Michael Baker INTERNATIONAL

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JN 145596 August 10, 2015

# Preliminary Drainage Study: NLP Valley Center Solar

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# PROJECT LOCATION & DESCRIPTION

## LOCATION

The proposed NLP Valley Center Solar LLC project ("Project") site is located in the community of Valley Center, California in north-central San Diego County. The subject site is located at 29471 Cole Grade Road and is bordered by Cole Grade Road to the west. The property is comprised of two separate parcels which include County Assessor Parcel Numbers (APNs) 188-120-09 and -10, totaling approximately 66 acres. A Vicinity Map is included in Appendix A.

## DESCRIPTON

The proposed approximate 26-acre fenced photovoltaic (PV) solar facility is intended for megawatt (MW) output. The Project design will consist of PV solar panels mounted on a collection of single-axis tracking (SAT) systems supported by machine-driven metal "H" piles or round pipe columns. The single axis system proposes solar panels aligned in rows that rotate to face east in the morning and west in the afternoon hours, tracking the sun about a north/south axis to maximize solar absorption. The ultimate arrangement/number of PV solar panels, racking, inverter pads, electrical equipment, structures, fencing, and internal access driveways are shown on the MUP Plot Plan to illustrate the general configuration of the proposed solar collection system; however this layout is subject to modification at final engineering design. The Project proposes all weather paving internal access road. The point of interconnection (POI) for transmission purposes will occur at an existing utility pole within the Cole Grade Road right-of-way (ROW) adjacent to the Project boundary. Project access to the site will be from Cole Grade Road. No offsite roadway or gen-tie improvements are required.

The subject property currently supports fallowed agricultural lands (citrus orchard). Many of the citrus trees have previously been removed from the property, and the land is generally devoid of vegetation or has minor cover of ruderal species. The site is generally flat, and onsite elevations range from approximately 1,465 feet above mean sea level (amsl) in the southwestern portion of the site to 1,510 feet amsl in the northeastern portion of the site. Several small structures and infrastructure supporting the former agricultural uses (e.g. house and storage sheds, etc.) are located east of the proposed PV facility on the 66- acre property and will remain.

# PROJECT DESIGN CRITERIA

The calculation procedures and standards for stormwater design are based upon standard County of San Diego reference manuals, including:

- San Diego County Hydrology Manual (SDCHM), June 2003
- San Diego County Hydraulic Design Manual (HDM), September 2014
- California Environmental Quality Act's (CEQA) Thresholds of Significance

# SCOPE OF REPORT

The objectives of this preliminary drainage study are outlined below:

1. Identify pertinent locations and quantify project site run-on and runoff for the 100-year storm event using the Rational Method,
2. Identify the limits of existing inundation across the project site for the 100-year storm event,
3. Document the hydraulic capacity of existing on-site culverts located within the development footprint,
4. Identify and evaluate potentially erosive conditions due to existing site run-on and/or runoff characteristics,
5. Show that the proposed project does not create an impact on the hydrologic and hydraulic properties of the site, as compared to existing conditions,
6. Directly address CEQA thresholds of significance.

# METHODOLOGY

## RATIONAL METHOD HYDOLOGY

Advanced Engineering Software (AES) HydroWIN v. 2013 was used for hydrologic modeling of the project site watershed. Design peak flow rates for the project site were developed based upon the Rational Method methodologies described in the County of San Diego Hydrology Manual (June 2003). The Rational Method is a physically-based model that calculates peak flow rates (Q) as a function of drainage area (A), rainfall intensity (i), and a runoff coefficient (c):

$$Q = c * i * A$$

## Runoff Coefficient (c)

On-site runoff coefficients were developed based upon SDCHM Table 3-1. Pre and post-development runoff coefficients were developed using an area-weighted composite runoff coefficient for the project site drainage basin based on land-use, hydrologic soil type, and impervious area. Calculations are included in Attachment B.

Off-site runoff coefficients where calculated internally within AES based on land-use and hydrologic soil type, in conformance with the SDCHM.

Land use was established based upon current geographic information system (GIS) land use data published by the San Diego Association of Governments (SANDAG). The SANDAG data indicated that the project site is comprised of "Vineyards" and "Orchards." A watershed land-use exhibit is included in Attachment A. An aerial photograph of the site is included in Attachment A.

The hydrologic soil type classifications were delineated using the current geology data available from SanDAG. The off-site watershed is comprised of hydrologic soil types B, C, D; whereas the project site is primarily type D. The off-site and on-site hydrologic analyses account for the differing hydrologic soil types within each drainage sub-basin. A project site soils map is included in Attachment A.

## Rainfall Intensity (i)

The 100-year, 6-hour precipitation depth, (3.7 inches) and 24-hour precipitation depth (8.1 inches) were obtained from the isopluvial maps found in Appendix B of the SDCHM. Copies are included in Attachment A of this report.

The time of concentration (Tc) for each drainage basin was calculated internally within AES using criteria outlined in the SDCHM.

## Drainage Area (A)

Off-site watersheds were delineated based upon 20-foot contour interval aerial topography obtained from Intermap. On-site delineations where based upon project specific one-foot contour interval topography.

The project site receives concentrated run-on at two locations and discharges runoff at two locations. Refer to the pre and post development conditions hydrologic work maps found in Attachment B. The following discussion pertains to drainage nodes of hydrologic and hydraulic interest:

**Node 110 (Property Site Run-On):** Located near the northwesterly corner of the property (not project) boundary, represents property site run-on (open channel flow) from a 126.5-acre tributary area. There is no development proposed at this location. See Node 102 below for "project site" run-on.

**Node 102 (Project Site):** Located immediately east of the Cole Grade Road, Via Valencia intersection, represents the location of two existing culverts (24-inch and 36-inch corrugated metal pipes – CMPs). Property site run-on at Node 110 is conveyed southerly to Node 102 via an existing natural channel. Proposed improvements will not include development within this natural channel. Downstream of Node 102, a 20-foot wide landscaped area will be installed parallel to Cole Grade Road (immediately east of the

road). This landscaped area will run approximately 1,000 feet along the westerly project boundary. The 100-year limits of inundation have been determined and are included in Attachment D.

**Node 100 (Project Site Discharge):** Located mid-way along the westerly project boundary, represents one of the two project site discharge locations. An existing 36-inch CMP culvert conveys runoff westerly beneath Cole Grade Road at this location. Approximately 141 acres drain to Node 100.

**Node 210 (Project Site Run-On):** Located midway along the northerly project boundary, represents project site run-on from a 25.6-acre tributary area.

**Node 200 (Project Site Discharge):** Located near the southwesterly corner of the project boundary, represents the second of three project site discharge locations. An 18-inch CMP culvert is located immediately upstream of Node 200. This culvert is not designed to convey Q100; as such, runoff bypasses this culvert in larger storm events and is discharged from the site as shallow concentrated flow at the southwesterly corner of the property. Approximately 49 acres drain to Node 200.

# HYDRAULICS

## Culvert Analyses

The existing capacity of each project site culvert has been determined using Bentley's CulvertMaster. This software accounts for inlet and outlet control using the widely excepted Federal Highway Administration's (FHA) methodology (HEC-18) for culvert capacity determination. Project site topography has been used to determine the allowable headwater at each culvert location prior to flow bypass. Refer to Appendix C.

## Flood Inundation

Inundation carries with it the risk of erosion or flood damage to proposed infrastructure. In order to assess the flooding risk on the project site, both Federal Emergency Management Agency (FEMA) and County of San Diego floodplain maps were reviewed. All information relating to existing regulatory floodplain delineations, or lack thereof, is presented in Appendix D.

Runoff is conveyed as open channel flow within natural channels in a southwesterly direction across the site. Manning's equation has been used to solve for normal depth using Bentley's FlowMaster software to determine the limits of inundation within these channels during the 100-year storm event.

The channel roughness was based on field conditions and Table A-5 of the San Diego County Drainage Design Manual. Channel cross-sections and slopes were developed based upon the best available topographic information and field observations. Refer to Appendix D for exhibits showing the 100-year limits of inundation under existing and proposed conditions.

## Scour and Erosion

In order to assess the level of erosion risk posed by concentrated flow, a simplified erosion analysis was performed. Using table 5-13 from the SDCHM, the maximum permissible velocity for "Unreinforced Vegetation" is 5.0 feet per second. Channel velocities have been identified on the 100-Year Inundation

Maps found in Appendix D. Additionally, the Universal Soil Loss Equation has been used to quantify the anticipated soil loss in tons (dry weight) under existing and proposed conditions. Refer to Appendix D.

# RESULTS

## HYDOLOGY

The tables below summarize the hydrologic properties of the project site under existing and proposed conditions. The proposed development, specifically new impervious surfaces, will not result in a calculable increase to the project site runoff coefficient. Approximately 4,429-square feet (0.1 acres) of new impervious area is proposed throughout the approximate 26-acre project. As a conservative approach, this total has been doubled when determining the impact to the project site runoff coefficient between existing and proposed conditions. An itemized list of new impervious area along with a detailed weighted runoff coefficient calculation is included in Appendix B.

Only minimal grading is proposed (southwest corner) and there are no alterations to the existing storm drain infrastructure, nor new storm drain infrastructure proposed. The minimal grading in the southwest corner will not impact drainage courses or the 100-year limits of inundation along the project boundary. As such the post-development time of concentration will remain substantially unchanged from the pre-development condition.

Refer to Appendix B for hydrologic work maps and AES output.

**100-YEAR EXISTING HYDROLOGIC SUMMARY**

| Node | Tc | c | i | Total Area | Total Q100 | V100 |
|---|---|---|---|---|---|---|
| - | min | - | in/hr | acres | cfs | ft/sec |
| 102 | 30.73 | 0.36 | 2.92 | 138.5 | 145.4 | 6.28 |
| 100 | 31.64 | 0.35 | 2.95 | 140.9 | 145.4 | 6.70 |
| 210 | 33.60 | 0.35 | 2.94 | 25.6 | 26.3 | 3.01 |
| 204 | 38.35 | 0.35 | 2.68 | 31.2 | 29.3 | 2.80 |
| 202 | 41.28 | 0.35 | 2.54 | 43.7 | 38.8 | 3.68 |
| 200 | 43.08 | 0.35 | 2.46 | 48.8 | 42.1 | 3.85 |
| *Refer to the Hydrologic Work Maps and AES output found in Appendix B* | | | | | | |

## 100-YEAR PROPOSED HYDROLOGIC SUMMARY

| Node | Tc | C (weighted) | i | Total Area | Total Q100 | V100 |
|---|---|---|---|---|---|---|
| - | min | - | in/hr | acres | cfs | ft/sec |
| 102 | 30.73 | 0.36 | 2.92 | 138.5 | 145.4 | 6.28 |
| 100 | 31.64 | 0.35 | 2.95 | 140.9 | 145.4 | 6.70 |
| 210 | 33.60 | 0.35 | 2.94 | 25.6 | 26.3 | 3.01 |
| 204 | 38.35 | 0.35 | 2.68 | 31.2 | 29.3 | 2.80 |
| 202 | 41.28 | 0.35 | 2.54 | 43.7 | 38.8 | 3.68 |
| 200 | 43.08 | 0.35 | 2.46 | 48.8 | 42.1 | 3.85 |
| *Refer to the Hydrologic Work Maps and AES output found in Appendix B* | | | | | | |

## RUNOFF COEFFICIENTS SUMMARY

| Node | Existing Condition Sub-Area | Proposed Condition Sub-Area | Existing Runoff Coefficient | Proposed Runoff Coefficient |
|---|---|---|---|---|
| - | acres | acres | - | - |
| 100 | 2.4 | 2.4 | 0.35 | 0.35 |
| 200 | 23.2 | 23.2 | 0.35 | 0.35 |
| *The proposed improvements will not result in a calculable change to on-site runoff coefficients – refer to the weighted runoff coefficient calculations found in Appendix B. "Sub-Area" in the column heading refers to the project site, not the total watershed area draining to each respective node.* | | | | |

# HYDRAULICS

## Culverts

The results from the culvert capacity calculations are presented below. In all cases, the existing culverts are not designed to convey the 100-year event without overtopping. Runoff not conveyed through the culvert will overtop the driveway/road and find its way into the downstream channel.

Proposed improvements will not result in an increase of runoff to either of the two existing culverts discharging runoff from the project site, nor will any new culverts be installed. As such, the hydraulic properties of the existing culverts will not be altered as a result of the proposed development. See Appendix C for CulvertMaster input and output.

**CULVERT SUMMARY**

| Facility | Node | Slope | Allowable Head Water | Capacity (prior to overtopping) | Q100 | V100 (exit velocity) |
|---|---|---|---|---|---|---|
| - | - | % | ft | cfs | cfs | ft/sec |
| 24-inch CMP | 102 | 4.76 | 4 | 20 | - | - |
| 36-inch CMP | 102 | 4.76 | 4 | 41 | - | - |
| * | 102 | - | 4 | 61 | 145 | 7.61 |
| 36-inch CMP | 100 | 3.75 | 3 | 27 | 145 | 9.26 |
| 18-inch CMP | 200 | 4.17 | 2.5 | 10 | 42 | 7.39 |

*Refer to Appendix C for Culvert Master Input and Output*

**Dual CMP culvert, one 24-inch and one 36-inch*

## Flood Inundation

Based upon a review of floodplain mapping available from FEMA and the County of San Diego, no regulatory floodplain exists on the project site. The project site lies within un-shaded zone X, which correlates with areas outside the 500-year floodplain. A FEMA FIRMette is included in Attachment A.

