
| HYDRAULIC RADIUS R | 0.8 | ft |
| VELOCITY (STORMDRAIN) | 13.4 | fps |
| $T_C$ (SD)= | 0.12 | minutes |

**NOTES:**

Exist Cross Culvert under berm

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft |
| LOW POINT ELEVATION | 576.0 | ft |
| ELEVATION DIFF (H) | 11.0 | ft |
| LENGTH (L) | 311 | ft |
| SLOPE (S) = (H/L) | 3.5% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 0.9 | ft |
| VELOCITY (CHANNEL) | 3.30 | fps |
| $T_C$ (CH)= | 1.57 | minutes |

**NOTES:**

defined broad channel south of berm (field verified new berm)

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 5 | ANG-RAD | 0.197 |
| b = | 50 | ANG-DEG | 11.310 |
| d = | 1 | FLOWING FULL ASS'M | |

Natural Channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft |
| LOW POINT ELEVATION | 555.0 | ft |
| ELEVATION DIFF (H) | 21.0 | ft |
| LENGTH (L) | 957 | ft |
| SLOPE (S) = (H/L) | 2.2% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.8 | ft |
| VELOCITY (CHANNEL) | 3.74 | fps |
| $T_C$ (CH)= | 4.27 | minutes |

**NOTES:**

channel begins to narrow

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 1.5 | FLOWING FULL ASS'M | |

Natural Channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 555.0 | ft |
| LOW POINT ELEVATION | 546.0 | ft |
| ELEVATION DIFF (H) | 9.0 | ft |
| LENGTH (L) | 326 | ft |
| SLOPE (S) = (H/L) | 2.8% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 4.0 | ft |
| HYDRAULIC RADIUS R | 1.0 | ft |
| VELOCITY (STORMDRAIN) | 19.0 | fps |
| $T_C$ (SD)= | 0.29 | minutes |

**NOTES:**

Proposed Cross Culvert under SR-11

Outfall/Rip Rap Pad

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 546.0 | ft |
| LOW POINT ELEVATION | 536.0 | ft |
| ELEVATION DIFF (H) | 10.0 | ft |
| LENGTH (L) | 700 | ft |
| SLOPE (S) = (H/L) | 1.4% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 1.0 | ft |
| VELOCITY (CHANNEL) | 3.58 | fps |
| $T_C$ (CH)= | 3.26 | minutes |

**NOTES:**

channellized - natural

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 2 | ANG-RAD | 0.464 |
| b = | 1 | ANG-DEG | 26.565 |
| d = | 2 | FLOWING FULL ASS'M | |

Natural Channel

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 29.19 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **29.19** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 0.9 | in/hr | X CA = |
| $i_{10}$ = | 1.4 | in/hr | X CA = |
| $i_{25}$ = | 1.7 | in/hr | X CA = |
| $i_{50}$ = | 2.0 | in/hr | X CA = |
| $i_{100}$ = | 2.1 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 59.2 |
| $Q_{10}$ = | 86.1 |
| $Q_{25}$ = | 118.3 |
| $Q_{50}$ = | 154.9 |
| $Q_{100}$ = | **168.1** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

SHEET FLOW
100' SHALLOW CONCENTRATED FLOW
318' CHANNEL FLOW
100' STORM DRAIN FLOW
311' CHANNEL FLOW
887' CHANNEL FLOW
Culvert F2
"ENF1" LINE
"ENF2" LINE
"SD11" LINE
"ALTA" LINE
ALTA ROAD
"SD12" LINE
CULVERT F2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=450'

# Culvert Calculator Report
## F2 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 559.00 | ft | Headwater Depth/Height | 0.98 | |
| Computed Headwater Elevation | 558.91 | ft | Discharge | 63.30 | cfs |
| Inlet Control HW Elev. | 558.60 | ft | Tailwater Elevation | 547.41 | ft |
| Outlet Control HW Elev. | 558.91 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.41 | ft |
| Slope Type | Steep | | Normal Depth | 1.41 | ft |
| Flow Regime | Supercritical | | Critical Depth | 2.40 | ft |
| Velocity Downstream | 16.05 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 558.91 | ft | Upstream Velocity Head | 1.00 | ft |
| Ke | 0.50 | | Entrance Loss | 0.50 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 558.60 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# Culvert Calculator Report
## F2 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 562.00 | ft | Headwater Depth/Height | 1.69 | |
| Computed Headwater Elevation | 561.78 | ft | Discharge | 128.40 | cfs |
| Inlet Control HW Elev. | 561.78 | ft | Tailwater Elevation | 548.11 | ft |
| Outlet Control HW Elev. | 561.37 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 555.00 | ft | Downstream Invert | 546.00 | ft |
| Length | 326.00 | ft | Constructed Slope | 2.8 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 2.11 | ft |
| Slope Type | Steep | | Normal Depth | 2.09 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.39 | ft |
| Velocity Downstream | 19.11 | ft/s | Critical Slope | 0.8 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 4.00 | ft |
| Section Size | 48 inch | | Rise | 4.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 561.37 | ft | Upstream Velocity Head | 1.98 | ft |
| Ke | 0.50 | | Entrance Loss | 0.99 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 561.78 | ft | Flow Control | Submerged | |
| Inlet Type | Square edge w/headwall | | Area Full | 12.6 | $ft^2$ |
| K | 0.00980 | | HDS 5 Chart | 1 | |
| M | 2.00000 | | HDS 5 Scale | 1 | |
| C | 0.03980 | | Equation Form | 1 | |
| Y | 0.67000 | | | | |

# F2 Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Culvert |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 11.17.09 | WATERSHED: | F2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 4110979 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 94.38 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.20 | Hilly ~ 10% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.47 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 99% | AT | 0.47 | 0.465 |
| PAVED SURFACE | 1% | AT | 0.90 | 0.009 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.47 |
| $C_{25}$ = | 0.52 |
| $C_{50}$ = | 0.57 |
| $C_{100}$ = | 0.59 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 630.0 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 629.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| MANNING'S n | 0.050 | | < = From Table 816.6A Fallow |
| $T_t$ (SFF)= | 7.16 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 629.0 | ft | |
| LOW POINT ELEVATION | 600.0 | ft | |
| ELEVATION DIFF (H) | 29.0 | ft | |
| LENGTH (L) | 667 | ft | |
| SLOPE (S) = (H/L) | 4.3% | | |
| VELOCITY (SCF) | 1.2 | fps | <=V FROM FIG 816.6 Short Grass Pasture/Nearly Bare Ground |
| $T_c$ (SH)= | 9.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 600.0 | ft | defined broad channel north of berm |
| LOW POINT ELEVATION | 589.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 ANG-RAD 0.197 |
| LENGTH (L) | 378 | ft | b = 50 ANG-DEG 11.310 |
| SLOPE (S) = (H/L) | 2.9% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural Channel |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.94 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_c$ (CH)= | 3.25 | minutes | |

# F2 Culvert TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 589.0 | ft | Exist Cross Culvert under berm |
| LOW POINT ELEVATION | 587.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.4 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.12 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | defined broad channel south of berm (field verified new berm) |
| LOW POINT ELEVATION | 576.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 5 / ANG-RAD / 0.197 |
| LENGTH (L) | 311 | ft | b = 50 / ANG-DEG / 11.310 |
| SLOPE (S) = (H/L) | 3.5% | | d = 1 / FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | Natural Channel |
| HYDRAULIC RADIUS R | 0.9 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.30 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 576.0 | ft | channel begins to narrow |
| LOW POINT ELEVATION | 555.0 | ft | CHANNEL DATA / TYPE = / TRAP'Z |
| ELEVATION DIFF (H) | 21.0 | ft | Z= 2 / ANG-RAD / 0.464 |
| LENGTH (L) | 957 | ft | b = 1 / ANG-DEG / 26.565 |
| SLOPE (S) = (H/L) | 2.2% | | d = 1.5 / FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | Natural Channel |
| HYDRAULIC RADIUS R | 0.8 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.74 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.27 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 25.64 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **25.64** | minutes |

**INTENSITY CHART:** Caltrans IDF2000

| | | | | **FLOW RESULTS:** | cfs | |
|---|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | **$Q_2$ =** | 33.7 | |
| $i_{10}$ = | 1.4 | in/hr | X CA = | **$Q_{10}$ =** | 63.3 | |
| $i_{25}$ = | 1.8 | in/hr | X CA = | **$Q_{25}$ =** | 87.0 | |
| $i_{50}$ = | 2.0 | in/hr | X CA = | **$Q_{50}$ =** | 109.1 | |
| $i_{100}$ = | 2.3 | in/hr | X CA = | **$Q_{100}$ =** | **128.4** | ~Use Caltrans 'i' for culvert sizing |

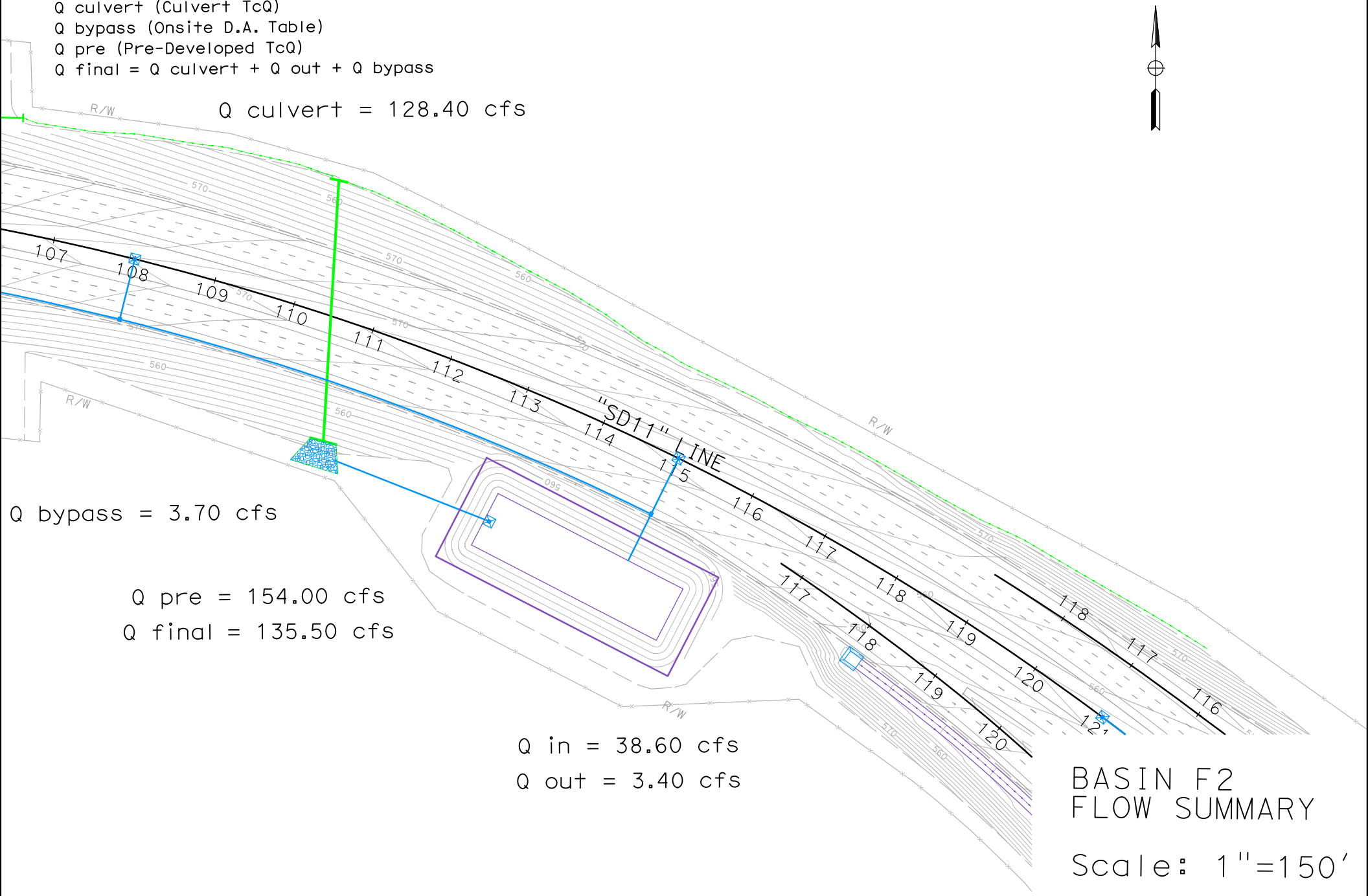
**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | **FLOW RESULTS** | cfs | |
|---|---|---|---|---|---|---|
| $i_2$ = | 1.0 | in/hr | X CA = | **$Q_2$ =** | 45.2 | |
| $i_{10}$ = | 1.5 | in/hr | X CA = | **$Q_{10}$ =** | 65.7 | |
| $i_{25}$ = | 1.8 | in/hr | X CA = | **$Q_{25}$ =** | 90.4 | |
| $i_{50}$ = | 2.2 | in/hr | X CA = | **$Q_{50}$ =** | 118.3 | |
| $i_{100}$ = | 2.3 | in/hr | X CA = | **$Q_{100}$ =** | **128.4** | ~Use County of SD 'i' for detention basin design |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN F2
FLOW SUMMARY

Scale: 1"=150'

# Basin F2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.04.10** | **WATERSHED:** | **F2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 154.0 | cfs | | | |
| Tc= | 30.0 | min | C= | 0.59 | |
| $P_{100,6}$= | 2.5 | in | A= | 125.36 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 30 | 20340 | 11.3 |
| 60 | 21600 | 12 |
| 90 | 24660 | 13.7 |
| 120 | 26820 | 14.9 |
| 150 | 32760 | 18.2 |
| 180 | 37260 | 20.7 |
| 210 | 54720 | 30.4 |
| 240 | 75960 | 42.2 |
| 270 | 277200 | 154 |
| 300 | 43920 | 24.4 |
| 330 | 29340 | 16.3 |
| 360 | 23040 | 12.8 |
| 390 | 0 | 0 |

**SUM= 667620 $ft^3$**
**15.33 acre-feet**

Check: V = C*A*$P_6$
V= 15.47 acre-feet
***OK***

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 168.1 | cfs | | | |
| Tc= | 29.2 | min | C= | 0.63 | |
| $P_{100,6}$= | 2.5 | in | A= | 127.36 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 29 | 21750 | 12.5 |
| 58 | 23142 | 13.3 |
| 87 | 26448 | 15.2 |
| 116 | 28710 | 16.5 |
| 145 | 34974 | 20.1 |
| 174 | 39846 | 22.9 |
| 203 | 58638 | 33.7 |
| 232 | 85956 | 49.4 |
| 261 | 292494 | 168.1 |
| 290 | 46980 | 27 |
| 319 | 31494 | 18.1 |
| 348 | 24534 | 14.1 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 714966 $ft^3$**
**16.41 acre-feet**

Check: V = C*A*$P_6$
V= 16.59 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **16.41** | *(Post)* | | |
| | **-** | **15.33** | *(Pre)* | | |
| **Retention volume =** | | **1.09** | **acre-feet** | **=** | **47346 $ft^3$** | **Basin Required** |

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 10.51 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **27837** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

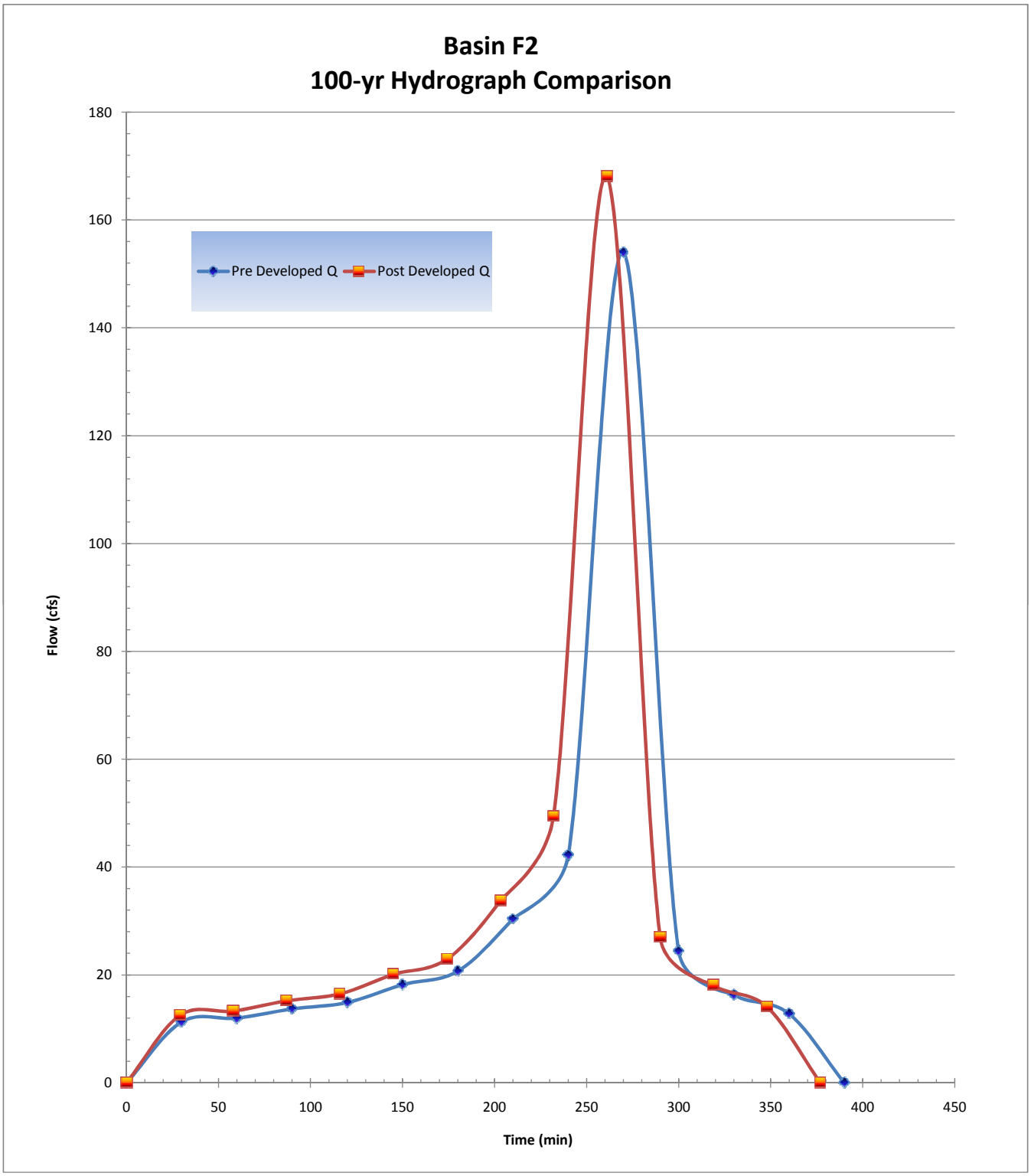
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 113000 | $ft^2$ |
| | A: | 2.59 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 40.34 tons

**Silt Accumulation Basin volume =** **897** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin F2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
180
0
50
100
150
200
250
300
350
400
450

# Basin F2 Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 11.13.09 | WATERSHED: | F2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 457600 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 10.51 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 75% | AT | 0.90 | 0.678 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 25% | AT | 0.55 | 0.136 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.81 |
| $C_{25}$ = | 0.89 |
| $C_{50}$ = | 1.00 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 599.0 | ft | Median to ES |
| LOW POINT ELEVATION | 597.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 113 | ft | to ES |
| SLOPE (S) = (H/L) | 1.8% | | |
| MANNING'S n | 0.016 | | AC < = FROM FIG 816.6A |
| $T_t$ (SFF)= | 2.52 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 597.0 | ft | Flow in Bioswale |
| LOW POINT ELEVATION | 596.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | assumed SCF and not channelized or flowing full yet |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.0 | fps | 0.5% , V FROM FIG 816.6 grass lined |
| $T_C$ (SH)= | 3.33 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 596.0 | ft | Flow in Bioswale |
| LOW POINT ELEVATION | 585.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 11.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 799 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.4% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.01 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 4.42 | minutes | |

# Basin F2 Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 580.0 | ft | Proposed onsite pipe (assumed 5' drop to invert) |
| LOW POINT ELEVATION | 549.0 | ft | Proposed Rip Rap Pad in Basin floor |
| ELEVATION DIFF (H) | 31.0 | ft | |
| LENGTH (L) | 1366 | ft | |
| SLOPE (S) = (H/L) | 2.3% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 10.9 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 2.09 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 12.37 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **12.37** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | **FLOW RESULTS** | **cfs** |
|---|---|---|---|---|---|
| $i_2$ = | 1.6 | in/hr | X CA = | **$Q_2$ =** | 13.8 |
| $i_{10}$ = | 2.4 | in/hr | X CA = | **$Q_{10}$ =** | 20.1 |
| $i_{25}$ = | 2.9 | in/hr | X CA = | **$Q_{25}$ =** | 27.6 |
| $i_{50}$ = | 3.5 | in/hr | X CA = | **$Q_{50}$ =** | 37.0 |
| $i_{100}$ = | 3.7 | in/hr | X CA = | **$Q_{100}$ =** | **38.6** |

**COUNTY $P_6$**

| | **inches** |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin F2 Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **110+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **11.17.09** | **WATERSHED:** | **F2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 38.6 | cfs | $C_{100}$= | 1.00 | |
| Tc= | 12.4 | min | A= | 10.51 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 12 | 1152 | 1.6 |
| 24 | 1152 | 1.6 |
| 36 | 1224 | 1.7 |
| 48 | 1224 | 1.7 |
| 60 | 1296 | 1.8 |
| 72 | 1368 | 1.9 |
| 84 | 1440 | 2 |
| 96 | 1512 | 2.1 |
| 108 | 1584 | 2.2 |
| 120 | 1656 | 2.3 |
| 132 | 1800 | 2.5 |
| 144 | 1872 | 2.6 |
| 156 | 2088 | 2.9 |
| 168 | 2232 | 3.1 |
| 180 | 2520 | 3.5 |
| 192 | 2736 | 3.8 |
| 204 | 3384 | 4.7 |
| 216 | 3816 | 5.3 |
| 228 | 5616 | 7.8 |
| 240 | 8424 | 11.7 |
| 252 | 27792 | 38.6 |
| 264 | 4536 | 6.3 |
| 276 | 3024 | 4.2 |
| 288 | 2376 | 3.3 |
| 300 | 1944 | 2.7 |
| 312 | 1728 | 2.4 |
| 324 | 1512 | 2.1 |
| 336 | 1368 | 1.9 |
| 348 | 1296 | 1.8 |
| 360 | 1152 | 1.6 |
| 372 | 0 | 0 |

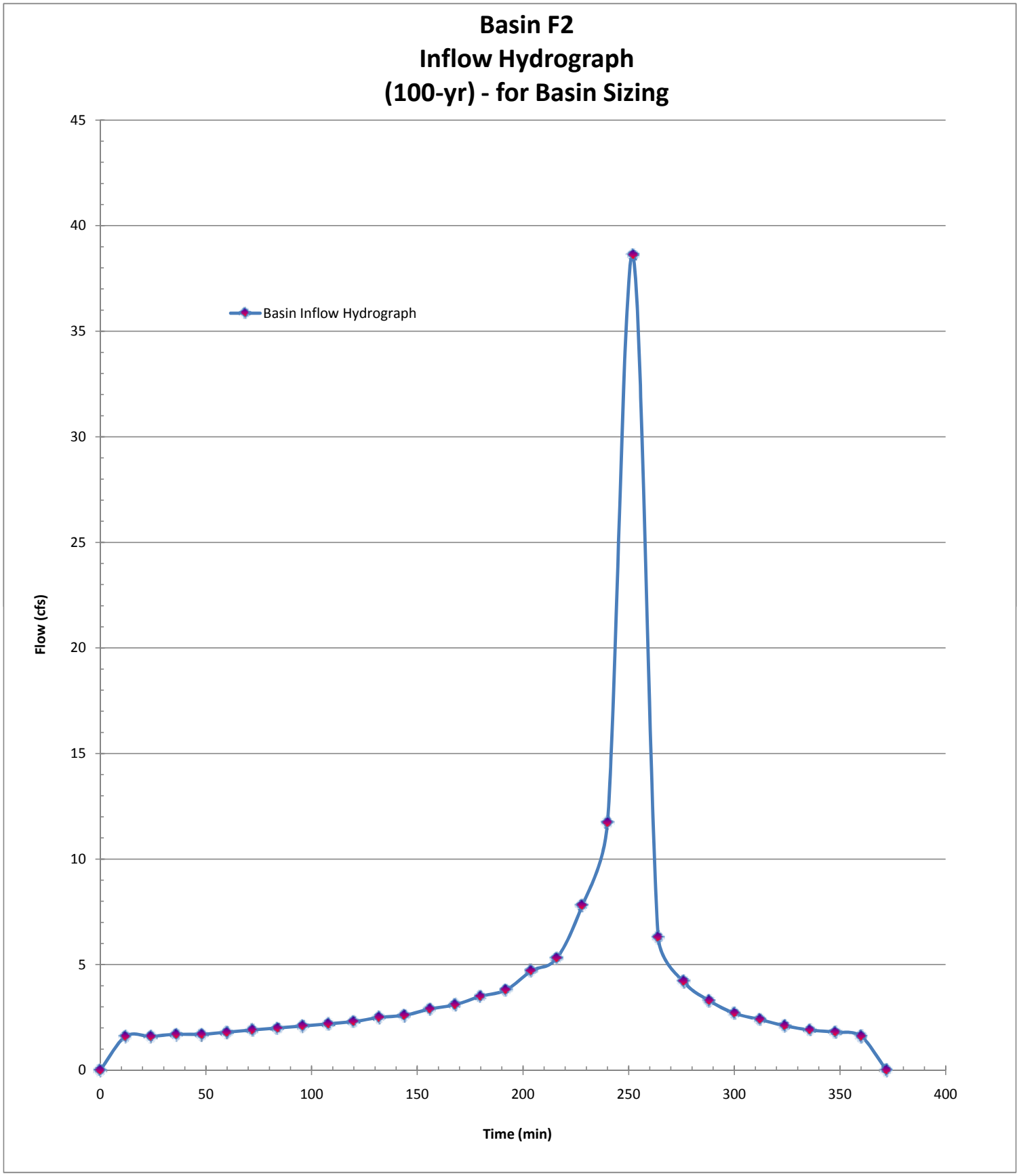
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM=** **94824** **$ft^3$**
**2.18** **acre-feet**

Onsite Runoff Volume

Check: $V = C*A*P_6$
V= 2.19 acre-feet
***OK***


Basin F2
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
5
10
15
20
25
30
35
40
45
0
50
100
150
200
250
300
350
400

# Basin F2 Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **113+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **F2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin Outlet** |

***Notes:***

Required Retention Basin Volume = 48243 $ft^3$

Actual Basin Inflow = 94824 $ft^3$ *OK*

***Flow Balance - determine maximum flow from basin***

| | | | | | |
|---|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 154.0 | cfs | | | |
| Post-Developed Peak Flow through Cross Culvert: | 128.4 | cfs | ~ | Includes: | F2.8.SL |
| Flow that does not reach detention basin (bypass per DA table): | 3.7 | cfs | ~ | $Q_{100}$ from: | F2.9.SL |
| Maximum flow allowed to be released by this detention basin: | 21.9 | cfs | | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 558.00 | ft |
| Basin flowline elevation = | 552.00 | ft |
| Maximum Basin Depth = | 6.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.00 | ft | 554.00 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 265 | ft |
| Base Width (W) | 85 | ft |
| W/L Ratio ® | 0.32 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 190229 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 552.00 | 0.00 | 0 | 0 | | 552.00 | 0.00 | | 0.00 |
| 1 | 552.20 | 0.20 | 4561 | 4561 | | 552.20 | 0.00 | | 0.00 |
| 2 | 552.40 | 0.40 | 4674 | 9235 | | 552.40 | 0.00 | | 0.00 |
| 3 | 552.60 | 0.60 | 4788 | 14023 | | 552.60 | 0.00 | | 0.00 |
| 4 | 552.80 | 0.80 | 4903 | 18927 | | 552.80 | 0.00 | | 0.00 |
| 5 | 553.00 | 1.00 | 5019 | 23946 | | 553.00 | 0.00 | | 0.00 |
| 6 | 553.20 | 1.20 | 5137 | 29083 | | 553.20 | 0.00 | | 0.00 |
| 7 | 553.40 | 1.40 | 5255 | 34338 | | 553.40 | 0.00 | | 0.00 |
| 8 | 553.60 | 1.60 | 5374 | 39712 | | 553.60 | 0.00 | | 0.00 |
| 9 | 553.80 | 1.80 | 5494 | 45206 | | 553.80 | 0.00 | | 0.00 |
| 10 | 554.00 | 2.00 | 5616 | 50822 | * | 554.00 | 0.00 | 0.00 | 0.00 |
| 11 | 554.20 | 2.20 | 5738 | 56560 | | 554.20 | 0.15 | | 0.15 |
| 12 | 554.40 | 2.40 | 5862 | 62422 | | 554.40 | 0.59 | | 0.59 |
| 13 | 554.60 | 2.60 | 5986 | 68408 | | 554.60 | 1.30 | | 1.30 |
| 14 | 554.80 | 2.80 | 6112 | 74519 | | 554.80 | 2.25 | | 2.25 |
| 15 | 555.00 | 3.00 | 6238 | 80757 | | 555.00 | 3.42 | | 3.42 |
| 16 | 555.20 | 3.20 | 6366 | 87123 | | 555.20 | 4.79 | | 4.79 |
| 17 | 555.40 | 3.40 | 6494 | 93618 | | 555.40 | 6.32 | | 6.32 |
| 18 | 555.60 | 3.60 | 6624 | 100242 | | 555.60 | 7.99 | | 7.99 |
| 19 | 555.80 | 3.80 | 6755 | 106997 | | 555.80 | 9.77 | | 9.77 |
| 20 | 556.00 | 4.00 | 6887 | 113883 | | 556.00 | 11.63 | | 11.63 |

# Basin F2 Routing

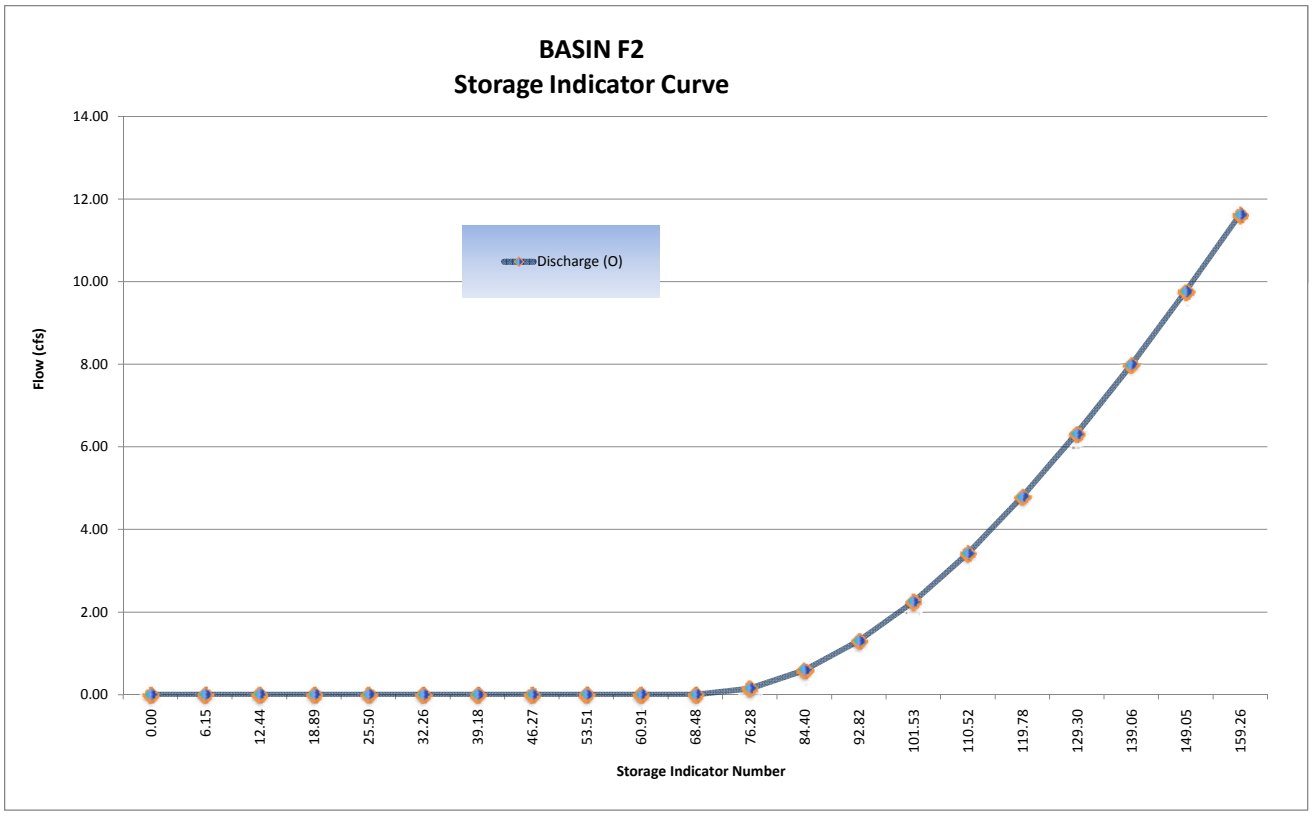
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 110+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | F |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin F2 |

user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 552.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 552.20 | 0.00 | 4561 | 0.00 | 6.15 | 6.15 |
| 552.40 | 0.00 | 9235 | 0.00 | 12.44 | 12.44 |
| 552.60 | 0.00 | 14023 | 0.00 | 18.89 | 18.89 |
| 552.80 | 0.00 | 18927 | 0.00 | 25.50 | 25.50 |
| 553.00 | 0.00 | 23946 | 0.00 | 32.26 | 32.26 |
| 553.20 | 0.00 | 29083 | 0.00 | 39.18 | 39.18 |
| 553.40 | 0.00 | 34338 | 0.00 | 46.27 | 46.27 |
| 553.60 | 0.00 | 39712 | 0.00 | 53.51 | 53.51 |
| 553.80 | 0.00 | 45206 | 0.00 | 60.91 | 60.91 |
| 554.00 | 0.00 | 50822 | 0.00 | 68.48 | 68.48 |
| 554.20 | 0.15 | 56560 | 0.08 | 76.21 | 76.28 |
| 554.40 | 0.59 | 62422 | 0.30 | 84.10 | 84.40 |
| 554.60 | 1.30 | 68408 | 0.65 | 92.17 | 92.82 |
| 554.80 | 2.25 | 74519 | 1.13 | 100.40 | 101.53 |
| 555.00 | 3.42 | 80757 | 1.71 | 108.81 | 110.52 |
| 555.20 | 4.79 | 87123 | 2.40 | 117.39 | 119.78 |
| 555.40 | 6.32 | 93618 | 3.16 | 126.14 | 129.30 |
| 555.60 | 7.99 | 100242 | 4.00 | 135.06 | 139.06 |
| 555.80 | 9.77 | 106997 | 4.89 | 144.16 | 149.05 |
| 556.00 | 11.63 | 113883 | 5.82 | 153.44 | 159.26 |

| | | |
|---|---|---|
| delta t = | 0.21 | hrs |
| delta t = | 12 | min |
| delta t = | 742.1936 | sec |



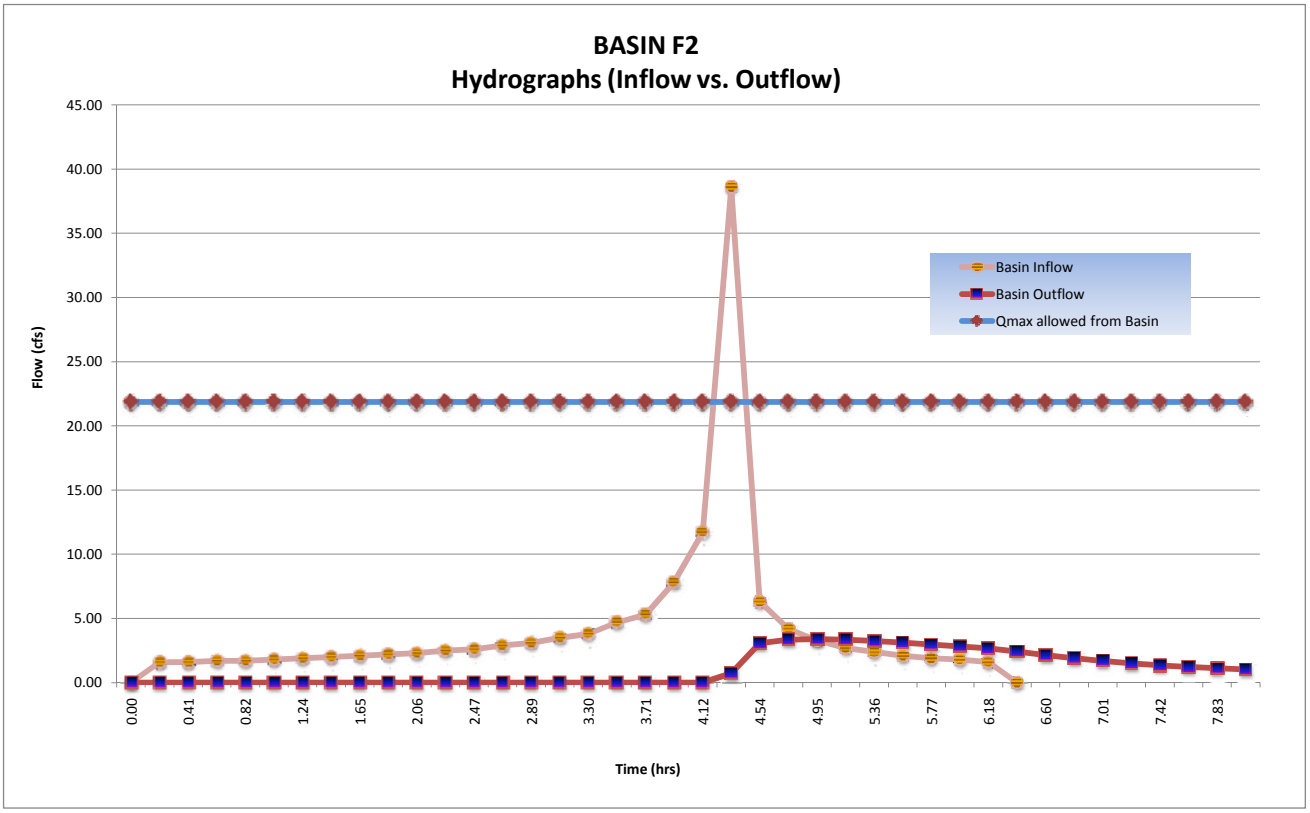
# Basin F2 Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} - \frac{O_2}{2}\right)$$

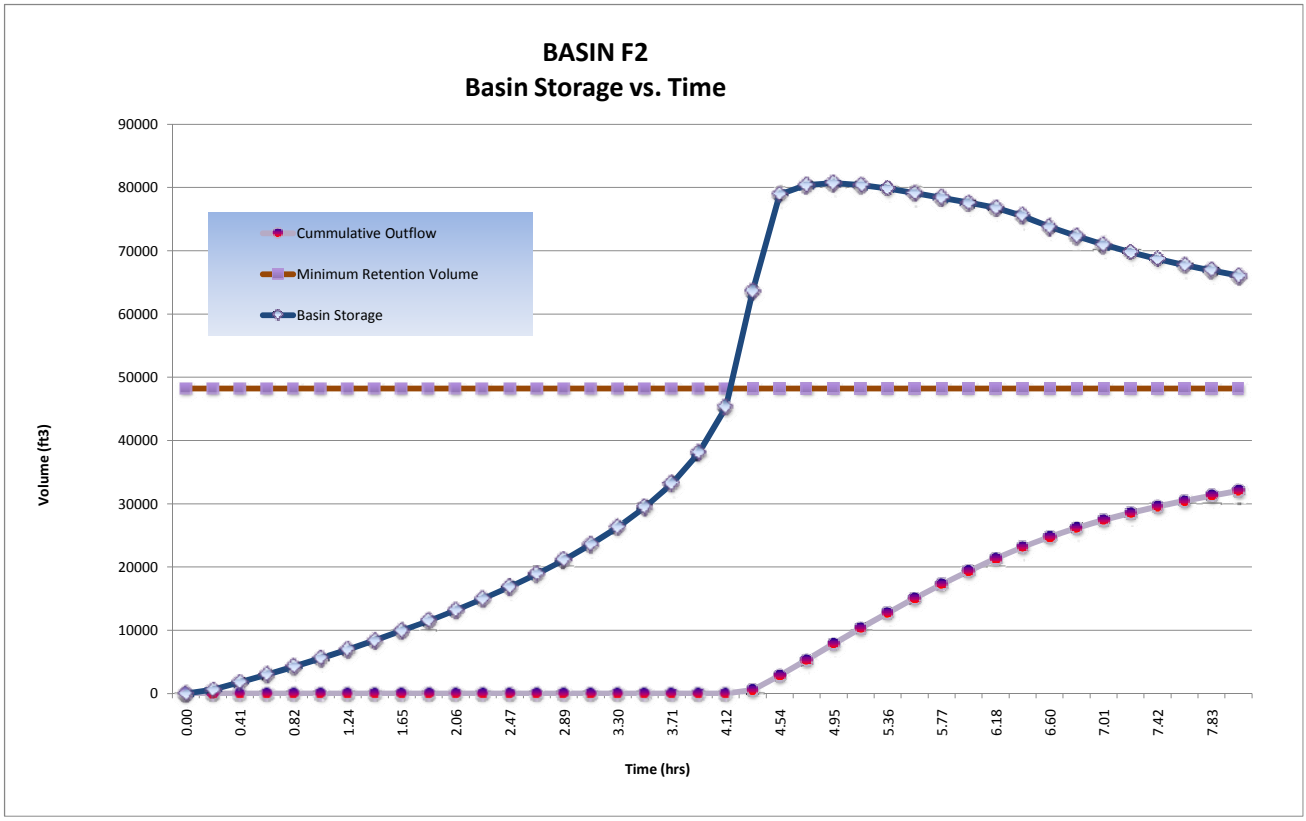
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.21 | 1.60 | 0.80 | 0.00 | 0.00 | 0.80 | 0.00 | 594 | 0 | 0 |
| 0.41 | 1.60 | 1.60 | 0.80 | 0.00 | 2.40 | 0.00 | 1781 | 0 | 0 |
| 0.62 | 1.70 | 1.65 | 2.40 | 0.00 | 4.05 | 0.00 | 3006 | 0 | 0 |
| 0.82 | 1.70 | 1.70 | 4.05 | 0.00 | 5.75 | 0.00 | 4268 | 0 | 0 |
| 1.03 | 1.80 | 1.75 | 5.75 | 0.00 | 7.50 | 0.00 | 5566 | 0 | 0 |
| 1.24 | 1.90 | 1.85 | 7.50 | 0.00 | 9.35 | 0.00 | 6940 | 0 | 0 |
| 1.44 | 2.00 | 1.95 | 9.35 | 0.00 | 11.30 | 0.00 | 8387 | 0 | 0 |
| 1.65 | 2.10 | 2.05 | 11.30 | 0.00 | 13.35 | 0.00 | 9908 | 0 | 0 |
| 1.86 | 2.20 | 2.15 | 13.35 | 0.00 | 15.50 | 0.00 | 11504 | 0 | 0 |
| 2.06 | 2.30 | 2.25 | 15.50 | 0.00 | 17.75 | 0.00 | 13174 | 0 | 0 |
| 2.27 | 2.50 | 2.40 | 17.75 | 0.00 | 20.15 | 0.00 | 14955 | 0 | 0 |
| 2.47 | 2.60 | 2.55 | 20.15 | 0.00 | 22.70 | 0.00 | 16848 | 0 | 0 |
| 2.68 | 2.90 | 2.75 | 22.70 | 0.00 | 25.45 | 0.00 | 18889 | 0 | 0 |
| 2.89 | 3.10 | 3.00 | 25.45 | 0.00 | 28.45 | 0.00 | 21115 | 0 | 0 |
| 3.09 | 3.50 | 3.30 | 28.45 | 0.00 | 31.75 | 0.00 | 23565 | 0 | 0 |
| 3.30 | 3.80 | 3.65 | 31.75 | 0.00 | 35.40 | 0.00 | 26274 | 0 | 0 |
| 3.50 | 4.70 | 4.25 | 35.40 | 0.00 | 39.65 | 0.00 | 29428 | 0 | 0 |
| 3.71 | 5.30 | 5.00 | 39.65 | 0.00 | 44.65 | 0.00 | 33139 | 0 | 0 |
| 3.92 | 7.80 | 6.55 | 44.65 | 0.00 | 51.20 | 0.00 | 38000 | 0 | 0 |
| 4.12 | 11.70 | 9.75 | 51.20 | 0.00 | 60.95 | 0.00 | 45237 | 0 | 0 |
| 4.33 | 38.60 | 25.15 | 60.95 | 0.00 | 86.10 | 0.73 | 63632 | 542 | 542 |
| 4.54 | 6.30 | 22.45 | 86.10 | 0.73 | 107.82 | 3.07 | 78884 | 2279 | 2820 |
| 4.74 | 4.20 | 5.25 | 107.82 | 3.07 | 110.00 | 3.35 | 80398 | 2486 | 5307 |
| 4.95 | 3.30 | 3.75 | 110.00 | 3.35 | 110.40 | 3.40 | 80676 | 2523 | 7830 |
| 5.15 | 2.70 | 3.00 | 110.40 | 3.40 | 110.00 | 3.35 | 80398 | 2486 | 10316 |
| 5.36 | 2.40 | 2.55 | 110.00 | 3.35 | 109.20 | 3.25 | 79841 | 2412 | 12729 |
| 5.57 | 2.10 | 2.25 | 109.20 | 3.25 | 108.20 | 3.12 | 79148 | 2316 | 15044 |
| 5.77 | 1.90 | 2.00 | 108.20 | 3.12 | 107.08 | 2.97 | 78372 | 2204 | 17249 |
| 5.98 | 1.80 | 1.85 | 107.08 | 2.97 | 105.96 | 2.83 | 77593 | 2100 | 19349 |
| 6.18 | 1.60 | 1.70 | 105.96 | 2.83 | 104.83 | 2.68 | 76810 | 1989 | 21338 |
| 6.39 | 0.00 | 0.80 | 104.83 | 2.68 | 102.95 | 2.43 | 75507 | 1804 | 23142 |
| 6.60 | | 0.00 | 102.95 | 2.43 | 100.52 | 2.14 | 73811 | 1588 | 24730 |
| 6.80 | | 0.00 | 100.52 | 2.14 | 98.38 | 1.91 | 72308 | 1418 | 26147 |
| 7.01 | | 0.00 | 98.38 | 1.91 | 96.47 | 1.70 | 70969 | 1262 | 27409 |
| 7.22 | | 0.00 | 96.47 | 1.70 | 94.77 | 1.51 | 69777 | 1121 | 28530 |
| 7.42 | | 0.00 | 94.77 | 1.51 | 93.26 | 1.35 | 68716 | 1002 | 29532 |
| 7.63 | | 0.00 | 93.26 | 1.35 | 91.91 | 1.22 | 67762 | 905 | 30437 |
| 7.83 | | 0.00 | 91.91 | 1.22 | 90.69 | 1.12 | 66894 | 831 | 31269 |
| 8.04 | | 0.00 | 90.69 | 1.12 | 89.57 | 1.03 | 66096 | 764 | 32033 |

## Basin F2 Routing



## Basin F2 Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **80,676** | **$ft^3$** | |
| **@ Stage:** | **555.00** | **ft** | |
| **Freeboard:** | **3.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **190,229** | **$ft^3$** | Basin **F2** |
| **Maximum flow rate released from this basin:** | **3.40** | **cfs** | |

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# G2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **Onsite Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **1.11.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

PAVED

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| G2.1.PV | 0.99 | 48800 | 1.1 | 5 | 4.0 | 4.44 | 6.6 | 7.31 | ~ | G2.1 | Basin G2 North | 127+00 | Rt |
| G2.2.PV | 0.99 | 52300 | 1.2 | 5 | 4.0 | 4.76 | 6.6 | 7.83 | ~ | G2.2 | Basin G2 North | 121+00 | Center |
| G2.3.PV | 0.99 | 46100 | 1.1 | 5 | 4.0 | 4.19 | 6.6 | 6.90 | ~ | G2.3 | Basin G2 North | 127+00 | Center |
| G2.4.PV | 0.99 | 28600 | 0.7 | 5 | 4.0 | 2.60 | 6.6 | 4.28 | ~ | G2.4 | Basin G2 North | 131+50 | Center |
| G2.5.PV | 0.99 | 45900 | 1.1 | 5 | 4.0 | 4.17 | 6.6 | 6.87 | ~ | G2.5 | Basin G2 South | 139+00 | Lt |
| G2.6.PV | 0.99 | 25800 | 0.6 | 5 | 4.0 | 2.35 | 6.6 | 3.86 | ~ | G2.6 | Basin G2 South | 139+00 | Rt |
| G2.7.PV | 0.99 | 11200 | 0.3 | 5 | 4.0 | 1.02 | 6.6 | 1.68 | ~ | G2.7 | Basin G2 South | 135+00 | Rt |
| G2.8.PV | 0.99 | 21200 | 0.5 | 5 | 4.0 | 1.93 | 6.6 | 3.17 | ~ | G2.8 | Basin G2 South | 131+80 | SDR2 |
| G2.9.PV | 0.99 | 38500 | 0.9 | 10 | 2.8 | 2.48 | 4.2 | 3.69 | G2.9 | G2.9 | Basin G2 South | 135+00 | SV2 |
| G2.10.PV | 0.99 | 30300 | 0.7 | 5 | 4.0 | 2.76 | 6.6 | 4.54 | ~ | G2.10 | Basin G2 North | 131+50 | Rt |
| G2.11.PV | 0.99 | 6100 | 0.1 | 5 | 4.0 | 0.55 | 6.6 | 0.91 | ~ | G2.11 | Basin G2 North | 131+50 | SV2 |
| G2.12.PV | 0.99 | 26200 | 0.6 | 5 | 4.0 | 2.38 | 6.6 | 3.92 | ~ | G2.12 | Basin G2 North | 105+00 | SV1 |
| G2.13.PV | 0.99 | 23000 | 0.5 | 5 | 4.0 | 2.09 | 6.6 | 3.44 | ~ | G2.13 | Basin G2 North | 105+00 | SV1 |
| G2.14.PV | 0.99 | 18000 | 0.4 | 5 | 4.0 | 1.64 | 6.6 | 2.69 | ~ | G2.14 | Basin G2 North | 102+00 | SV1 |
| G2.15.PV | 0.99 | 16700 | 0.4 | 5 | 4.0 | 1.52 | 6.6 | 2.50 | ~ | G2.15 | Basin G2 North | 102+00 | SV1 |
| G2.16.PV | 0.99 | 37300 | 0.9 | 5 | 4.0 | 3.39 | 6.6 | 5.58 | ~ | G2.16 | Basin G2 South | 139+00 | SDR2 |
| G2.17.PV | 0.99 | 63400 | 1.5 | 5 | 4.0 | 5.76 | 6.6 | 9.49 | ~ | G2.17 | Basin G2 South | 139+00 | SV2 |
| G2.18.PV | 0.99 | 75300 | 1.7 | 5 | 4.0 | 6.85 | 6.6 | 11.27 | ~ | G2.18 | Basin G2 South | Toll 1 Bldg | ~ |
| G2.19.PV | 0.99 | 59500 | 1.4 | 5 | 4.0 | 5.41 | 6.6 | 8.91 | ~ | G2.19 | Basin G2 South | Toll 2 Prkg | ~ |
| G2.20.PV | 0.99 | 89500 | 2.1 | 10 | 2.8 | 5.75 | 4.2 | 8.57 | G2.20 | G2.20 | Basin G2 North | 123+00 | SDR2 |
| G2.21.PV | 0.99 | 38100 | 0.9 | 5 | 4.0 | 3.46 | 6.6 | 5.70 | ~ | G2.21 | Basin G2 North | 114+00 | SV4 |
| G2.22.PV | 0.99 | 11000 | 0.3 | 5 | 4.0 | 1.00 | 6.6 | 1.65 | ~ | G2.22 | Basin G2 South | 100+00 | SV1 |
| G2.23.PV | 0.99 | 11000 | 0.3 | 5 | 4.0 | 1.00 | 6.6 | 1.65 | ~ | G2.23 | Basin G2 South | 100+00 | SV1 |
| G2.27.PV | 0.99 | 34900 | 0.8 | 5 | 4.0 | 3.17 | 6.6 | 5.22 | ~ | ~ | bypass* | 96+50 | SV1 |

Σ 858700 *PAVED*

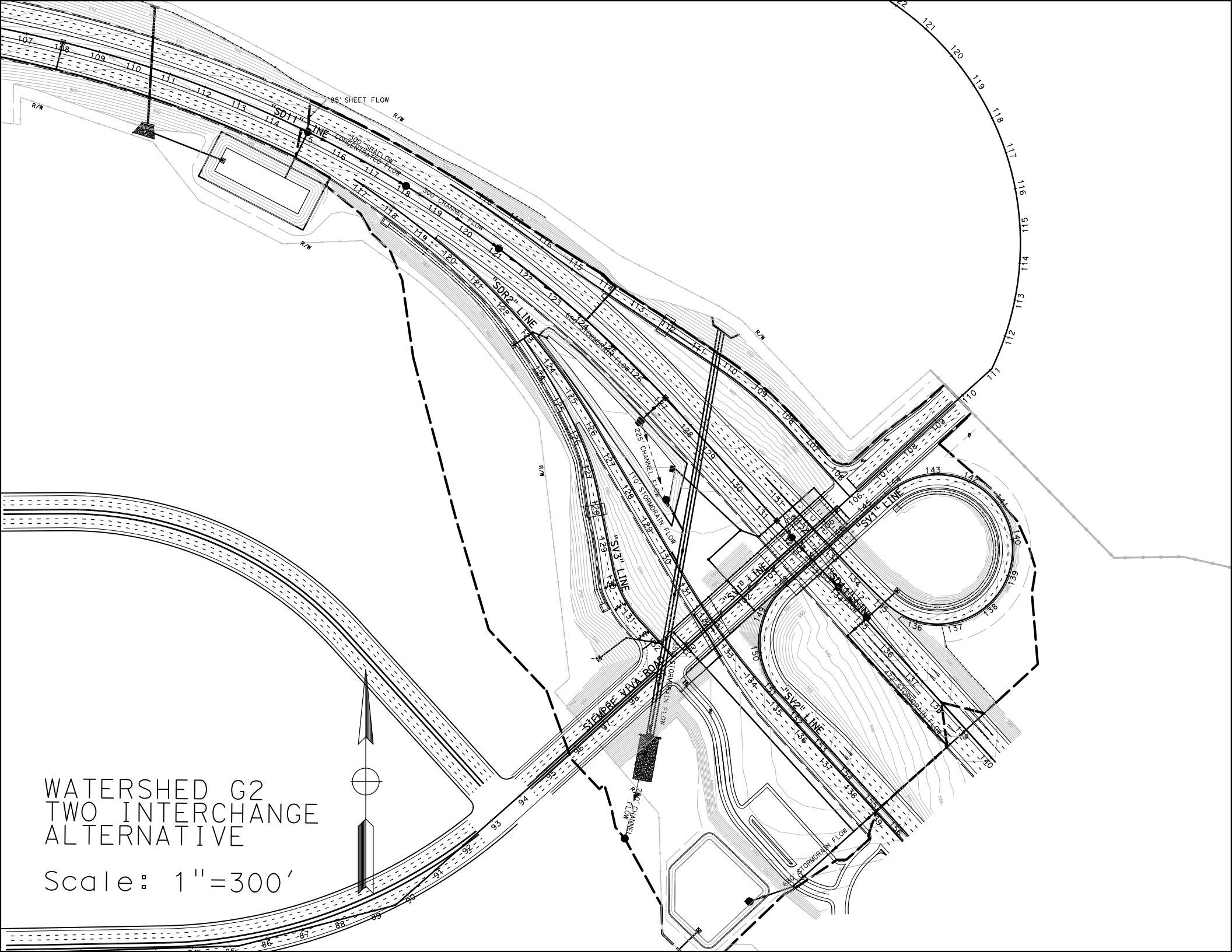
SLOPE

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| G2.5.SL | 0.61 | 14900 | 0.3 | 10 | 2.8 | 0.59 | 4.2 | 0.88 | ~ | G2.5 | Basin G2 South | 139+00 | Lt |
| G2.6.SL | 0.61 | 71700 | 1.6 | 10 | 2.8 | 2.84 | 4.2 | 4.23 | ~ | G2.6 | Basin G2 South | 139+00 | Rt |
| G2.7.SL | 0.61 | 30300 | 0.7 | 10 | 2.8 | 1.20 | 4.2 | 1.79 | ~ | G2.7 | Basin G2 South | 135+00 | Rt |
| G2.8.SL | 0.61 | 48800 | 1.1 | 10 | 2.8 | 1.93 | 4.2 | 2.88 | ~ | G2.8 | Basin G2 South | 131+80 | SDR2 |
| G2.9.SL | 0.61 | 92200 | 2.1 | 10 | 2.8 | 3.65 | 4.2 | 5.44 | G2.9 | G2.9 | Basin G2 South | 135+00 | SV2 |
| G2.11.SL | 0.61 | 56700 | 1.3 | 10 | 2.8 | 2.25 | 4.2 | 3.34 | ~ | G2.11 | Basin G2 North | 131+50 | SV2 |
| G2.20.SL | 0.61 | 63000 | 1.4 | 10 | 2.8 | 2.50 | 4.2 | 3.72 | G2.20 | G2.20 | Basin G2 North | 123+00 | SDR2 |
| G2.24.SL | 0.61 | 56700 | 1.3 | 10 | 2.8 | 2.25 | 4.2 | 3.34 | ~ | G2.24 | Basin G2 South | 139+00 | Lt |
| G2.25.SL | 0.61 | 132900 | 3.1 | 10 | 2.8 | 5.26 | 4.2 | 7.84 | ~ | G2.25 | Basin G2 North | 130+50 | SDR2 |
| G2.26.SL | 0.61 | 101200 | 2.3 | 10 | 2.8 | 4.01 | 4.2 | 5.97 | ~ | G2.26 | Basin G2 South | 135+00 | Rt |
| G2.27.SL | 0.61 | 74200 | 1.7 | 10 | 2.8 | 2.94 | 4.2 | 4.38 | ~ | ~ | bypass* | 96+50 | SV1 |

Σ 742600 *SLOPE*

* flow that does not reach the basin

| | | |
|---|---|---|
| Total : | 1601300 | 36.8 |
| | *SF* | *ac* |


WATERSHED G2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=300'
"SD11" LINE
85' SHEET FLOW
300' SHALLOW CONCENTRATED FLOW
300' CHANNEL FLOW
"SDR2" LINE
60' STORMDRAIN FLOW
225' CHANNEL FLOW
110' STORMDRAIN FLOW
"SV3" LINE
"SV1" LINE
"SV2" LINE
"SV4" LINE
"SV1" LINE
SIEMPRE VIVA ROAD
STORMDRAIN FLOW
200' CHANNEL FLOW
STORMDRAIN FLOW
R/W

# G2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 1.11.10 | WATERSHED: | G2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Two Interchange Option |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1974747 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 45.33 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.12 | Relatively Flat ~ 4% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - see Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.39 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 19% | AT | 0.39 | 0.074 |
| PAVED SURFACE | 43% | AT | 0.90 | 0.391 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 38% | AT | 0.55 | 0.207 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.67 |
| $C_{25}$ = | 0.74 |
| $C_{50}$ = | 0.81 |
| $C_{100}$ = | 0.84 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 569.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 564.0 | ft | |
| ELEVATION DIFF (H) | 5.0 | ft | |
| LENGTH (L) | 85 | ft | |
| SLOPE (S) = (H/L) | 5.9% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.24 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 564.0 | ft | within median, low flows, not 'channel' |
| LOW POINT ELEVATION | 561.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 300 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 4.00 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 561.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 4.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.3% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.12 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.35 | minutes | |

# G2 Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft | Proposed storm drain through median (elev at pipe invert) |
| LOW POINT ELEVATION | 542.0 | ft | Sta 127+00 |
| ELEVATION DIFF (H) | 10.0 | ft | |
| LENGTH (L) | 690 | ft | |
| SLOPE (S) = (H/L) | 1.4% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 8.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.32 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 542.0 | ft | Detention basin (low flow channel) |
| LOW POINT ELEVATION | 540.0 | ft | CHANNEL DATA — TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 2.0 | ft | Z= 4 — ANG-RAD — 0.245 |
| LENGTH (L) | 225 | ft | b = 0 — ANG-DEG — 14.036 |
| SLOPE (S) = (H/L) | 0.9% | | d = 1 — FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 1.73 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.16 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 540.0 | ft | Proposed storm drain connecting to cross culvert |
| LOW POINT ELEVATION | 534.0 | ft | Sta 135+00 |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 110 | ft | |
| SLOPE (S) = (H/L) | 5.5% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 16.9 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.11 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 534.0 | ft | Proposed RCB |
| LOW POINT ELEVATION | 523.0 | ft | Outlet |
| ELEVATION DIFF (H) | 11.0 | ft | |
| LENGTH (L) | 550 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 4.0 | ft | |
| HYDRAULIC RADIUS R | 1.0 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 16.2 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.57 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 523.0 | ft | RCP to confluence point |
| LOW POINT ELEVATION | 515.0 | ft | CHANNEL DATA — TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 8.0 | ft | Z= 4 — ANG-RAD — 0.245 |
| LENGTH (L) | 280 | ft | b = 2 — ANG-DEG — 14.036 |
| SLOPE (S) = (H/L) | 2.9% | | d = 1 — FLOWING FULL ASS'M |
| MANNING'S n | 0.055 | | HDM Table 864.3A, Depressed Median - Earth (with growth) and RCP |
| HYDRAULIC RADIUS R | 0.6 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.21 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 1.46 | minutes | |

# G2 Post-Developed TcQ

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 13.21 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **13.21** | minutes |

**INTENSITY CHART:**

$$I = 7.44\ P_6\ D^{-0.645}$$

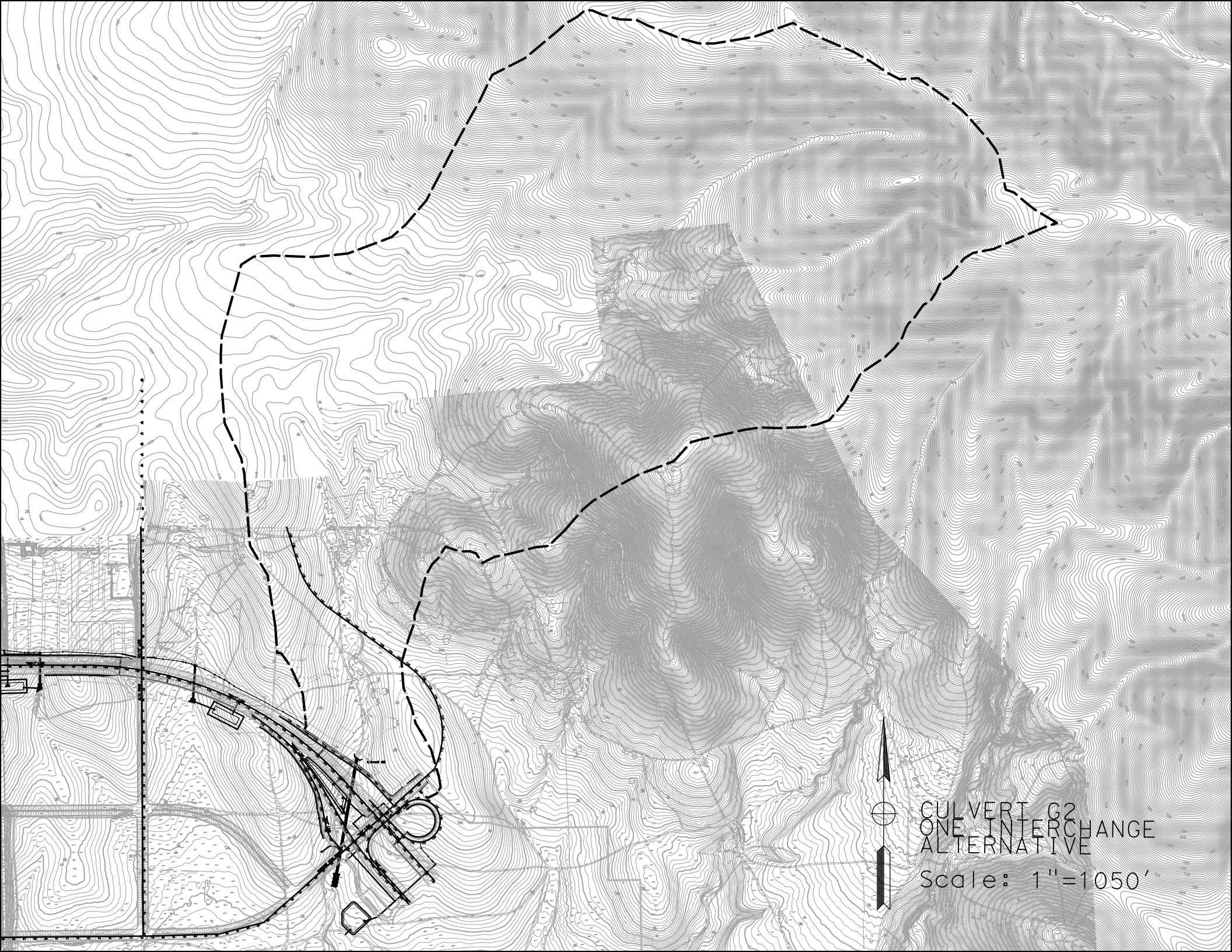
| | | | |
|---|---|---|---|
| $i_2$ = | 1.5 | in/hr | X CA = |
| $i_{10}$ = | 2.3 | in/hr | X CA = |
| $i_{25}$ = | 2.8 | in/hr | X CA = |
| $i_{50}$ = | 3.4 | in/hr | X CA = |
| $i_{100}$ = | 3.5 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 47.2 |
| **$Q_{10}$ =** | 68.6 |
| **$Q_{25}$ =** | 94.3 |
| **$Q_{50}$ =** | 123.5 |
| **$Q_{100}$ =** | **134.0** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


CULVERT G2
ONE INTERCHANGE
ALTERNATIVE
Scale: 1"=1050'

# Culvert Calculator Report
## G2 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 548.00 | ft | Headwater Depth/Height | 1.85 | |
| Computed Headwater Elevation | 547.39 | ft | Discharge | 658.00 | cfs |
| Inlet Control HW Elev. | 547.39 | ft | Tailwater Elevation | 518.04 | ft |
| Outlet Control HW Elev. | 546.56 | ft | Control Type | Inlet Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 540.00 | ft | Downstream Invert | 516.00 | ft |
| Length | 1,150.00 | ft | Constructed Slope | 2.1 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 2.04 | ft |
| Slope Type | Steep | | Normal Depth | 2.04 | ft |
| Flow Regime | Supercritical | | Critical Depth | 3.75 | ft |
| Velocity Downstream | 20.17 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Box | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 8.00 | ft |
| Section Size | 8 x 4 ft | | Rise | 4.00 | ft |
| Number Sections | 2 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 546.56 | ft | Upstream Velocity Head | 1.87 | ft |
| Ke | 0.50 | | Entrance Loss | 0.94 | ft |

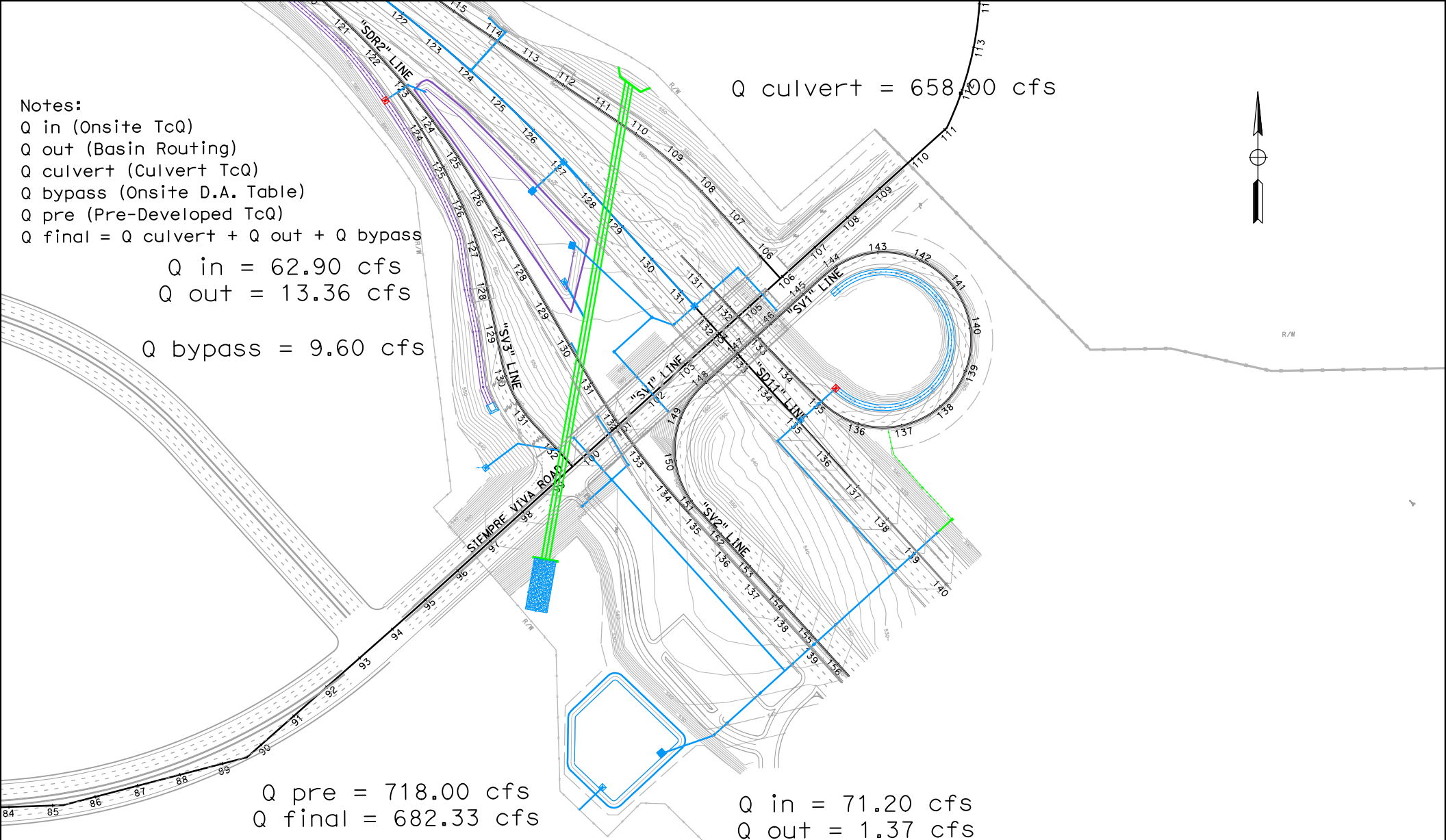
| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 547.39 | ft | Flow Control | Submerged | |
| Inlet Type | 90 and 15° wingwall flares | | Area Full | 64.0 | $ft^2$ |
| K | 0.06100 | | HDS 5 Chart | 8 | |
| M | 0.75000 | | HDS 5 Scale | 2 | |
| C | 0.04000 | | Equation Form | 1 | |
| Y | 0.80000 | | | | |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass

Q in = 62.90 cfs
Q out = 13.36 cfs

Q bypass = 9.60 cfs

Q culvert = 658.00 cfs




Q pre = 718.00 cfs
Q final = 682.33 cfs

Q in = 71.20 cfs
Q out = 1.37 cfs

BASIN G2
FLOW SUMMARY

Scale: 1"=300'

# Basin G2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.11.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Two Interchange Option** |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 60.0 | cfs | | | |
| Tc= | 17.0 | min | C= | 0.49 | |
| $P_{100,6}$= | 2.5 | in | A= | 41.08 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 17 | 3060 | 3 |
| 34 | 3162 | 3.1 |
| 51 | 3468 | 3.4 |
| 68 | 3570 | 3.5 |
| 85 | 3876 | 3.8 |
| 102 | 4080 | 4 |
| 119 | 4488 | 4.4 |
| 136 | 4794 | 4.7 |
| 153 | 5508 | 5.4 |
| 170 | 5916 | 5.8 |
| 187 | 7242 | 7.1 |
| 204 | 8262 | 8.1 |
| 221 | 12138 | 11.9 |
| 238 | 17340 | 17 |
| 255 | 61200 | 60 |
| 272 | 9792 | 9.6 |
| 289 | 6528 | 6.4 |
| 306 | 5100 | 5 |
| 323 | 4284 | 4.2 |
| 340 | 3672 | 3.6 |
| 357 | 3366 | 3.3 |
| 374 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 180846 $ft^3$**
**4.15 acre-feet**

Check: V = C*A*$P_6$
V= 4.17 acre-feet
***OK***

# Basin G2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 134.0 | cfs | | | |
| Tc= | 13.2 | min | C= | 0.84 | |
| $P_{100,6}$= | 2.5 | in | A= | 45.33 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 0 | 0 |
| 26 | 4524 | 5.8 |
| 39 | 4680 | 6 |
| 52 | 4914 | 6.3 |
| 65 | 5070 | 6.5 |
| 78 | 5382 | 6.9 |
| 91 | 5538 | 7.1 |
| 104 | 5928 | 7.6 |
| 117 | 6162 | 7.9 |
| 130 | 6708 | 8.6 |
| 143 | 7020 | 9 |
| 156 | 7800 | 10 |
| 169 | 8268 | 10.6 |
| 182 | 9438 | 12.1 |
| 195 | 10218 | 13.1 |
| 208 | 12480 | 16 |
| 221 | 14274 | 18.3 |
| 234 | 20904 | 26.8 |
| 247 | 30576 | 39.2 |
| 260 | 104520 | 134 |
| 273 | 16770 | 21.5 |
| 286 | 11232 | 14.4 |
| 299 | 8814 | 11.3 |
| 312 | 7332 | 9.4 |
| 325 | 6396 | 8.2 |
| 338 | 5694 | 7.3 |
| 351 | 5148 | 6.6 |
| 364 | 4758 | 6.1 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 340548 $ft^3$**
**7.82 acre-feet**

Check: V = C*A*$P_6$
V= 7.93 acre-feet
***OK***

**7.82**
**- 4.15**
**Retention volume = 3.67 acre-feet = 159702 $ft^3$ Basin Required**

# Basin G2 Retention

**WATER QUALITY VOLUME CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

| | | | |
|---|---|---|---|
| $C_{100}$= | 0.96 | | Max C from North/South Onsite |
| A= | 34.26 | acres | Sum of North/South Onsite Area |
| $WQ_{72}$: | 0.73 | in/area | |

**Water Quality Volume (WQV) =** **90776** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**If this volume is less than retention requirement, do not add volume since WQ is addressed in Retention**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

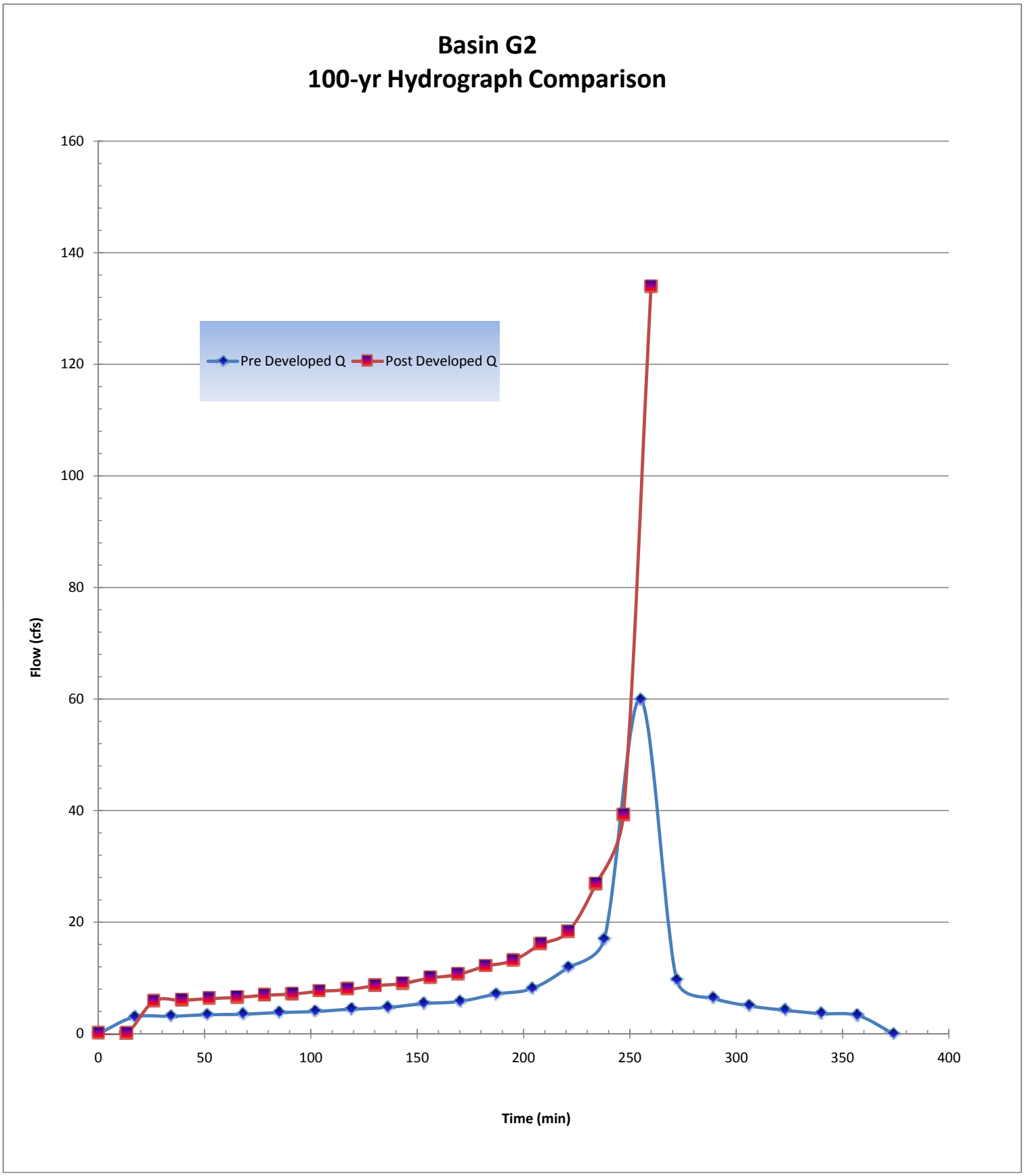
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 668400 | $ft^2$ |
| | A: | 15.34 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 238.64 tons

**Silt Accumulation Basin volume =** **5303** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Basin G2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
300
350
400

# Basin G2-North Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 127+00 |
| BY: | M.BRUNING | DATE: | 01.11.10 | WATERSHED: | G2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G2-North |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 676300 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 15.53 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

NOTES:

| | |
|---|---|
| RELIEF (.08-.35) | 0.00 |
| INFILTRATION (.04-.16) | 0.00 |
| VEGETATION (.04-.16) | 0.00 |
| STORAGE (.04-.12) | 0.00 |
| TOTAL C = | 0.00 |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 63% | AT | 0.90 | 0.564 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 37% | AT | 0.55 | 0.205 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.77 |
| $C_{25}$ = | 0.85 |
| $C_{50}$ = | 0.92 |
| $C_{100}$ = | 0.96 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 569.0 | ft | From asphalt, superelevation |
| LOW POINT ELEVATION | 564.0 | ft | |
| ELEVATION DIFF (H) | 5.0 | ft | |
| LENGTH (L) | 85 | ft | |
| SLOPE (S) = (H/L) | 5.9% | | |
| MANNING'S n | 0.016 | | < = FROM TABLE 816.6A Asphalt Paving |
| $T_t$ (SFF)= | 1.24 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 564.0 | ft | within median, low flows, not 'channel' |
| LOW POINT ELEVATION | 561.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 300 | ft | |
| SLOPE (S) = (H/L) | 1.0% | | |
| VELOCITY (SCF) | 1.3 | fps | <=V FROM FIG 816.5 nearly bare ground |
| $T_C$ (SH)= | 4.00 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 561.0 | ft | median ditch |
| LOW POINT ELEVATION | 557.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 4.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 300 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.3% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.12 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 2.35 | minutes | |

# Basin G2-North Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 552.0 | ft | Proposed storm drain through median (elev at pipe invert) |
| LOW POINT ELEVATION | 542.0 | ft | Sta 127+00 |
| ELEVATION DIFF (H) | 10.0 | ft | |
| LENGTH (L) | 690 | ft | |
| SLOPE (S) = (H/L) | 1.4% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 2.0 | ft | |
| HYDRAULIC RADIUS R | 0.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 8.7 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.32 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 8.92 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 22.1 |
| **$Q_{10}$ =** | 32.2 |
| **$Q_{25}$ =** | 44.3 |
| **$Q_{50}$ =** | 58.0 |
| **$Q_{100}$ =** | **62.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G2North Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **127+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.11.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G2-North** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 62.9 | cfs | $C_{100}$= | 0.96 | |
| Tc= | 10.0 | min | A= | 15.53 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1320 | 2.2 |
| 20 | 1380 | 2.3 |
| 30 | 1440 | 2.4 |
| 40 | 1440 | 2.4 |
| 50 | 1500 | 2.5 |
| 60 | 1560 | 2.6 |
| 70 | 1620 | 2.7 |
| 80 | 1680 | 2.8 |
| 90 | 1740 | 2.9 |
| 100 | 1800 | 3 |
| 110 | 1920 | 3.2 |
| 120 | 1980 | 3.3 |
| 130 | 2100 | 3.5 |
| 140 | 2220 | 3.7 |
| 150 | 2400 | 4 |
| 160 | 2520 | 4.2 |
| 170 | 2760 | 4.6 |
| 180 | 2940 | 4.9 |
| 190 | 3360 | 5.6 |
| 200 | 3660 | 6.1 |
| 210 | 4440 | 7.4 |
| 220 | 5100 | 8.5 |
| 230 | 7440 | 12.4 |
| 240 | 10440 | 17.4 |
| 250 | 37740 | 62.9 |
| 260 | 6000 | 10 |
| 270 | 4020 | 6.7 |
| 280 | 3120 | 5.2 |
| 290 | 2640 | 4.4 |
| 300 | 2280 | 3.8 |
| 310 | 2040 | 3.4 |
| 320 | 1860 | 3.1 |
| 330 | 1680 | 2.8 |
| 340 | 1560 | 2.6 |
| 350 | 1500 | 2.5 |
| 360 | 1380 | 2.3 |
| 370 | 0 | 0 |

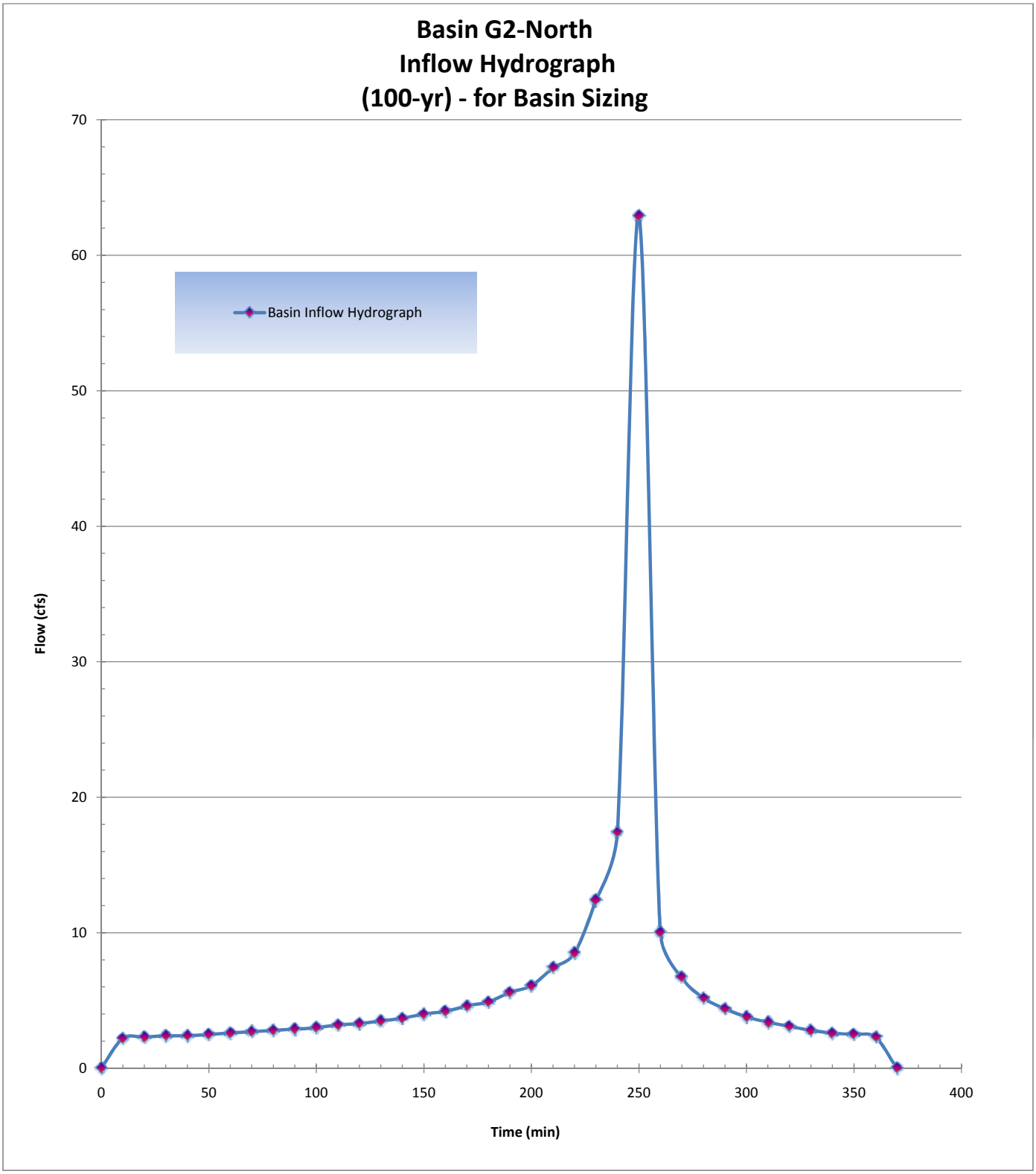
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 134580 $ft^3$**
**3.09 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 3.11 acre-feet
***OK***


Basin G2-North
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
0
50
100
150
200
250
300
350
400

# Basin G2-North Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **127+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G2-North** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 165005 | $ft^3$ | from G2-ALL |
| Retention volume from this basin = | 51890 | | at 3.4' depth, see G2-South for remainder of storage |
| Actual Basin Inflow = | 134580 | $ft^3$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G2-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G2 |
| Flow that does not reach detention basin (bypass per DA table): | 9.6 | cfs | $Q_{100}$ from: G2.27.PVG2.27.SL |
| Maximum flow allowed to be released by this detention basin: | 15.8 | cfs | *31%* of G2-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | | | |
|---|---|---|---|---|
| Basin - Top of basin berm elevation = | | | 546.60 | ft |
| Basin flowline elevation = | | | 540.00 | ft |
| Maximum Basin Depth = | | | 6.60 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 3.40 | ft | 543.40 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | 200 | ft | L/2 due to sloped floor |
| Base Width (W) | 58 | ft | average |
| W/L Ratio ® | 0.29 | | |
| Side Slopes (Z) | 1: 4 | | |
| Total Volume (V): | 127310 | $ft^2$ | |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 540.00 | 0.00 | 0 | 0 | | 540.00 | 0.00 | | 0.00 |
| 1 | 540.20 | 0.20 | 2341 | 2341 | | 540.20 | 0.00 | | 0.00 |
| 2 | 540.40 | 0.40 | 2425 | 4766 | | 540.40 | 0.00 | | 0.00 |
| 3 | 540.60 | 0.60 | 2509 | 7275 | | 540.60 | 0.00 | | 0.00 |
| 4 | 540.80 | 0.80 | 2595 | 9870 | | 540.80 | 0.00 | | 0.00 |
| 5 | 541.00 | 1.00 | 2681 | 12551 | | 541.00 | 0.00 | | 0.00 |
| 6 | 541.20 | 1.20 | 2769 | 15320 | | 541.20 | 0.00 | | 0.00 |
| 7 | 541.40 | 1.40 | 2858 | 18178 | | 541.40 | 0.00 | | 0.00 |
| 8 | 541.60 | 1.60 | 2948 | 21126 | | 541.60 | 0.00 | | 0.00 |
| 9 | 541.80 | 1.80 | 3039 | 24165 | | 541.80 | 0.00 | | 0.00 |
| 10 | 542.00 | 2.00 | 3131 | 27296 | | 542.00 | 0.00 | | 0.00 |
| 11 | 542.20 | 2.20 | 3225 | 30521 | | 542.20 | 0.00 | | 0.00 |
| 12 | 542.40 | 2.40 | 3319 | 33840 | | 542.40 | 0.00 | | 0.00 |
| 13 | 542.60 | 2.60 | 3415 | 37255 | | 542.60 | 0.00 | | 0.00 |
| 14 | 542.80 | 2.80 | 3511 | 40766 | | 542.80 | 0.00 | 0.00 | 0.00 |
| 15 | 543.00 | 3.00 | 3609 | 44375 | | 543.00 | 0.00 | | 0.00 |
| 16 | 543.20 | 3.20 | 3708 | 48082 | | 543.20 | 0.00 | | 0.00 |
| 17 | 543.40 | 3.40 | 3808 | 51890 | * | 543.40 | 0.00 | | 0.00 |
| 18 | 543.60 | 3.60 | 3909 | 55799 | | 543.60 | 0.15 | | 0.15 |
| 19 | 543.80 | 3.80 | 4011 | 59810 | | 543.80 | 0.59 | | 0.59 |
| 20 | 544.00 | 4.00 | 4114 | 63924 | | 544.00 | 1.30 | | 1.30 |
| 21 | 544.20 | 4.20 | 4219 | 68143 | | 544.20 | 2.25 | | 2.25 |
| 22 | 544.40 | 4.40 | 4324 | 72467 | | 544.40 | 3.42 | | 3.42 |
| 23 | 544.60 | 4.60 | 4431 | 76897 | | 544.60 | 4.79 | | 4.79 |
| 24 | 544.80 | 4.80 | 4538 | 81436 | | 544.80 | 6.32 | | 6.32 |
| 25 | 545.00 | 5.00 | 4647 | 86083 | | 545.00 | 7.99 | | 7.99 |
| 26 | 545.20 | 5.20 | 4757 | 90840 | | 545.20 | 9.77 | | 9.77 |
| 27 | 545.40 | 5.40 | 4868 | 95708 | | 545.40 | 11.63 | | 11.63 |
| 28 | 545.60 | 5.60 | 4980 | 100688 | | 545.60 | 13.53 | | 13.53 |

# Basin G2-North Routing

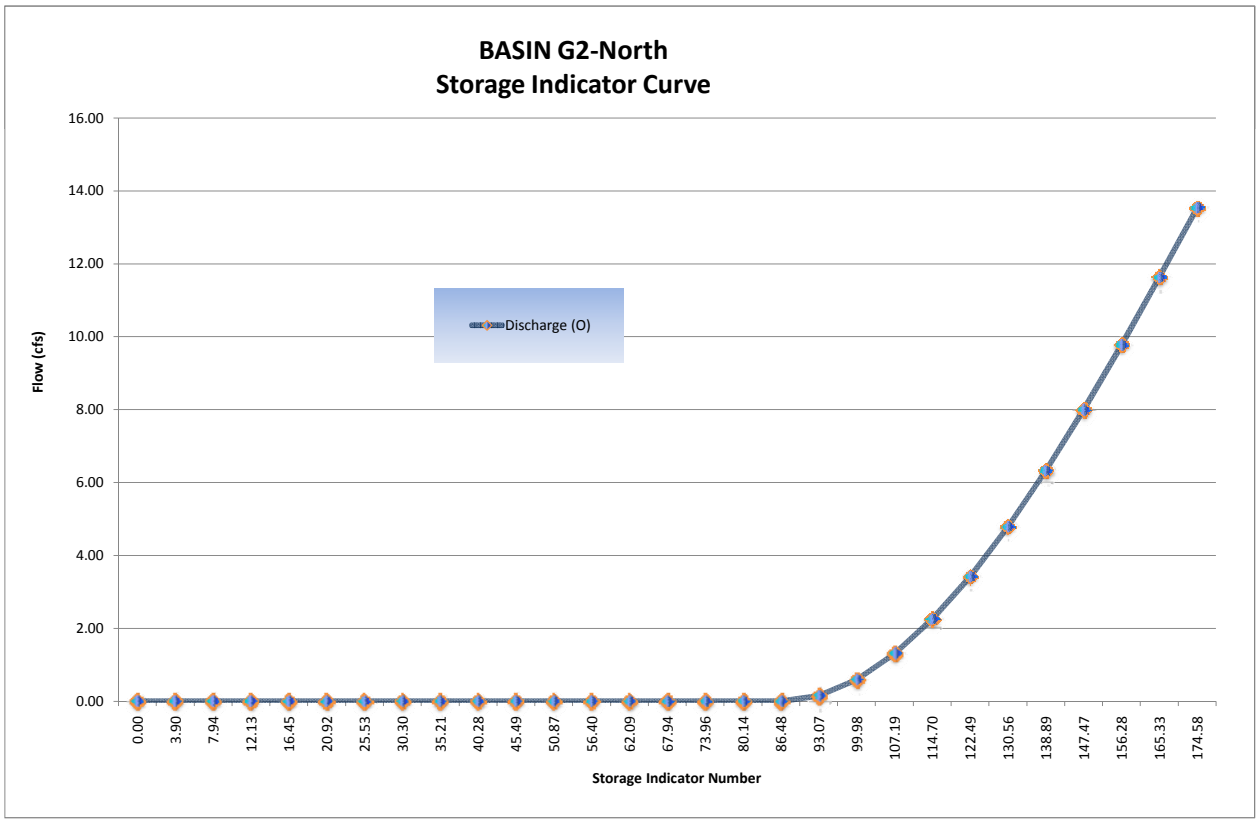
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 127+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G2-North |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 540.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 540.20 | 0.00 | 2341 | 0.00 | 3.90 | 3.90 |
| 540.40 | 0.00 | 4766 | 0.00 | 7.94 | 7.94 |
| 540.60 | 0.00 | 7275 | 0.00 | 12.13 | 12.13 |
| 540.80 | 0.00 | 9870 | 0.00 | 16.45 | 16.45 |
| 541.00 | 0.00 | 12551 | 0.00 | 20.92 | 20.92 |
| 541.20 | 0.00 | 15320 | 0.00 | 25.53 | 25.53 |
| 541.40 | 0.00 | 18178 | 0.00 | 30.30 | 30.30 |
| 541.60 | 0.00 | 21126 | 0.00 | 35.21 | 35.21 |
| 541.80 | 0.00 | 24165 | 0.00 | 40.28 | 40.28 |
| 542.00 | 0.00 | 27296 | 0.00 | 45.49 | 45.49 |
| 542.20 | 0.00 | 30521 | 0.00 | 50.87 | 50.87 |
| 542.40 | 0.00 | 33840 | 0.00 | 56.40 | 56.40 |
| 542.60 | 0.00 | 37255 | 0.00 | 62.09 | 62.09 |
| 542.80 | 0.00 | 40766 | 0.00 | 67.94 | 67.94 |
| 543.00 | 0.00 | 44375 | 0.00 | 73.96 | 73.96 |
| 543.20 | 0.00 | 48082 | 0.00 | 80.14 | 80.14 |
| 543.40 | 0.00 | 51890 | 0.00 | 86.48 | 86.48 |
| 543.60 | 0.15 | 55799 | 0.08 | 93.00 | 93.07 |
| 543.80 | 0.59 | 59810 | 0.30 | 99.68 | 99.98 |
| 544.00 | 1.30 | 63924 | 0.65 | 106.54 | 107.19 |
| 544.20 | 2.25 | 68143 | 1.13 | 113.57 | 114.70 |
| 544.40 | 3.42 | 72467 | 1.71 | 120.78 | 122.49 |
| 544.60 | 4.79 | 76897 | 2.40 | 128.16 | 130.56 |
| 544.80 | 6.32 | 81436 | 3.16 | 135.73 | 138.89 |
| 545.00 | 7.99 | 86083 | 4.00 | 143.47 | 147.47 |
| 545.20 | 9.77 | 90840 | 4.89 | 151.40 | 156.28 |
| 545.40 | 11.63 | 95708 | 5.82 | 159.51 | 165.33 |
| 545.60 | 13.53 | 100688 | 6.77 | 167.81 | 174.58 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



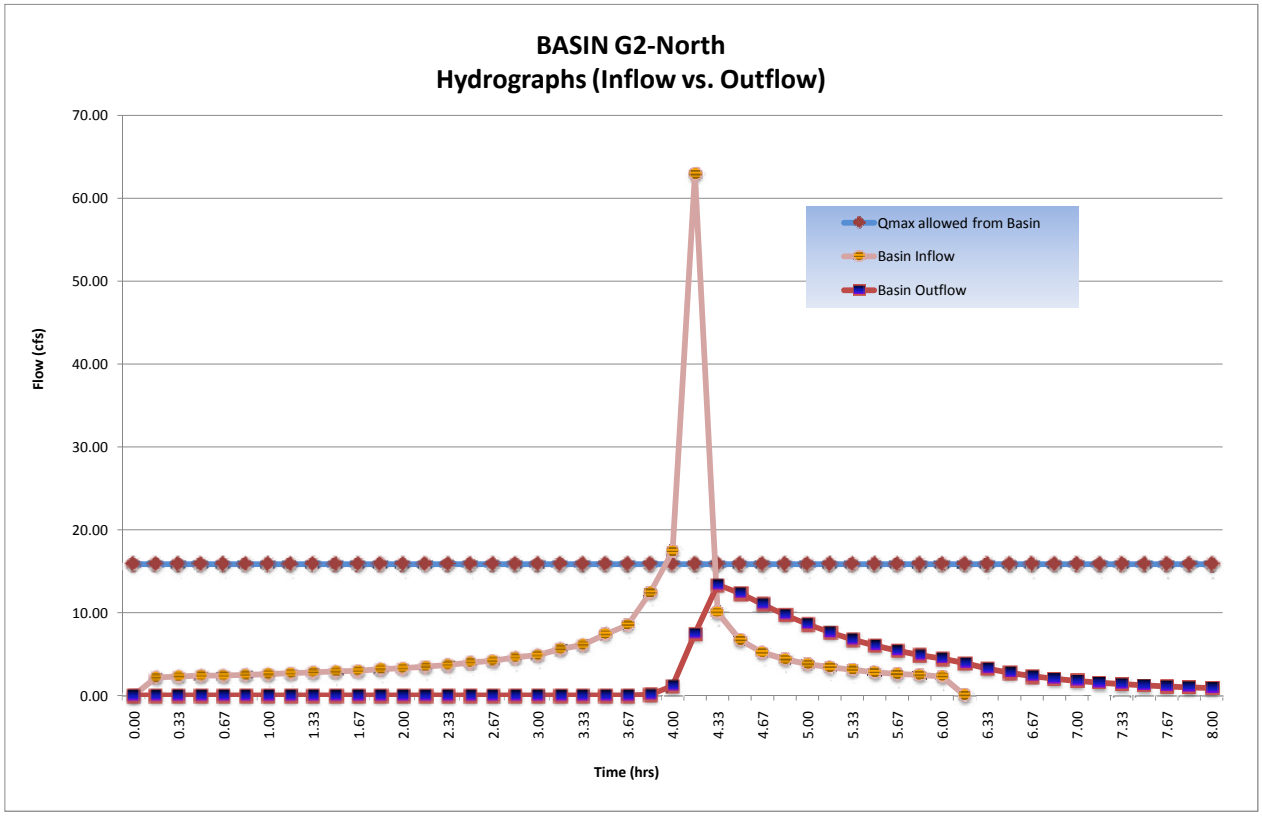
# Basin G2-North Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