Using project site topography, field observations, and 100-year rational method hydrology, the anticipated 100-year limit of inundation has been determined and plotted under existing and proposed conditions – refer to Appendix D for results and exhibits. Proposed grading will not result in a change to the limits of inundation adjacent to the property boundary. All proposed pads will be located outside the 100-year limit of inundation. A small percentage of the solar panels will be located within the outer limits of the 100-year limit of inundation. All electrical and mechanical equipment will be elevated one foot above the maximum inundation depth. In all cases where the solar panel support posts are within the 100-year inundation limit, local velocities are considered non-erosive based upon standards in Table 5-13 of the SDCHM. Despite the non-erosive velocity, deepened footings will be considered as a factor of safety against local scour.

## Erosion and Scour

Proposed impacts will have no adverse impact on the tributary flow rate, drainage area, or structural properties of the existing culverts along the project boundary. Discharge from the existing project site culverts is considered erosive in some cases – the proposed project will not make this existing condition worse. A majority of the proposed improvements will avoid the 100-year limits of inundation. In some cases, solar panel installation will overlap with the fringe area. In these areas, deepened solar panel posts are recommended to protect against local pier scour potentially created by flow vortices.

Development within the southwest corner of the project site will overlap with the 100-year limit of inundation (near Node 200). However, this area contains a channel with significantly less flow as compared to the other discharge location (Node 100).

A non-toxic, biodegradable, permeable soil-binding agent or permeable rock material will be applied to all disturbed or exposed surface areas as follows: a) A permeable soil-binding agent suitable for both traffic and non-traffic areas shall be used. These agents shall be biodegradable, eco-safe, with liquid copolymers that stabilize and solidify soils or aggregates and facilitate dust suppression; or, b) alternatively, a permeable rock material consisting of either river stone decomposed granite or gravel could be placed in a thin cover over all exposed surface area in-lieu of the binding agent referenced above. In-lieu of, or in combination with a) and b) above, the areas located between the arrays, and any non-drivable surface may be re-vegetated with native noninvasive plant species.

The universal soil loss equation has been used per guidelines found on page 5.7 of the San Diego County Hydrology Manual (June 2003). As described in Section 5.2.6.1 of the SDCHM, the rainfall erosion index (R) is based on the 2-year, 6-hour intensity. The soil erodibility factor (K) has been selected based on an average value obtained from using both the SanDAG soil data and the K-factors given in Table 5-2 of the SDCHM. The slope length and steepness factors (Ls) have been calculated using project site topography and Figure 5-5 from the SDCHM. The cropping management factor (C) has been calculated using Table 5-3 from the SDCHM. The erosion control practice factor (P) has been calculated using Table 5-6 from the SDCHM. The anticipated soils loss (As: tons, dry weight) 1.64. Supporting calculations are found in Attachment D of this report.

# CONCLUSIONS

The following are conclusions and design recommendations based upon the analysis presented in this report and its Attachments:

1. The Rational Method has been used to calculate the 100-year peak flow rate at both the project site run-on and runoff boundaries. The proposed improvements will not result in an increase peak flow discharge from the project site, as compared to pre-development conditions. Refer to the Hydrologic Work Maps and AES output found in Attachment B.

2. Results from the hydrologic analyses have been used, along with project specific 1-foot contour topography, to plot the limits of inundation through the site during the 100-year event. A small portion of the site plan falls within the limits of inundation. Solar panel support posts will be deepened in these areas to protect against potential local scour. Additionally, all solar panels (at maximum tilt) and inverter pads shall be elevated so that the lowest horizontal structural member is at least one foot above the anticipated inundation depth established within this study. Refer to the 100-Year Inundation Work Map and FlowMaster output found in Attachment D.

3. The existing culverts on-site are not sized to convey the 100-year event prior to overtopping. The capacity, prior to overtopping, has been documented within this report. Proposed improvements will not physically alter any existing culvert or divert additional runoff to any existing culvert, as compared to pre development conditions. Refer to Attachment C for hydraulic calculations.

4. Due to site topography and the amount of runoff, erosive velocities occur in some locations throughout the site. These erosive velocities are limited to the defined channels conveying runoff southwesterly through the site. Fortunately, the proposed improvements avoid these areas for the most part. In some cases, solar panels are located within the fringe area of inundation. In the southwest corner, several panels are located within the limits of inundation; however, velocities are below five feet per second in this area. Deepened footings for all solar panel posts located within any portion of 100-year inundation limit area are recommended as a counter measure against local scour. A non-toxic, biodegradable, permeable soil-binding agent or permeable rock material shall be applied to all disturbed or exposed surface areas.

5. Based on the size of the project site and the minimal amount of proposed impervious area (4,429 square feet, 0.1 acres, doubled for conservatism), the increase to the on-site post development composite runoff coefficient is less than 0.01. No export or import of soil is proposed. The project site drainage areas will not be changed, as compared to existing conditions. There is no anticipated increase in project site peak flow runoff, thus peak flow attenuation is not warranted.

6. Refer to the following section for CEQA's Thresholds of Significance.

# CEQA GUIDELINES FOR DETERMINING SIGNIFICANCE

1. **Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?**

   The project will not alter the existing drainage pattern across the site. Upon completion of the project, runoff will continue to flow southwesterly towards Cole Grade Road as it does in the existing condition. As runoff sheet flows off the solar panels, the permeable soil binder will prevent significant erosive and allow runoff to continue in a sheet flow manner off-site.

2. **Will the project increase water surface elevation in a watercourse within a watershed equal to or greater than 1 square mile, by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?**

   The project will not increase water surface elevations across the site or downstream. Proposed improvements will not alter the existing hydrologic and hydraulic properties of the site. No increase in peak flow discharge is anticipated as a result of the proposed project.

3. **Will the project result in increased velocities and peak flow rates exiting the project site that could cause flooding downstream or exceed the storm water drainage system capacity serving the site?**

   The project will not increase runoff velocities or peak flow rates leaving the site. Runoff will continue to flow as it does under existing conditions. The project will not cause flooding downstream, nor will it hydraulically impact downstream storm water infrastructure.

4. **Will the project result in placing housing, habitable structures, or unanchored impediments to flow in a 100-year floodplain area or other special flood hazard area, as shown on a FIRM, a County Flood Plain Map or County Alluvial Fan Map, which would subsequently endanger health, safety and property due to flooding?**

   There are no proposed habitable structures as part of the project. All proposed solar panels and inverters will be anchored down and elevated based upon County Standards (i.e. one foot above the base flood elevation).

5. **Will the project place structures within a 100-year flood hazard or alter the floodway in a manner that would redirect or impede flow resulting in any of the following:**

   a) **Alter the line of inundation resulting in the placement of other housing in a 100 year flood hazard**

   b) **Increase water surface elevation in a watercourse with a watershed equal to or greater than 1 square mile by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?**

A small percentage of the solar panels will be located within the fringe area of the 100-year limit of inundation (southwest corner of the project site). The solar panel support posts (approximately 4 square inches each) will not redirect or impede flow.

# REFERENCES

County, S. D. (June 2003). *San Diego County Hydrology Manual.*

County, S. D. (September 2014). *San Diego County Hydraulic Design Manual.*

# Appendix A: Watershed Information

Vicinity Map
Aerial Exhibit
FEMA FIRM
Soil Exhibit
Land-Use Exhibit
100-YR, 6-HR & 24-HR Isopluvials

Michael Baker
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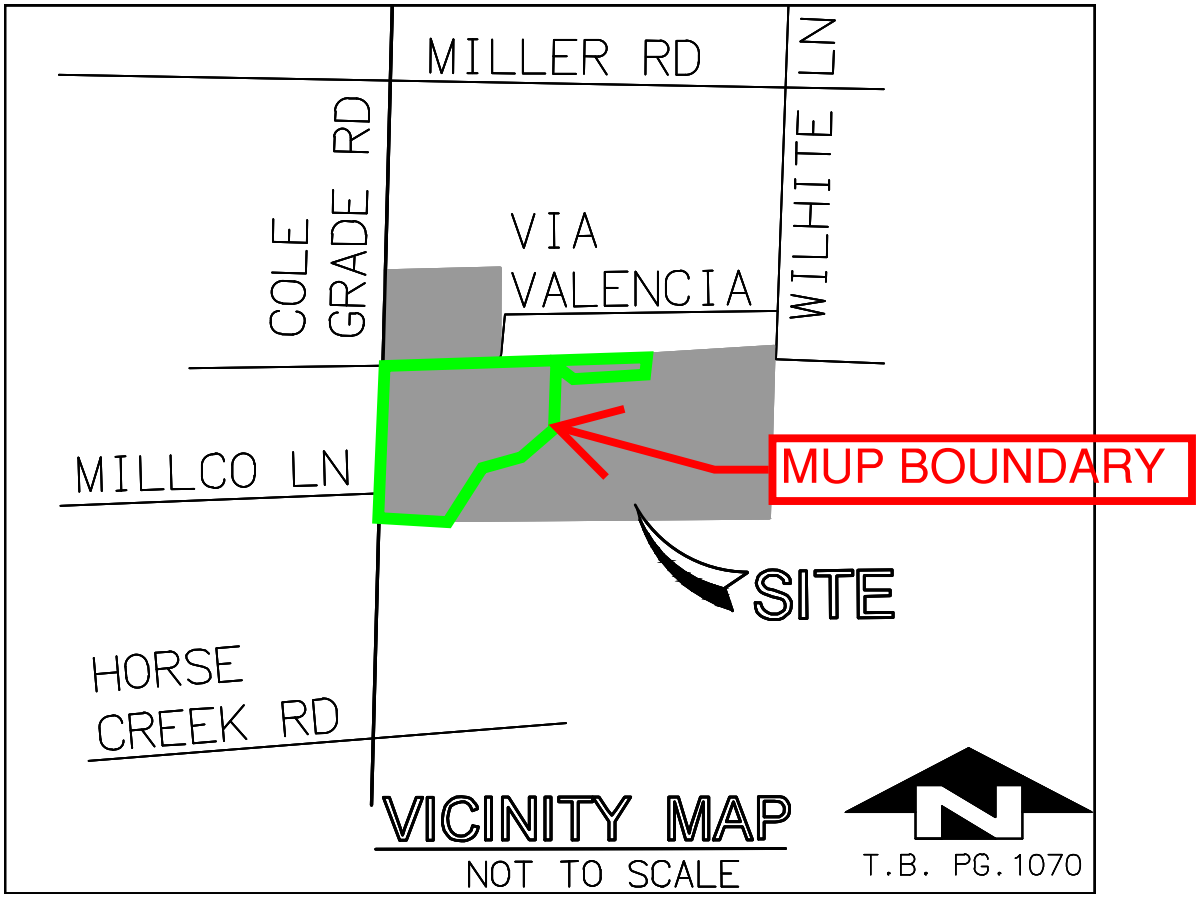
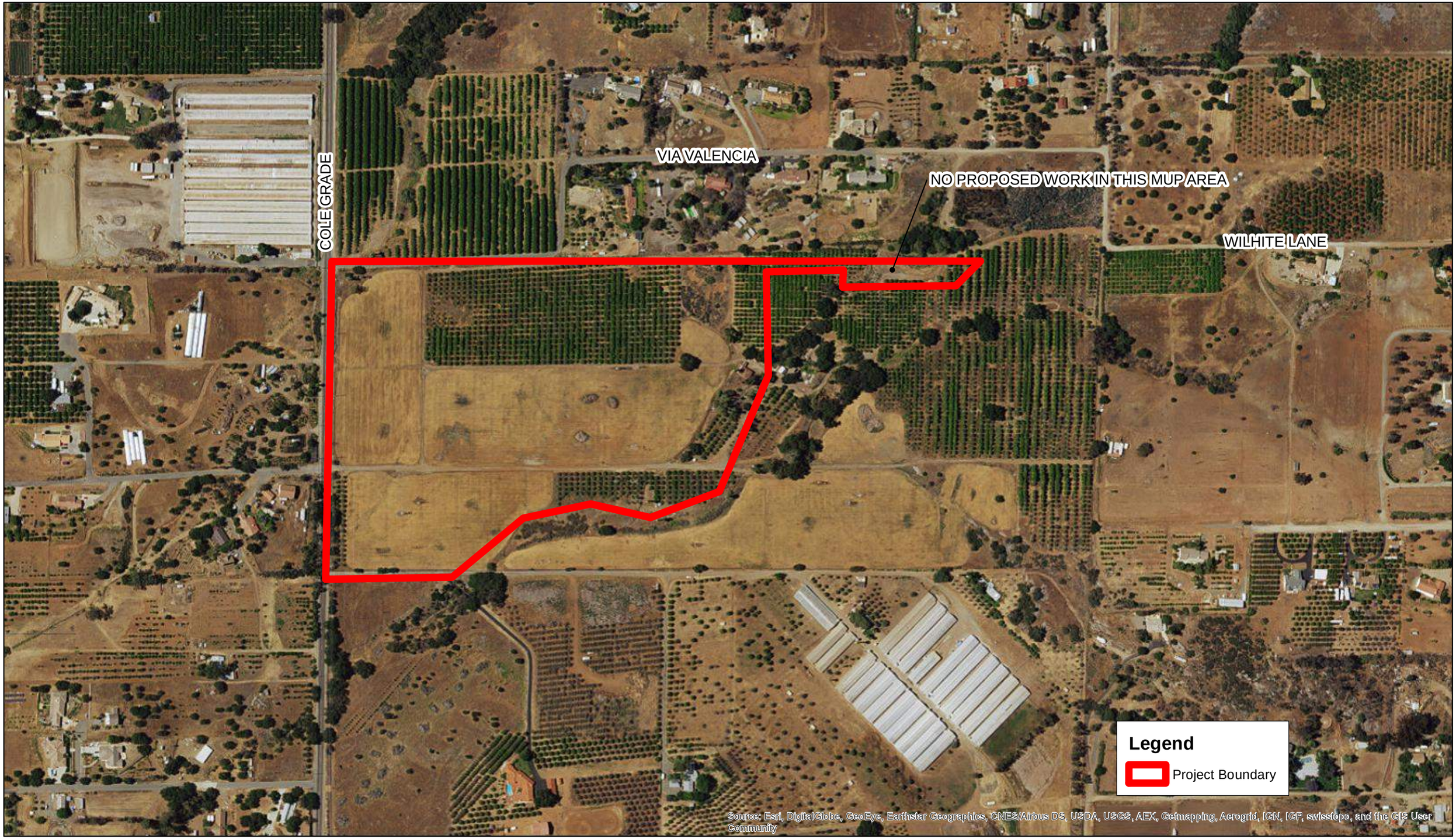