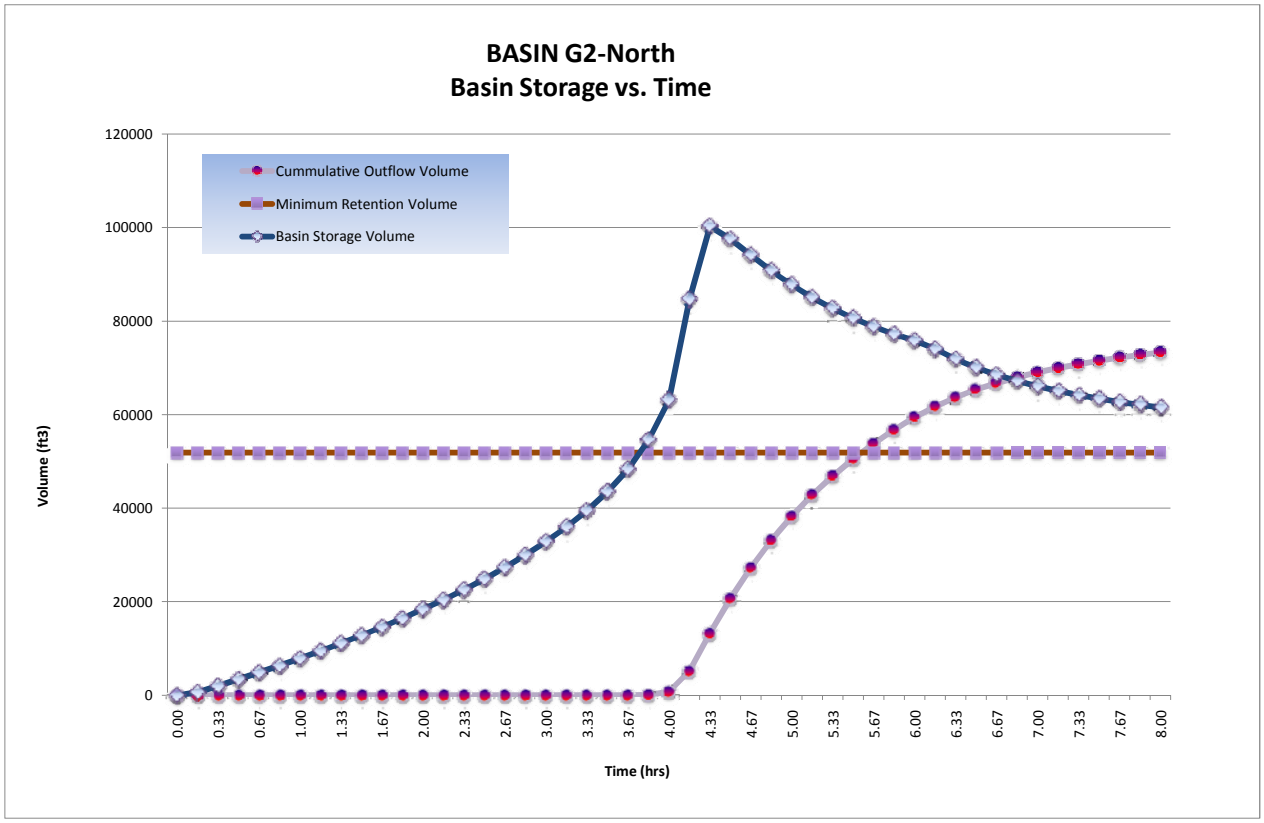
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 2.20 | 1.10 | 0.00 | 0.00 | 1.10 | 0.00 | 660 | 0 | 0 |
| 0.33 | 2.30 | 2.25 | 1.10 | 0.00 | 3.35 | 0.00 | 2010 | 0 | 0 |
| 0.50 | 2.40 | 2.35 | 3.35 | 0.00 | 5.70 | 0.00 | 3420 | 0 | 0 |
| 0.67 | 2.40 | 2.40 | 5.70 | 0.00 | 8.10 | 0.00 | 4860 | 0 | 0 |
| 0.83 | 2.50 | 2.45 | 8.10 | 0.00 | 10.55 | 0.00 | 6330 | 0 | 0 |
| 1.00 | 2.60 | 2.55 | 10.55 | 0.00 | 13.10 | 0.00 | 7860 | 0 | 0 |
| 1.17 | 2.70 | 2.65 | 13.10 | 0.00 | 15.75 | 0.00 | 9450 | 0 | 0 |
| 1.33 | 2.80 | 2.75 | 15.75 | 0.00 | 18.50 | 0.00 | 11100 | 0 | 0 |
| 1.50 | 2.90 | 2.85 | 18.50 | 0.00 | 21.35 | 0.00 | 12810 | 0 | 0 |
| 1.67 | 3.00 | 2.95 | 21.35 | 0.00 | 24.30 | 0.00 | 14580 | 0 | 0 |
| 1.83 | 3.20 | 3.10 | 24.30 | 0.00 | 27.40 | 0.00 | 16440 | 0 | 0 |
| 2.00 | 3.30 | 3.25 | 27.40 | 0.00 | 30.65 | 0.00 | 18390 | 0 | 0 |
| 2.17 | 3.50 | 3.40 | 30.65 | 0.00 | 34.05 | 0.00 | 20430 | 0 | 0 |
| 2.33 | 3.70 | 3.60 | 34.05 | 0.00 | 37.65 | 0.00 | 22590 | 0 | 0 |
| 2.50 | 4.00 | 3.85 | 37.65 | 0.00 | 41.50 | 0.00 | 24900 | 0 | 0 |
| 2.67 | 4.20 | 4.10 | 41.50 | 0.00 | 45.60 | 0.00 | 27360 | 0 | 0 |
| 2.83 | 4.60 | 4.40 | 45.60 | 0.00 | 50.00 | 0.00 | 30000 | 0 | 0 |
| 3.00 | 4.90 | 4.75 | 50.00 | 0.00 | 54.75 | 0.00 | 32850 | 0 | 0 |
| 3.17 | 5.60 | 5.25 | 54.75 | 0.00 | 60.00 | 0.00 | 36000 | 0 | 0 |
| 3.33 | 6.10 | 5.85 | 60.00 | 0.00 | 65.85 | 0.00 | 39510 | 0 | 0 |
| 3.50 | 7.40 | 6.75 | 65.85 | 0.00 | 72.60 | 0.00 | 43560 | 0 | 0 |
| 3.67 | 8.50 | 7.95 | 72.60 | 0.00 | 80.55 | 0.00 | 48330 | 0 | 0 |
| 3.83 | 12.40 | 10.45 | 80.55 | 0.00 | 91.00 | 0.10 | 54570 | 60 | 60 |
| 4.00 | 17.40 | 14.90 | 91.00 | 0.10 | 105.80 | 1.16 | 63132 | 696 | 756 |
| 4.17 | 62.90 | 40.15 | 105.80 | 1.16 | 144.79 | 7.47 | 84633 | 4482 | 5238 |
| 4.33 | 10.00 | 36.45 | 144.79 | 7.47 | 173.77 | 13.36 | 100254 | 8016 | 13254 |
| 4.50 | 6.70 | 8.35 | 173.77 | 13.36 | 168.76 | 12.33 | 97557 | 7398 | 20652 |
| 4.67 | 5.20 | 5.95 | 168.76 | 12.33 | 162.38 | 11.02 | 94122 | 6612 | 27264 |
| 4.83 | 4.40 | 4.80 | 162.38 | 11.02 | 156.16 | 9.74 | 90774 | 5844 | 33108 |
| 5.00 | 3.80 | 4.10 | 156.16 | 9.74 | 150.52 | 8.61 | 87729 | 5166 | 38274 |
| 5.17 | 3.40 | 3.60 | 150.52 | 8.61 | 145.51 | 7.61 | 85023 | 4566 | 42840 |
| 5.33 | 3.10 | 3.25 | 145.51 | 7.61 | 141.15 | 6.76 | 82662 | 4056 | 46896 |
| 5.50 | 2.80 | 2.95 | 141.15 | 6.76 | 137.34 | 6.04 | 80592 | 3624 | 50520 |
| 5.67 | 2.60 | 2.70 | 137.34 | 6.04 | 134.00 | 5.42 | 78774 | 3252 | 53772 |
| 5.83 | 2.50 | 2.55 | 134.00 | 5.42 | 131.13 | 4.90 | 77208 | 2940 | 56712 |
| 6.00 | 2.30 | 2.40 | 131.13 | 4.90 | 128.63 | 4.46 | 75840 | 2676 | 59388 |
| 6.17 | 0.00 | 1.15 | 128.63 | 4.46 | 125.32 | 3.90 | 74022 | 2340 | 61728 |
| 6.33 | | 0.00 | 125.32 | 3.90 | 121.42 | 3.26 | 71874 | 1956 | 63684 |
| 6.50 | | 0.00 | 121.42 | 3.26 | 118.16 | 2.77 | 70065 | 1662 | 65346 |
| 6.67 | | 0.00 | 118.16 | 2.77 | 115.39 | 2.35 | 68529 | 1410 | 66756 |
| 6.83 | | 0.00 | 115.39 | 2.35 | 113.04 | 2.04 | 67212 | 1224 | 67980 |
| 7.00 | | 0.00 | 113.04 | 2.04 | 111.00 | 1.78 | 66066 | 1068 | 69048 |
| 7.17 | | 0.00 | 111.00 | 1.78 | 109.22 | 1.56 | 65064 | 936 | 69984 |
| 7.33 | | 0.00 | 109.22 | 1.56 | 107.66 | 1.36 | 64188 | 816 | 70800 |
| 7.50 | | 0.00 | 107.66 | 1.36 | 106.30 | 1.21 | 63417 | 726 | 71526 |
| 7.67 | | 0.00 | 106.30 | 1.21 | 105.09 | 1.09 | 62727 | 654 | 72180 |
| 7.83 | | 0.00 | 105.09 | 1.09 | 104.00 | 0.99 | 62103 | 594 | 72774 |
| 8.00 | | 0.00 | 104.00 | 0.99 | 103.01 | 0.89 | 61539 | 534 | 73308 |

## Basin G2-North Routing



## Basin G2-North Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **100,254** | **$ft^3$** | |
| **@ Stage:** | **545.60** | **ft** | |
| **Freeboard:** | **1.0** | **ft** | > 1' Freeboard |
| **Final Total Basin Volume Provided:** | **127,310** | **$ft^3$** | Basin **G2-North** |
| **Maximum flow rate released from this basin:** | **13.36** | **cfs** | |

# Basin G2-South Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 01.11.10 | WATERSHED: | G2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G2-South |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 815900 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 18.73 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: USER INPUT

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 49% | AT | 0.90 | 0.441 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 51% | AT | 0.55 | 0.280 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.72 |
| $C_{25}$ = | 0.79 |
| $C_{50}$ = | 0.87 |
| $C_{100}$ = | 0.90 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 544.0 | ft | From median, north of SV Line |
| LOW POINT ELEVATION | 542.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 60 | ft | |
| SLOPE (S) = (H/L) | 3.3% | | |
| MANNING'S n | 0.050 | | < = FROM TABLE 816.6A Fallow |
| $T_t$ (SFF)= | 2.94 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 542.0 | ft | assumed SCF and not channelized or flowing full yet |
| LOW POINT ELEVATION | 539.0 | ft | |
| ELEVATION DIFF (H) | 3.0 | ft | |
| LENGTH (L) | 183 | ft | |
| SLOPE (S) = (H/L) | 1.6% | | |
| VELOCITY (SCF) | 0.8 | fps | <=V FROM FIG 816.5 short grass |
| $T_C$ (SH)= | 3.81 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 539.0 | ft | median ditch |
| LOW POINT ELEVATION | 537.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 2.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 112 | ft | b = 0 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.8% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 2.46 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.76 | minutes | |

# Basin G2-South Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft | |
| LOW POINT ELEVATION | 525.0 | ft | |
| ELEVATION DIFF (H) | 7.0 | ft | |
| LENGTH (L) | 472 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 11.5 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.68 | minutes | |

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 525.0 | ft | Proposed storm to basin |
| LOW POINT ELEVATION | 512.0 | ft | |
| ELEVATION DIFF (H) | 13.0 | ft | |
| LENGTH (L) | 680 | ft | |
| SLOPE (S) = (H/L) | 1.9% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 3.0 | ft | |
| HYDRAULIC RADIUS R | 0.8 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 13.1 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 0.87 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 9.06 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | $Q_2$ = | 25.1 |
| $i_{10}$ = | 2.7 | in/hr | X CA = | $Q_{10}$ = | 36.4 |
| $i_{25}$ = | 3.4 | in/hr | X CA = | $Q_{25}$ = | 50.1 |
| $i_{50}$ = | 4.0 | in/hr | X CA = | $Q_{50}$ = | 65.6 |
| $i_{100}$ = | 4.2 | in/hr | X CA = | $Q_{100}$ = | **71.2** |

**FLOW RESULTS:** cfs

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin G2South Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.11.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G2-South** |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 71.2 | cfs | $C_{100}$= | 0.90 | |
| Tc= | 10.0 | min | A= | 18.73 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1500 | 2.5 |
| 20 | 1560 | 2.6 |
| 30 | 1620 | 2.7 |
| 40 | 1620 | 2.7 |
| 50 | 1680 | 2.8 |
| 60 | 1740 | 2.9 |
| 70 | 1800 | 3 |
| 80 | 1860 | 3.1 |
| 90 | 1980 | 3.3 |
| 100 | 2040 | 3.4 |
| 110 | 2160 | 3.6 |
| 120 | 2220 | 3.7 |
| 130 | 2400 | 4 |
| 140 | 2460 | 4.1 |
| 150 | 2700 | 4.5 |
| 160 | 2820 | 4.7 |
| 170 | 3120 | 5.2 |
| 180 | 3300 | 5.5 |
| 190 | 3780 | 6.3 |
| 200 | 4140 | 6.9 |
| 210 | 5040 | 8.4 |
| 220 | 5760 | 9.6 |
| 230 | 8460 | 14.1 |
| 240 | 11760 | 19.6 |
| 250 | 42720 | 71.2 |
| 260 | 6780 | 11.3 |
| 270 | 4500 | 7.5 |
| 280 | 3540 | 5.9 |
| 290 | 2940 | 4.9 |
| 300 | 2580 | 4.3 |
| 310 | 2280 | 3.8 |
| 320 | 2100 | 3.5 |
| 330 | 1920 | 3.2 |
| 340 | 1800 | 3 |
| 350 | 1680 | 2.8 |
| 360 | 1560 | 2.6 |
| 370 | 0 | 0 |

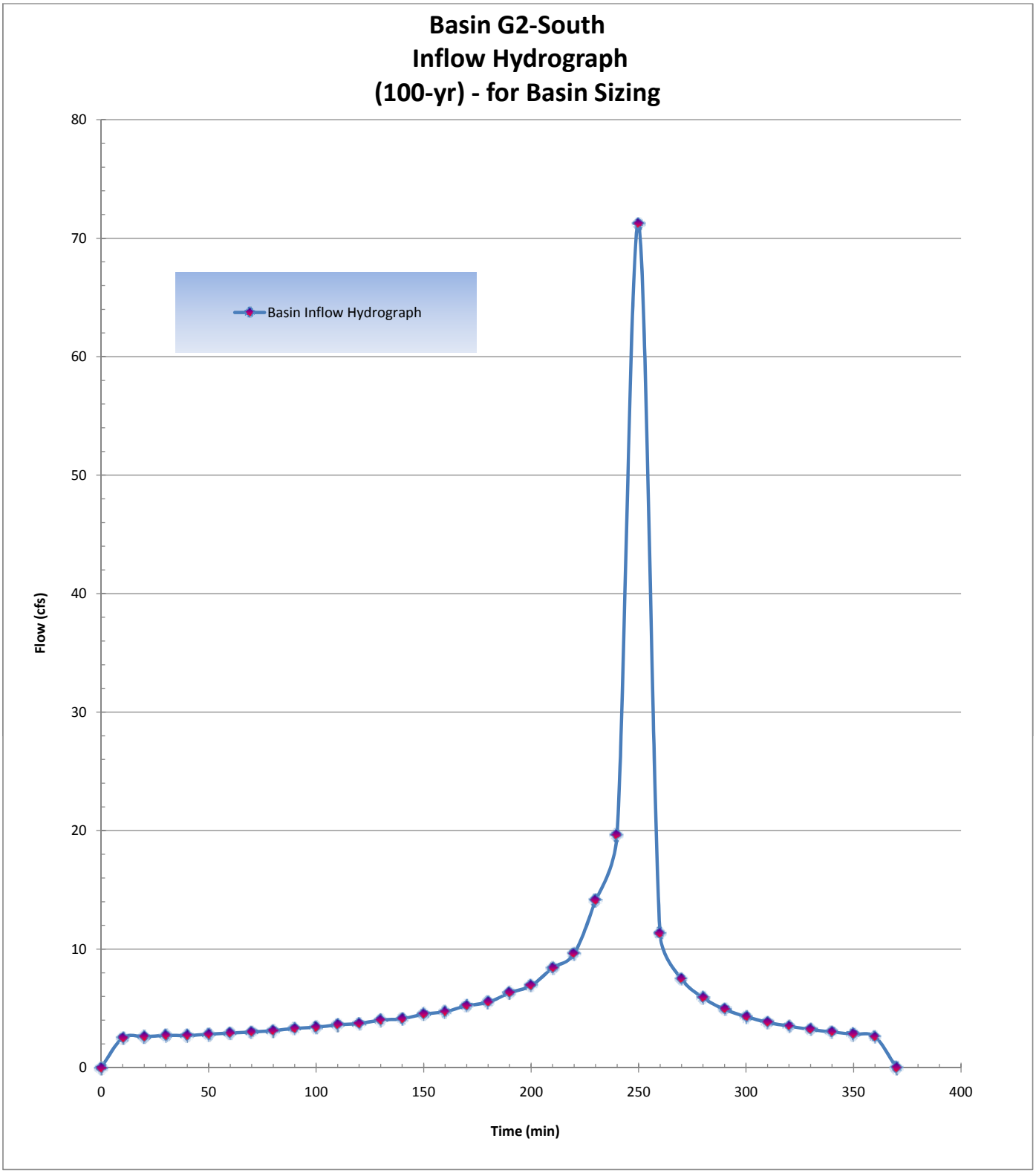
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 151920 $ft^3$**
**3.49 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 3.52 acre-feet
***OK***


Basin G2-South
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
350
400

# Basin G2-South Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **139+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **G2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin G2-South** |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required Retention Basin Volume = | 165005 | $ft^3$ | from G2-ALL |
| Retention volume from G2-North Basin = | 51890 | $ft^4$ | |
| Minimum Retention volume from this basin = | 113115 | | balance of required retention for G2-ALL |
| Actual Basin Inflow = | 151920 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 60.0 | cfs | from G2-ALL |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert G2 |
| Flow that does not reach detention basin (bypass per DA table): | 9.6 | cfs | $Q_{100}$ from: G2.27.PVG2.27.SL |
| Maximum flow to be released by G2-North basin: | 15.8 | cfs | *31%* of G2-ALL (per retention ratios) |
| Maximum flow allowed to be released by this detention basin: | 23.7 | cfs | *69%* of G2-ALL (per retention ratios) |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 517.00 | ft |
| Basin flowline elevation = | 512.00 | ft |
| Maximum Basin Depth = | 5.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 3.20 | ft | 515.20 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 180 | ft |
| Base Width (W) | 180 | ft |
| W/L Ratio ® | 1.00 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 200532 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 ~ *assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 512.00 | 0.00 | 0 | 0 | | 512.00 | 0.00 | 0.00 | 0.00 |
| 1 | 512.20 | 0.20 | 6539 | 6539 | | 512.20 | 0.00 | | 0.00 |
| 2 | 512.40 | 0.40 | 6656 | 13195 | | 512.40 | 0.00 | | 0.00 |
| 3 | 512.60 | 0.60 | 6775 | 19970 | | 512.60 | 0.00 | | 0.00 |
| 4 | 512.80 | 0.80 | 6894 | 26863 | | 512.80 | 0.00 | | 0.00 |
| 5 | 513.00 | 1.00 | 7014 | 33877 | | 513.00 | 0.00 | | 0.00 |
| 6 | 513.20 | 1.20 | 7135 | 41012 | | 513.20 | 0.00 | | 0.00 |
| 7 | 513.40 | 1.40 | 7256 | 48268 | | 513.40 | 0.00 | | 0.00 |
| 8 | 513.60 | 1.60 | 7378 | 55646 | | 513.60 | 0.00 | | 0.00 |
| 9 | 513.80 | 1.80 | 7501 | 63148 | | 513.80 | 0.00 | | 0.00 |
| 10 | 514.00 | 2.00 | 7625 | 70773 | | 514.00 | 0.00 | | 0.00 |
| 11 | 514.20 | 2.20 | 7750 | 78523 | | 514.20 | 0.00 | | 0.00 |
| 12 | 514.40 | 2.40 | 7875 | 86398 | | 514.40 | 0.00 | 0.00 | 0.00 |
| 13 | 514.60 | 2.60 | 8001 | 94399 | | 514.60 | 0.00 | | 0.00 |
| 14 | 514.80 | 2.80 | 8128 | 102528 | | 514.80 | 0.00 | | 0.00 |
| 15 | 515.00 | 3.00 | 8256 | 110784 | | 515.00 | 0.00 | | 0.00 |
| 16 | 515.20 | 3.20 | 8384 | 119168 | * | 515.20 | 0.00 | | 0.00 |
| 17 | 515.40 | 3.40 | 8513 | 127681 | | 515.40 | 0.15 | | 0.15 |
| 18 | 515.60 | 3.60 | 8643 | 136325 | | 515.60 | 0.59 | | 0.59 |
| 19 | 515.80 | 3.80 | 8774 | 145099 | | 515.80 | 1.30 | | 1.30 |
| 20 | 516.00 | 4.00 | 8906 | 154004 | | 516.00 | 2.25 | | 2.25 |
| 21 | 516.20 | 4.20 | 9038 | 163042 | | 516.20 | 3.42 | | 3.42 |
| 22 | 516.40 | 4.40 | 9171 | 172213 | | 516.40 | 4.79 | | 4.79 |
| 23 | 516.60 | 4.60 | 9305 | 181518 | | 516.60 | 6.32 | | 6.32 |
| 24 | 516.80 | 4.80 | 9439 | 190957 | | 516.80 | 7.99 | | 7.99 |
| 25 | 517.00 | 5.00 | 9575 | 200532 | | 517.00 | 9.77 | | 9.77 |

# Basin G2-South Routing

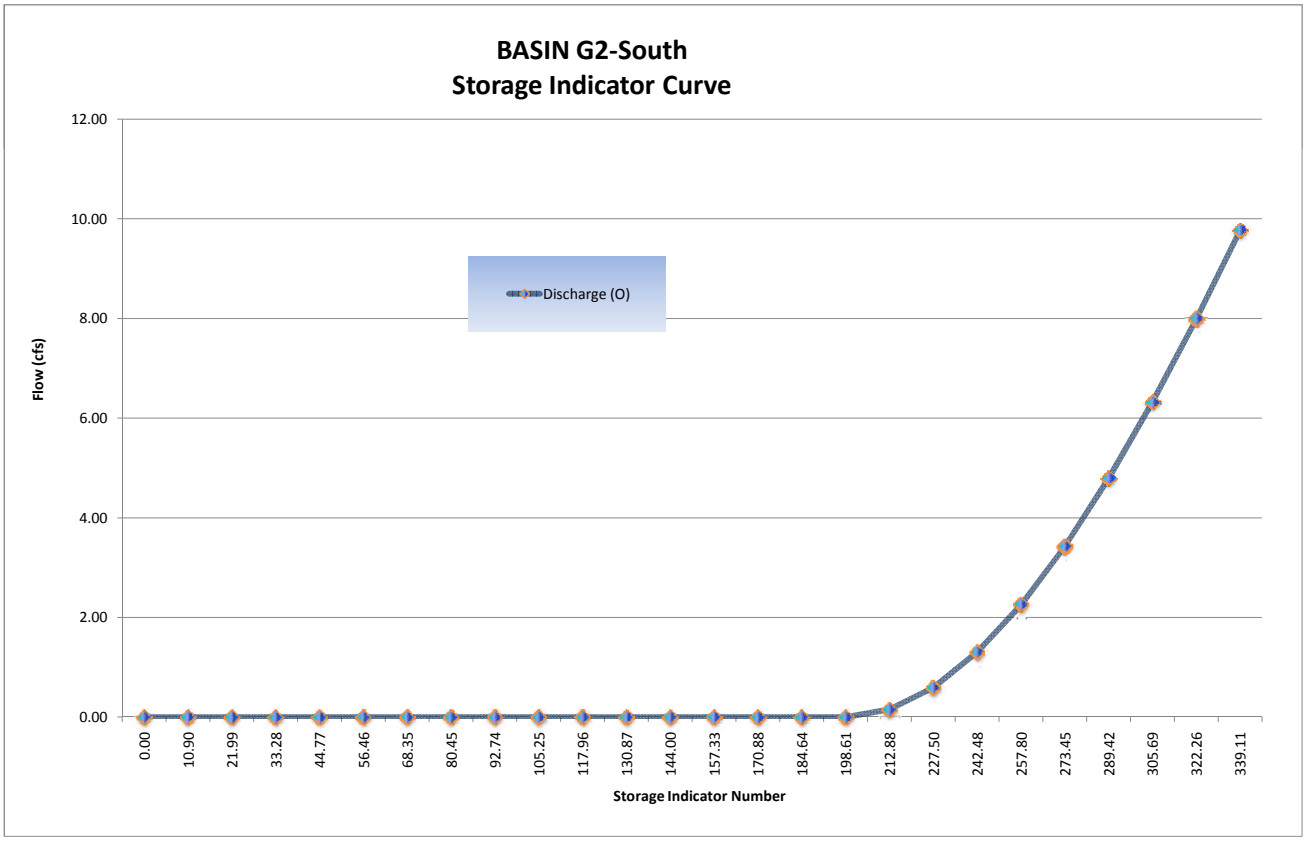
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 139+00 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | G2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin G2-South |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 512.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 512.20 | 0.00 | 6539 | 0.00 | 10.90 | 10.90 |
| 512.40 | 0.00 | 13195 | 0.00 | 21.99 | 21.99 |
| 512.60 | 0.00 | 19970 | 0.00 | 33.28 | 33.28 |
| 512.80 | 0.00 | 26863 | 0.00 | 44.77 | 44.77 |
| 513.00 | 0.00 | 33877 | 0.00 | 56.46 | 56.46 |
| 513.20 | 0.00 | 41012 | 0.00 | 68.35 | 68.35 |
| 513.40 | 0.00 | 48268 | 0.00 | 80.45 | 80.45 |
| 513.60 | 0.00 | 55646 | 0.00 | 92.74 | 92.74 |
| 513.80 | 0.00 | 63148 | 0.00 | 105.25 | 105.25 |
| 514.00 | 0.00 | 70773 | 0.00 | 117.96 | 117.96 |
| 514.20 | 0.00 | 78523 | 0.00 | 130.87 | 130.87 |
| 514.40 | 0.00 | 86398 | 0.00 | 144.00 | 144.00 |
| 514.60 | 0.00 | 94399 | 0.00 | 157.33 | 157.33 |
| 514.80 | 0.00 | 102528 | 0.00 | 170.88 | 170.88 |
| 515.00 | 0.00 | 110784 | 0.00 | 184.64 | 184.64 |
| 515.20 | 0.00 | 119168 | 0.00 | 198.61 | 198.61 |
| 515.40 | 0.15 | 127681 | 0.08 | 212.80 | 212.88 |
| 515.60 | 0.59 | 136325 | 0.30 | 227.21 | 227.50 |
| 515.80 | 1.30 | 145099 | 0.65 | 241.83 | 242.48 |
| 516.00 | 2.25 | 154004 | 1.13 | 256.67 | 257.80 |
| 516.20 | 3.42 | 163042 | 1.71 | 271.74 | 273.45 |
| 516.40 | 4.79 | 172213 | 2.40 | 287.02 | 289.42 |
| 516.60 | 6.32 | 181518 | 3.16 | 302.53 | 305.69 |
| 516.80 | 7.99 | 190957 | 4.00 | 318.26 | 322.26 |
| 517.00 | 9.77 | 200532 | 4.89 | 334.22 | 339.11 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



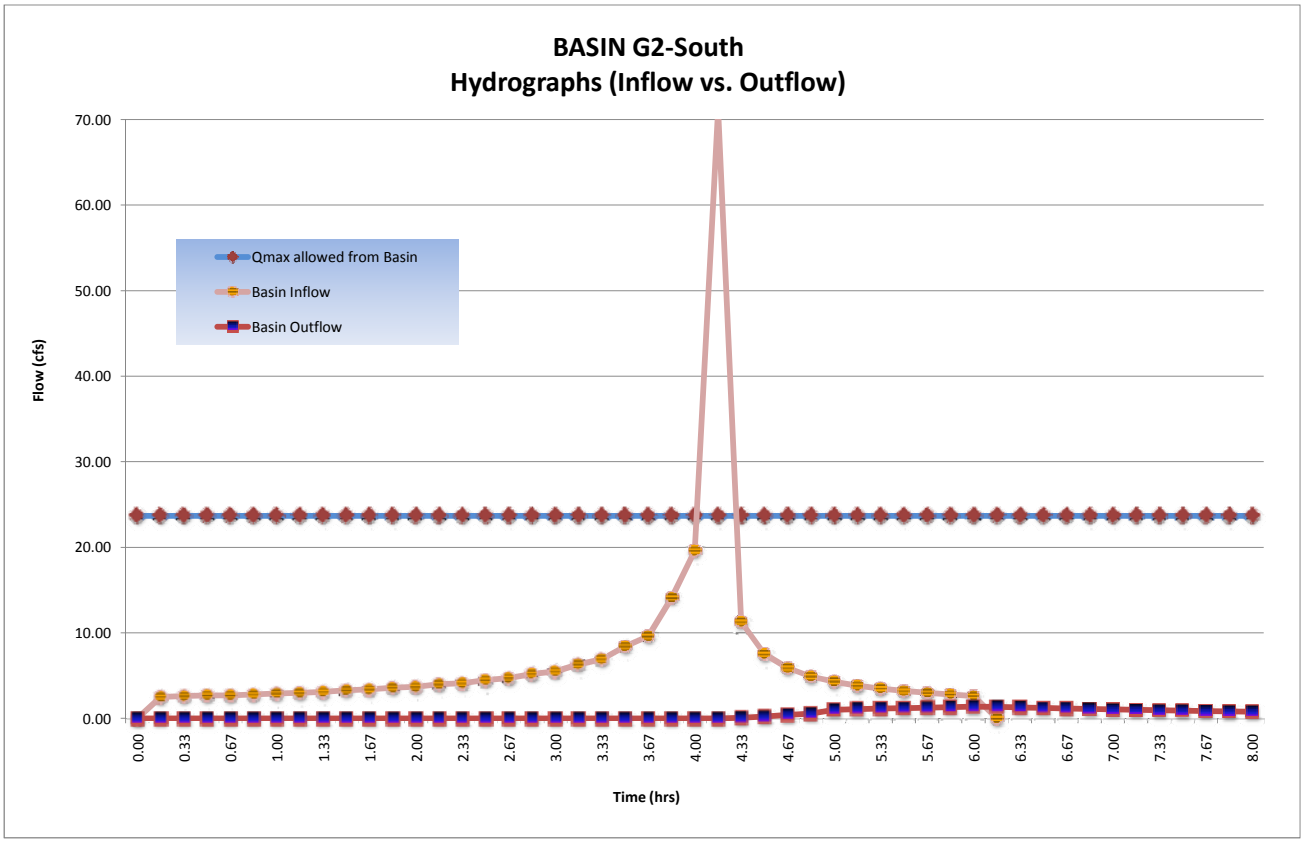
# Basin G2-South Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} - \frac{O_1}{2}\right) - O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

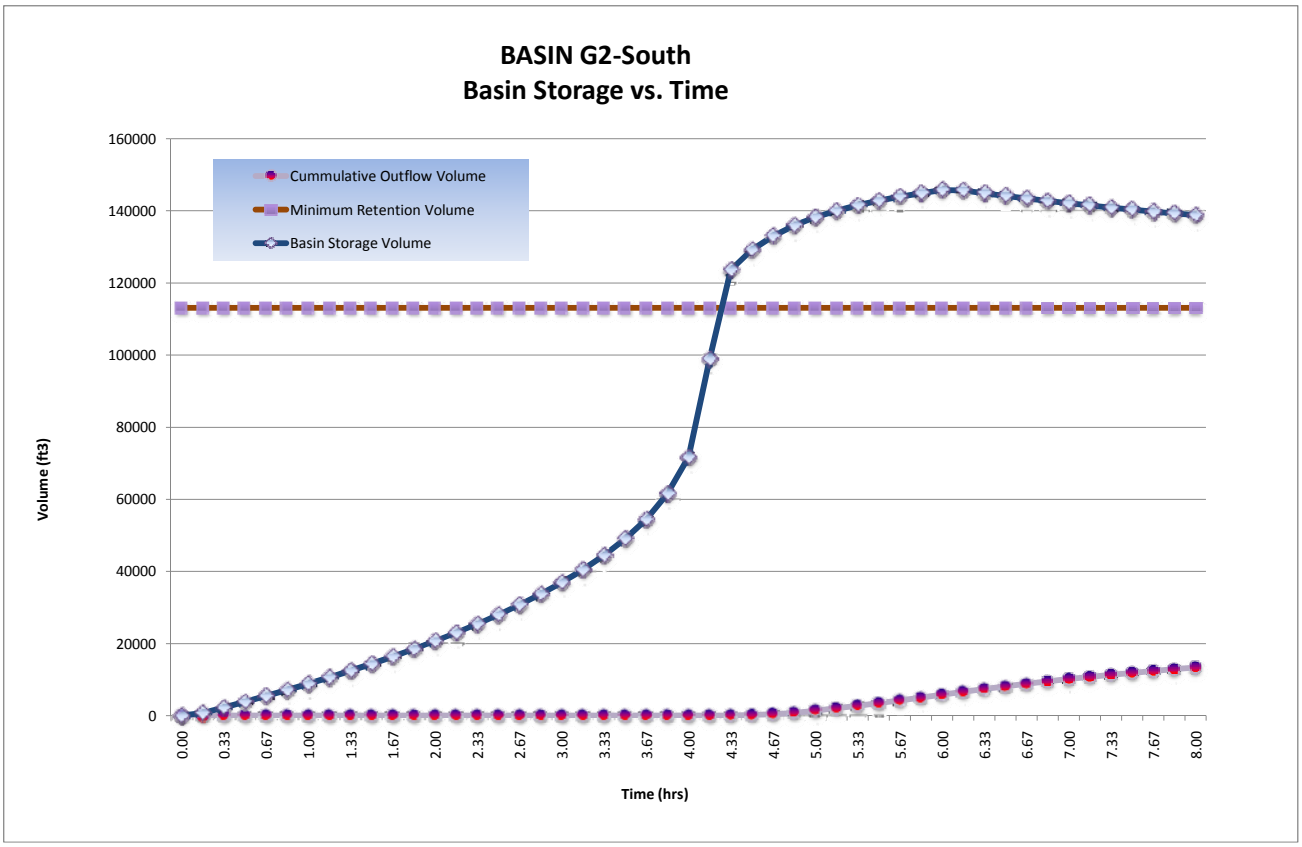
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 2.50 | 1.25 | 0.00 | 0.00 | 1.25 | 0.00 | 750 | 0 | 0 |
| 0.33 | 2.60 | 2.55 | 1.25 | 0.00 | 3.80 | 0.00 | 2280 | 0 | 0 |
| 0.50 | 2.70 | 2.65 | 3.80 | 0.00 | 6.45 | 0.00 | 3870 | 0 | 0 |
| 0.67 | 2.70 | 2.70 | 6.45 | 0.00 | 9.15 | 0.00 | 5490 | 0 | 0 |
| 0.83 | 2.80 | 2.75 | 9.15 | 0.00 | 11.90 | 0.00 | 7140 | 0 | 0 |
| 1.00 | 2.90 | 2.85 | 11.90 | 0.00 | 14.75 | 0.00 | 8850 | 0 | 0 |
| 1.17 | 3.00 | 2.95 | 14.75 | 0.00 | 17.70 | 0.00 | 10620 | 0 | 0 |
| 1.33 | 3.10 | 3.05 | 17.70 | 0.00 | 20.75 | 0.00 | 12450 | 0 | 0 |
| 1.50 | 3.30 | 3.20 | 20.75 | 0.00 | 23.95 | 0.00 | 14370 | 0 | 0 |
| 1.67 | 3.40 | 3.35 | 23.95 | 0.00 | 27.30 | 0.00 | 16380 | 0 | 0 |
| 1.83 | 3.60 | 3.50 | 27.30 | 0.00 | 30.80 | 0.00 | 18480 | 0 | 0 |
| 2.00 | 3.70 | 3.65 | 30.80 | 0.00 | 34.45 | 0.00 | 20670 | 0 | 0 |
| 2.17 | 4.00 | 3.85 | 34.45 | 0.00 | 38.30 | 0.00 | 22980 | 0 | 0 |
| 2.33 | 4.10 | 4.05 | 38.30 | 0.00 | 42.35 | 0.00 | 25410 | 0 | 0 |
| 2.50 | 4.50 | 4.30 | 42.35 | 0.00 | 46.65 | 0.00 | 27990 | 0 | 0 |
| 2.67 | 4.70 | 4.60 | 46.65 | 0.00 | 51.25 | 0.00 | 30750 | 0 | 0 |
| 2.83 | 5.20 | 4.95 | 51.25 | 0.00 | 56.20 | 0.00 | 33720 | 0 | 0 |
| 3.00 | 5.50 | 5.35 | 56.20 | 0.00 | 61.55 | 0.00 | 36930 | 0 | 0 |
| 3.17 | 6.30 | 5.90 | 61.55 | 0.00 | 67.45 | 0.00 | 40470 | 0 | 0 |
| 3.33 | 6.90 | 6.60 | 67.45 | 0.00 | 74.05 | 0.00 | 44430 | 0 | 0 |
| 3.50 | 8.40 | 7.65 | 74.05 | 0.00 | 81.70 | 0.00 | 49020 | 0 | 0 |
| 3.67 | 9.60 | 9.00 | 81.70 | 0.00 | 90.70 | 0.00 | 54420 | 0 | 0 |
| 3.83 | 14.10 | 11.85 | 90.70 | 0.00 | 102.55 | 0.00 | 61530 | 0 | 0 |
| 4.00 | 19.60 | 16.85 | 102.55 | 0.00 | 119.40 | 0.00 | 71640 | 0 | 0 |
| 4.17 | 71.20 | 45.40 | 119.40 | 0.00 | 164.80 | 0.00 | 98880 | 0 | 0 |
| 4.33 | 11.30 | 41.25 | 164.80 | 0.00 | 206.05 | 0.08 | 123606 | 48 | 48 |
| 4.50 | 7.50 | 9.40 | 206.05 | 0.08 | 215.37 | 0.22 | 129156 | 132 | 180 |
| 4.67 | 5.90 | 6.70 | 215.37 | 0.22 | 221.85 | 0.42 | 132984 | 252 | 432 |
| 4.83 | 4.90 | 5.40 | 221.85 | 0.42 | 226.83 | 0.57 | 135927 | 342 | 774 |
| 5.00 | 4.30 | 4.60 | 226.83 | 0.57 | 230.86 | 1.02 | 138210 | 612 | 1386 |
| 5.17 | 3.80 | 4.05 | 230.86 | 1.02 | 233.89 | 1.09 | 140007 | 654 | 2040 |
| 5.33 | 3.50 | 3.65 | 233.89 | 1.09 | 236.45 | 1.16 | 141522 | 696 | 2736 |
| 5.50 | 3.20 | 3.35 | 236.45 | 1.16 | 238.64 | 1.21 | 142821 | 726 | 3462 |
| 5.67 | 3.00 | 3.10 | 238.64 | 1.21 | 240.53 | 1.25 | 143943 | 750 | 4212 |
| 5.83 | 2.80 | 2.90 | 240.53 | 1.25 | 242.18 | 1.29 | 144921 | 774 | 4986 |
| 6.00 | 2.60 | 2.70 | 242.18 | 1.29 | 243.59 | 1.37 | 145743 | 822 | 5808 |
| 6.17 | 0.00 | 1.30 | 243.59 | 1.37 | 243.52 | 1.36 | 145704 | 816 | 6624 |
| 6.33 | | 0.00 | 243.52 | 1.36 | 242.16 | 1.28 | 144912 | 768 | 7392 |
| 6.50 | | 0.00 | 242.16 | 1.28 | 240.88 | 1.22 | 144162 | 732 | 8124 |
| 6.67 | | 0.00 | 240.88 | 1.22 | 239.66 | 1.17 | 143445 | 702 | 8826 |
| 6.83 | | 0.00 | 239.66 | 1.17 | 238.49 | 1.11 | 142761 | 666 | 9492 |
| 7.00 | | 0.00 | 238.49 | 1.11 | 237.38 | 1.06 | 142110 | 636 | 10128 |
| 7.17 | | 0.00 | 237.38 | 1.06 | 236.32 | 1.01 | 141489 | 606 | 10734 |
| 7.33 | | 0.00 | 236.32 | 1.01 | 235.31 | 0.96 | 140898 | 576 | 11310 |
| 7.50 | | 0.00 | 235.31 | 0.96 | 234.35 | 0.91 | 140337 | 546 | 11856 |
| 7.67 | | 0.00 | 234.35 | 0.91 | 233.44 | 0.87 | 139803 | 522 | 12378 |
| 7.83 | | 0.00 | 233.44 | 0.87 | 232.57 | 0.83 | 139293 | 498 | 12876 |
| 8.00 | | 0.00 | 232.57 | 0.83 | 231.74 | 0.79 | 138807 | 474 | 13350 |

## Basin G2-South Routing



## Basin G2-South Routing




| | | |
|---|---|---|
| **Detention/Retention Basin Volume Required:** | **145,743** | **$ft^3$** |
| **@ Stage:** | **516.00** | **ft** |
| **Freeboard:** | **1.0** | **ft** |
| **Final Total Basin Volume Provided:** | **200,532** | **$ft^3$** |
| **Maximum flow rate released from this basin:** | **1.37** | **cfs** |

> 1' Freeboard

Basin **G2-South**

# X2 Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.27.10** | **WATERSHED:** | **X2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X2** |

PAVED

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| X2.1.PV | 0.99 | 2900 | 0.1 | 5 | 4.0 | 0.26 | 6.6 | 0.43 | ~ | X1.1 | bypass* | 40+00 | Rt |
| X2.2.PV | 0.99 | 71300 | 1.6 | 5 | 4.0 | 6.46 | 6.6 | 10.67 | ~ | X1.2 | bypass* | 40+50 | Rt |
| X2.3.PV | 0.99 | 2850 | 0.1 | 5 | 4.0 | 0.26 | 6.6 | 0.43 | ~ | X1.3 | bypass* | 40+00 | Lt |
| X2.4.PV | 0.99 | 71100 | 1.6 | 5 | 4.0 | 6.44 | 6.6 | 10.64 | ~ | X1.4 | bypass* | 40+50 | Lt |

Σ 148150 *PAVED*

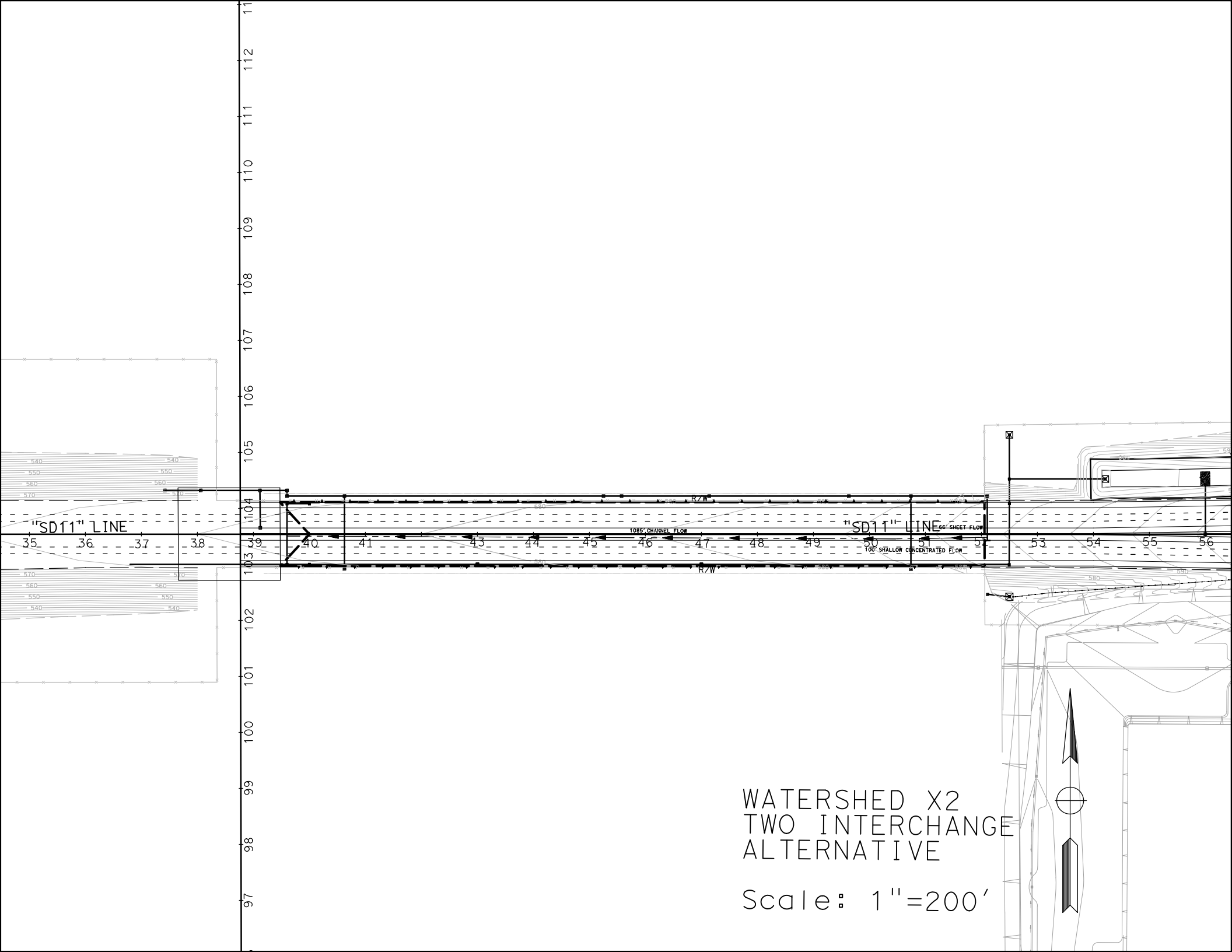
SLOPE

| | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Area** | | **Tc** | $i_{25}$ | $Q_{25}$ | $i_{100}$ | $Q_{100}$ | **Drains to:** | | | | |
| **Name** | **C** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| ~ | 0.61 | 0 | 0.0 | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ | ~ |

Σ 0 *SLOPE*

*flow that does not reach the basin

| Total : | 148150 | 3.4 |
|---|---|---|
| | *SF* | *ac* |


"SD11" LINE
"SD11" LINE
R/W
R/W
1085' CHANNEL FLOW
66' SHEET FLOW
100' SHALLOW CONCENTRATED FLOW
35
36
37
38
39
40
41
43
44
45
46
47
48
49
50
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53
54
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104
105
106
107
108
109
110
111
112
WATERSHED X2
TWO INTERCHANGE
ALTERNATIVE
Scale: 1"=200'

# X2 Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 40+00 |
| BY: | M.BRUNING | DATE: | 01.27.10 | WATERSHED: | X2 |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | X2 |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 140433 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 3.22 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | NOTES: |
|---|---|---|
| RELIEF (.08-.35) | 0.22 | Hilly Slopes ~ 15% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Poor natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.49 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.49 | 0.000 |
| PAVED SURFACE | 100% | AT | 0.90 | 0.900 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.90 |
| $C_{25}$ = | 0.99 |
| $C_{50}$ = | 1.00 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{.4\,5} n^{.4\,5}}{P_2^{.1/2} s^{.2\,5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 587.0 | ft | SR-11 at Sta 52 CL |
| LOW POINT ELEVATION | 586.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 66 | ft | |
| SLOPE (S) = (H/L) | 1.5% | | |
| MANNING'S n | 0.016 | | < = FROM FIG 816.6A HMA |
| $T_t$ (SFF)= | 1.75 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 586.0 | ft | assumed not channelized yet |
| LOW POINT ELEVATION | 584.0 | ft | |
| ELEVATION DIFF (H) | 2.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 2.0% | | |
| VELOCITY (SCF) | 4.0 | fps | <=V FROM FIG 816.5 HMA |
| $T_C$ (SH)= | 0.42 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 584.0 | ft | channelizes in shoulder of structure |
| LOW POINT ELEVATION | 578.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 6.0 | ft | Z= 20 ANG-RAD 0.050 |
| LENGTH (L) | 1085 | ft | b = 10 ANG-DEG 2.862 |
| SLOPE (S) = (H/L) | 0.6% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.016 | | HMA |
| HYDRAULIC RADIUS R | 0.3 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.33 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 5.43 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 7.60 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | | |
|---|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = | |
| $i_{10}$ = | 2.7 | in/hr | X CA = | |
| $i_{25}$ = | 3.4 | in/hr | X CA = | |
| $i_{50}$ = | 4.0 | in/hr | X CA = | |
| $i_{100}$ = | 4.2 | in/hr | X CA = | |

**FLOW RESULTS:**

| | cfs |
|---|---|
| $Q_2$ = | 5.4 |
| $Q_{10}$ = | 7.8 |
| $Q_{25}$ = | 10.8 |
| $Q_{50}$ = | 13.0 |
| $Q_{100}$ = | **13.6** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin X2 Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **40+00** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.27.10** | **WATERSHED:** | **X2** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **X2** |

***Notes:***

* The difference between pre-developed and post-developed values gives the approximate volume to detain.
Stage-Storage calculations will determine accurate volume

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 10.4 | cfs | | | |
| Tc= | 10.0 | min | C= | 0.76 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 240 | 0.4 |
| 20 | 240 | 0.4 |
| 30 | 240 | 0.4 |
| 40 | 240 | 0.4 |
| 50 | 240 | 0.4 |
| 60 | 240 | 0.4 |
| 70 | 240 | 0.4 |
| 80 | 300 | 0.5 |
| 90 | 300 | 0.5 |
| 100 | 300 | 0.5 |
| 110 | 300 | 0.5 |
| 120 | 300 | 0.5 |
| 130 | 360 | 0.6 |
| 140 | 360 | 0.6 |
| 150 | 420 | 0.7 |
| 160 | 420 | 0.7 |
| 170 | 480 | 0.8 |
| 180 | 480 | 0.8 |
| 190 | 540 | 0.9 |
| 200 | 600 | 1 |
| 210 | 720 | 1.2 |
| 220 | 840 | 1.4 |
| 230 | 1200 | 2 |
| 240 | 1680 | 2.8 |
| 250 | 6240 | 10.4 |
| 260 | 960 | 1.6 |
| 270 | 660 | 1.1 |
| 280 | 540 | 0.9 |
| 290 | 420 | 0.7 |
| 300 | 360 | 0.6 |
| 310 | 360 | 0.6 |
| 320 | 300 | 0.5 |
| 330 | 300 | 0.5 |
| 340 | 240 | 0.4 |
| 350 | 240 | 0.4 |
| 360 | 240 | 0.4 |
| 370 | 0 | 0 |

**SUM= 22140 $ft^3$**
**0.51 acre-feet**

Check: $V = C*A*P_6$
V= 0.51 acre-feet
***OK***

# Basin X2 Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 13.6 | cfs | | | |
| Tc= | 10.0 | min | C= | 1.00 | |
| $P_{100,6}$= | 2.5 | in | A= | 3.22 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 300 | 0.5 |
| 20 | 300 | 0.5 |
| 30 | 300 | 0.5 |
| 40 | 300 | 0.5 |
| 50 | 300 | 0.5 |
| 60 | 360 | 0.6 |
| 70 | 360 | 0.6 |
| 80 | 360 | 0.6 |
| 90 | 360 | 0.6 |
| 100 | 360 | 0.6 |
| 110 | 420 | 0.7 |
| 120 | 420 | 0.7 |
| 130 | 480 | 0.8 |
| 140 | 480 | 0.8 |
| 150 | 540 | 0.9 |
| 160 | 540 | 0.9 |
| 170 | 600 | 1 |
| 180 | 660 | 1.1 |
| 190 | 720 | 1.2 |
| 200 | 780 | 1.3 |
| 210 | 960 | 1.6 |
| 220 | 1080 | 1.8 |
| 230 | 1620 | 2.7 |
| 240 | 2220 | 3.7 |
| 250 | 8160 | 13.6 |
| 260 | 1320 | 2.2 |
| 270 | 840 | 1.4 |
| 280 | 660 | 1.1 |
| 290 | 540 | 0.9 |
| 300 | 480 | 0.8 |
| 310 | 420 | 0.7 |
| 320 | 420 | 0.7 |
| 330 | 360 | 0.6 |
| 340 | 360 | 0.6 |
| 350 | 300 | 0.5 |
| 360 | 300 | 0.5 |
| 370 | 0 | 0 |

**SUM= 28980 $ft^3$**
**0.67 acre-feet**

Check: V = C*A*$P_6$
V= 0.67 acre-feet
***OK***

**0.67**
\- **0.51**

**Attenuation volume = 0.16 acre-feet = 6840 $ft^3$** **Basin Required**
**REFER TO BASIN Y**

# Basin X2 Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 3.22 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **8543** **$ft^3$**

**WQV to be added to retention volume =** **1703** **$ft^3$** **Add this Volume to Basin**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

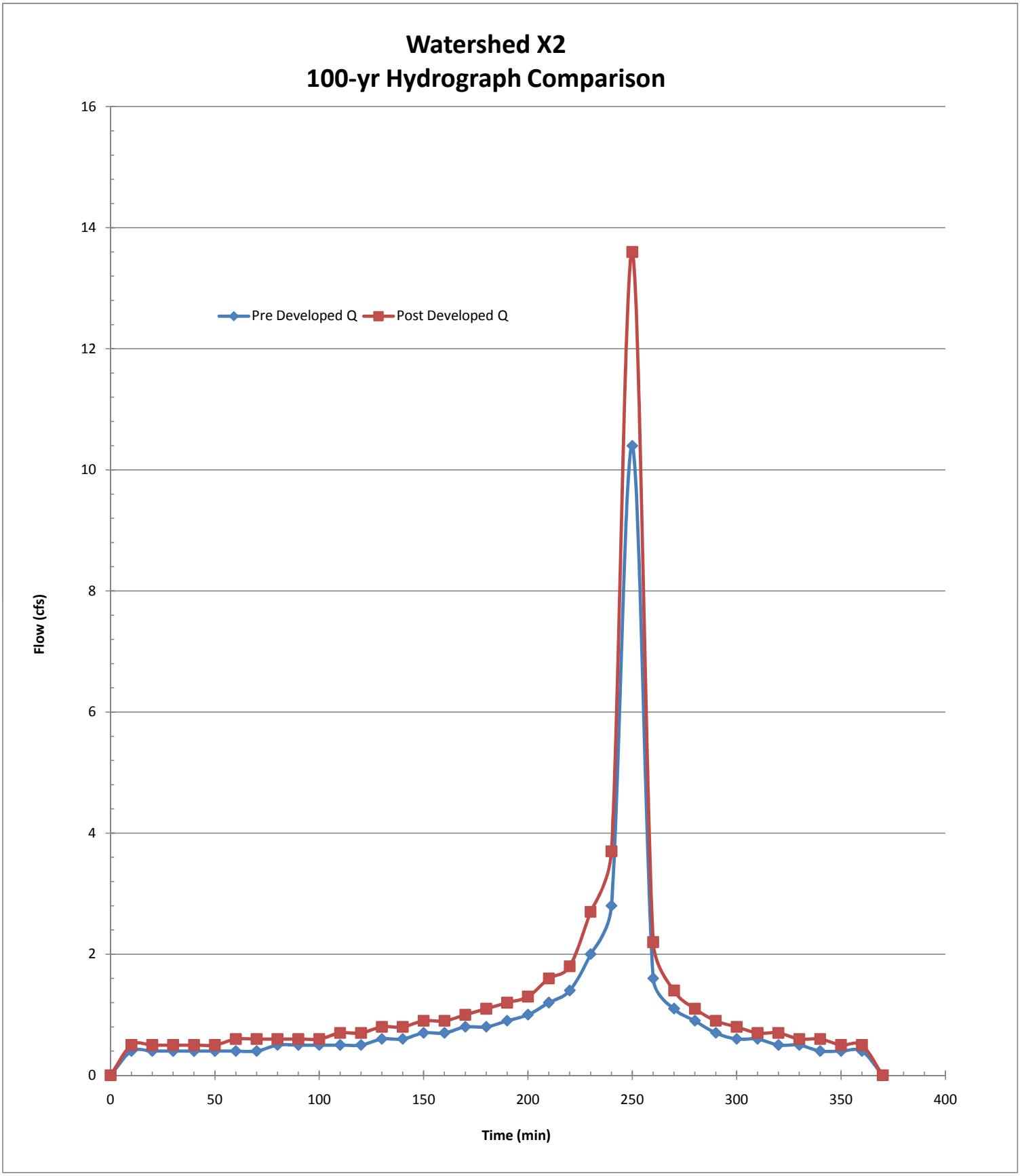
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 0 | $ft^2$ |
| | A: | 0.00 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 0.00 tons

**Silt Accumulation Basin volume =** **0** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Watershed X2
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
250
300
350
400

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## Detention/Retention Basin Flows and Sizes – Two Interchange Alternative

| Watershed | Location | Flow | | | Runoff Volume | | | Basin Volume - Breakdown | | | Basin Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Developed | Post-Developed | Increase | Pre-Developed | Post-Developed | Increase | Retention Provided | Detention | 1' Freeboard (minimum) | Final Volume | Length | Width | Depth | Free-board | Name |
| Name | (Sta) | (cfs) | (cfs) | (cfs) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | (ft) | (ft) | (ft) | (ft) | |
| X | 40+00 | 10.38 | 13.58 | 3.20 | 22,140 | 28,980 | 6,840 | ~ | ~ | ~ | Routed to Basin Y-EAST | ~ | ~ | ~ | ~ | ~ |
| A | 53+00 | 23.50 | 44.61 | 21.12 | 50,220 | 116,340 | 66,120 | 69,656 | 11,849 | 34,261 | 115,766 | 350 | 30 | 5.6 | 1.0 | A2 |
| B | 69+00 | 30.80 | 31.25 | 0.45 | 124,488 | 118,080 | (6,408) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| C | 78+00 | 16.38 | 9.18 | (7.20) | 35,100 | 19,620 | (15,480) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| D | 80+00 | 18.54 | 8.43 | (10.10) | 42,636 | 18,120 | (24,516) | ~ | ~ | ~ | No Basin Required | ~ | ~ | ~ | ~ | ~ |
| E | 96+00 | 61.90 | 87.94 | 26.04 | 232,050 | 325,266 | 93,216 | 110,043 | 25,134 | 50,041 | 185,217 | 285 | 75 | 6.0 | 1.2 | E2 |
| F | 110+00 | 154.03 | 168.07 | 14.05 | 667,620 | 714,966 | 47,346 | 50,822 | 29,855 | 109,552 | 190,229 | 265 | 85 | 6.0 | 3.0 | F2 |
| G | 127+00 | 59.99 | 134.01 | 74.02 | 180,846 | 340,548 | 159,702 | 51,890 | 48,364 | 27,056 | 127,310 | 200 | 58 | 6.6 | 1.0 | G2-North |
| | 139+00 | | | | | | | 119,168 | 26,575 | 54,789 | 200,532 | 180 | 180 | 5.0 | 1.0 | G2-South |

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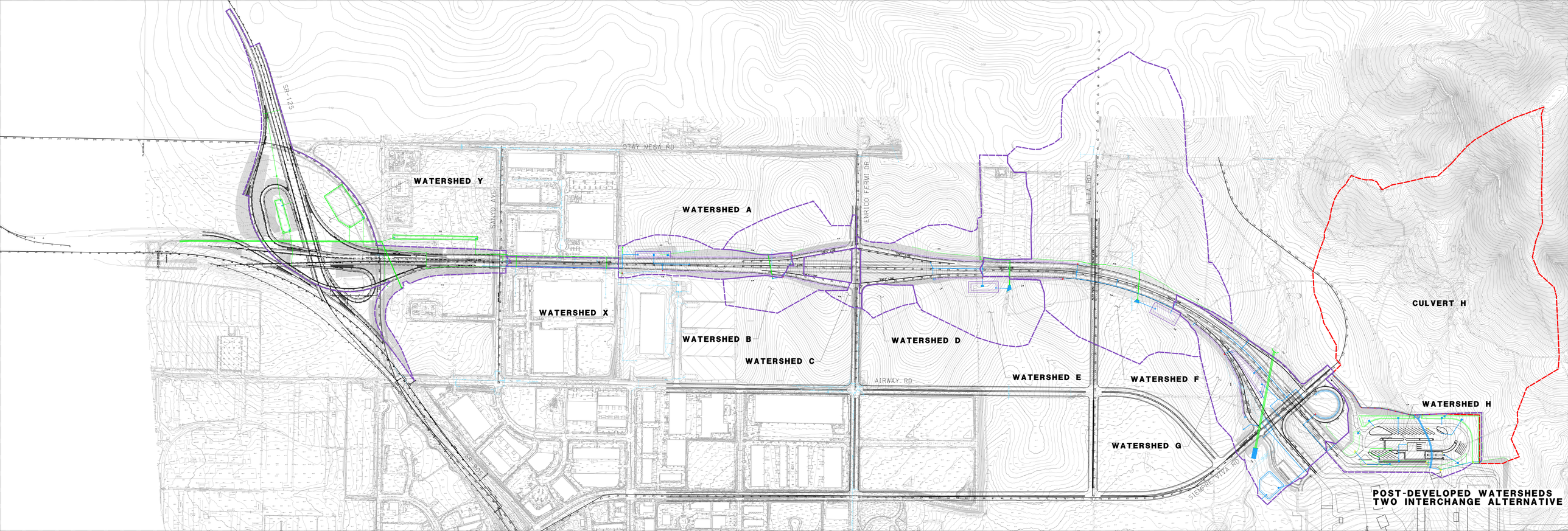


POST-DEVELOPED WATERSHEDS
TWO INTERCHANGE ALTERNATIVE

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# *Appendix E* Commercial Vehicle Enforcement Facility (CVEF)

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

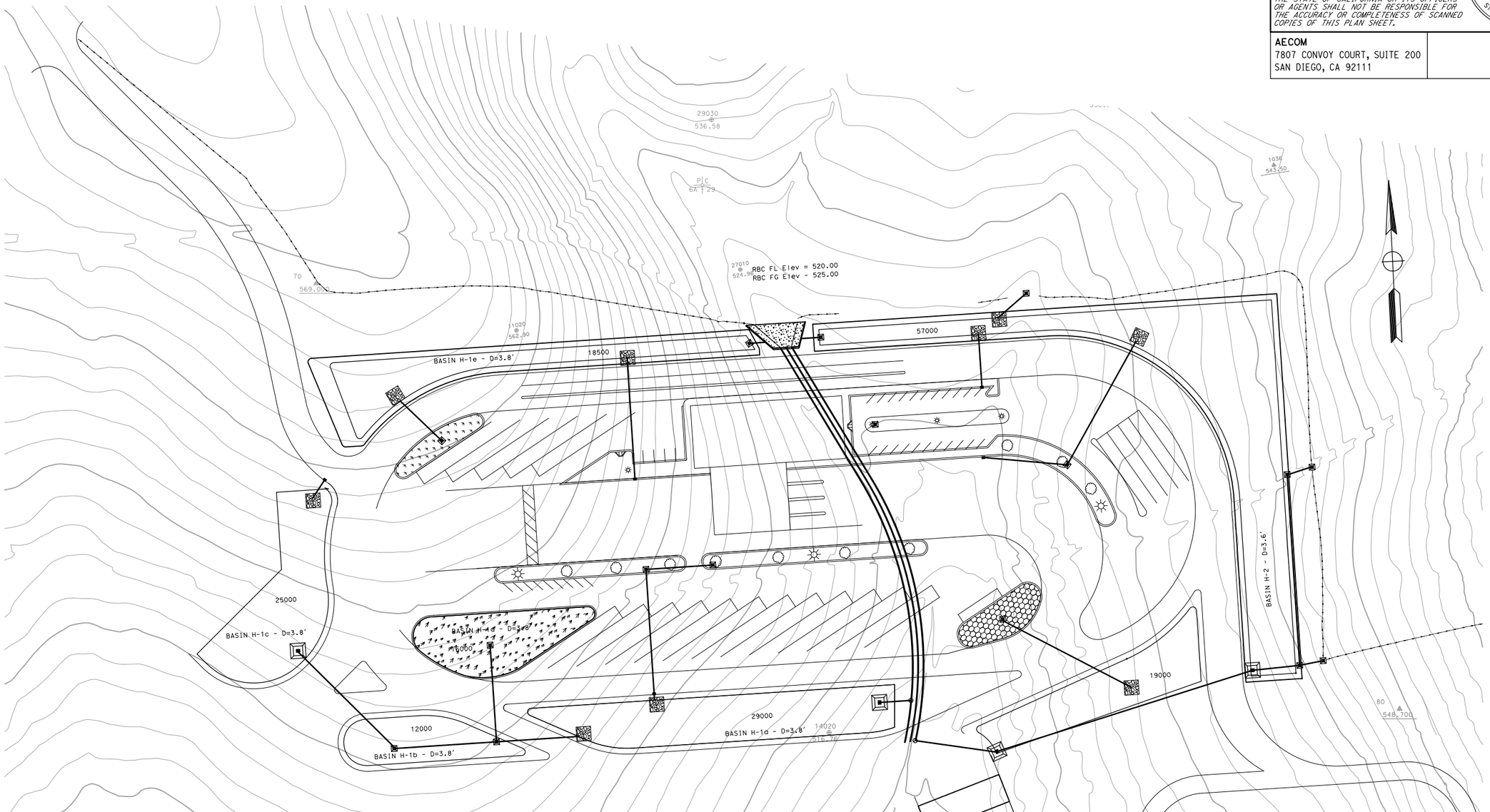
REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

*THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.*


**AECOM**
7807 CONVOY COURT, SUITE 200
SAN DIEGO, CA 92111


NOTE:

FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.




THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

# DRAINAGE PLAN
# D-CVEF

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | |
| GERARD DALZIEL | |

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 11-13-09
DATE PLOTTED => 2/3/2010
TIME PLOTTED => 5:16:05 PM

60099859

2/3/2010 5:16:04 PM YamanakaG H:\Caltrans\2208300\Cad\planset\b056300iaCVEF.dgn
BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => YamanakaG
DGN FILE => ...\b056300iaCVEF.dgn

CU XXXXX

EA 06002

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| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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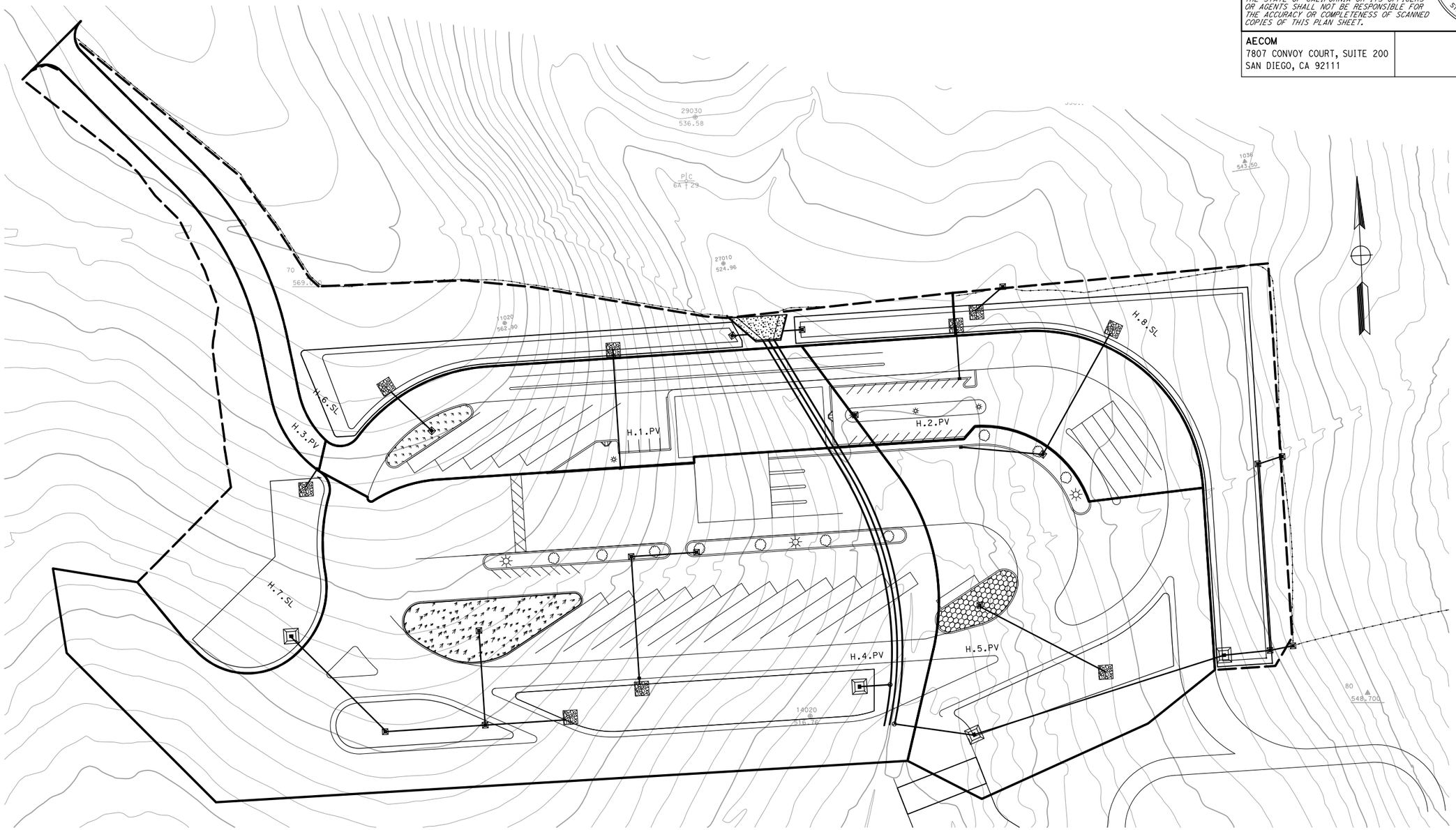
**AECOM**
7807 CONVOY COURT, SUITE 200
SAN DIEGO, CA 92111


NOTE:

FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.




THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

# DRAINAGE AREA PLAN

# DA-CVEF

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

CALCULATED-DESIGNED BY / CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 11-13-09 DATE PLOTTED => 2/3/2010 TIME PLOTTED => 5:17:24 PM

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# H Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **On-site Drainage Areas (D.A.)** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.12.10** | **WATERSHED:** | **H** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| | **Name** | **$C_{25}$** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| PAVED | H.1.PV | 0.99 | 104000 | 2.4 | 10 | 2.8 | 6.66 | 4.2 | 9.96 | ~ | H.1 | Basin H | CVEF | ~ |
| | H.2.PV | 0.99 | 80500 | 1.8 | 10 | 2.8 | 5.15 | 4.2 | 7.71 | ~ | H.2 | Basin H | CVEF | ~ |
| | H.3.PV | 0.99 | 29000 | 0.7 | 10 | 2.8 | 1.86 | 4.2 | 2.78 | ~ | H.3 | Basin H | CVEF | ~ |
| | H.4.PV | 0.99 | 444000 | 10.2 | 10 | 2.8 | 28.43 | 4.2 | 42.51 | ~ | H.4 | Basin H | CVEF | ~ |
| | H.5.PV | 0.99 | 167000 | 3.8 | 10 | 2.8 | 10.69 | 4.2 | 15.99 | ~ | H.5 | Basin H | CVEF | ~ |

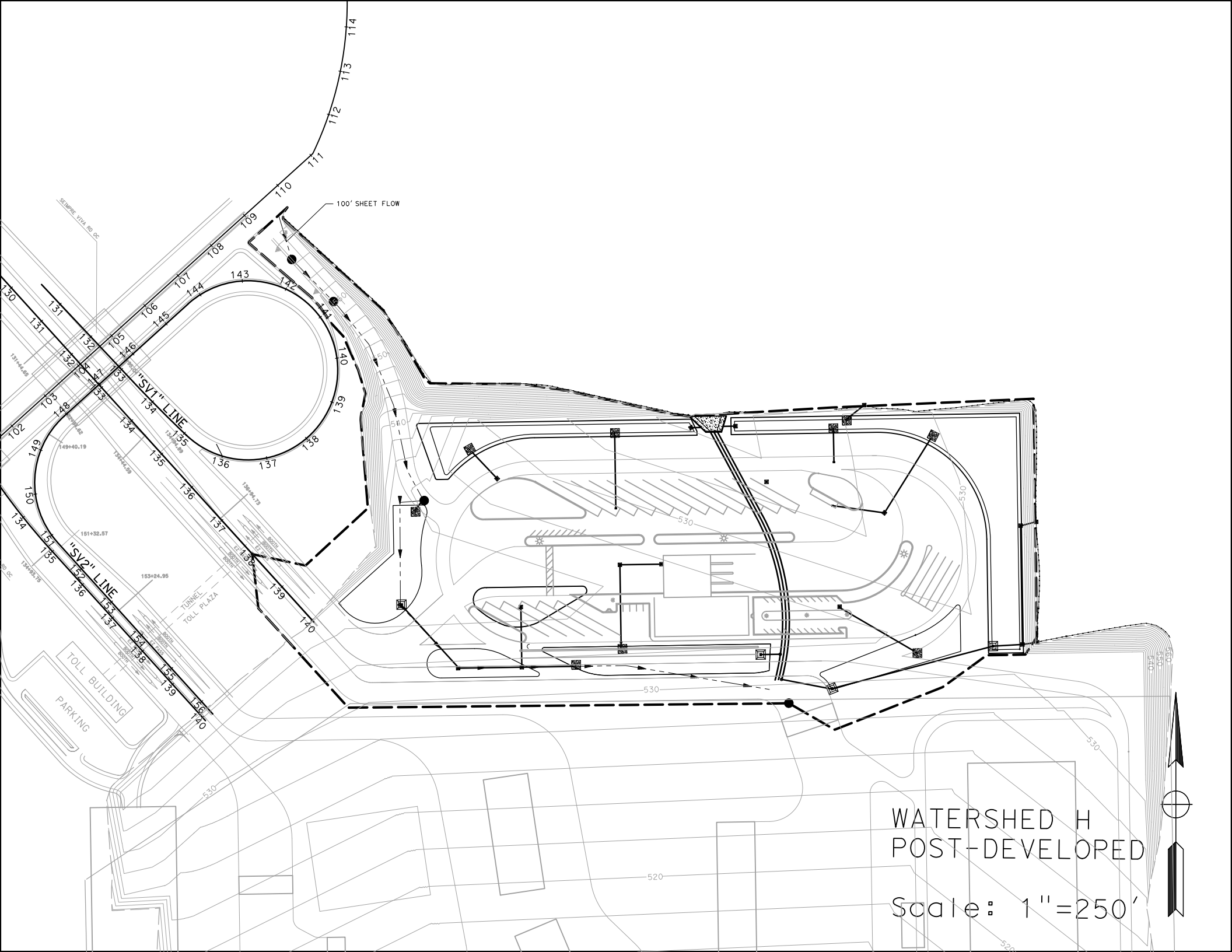
Σ 824500 *PAVED*

| | | | | | | Caltrans | Caltrans | County | County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Area** | | **Tc** | **$i_{25}$** | **$Q_{25}$** | **$i_{100}$** | **$Q_{100}$** | **Drains to:** | | | | |
| | **Name** | **$C_{25}$** | *SF* | *Acres* | *min* | *in/hr* | *cfs* | *in/hr* | *cfs* | Bioswale | Inlet | Destination | @ Station | Offset |
| SLOPE | H.6.SL | 0.61 | 107000 | 2.5 | 10 | 2.8 | 4.22 | 4.2 | 6.31 | ~ | ~ | Basin H | CVEF | ~ |
| | H.7.SL | 0.61 | 88000 | 2.0 | 10 | 2.8 | 3.47 | 4.2 | 5.19 | ~ | ~ | Basin H | CVEF | ~ |
| | H.8.SL | 0.61 | 98000 | 2.2 | 10 | 2.8 | 3.87 | 4.2 | 5.78 | ~ | ~ | Basin H | CVEF | ~ |

Σ 293000 *SLOPE*

| | | |
|---|---|---|
| Total : | 1117500 | 25.65 |
| | *SF* | *ac* |

| | |
|---|---|
| C: | 0.89 |
| $C_{100}$: | 1.00 |


100' SHEET FLOW
"SV1" LINE
"SV2" LINE
TOLL BUILDING
PARKING
TUNNEL
TOLL PLAZA
WATERSHED H
POST-DEVELOPED
Scale: 1"=250'

# H Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | CVEF |
| BY: | M.BRUNING | DATE: | 01.12.10 | WATERSHED: | H |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1117500 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 25.65 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 74% | AT | 0.90 | 0.664 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 26% | AT | 0.55 | 0.144 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.81 |
| $C_{25}$ = | 0.89 |
| $C_{50}$ = | 0.97 |
| $C_{100}$ = | 1.00 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42 L^{4/5} n^{4/5}}{P_2^{1/2} s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 570.0 | ft | CVEF Access Road from S.V. |
| LOW POINT ELEVATION | 566.0 | ft | |
| ELEVATION DIFF (H) | 4.0 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 4.0% | | |
| MANNING'S n | 0.016 | | < = from Table 816.6A HMA |
| $T_t$ (SFF)= | 1.65 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 566.0 | ft | down access road |
| LOW POINT ELEVATION | 560.0 | ft | |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 120 | ft | |
| SLOPE (S) = (H/L) | 5.0% | | |
| VELOCITY (SCF) | 5.0 | fps | <=V from Figure 816.5 Gutter, not concentrated |
| $T_C$ (SH)= | 0.40 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 560.0 | ft | channelizes in gutter of access road |
| LOW POINT ELEVATION | 532.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 28.0 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 493 | ft | b = 8 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 5.7% | | d = 0.5 FLOWING FULL ASS'M |
| MANNING'S n | 0.016 | | HMA |
| HYDRAULIC RADIUS R | 0.4 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 12.83 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 0.64 | minutes | |

# H Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 532.0 | ft |
| LOW POINT ELEVATION | 518.0 | ft |
| ELEVATION DIFF (H) | 14.0 | ft |
| LENGTH (L) | 1175 | ft |
| SLOPE (S) = (H/L) | 1.2% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 4.0 | ft |
| HYDRAULIC RADIUS R | 1.0 | ft |
| VELOCITY (STORMDRAIN) | 12.5 | fps |
| $T_C$ (SD)= | 1.57 | minutes |

**NOTES:**

| |
|---|
| Assume piped to Basin |
| Basin FL |
| |
| |
| |
| |
| |
| R=D/4, Assume: flowing full |
| $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 4.26 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

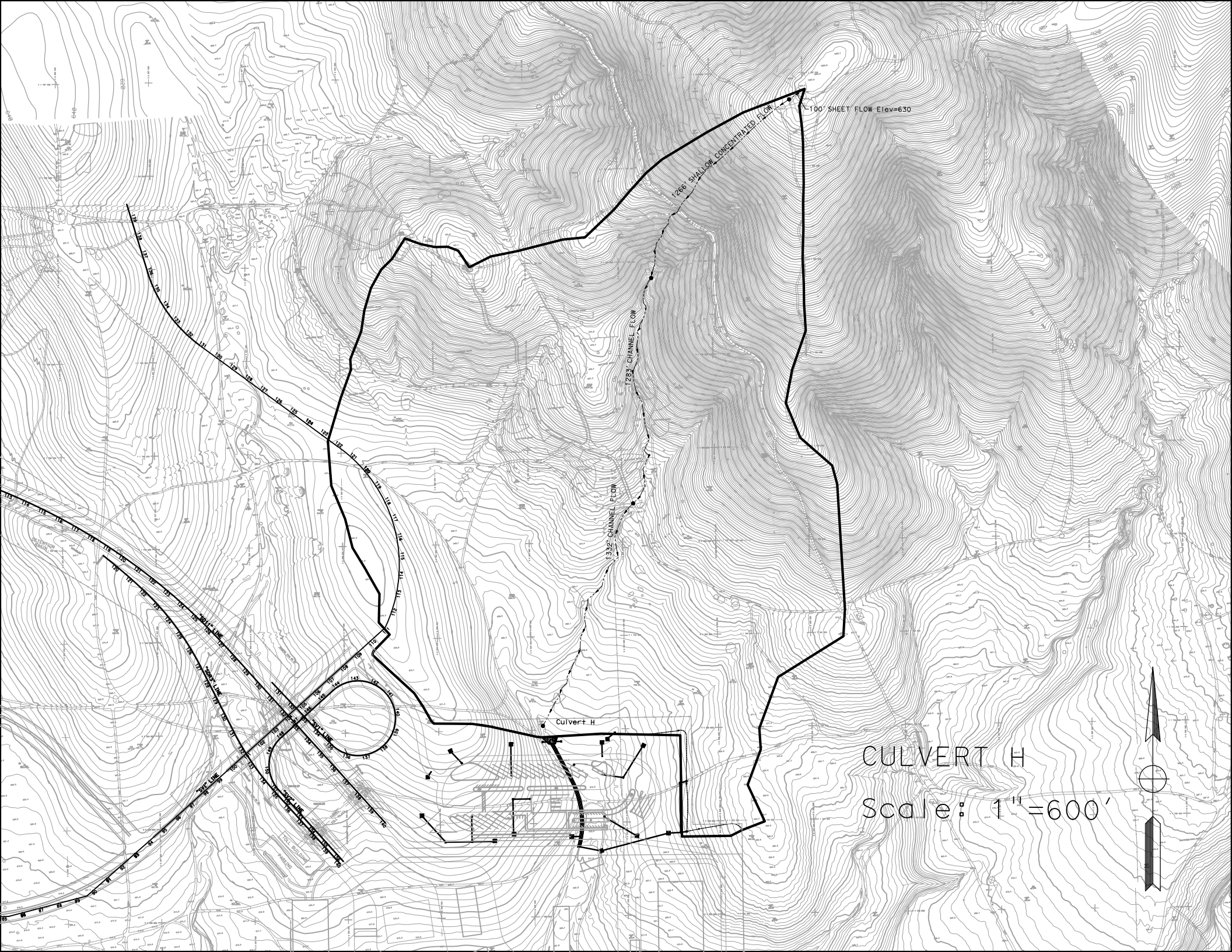
| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 38.4 |
| **$Q_{10}$ =** | 55.9 |
| **$Q_{25}$ =** | 76.9 |
| **$Q_{50}$ =** | 100.6 |
| **$Q_{100}$ =** | **108.1** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |


100' SHEET FLOW Elev=630
1266' SHALLOW CONCENTRATED FLOW
1233' CHANNEL FLOW
1332' CHANNEL FLOW
Culvert H
CULVERT H
Scale: 1"=600'

# Culvert Calculator Report
# H CVEF 10-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 524.00 | ft | Headwater Depth/Height | 0.65 | |
| Computed Headwater Elevation | 522.61 | ft | Discharge | 123.90 | cfs |
| Inlet Control HW Elev. | 522.36 | ft | Tailwater Elevation | 511.76 | ft |
| Outlet Control HW Elev. | 522.61 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 520.00 | ft | Downstream Invert | 510.00 | ft |
| Length | 694.00 | ft | Constructed Slope | 1.4 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | CompositeS1S2 | | Depth, Downstream | 1.76 | ft |
| Slope Type | Steep | | Normal Depth | 0.94 | ft |
| Flow Regime | N/A | | Critical Depth | 1.49 | ft |
| Velocity Downstream | 5.87 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Box | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 6.00 | ft |
| Section Size | 6 x 4 ft | | Rise | 4.00 | ft |
| Number Sections | 2 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 522.61 | ft | Upstream Velocity Head | 0.75 | ft |
| Ke | 0.50 | | Entrance Loss | 0.37 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 522.36 | ft | Flow Control | Unsubmerged | |
| Inlet Type 45° bevels; 10 - 45° skewed headwall | | | Area Full | 48.0 | $ft^2$ |
| K | 0.49800 | | HDS 5 Chart | 11 | |
| M | 0.66700 | | HDS 5 Scale | 4 | |
| C | 0.03270 | | Equation Form | 2 | |
| Y | 0.75000 | | | | |

# Culvert Calculator Report
# H CVEF 100-yr

Solve For: Headwater Elevation

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Allowable HW Elevation | 525.00 | ft | Headwater Depth/Height | 1.05 | |
| Computed Headwater Elevation | 524.18 | ft | Discharge | 251.60 | cfs |
| Inlet Control HW Elev. | 523.79 | ft | Tailwater Elevation | 511.44 | ft |
| Outlet Control HW Elev. | 524.18 | ft | Control Type | Entrance Control | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 520.00 | ft | Downstream Invert | 510.00 | ft |
| Length | 694.00 | ft | Constructed Slope | 1.4 | % |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.52 | ft |
| Slope Type | Steep | | Normal Depth | 1.52 | ft |
| Flow Regime | Supercritical | | Critical Depth | 2.39 | ft |
| Velocity Downstream | 13.80 | ft/s | Critical Slope | 0.4 | % |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Box | | Mannings Coefficient | 0.013 | |
| Section Material | Concrete | | Span | 6.00 | ft |
| Section Size | 6 x 4 ft | | Rise | 4.00 | ft |
| Number Sections | 2 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 524.18 | ft | Upstream Velocity Head | 1.20 | ft |
| Ke | 0.50 | | Entrance Loss | 0.60 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 523.79 | ft | Flow Control | Unsubmerged | |
| Inlet Type 45° bevels; 10 - 45° skewed headwall | | | Area Full | 48.0 | $ft^2$ |
| K | 0.49800 | | HDS 5 Chart | 11 | |
| M | 0.66700 | | HDS 5 Scale | 4 | |
| C | 0.03270 | | Equation Form | 2 | |
| Y | 0.75000 | | | | |

# H Culvert TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Culvert |
| JOB #: | 11A1190 | | | STATION: | CVEF |
| BY: | M.BRUNING | DATE: | 01.12.10 | WATERSHED: | H |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Culvert |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 7050716 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 161.86 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.22 | Hilly Slopes ~ 15% |
| INFILTRATION (.04-.16) | 0.12 | Negligible infiltration capacity - See Geotechnical Report |
| VEGETATION (.04-.16) | 0.08 | Fair natural cover |
| STORAGE (.04-.12) | 0.07 | Normal |
| TOTAL C = | 0.49 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 100% | AT | 0.49 | 0.490 |
| PAVED SURFACE | 0% | AT | 0.90 | 0.000 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 0% | AT | 0.55 | 0.000 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.49 |
| $C_{25}$ = | 0.54 |
| $C_{50}$ = | 0.59 |
| $C_{100}$ = | 0.61 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

NOTES: $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 1023.9 | ft | Northern watershed boundary |
| LOW POINT ELEVATION | 1014.0 | ft | |
| ELEVATION DIFF (H) | 9.9 | ft | |
| LENGTH (L) | 100 | ft | |
| SLOPE (S) = (H/L) | 9.9% | | |
| MANNING'S n | 0.050 | | < = FROM TABLE 816.6A Fallow |
| $T_t$ (SFF)= | 2.86 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 1014.0 | ft | |
| LOW POINT ELEVATION | 672.0 | ft | |
| ELEVATION DIFF (H) | 342.0 | ft | |
| LENGTH (L) | 1266 | ft | |
| SLOPE (S) = (H/L) | 27.0% | | |
| VELOCITY (SCF) | 3.3 | fps | <=V FROM FIG 816.6 Earthen/Grasses |
| $T_C$ (SH)= | 6.39 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

NOTES:

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 672.0 | ft | channelizes |
| LOW POINT ELEVATION | 581.1 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 90.9 | ft | Z= 2 ANG-RAD 0.464 |
| LENGTH (L) | 1283 | ft | b = 0.5 ANG-DEG 26.565 |
| SLOPE (S) = (H/L) | 7.1% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.080 | | grass/earthen |
| HYDRAULIC RADIUS R | 0.5 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.13 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_C$ (CH)= | 6.82 | minutes | |

# H Culvert TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 581.1 | ft |
| LOW POINT ELEVATION | 525.0 | ft |
| ELEVATION DIFF (H) | 56.1 | ft |
| LENGTH (L) | 1332 | ft |
| SLOPE (S) = (H/L) | 4.2% | |
| MANNING'S n | 0.080 | |
| HYDRAULIC RADIUS R | 1.2 | ft |
| VELOCITY (CHANNEL) | 4.43 | fps |
| $T_C$ (CH)= | 5.01 | minutes |

**NOTES:**

broader channel at confluence

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 3 | ANG-RAD | 0.322 |
| b = | 20 | ANG-DEG | 18.435 |
| d = | 1.5 | FLOWING FULL ASS'M | |

grass/earthen

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 21.09 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE $T_C$ =** | **21.09** | minutes |

**INTENSITY CHART:** **Caltrans IDF2000**

**FLOW RESULTS**

| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 0.8 | in/hr | X CA = | $Q_2$ = | 65.8 |
| $i_{10}$ = | 1.6 | in/hr | X CA = | $Q_{10}$ = | 123.6 |
| $i_{25}$ = | 1.9 | in/hr | X CA = | $Q_{25}$ = | 169.9 |
| $i_{50}$ = | 2.2 | in/hr | X CA = | $Q_{50}$ = | 213.2 |
| $i_{100}$ = | 2.5 | in/hr | X CA = | $Q_{100}$ = | **250.9** |

~Use Caltrans 'i' for culvert sizing

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

**FLOW RESULTS**

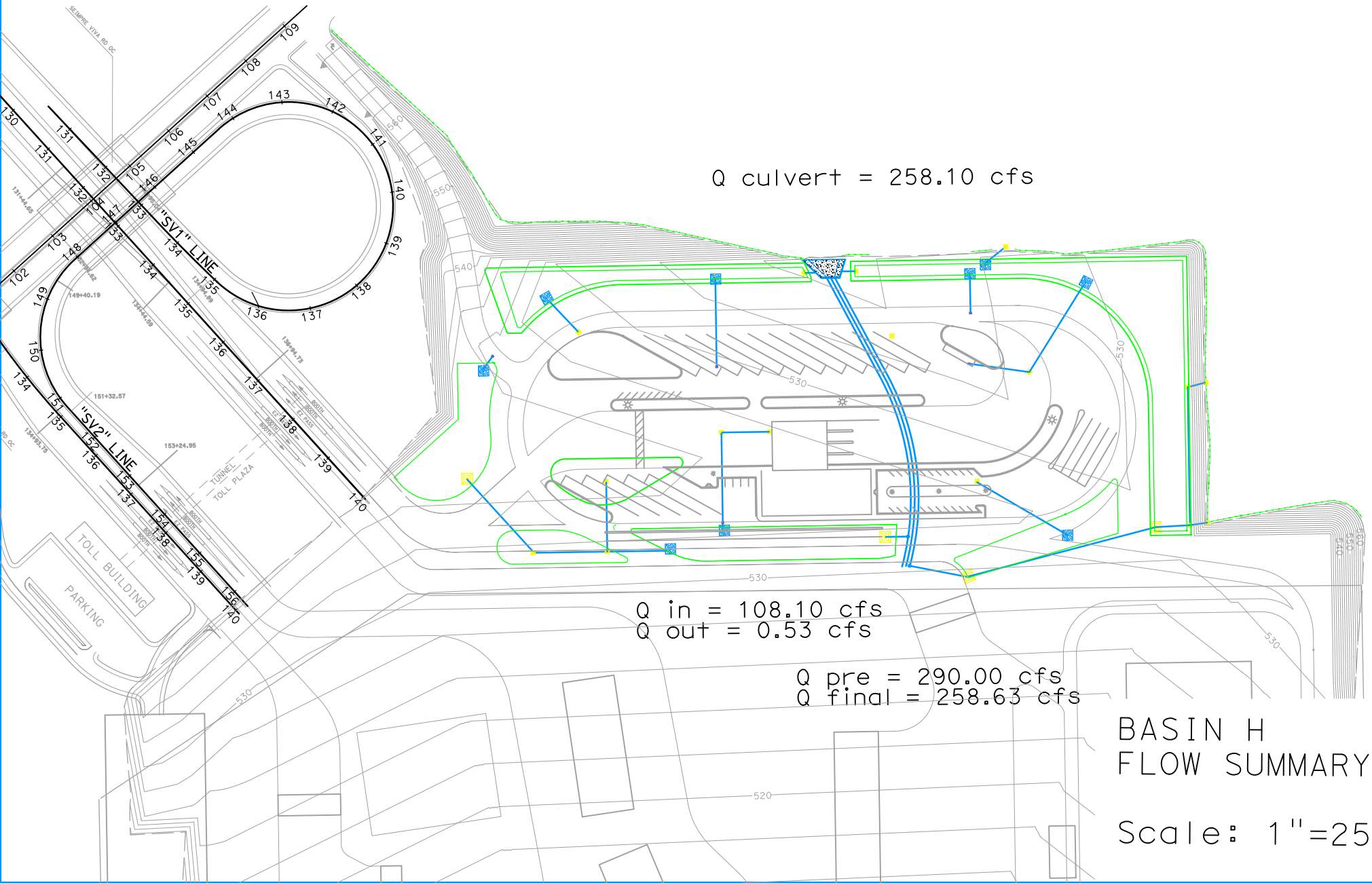
| | | | | | cfs |
|---|---|---|---|---|---|
| $i_2$ = | 1.1 | in/hr | X CA = | $Q_2$ = | 90.8 |
| $i_{10}$ = | 1.7 | in/hr | X CA = | $Q_{10}$ = | 132.1 |
| $i_{25}$ = | 2.1 | in/hr | X CA = | $Q_{25}$ = | 181.7 |
| $i_{50}$ = | 2.5 | in/hr | X CA = | $Q_{50}$ = | 237.8 |
| $i_{100}$ = | 2.6 | in/hr | X CA = | $Q_{100}$ = | **258.1** |

~Use County of SD 'i' for detention basin design

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN H
FLOW SUMMARY

Scale: 1"=250'

# Basin H Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **CVEF** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.12.10** | **WATERSHED:** | **H** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

* The difference between pre-developed and post-developed values gives the approximate volume to detain.
Stage-Storage calculations will determine accurate volume

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 31.9 | cfs | | | |
| Tc= | 12.6 | min | C= | 0.61 | |
| $P_{100,6}$= | 2.5 | in | A= | 14.33 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 13 | 0 | 0 |
| 26 | 1014 | 1.3 |
| 39 | 1092 | 1.4 |
| 52 | 1092 | 1.4 |
| 65 | 1170 | 1.5 |
| 78 | 1248 | 1.6 |
| 91 | 1248 | 1.6 |
| 104 | 1326 | 1.7 |
| 117 | 1404 | 1.8 |
| 130 | 1560 | 2 |
| 143 | 1638 | 2.1 |
| 156 | 1794 | 2.3 |
| 169 | 1872 | 2.4 |
| 182 | 2184 | 2.8 |
| 195 | 2340 | 3 |
| 208 | 2886 | 3.7 |
| 221 | 3276 | 4.2 |
| 234 | 4836 | 6.2 |
| 247 | 6162 | 7.9 |
| 260 | 24882 | 31.9 |
| 273 | 3822 | 4.9 |
| 286 | 2574 | 3.3 |
| 299 | 2028 | 2.6 |
| 312 | 1716 | 2.2 |
| 325 | 1482 | 1.9 |
| 338 | 1326 | 1.7 |
| 351 | 1170 | 1.5 |
| 364 | 1092 | 1.4 |
| 377 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

| | | |
|---|---|---|
| **SUM=** | **78234** | **$ft^3$** |
| | **1.80** | **acre-feet** |

Check: $V = C*A*P_6$

V= 1.83 acre-feet

***OK***

# Basin H Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 108.1 | cfs | | | |
| Tc= | 10.0 | min | C= | 1.00 | |
| $P_{100,6}$= | 2.5 | in | A= | 25.65 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 2280 | 3.8 |
| 20 | 2340 | 3.9 |
| 30 | 2460 | 4.1 |
| 40 | 2460 | 4.1 |
| 50 | 2580 | 4.3 |
| 60 | 2640 | 4.4 |
| 70 | 2760 | 4.6 |
| 80 | 2820 | 4.7 |
| 90 | 3000 | 5 |
| 100 | 3060 | 5.1 |
| 110 | 3300 | 5.5 |
| 120 | 3360 | 5.6 |
| 130 | 3660 | 6.1 |
| 140 | 3780 | 6.3 |
| 150 | 4080 | 6.8 |
| 160 | 4320 | 7.2 |
| 170 | 4740 | 7.9 |
| 180 | 5040 | 8.4 |
| 190 | 5820 | 9.7 |
| 200 | 6300 | 10.5 |
| 210 | 7680 | 12.8 |
| 220 | 8760 | 14.6 |
| 230 | 12840 | 21.4 |
| 240 | 18060 | 30.1 |
| 250 | 64860 | 108.1 |
| 260 | 10320 | 17.2 |
| 270 | 6900 | 11.5 |
| 280 | 5400 | 9 |
| 290 | 4500 | 7.5 |
| 300 | 3900 | 6.5 |
| 310 | 3480 | 5.8 |
| 320 | 3180 | 5.3 |
| 330 | 2940 | 4.9 |
| 340 | 2700 | 4.5 |
| 350 | 2520 | 4.2 |
| 360 | 2400 | 4 |
| 370 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 231240 $ft^3$**
**5.31 acre-feet**

Check: $V = C*A*P_6$
V= 5.34 acre-feet
***OK***

**5.31**
**- 1.80**
**Attenuation volume = 3.51 acre-feet = 153006 $ft^3$ Basin Required**

# Basin H Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 1.00
A= 25.65 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **67981** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**If the WQV is less than retention requirement, do not add volume since WQ is addressed in Retention**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 293000 $ft^2$

| | | | |
|---|---|---|---|
| | A: | 6.73 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr.Ac |

Volume for 10-year Silt Accumulation = 104.61 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

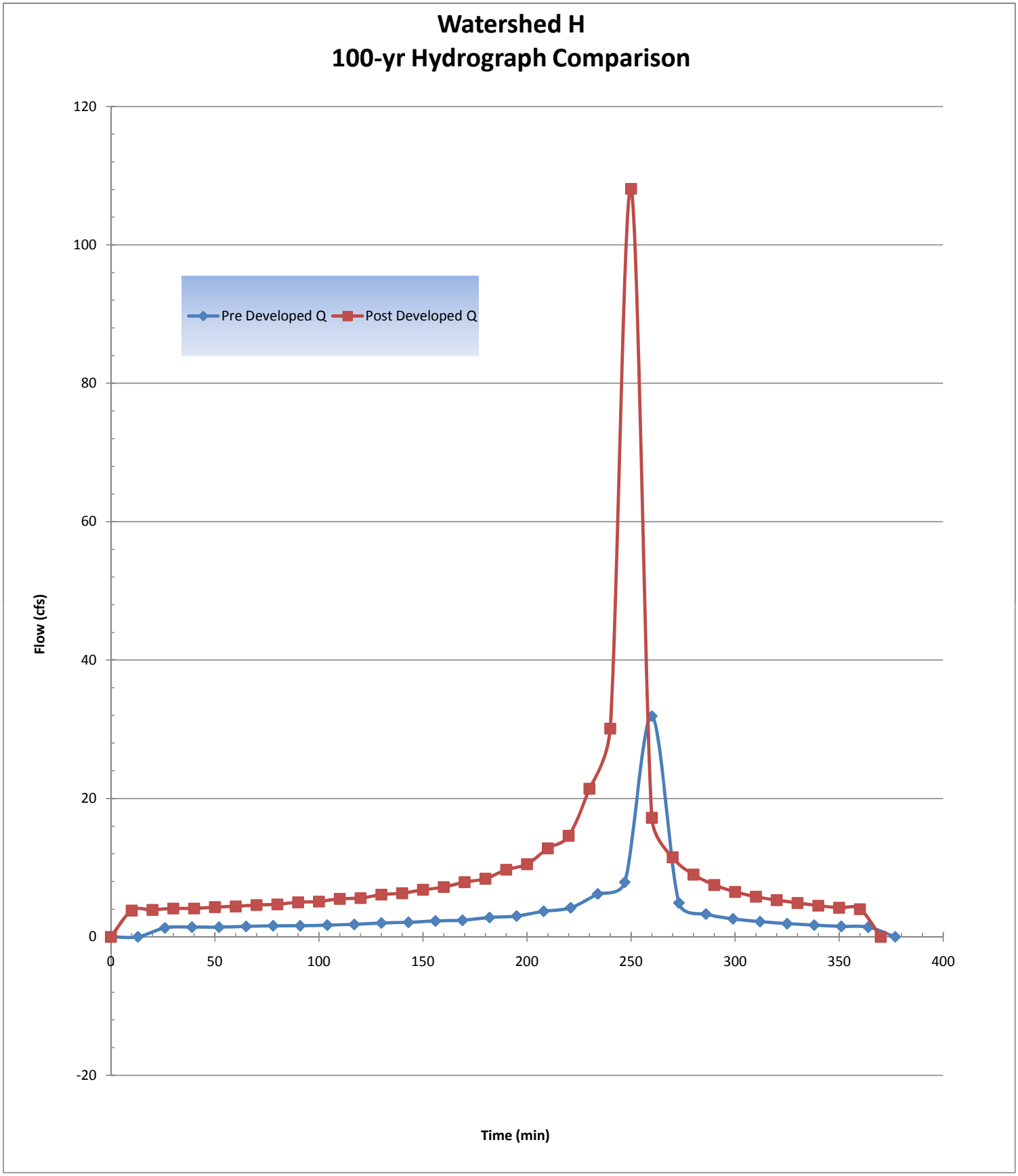
$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **2325** **$ft^3$**

**Add this volume to Basin volume due to silts from cut slopes**


Watershed H
100-yr Hydrograph Comparison
Pre Developed Q
Post Developed Q
Flow (cfs)
Time (min)
120
100
80
60
40
20
0
-20
0
50
100
150
200
250
300
350
400

# Basin H Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **~** |
| **BY:** | **M.BRUNING** | **DATE:** | **01.12.10** | **WATERSHED:** | **H** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin H** |