MILLER RD
COLE GRADE RD
WILHITE LN
VIA VALENCIA
MILLCO LN
MUP BOUNDARY
SITE
HORSE CREEK RD
VICINITY MAP
NOT TO SCALE
T.B. PG. 1070

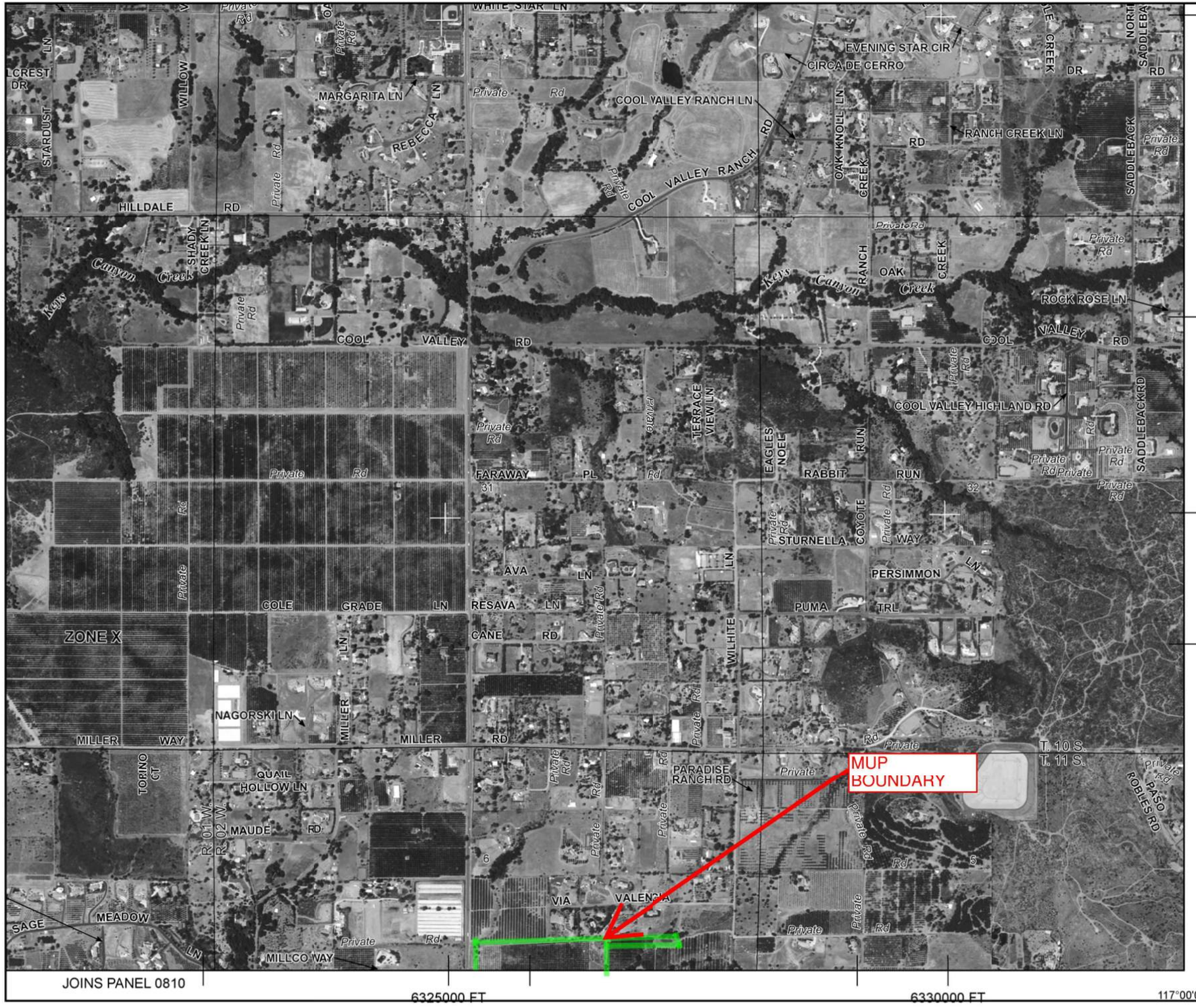



San Diego Network M:\Mdata\135828\GIS\MXD

N

0 325 650 1,300 Feet

**NORTHLIGHT POWER - VALLEY CENTER**
**AERIAL EXHIBT**
**RBF JN 135828**
**8-6-15**




e Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

0 500 1,000 1,500 2,000 FEET

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0520G

# FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 520 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

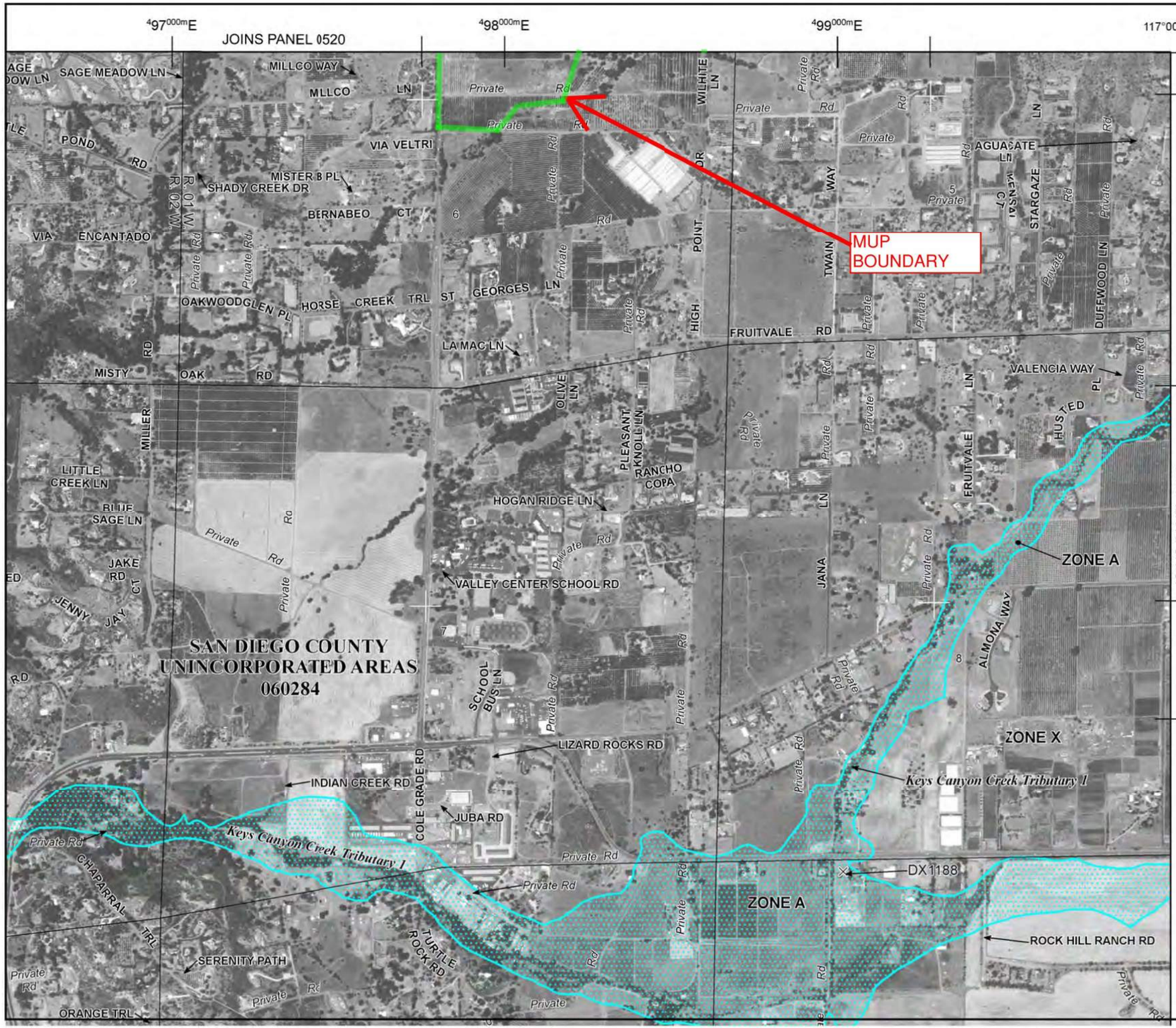
| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| SAN DIEGO COUNTY | 060284 | 0520 | G |

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

**MAP NUMBER**
**06073C0520G**

**MAP REVISED**
**MAY 16, 2012**

Federal Emergency Management Agency




ance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

0 500 1,000 1,500 2,000 FEET

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0810G

# FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 810 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| ESCONDIDO, CITY OF | 060290 | 0810 | G |
| SAN DIEGO COUNTY | 060284 | 0810 | G |

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

MAP NUMBER
06073C0810G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

NO WORK PROPOSED IN THIS SECTION OF THE MUP AREA

**Legend**

Project Boundary

Watershed

**Hydrologic Soil Type**

B

C

D

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Diego Network M:\Mdata\135828\GIS\MXD

N

0 500 1,000 2,000 Feet

**NORTHLIGHT POWER - VALLEY CENTER**
**Hydrologic Soil Type**
**RBF JN 135828**
**8-6-15**

NO WORK PROPOSED IN THIS SECTION OF THE MUP AREA

## Legend

- Project Boundary
- Watershed

**landuse**

- Orchard or Vineyard
- Other Retail Trade and Strip Commercial
- Road Right of Way
- Spaced Rural Residential
- Vacant and Undeveloped Land

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

San Diego Network M:\Mdata\135828\GIS\MXD

RBF CONSULTING A Baker Company

N

0 500 1,000 2,000 Feet

**NORTHLIGHT POWER - VALLEY CENTER**
**LAND USE EXHIBT**
**RBF JN 135828**
**8-6-15**


# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

P(6)100 = 3.7

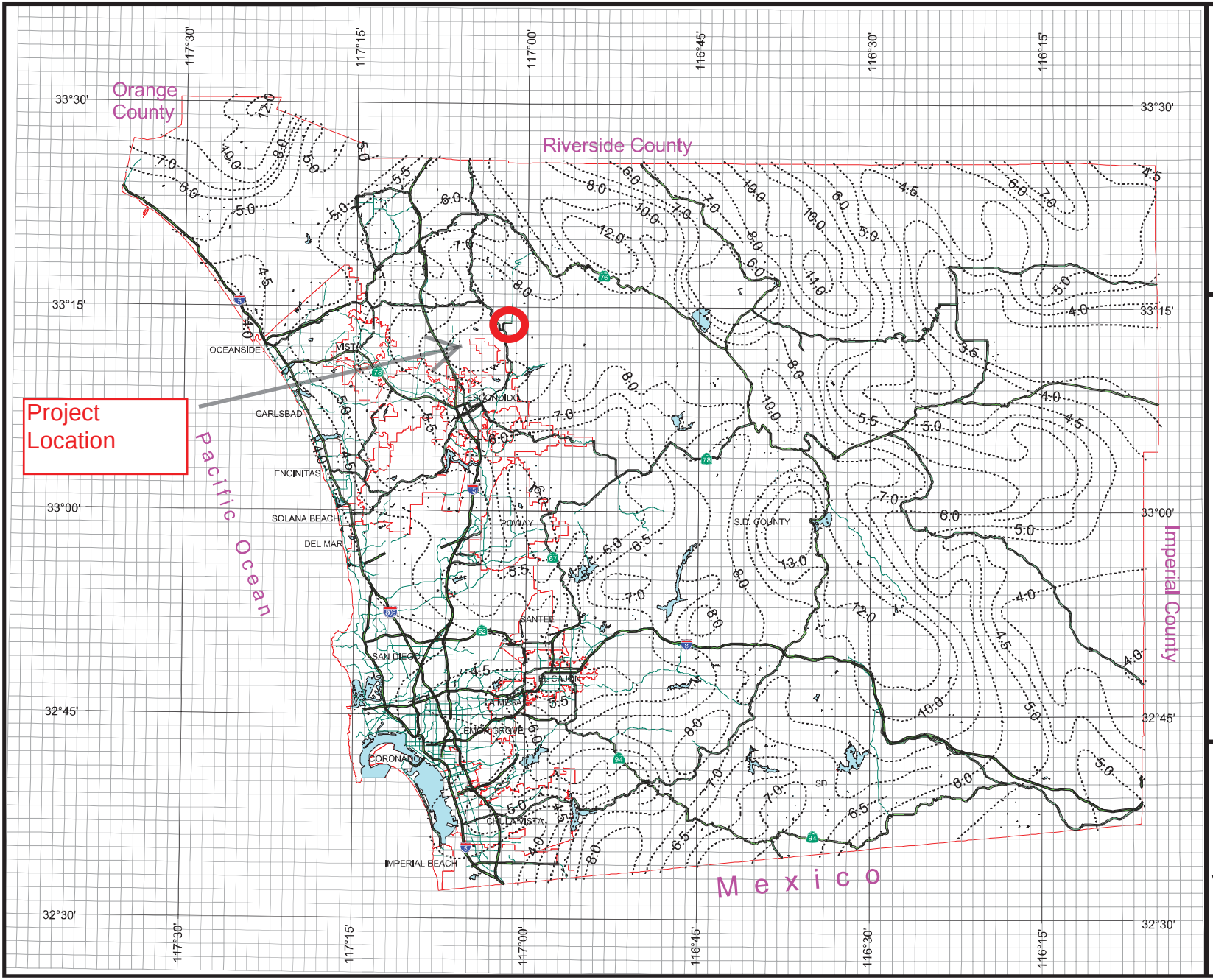
DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles




# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 24 Hours**

P(24)100 = 8.1

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

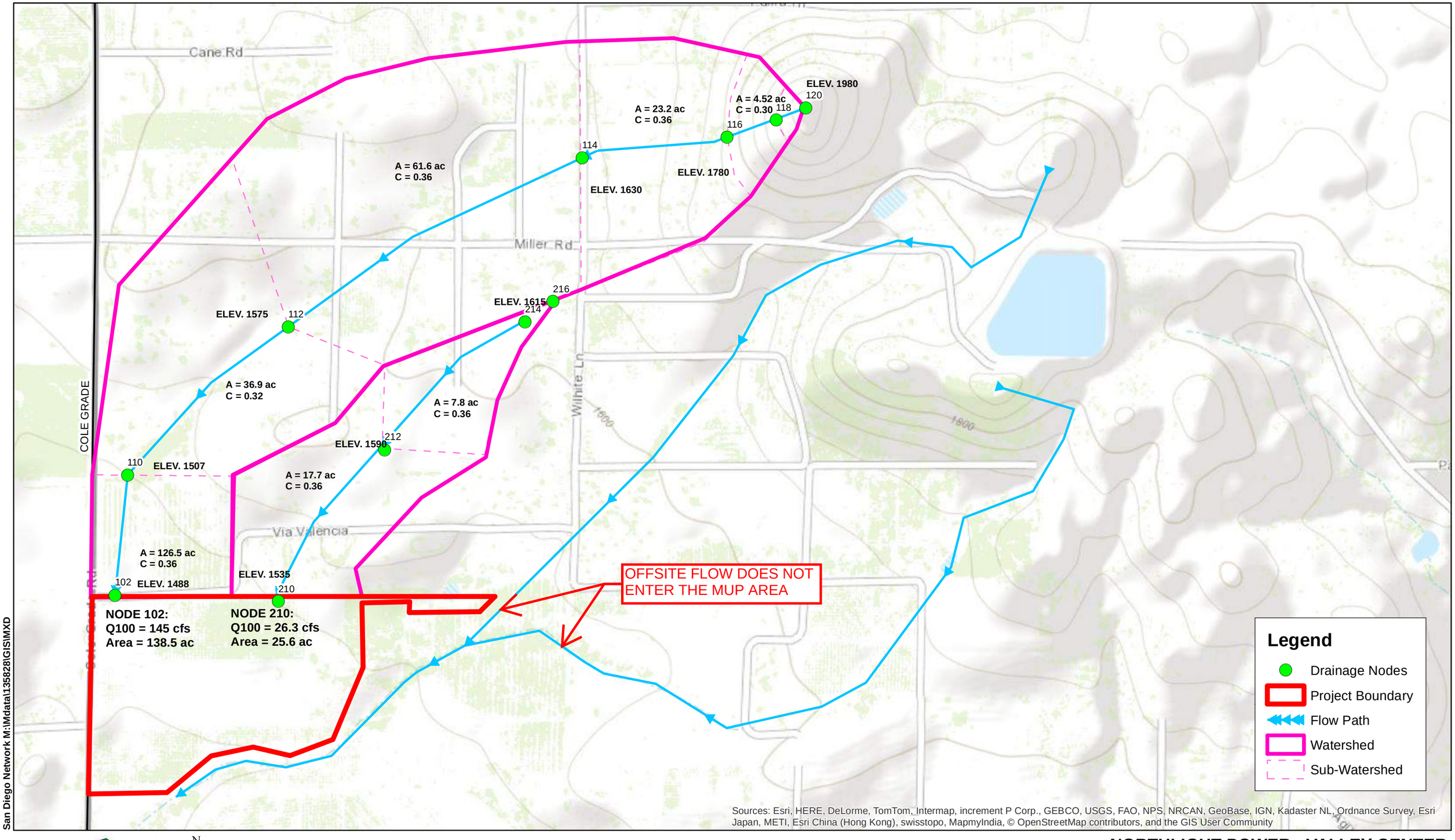


3 0 3 Miles

# Appendix B: Hydrologic Calculations

Off-Site Hydrologic Work Map
Weighted Runoff Coefficient
Existing Condition Work Map
Existing Condition AES
Proposed Condition Work Map
Proposed Condition AES

Michael Baker
INTERNATIONAL




San Diego Network M:\Mdata\135828\GIS\MXD

RBF CONSULTING A Baker Company

N

0 500 1,000 2,000 Feet

**NORTHLIGHT POWER - VALLEY CENTER**
**OFF-SITE HYDROLOGIC WORK MAP**
**RBF JN 135828**
**8-6-15**

# ON-SITE Runoff Coefficients

## EXISTING Condition

| Land Use | Node 100 | |
|---|---|---|
| | Area | C |
| Type D Natural | 2.40 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| **Total** | **2.40** | |

**Weighted C = 0.35**

| Land Use | Node 204 | |
|---|---|---|
| | Area | C |
| Type D Natural | 5.60 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| **Total** | **5.60** | |

**Weighted C = 0.35**

| Land Use | Node 202 | |
|---|---|---|
| | Area | C |
| Type D Natural | 12.50 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| **Total** | **12.50** | |

**Weighted C = 0.35**

| Land Use | Node 200 | |
|---|---|---|
| | Area | C |
| Type D Natural | 5.10 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| **Total** | **5.10** | |

**Weighted C = 0.35**

| | | |
|---|---|---|
| **Total Area =** | **25.60** | **ac** |
| **Total Impervious =** | **0.00** | **ac** |

## PROPOSED Condition

| Land Use | Node 100 | |
|---|---|---|
| | Area | C |
| Type D, Natural | 2.382 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| PR. Impervious | 0.018 | 0.90 |
| | | |
| **Total** | **2.40** | |

**Weighted C = 0.35**

| Land Use | Node 204 | |
|---|---|---|
| | Area | C |
| Type D Natural | 5.556 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| PR. Impervious | 0.044 | 0.90 |
| **Total** | **5.60** | |

**Weighted C = 0.35**

| Land Use | Node 202 | |
|---|---|---|
| | Area | C |
| Type D Natural | 12.402 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| PR. Impervious | 0.098 | 0.90 |
| **Total** | **12.50** | |

**Weighted C = 0.35**

| Land Use | Node 200 | |
|---|---|---|
| | Area | C |
| Type D Natural | 5.06 | 0.35 |
| EX. Impervious | 0.00 | 0.90 |
| PR. Impervious | 0.04 | 0.90 |
| **Total** | **5.10** | |

**Weighted C = 0.35**

| | | |
|---|---|---|
| **Total Area =** | **25.60** | **ac** |
| **Total Impervious =** | **0.20** | **ac** |

## Proposed (PR) Impervious

| Description | Quantity | Unit | Area (SF) | Total (SF) |
|---|---|---|---|---|
| Fence Post | 500 | EA | - | 11 |
| Inverter Pads | 2 | EA | 500.00 | 1,000 |
| Metrological Station | 1 | EA | 25.00 | 25 |
| Solar Connect Pad | 1 | EA | 33.00 | 33 |
| Solar Panel Posts | 3,360 | LS | - | 3,360 |
| | | | Sub-Total | 4,429 |
| | | | 100% Factor of Safety | 2.00 |
| | | | TOTAL = | 8,858 SF |

**TOTAL IMPERVIOUS SURFACES = 0.20 AC**

| CULVERT SUMMARY TABLE | | | | |
|---|---|---|---|---|
| FACILITY | NODE | ALLOWABLE HW DEPTH (FT) | CAPACITY (CFS) | Q(100) (CFS) |
| 24" & 36" CMP | 102 | 4.0 | 61 | 145 |
| 36" CMP | 100 | 3.0 | 27 | 145 |
| 18" CMP | 200 | 2.5 | 10 | 42 |
| ALLOWABLE HW DEPTH = MAX DEPTH IMMEDIATELY UPSTREAM OF THE CULVERT PRIOR TO OVERTOPPING | | | | |

NODE 110:
REFER TO OFF-SITE WORK MAP
Q100 = 138 CFS
AREA = 126.5 AC

110

NO PROPOSED DEVELOPMENT

NODE 210:
REFER TO OFF-SITE WORK MAP
Q100 = 26 CFS
AREA = 25.6 AC

210

NO PROPOSED DEVELOPMENT

36" CMP

24" CMP

NODE 102:
Q100 = 145 CFS
AREA = 138.5 AC

102

A=2.4 AC
C=0.35

NODE 100:
Q100 = 145 CFS
AREA = 140.9 AC

100

36" CMP

A=12.5 AC
C=0.35

A=5.6 AC
C=0.35

NO PROPOSED DEVELOPMENT

204

202

A=5.1 AC
C=0.35

18" CMP

200

NODE 200:
Q100 = 42 CFS
AREA = 48.8 AC

FOUND CONC MONUMENT WITH PIN, LABELED "LS 1880" PER ROS 549, 587, 605, 2689, 5400, PM 2909

SCALE: 1"=250'

## LEGEND

311 OFF-SITE DRAINAGE NODE

102 ON-SITE DRAINAGE NODE

DRAINAGE BASIN

FLOW PATH

MUP BOUNDARY

FLOW DIRECTION

250 125 0 250 500 750

SCALE: 1"=250'

# NLP VALLEY CENTER SOLAR
# EXISTING HYDROLOGY 100YR

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 • FAX 858.614.5001 • www.RBF.com

\\SANDCA1FS1\HROOT\PDATA\145596\CADD\STRMWATER\EX WORK MAP.DWG CHOY, DARREN 8/6/2015 2:46 PM

```
************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                            Analysis prepared by:

                                RBF Consulting
                             14257 Alton Parkway
                                  Irvine, CA
                                    92618

 ************************** DESCRIPTION OF STUDY *************************
* NLP VALLEY CENTER SOLAR PROJECT                                        *
* Existing Condition                                                     *
* MICHAEL BAKER INT. JN 145596                                           *
 ************************************************************************

  FILE NAME: EX100NLP.DAT
  TIME/DATE OF STUDY: 15:39 06/11/2015
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+------------------------------------------------------------------------+
| Sub-Basin 100                                                          |
| Discharges to Cole Grade Road (westerly project boundary)              |
|                                                                        |
+------------------------------------------------------------------------+

************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    118.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  OPEN BRUSH GOOD COVER RUNOFF COEFFICIENT = .3000
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  75
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1980.00
  DOWNSTREAM ELEVATION(FEET) =   1960.00
  ELEVATION DIFFERENCE(FEET) =     20.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.684
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.084
  SUBAREA RUNOFF(CFS) =      0.65
  TOTAL AREA(ACRES) =      0.27   TOTAL RUNOFF(CFS) =      0.65

************************************************************************
  FLOW PROCESS FROM NODE    118.00 TO NODE    116.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1960.00  DOWNSTREAM(FEET) =   1780.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   460.00   CHANNEL SLOPE =  0.3913
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.308
  OPEN BRUSH GOOD COVER RUNOFF COEFFICIENT = .3000
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  75
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.45
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   3.13
  Tc(MIN.) =    9.82
  SUBAREA AREA(ACRES) =     4.52       SUBAREA RUNOFF(CFS) =    8.55
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.300
  TOTAL AREA(ACRES) =        4.8         PEAK FLOW RATE(CFS) =       9.06

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   3.19
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    116.00 =     560.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    114.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1780.00  DOWNSTREAM(FEET) =   1630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1020.00   CHANNEL SLOPE =  0.1471
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.137
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      30.60
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.62
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   3.68
  Tc(MIN.) =   13.50
  SUBAREA AREA(ACRES) =    23.23       SUBAREA RUNOFF(CFS) =   42.96
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
  TOTAL AREA(ACRES) =       28.0         PEAK FLOW RATE(CFS) =      50.35

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   5.63
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    114.00 =    1580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    114.00 TO NODE    112.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1630.00  DOWNSTREAM(FEET) =   1575.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2228.00   CHANNEL SLOPE =  0.0247
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.703
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      92.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.16
  AVERAGE FLOW DEPTH(FEET) =   0.22   TRAVEL TIME(MIN.) =   8.93
  Tc(MIN.) =   22.43
  SUBAREA AREA(ACRES) =    61.55       SUBAREA RUNOFF(CFS) =   82.05
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.357
  TOTAL AREA(ACRES) =       89.6         PEAK FLOW RATE(CFS) =     118.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   4.53
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    112.00 =    3808.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    110.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1575.00  DOWNSTREAM(FEET) =   1507.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1493.00   CHANNEL SLOPE =  0.0455
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.150
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3200
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     137.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.90
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   6.39
  Tc(MIN.) =   28.81
  SUBAREA AREA(ACRES) =    36.93       SUBAREA RUNOFF(CFS) =   37.23
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.346
  TOTAL AREA(ACRES) =      126.5         PEAK FLOW RATE(CFS) =     137.90

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   3.92
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    110.00 =    5301.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1507.00  DOWNSTREAM(FEET) =   1488.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   722.00   CHANNEL SLOPE =  0.0263
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.022
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3600
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     144.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.29
  AVERAGE FLOW DEPTH(FEET) =   0.73   TRAVEL TIME(MIN.) =   1.91
  Tc(MIN.) =   30.73
  SUBAREA AREA(ACRES) =    12.00       SUBAREA RUNOFF(CFS) =   13.06
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.347
  TOTAL AREA(ACRES) =      138.5         PEAK FLOW RATE(CFS) =     145.36
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.74   FLOW VELOCITY(FEET/SEC.) =   6.28
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    102.00 =    6023.00 FEET.

+----------------------------------------------------------------------------+
| Begin On-Site Flow Contribution                                            |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1488.00  DOWNSTREAM(FEET) =   1480.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   370.00   CHANNEL SLOPE =  0.0216
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.966
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     146.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.74
  AVERAGE FLOW DEPTH(FEET) =   0.99   TRAVEL TIME(MIN.) =   0.91
  Tc(MIN.) =   31.64
  SUBAREA AREA(ACRES) =     2.35       SUBAREA RUNOFF(CFS) =    2.44
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.347
  TOTAL AREA(ACRES) =      140.9         PEAK FLOW RATE(CFS) =     145.36

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.99   FLOW VELOCITY(FEET/SEC.) =   6.70
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    100.00 =    6393.00 FEET.

+----------------------------------------------------------------------------+
| Sub-Basin 200                                                              |
| Discharges to southwesterly project corner                                 |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    216.00 TO NODE    214.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3200
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  65
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1615.00
  DOWNSTREAM ELEVATION(FEET) =   1612.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.735
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.343
  SUBAREA RUNOFF(CFS) =      0.32
  TOTAL AREA(ACRES) =      0.16   TOTAL RUNOFF(CFS) =      0.32

****************************************************************************
  FLOW PROCESS FROM NODE    214.00 TO NODE    212.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1612.00  DOWNSTREAM(FEET) =   1590.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1213.00   CHANNEL SLOPE =  0.0181
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.365
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.34
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.24
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =  16.28
  Tc(MIN.) =   26.01
  SUBAREA AREA(ACRES) =     7.78       SUBAREA RUNOFF(CFS) =    9.42
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.359
  TOTAL AREA(ACRES) =        7.9         PEAK FLOW RATE(CFS) =       9.60

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.50
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    212.00 =    1313.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    212.00 TO NODE    210.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1590.00  DOWNSTREAM(FEET) =   1535.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1188.00   CHANNEL SLOPE =  0.0463
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.853
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
```

```
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.73
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.61
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   7.59
  Tc(MIN.) =   33.60
  SUBAREA AREA(ACRES) =    17.66       SUBAREA RUNOFF(CFS) =   18.14
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.360
  TOTAL AREA(ACRES) =       25.6         PEAK FLOW RATE(CFS) =      26.27

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   3.01
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    210.00 =    2501.00 FEET.

+-------------------------------------------------------------------------+
| Beign On-Site Flow Contribution                                         |
|                                                                         |
|                                                                         |
+-------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    204.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1534.00  DOWNSTREAM(FEET) =   1485.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   787.00   CHANNEL SLOPE =  0.0623
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.619
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.84
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.76
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   4.75
  Tc(MIN.) =   38.35
  SUBAREA AREA(ACRES) =     5.60       SUBAREA RUNOFF(CFS) =    5.13
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.358
  TOTAL AREA(ACRES) =       31.2         PEAK FLOW RATE(CFS) =      29.26

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.80
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    204.00 =    3288.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1485.00  DOWNSTREAM(FEET) =   1475.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   627.00   CHANNEL SLOPE =  0.0159
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.498
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      34.70
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.57
  AVERAGE FLOW DEPTH(FEET) =   0.45   TRAVEL TIME(MIN.) =   2.93
  Tc(MIN.) =   41.28
  SUBAREA AREA(ACRES) =    12.45       SUBAREA RUNOFF(CFS) =   10.89
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.356
  TOTAL AREA(ACRES) =       43.7         PEAK FLOW RATE(CFS) =      38.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.49   FLOW VELOCITY(FEET/SEC.) =   3.68
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    202.00 =    3915.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1475.00  DOWNSTREAM(FEET) =   1465.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   407.00   CHANNEL SLOPE =  0.0246
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.430
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      40.96
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.77
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   1.80
  Tc(MIN.) =   43.08
  SUBAREA AREA(ACRES) =     5.10       SUBAREA RUNOFF(CFS) =    4.34
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.355
  TOTAL AREA(ACRES) =       48.8         PEAK FLOW RATE(CFS) =      42.07

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.36   FLOW VELOCITY(FEET/SEC.) =   3.85
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    200.00 =    4322.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       48.8  TC(MIN.) =     43.08
```

```
  PEAK FLOW RATE(CFS)   =      42.07
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

| CULVERT SUMMARY TABLE | | | | |
|---|---|---|---|---|
| FACILITY | NODE | ALLOWABLE HW DEPTH (FT) | CAPACITY (CFS) | Q(100) (CFS) |
| 24" & 36" CMP | 102 | 4.0 | 61 | 145 |
| 36" CMP | 100 | 3.0 | 27 | 145 |
| 18" CMP | 200 | 2.5 | 10 | 42 |
| ALLOWABLE HW DEPTH = MAX DEPTH IMMEDIATELY UPSTREAM OF THE CULVERT PRIOR TO OVERTOPPING | | | | |

NODE 110:
REFER TO OFF-SITE WORK MAP
Q100 = 138 CFS
AREA = 126.5 AC

110

NO PROPOSED DEVELOPMENT

36" CMP

24" CMP

NODE 210:
REFER TO OFF-SITE WORK MAP
Q100 = 26 CFS
AREA = 25.6 AC

NO PROPOSED DEVELOPMENT

210

NODE 102:
Q100 = 145 CFS
AREA = 138.5 AC

102

VIA VALENCIA

A=2.4 AC
C=0.35

NODE 100:
Q100 = 145 CFS
AREA = 140.9 AC

100

36" CMP

COLLEGE BLVD

A=12.5 AC
C=0.35

A=5.6 AC
C=0.35

202

204

A=5.1 AC
C=0.35

NO PROPOSED DEVELOPMENT

18" CMP

200 NODE 200:
Q100 = 42 CFS
AREA = 48.8 AC

SCALE: 1"=250'

## LEGEND

311 OFF-SITE DRAINAGE NODE

102 ON-SITE DRAINAGE NODE

DRAINAGE BASIN

FLOW PATH

MUP BOUNDARY

FLOW DIRECTION

250 125 0 250 500 750

SCALE: 1"=250'

# NLP VALLEY CENTER SOLAR
# PROPOSED HYDROLOGY 100YR

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAIREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 • FAX 858.614.5001 • www.RBF.com

\\SANDCA1FS1\HROOT\PDATA\145596\CADD\STRMWATER\PR WORK MAP.DWG CHOY, DARREN 8/6/2015 2:50 PM

```
************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2013 Advanced Engineering Software (aes)
              Ver. 20.0 Release Date: 06/01/2013  License ID 1264

                           Analysis prepared by:

                               RBF Consulting
                             14257 Alton Parkway
                                  Irvine, CA
                                    92618

 ************************** DESCRIPTION OF STUDY *************************
* NLP VALLEY CENTER SOLAR PROJECT                                        *
* Proposed Condition                                                     *
* MICHAEL BAKER INT. JN 145596                                           *
 ************************************************************************

  FILE NAME: PR100NLP.DAT
  TIME/DATE OF STUDY: 15:45 06/11/2015
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+------------------------------------------------------------------------+
| Sub-Basin 100                                                          |
|                                                                        |
|                                                                        |
+------------------------------------------------------------------------+

************************************************************************
  FLOW PROCESS FROM NODE    120.00 TO NODE    118.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  OPEN BRUSH GOOD COVER RUNOFF COEFFICIENT = .3000
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  75
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1980.00
  DOWNSTREAM ELEVATION(FEET) =   1960.00
  ELEVATION DIFFERENCE(FEET) =     20.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.684
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.084
  SUBAREA RUNOFF(CFS) =      0.65
  TOTAL AREA(ACRES) =      0.27   TOTAL RUNOFF(CFS) =      0.65

************************************************************************
  FLOW PROCESS FROM NODE    118.00 TO NODE    116.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1960.00  DOWNSTREAM(FEET) =   1780.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   460.00   CHANNEL SLOPE =  0.3913
  CHANNEL BASE(FEET) =   50.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.308
  OPEN BRUSH GOOD COVER RUNOFF COEFFICIENT = .3000
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  75
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.45
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =   3.13
  Tc(MIN.) =    9.82
  SUBAREA AREA(ACRES) =     4.52       SUBAREA RUNOFF(CFS) =    8.55
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.300
  TOTAL AREA(ACRES) =        4.8         PEAK FLOW RATE(CFS) =       9.06

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   3.19
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    116.00 =     560.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    114.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1780.00  DOWNSTREAM(FEET) =   1630.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1020.00   CHANNEL SLOPE =  0.1471
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.137
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      30.60
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.62
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   3.68
  Tc(MIN.) =   13.50
  SUBAREA AREA(ACRES) =    23.23       SUBAREA RUNOFF(CFS) =   42.96
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.350
  TOTAL AREA(ACRES) =       28.0         PEAK FLOW RATE(CFS) =      50.35

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   5.63
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    114.00 =    1580.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    114.00 TO NODE    112.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1630.00  DOWNSTREAM(FEET) =   1575.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2228.00   CHANNEL SLOPE =  0.0247
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.703
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      92.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.16
  AVERAGE FLOW DEPTH(FEET) =   0.22   TRAVEL TIME(MIN.) =   8.93
  Tc(MIN.) =   22.43
  SUBAREA AREA(ACRES) =    61.55       SUBAREA RUNOFF(CFS) =   82.05
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.357
  TOTAL AREA(ACRES) =       89.6         PEAK FLOW RATE(CFS) =     118.34

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   4.53
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    112.00 =    3808.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    110.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1575.00  DOWNSTREAM(FEET) =   1507.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1493.00   CHANNEL SLOPE =  0.0455
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.040   MAXIMUM DEPTH(FEET) =   4.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.150
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3200
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     137.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.90
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   6.39
  Tc(MIN.) =   28.81
  SUBAREA AREA(ACRES) =    36.93       SUBAREA RUNOFF(CFS) =   37.23
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.346
  TOTAL AREA(ACRES) =      126.5         PEAK FLOW RATE(CFS) =     137.90

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   3.92
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    110.00 =    5301.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    110.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1507.00  DOWNSTREAM(FEET) =   1488.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   722.00   CHANNEL SLOPE =  0.0263
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.022
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3600
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     144.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.29
  AVERAGE FLOW DEPTH(FEET) =   0.73   TRAVEL TIME(MIN.) =   1.91
  Tc(MIN.) =   30.73
  SUBAREA AREA(ACRES) =    12.00       SUBAREA RUNOFF(CFS) =   13.06
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.347
  TOTAL AREA(ACRES) =      138.5         PEAK FLOW RATE(CFS) =     145.36
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.74   FLOW VELOCITY(FEET/SEC.) =   6.28
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    102.00 =    6023.00 FEET.

+----------------------------------------------------------------------------+
| Begin On-Site Flow Contribution                                            |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    100.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1488.00  DOWNSTREAM(FEET) =   1480.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   370.00   CHANNEL SLOPE =  0.0216
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.966
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  65
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     146.58
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.74
  AVERAGE FLOW DEPTH(FEET) =   0.99   TRAVEL TIME(MIN.) =   0.91
  Tc(MIN.) =   31.64
  SUBAREA AREA(ACRES) =     2.35       SUBAREA RUNOFF(CFS) =    2.44
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.347
  TOTAL AREA(ACRES) =      140.9         PEAK FLOW RATE(CFS) =     145.36

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.99   FLOW VELOCITY(FEET/SEC.) =   6.70
  LONGEST FLOWPATH FROM NODE    120.00 TO NODE    100.00 =    6393.00 FEET.