***Notes:***
This is the actual flow entering the detention basin

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

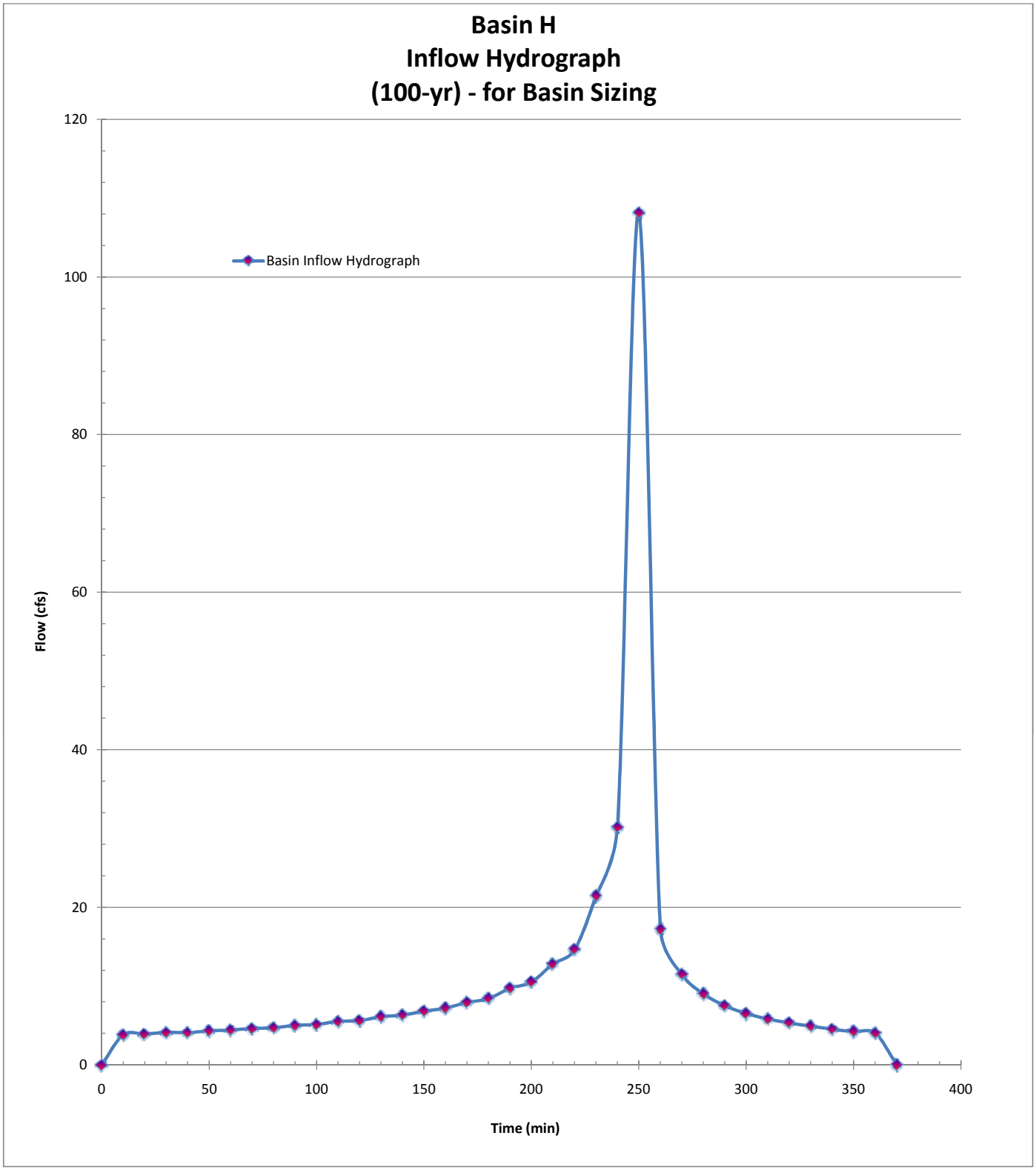
| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 108.1 | cfs | $C_{100}$= | 1.00 | |
| Tc= | 10.0 | min | | | |
| $P_{100,6}$= | 2.5 | in | A= | 25.65 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 2280 | 3.8 |
| 20 | 2340 | 3.9 |
| 30 | 2460 | 4.1 |
| 40 | 2460 | 4.1 |
| 50 | 2580 | 4.3 |
| 60 | 2640 | 4.4 |
| 70 | 2760 | 4.6 |
| 80 | 2820 | 4.7 |
| 90 | 3000 | 5 |
| 100 | 3060 | 5.1 |
| 110 | 3300 | 5.5 |
| 120 | 3360 | 5.6 |
| 130 | 3660 | 6.1 |
| 140 | 3780 | 6.3 |
| 150 | 4080 | 6.8 |
| 160 | 4320 | 7.2 |
| 170 | 4740 | 7.9 |
| 180 | 5040 | 8.4 |
| 190 | 5820 | 9.7 |
| 200 | 6300 | 10.5 |
| 210 | 7680 | 12.8 |
| 220 | 8760 | 14.6 |
| 230 | 12840 | 21.4 |
| 240 | 18060 | 30.1 |
| 250 | 64860 | 108.1 |
| 260 | 10320 | 17.2 |
| 270 | 6900 | 11.5 |
| 280 | 5400 | 9 |
| 290 | 4500 | 7.5 |
| 300 | 3900 | 6.5 |
| 310 | 3480 | 5.8 |
| 320 | 3180 | 5.3 |
| 330 | 2940 | 4.9 |
| 340 | 2700 | 4.5 |
| 350 | 2520 | 4.2 |
| 360 | 2400 | 4 |
| 370 | 0 | 0 |

**SUM= 231240 $ft^3$**
**5.31 acre-feet**

Onsite Runoff Volume

Check: $V = C*A*P_6$
V= 5.34 acre-feet
***OK***


Basin H
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
0
50
100
150
200
250
300
350
400

# Basin H Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **CVEF** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **H** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | **Basin H** |

***Notes:***

| | | | | |
|---|---|---|---|---|
| Required Retention Basin Volume = | 155331 | $ft^3$ | | |
| Actual Basin Inflow = | 231240 | $ft^4$ | *OK* | |

***Flow Balance - determine maximum flow from basin***

| | | | | |
|---|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 31.9 | cfs | | |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | | Culvert flow is separate in this run |
| Flow that does not reach detention basin (bypass per DA table): | 0.0 | cfs | ~ | $Q_{100}$ from: |
| Maximum flow allowed to be released by this detention basin: | 31.9 | cfs | | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 528.00 | ft |
| Basin flowline elevation = | 524.00 | ft |
| Maximum Basin Depth = | 4.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 1.20 | ft | 525.20 | ft |
| Outlet pipe diameter = | 2.00 | ft | | |

***Basin Characteristics***

| | | |
|---|---|---|
| Base Length (L) | 652 | ft |
| Base Width (W) | 215 | ft |
| W/L Ratio ® | 0.33 | |
| Side Slopes (Z) | 1: 4 | |
| Total Volume (V): | 617750 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 524.00 | 0.00 | 0 | 0 | | 524.00 | 0.00 | | 0.00 |
| 1 | 524.20 | 0.20 | 28187 | 28187 | | 524.20 | 0.00 | | 0.00 |
| 2 | 524.40 | 0.40 | 28466 | 56653 | | 524.40 | 0.00 | | 0.00 |
| 3 | 524.60 | 0.60 | 28745 | 85398 | | 524.60 | 0.00 | | 0.00 |
| 4 | 524.80 | 0.80 | 29026 | 114423 | | 524.80 | 0.00 | | 0.00 |
| 5 | 525.00 | 1.00 | 29307 | 143731 | | 525.00 | 0.00 | | 0.00 |
| 6 | 525.20 | 1.20 | 29590 | 173320 | * | 525.20 | 0.00 | | 0.00 |
| 7 | 525.40 | 1.40 | 29873 | 203194 | | 525.40 | 0.15 | | 0.15 |
| 8 | 525.60 | 1.60 | 30158 | 233352 | | 525.60 | 0.59 | | 0.59 |
| 9 | 525.80 | 1.80 | 30444 | 263796 | | 525.80 | 1.30 | 0.00 | 1.30 |
| 10 | 526.00 | 2.00 | 30730 | 294526 | | 526.00 | 2.25 | | 2.25 |
| 11 | 526.20 | 2.20 | 31018 | 325544 | | 526.20 | 3.42 | | 3.42 |
| 12 | 526.40 | 2.40 | 31307 | 356851 | | 526.40 | 4.79 | | 4.79 |
| 13 | 526.60 | 2.60 | 31597 | 388448 | | 526.60 | 6.32 | | 6.32 |
| 14 | 526.80 | 2.80 | 31887 | 420335 | | 526.80 | 7.99 | | 7.99 |
| 15 | 527.00 | 3.00 | 32179 | 452514 | | 527.00 | 9.77 | | 9.77 |
| 16 | 527.20 | 3.20 | 32472 | 484987 | | 527.20 | 11.63 | | 11.63 |
| 17 | 527.40 | 3.40 | 32766 | 517753 | | 527.40 | 13.53 | | 13.53 |
| 18 | 527.60 | 3.60 | 33061 | 550814 | | 527.60 | 15.46 | | 15.46 |

# Basin H Routing

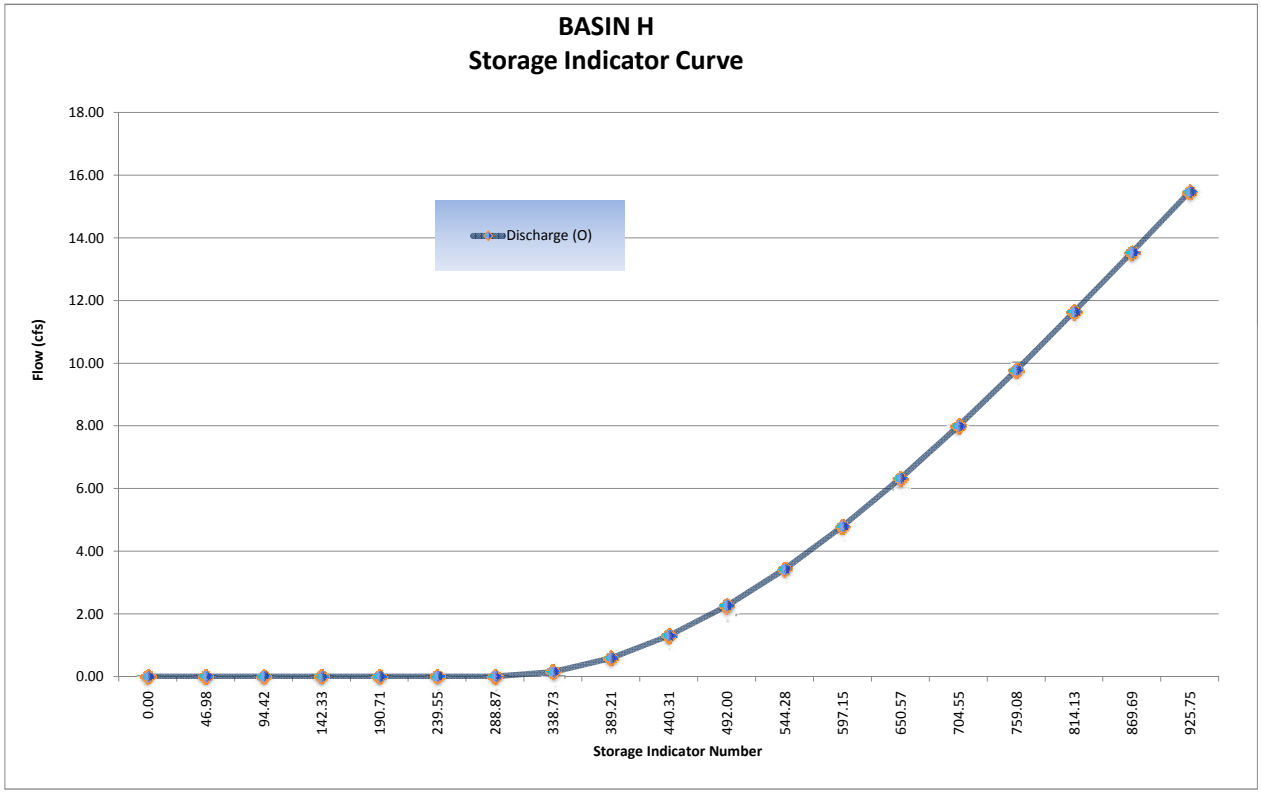
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | CVEF |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | H |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin H |

user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 524.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 524.20 | 0.00 | 28187 | 0.00 | 46.98 | 46.98 |
| 524.40 | 0.00 | 56653 | 0.00 | 94.42 | 94.42 |
| 524.60 | 0.00 | 85398 | 0.00 | 142.33 | 142.33 |
| 524.80 | 0.00 | 114423 | 0.00 | 190.71 | 190.71 |
| 525.00 | 0.00 | 143731 | 0.00 | 239.55 | 239.55 |
| 525.20 | 0.00 | 173320 | 0.00 | 288.87 | 288.87 |
| 525.40 | 0.15 | 203194 | 0.08 | 338.66 | 338.73 |
| 525.60 | 0.59 | 233352 | 0.30 | 388.92 | 389.21 |
| 525.80 | 1.30 | 263796 | 0.65 | 439.66 | 440.31 |
| 526.00 | 2.25 | 294526 | 1.13 | 490.88 | 492.00 |
| 526.20 | 3.42 | 325544 | 1.71 | 542.57 | 544.28 |
| 526.40 | 4.79 | 356851 | 2.40 | 594.75 | 597.15 |
| 526.60 | 6.32 | 388448 | 3.16 | 647.41 | 650.57 |
| 526.80 | 7.99 | 420335 | 4.00 | 700.56 | 704.55 |
| 527.00 | 9.77 | 452514 | 4.89 | 754.19 | 759.08 |
| 527.20 | 11.63 | 484987 | 5.82 | 808.31 | 814.13 |
| 527.40 | 13.53 | 517753 | 6.77 | 862.92 | 869.69 |
| 527.60 | 15.46 | 550814 | 7.73 | 918.02 | 925.75 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10.00 | min |
| delta t = | 600 | sec |



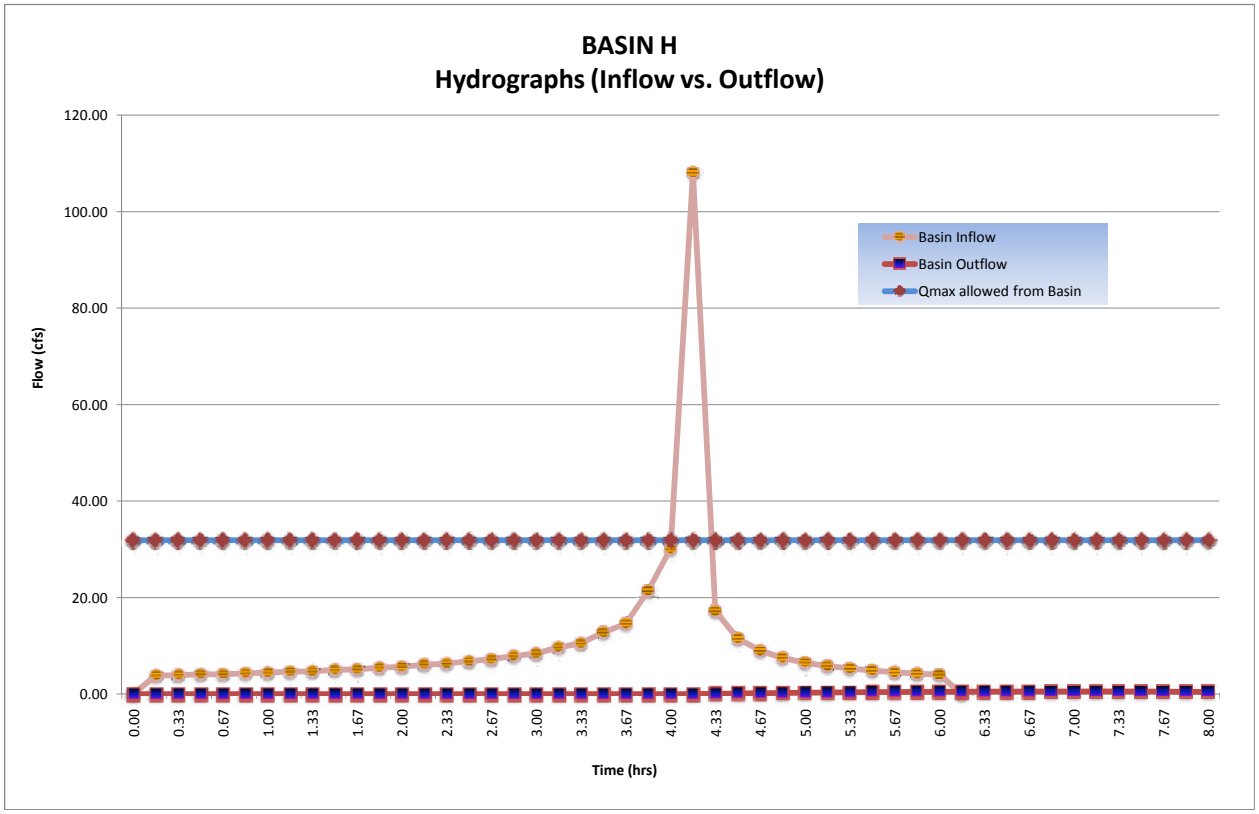
# Basin H Routing

$$\frac{I_1 + I_2}{2} + \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) - O_1 - \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

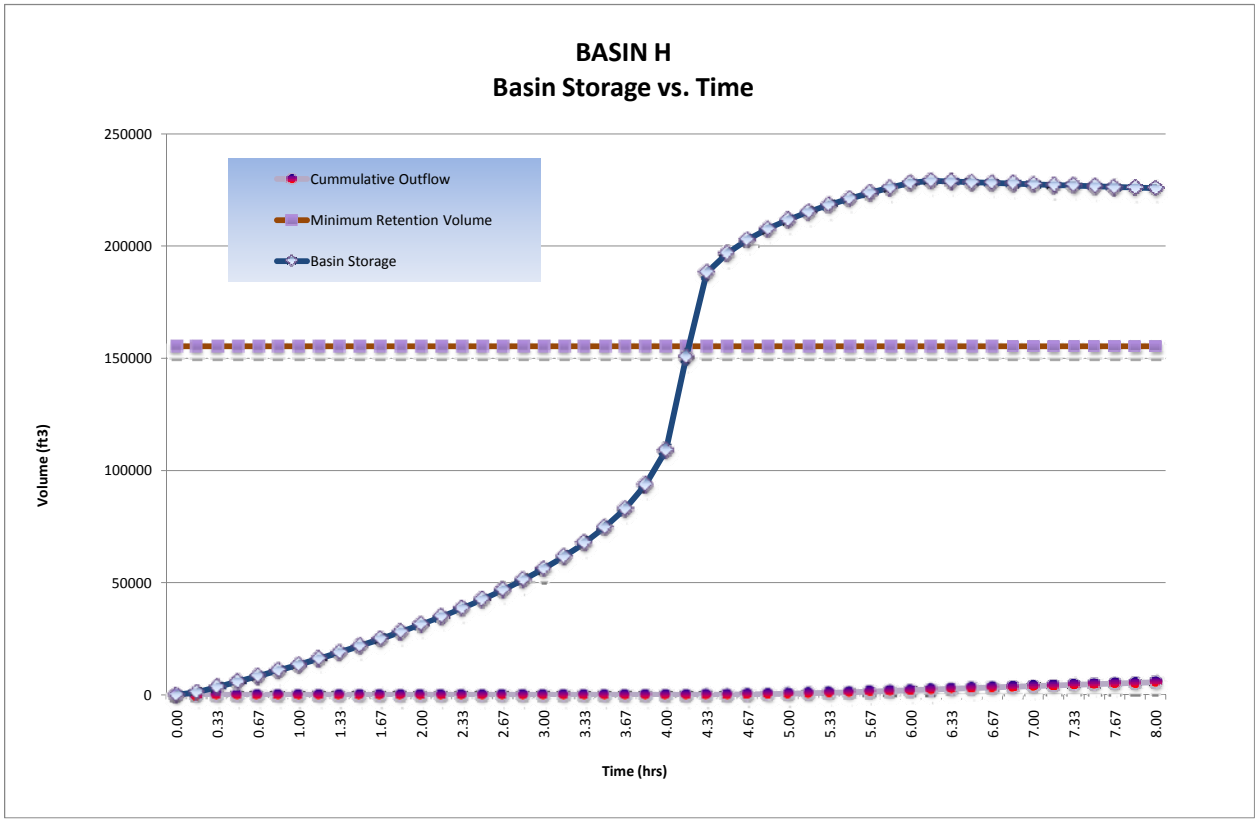
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) $(S_1/\text{delta t} + O_1/2)$ (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | (6) *Storage Indicator #* $S_2/\text{delta t} + O_2/2$ (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes: Basin Storage *(ft3)* | Volumes: Incremental Outflow *(ft3)* | Volumes: Cummulative Outflow *(ft3)* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 3.80 | 1.90 | 0.00 | 0.00 | 1.90 | 0.00 | 1140 | 0 | 0 |
| 0.33 | 3.90 | 3.85 | 1.90 | 0.00 | 5.75 | 0.00 | 3450 | 0 | 0 |
| 0.50 | 4.10 | 4.00 | 5.75 | 0.00 | 9.75 | 0.00 | 5850 | 0 | 0 |
| 0.67 | 4.10 | 4.10 | 9.75 | 0.00 | 13.85 | 0.00 | 8310 | 0 | 0 |
| 0.83 | 4.30 | 4.20 | 13.85 | 0.00 | 18.05 | 0.00 | 10830 | 0 | 0 |
| 1.00 | 4.40 | 4.35 | 18.05 | 0.00 | 22.40 | 0.00 | 13440 | 0 | 0 |
| 1.17 | 4.60 | 4.50 | 22.40 | 0.00 | 26.90 | 0.00 | 16140 | 0 | 0 |
| 1.33 | 4.70 | 4.65 | 26.90 | 0.00 | 31.55 | 0.00 | 18930 | 0 | 0 |
| 1.50 | 5.00 | 4.85 | 31.55 | 0.00 | 36.40 | 0.00 | 21840 | 0 | 0 |
| 1.67 | 5.10 | 5.05 | 36.40 | 0.00 | 41.45 | 0.00 | 24870 | 0 | 0 |
| 1.83 | 5.50 | 5.30 | 41.45 | 0.00 | 46.75 | 0.00 | 28050 | 0 | 0 |
| 2.00 | 5.60 | 5.55 | 46.75 | 0.00 | 52.30 | 0.00 | 31380 | 0 | 0 |
| 2.17 | 6.10 | 5.85 | 52.30 | 0.00 | 58.15 | 0.00 | 34890 | 0 | 0 |
| 2.33 | 6.30 | 6.20 | 58.15 | 0.00 | 64.35 | 0.00 | 38610 | 0 | 0 |
| 2.50 | 6.80 | 6.55 | 64.35 | 0.00 | 70.90 | 0.00 | 42540 | 0 | 0 |
| 2.67 | 7.20 | 7.00 | 70.90 | 0.00 | 77.90 | 0.00 | 46740 | 0 | 0 |
| 2.83 | 7.90 | 7.55 | 77.90 | 0.00 | 85.45 | 0.00 | 51270 | 0 | 0 |
| 3.00 | 8.40 | 8.15 | 85.45 | 0.00 | 93.60 | 0.00 | 56160 | 0 | 0 |
| 3.17 | 9.70 | 9.05 | 93.60 | 0.00 | 102.65 | 0.00 | 61590 | 0 | 0 |
| 3.33 | 10.50 | 10.10 | 102.65 | 0.00 | 112.75 | 0.00 | 67650 | 0 | 0 |
| 3.50 | 12.80 | 11.65 | 112.75 | 0.00 | 124.40 | 0.00 | 74640 | 0 | 0 |
| 3.67 | 14.60 | 13.70 | 124.40 | 0.00 | 138.10 | 0.00 | 82860 | 0 | 0 |
| 3.83 | 21.40 | 18.00 | 138.10 | 0.00 | 156.10 | 0.00 | 93660 | 0 | 0 |
| 4.00 | 30.10 | 25.75 | 156.10 | 0.00 | 181.85 | 0.00 | 109110 | 0 | 0 |
| 4.17 | 108.10 | 69.10 | 181.85 | 0.00 | 250.95 | 0.00 | 150570 | 0 | 0 |
| 4.33 | 17.20 | 62.65 | 250.95 | 0.00 | 313.60 | 0.07 | 188139 | 42 | 42 |
| 4.50 | 11.50 | 14.35 | 313.60 | 0.07 | 327.88 | 0.12 | 196692 | 72 | 114 |
| 4.67 | 9.00 | 10.25 | 327.88 | 0.12 | 338.01 | 0.15 | 202761 | 90 | 204 |
| 4.83 | 7.50 | 8.25 | 338.01 | 0.15 | 346.11 | 0.21 | 207603 | 126 | 330 |
| 5.00 | 6.50 | 7.00 | 346.11 | 0.21 | 352.90 | 0.27 | 211659 | 162 | 492 |
| 5.17 | 5.80 | 6.15 | 352.90 | 0.27 | 358.78 | 0.32 | 215172 | 192 | 684 |
| 5.33 | 5.30 | 5.55 | 358.78 | 0.32 | 364.01 | 0.37 | 218295 | 222 | 906 |
| 5.50 | 4.90 | 5.10 | 364.01 | 0.37 | 368.74 | 0.41 | 221121 | 246 | 1152 |
| 5.67 | 4.50 | 4.70 | 368.74 | 0.41 | 373.03 | 0.45 | 223683 | 270 | 1422 |
| 5.83 | 4.20 | 4.35 | 373.03 | 0.45 | 376.93 | 0.48 | 226014 | 288 | 1710 |
| 6.00 | 4.00 | 4.10 | 376.93 | 0.48 | 380.55 | 0.51 | 228177 | 306 | 2016 |
| 6.17 | 0.00 | 2.00 | 380.55 | 0.51 | 382.04 | 0.53 | 229065 | 318 | 2334 |
| 6.33 | | 0.00 | 382.04 | 0.53 | 381.51 | 0.52 | 228750 | 312 | 2646 |
| 6.50 | | 0.00 | 381.51 | 0.52 | 380.99 | 0.52 | 228438 | 312 | 2958 |
| 6.67 | | 0.00 | 380.99 | 0.52 | 380.47 | 0.51 | 228129 | 306 | 3264 |
| 6.83 | | 0.00 | 380.47 | 0.51 | 379.96 | 0.51 | 227823 | 306 | 3570 |
| 7.00 | | 0.00 | 379.96 | 0.51 | 379.45 | 0.50 | 227520 | 300 | 3870 |
| 7.17 | | 0.00 | 379.45 | 0.50 | 378.95 | 0.50 | 227220 | 300 | 4170 |
| 7.33 | | 0.00 | 378.95 | 0.50 | 378.45 | 0.50 | 226920 | 300 | 4470 |
| 7.50 | | 0.00 | 378.45 | 0.50 | 377.95 | 0.49 | 226623 | 294 | 4764 |
| 7.67 | | 0.00 | 377.95 | 0.49 | 377.46 | 0.49 | 226329 | 294 | 5058 |
| 7.83 | | 0.00 | 377.46 | 0.49 | 376.97 | 0.48 | 226038 | 288 | 5346 |
| 8.00 | | 0.00 | 376.97 | 0.48 | 376.49 | 0.48 | 225750 | 288 | 5634 |

## Basin H Routing



## Basin H Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **229,065** | **ft$^3$** | |
| **@ Stage:** | **525.60** | **ft** | |
| **Freeboard:** | **1.4** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **617,750** | **ft$^3$** | Basin **H** |
| **Maximum flow rate released from this basin:** | **0.53** | **cfs** | |

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## Detention/Retention Basin Flows and Sizes – Watershed H

| Watershed | Location | Flow | | | Runoff Volume | | | Basin Volume - Breakdown | | | Basin Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Developed | Post-Developed | Increase | Pre-Developed | Post-Developed | Increase | Retention Provided | Detention | 1' Freeboard (minimum) | Final Volume | Length | Width | Depth | Freeboard | Name |
| Name | (Sta) | (cfs) | (cfs) | (cfs) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | (ft) | (ft) | (ft) | (ft) | |
| H | CVEF | 31.89 | 108.06 | 76.17 | 78,234 | 231,240 | 153,006 | 173,320 | 55,745 | 388,685 | 617,750 | 652 | 215 | 4.0 | 1.4 | H |

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PLANS APPROVAL DATE

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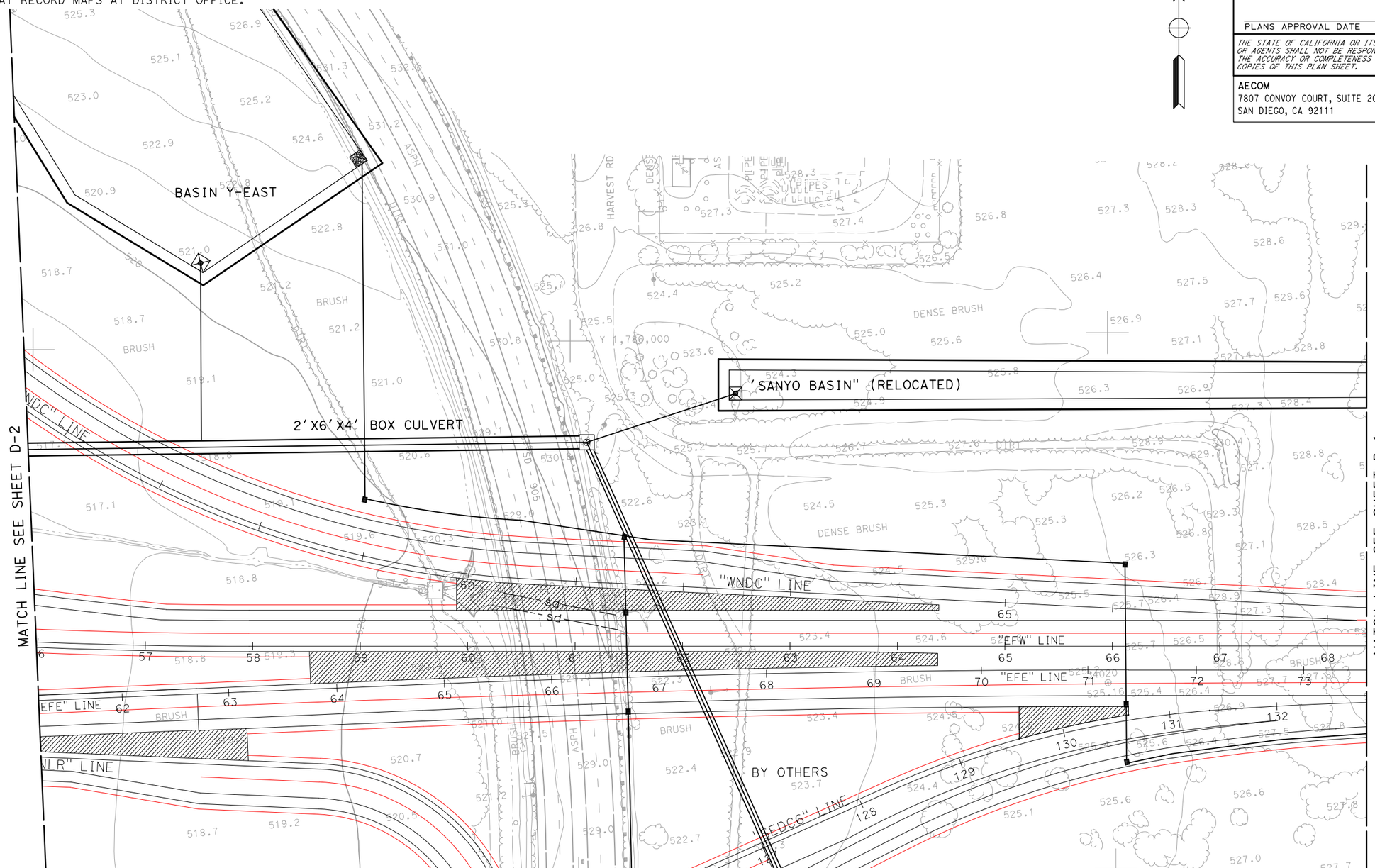


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ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

# DRAINAGE PLAN

**D-1**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

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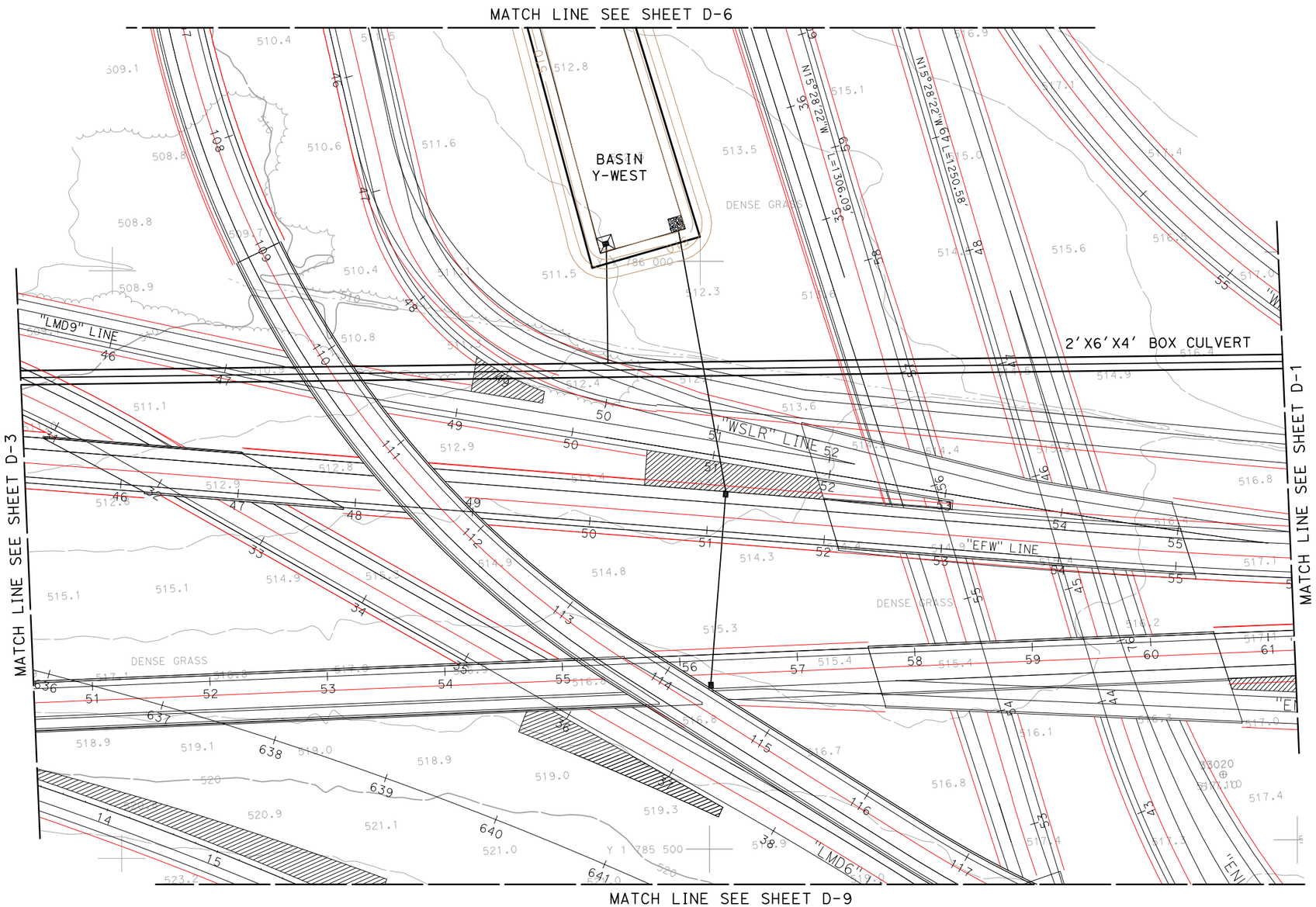


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SCALE 1"=50'

# DRAINAGE PLAN

D-2

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|---|---|
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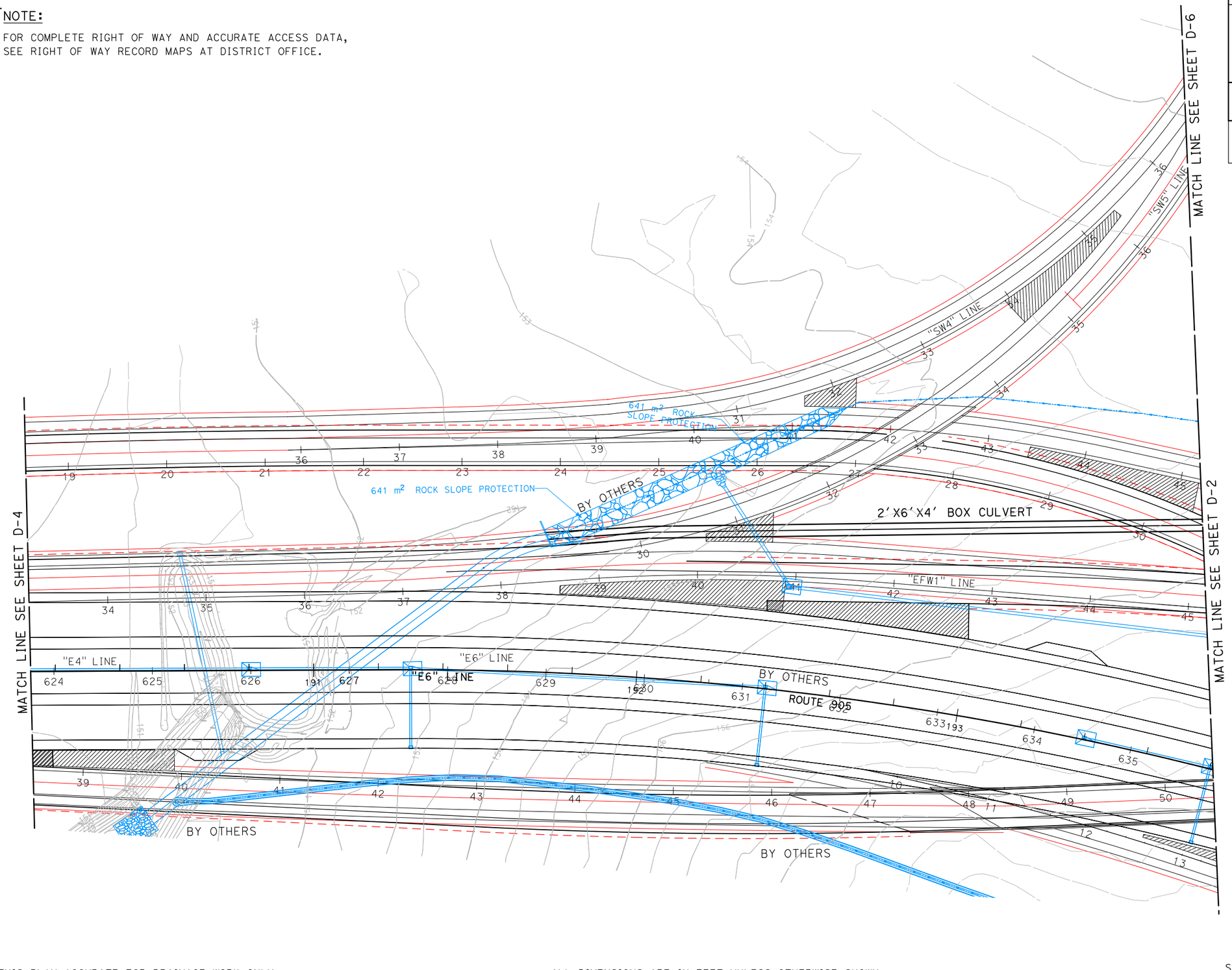


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SCALE 1"=50'

# DRAINAGE PLAN

**D-3**

| | |
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| DATE REVISED | GERARD DALZIEL |
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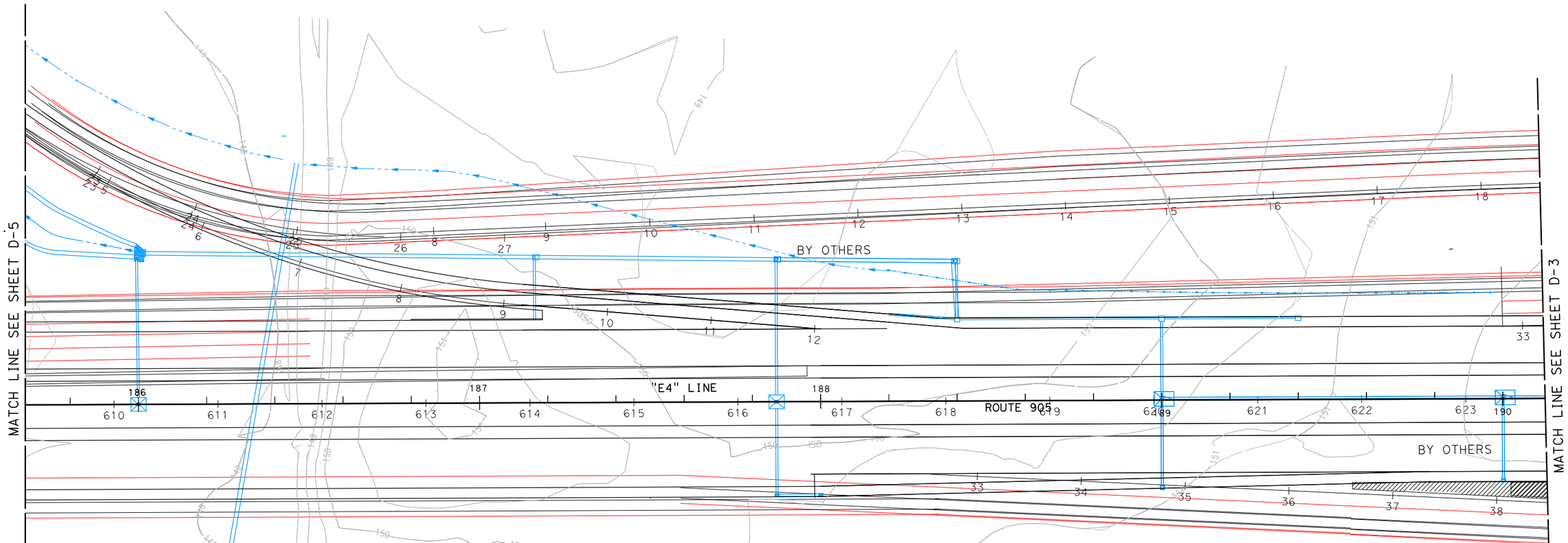


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SCALE 1"=50'

# DRAINAGE PLAN

**D-4**

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| | |

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DGN FILE => ...\b056300ia004.dgn

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EA 06002

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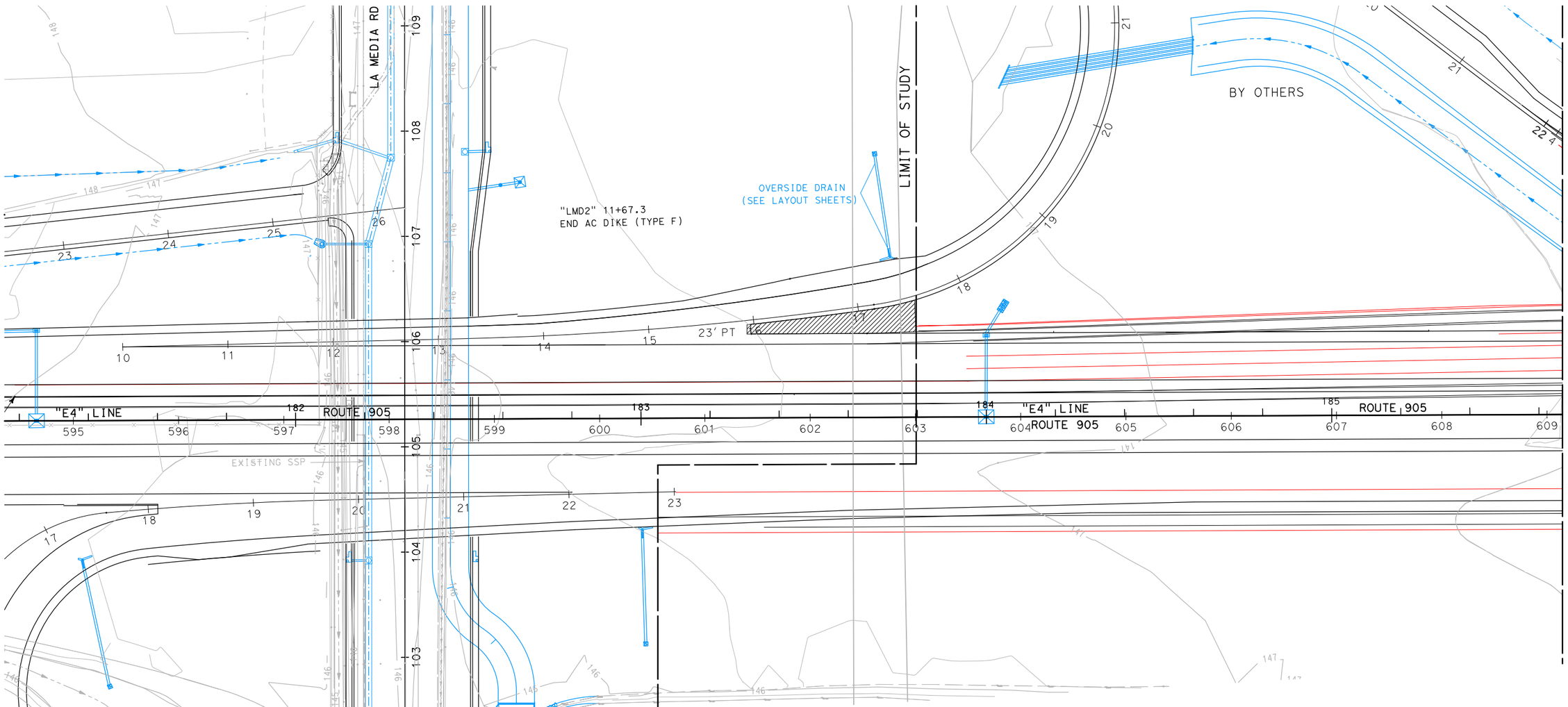


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SCALE 1"=50'

# DRAINAGE PLAN

**D-5**

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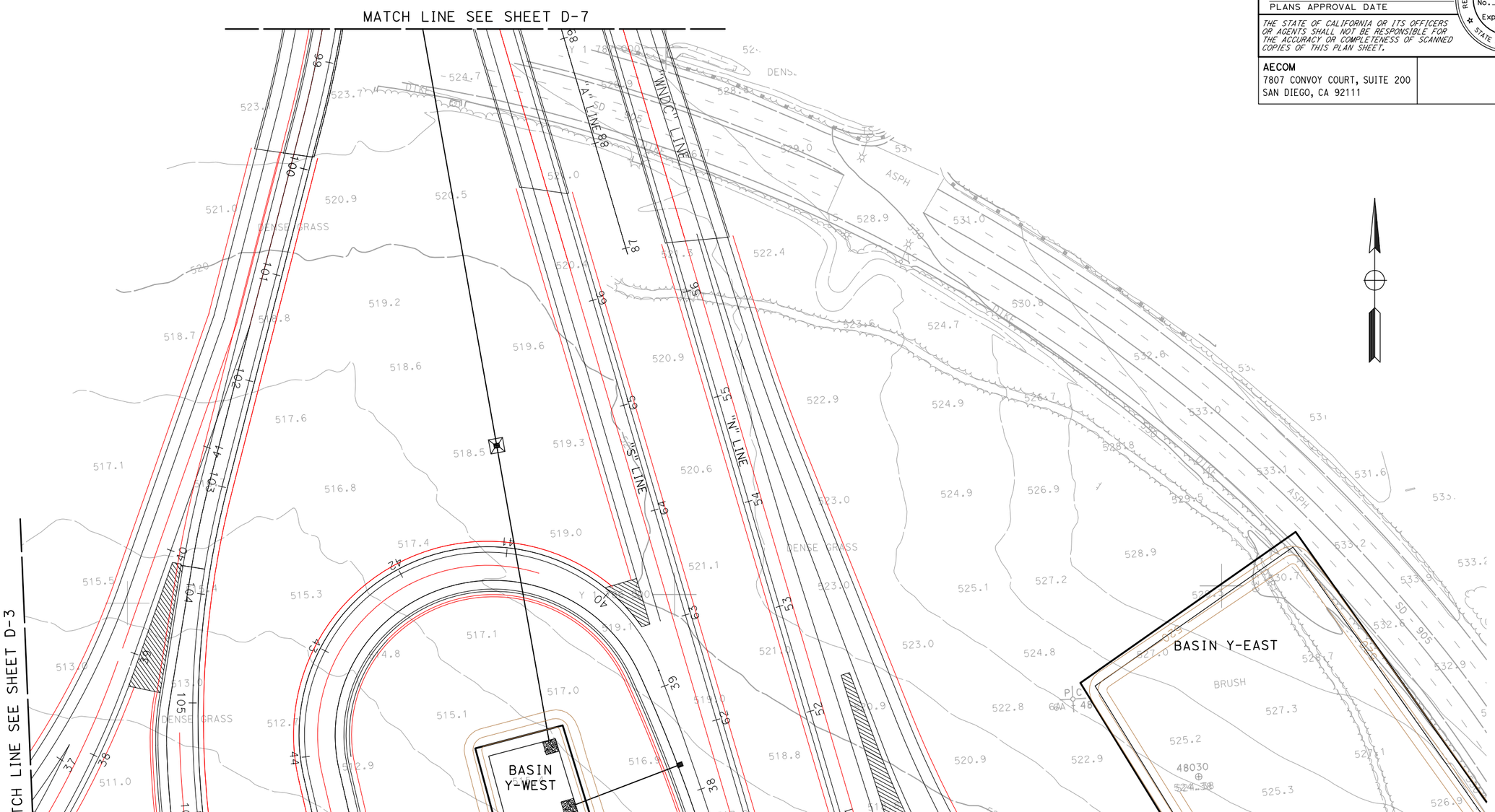


# DRAINAGE PLAN

D-6

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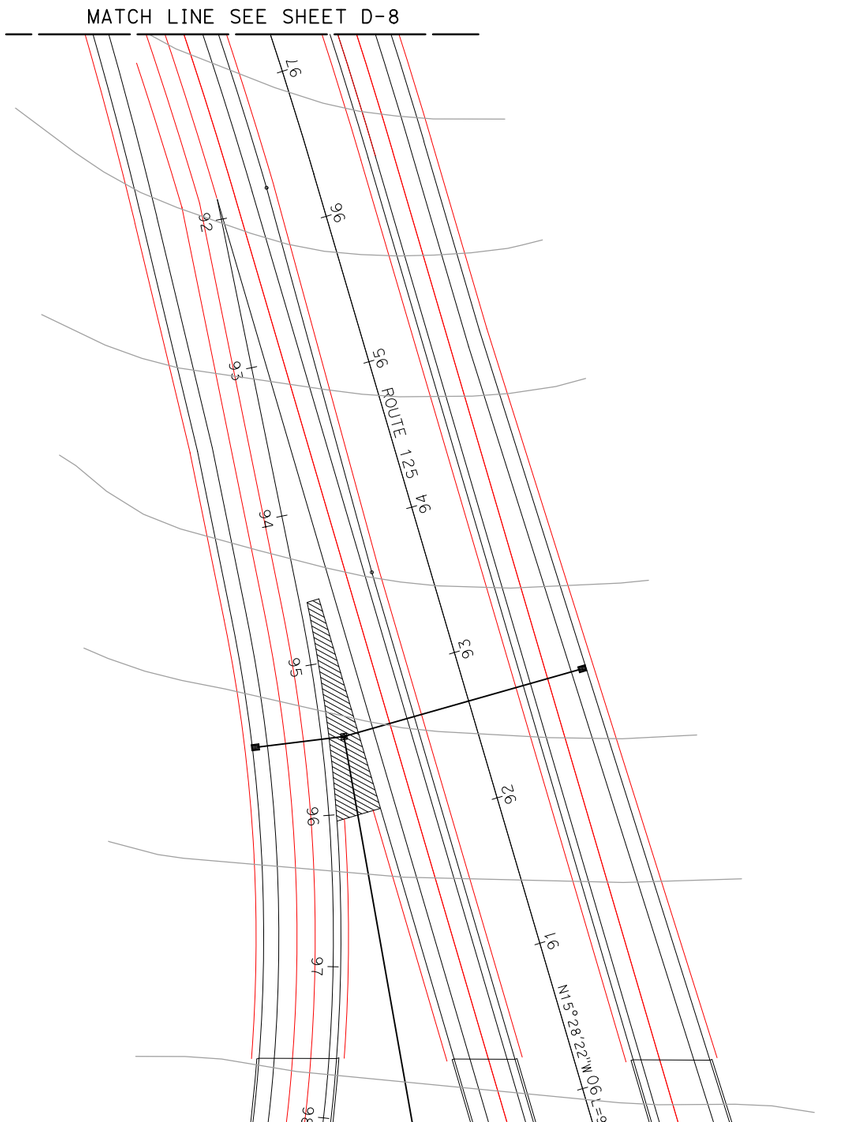