+----------------------------------------------------------------------------+
| Sub-Bain 200                                                               |
|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    216.00 TO NODE    214.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3200
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  65
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1615.00
  DOWNSTREAM ELEVATION(FEET) =   1612.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    9.735
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.343
  SUBAREA RUNOFF(CFS) =      0.32
  TOTAL AREA(ACRES) =      0.16   TOTAL RUNOFF(CFS) =      0.32

****************************************************************************
  FLOW PROCESS FROM NODE    214.00 TO NODE    212.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1612.00  DOWNSTREAM(FEET) =   1590.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1213.00   CHANNEL SLOPE =  0.0181
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.365
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.34
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.24
  AVERAGE FLOW DEPTH(FEET) =   0.04   TRAVEL TIME(MIN.) =  16.28
  Tc(MIN.) =   26.01
  SUBAREA AREA(ACRES) =     7.78       SUBAREA RUNOFF(CFS) =    9.42
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.359
  TOTAL AREA(ACRES) =        7.9         PEAK FLOW RATE(CFS) =       9.60

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.06   FLOW VELOCITY(FEET/SEC.) =   1.50
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    212.00 =    1313.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    212.00 TO NODE    210.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1590.00  DOWNSTREAM(FEET) =   1535.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1188.00   CHANNEL SLOPE =  0.0463
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.020   MAXIMUM DEPTH(FEET) =   2.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.853
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3600
  SOIL CLASSIFICATION IS "C"
```

```
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.73
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.61
  AVERAGE FLOW DEPTH(FEET) =   0.07   TRAVEL TIME(MIN.) =   7.59
  Tc(MIN.) =   33.60
  SUBAREA AREA(ACRES) =    17.66       SUBAREA RUNOFF(CFS) =   18.14
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.360
  TOTAL AREA(ACRES) =       25.6         PEAK FLOW RATE(CFS) =      26.27

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   3.01
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    210.00 =    2501.00 FEET.

+-------------------------------------------------------------------------+
| Begin On-Site Flow Contribution                                         |
|                                                                         |
|                                                                         |
+-------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    204.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1534.00  DOWNSTREAM(FEET) =   1485.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   787.00   CHANNEL SLOPE =  0.0623
  CHANNEL BASE(FEET) =  100.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   3.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.619
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.84
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.76
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   4.75
  Tc(MIN.) =   38.35
  SUBAREA AREA(ACRES) =     5.60       SUBAREA RUNOFF(CFS) =    5.13
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.358
  TOTAL AREA(ACRES) =       31.2         PEAK FLOW RATE(CFS) =      29.26

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.80
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    204.00 =    3288.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    202.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1485.00  DOWNSTREAM(FEET) =   1475.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   627.00   CHANNEL SLOPE =  0.0159
  CHANNEL BASE(FEET) =   20.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.498
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      34.70
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.57
  AVERAGE FLOW DEPTH(FEET) =   0.45   TRAVEL TIME(MIN.) =   2.93
  Tc(MIN.) =   41.28
  SUBAREA AREA(ACRES) =    12.45       SUBAREA RUNOFF(CFS) =   10.89
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.356
  TOTAL AREA(ACRES) =       43.7         PEAK FLOW RATE(CFS) =      38.79

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.49   FLOW VELOCITY(FEET/SEC.) =   3.68
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    202.00 =    3915.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    200.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1475.00  DOWNSTREAM(FEET) =   1465.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   407.00   CHANNEL SLOPE =  0.0246
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.430
  *USER SPECIFIED(SUBAREA):
  VINEYARDS(DISKED) COVER RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  76
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      40.96
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.77
  AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   1.80
  Tc(MIN.) =   43.08
  SUBAREA AREA(ACRES) =     5.10       SUBAREA RUNOFF(CFS) =    4.34
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.355
  TOTAL AREA(ACRES) =       48.8         PEAK FLOW RATE(CFS) =      42.07

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.36   FLOW VELOCITY(FEET/SEC.) =   3.85
  LONGEST FLOWPATH FROM NODE    216.00 TO NODE    200.00 =    4322.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       48.8  TC(MIN.) =     43.08
```

```
  PEAK FLOW RATE(CFS)   =      42.07
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

# Appendix C: Culvert Master Input & Output

Michael Baker
INTERNATIONAL

# Existing 24" CMP - Node 102

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Computed Headwater Eleva | 1,491.38 | ft | Discharge | 21.00 | cfs |
| Inlet Control HW Elev. | 1,490.55 | ft | Tailwater Elevation | N/A | ft |
| Outlet Control HW Elev. | 1,491.38 | ft | Control Type | Outlet Control | |
| Headwater Depth/Height | 2.19 | | | | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 1,487.00 | ft | Downstream Invert | 1,485.00 | ft |
| Length | 42.00 | ft | Constructed Slope | 0.000000 | ft/ft |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | CompositeH2PressureProfile | | Depth, Downstream | 1.64 | ft |
| Slope Type | Horizontal | | Normal Depth | N/A | ft |
| Flow Regime | Subcritical | | Critical Depth | 1.64 | ft |
| Velocity Downstream | 7.61 | ft/s | Critical Slope | 0.029289 | ft/ft |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.024 | |
| Section Material | CMP | | Span | 2.00 | ft |
| Section Size | 24 inch | | Rise | 2.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 1,491.38 | ft | Upstream Velocity Head | 0.69 | ft |
| Ke | 0.90 | | Entrance Loss | 0.62 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 1,490.55 | ft | Flow Control | Submerged | |
| Inlet Type | Projecting | | Area Full | 3.1 | ft² |
| K | 0.03400 | | HDS 5 Chart | 2 | |
| M | 1.50000 | | HDS 5 Scale | 3 | |
| C | 0.05530 | | Equation Form | 1 | |
| Y | 0.54000 | | | | |

# Existing 24" CMP - Node 102

| Range Data: | | | |
|---|---|---|---|
| | Minimum | Maximum | Increment |
| Allowable HW E | 1,487.00 | 1,492.00 | 0.50 ft |

| HW Elev. (ft) | Discharge (cfs) |
|---|---|
| 1,487.00 | 0.00 |
| 1,487.50 | 0.13 |
| 1,488.00 | 2.43 |
| 1,488.50 | 5.57 |
| 1,489.00 | 9.27 |
| 1,489.50 | 12.61 |
| 1,490.00 | 15.15 |
| 1,490.50 | 17.43 |
| 1,491.00 | 19.51 |
| 1,491.50 | 21.44 |
| 1,492.00 | 23.24 |

# Existing 36" CMP - Node 102

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Computed Headwater Eleva | 1,490.54 | ft | Discharge | 35.00 | cfs |
| Inlet Control HW Elev. | 1,490.25 | ft | Tailwater Elevation | N/A | ft |
| Outlet Control HW Elev. | 1,490.54 | ft | Control Type | Outlet Control | |
| Headwater Depth/Height | 1.18 | | | | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 1,487.00 | ft | Downstream Invert | 1,485.00 | ft |
| Length | 42.00 | ft | Constructed Slope | 0.000000 | ft/ft |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | H2 | | Depth, Downstream | 1.92 | ft |
| Slope Type | Horizontal | | Normal Depth | N/A | ft |
| Flow Regime | Subcritical | | Critical Depth | 1.92 | ft |
| Velocity Downstream | 7.31 | ft/s | Critical Slope | 0.017080 | ft/ft |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.024 | |
| Section Material | CMP | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 1,490.54 | ft | Upstream Velocity Head | 0.41 | ft |
| Ke | 0.90 | | Entrance Loss | 0.37 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 1,490.25 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Projecting | | Area Full | 7.1 | ft² |
| K | 0.03400 | | HDS 5 Chart | 2 | |
| M | 1.50000 | | HDS 5 Scale | 3 | |
| C | 0.05530 | | Equation Form | 1 | |
| Y | 0.54000 | | | | |

# Existing 36" CMP - Node 102

| Range Data: | | | |
|---|---|---|---|
| | Minimum | Maximum | Increment |
| Allowable HW E | 1,487.00 | 1,492.00 | 0.50 ft |

| HW Elev. (ft) | Discharge (cfs) |
|---|---|
| 1,487.00 | 0.00 |
| 1,487.50 | 0.60 |
| 1,488.00 | 3.31 |
| 1,488.50 | 7.30 |
| 1,489.00 | 13.30 |
| 1,489.50 | 20.02 |
| 1,490.00 | 27.30 |
| 1,490.50 | 34.48 |
| 1,491.00 | 40.72 |
| 1,491.50 | 45.89 |
| 1,492.00 | 50.71 |

# Existing 36" CMP - Node 100

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Computed Headwater Eleva | 1,480.98 | ft | Discharge | 27.00 | cfs |
| Inlet Control HW Elev. | 1,480.64 | ft | Tailwater Elevation | N/A | ft |
| Outlet Control HW Elev. | 1,480.98 | ft | Control Type | Entrance Control | |
| Headwater Depth/Height | 0.99 | | | | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 1,478.00 | ft | Downstream Invert | 1,475.00 | ft |
| Length | 80.00 | ft | Constructed Slope | 0.037500 | ft/ft |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.29 | ft |
| Slope Type | Steep | | Normal Depth | 1.29 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.68 | ft |
| Velocity Downstream | 9.26 | ft/s | Critical Slope | 0.015385 | ft/ft |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.024 | |
| Section Material | CMP | | Span | 3.00 | ft |
| Section Size | 36 inch | | Rise | 3.00 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 1,480.98 | ft | Upstream Velocity Head | 0.68 | ft |
| Ke | 0.90 | | Entrance Loss | 0.62 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 1,480.64 | ft | Flow Control | Unsubmerged | |
| Inlet Type | Projecting | | Area Full | 7.1 | ft² |
| K | 0.03400 | | HDS 5 Chart | 2 | |
| M | 1.50000 | | HDS 5 Scale | 3 | |
| C | 0.05530 | | Equation Form | 1 | |
| Y | 0.54000 | | | | |

# Existing 36" CMP - Node 100

| Range Data: | | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Increment | |
| Allowable HW E | 1,478.00 | 1,482.00 | 0.50 | ft |

| HW Elev. (ft) | Discharge (cfs) |
|---|---|
| 1,478.00 | 0.00 |
| 1,478.50 | 0.96 |
| 1,479.00 | 3.71 |
| 1,479.50 | 7.99 |
| 1,480.00 | 13.54 |
| 1,480.50 | 20.08 |
| 1,481.00 | 27.33 |
| 1,481.50 | 34.97 |
| 1,482.00 | 42.70 |

# Existing 18" CMP - Node 200

Component:Culvert-1

| Culvert Summary | | | | | |
|---|---|---|---|---|---|
| Computed Headwater Eleva | 1,468.55 | ft | Discharge | 10.00 | cfs |
| Inlet Control HW Elev. | 1,468.55 | ft | Tailwater Elevation | N/A | ft |
| Outlet Control HW Elev. | 1,468.47 | ft | Control Type | Inlet Control | |
| Headwater Depth/Height | 1.70 | | | | |

| Grades | | | | | |
|---|---|---|---|---|---|
| Upstream Invert | 1,466.00 | ft | Downstream Invert | 1,461.00 | ft |
| Length | 120.00 | ft | Constructed Slope | 0.041667 | ft/ft |

| Hydraulic Profile | | | | | |
|---|---|---|---|---|---|
| Profile | S2 | | Depth, Downstream | 1.07 | ft |
| Slope Type | Steep | | Normal Depth | 1.07 | ft |
| Flow Regime | Supercritical | | Critical Depth | 1.22 | ft |
| Velocity Downstream | 7.39 | ft/s | Critical Slope | 0.031376 | ft/ft |

| Section | | | | | |
|---|---|---|---|---|---|
| Section Shape | Circular | | Mannings Coefficient | 0.024 | |
| Section Material | CMP | | Span | 1.50 | ft |
| Section Size | 18 inch | | Rise | 1.50 | ft |
| Number Sections | 1 | | | | |

| Outlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Outlet Control HW Elev. | 1,468.47 | ft | Upstream Velocity Head | 0.66 | ft |
| Ke | 0.90 | | Entrance Loss | 0.59 | ft |

| Inlet Control Properties | | | | | |
|---|---|---|---|---|---|
| Inlet Control HW Elev. | 1,468.55 | ft | Flow Control | Submerged | |
| Inlet Type | Projecting | | Area Full | 1.8 | ft² |
| K | 0.03400 | | HDS 5 Chart | 2 | |
| M | 1.50000 | | HDS 5 Scale | 3 | |
| C | 0.05530 | | Equation Form | 1 | |
| Y | 0.54000 | | | | |