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SCALE 1"=50'

# DRAINAGE PLAN

**D-7**

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KIRK BRADBURY
No. 71673
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STATE OF CALIFORNIA

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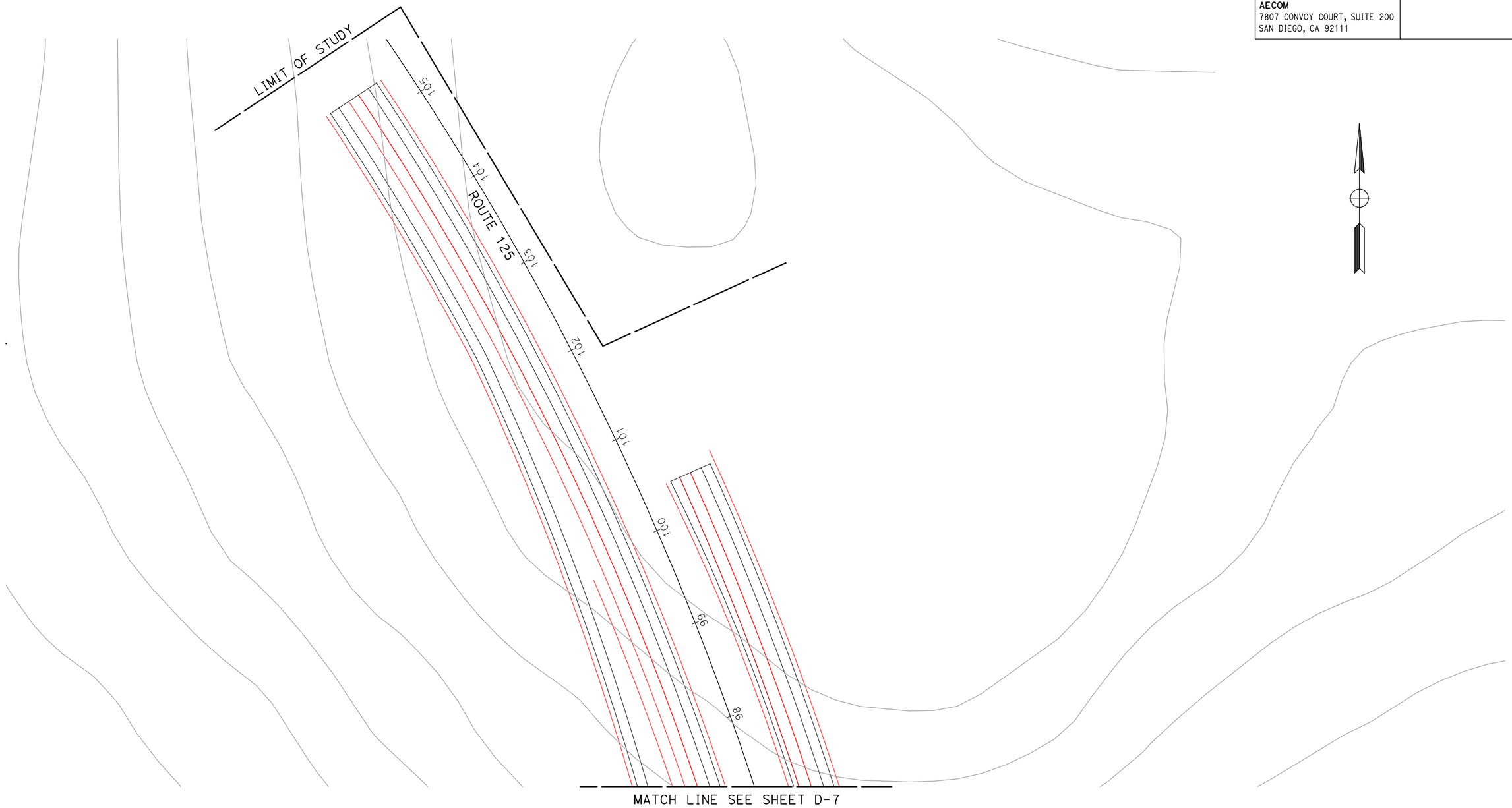


# DRAINAGE PLAN

**D-8**

SCALE 1"=50'

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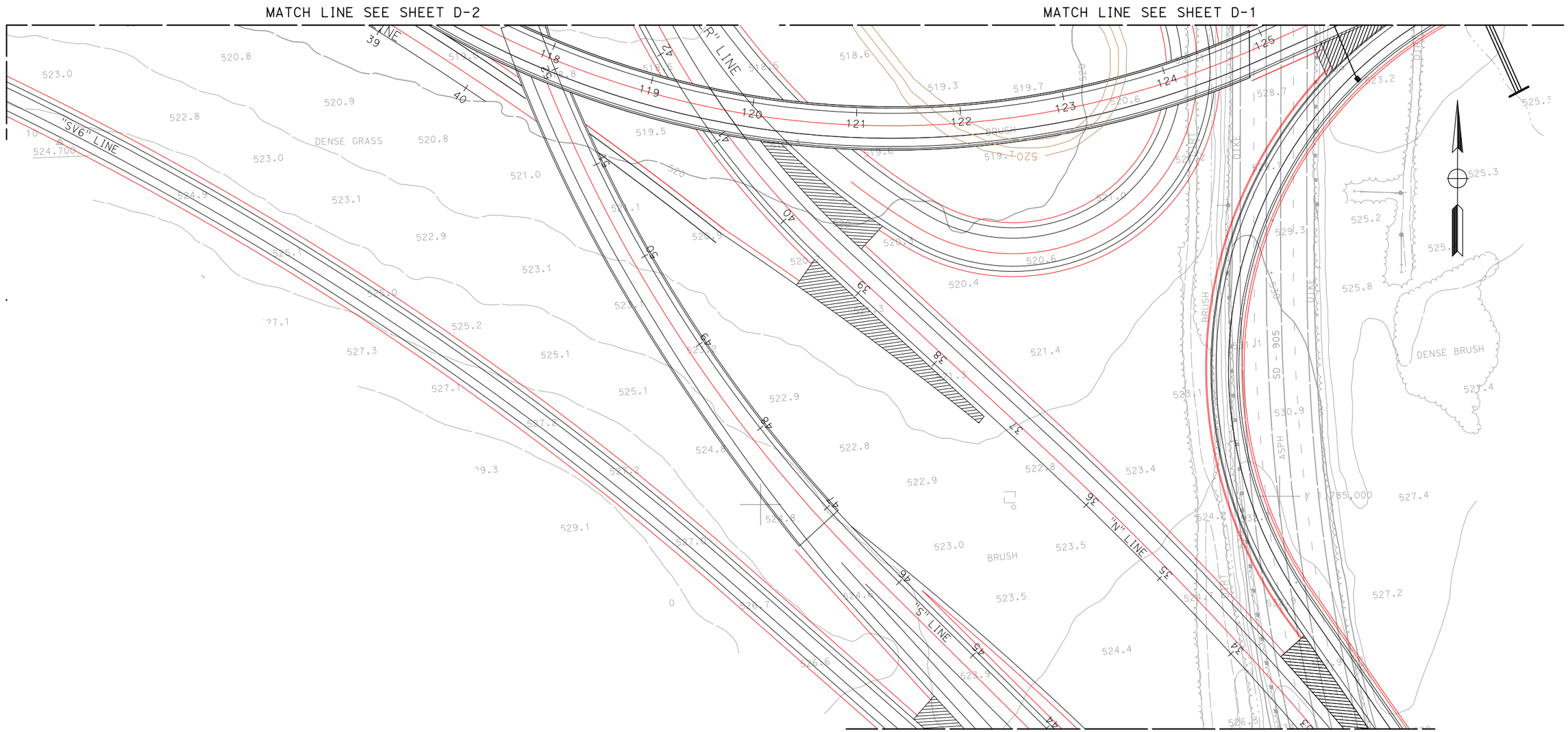


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SCALE 1"=50'

# DRAINAGE PLAN

**D-9**

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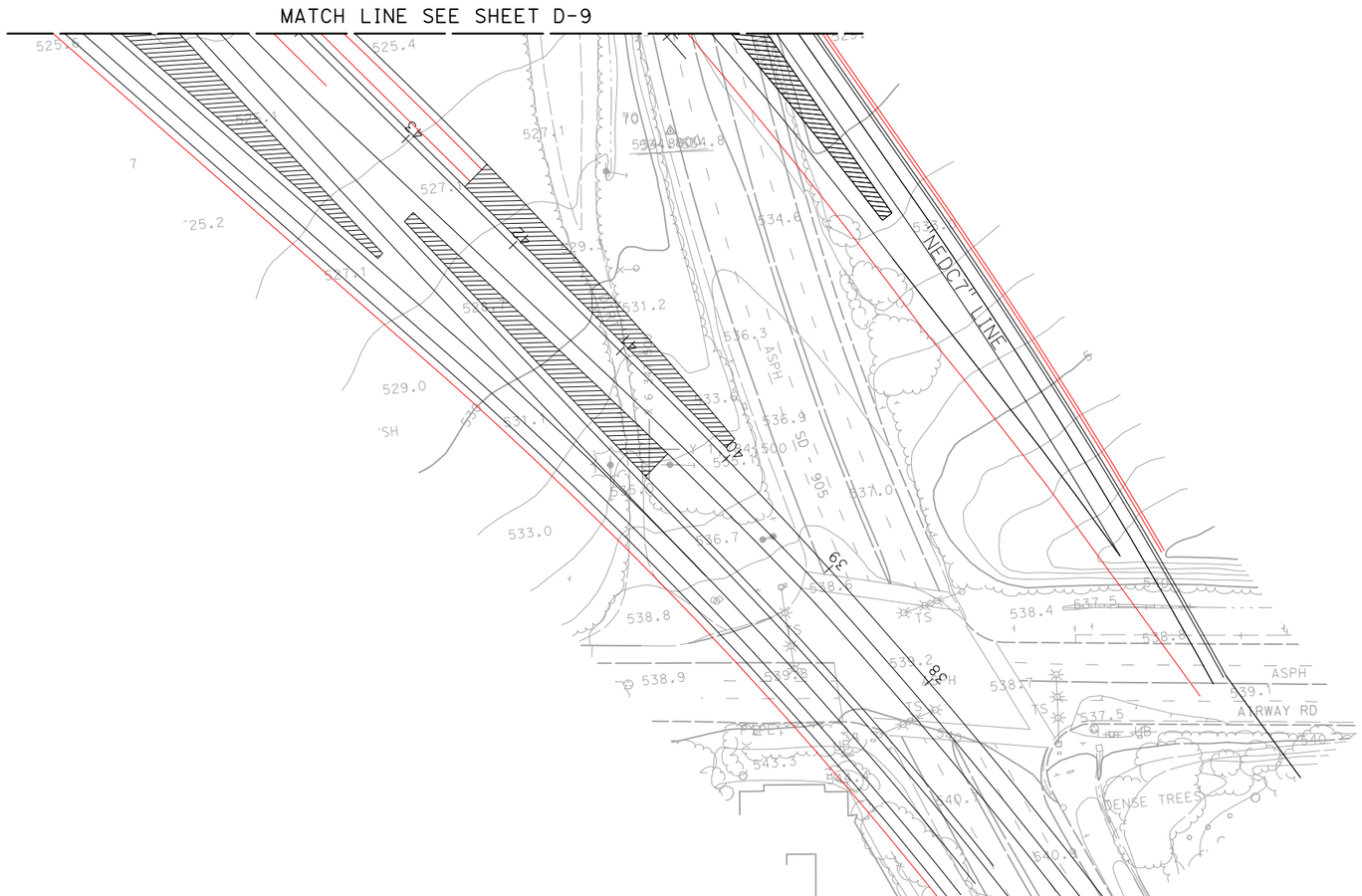


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# DRAINAGE PLAN

**D-10**

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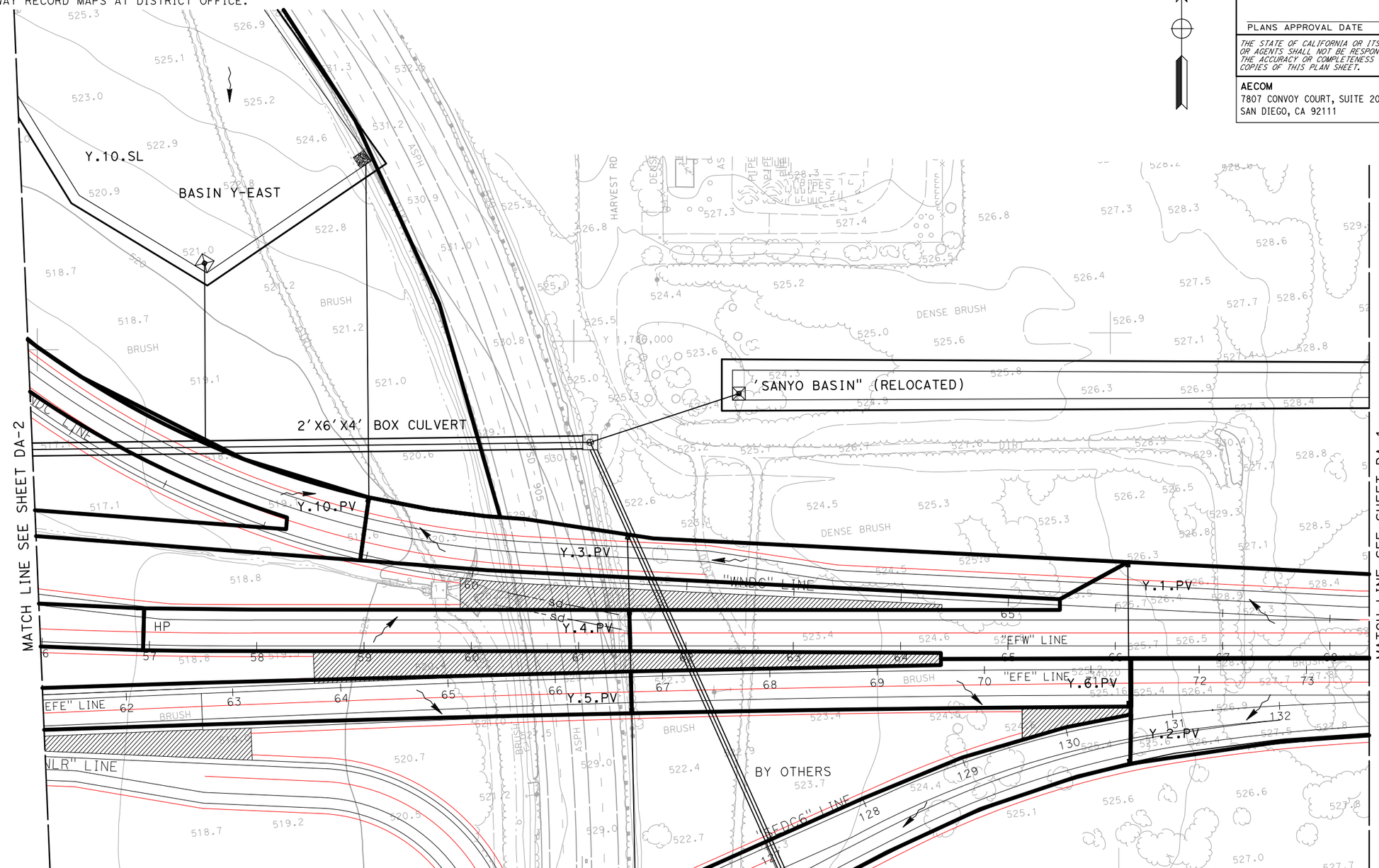


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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-1**

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

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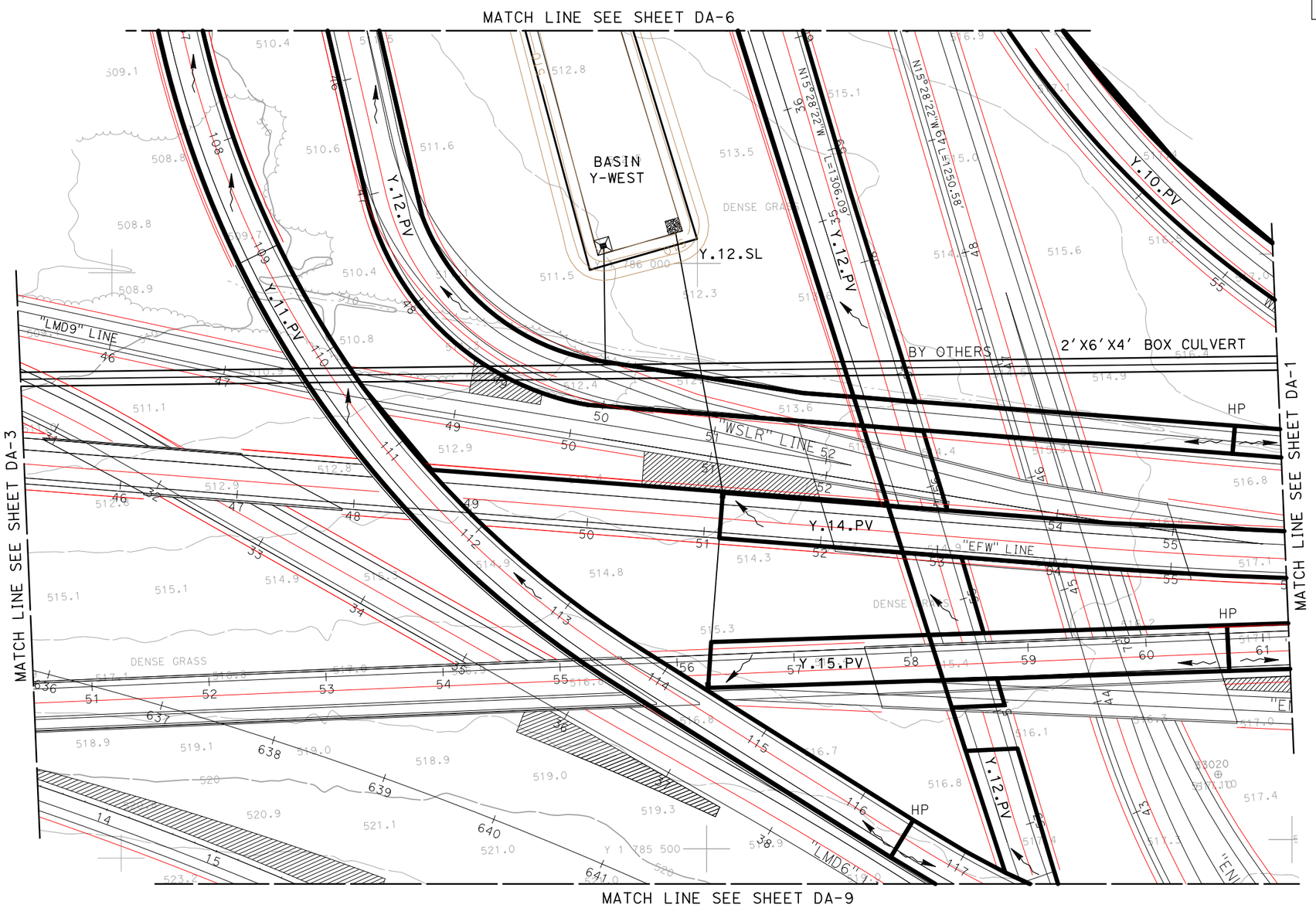


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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-2**

| REVISED BY | DATE REVISED |
|---|---|
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CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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SAN DIEGO, CA 92111


NOTE:

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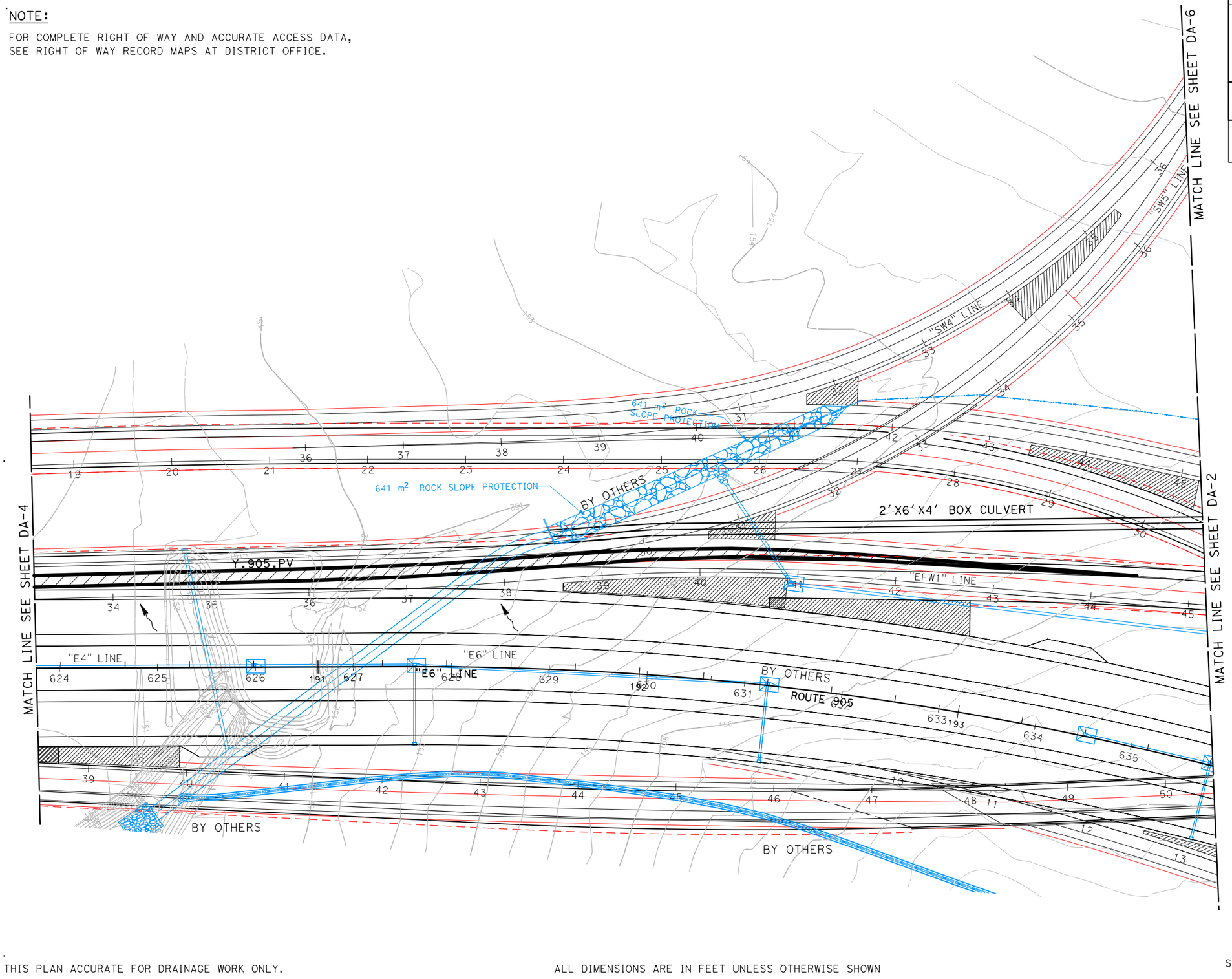


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-3**

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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3/3/2010 5:05:38 PM CarrilloG H:\Caltrans\2208300\Cad\planset\905\b056300ia003da.dgn

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => CarrilloG
DGN FILE => ...\b056300ia003da.dgn

CU XXXXX | EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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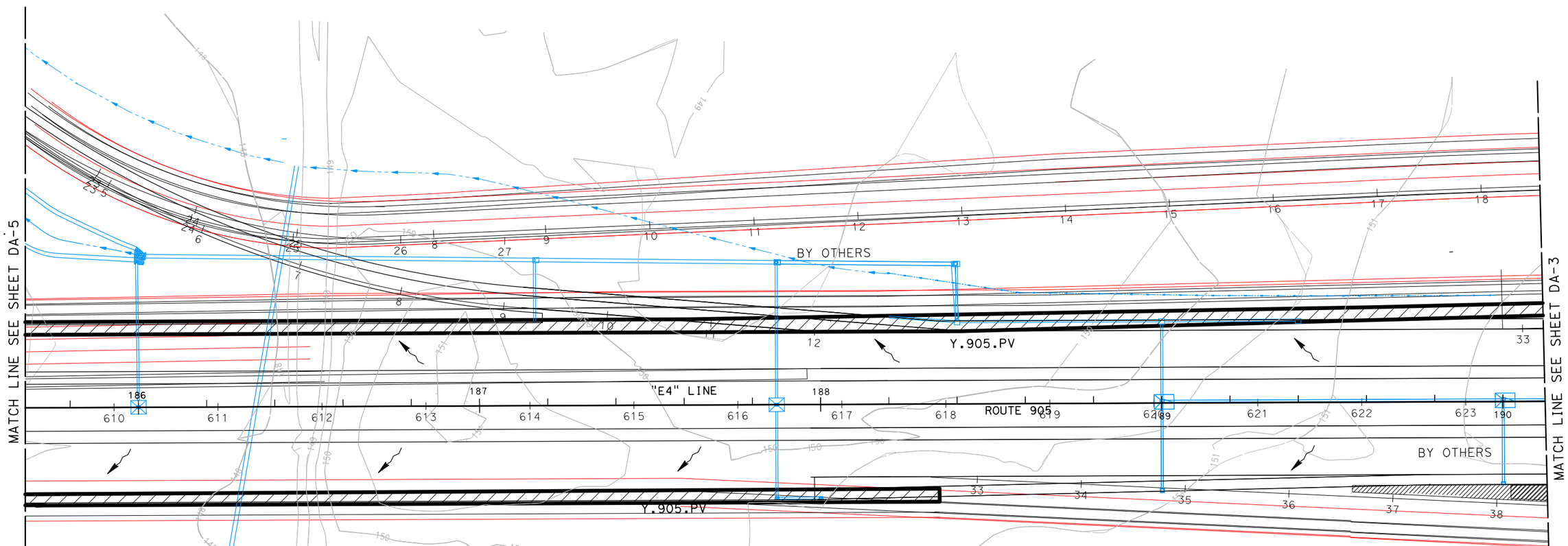


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-4**

| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |

CALCULATED-DESIGNED BY / CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: KIRK BRADBURY

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3/3/2010 5:02:44 PM CarrilloG H:\Caltrans\2208300\Cad\planset\905\b056300ia004da.dgn

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DGN FILE => ...\b056300ia004da.dgn

CU XXXXX

EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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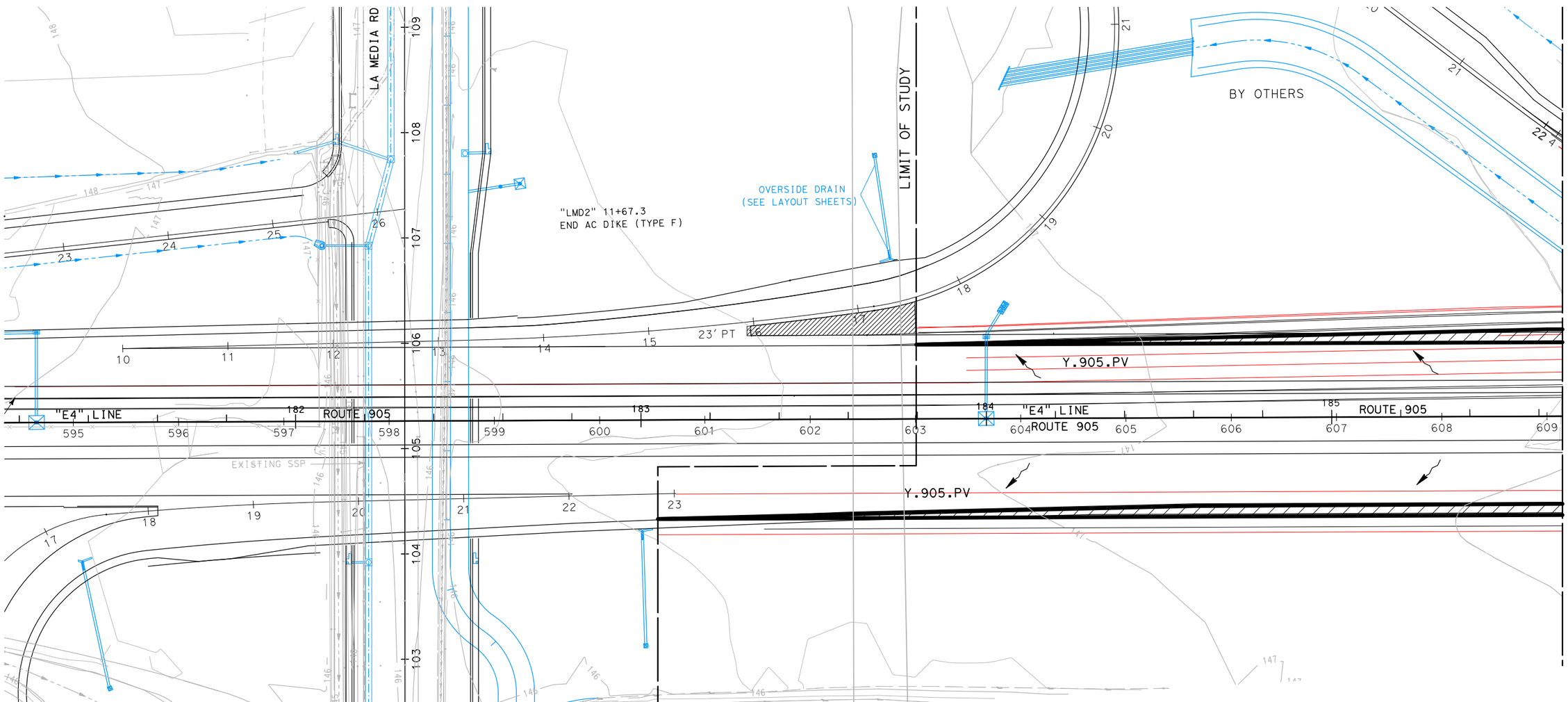


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SCALE 1"=50'

# DRAINAGE AREA PLAN

**DA-5**

| REVISED BY | DATE REVISED |
|---|---|
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DGN FILE => ...\b056300ia005da.dgn

CU XXXXX

EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

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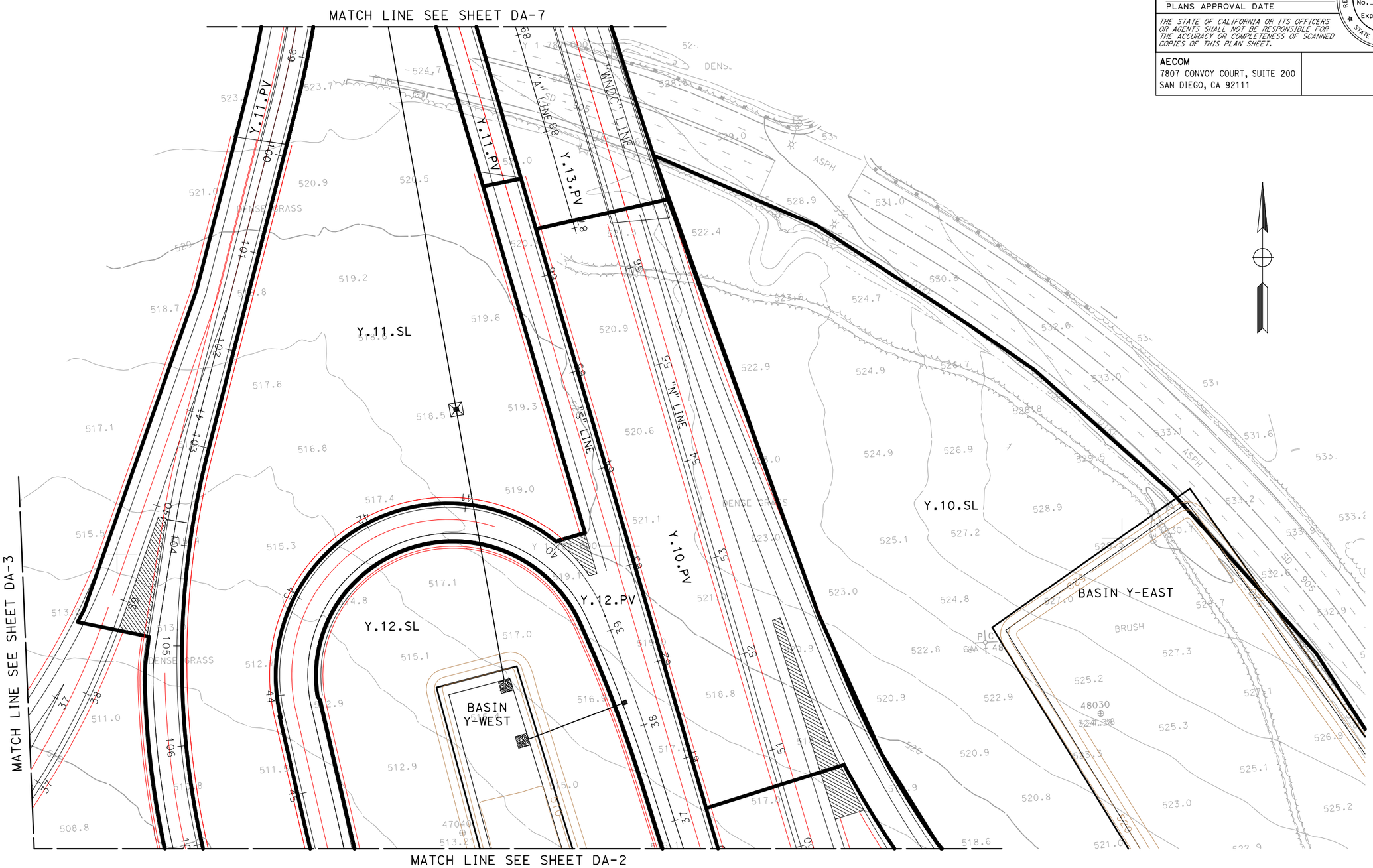


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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-6**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

DATE REVISED

LAST REVISION 11-13-09

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TIME PLOTTED => 5:08:43 PM

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3/3/2010 5:08:43 PM CarrilloG H:\Caltrans\2208300\Cad\planset\905\b056300ia006da.dgn

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USERNAME => CarrilloG

DGN FILE => ...\b056300ia006da.dgn

CU XXXXX

EA 06002

| Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER KIRK BRADBURY No. 71673 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

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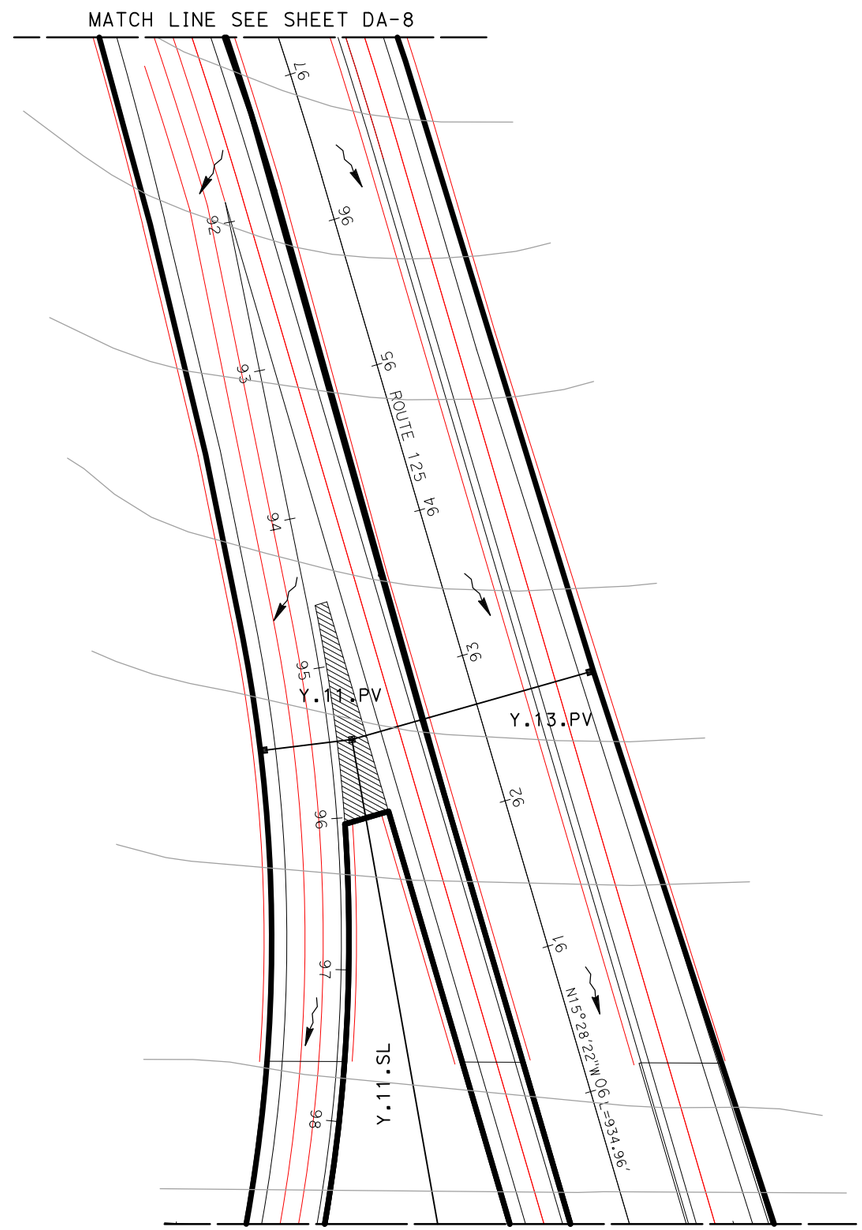


THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-7**

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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CALCULATED-DESIGNED BY: MIKE BRUNING

CHECKED BY: GERARD DALZIEL

REVISED BY

DATE REVISED

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| 11 | SD | 11 | 23.3/26.6 | | |

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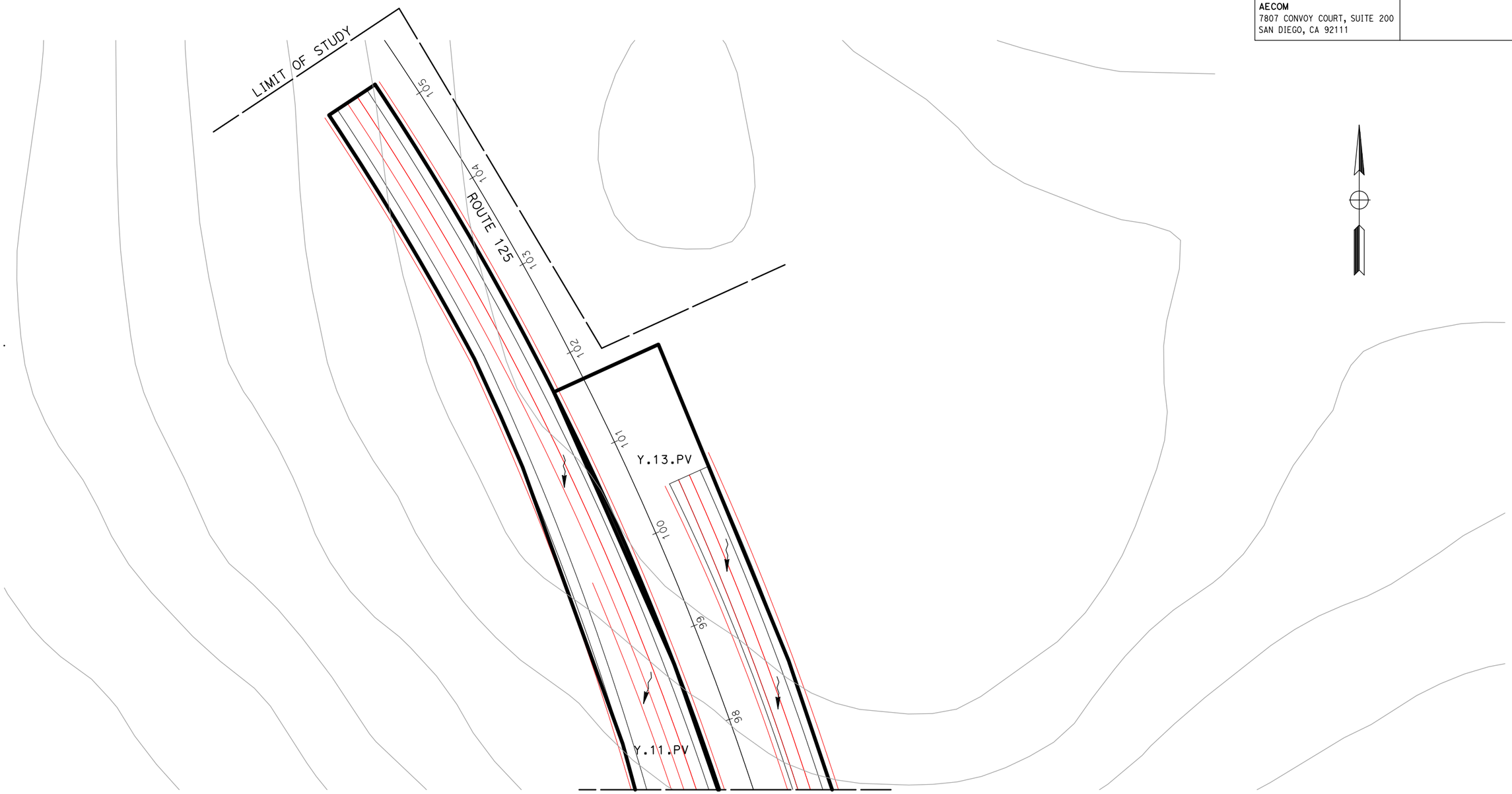


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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-8**

| REVISED BY | DATE REVISED |
|---|---|
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PLANS APPROVAL DATE

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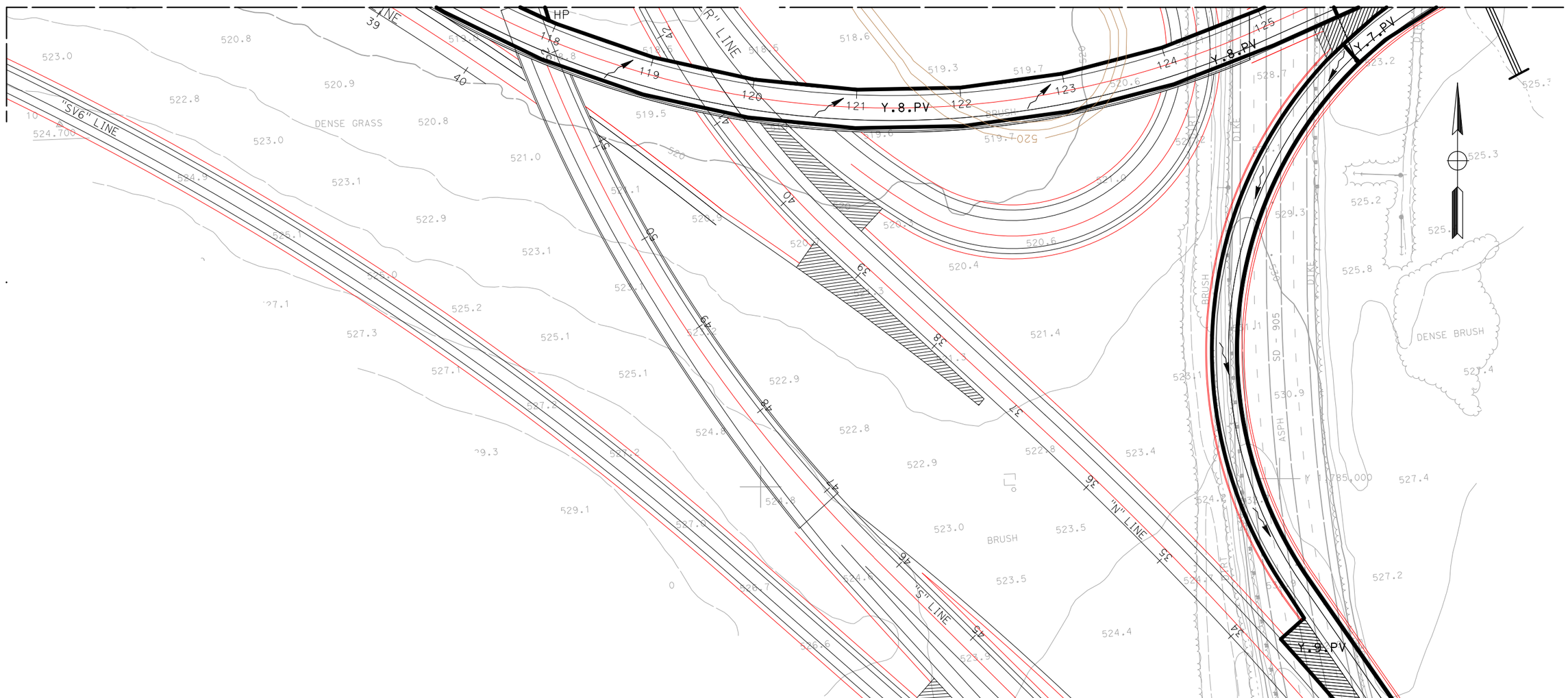
MATCH LINE SEE SHEET DA-2

MATCH LINE SEE SHEET DA-1




MATCH LINE SEE SHEET DA-10

# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-9**

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| REVISED BY | DATE REVISED |
|---|---|
| MIKE BRUNING | GERARD DALZIEL |
| CALCULATED-DESIGNED BY | CHECKED BY |
| CONSULTANT FUNCTIONAL SUPERVISOR | KIRK BRADBURY |

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|---|---|---|---|---|---|
| 11 | SD | 11 | 23.3/26.6 | | |

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PLANS APPROVAL DATE

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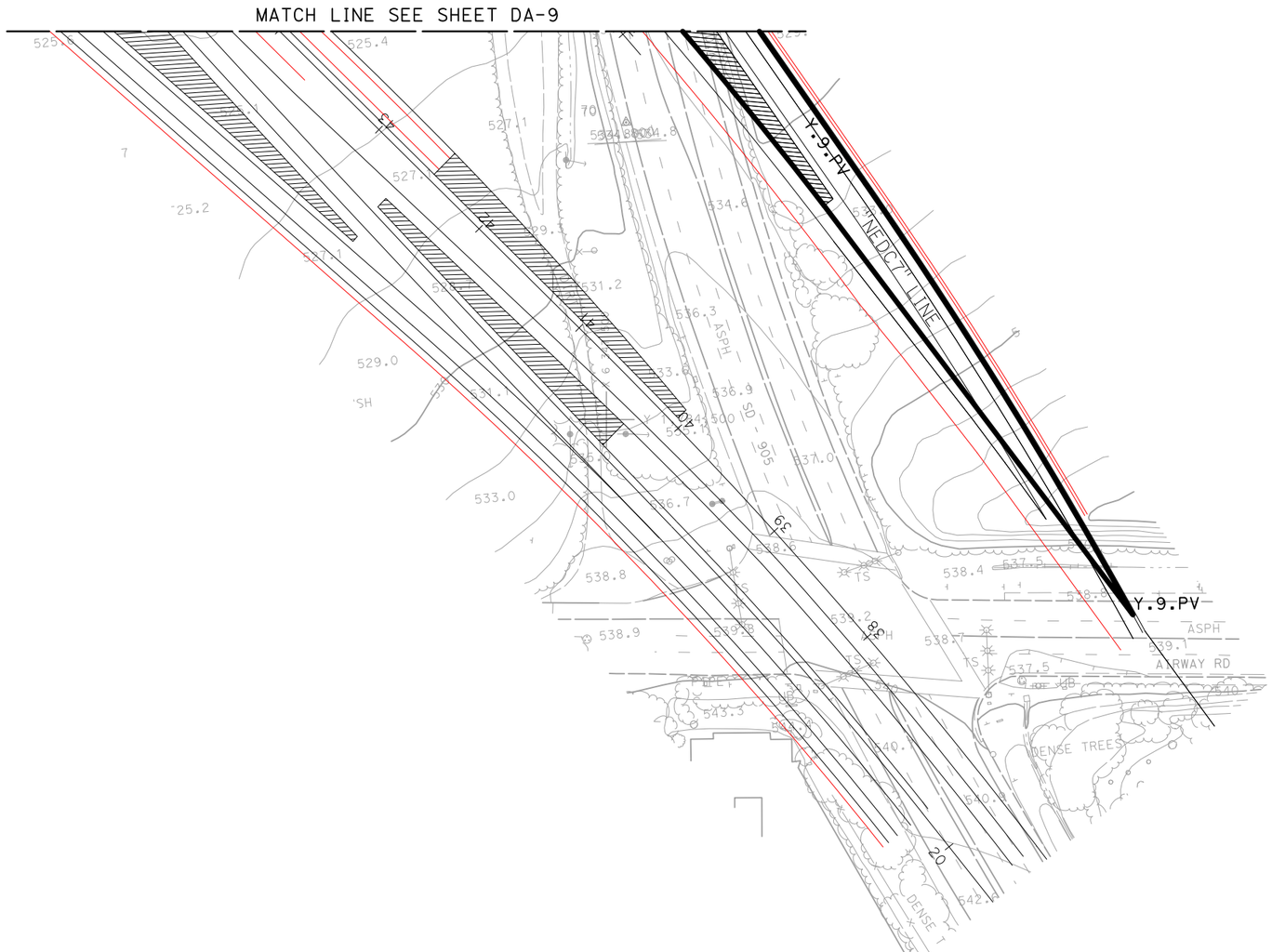


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# DRAINAGE AREA PLAN

SCALE 1"=50'

**DA-10**

| REVISED BY | DATE REVISED |
|---|---|
| | |

| CALCULATED-DESIGNED BY | MIKE BRUNING |
|---|---|
| CHECKED BY | GERARD DALZIEL |
| CONSULTANT FUNCTIONAL SUPERVISOR | KIRK BRADBURY |

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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# Y Onsite D.A. Table

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | Onsite Drainage Areas (D.A.) |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