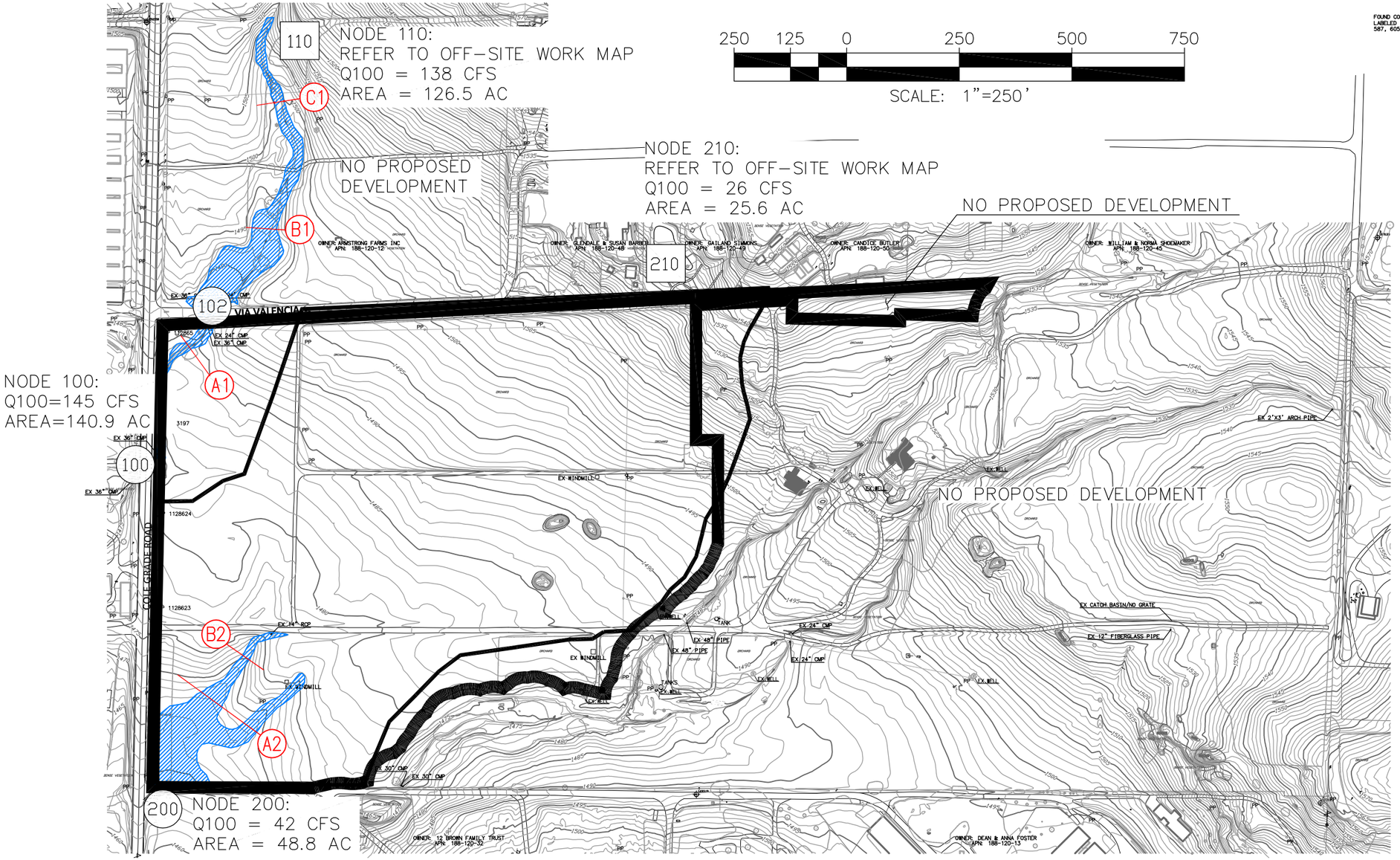
# Existing 18" CMP - Node 200

| Range Data: | | | | |
|---|---|---|---|---|
| | Minimum | Maximum | Increment | |
| Discharge | 0.00 | 48.80 | 10.00 | cfs |

| Discharge (cfs) | HW Elev. (ft) |
|---|---|
| 0.00 | 1,466.00 |
| 10.00 | 1,468.55 |
| 20.00 | 1,481.10 |
| 30.00 | 1,504.37 |
| 40.00 | 1,536.94 |
| 48.80 | 1,573.30 |

# Appendix D:
# 100-YR Project Site Inundation & Soil Loss

Michael Baker
INTERNATIONAL




250 125 0 250 500 750

SCALE: 1"=250'

## LEGEND

- INUNDATION LIMITS
- (102) ON-SITE DRAINAGE NODE
- DRAINAGE BASIN
- (A1) CROSS-SECTION
- [311] OFF-SITE DRAINAGE NODE
- MUP BOUNDARY

SCALE: 1"=250'

## CHANNEL CROSS SECTIONS

| SECTION | SLOPE | TOP WIDTH | DEPTH | VELOCITY | Q100 |
|---|---|---|---|---|---|
| | % | FT | FT | FT/SEC | CFS |
| A1 | 4.1 | 22.0 | 1.9 | 8.4 | 145 |
| B1 | 2.2 | 53.8 | 1.0 | 4.9 | 145 |
| C1 | 2.1 | 21.7 | 1.7 | 7.0 | 145 |
| A2 | 1.7 | 59.6 | 0.5 | 2.7 | 42 |
| B2 | 2.2 | 21.3 | 0.9 | 4.3 | 42 |

# NLP VALLEY CENTER SOLAR
# EXISTING CONDITION
# 100YR FLOOD INUNDATION MAP

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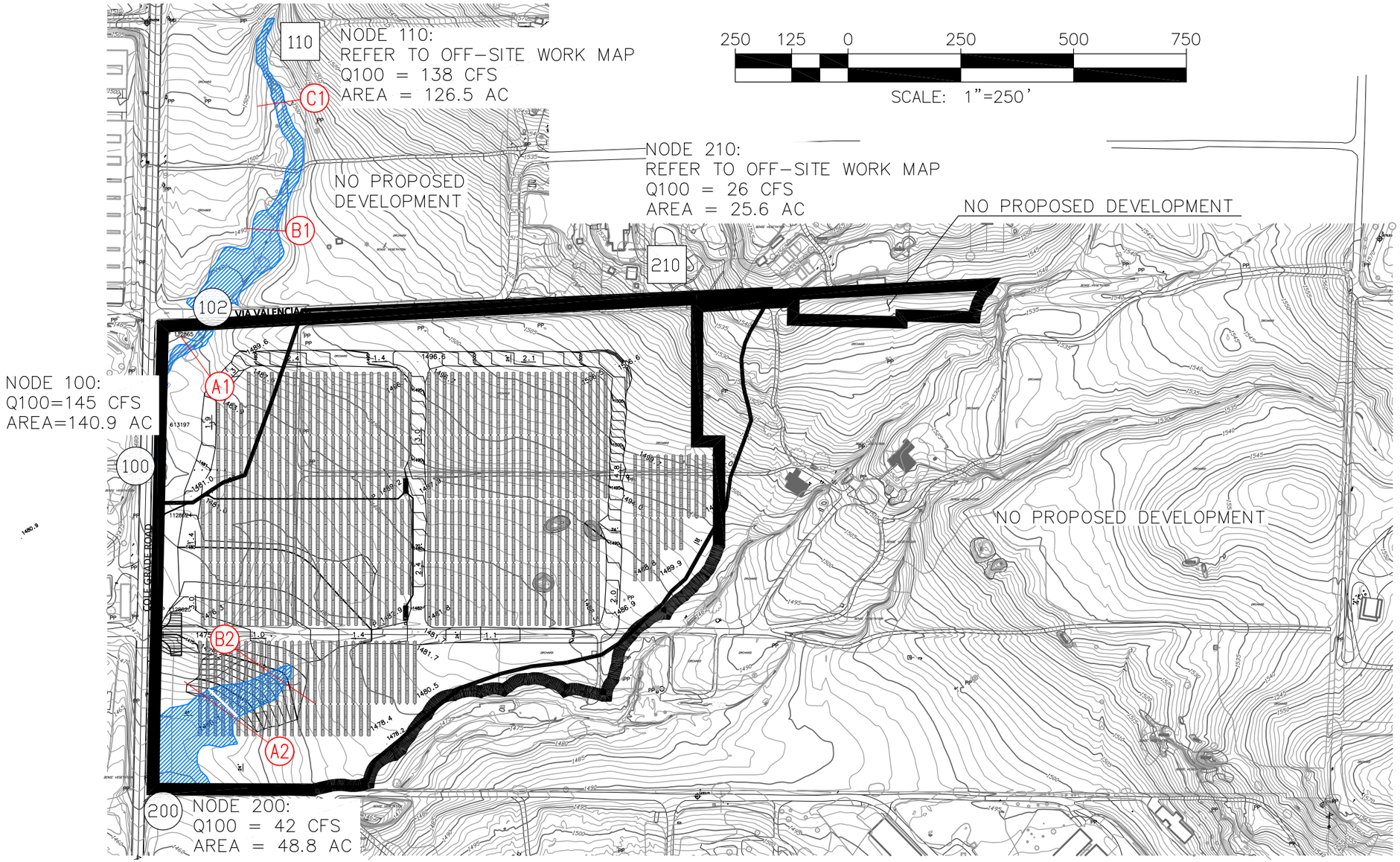
\\SANDCA1FS1\HROOT\PDATA\145596\CADD\STRMWATER\EXISTING 100-YEAR INUNDATION WORK MAP.DWG CHOY, DARREN 8/7/2015 11:37 AM




## LEGEND

- INUNDATION LIMITS
- 102 — ON-SITE DRAINAGE NODE
- DRAINAGE BASIN
- A1 — CROSS-SECTION
- 311 — OFF-SITE DRAINAGE NODE
- MUP BOUNDARY

SCALE: 1"=250'

| CHANNEL CROSS SECTIONS | | | | | |
|---|---|---|---|---|---|
| SECTION | SLOPE | TOP WIDTH | DEPTH | VELOCITY | Q100 |
| | % | FT | FT | FT/SEC | CFS |
| A1 | 4.1 | 22.0 | 1.9 | 8.4 | 145 |
| B1 | 2.2 | 53.8 | 1.0 | 4.9 | 145 |
| C1 | 2.1 | 21.7 | 1.7 | 7.0 | 145 |
| A2 | 1.7 | 89.1 | 0.2 | 2.3 | 42 |
| B2 | 2.2 | 43.5 | 0.5 | 4.2 | 42 |

# NLP VALLEY CENTER SOLAR
# PROPOSED CONDITION
# 100 YR FLOOD INUNDATION MAP

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\\SANDCA1FS1\HROOT\PDATA\145596\CADD\STRMWATER\PROPOSED 100-YEAR INUNDATION WORK MAP.DWG CHOY, DARREN 8/7/2015 11:42 AM

# Worksheet for Existing A - 1 (No Proposed Condition)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.04131 | ft/ft |
| Discharge | 145.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1485.00 |
| 0+54 | 1484.00 |
| 0+64 | 1483.00 |
| 0+71 | 1482.00 |
| 0+75 | 1481.00 |
| 0+77 | 1482.00 |
| 0+87 | 1483.00 |
| 0+95 | 1484.00 |
| 1+07 | 1485.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1485.00) | (1+07, 1485.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.95 | ft |
| Elevation Range | 1481.00 to 1485.00 ft | |
| Flow Area | 17.27 | ft² |
| Wetted Perimeter | 22.66 | ft |

# Worksheet for Existing A - 1 (No Proposed Condition)

## Results

| | | | |
|---|---|---|---|
| Hydraulic Radius | | 0.76 | ft |
| Top Width | | 22.20 | ft |
| Normal Depth | | 1.95 | ft |
| Critical Depth | | 2.32 | ft |
| Critical Slope | | 0.01376 | ft/ft |
| Velocity | | 8.40 | ft/s |
| Velocity Head | | 1.10 | ft |
| Specific Energy | | 3.05 | ft |
| Froude Number | | 1.68 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.95 | ft |
| Critical Depth | 2.32 | ft |
| Channel Slope | 0.04131 | ft/ft |
| Critical Slope | 0.01376 | ft/ft |

# Cross Section for A - 1 (No Proposed Condition)

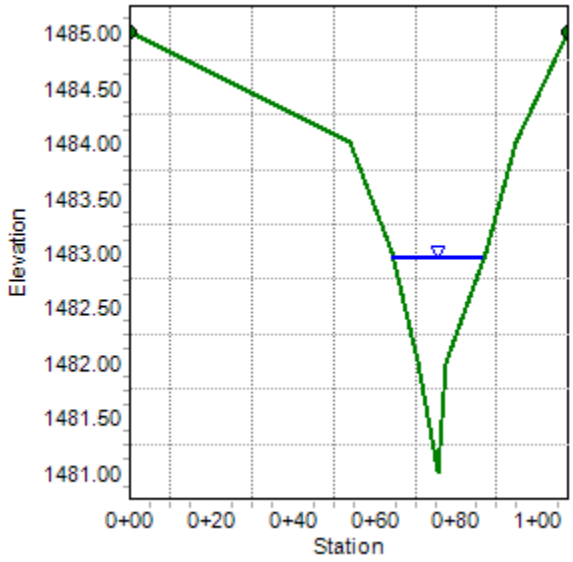
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.04131 | ft/ft |
| Normal Depth | 1.95 | ft |
| Discharge | 145.00 | ft³/s |

## Cross Section Image



# Worksheet for Existing B - 1 (No Proposed Condition)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02260 | ft/ft |
| Discharge | 145.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1495.00 |
| 0+08 | 1494.00 |
| 0+20 | 1493.00 |
| 0+31 | 1492.00 |
| 0+73 | 1493.00 |
| 0+80 | 1494.00 |
| 0+86 | 1495.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1495.00) | (0+86, 1495.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.05 | ft |
| Elevation Range | 1492.00 to 1495.00 ft | |
| Flow Area | 29.31 | ft² |
| Wetted Perimeter | 54.10 | ft |
| Hydraulic Radius | 0.54 | ft |
| Top Width | 54.04 | ft |

# Worksheet for Existing B - 1 (No Proposed Condition)

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 1.05 | ft |
| Critical Depth | | 1.12 | ft |
| Critical Slope | | 0.01559 | ft/ft |
| Velocity | | 4.95 | ft/s |
| Velocity Head | | 0.38 | ft |
| Specific Energy | | 1.43 | ft |
| Froude Number | | 1.18 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.05 | ft |
| Critical Depth | 1.12 | ft |
| Channel Slope | 0.02260 | ft/ft |
| Critical Slope | 0.01559 | ft/ft |