PAVED

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | C | SF | Acres | min | in/hr | cfs | in/hr | cfs | Bioswale | Inlet | Destination | @ Station | Offset |
| A2.1.PV | 0.99 | 99500 | 2.3 | 5 | 4.0 | 9.05 | 6.6 | 14.90 | A2.1 | ~ | Basin Y-East | 56+00 | Lt |
| A2.2.PV | 0.99 | 104500 | 2.4 | 5 | 4.0 | 9.50 | 6.6 | 15.64 | A2.2 | A2.2 | Basin Y-East | 57+00 | Rt |
| A2.3.PV | 0.99 | 35100 | 0.8 | 5 | 4.0 | 3.19 | 6.6 | 5.25 | ~ | A2.3 | Basin Y-East | 52+50 | Lt |
| A2.4.PV | 0.99 | 26200 | 0.6 | 5 | 4.0 | 2.38 | 6.6 | 3.92 | ~ | A2.4 | Basin Y-East | 52+50 | Rt |
| X2.1.PV | 0.99 | 2900 | 0.1 | 5 | 4.0 | 0.26 | 6.6 | 0.43 | ~ | X1.1 | Basin Y-East | 40+00 | Rt |
| X2.2.PV | 0.99 | 71300 | 1.6 | 5 | 4.0 | 6.46 | 6.6 | 10.67 | ~ | X1.2 | Basin Y-East | 40+50 | Rt |
| X2.3.PV | 0.99 | 2900 | 0.1 | 5 | 4.0 | 0.26 | 6.6 | 0.43 | ~ | X1.3 | Basin Y-East | 40+00 | Lt |
| X2.4.PV | 0.99 | 71100 | 1.6 | 5 | 4.0 | 6.44 | 6.6 | 10.64 | ~ | X1.4 | Basin Y-East | 40+50 | Lt |
| Y.1.PV | 0.99 | 84300 | 1.9 | 5 | 4.0 | 7.63 | 6.6 | 12.62 | ~ | Y.1 | Basin Y-East | ~ | ~ |
| Y.2.PV | 0.99 | 61500 | 1.4 | 5 | 4.0 | 5.57 | 6.6 | 9.21 | ~ | Y.2 | Basin Y-East | ~ | ~ |
| Y.3.PV | 0.99 | 28600 | 0.7 | 5 | 4.0 | 2.59 | 6.6 | 4.28 | ~ | Y.3 | Basin Y-East | ~ | ~ |
| Y.4.PV | 0.99 | 17600 | 0.4 | 5 | 4.0 | 1.59 | 6.6 | 2.63 | ~ | Y.4 | Basin Y-East | ~ | ~ |
| Y.5.PV | 0.99 | 23300 | 0.5 | 5 | 4.0 | 2.11 | 6.6 | 3.49 | ~ | Y.5 | Basin Y-East | ~ | ~ |
| Y.6.PV | 0.99 | 19500 | 0.4 | 5 | 4.0 | 1.77 | 6.6 | 2.92 | ~ | Y.6 | Basin Y-East | ~ | ~ |
| Y.7.PV | 0.99 | 27200 | 0.6 | 5 | 4.0 | 2.46 | 6.6 | 4.07 | ~ | Y.7 | Basin Y-East | ~ | ~ |
| Y.8.PV | 0.99 | 34400 | 0.8 | 5 | 4.0 | 3.11 | 6.6 | 5.15 | ~ | Y.8 | Basin Y-East | ~ | ~ |
| Y.9.PV | 0.99 | 32100 | 0.7 | 5 | 4.0 | 2.91 | 6.6 | 4.81 | ~ | Y.9 | bypass* | ~ | ~ |
| Y.10.PV | 0.99 | 128200 | 2.9 | 5 | 4.0 | 11.61 | 6.6 | 19.19 | ~ | Y.10 | Basin Y-East | ~ | ~ |
| Y.11.PV | 0.99 | 210900 | 4.8 | 5 | 4.0 | 19.09 | 6.6 | 31.57 | ~ | Y.11 | Basin Y-West | ~ | ~ |
| Y.12.PV | 0.99 | 115500 | 2.7 | 5 | 4.0 | 10.46 | 6.6 | 17.29 | ~ | Y.12 | Basin Y-West | ~ | ~ |
| Y.13.PV | 0.99 | 171400 | 3.9 | 5 | 4.0 | 15.52 | 6.6 | 25.66 | ~ | Y.13 | Basin Y-West | ~ | ~ |
| Y.14.PV | 0.99 | 22800 | 0.5 | 5 | 4.0 | 2.06 | 6.6 | 3.41 | ~ | Y.14 | Basin Y-West | ~ | ~ |
| Y.15.PV | 0.99 | 17300 | 0.4 | 5 | 4.0 | 1.57 | 6.6 | 2.59 | ~ | Y.15 | Basin Y-West | ~ | ~ |
| Y.905.PV | 0.99 | 49600 | 1.1 | 5 | 4.0 | 4.49 | 6.6 | 7.43 | ~ | ~ | Basin Y-West | ~ | ~ |

Σ 1457700 *PAVED*

SLOPE

| | | Area | | Tc | Caltrans $i_{25}$ | Caltrans $Q_{25}$ | County $i_{100}$ | County $Q_{100}$ | Drains to: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | C | SF | Acres | min | in/hr | cfs | in/hr | cfs | Bioswale | Inlet | Destination | @ Station | Offset |
| A2.1.SL | 0.61 | 94700 | 2.2 | 10 | 2.8 | 3.75 | 4.2 | 5.59 | A2.1 | ~ | Basin Y-East | 56+00 | Lt |
| A2.2.SL | 0.61 | 81400 | 1.9 | 10 | 2.8 | 3.22 | 4.2 | 4.80 | A2.2 | A2.2 | Basin Y-East | 57+00 | Rt |
| A2.5.SL | 0.61 | 38800 | 0.9 | 10 | 2.8 | 1.54 | 4.2 | 2.29 | ~ | A2.5 | bypass* | 52+50 | Rt |
| A2.6.SL | 0.61 | 83900 | 1.9 | 10 | 2.8 | 3.32 | 4.2 | 4.95 | ~ | A2.6 | Basin Y-East | 53+00 | Lt |
| Y.10.SL | 0.61 | 369500 | 8.5 | 10 | 2.8 | 14.64 | 4.2 | 21.80 | ~ | Y.10 | Basin Y-East | ~ | ~ |
| Y.11.SL | 0.61 | 236600 | 5.4 | 10 | 2.8 | 9.37 | 4.2 | 13.96 | ~ | Y.11 | Basin Y-West | ~ | ~ |
| Y.12.SL | 0.61 | 169500 | 3.9 | 10 | 2.8 | 6.71 | 4.2 | 10.00 | ~ | Y.12 | Basin Y-West | ~ | ~ |
| Y.905.SL | 0.61 | 890473 | 20.4 | 10 | 2.8 | 35.28 | 4.2 | 52.53 | ~ | ~ | bypass* | ~ | ~ |

Σ 1964873 *SLOPE*

** flow that does not reach the basin*

| Total : | 3422573 | 78.6 |
|---|---|---|
| | *SF* | *ac* |

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# Y Post-Developed TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Post-Developed |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 3422573 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 78.57 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 43% | AT | 0.90 | 0.383 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 57% | AT | 0.55 | 0.316 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.70 |
| $C_{25}$ = | 0.77 |
| $C_{50}$ = | 0.84 |
| $C_{100}$ = | 0.87 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 611.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 610.0 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 1.5 | ft | |
| LENGTH (L) | 125 | ft | To Bioswale |
| SLOPE (S) = (H/L) | 1.2% | | |
| MANNING'S n | 0.016 | | <= From Table 816.6A AC |
| $T_t$ (SFF)= | 3.20 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | Origin of Bioswale |
| LOW POINT ELEVATION | 609.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | Assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.8 | fps | 0.5% ,V From Figure 816.6 Grassed Waterway |
| $T_c$ (SH)= | 1.85 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 609.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 19.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1158 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.6% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.29 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_c$ (CH)= | 5.87 | minutes | |

# Y Post-Developed TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 590.0 | ft |
| LOW POINT ELEVATION | 584.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 345 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.013 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 13.03 | fps |
| $T_C$ (CH)= | 0.44 | minutes |

**NOTES:**

Assume former basin is conc channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

Concrete

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 579.0 | ft |
| LOW POINT ELEVATION | 520.0 | ft |
| ELEVATION DIFF (H) | 59.0 | ft |
| LENGTH (L) | 3725 | ft |
| SLOPE (S) = (H/L) | 1.6% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 9.1 | fps |
| $T_C$ (SD)= | 6.83 | minutes |

**NOTES:**

Proposed basin outlet pipe

Discharge at basin Y

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 520.0 | ft |
| LOW POINT ELEVATION | 514.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 176 | ft |
| SLOPE (S) = (H/L) | 3.4% | |
| MANNING'S n | 0.050 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 4.74 | fps |
| $T_C$ (CH)= | 0.62 | minutes |

**NOTES:**

basin Y

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

HDM Table 864.3A, Depressed Median - Earth (with growth)

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 514.0 | ft |
| LOW POINT ELEVATION | 511.0 | ft |
| ELEVATION DIFF (H) | 3.0 | ft |
| LENGTH (L) | 171 | ft |
| SLOPE (S) = (H/L) | 1.8% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 9.6 | fps |
| $T_C$ (SD)= | 0.30 | minutes |

**NOTES:**

Discharge at basin Y

Discharge at burried box culvert

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

# Y Post-Developed TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | | NOTES: |
|---|---|---|---|
| HIGH PT ELEVATION | 511.0 | ft | |
| LOW POINT ELEVATION | 500.0 | ft | |
| ELEVATION DIFF (H) | 11.0 | ft | |
| LENGTH (L) | 994 | ft | |
| SLOPE (S) = (H/L) | 1.1% | | |
| MANNING'S n | 0.013 | | RCP |
| PIPE DIAMETER d | 6.0 | ft | |
| HYDRAULIC RADIUS R | 1.5 | ft | R=D/4, Assume: flowing full |
| VELOCITY (STORMDRAIN) | 15.8 | fps | $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| $T_C$ (SD)= | 1.05 | minutes | |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 20.15 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **20.15** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

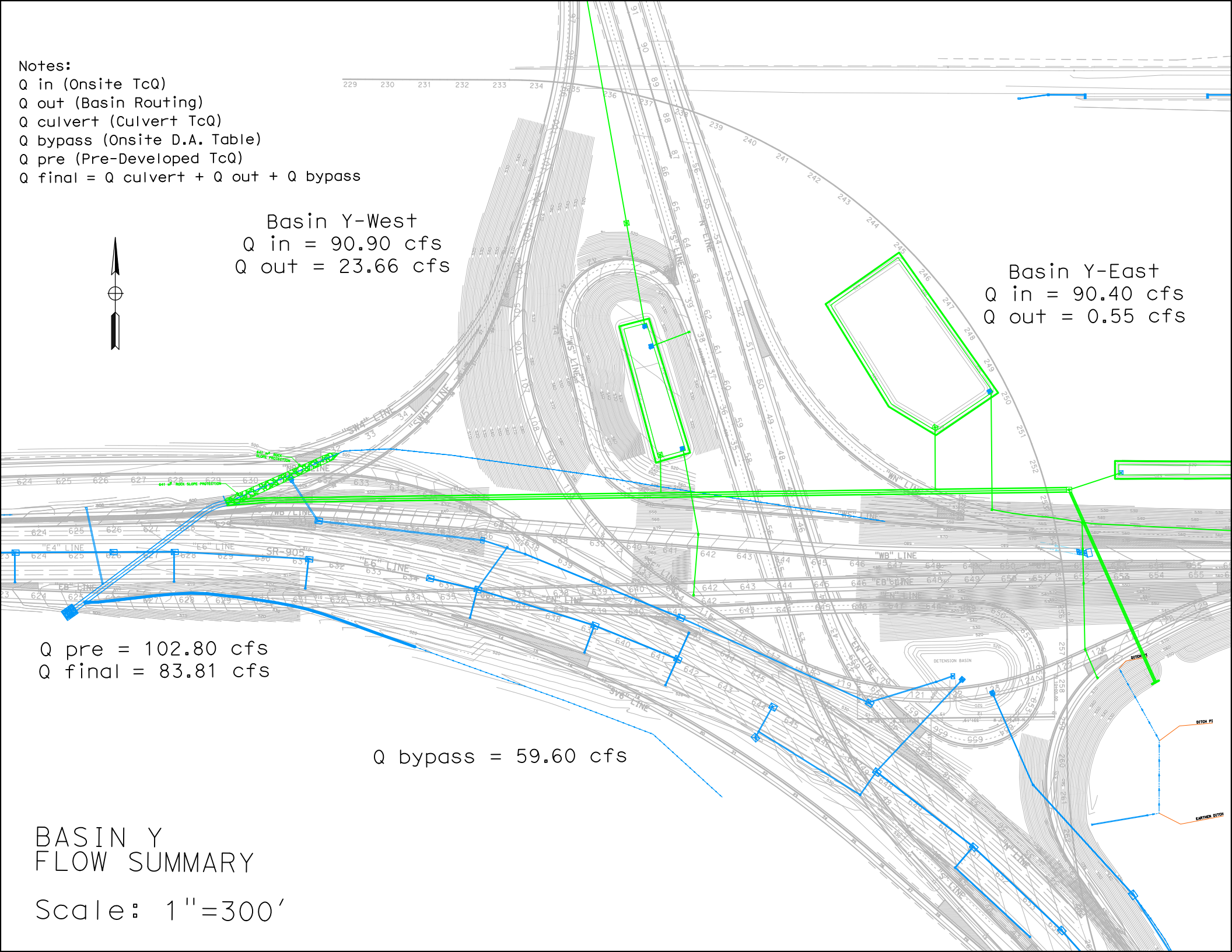
| | | | | | |
|---|---|---|---|---|---|
| $i_2$ = | 1.2 | in/hr | X CA = | $Q_2$ = | 64.8 |
| $i_{10}$ = | 1.7 | in/hr | X CA = | $Q_{10}$ = | 94.2 |
| $i_{25}$ = | 2.1 | in/hr | X CA = | $Q_{25}$ = | 129.6 |
| $i_{50}$ = | 2.6 | in/hr | X CA = | $Q_{50}$ = | 169.6 |
| $i_{100}$ = | 2.7 | in/hr | X CA = | $Q_{100}$ = | **184.0** |

**FLOW RESULTS:** cfs

**COUNTY $P_6$** inches

| | |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

Notes:
Q in (Onsite TcQ)
Q out (Basin Routing)
Q culvert (Culvert TcQ)
Q bypass (Onsite D.A. Table)
Q pre (Pre-Developed TcQ)
Q final = Q culvert + Q out + Q bypass




BASIN Y
FLOW SUMMARY

Scale: 1"=300'

# Basin Y-East Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-East** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 102.8 | cfs | | | |
| Tc= | 23.5 | min | C= | 0.58 | |
| $P_{100,6}$= | 2.5 | in | A= | 72.78 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 24 | 9216 | 6.4 |
| 48 | 9648 | 6.7 |
| 72 | 10656 | 7.4 |
| 96 | 11376 | 7.9 |
| 120 | 12960 | 9 |
| 144 | 14112 | 9.8 |
| 168 | 17280 | 12 |
| 192 | 19584 | 13.6 |
| 216 | 28800 | 20 |
| 240 | 38160 | 26.5 |
| 264 | 148032 | 102.8 |
| 288 | 23184 | 16.1 |
| 312 | 15408 | 10.7 |
| 336 | 12096 | 8.4 |
| 360 | 10080 | 7 |
| 384 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 380592 $ft^3$**
**8.74 acre-feet**

Check: $V = C*A*P_6$
V= 8.81 acre-feet
***OK***

# Basin Y-East Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 184.0 | cfs | | | |
| Tc= | 20.2 | min | C= | 0.87 | |
| $P_{100,6}$= | 2.5 | in | A= | 78.57 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 20 | 12360 | 10.3 |
| 40 | 12840 | 10.7 |
| 60 | 14040 | 11.7 |
| 80 | 14640 | 12.2 |
| 100 | 16200 | 13.5 |
| 120 | 17280 | 14.4 |
| 140 | 19680 | 16.4 |
| 160 | 21360 | 17.8 |
| 180 | 26160 | 21.8 |
| 200 | 29760 | 24.8 |
| 220 | 43800 | 36.5 |
| 240 | 61800 | 51.5 |
| 260 | 220800 | 184 |
| 280 | 35040 | 29.2 |
| 300 | 23520 | 19.6 |
| 320 | 18360 | 15.3 |
| 340 | 15360 | 12.8 |
| 360 | 13440 | 11.2 |
| 380 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 616440 $ft^3$**
**14.15 acre-feet**

Check: $V = C*A*P_6$
V= 14.30 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **14.15** | *(Post)* | | |
| | **-** | **8.74** | *(Pre)* | | |
| **Retention volume =** | | **5.41** | **acre-feet** | **=** | **235848 $ft^3$** **Basin Required** |

# Basin Y-East Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.94
A= 33.69 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **89279** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Universal Soil Loss Equation (SDCHM 5.2.3)

$A_s = RKLsCP$

where:

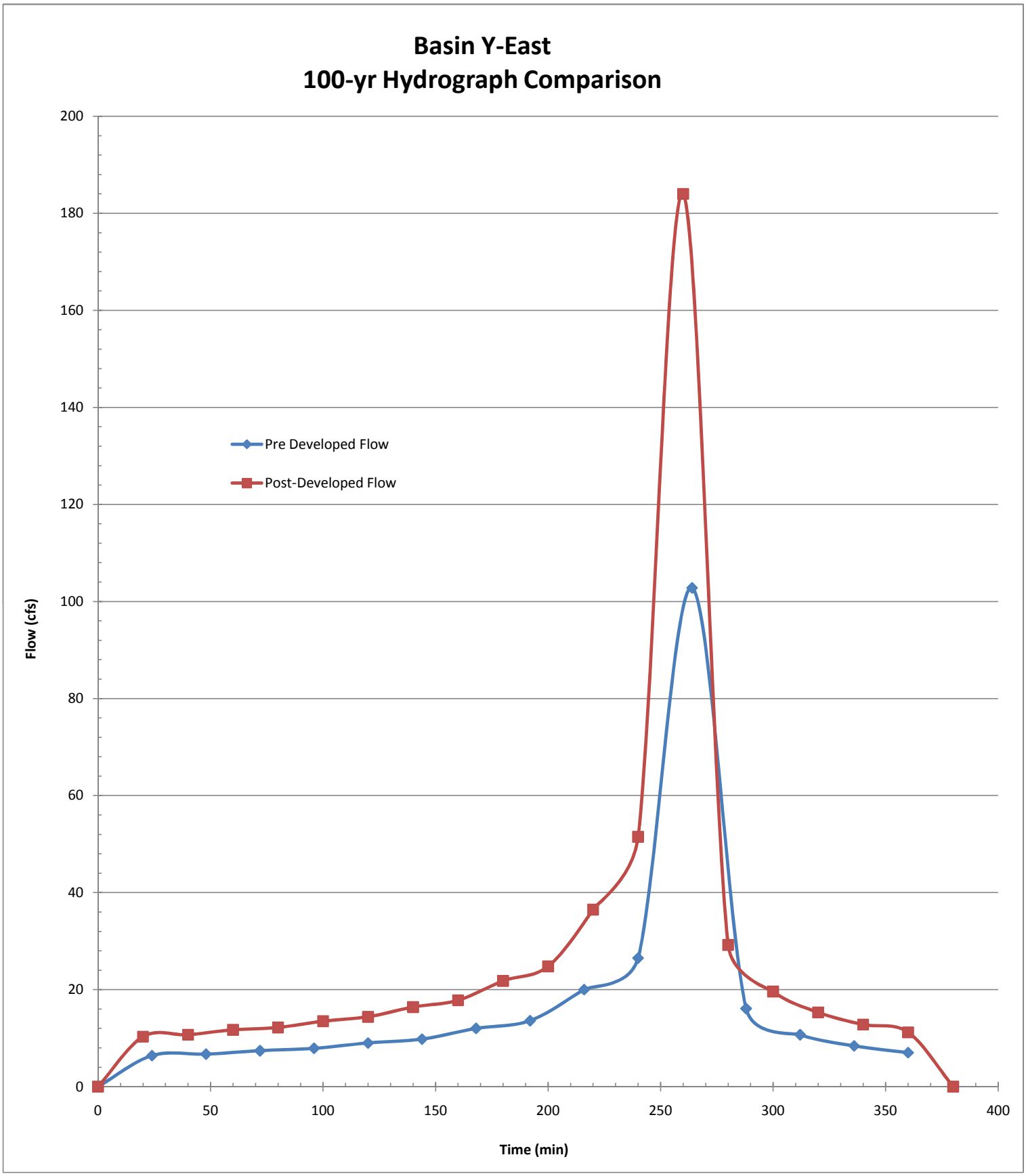
$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

| | | | |
|---|---|---|---|
| Onsite Highway *Sloped* runoff area, A: | | 629500 | $ft^2$ |
| | A: | 14.45 | acres |
| | | 10.00 | years |
| where: | R= | 30.00 | |
| | K= | 0.24 | |
| | Ls= | 18.00 | |
| | C= | 0.012 | |
| | P= | 1.00 | |
| | As | 1.56 | tons/yr*Ac |

Volume for 10-year Silt Accumulation = 224.75 tons

**Silt Accumulation Basin volume =** **4994** **$ft^3$** **Add this volume to Basin**

**Add this volume to Basin volume due to silts from cut slopes**


Basin Y-East
100-yr Hydrograph Comparison
Pre Developed Flow
Post-Developed Flow
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
300
350
400

# Basin Y-East Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y-East |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 1467600 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 33.69 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 57% | AT | 0.90 | 0.514 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 43% | AT | 0.55 | 0.236 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.75 |
| $C_{25}$ = | 0.82 |
| $C_{50}$ = | 0.90 |
| $C_{100}$ = | 0.94 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 611.5 | ft | SR-11 CL |
| LOW POINT ELEVATION | 610.0 | ft | SR-11 ES |
| ELEVATION DIFF (H) | 1.5 | ft | |
| LENGTH (L) | 125 | ft | To Bioswale |
| SLOPE (S) = (H/L) | 1.2% | | |
| MANNING'S n | 0.016 | | <= From Table 816.6A AC |
| $T_t$ (SFF)= | 3.20 | minutes | |

**SHALLOW CONCENTRATED FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 610.0 | ft | Origin of Bioswale |
| LOW POINT ELEVATION | 609.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 200 | ft | Assumed bioswale does not have enough flow to be channelized |
| SLOPE (S) = (H/L) | 0.5% | | |
| VELOCITY (SCF) | 1.8 | fps | 0.5% ,V From Figure 816.6 Grassed Waterway |
| $T_c$ (SH)= | 1.85 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 609.0 | ft | Begin channel flow in bioswale |
| LOW POINT ELEVATION | 590.0 | ft | CHANNEL DATA TYPE = TRAP'Z |
| ELEVATION DIFF (H) | 19.0 | ft | Z= 4 ANG-RAD 0.245 |
| LENGTH (L) | 1158 | ft | b = 13 ANG-DEG 14.036 |
| SLOPE (S) = (H/L) | 1.6% | | d = 1 FLOWING FULL ASS'M |
| MANNING'S n | 0.050 | | HDM Table 864.3A, Depressed Median - Earth (with growth) |
| HYDRAULIC RADIUS R | 0.80 | ft | R=(bdsinA+d^2cosA)/(bsinA+2d) |
| VELOCITY (CHANNEL) | 3.29 | fps | From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$ |
| $T_c$ (CH)= | 5.87 | minutes | |

# Basin Y-East Inflow TcQ

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 590.0 | ft |
| LOW POINT ELEVATION | 584.0 | ft |
| ELEVATION DIFF (H) | 6.0 | ft |
| LENGTH (L) | 345 | ft |
| SLOPE (S) = (H/L) | 1.7% | |
| MANNING'S n | 0.013 | |
| HYDRAULIC RADIUS R | 0.80 | ft |
| VELOCITY (CHANNEL) | 13.03 | fps |
| $T_C$ (CH)= | 0.44 | minutes |

**NOTES:**

Assume former basin is conc channel

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

Concrete

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 579.0 | ft |
| LOW POINT ELEVATION | 520.0 | ft |
| ELEVATION DIFF (H) | 59.0 | ft |
| LENGTH (L) | 3725 | ft |
| SLOPE (S) = (H/L) | 1.6% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 9.1 | fps |
| $T_C$ (SD)= | 6.83 | minutes |

**NOTES:**

Proposed basin outlet pipe

Discharge at Basin Y-East

RCP

R=D/4, Assume: flowing full

$V = \frac{K_u}{n} R^{2/3} S^{1/2}$

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 18.19 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **18.19** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.3 | in/hr | X CA = |
| $i_{10}$ = | 1.8 | in/hr | X CA = |
| $i_{25}$ = | 2.3 | in/hr | X CA = |
| $i_{50}$ = | 2.7 | in/hr | X CA = |
| $i_{100}$ = | 2.9 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 31.8 |
| **$Q_{10}$ =** | 46.3 |
| **$Q_{25}$ =** | 63.7 |
| **$Q_{50}$ =** | 83.3 |
| **$Q_{100}$ =** | **90.4** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin Y-East Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-East** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 90.4 | cfs | $C_{100}$= | 0.94 | |
| Tc= | 18.2 | min | A= | 33.69 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 18 | 5184 | 4.8 |
| 36 | 5508 | 5.1 |
| 54 | 5724 | 5.3 |
| 72 | 6264 | 5.8 |
| 90 | 6588 | 6.1 |
| 108 | 7236 | 6.7 |
| 126 | 7668 | 7.1 |
| 144 | 8856 | 8.2 |
| 162 | 9504 | 8.8 |
| 180 | 11664 | 10.8 |
| 198 | 13284 | 12.3 |
| 216 | 19548 | 18.1 |
| 234 | 28512 | 26.4 |
| 252 | 97632 | 90.4 |
| 270 | 15660 | 14.5 |
| 288 | 10476 | 9.7 |
| 306 | 8208 | 7.6 |
| 324 | 6912 | 6.4 |
| 342 | 5940 | 5.5 |
| 360 | 5292 | 4.9 |
| 378 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1260 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

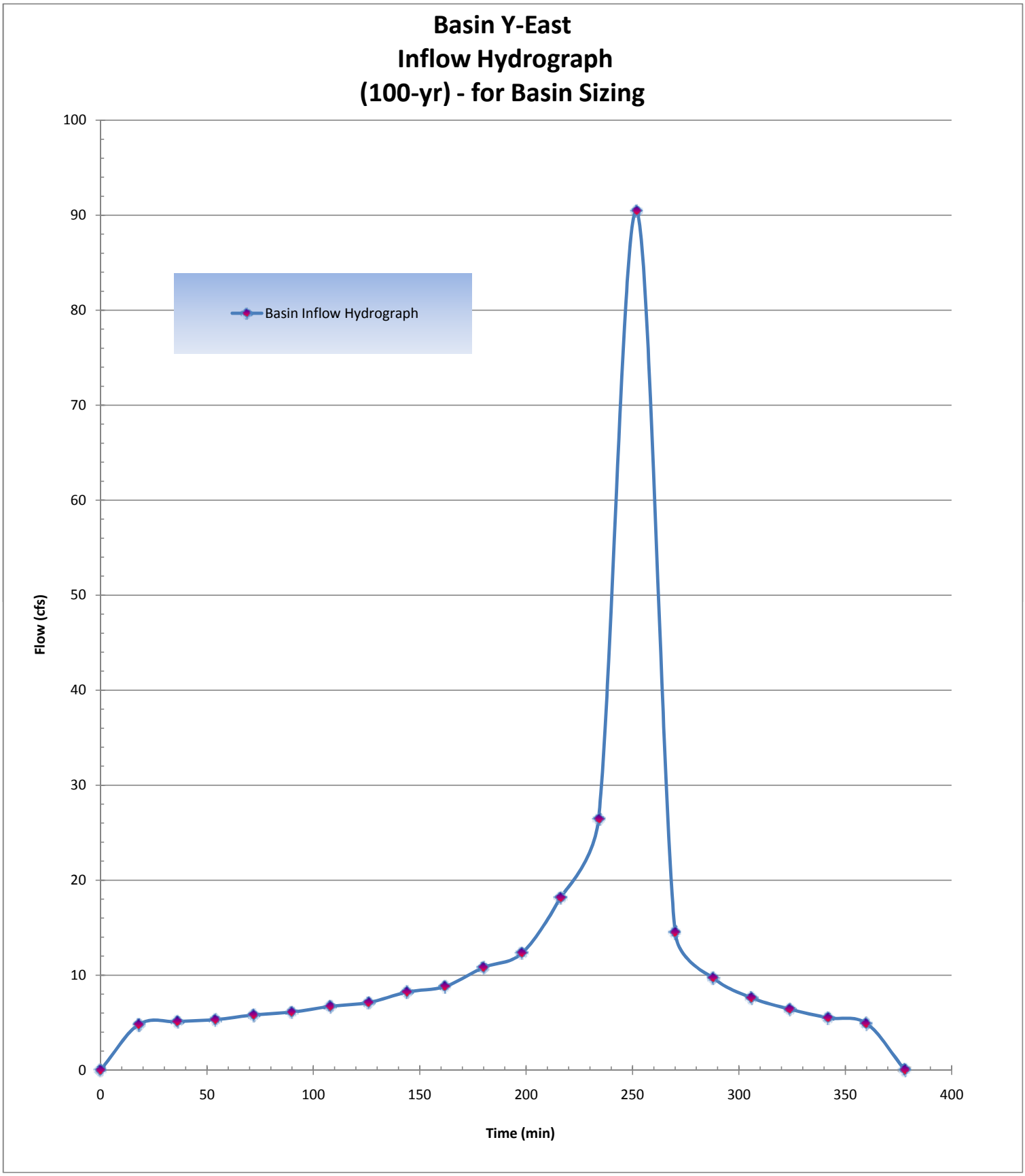
**SUM= 285660 $ft^3$**
**6.56 acre-feet**

Onsite Runoff Volume

Check: $V = C*A*P_6$

V= 6.58 acre-feet

***OK***


Basin Y-East
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400

# Basin Y-East Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-East** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required retention volume = | 240842 | $ft^3$ | |
| Retention volume from this basin = | 244765 | | at 2.4' depth |
| Actual Basin Inflow = | 285660 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 102.8 | cfs | |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert Y |
| Flow that does not reach detention basin (bypass per DA table): | 59.6 | cfs | $Q_{100}$ from: Y.9.PV A2.5.SL Y.905.SL |
| Maximum flow allowed to be released by this basin: | 43.2 | cfs | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | | | |
|---|---|---|---|---|
| Basin - Top of basin berm elevation = | | | 520.00 | ft |
| Basin flowline elevation = | | | 514.00 | ft |
| Maximum Basin Depth = | | | 6.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 2.40 | ft | 516.40 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | | 425 | ft |
| Base Width (W) | | 225 | ft |
| W/L Ratio ® | | 0.53 | |
| Side Slopes (Z) | 1: | 4 | |
| Total Volume (V): | | 671445 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 *~ assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 514.00 | 0.00 | 0 | 0 | | 514.00 | 0.00 | | 0.00 |
| 1 | 514.20 | 0.20 | 19229 | 19229 | | 514.20 | 0.00 | | 0.00 |
| 2 | 514.40 | 0.40 | 19439 | 38668 | | 514.40 | 0.00 | | 0.00 |
| 3 | 514.60 | 0.60 | 19649 | 58318 | | 514.60 | 0.00 | | 0.00 |
| 4 | 514.80 | 0.80 | 19860 | 78178 | | 514.80 | 0.00 | | 0.00 |
| 5 | 515.00 | 1.00 | 20072 | 98250 | | 515.00 | 0.00 | | 0.00 |
| 6 | 515.20 | 1.20 | 20285 | 118536 | | 515.20 | 0.00 | | 0.00 |
| 7 | 515.40 | 1.40 | 20499 | 139035 | | 515.40 | 0.00 | | 0.00 |
| 8 | 515.60 | 1.60 | 20714 | 159748 | | 515.60 | 0.00 | | 0.00 |
| 9 | 515.80 | 1.80 | 20929 | 180677 | | 515.80 | 0.00 | | 0.00 |
| 10 | 516.00 | 2.00 | 21145 | 201822 | | 516.00 | 0.00 | | 0.00 |
| 11 | 516.20 | 2.20 | 21362 | 223185 | | 516.20 | 0.00 | | 0.00 |
| 12 | 516.40 | 2.40 | 21580 | 244765 | * | 516.40 | 0.00 | | 0.00 |
| 13 | 516.60 | 2.60 | 21799 | 266564 | | 516.60 | 0.15 | | 0.15 |
| 14 | 516.80 | 2.80 | 22019 | 288583 | | 516.80 | 0.59 | | 0.59 |
| 15 | 517.00 | 3.00 | 22239 | 310822 | | 517.00 | 1.30 | 0.00 | 1.30 |
| 16 | 517.20 | 3.20 | 22461 | 333282 | | 517.20 | 2.25 | | 2.25 |
| 17 | 517.40 | 3.40 | 22683 | 355965 | | 517.40 | 3.42 | | 3.42 |
| 18 | 517.60 | 3.60 | 22906 | 378871 | | 517.60 | 4.79 | | 4.79 |
| 19 | 517.80 | 3.80 | 23130 | 402000 | | 517.80 | 6.32 | | 6.32 |
| 20 | 518.00 | 4.00 | 23354 | 425355 | | 518.00 | 7.99 | | 7.99 |
| 21 | 518.20 | 4.20 | 23580 | 448935 | | 518.20 | 9.77 | | 9.77 |
| 22 | 518.40 | 4.40 | 23806 | 472741 | | 518.40 | 11.63 | | 11.63 |
| 23 | 518.60 | 4.60 | 24034 | 496775 | | 518.60 | 13.53 | | 13.53 |
| 24 | 518.80 | 4.80 | 24262 | 521036 | | 518.80 | 15.46 | | 15.46 |
| 25 | 519.00 | 5.00 | 24491 | 545527 | | 519.00 | 17.37 | | 17.37 |
| 26 | 519.20 | 5.20 | 24721 | 570248 | | 519.20 | 19.16 | | 19.16 |
| 27 | 519.40 | 5.40 | 24951 | 595199 | | 519.40 | 20.41 | | 20.41 |
| 28 | 519.60 | 5.60 | 25183 | 620382 | | 519.60 | 21.59 | | 21.59 |
| 29 | 519.80 | 5.80 | 25415 | 645797 | | 519.80 | 22.71 | | 22.71 |
| 30 | 520.00 | 6.00 | 25648 | 671445 | | 520.00 | 23.78 | | 23.78 |

# Basin Y-East Routing

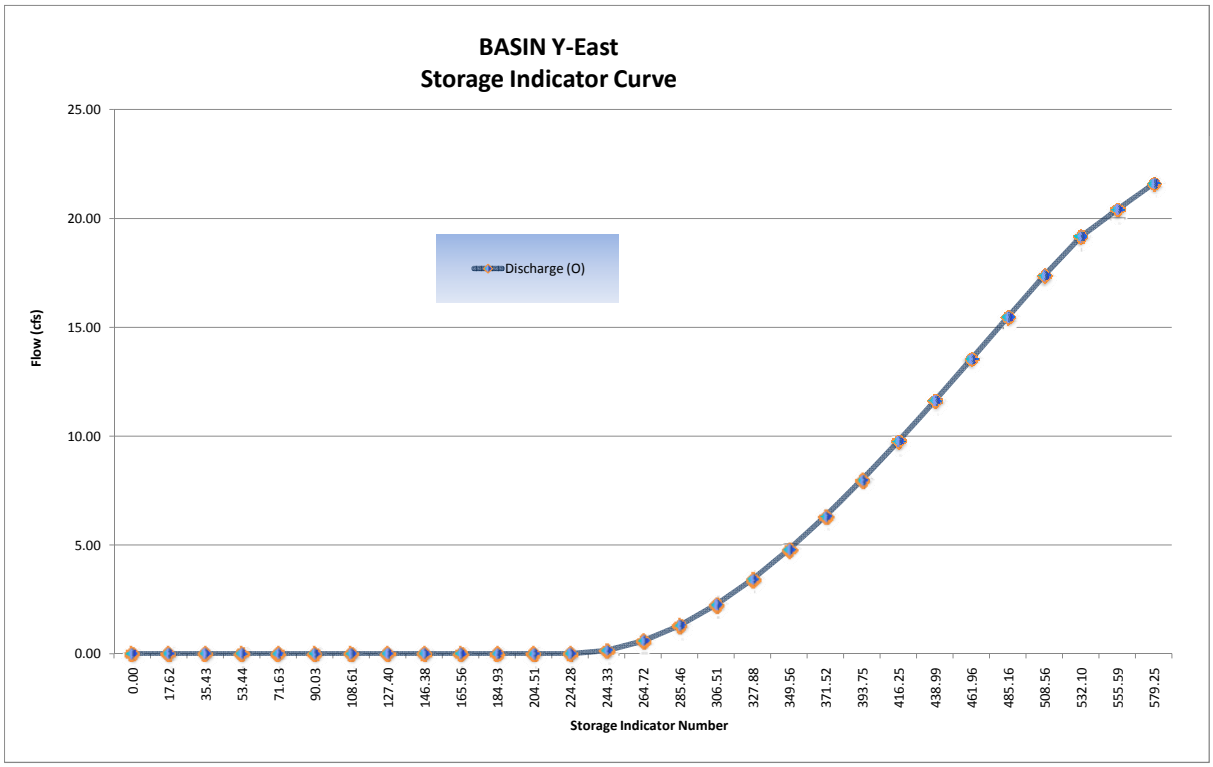
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y-East |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin Y-East |

user input
linked input

## STORAGE INDICATOR NUMBERS TABLE

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 514.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 514.20 | 0.00 | 19229 | 0.00 | 17.62 | 17.62 |
| 514.40 | 0.00 | 38668 | 0.00 | 35.43 | 35.43 |
| 514.60 | 0.00 | 58318 | 0.00 | 53.44 | 53.44 |
| 514.80 | 0.00 | 78178 | 0.00 | 71.63 | 71.63 |
| 515.00 | 0.00 | 98250 | 0.00 | 90.03 | 90.03 |
| 515.20 | 0.00 | 118536 | 0.00 | 108.61 | 108.61 |
| 515.40 | 0.00 | 139035 | 0.00 | 127.40 | 127.40 |
| 515.60 | 0.00 | 159748 | 0.00 | 146.38 | 146.38 |
| 515.80 | 0.00 | 180677 | 0.00 | 165.56 | 165.56 |
| 516.00 | 0.00 | 201822 | 0.00 | 184.93 | 184.93 |
| 516.20 | 0.00 | 223185 | 0.00 | 204.51 | 204.51 |
| 516.40 | 0.00 | 244765 | 0.00 | 224.28 | 224.28 |
| 516.60 | 0.15 | 266564 | 0.08 | 244.25 | 244.33 |
| 516.80 | 0.59 | 288583 | 0.30 | 264.43 | 264.72 |
| 517.00 | 1.30 | 310822 | 0.65 | 284.81 | 285.46 |
| 517.20 | 2.25 | 333282 | 1.13 | 305.39 | 306.51 |
| 517.40 | 3.42 | 355965 | 1.71 | 326.17 | 327.88 |
| 517.60 | 4.79 | 378871 | 2.40 | 347.16 | 349.56 |
| 517.80 | 6.32 | 402000 | 3.16 | 368.36 | 371.52 |
| 518.00 | 7.99 | 425355 | 4.00 | 389.76 | 393.75 |
| 518.20 | 9.77 | 448935 | 4.89 | 411.36 | 416.25 |
| 518.40 | 11.63 | 472741 | 5.82 | 433.18 | 438.99 |
| 518.60 | 13.53 | 496775 | 6.77 | 455.20 | 461.96 |
| 518.80 | 15.46 | 521036 | 7.73 | 477.43 | 485.16 |
| 519.00 | 17.37 | 545527 | 8.69 | 499.87 | 508.56 |
| 519.20 | 19.16 | 570248 | 9.58 | 522.52 | 532.10 |
| 519.40 | 20.41 | 595199 | 10.21 | 545.38 | 555.59 |
| 519.60 | 21.59 | 620382 | 10.80 | 568.46 | 579.25 |
| 519.80 | 22.71 | 645797 | 11.36 | 591.75 | 603.10 |
| 520.00 | 23.78 | 671445 | 11.89 | 615.25 | 627.14 |

| | | |
|---|---|---|
| delta t = | 0.30 | hrs |
| delta t = | 18 | min |
| delta t = | 1091.338 | sec |

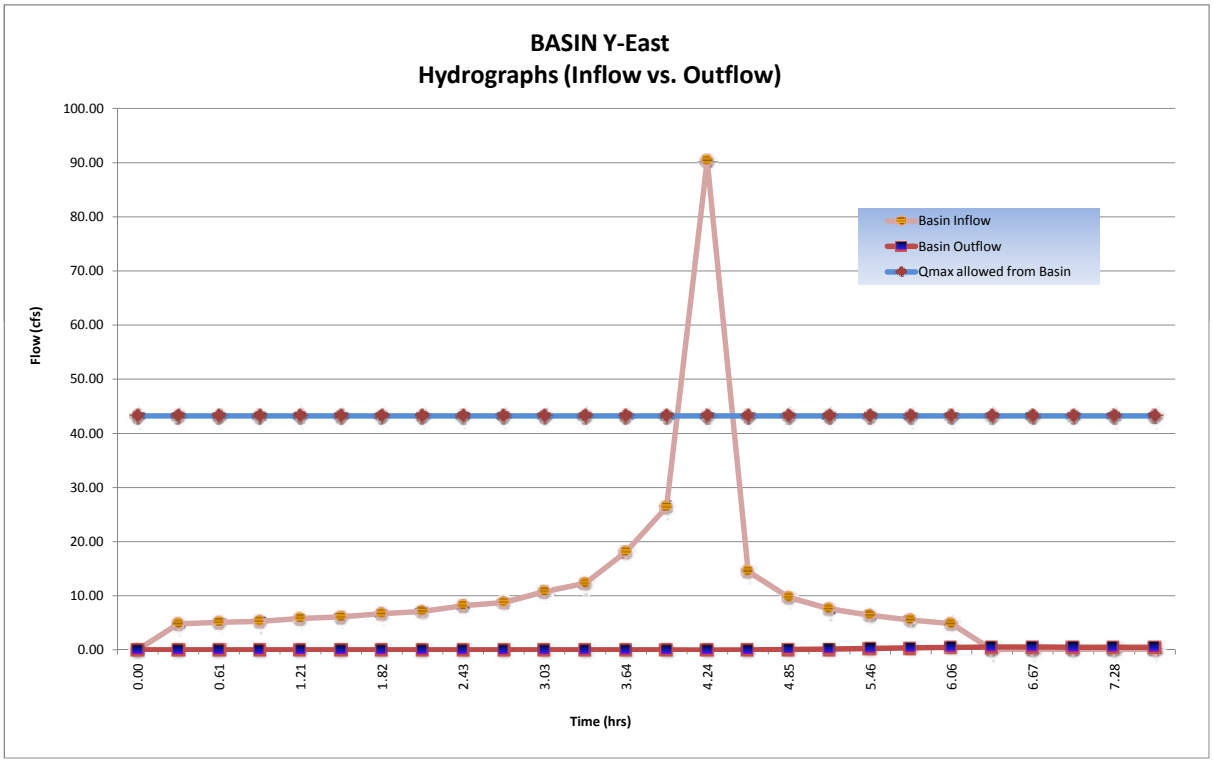


# Basin Y-East Routing

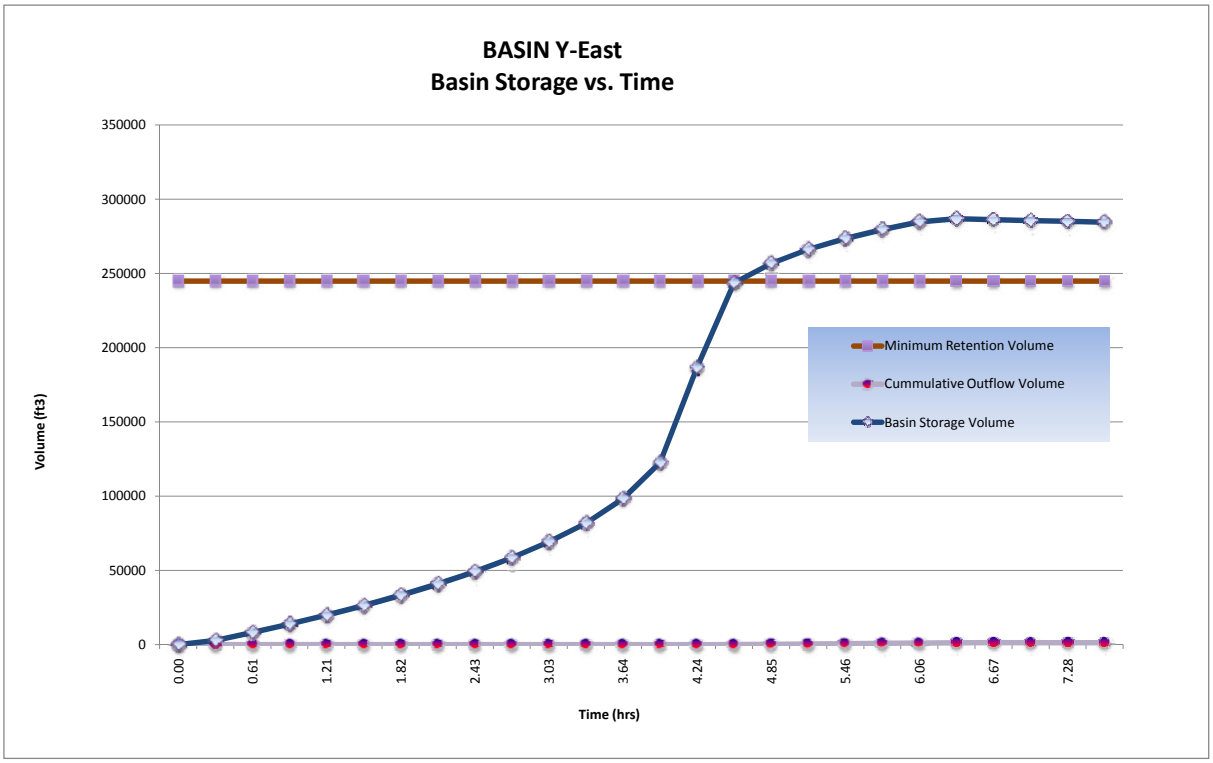
$$\frac{I_1 + I_2}{2} - \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) = O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.30 | 4.80 | 2.40 | 0.00 | 0.00 | 2.40 | 0.00 | 2619 | 0 | 0 |
| 0.61 | 5.10 | 4.95 | 2.40 | 0.00 | 7.35 | 0.00 | 8021 | 0 | 0 |
| 0.91 | 5.30 | 5.20 | 7.35 | 0.00 | 12.55 | 0.00 | 13696 | 0 | 0 |
| 1.21 | 5.80 | 5.55 | 12.55 | 0.00 | 18.10 | 0.00 | 19753 | 0 | 0 |
| 1.52 | 6.10 | 5.95 | 18.10 | 0.00 | 24.05 | 0.00 | 26247 | 0 | 0 |
| 1.82 | 6.70 | 6.40 | 24.05 | 0.00 | 30.45 | 0.00 | 33231 | 0 | 0 |
| 2.12 | 7.10 | 6.90 | 30.45 | 0.00 | 37.35 | 0.00 | 40761 | 0 | 0 |
| 2.43 | 8.20 | 7.65 | 37.35 | 0.00 | 45.00 | 0.00 | 49110 | 0 | 0 |
| 2.73 | 8.80 | 8.50 | 45.00 | 0.00 | 53.50 | 0.00 | 58387 | 0 | 0 |
| 3.03 | 10.80 | 9.80 | 53.50 | 0.00 | 63.30 | 0.00 | 69082 | 0 | 0 |
| 3.33 | 12.30 | 11.55 | 63.30 | 0.00 | 74.85 | 0.00 | 81687 | 0 | 0 |
| 3.64 | 18.10 | 15.20 | 74.85 | 0.00 | 90.05 | 0.00 | 98275 | 0 | 0 |
| 3.94 | 26.40 | 22.25 | 90.05 | 0.00 | 112.30 | 0.00 | 122557 | 0 | 0 |
| 4.24 | 90.40 | 58.40 | 112.30 | 0.00 | 170.70 | 0.00 | 186291 | 0 | 0 |
| 4.55 | 14.50 | 52.45 | 170.70 | 0.00 | 223.15 | 0.00 | 243532 | 0 | 0 |
| 4.85 | 9.70 | 12.10 | 223.15 | 0.00 | 235.25 | 0.08 | 256694 | 87 | 87 |
| 5.15 | 7.60 | 8.65 | 235.25 | 0.08 | 243.82 | 0.15 | 266008 | 164 | 251 |
| 5.46 | 6.40 | 7.00 | 243.82 | 0.15 | 250.67 | 0.29 | 273407 | 316 | 480 |
| 5.76 | 5.50 | 5.95 | 250.67 | 0.29 | 256.33 | 0.41 | 279519 | 447 | 764 |
| 6.06 | 4.90 | 5.20 | 256.33 | 0.41 | 261.12 | 0.51 | 284692 | 557 | 1004 |
| 6.37 | 0.00 | 2.45 | 261.12 | 0.51 | 263.06 | 0.55 | 286787 | 600 | 1157 |
| 6.67 | 0.00 | 0.00 | 263.06 | 0.55 | 262.51 | 0.54 | 286192 | 589 | 1190 |
| 6.97 | 0.00 | 0.00 | 262.51 | 0.54 | 261.97 | 0.53 | 285609 | 578 | 1168 |
| 7.28 | 0.00 | 0.00 | 261.97 | 0.53 | 261.44 | 0.52 | 285036 | 567 | 1146 |
| 7.58 | 0.00 | 0.00 | 261.44 | 0.52 | 260.92 | 0.51 | 284474 | 557 | 1124 |
| 7.88 | 0.00 | 0.00 | 260.92 | 0.51 | 260.41 | 0.50 | 283923 | 546 | 1102 |
| 8.19 | 0.00 | 0.00 | 260.41 | 0.50 | 259.91 | 0.49 | 283382 | 535 | 1080 |



## Basin Y-East Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **286,787** | **ft$^3$** | |
| **@ Stage:** | **516.80** | **ft** | |
| **Freeboard:** | **3.2** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **671,445** | **ft$^3$** | Basin **Y-East** |
| **Maximum flow rate released from this basin:** | **0.55** | **cfs** | |

# Basin Y-West Retention

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-West** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

* The difference between pre-developed and post-developed values gives the volume to retain.

**RETENTION BASIN VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Pre-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 102.8 | cfs | | | |
| Tc= | 23.5 | min | C= | 0.58 | |
| $P_{100,6}$= | 2.5 | in | A= | 72.78 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 24 | 9216 | 6.4 |
| 48 | 9648 | 6.7 |
| 72 | 10656 | 7.4 |
| 96 | 11376 | 7.9 |
| 120 | 12960 | 9 |
| 144 | 14112 | 9.8 |
| 168 | 17280 | 12 |
| 192 | 19584 | 13.6 |
| 216 | 28800 | 20 |
| 240 | 38160 | 26.5 |
| 264 | 148032 | 102.8 |
| 288 | 23184 | 16.1 |
| 312 | 15408 | 10.7 |
| 336 | 12096 | 8.4 |
| 360 | 10080 | 7 |
| 384 | 0 | 0 |

Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 380592 $ft^3$**
**8.74 acre-feet**

Check: $V = C*A*P_6$
V= 8.81 acre-feet
***OK***

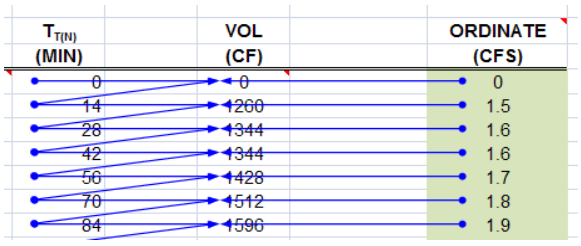
# Basin Y-West Retention

## Post-Developed volume calculations

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 184.0 | cfs | | | |
| Tc= | 20.2 | min | C= | 0.87 | |
| $P_{100,6}$= | 2.5 | in | A= | 78.57 | acres |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 20 | 12360 | 10.3 |
| 40 | 12840 | 10.7 |
| 60 | 14040 | 11.7 |
| 80 | 14640 | 12.2 |
| 100 | 16200 | 13.5 |
| 120 | 17280 | 14.4 |
| 140 | 19680 | 16.4 |
| 160 | 21360 | 17.8 |
| 180 | 26160 | 21.8 |
| 200 | 29760 | 24.8 |
| 220 | 43800 | 36.5 |
| 240 | 61800 | 51.5 |
| 260 | 220800 | 184 |
| 280 | 35040 | 29.2 |
| 300 | 23520 | 19.6 |
| 320 | 18360 | 15.3 |
| 340 | 15360 | 12.8 |
| 360 | 13440 | 11.2 |
| 380 | 0 | 0 |

Example of Steps:




**SUM= 616440 $ft^3$**
**14.15 acre-feet**

Check: V = C*A*$P_6$
V= 14.30 acre-feet
***OK***

| | | | | | |
|---|---|---|---|---|---|
| | | **14.15** | *(Post)* | | |
| | - | **8.74** | *(Pre)* | | |
| **Retention volume =** | | **5.41** | **acre-feet** | **=** | **235848 $ft^3$** **Basin Required** |

# Basin Y-West Retention

**WATER QUALITY VOLUME (WQV) CALCULATION**

Per the Caltrans Storm Water Quality Handbook: Project Planning and Design Guide (PPDG) (May 2007)
*Provide additional capacity for Water Quality*

*Output from Basin Sizer*

**Water Quality Volumes**

**Maximized Volume Method (in/area)***

| Basin Drainage Time (hrs) | Runoff Coefficient 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|
| 12 | 0.13 | 0.16 | 0.21 | 0.25 | 0.28 | 0.33 | 0.37 | 0.4 |
| 24 | 0.16 | 0.21 | 0.27 | 0.31 | 0.37 | 0.42 | 0.46 | 0.52 |
| 48 | 0.2 | 0.26 | 0.32 | 0.38 | 0.44 | 0.51 | 0.57 | 0.58 |
| 72 | 0.22 | 0.29 | 0.37 | 0.43 | 0.51 | 0.58 | 0.66 | 0.73 |

$C_{100}$= 0.95
A= 22.81 acres

$WQ_{72}$: 0.73 in/area

**Water Quality Volume (WQV) =** **60444** **$ft^3$**

**WQV to be added to retention volume =** **0** **$ft^3$** **WQV is within Retention**

**Add difference between WQV and Retention Volume**

**SILT ACCUMULATION ANALYSIS (Long Term)**

Per the United States International Boundary and Water Commission (IBWC)
*Provide additional capacity for a 10-year volume of silt accumulation*

Onsite Highway *Sloped* runoff area, A: 406100 $ft^2$
A: 9.32 acres
10.00 years
where: R= 30.00
K= 0.24
Ls= 18.00
C= 0.012
P= 1.00
As 1.56 tons/yr*Ac

Volume for 10-year Silt Accumulation = 144.99 tons

Universal Soil Loss Equation (SDCHM 5.2.3)

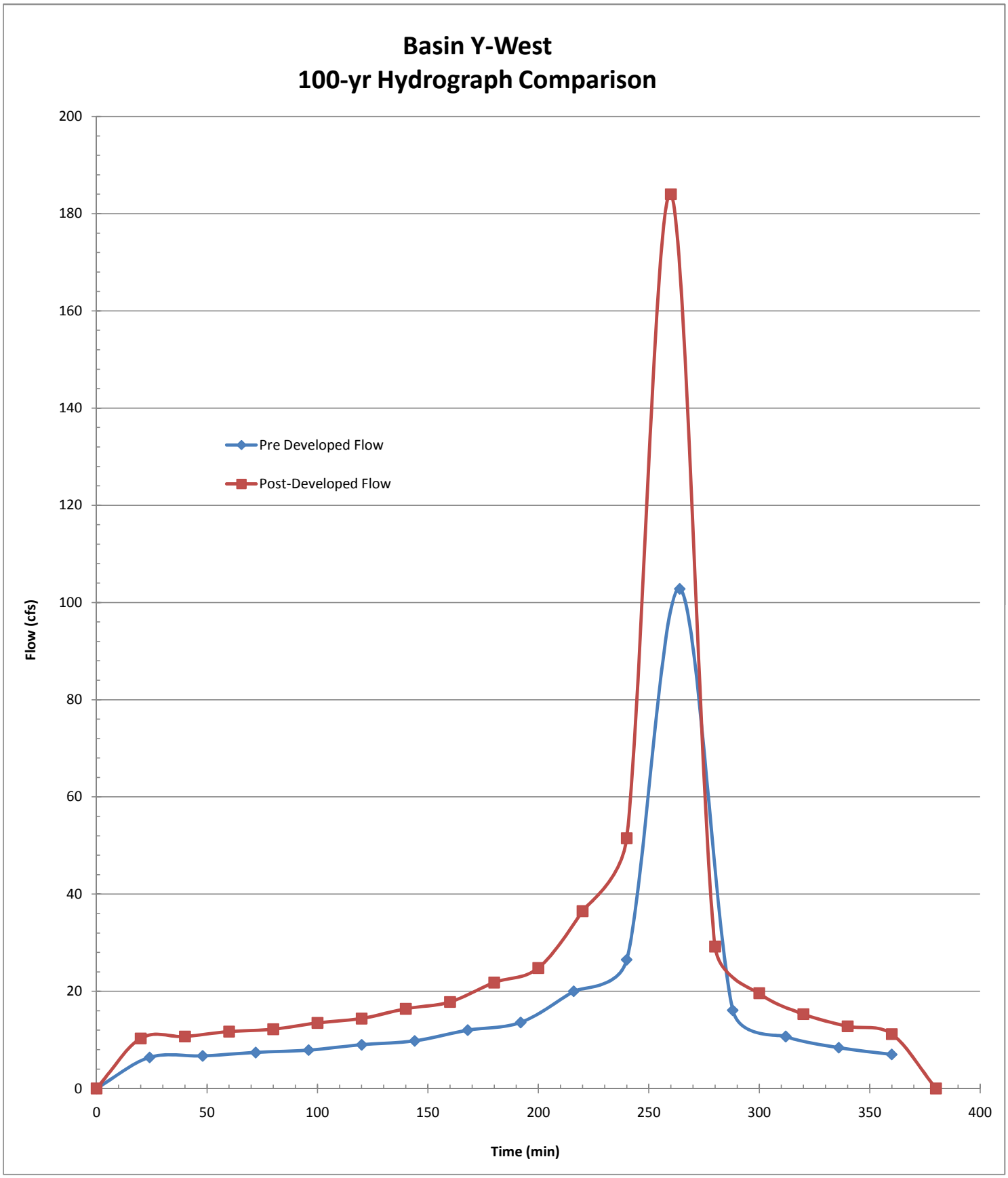
$A_s = RKLsCP$

where:

$A_s$ = the computed soil loss in tons (dry weight)
R = the rainfall erosion index for the given storm period
K = the soil erodibility factor
L = the slope length factor
s = the slope gradient factor
C = cropping management (vegetation) factor
P = erosion control practice factor

**Silt Accumulation Basin volume =** **3222** **$ft^3$** **Add this volume to Basin**

**Add this volume to Basin volume due to silts from cut slopes**


Basin Y-West
100-yr Hydrograph Comparison
Pre Developed Flow
Post-Developed Flow
Flow (cfs)
Time (min)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
300
350
400

# Basin Y-West Inflow TcQ

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y-West |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | |

**BASIN AREA:**

| | | | | |
|---|---|---|---|---|
| A = | 993600 | ft^2 | SOURCE: | MICROSTATION/USGS |
| | 22.81 | acres | | (SCALE = 1:1) |

**COEFFICIENT OF RUNOFF:**

KEY: User Input | Designer Tool

UNDEVELOPED AREA C (FROM HDM FIG. 819.2A)

| | | |
|---|---|---|
| RELIEF (.08-.35) | 0.00 | |
| INFILTRATION (.04-.16) | 0.00 | |
| VEGETATION (.04-.16) | 0.00 | |
| STORAGE (.04-.12) | 0.00 | |
| TOTAL C = | 0.00 | |

| | | | | |
|---|---|---|---|---|
| UNDEVELOPED AREA | 0% | AT | 0.00 | 0.000 |
| PAVED SURFACE | 59% | AT | 0.90 | 0.532 |
| COMMERCIAL AREA | 0% | AT | 0.85 | 0.000 |
| CUT SLOPE (2:1 and 4:1) | 41% | AT | 0.55 | 0.225 |
| TOTAL | 100% | | | |
| | (100%) | | | |

| | |
|---|---|
| $C_{2,10}$ = | 0.76 |
| $C_{25}$ = | 0.83 |
| $C_{50}$ = | 0.91 |
| $C_{100}$ = | 0.95 |

**TIME OF CONCENTRATION:**

**SHEET FLOW:** $T_t = \frac{0.42L^{4/5}n^{4/5}}{P_2^{1/2}s^{2/5}}$

**NOTES:** $P_{2,24}$ (in) = 1.80

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 565.0 | ft | |
| LOW POINT ELEVATION | 564.0 | ft | |
| ELEVATION DIFF (H) | 1.0 | ft | |
| LENGTH (L) | 111 | ft | |
| SLOPE (S) = (H/L) | 0.9% | | |
| MANNING'S n | 0.016 | | <= From Table 816.6A AC |
| $T_t$ (SFF)= | 3.26 | minutes | |

**CHANNEL FLOW:** $T_t = \frac{L}{60\,V}$

**NOTES:**

| | | | |
|---|---|---|---|
| HIGH PT ELEVATION | 564.0 | ft | |
| LOW POINT ELEVATION | 558.0 | ft | |
| ELEVATION DIFF (H) | 6.0 | ft | |
| LENGTH (L) | 787 | ft | |
| SLOPE (S) = (H/L) | 0.8% | | |
| MANNING'S n | 0.016 | | |
| HYDRAULIC RADIUS R | 0.80 | ft | |
| VELOCITY (CHANNEL) | 7.01 | fps | |
| $T_C$ (CH)= | 1.87 | minutes | |

| CHANNEL DATA | | TYPE = | TRAP'Z |
|---|---|---|---|
| Z= | 4 | ANG-RAD | 0.245 |
| b = | 13 | ANG-DEG | 14.036 |
| d = | 1 | FLOWING FULL ASS'M | |

AC

R=(bdsinA+d^2cosA)/(bsinA+2d)

From Manning's Equation assuming flowing full: $V=1.49/n(R^{2/3}S^{1/2})$

# Basin Y-West Inflow TcQ

**STORMDRAIN FLOW:** $T_t = \frac{L}{60\,V}$

| | | |
|---|---|---|
| HIGH PT ELEVATION | 554.0 | ft |
| LOW POINT ELEVATION | 510.0 | ft |
| ELEVATION DIFF (H) | 44.0 | ft |
| LENGTH (L) | 1046 | ft |
| SLOPE (S) = (H/L) | 4.2% | |
| MANNING'S n | 0.013 | |
| PIPE DIAMETER d | 2.0 | ft |
| HYDRAULIC RADIUS R | 0.5 | ft |
| VELOCITY (STORMDRAIN) | 14.8 | fps |
| $T_C$ (SD)= | 1.18 | minutes |

**NOTES:**

| |
|---|
| Proposed pipe to basin |
| Discharge into Basin Y-West |
| |
| |
| |
| RCP |
| |
| R=D/4, Assume: flowing full |
| $V = \frac{K_u}{n} R^{2/3} S^{1/2}$ |
| |

| | | |
|---|---|---|
| **Tc (TOTAL) =** | 6.31 | minutes |
| **Minimum Tc =** | 10 | minutes |
| **USE Tc =** | **10.00** | minutes |

**INTENSITY CHART:** $I = 7.44\,P_6\,D^{-0.645}$

| | | | |
|---|---|---|---|
| $i_2$ = | 1.9 | in/hr | X CA = |
| $i_{10}$ = | 2.7 | in/hr | X CA = |
| $i_{25}$ = | 3.4 | in/hr | X CA = |
| $i_{50}$ = | 4.0 | in/hr | X CA = |
| $i_{100}$ = | 4.2 | in/hr | X CA = |

**FLOW RESULTS:**

| | cfs |
|---|---|
| **$Q_2$ =** | 32.0 |
| **$Q_{10}$ =** | 46.5 |
| **$Q_{25}$ =** | 64.0 |
| **$Q_{50}$ =** | 83.8 |
| **$Q_{100}$ =** | **90.9** |

**COUNTY $P_6$**

| | inches |
|---|---|
| 2-year: | 1.1 |
| 10-year: | 1.6 |
| 25-year: | 2.0 |
| 50-year: | 2.4 |
| 100-year: | 2.5 |

# Basin Y-West Inflow Hydrograph

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-West** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

* This is the actual flow entering the detention basin.

**ONSITE RUNOFF VOLUME**

100-year, 6 hour duration storm event, use the Rational Method Hydrograph Procedure (SDCHM 6-1) ~ RatHydro

## Basin Inflow Hydrograph

Basin Inflow Q

| | | | | | |
|---|---|---|---|---|---|
| $Q_{100}$= | 90.9 | cfs | $C_{100}$= | 0.95 | |
| Tc= | 10.0 | min | A= | 22.81 | acres |
| $P_{100,6}$= | 2.5 | in | | | |

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 10 | 1920 | 3.2 |
| 20 | 1980 | 3.3 |
| 30 | 2040 | 3.4 |
| 40 | 2100 | 3.5 |
| 50 | 2220 | 3.7 |
| 60 | 2220 | 3.7 |
| 70 | 2340 | 3.9 |
| 80 | 2400 | 4 |
| 90 | 2520 | 4.2 |
| 100 | 2580 | 4.3 |
| 110 | 2760 | 4.6 |
| 120 | 2880 | 4.8 |
| 130 | 3060 | 5.1 |
| 140 | 3180 | 5.3 |
| 150 | 3480 | 5.8 |
| 160 | 3600 | 6 |
| 170 | 4020 | 6.7 |
| 180 | 4260 | 7.1 |
| 190 | 4920 | 8.2 |
| 200 | 5280 | 8.8 |
| 210 | 6480 | 10.8 |
| 220 | 7380 | 12.3 |
| 230 | 10860 | 18.1 |
| 240 | 15480 | 25.8 |
| 250 | 54540 | 90.9 |
| 260 | 8700 | 14.5 |
| 270 | 5820 | 9.7 |
| 280 | 4560 | 7.6 |
| 290 | 3840 | 6.4 |
| 300 | 3300 | 5.5 |
| 310 | 2940 | 4.9 |
| 320 | 2700 | 4.5 |
| 330 | 2460 | 4.1 |
| 340 | 2280 | 3.8 |
| 350 | 2160 | 3.6 |
| 360 | 2040 | 3.4 |
| 370 | 0 | 0 |

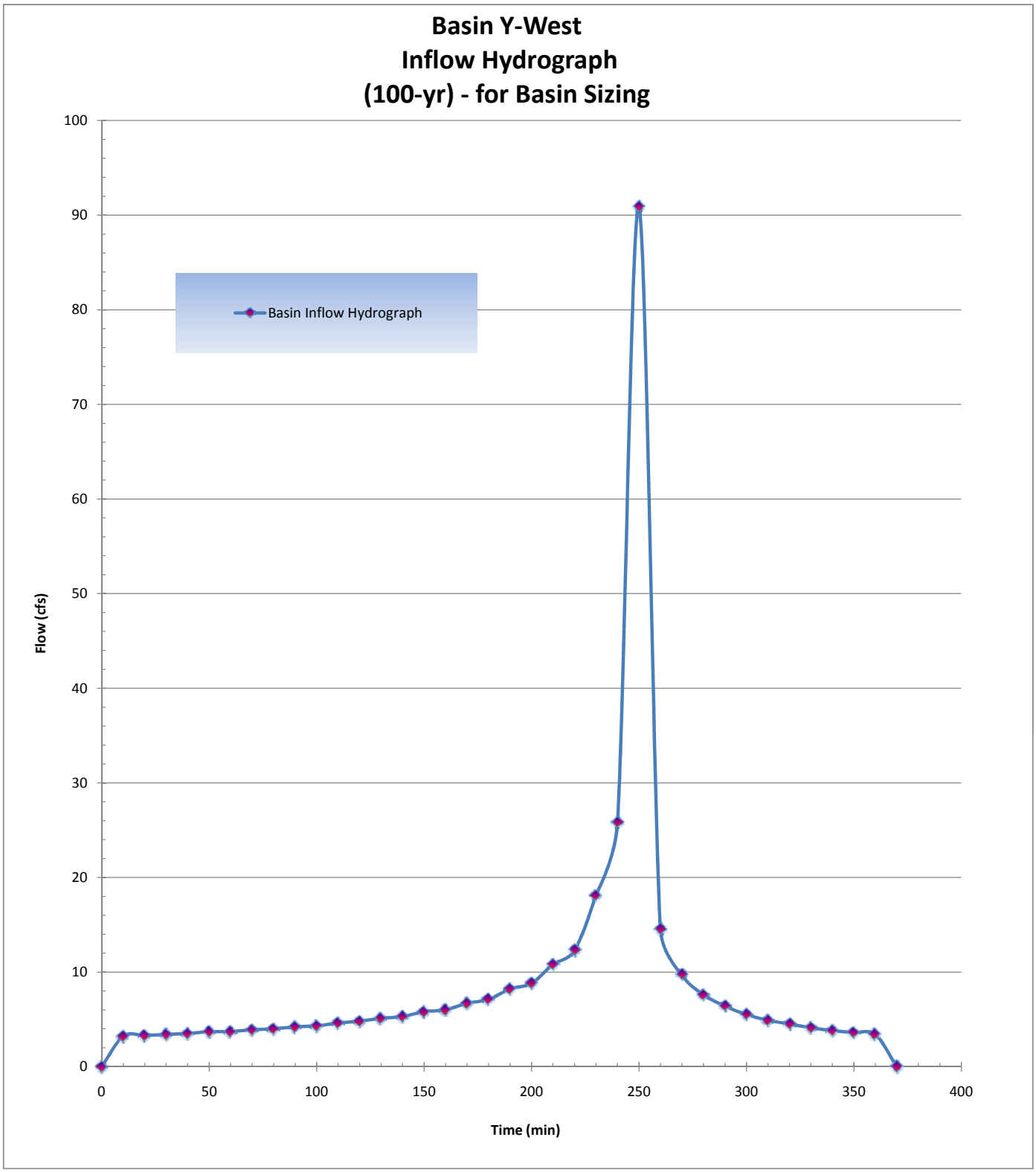
Example of Steps:

| $T_{T(N)}$ (MIN) | VOL (CF) | ORDINATE (CFS) |
|---|---|---|
| 0 | 0 | 0 |
| 14 | 1200 | 1.5 |
| 28 | 1344 | 1.6 |
| 42 | 1344 | 1.6 |
| 56 | 1428 | 1.7 |
| 70 | 1512 | 1.8 |
| 84 | 1596 | 1.9 |

**SUM= 195300 $ft^3$**
**4.48 acre-feet**

Onsite Runoff Volume

Check: V = C*A*$P_6$
V= 4.50 acre-feet
***OK***


Basin Y-West
Inflow Hydrograph
(100-yr) - for Basin Sizing
Basin Inflow Hydrograph
Flow (cfs)
Time (min)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400

# Basin Y-West Outlet

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT:** | **SR-11** | | | **DESCRIPTION:** | **SR-11 Basin** |
| **JOB #:** | **11A1190** | | | **STATION:** | **125/905** |
| **BY:** | **M.BRUNING** | **DATE:** | **02.19.10** | **WATERSHED:** | **Y-West** |
| **CHK:** | **G.DALZIEL** | **DATE:** | | **SYSTEM:** | |

***Notes:***

***Volumes:***

| | | | |
|---|---|---|---|
| Required retention volume = | 3222 | $ft^3$ | Silt only |
| Retention volume from this basin = | 3564 | | at 0.2' depth |
| Actual Basin Inflow = | 195300 | $ft^4$ | *OK* |

***Flow Balance - determine maximum flow from basin***

| | | | |
|---|---|---|---|
| Predeveloped Peak 100-year Flow: | 102.8 | cfs | |
| Post-Developed Peak Flow through Cross Culvert: | 0.0 | cfs | Independent of Culvert Y |
| Flow that does not reach detention basin (bypass per DA table): | 60.2 | cfs | $Q_{100}$ from: A2.5.SL Y.905.SL Y-East Basin |
| Maximum flow allowed to be released by this basin: | 42.6 | cfs | |

***Outlet Pipe***

*Assume: trapezoid basin/flat bottom, one outlet pipe set above basin invert*

| | | |
|---|---|---|
| Basin - Top of basin berm elevation = | 512.00 | ft |
| Basin flowline elevation = | 507.00 | ft |
| Maximum Basin Depth = | 5.00 | ft |

*Assume Culvert Design: free outfall, square-edge w/headwall*

| | | | | |
|---|---|---|---|---|
| Outlet pipe invert from basin floor = | 0.20 | ft | 507.20 | ft |
| Outlet pipe diameter = | 2 | ft | | |

***Basin Characteristics***

| | | | |
|---|---|---|---|
| Base Length (L) | | 350 | ft |
| Base Width (W) | | 50 | ft |
| W/L Ratio ® | | 0.14 | |
| Side Slopes (Z) | 1: | 4 | |
| Total Volume (V): | | 131854 | $ft^2$ |

***Infiltration Rate:*** Rate (min/inch): 71.1 Location: PT-C2 ~ *assume no infiltration*

| Detention Basin Data | | | | | | Outlet Pipe | | Infiltration | Total |
|---|---|---|---|---|---|---|---|---|---|
| Stage | Water Surface Elevation (ft) | Depth | $V_{avg}$ staged (ft3) | $V_{avg}$ cumm. (ft3) | | HW Elev. (ft) | Discharge $Q_{out}$ (cfs) | $Q_{inf}$ (cfs) | $Q_{total}$ (cfs) |
| 0 | 507.00 | 0.00 | 0 | 0 | | 507.00 | 0.00 | | 0.00 |
| 1 | 507.20 | 0.20 | 3564 | 3564 | * | 507.20 | 0.00 | | 0.00 |
| 2 | 507.40 | 0.40 | 3693 | 7257 | | 507.40 | 0.15 | | 0.15 |
| 3 | 507.60 | 0.60 | 3824 | 11081 | | 507.60 | 0.59 | | 0.59 |
| 4 | 507.80 | 0.80 | 3956 | 15037 | | 507.80 | 1.30 | | 1.30 |
| 5 | 508.00 | 1.00 | 4091 | 19128 | | 508.00 | 2.25 | | 2.25 |
| 6 | 508.20 | 1.20 | 4227 | 23355 | | 508.20 | 3.42 | | 3.42 |
| 7 | 508.40 | 1.40 | 4365 | 27719 | | 508.40 | 4.79 | | 4.79 |
| 8 | 508.60 | 1.60 | 4504 | 32223 | | 508.60 | 6.32 | | 6.32 |
| 9 | 508.80 | 1.80 | 4646 | 36869 | | 508.80 | 7.99 | | 7.99 |
| 10 | 509.00 | 2.00 | 4789 | 41658 | | 509.00 | 9.77 | | 9.77 |
| 11 | 509.20 | 2.20 | 4934 | 46591 | | 509.20 | 11.63 | | 11.63 |
| 12 | 509.40 | 2.40 | 5080 | 51671 | | 509.40 | 13.53 | | 13.53 |
| 13 | 509.60 | 2.60 | 5229 | 56900 | | 509.60 | 15.46 | 0.00 | 15.46 |
| 14 | 509.80 | 2.80 | 5379 | 62278 | | 509.80 | 17.37 | | 17.37 |
| 15 | 510.00 | 3.00 | 5531 | 67809 | | 510.00 | 19.16 | | 19.16 |
| 16 | 510.20 | 3.20 | 5684 | 73493 | | 510.20 | 20.41 | | 20.41 |
| 17 | 510.40 | 3.40 | 5840 | 79333 | | 510.40 | 21.59 | | 21.59 |
| 18 | 510.60 | 3.60 | 5997 | 85329 | | 510.60 | 22.71 | | 22.71 |
| 19 | 510.80 | 3.80 | 6156 | 91485 | | 510.80 | 23.78 | | 23.78 |
| 20 | 511.00 | 4.00 | 6316 | 97801 | | 511.00 | 24.80 | | 24.80 |
| 21 | 511.20 | 4.20 | 6479 | 104280 | | 511.20 | 25.78 | | 25.78 |
| 22 | 511.40 | 4.40 | 6643 | 110923 | | 511.40 | 26.72 | | 26.72 |
| 23 | 511.60 | 4.60 | 6809 | 117731 | | 511.60 | 27.64 | | 27.64 |
| 24 | 511.80 | 4.80 | 6976 | 124708 | | 511.80 | 28.52 | | 28.52 |
| 25 | 512.00 | 5.00 | 7146 | 131854 | | 512.00 | 29.38 | | 29.38 |

# Basin Y-West Routing

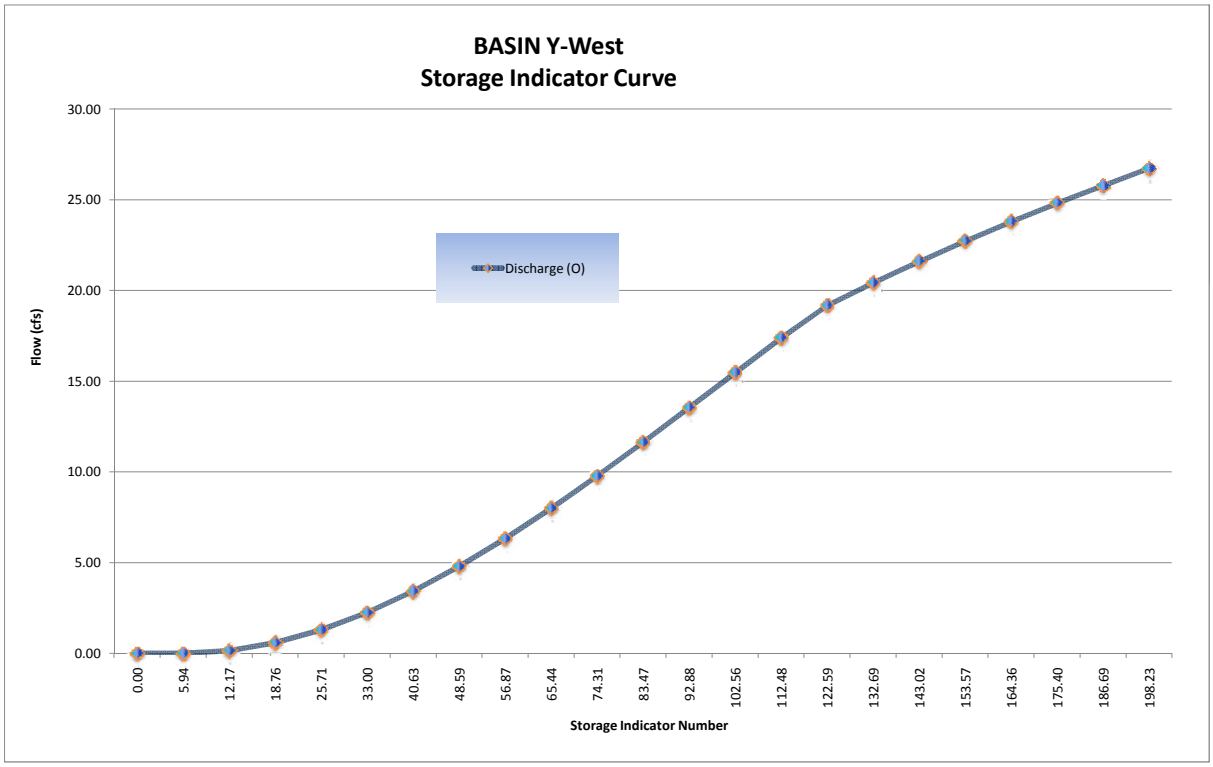
| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | SR-11 | | | DESCRIPTION: | SR-11 Basin |
| JOB #: | 11A1190 | | | STATION: | 125/905 |
| BY: | M.BRUNING | DATE: | 02.19.10 | WATERSHED: | Y-West |
| CHK: | G.DALZIEL | DATE: | | SYSTEM: | Basin Y-West |

user input
linked input

**STORAGE INDICATOR NUMBERS TABLE**

| (1) Stage (ft) | (2) Discharge (O) (cfs) | (3) Storage (S) ($ft^3$) | (4) $O_2/2$ (cfs) | (5) $S_2$/delta t (cfs) | (6) $S_2$/delta t + $O_2/2$ (cfs) |
|---|---|---|---|---|---|
| | | | | | *Storage Indicator #* |
| 507.00 | 0.00 | 0 | 0.00 | 0.00 | 0.00 |
| 507.20 | 0.00 | 3564 | 0.00 | 5.94 | 5.94 |
| 507.40 | 0.15 | 7257 | 0.08 | 12.09 | 12.17 |
| 507.60 | 0.59 | 11081 | 0.30 | 18.47 | 18.76 |
| 507.80 | 1.30 | 15037 | 0.65 | 25.06 | 25.71 |
| 508.00 | 2.25 | 19128 | 1.13 | 31.88 | 33.00 |
| 508.20 | 3.42 | 23355 | 1.71 | 38.92 | 40.63 |
| 508.40 | 4.79 | 27719 | 2.40 | 46.20 | 48.59 |
| 508.60 | 6.32 | 32223 | 3.16 | 53.71 | 56.87 |
| 508.80 | 7.99 | 36869 | 4.00 | 61.45 | 65.44 |
| 509.00 | 9.77 | 41658 | 4.89 | 69.43 | 74.31 |
| 509.20 | 11.63 | 46591 | 5.82 | 77.65 | 83.47 |
| 509.40 | 13.53 | 51671 | 6.77 | 86.12 | 92.88 |
| 509.60 | 15.46 | 56900 | 7.73 | 94.83 | 102.56 |
| 509.80 | 17.37 | 62278 | 8.69 | 103.80 | 112.48 |
| 510.00 | 19.16 | 67809 | 9.58 | 113.01 | 122.59 |
| 510.20 | 20.41 | 73493 | 10.21 | 122.49 | 132.69 |
| 510.40 | 21.59 | 79333 | 10.80 | 132.22 | 143.02 |
| 510.60 | 22.71 | 85329 | 11.36 | 142.22 | 153.57 |
| 510.80 | 23.78 | 91485 | 11.89 | 152.47 | 164.36 |
| 511.00 | 24.80 | 97801 | 12.40 | 163.00 | 175.40 |
| 511.20 | 25.78 | 104280 | 12.89 | 173.80 | 186.69 |
| 511.40 | 26.72 | 110923 | 13.36 | 184.87 | 198.23 |

| | | |
|---|---|---|
| delta t = | 0.17 | hrs |
| delta t = | 10 | min |
| delta t = | 600 | sec |



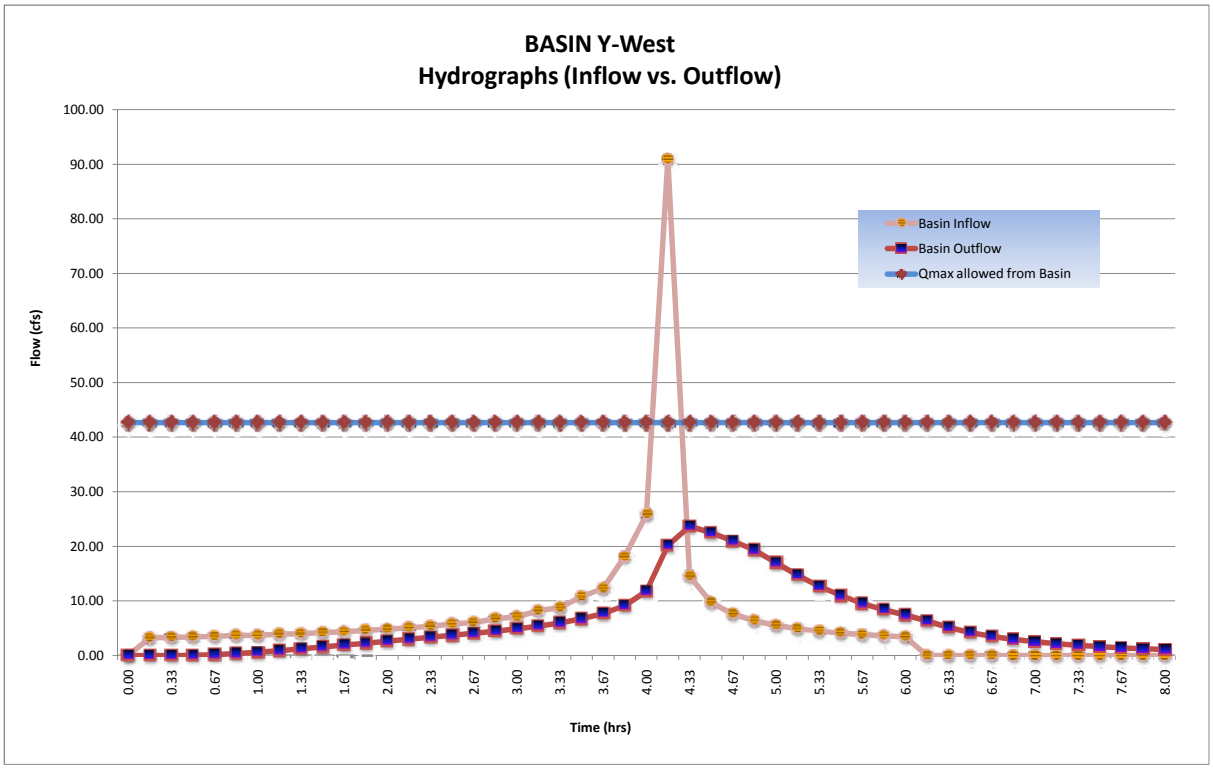
# Basin Y-West Routing

$$\frac{I_1 + I_2}{2} - \left(\frac{S_1}{\Delta t} + \frac{O_1}{2}\right) = O_1 = \left(\frac{S_2}{\Delta t} + \frac{O_2}{2}\right)$$

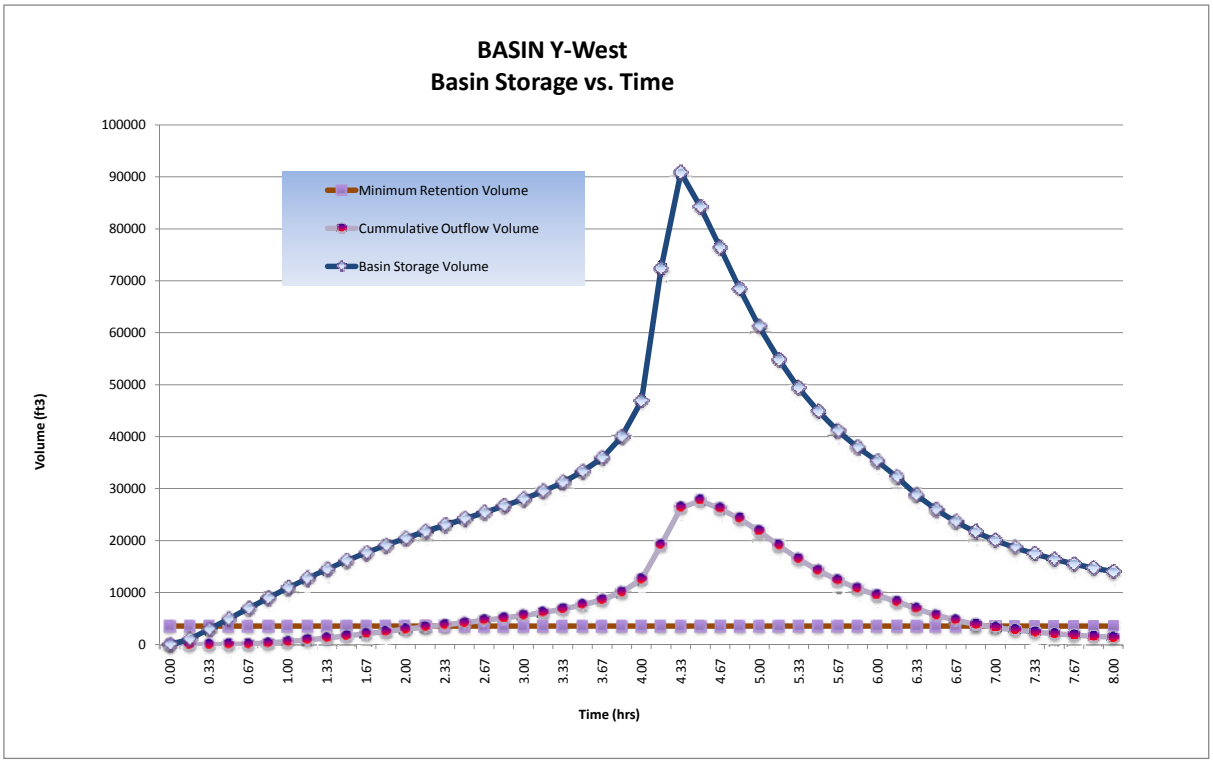
**FINAL ROUTING TABLE**

| (1) Time (hrs) | (2) Inflow (cfs) ($Q_{post}$) | (3) $(I_1+I_2)/2$ (cfs) | (4) ($S_1$/delta t + $O_1$/2) (cfs) *col (6) from prev row* | (5) $O_1$ (cfs) *col (7) from prev row* | *Storage Indicator #* (6) $S_2$/delta t + $O_2$/2 (cfs) *col (3)+(4)-(5)* | (7) $O_2$ (cfs) *(Hard input)* | Volumes (ft3) Basin Storage *Volume* | Incremental Outflow *Volume* | Cummulative Outflow *Volume* |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| 0.17 | 3.20 | 1.60 | 0.00 | 0.00 | 1.60 | 0.00 | 960 | 0 | 0 |
| 0.33 | 3.30 | 3.25 | 1.60 | 0.00 | 4.85 | 0.00 | 2910 | 0 | 0 |
| 0.50 | 3.40 | 3.35 | 4.85 | 0.00 | 8.20 | 0.05 | 4905 | 30 | 30 |
| 0.67 | 3.50 | 3.45 | 8.20 | 0.05 | 11.60 | 0.14 | 6918 | 84 | 114 |
| 0.83 | 3.70 | 3.60 | 11.60 | 0.14 | 15.06 | 0.34 | 8934 | 204 | 288 |
| 1.00 | 3.70 | 3.70 | 15.06 | 0.34 | 18.42 | 0.57 | 10881 | 342 | 546 |
| 1.17 | 3.90 | 3.80 | 18.42 | 0.57 | 21.65 | 0.88 | 12726 | 528 | 870 |
| 1.33 | 4.00 | 3.95 | 21.65 | 0.88 | 24.72 | 1.20 | 14472 | 720 | 1248 |
| 1.50 | 4.20 | 4.10 | 24.72 | 1.20 | 27.62 | 1.55 | 16107 | 930 | 1650 |
| 1.67 | 4.30 | 4.25 | 27.62 | 1.55 | 30.32 | 1.90 | 17622 | 1140 | 2070 |
| 1.83 | 4.60 | 4.45 | 30.32 | 1.90 | 32.87 | 2.23 | 19053 | 1338 | 2478 |
| 2.00 | 4.80 | 4.70 | 32.87 | 2.23 | 35.34 | 2.61 | 20421 | 1566 | 2904 |
| 2.17 | 5.10 | 4.95 | 35.34 | 2.61 | 37.68 | 2.97 | 21717 | 1782 | 3348 |
| 2.33 | 5.30 | 5.20 | 37.68 | 2.97 | 39.91 | 3.31 | 22953 | 1986 | 3768 |
| 2.50 | 5.80 | 5.55 | 39.91 | 3.31 | 42.15 | 3.68 | 24186 | 2208 | 4194 |
| 2.67 | 6.00 | 5.90 | 42.15 | 3.68 | 44.37 | 4.06 | 25404 | 2436 | 4644 |
| 2.83 | 6.70 | 6.35 | 44.37 | 4.06 | 46.66 | 4.46 | 26658 | 2676 | 5112 |
| 3.00 | 7.10 | 6.90 | 46.66 | 4.46 | 49.10 | 4.88 | 27996 | 2928 | 5604 |
| 3.17 | 8.20 | 7.65 | 49.10 | 4.88 | 51.87 | 5.40 | 29502 | 3240 | 6168 |
| 3.33 | 8.80 | 8.50 | 51.87 | 5.40 | 54.97 | 5.97 | 31191 | 3582 | 6822 |
| 3.50 | 10.80 | 9.80 | 54.97 | 5.97 | 58.80 | 6.70 | 33270 | 4020 | 7602 |
| 3.67 | 12.30 | 11.55 | 58.80 | 6.70 | 63.65 | 7.64 | 35898 | 4584 | 8604 |
| 3.83 | 18.10 | 15.20 | 63.65 | 7.64 | 71.21 | 9.15 | 39981 | 5490 | 10074 |
| 4.00 | 25.80 | 21.95 | 71.21 | 9.15 | 84.01 | 11.74 | 46884 | 7044 | 12534 |
| 4.17 | 90.90 | 58.35 | 84.01 | 11.74 | 130.62 | 20.15 | 72327 | 12090 | 19134 |
| 4.33 | 14.50 | 52.70 | 130.62 | 20.15 | 163.17 | 23.66 | 90804 | 14196 | 26286 |
| 4.50 | 9.70 | 12.10 | 163.17 | 23.66 | 151.61 | 22.50 | 84216 | 13500 | 27696 |
| 4.67 | 7.60 | 8.65 | 151.61 | 22.50 | 137.76 | 20.99 | 76359 | 12594 | 26094 |
| 4.83 | 6.40 | 7.00 | 137.76 | 20.99 | 123.77 | 19.31 | 68469 | 11586 | 24180 |
| 5.00 | 5.50 | 5.95 | 123.77 | 19.31 | 110.41 | 16.97 | 61155 | 10182 | 21768 |
| 5.17 | 4.90 | 5.20 | 110.41 | 16.97 | 98.64 | 14.68 | 54780 | 8808 | 18990 |
| 5.33 | 4.50 | 4.70 | 98.64 | 14.68 | 88.66 | 12.68 | 49392 | 7608 | 16416 |
| 5.50 | 4.10 | 4.30 | 88.66 | 12.68 | 80.28 | 10.98 | 44874 | 6588 | 14196 |
| 5.67 | 3.80 | 3.95 | 80.28 | 10.98 | 73.25 | 9.56 | 41082 | 5736 | 12324 |
| 5.83 | 3.60 | 3.70 | 73.25 | 9.56 | 67.39 | 8.38 | 37920 | 5028 | 10764 |
| 6.00 | 3.40 | 3.50 | 67.39 | 8.38 | 62.51 | 7.42 | 35280 | 4452 | 9480 |
| 6.17 | 0.00 | 1.70 | 62.51 | 7.42 | 56.79 | 6.31 | 32181 | 3786 | 8238 |
| 6.33 | 0.00 | 0.00 | 56.79 | 6.31 | 50.48 | 5.14 | 28746 | 3084 | 6870 |
| 6.50 | 0.00 | 0.00 | 50.48 | 5.14 | 45.34 | 4.23 | 25935 | 2538 | 5622 |
| 6.67 | 0.00 | 0.00 | 45.34 | 4.23 | 41.11 | 3.50 | 23616 | 2100 | 4638 |
| 6.83 | 0.00 | 0.00 | 41.11 | 3.50 | 37.61 | 2.96 | 21678 | 1776 | 3876 |
| 7.00 | 0.00 | 0.00 | 37.61 | 2.96 | 34.65 | 2.50 | 20040 | 1500 | 3276 |
| 7.17 | 0.00 | 0.00 | 34.65 | 2.50 | 32.15 | 2.14 | 18648 | 1284 | 2784 |
| 7.33 | 0.00 | 0.00 | 32.15 | 2.14 | 30.01 | 1.86 | 17448 | 1116 | 2400 |
| 7.50 | 0.00 | 0.00 | 30.01 | 1.86 | 28.15 | 1.62 | 16404 | 972 | 2088 |
| 7.67 | 0.00 | 0.00 | 28.15 | 1.62 | 26.53 | 1.41 | 15495 | 846 | 1818 |
| 7.83 | 0.00 | 0.00 | 26.53 | 1.41 | 25.12 | 1.24 | 14700 | 744 | 1590 |
| 8.00 | 0.00 | 0.00 | 25.12 | 1.24 | 23.88 | 1.11 | 13995 | 666 | 1410 |

## Basin Y-West Routing



## Basin Y-West Routing




| | | | |
|---|---|---|---|
| **Detention/Retention Basin Volume Required:** | **90,804** | **ft$^3$** | |
| **@ Stage:** | **510.80** | **ft** | |
| **Freeboard:** | **1.2** | **ft** | >1' Freeboard |
| **Final Total Basin Volume Provided:** | **131,854** | **ft$^3$** | Basin **Y-West** |
| **Maximum flow rate released from this basin:** | **23.66** | **cfs** | |

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## Detention/Retention Basin Flows and Sizes – Watershed Y

| Watershed | Location | Flow | | | Runoff Volume | | | Basin Volume - Breakdown | | | Basin Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-Developed | Post-Developed | Increase | Pre-Developed | Post-Developed | Increase | Retention Provided | Detention | 1' Freeboard (minimum) | Final Volume | Length | Width | Depth | Freeboard | Name |
| Name | (Sta) | (cfs) | (cfs) | (cfs) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | ($ft^3$) | (ft) | (ft) | (ft) | (ft) | |
| Y | 905/125 | 102.82 | 184.03 | 81.21 | 380,592 | 616,440 | 235,848 | 244,765 | 42,022 | 384,658 | 671,445 | 425 | 225 | 6.0 | 3.2 | Y-EAST |
| | | | | | | | | 3,564 | 87,240 | 41,050 | 131,854 | 350 | 50 | 5.0 | 1.2 | Y-WEST |

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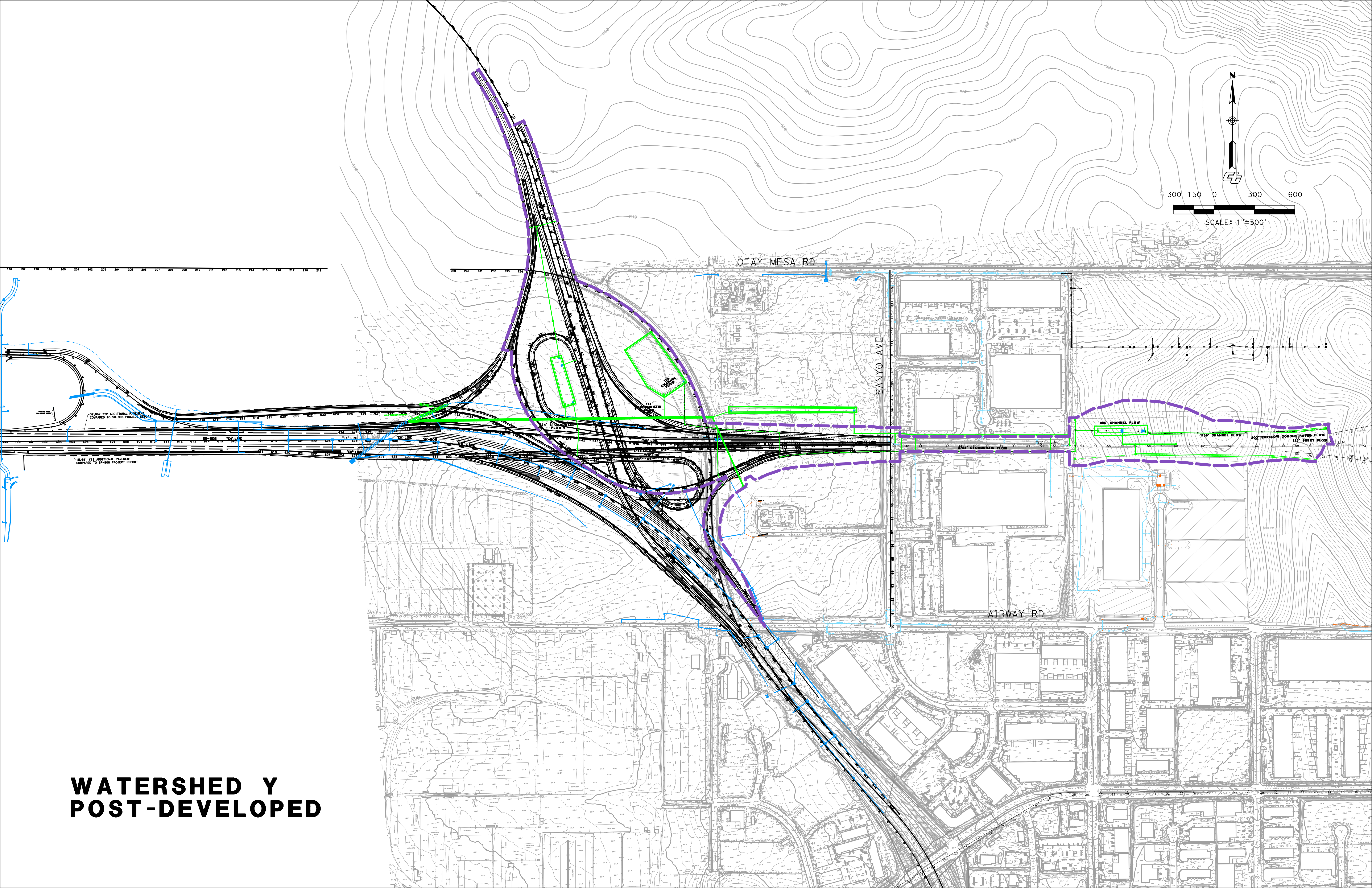
OTAY MESA RD
SANYO AVE
AIRWAY RD
SR-905
"E4" LINE
"E6" LINE
"E8" LINE
"SD11" LINE
"ENF3" LINE
32,067 ft2 ADDITIONAL PAVEMENT COMPARED TO SR-906 PROJECT REPORT
15,681 ft2 ADDITIONAL PAVEMENT COMPARED TO SR-906 PROJECT REPORT
178' CHANNEL FLOW
171' STORMDRAIN FLOW
894' STORMDRAIN FLOW
3725' STORMDRAIN FLOW
345' CHANNEL FLOW
1158' CHANNEL FLOW
200' SHALLOW CONCENTRATED FLOW
125' SHEET FLOW
N
300 150 0 300 600
SCALE: 1"=300'
WATERSHED Y
POST-DEVELOPED

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# *Appendix G* IBWC and County Correspondence

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# County of San Diego

DEPARTMENT OF PUBLIC WORKS

JOHN L. SNYDER
DIRECTOR

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July 3, 2007

Mr. Tim Brownson
District Hydraulic Engineer
California Department of Transportation – District 11
4050 Taylor Street
San Diego, CA 92110

FLOODPLAIN IMPACT ASSESSMENT OF PROPOSED OTAY MESA EAST POE AND SR-11

Dear Mr. Brownson:

We have reviewed your letter of May 14, 2007, requesting our endorsement of your conclusion that there is no need for a Floodplain Impact Assessment of the proposed Otay Mesa East POE and SR-11.

The subject proposed project as depicted on Exhibit 2A is partially located within the FIRM No. 06073C2183F, which determined the area as Zone X outside the 500-year floodplain. Therefore, we concurred with your conclusion that the subject proposed project does not require a Floodplain Impact Assessment.

However, with regard to flood management in East Otay Mesa all developments are subject to guidelines of the County's East Otay Mesa Specific Plan Comprehensive Flood Control Master Plan 1994. Essentially, developments within East Otay Mesa area are required to provide local or regional detention basins.

If you have any questions or need additional information, please contact me at (858) 694-3672 or by email Cid.Tesoro@sdcounty.gov.

Sincerely,

CID TESORO, Manager
Watershed Protection Program

CT/ez

cc: Hung Tran, Department of Public Works, MS 0384