# Cross Section for B - 1 (No Proposed Condition)

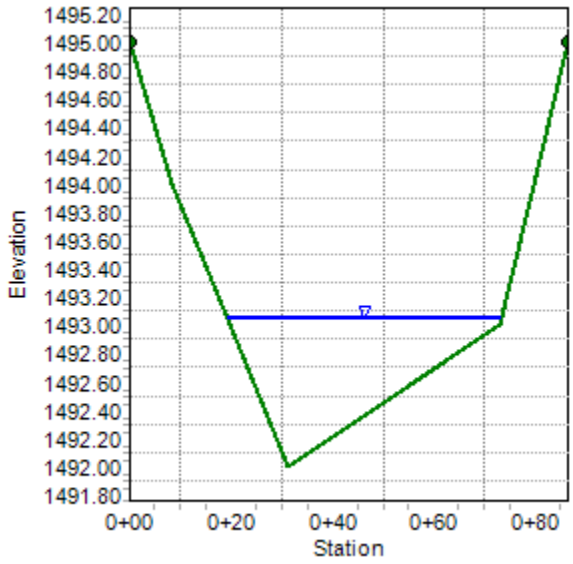
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02260 | ft/ft |
| Normal Depth | 1.05 | ft |
| Discharge | 145.00 | ft³/s |

## Cross Section Image



# Worksheet for Existing C - 1 (No Proposed Condition)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02160 | ft/ft |
| Discharge | 145.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1503.00 |
| 0+06 | 1502.00 |
| 0+13 | 1501.00 |
| 0+36 | 1500.00 |
| 0+40 | 1499.00 |
| 0+44 | 1498.00 |
| 0+55 | 1499.00 |
| 0+61 | 1500.00 |
| 0+76 | 1501.00 |
| 0+88 | 1502.00 |
| 0+99 | 1503.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1503.00) | (0+99, 1503.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 1.73 | ft |
| Elevation Range | 1498.00 to 1503.00 ft | |

# Worksheet for Existing C - 1 (No Proposed Condition)

## Results

| | | | |
|---|---|---|---|
| Flow Area | | 20.75 | ft² |
| Wetted Perimeter | | 22.06 | ft |
| Hydraulic Radius | | 0.94 | ft |
| Top Width | | 21.72 | ft |
| Normal Depth | | 1.73 | ft |
| Critical Depth | | 1.91 | ft |
| Critical Slope | | 0.01314 | ft/ft |
| Velocity | | 6.99 | ft/s |
| Velocity Head | | 0.76 | ft |
| Specific Energy | | 2.49 | ft |
| Froude Number | | 1.26 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 1.73 | ft |
| Critical Depth | 1.91 | ft |
| Channel Slope | 0.02160 | ft/ft |
| Critical Slope | 0.01314 | ft/ft |

# Cross Section for C - 1 (No Proposed Condition)

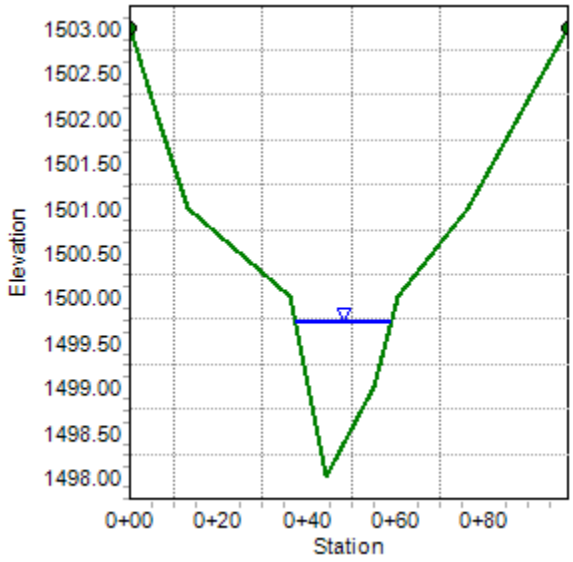
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02160 | ft/ft |
| Normal Depth | 1.73 | ft |
| Discharge | 145.00 | ft³/s |

## Cross Section Image



# Worksheet for Existing A - 2

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.01760 | ft/ft |
| Discharge | 42.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1470.00 |
| 0+33 | 1469.00 |
| 0+50 | 1468.00 |
| 0+99 | 1469.00 |
| 1+19 | 1469.50 |
| 1+36 | 1469.00 |
| 1+67 | 1468.00 |
| 1+85 | 1469.00 |
| 1+97 | 1470.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1470.00) | (1+97, 1470.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.52 | ft |
| Elevation Range | 1468.00 to 1470.00 ft | |
| Flow Area | 15.39 | ft² |
| Wetted Perimeter | 59.67 | ft |

# Worksheet for Existing A - 2

## Results

| | | | |
|---|---|---|---|
| Hydraulic Radius | | 0.26 | ft |
| Top Width | | 59.63 | ft |
| Normal Depth | | 0.52 | ft |
| Critical Depth | | 0.50 | ft |
| Critical Slope | | 0.02083 | ft/ft |
| Velocity | | 2.66 | ft/s |
| Velocity Head | | 0.11 | ft |
| Specific Energy | | 0.63 | ft |
| Froude Number | | 0.92 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.52 | ft |
| Critical Depth | 0.50 | ft |
| Channel Slope | 0.01760 | ft/ft |
| Critical Slope | 0.02083 | ft/ft |

# Cross Section for Existing A - 2

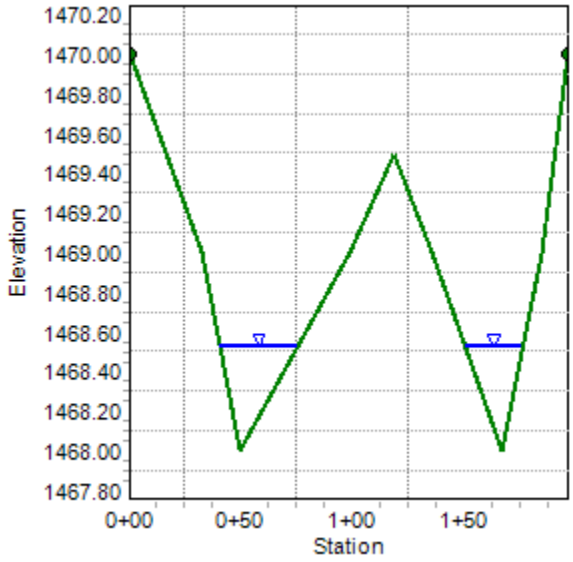
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.01760 | ft/ft |
| Normal Depth | 0.52 | ft |
| Discharge | 42.00 | ft³/s |

## Cross Section Image



# Worksheet for Existing B - 2

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02260 | ft/ft |
| Discharge | 42.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1475.00 |
| 0+13 | 1474.00 |
| 0+23 | 1473.00 |
| 0+30 | 1472.00 |
| 0+36 | 1471.00 |
| 0+43 | 1470.00 |
| 0+60 | 1471.00 |
| 0+71 | 1472.00 |
| 0+82 | 1473.00 |
| 0+92 | 1474.00 |
| 1+00 | 1475.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1475.00) | (1+00, 1475.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.89 | ft |
| Elevation Range | 1470.00 to 1475.00 ft | |

# Worksheet for Existing B - 2

## Results

| | | | |
|---|---|---|---|
| Flow Area | | 9.48 | ft² |
| Wetted Perimeter | | 21.41 | ft |
| Hydraulic Radius | | 0.44 | ft |
| Top Width | | 21.32 | ft |
| Normal Depth | | 0.89 | ft |
| Critical Depth | | 0.94 | ft |
| Critical Slope | | 0.01698 | ft/ft |
| Velocity | | 4.32 | ft/s |
| Velocity Head | | 0.29 | ft |
| Specific Energy | | 1.18 | ft |
| Froude Number | | 1.14 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.89 | ft |
| Critical Depth | 0.94 | ft |
| Channel Slope | 0.02260 | ft/ft |
| Critical Slope | 0.01698 | ft/ft |

# Worksheet for Proposed A - 2

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.01760 | ft/ft |
| Discharge | 42.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1471.00 |
| 0+16 | 1470.00 |
| 0+30 | 1469.00 |
| 1+15 | 1468.00 |
| 1+77 | 1468.00 |
| 2+04 | 1469.00 |
| 2+31 | 1470.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1471.00) | (2+31, 1470.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.24 | ft |
| Elevation Range | 1468.00 to 1471.00 ft | |
| Flow Area | 18.34 | ft² |
| Wetted Perimeter | 89.18 | ft |
| Hydraulic Radius | 0.21 | ft |
| Top Width | 89.18 | ft |

# Worksheet for Proposed A - 2

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.24 | ft |
| Critical Depth | | 0.23 | ft |
| Critical Slope | | 0.02270 | ft/ft |
| Velocity | | 2.29 | ft/s |
| Velocity Head | | 0.08 | ft |
| Specific Energy | | 0.32 | ft |
| Froude Number | | 0.89 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.24 | ft |
| Critical Depth | 0.23 | ft |
| Channel Slope | 0.01760 | ft/ft |
| Critical Slope | 0.02270 | ft/ft |

# Cross Section for Existing B - 2

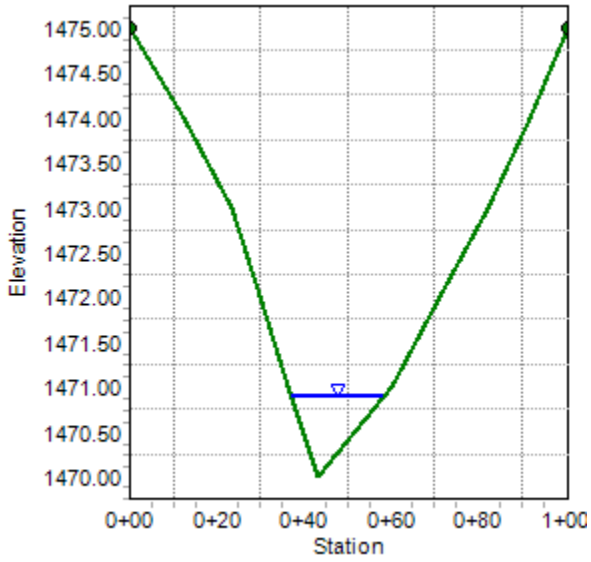
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.02260 | ft/ft |
| Normal Depth | 0.89 | ft |
| Discharge | 42.00 | ft³/s |

## Cross Section Image



# Worksheet for Proposed A - 2

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.01760 | ft/ft |
| Discharge | 42.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1471.00 |
| 0+16 | 1470.00 |
| 0+30 | 1469.00 |
| 1+15 | 1468.00 |
| 1+77 | 1468.00 |
| 2+04 | 1469.00 |
| 2+31 | 1470.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1471.00) | (2+31, 1470.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.24 | ft |
| Elevation Range | 1468.00 to 1471.00 ft | |
| Flow Area | 18.34 | ft² |
| Wetted Perimeter | 89.18 | ft |
| Hydraulic Radius | 0.21 | ft |
| Top Width | 89.18 | ft |

# Worksheet for Proposed A - 2

## Results

| | | | |
|---|---|---|---|
| Normal Depth | | 0.24 | ft |
| Critical Depth | | 0.23 | ft |
| Critical Slope | | 0.02270 | ft/ft |
| Velocity | | 2.29 | ft/s |
| Velocity Head | | 0.08 | ft |
| Specific Energy | | 0.32 | ft |
| Froude Number | | 0.89 | |
| Flow Type | Subcritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.24 | ft |
| Critical Depth | 0.23 | ft |
| Channel Slope | 0.01760 | ft/ft |
| Critical Slope | 0.02270 | ft/ft |

# Cross Section for Proposed A - 2

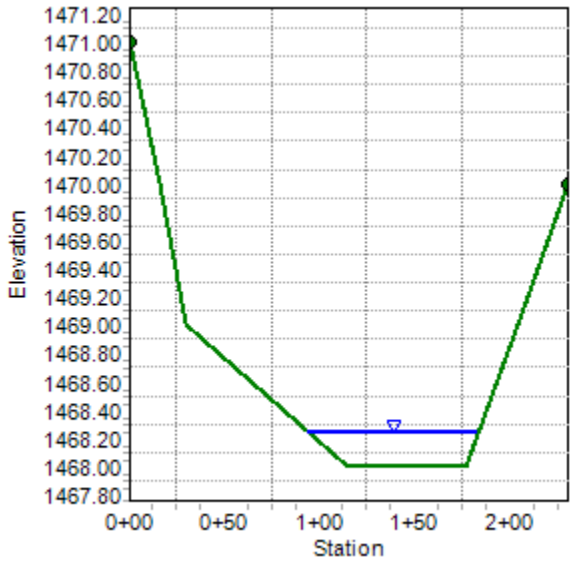
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.01760 | ft/ft |
| Normal Depth | 0.24 | ft |
| Discharge | 42.00 | ft³/s |

## Cross Section Image



# Worksheet for Proposed B - 2

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.05000 | ft/ft |
| Discharge | 42.00 | ft³/s |

Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 1477.00 |
| 0+22 | 1476.00 |
| 0+76 | 1475.00 |
| 1+04 | 1474.00 |
| 1+70 | 1475.00 |
| 2+27 | 1476.00 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00, 1477.00) | (2+27, 1476.00) | 0.030 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.46 | ft |
| Elevation Range | 1474.00 to 1477.00 ft | |
| Flow Area | 10.07 | ft² |
| Wetted Perimeter | 43.52 | ft |
| Hydraulic Radius | 0.23 | ft |
| Top Width | 43.51 | ft |
| Normal Depth | 0.46 | ft |

# Worksheet for Proposed B - 2

## Results

| | | | |
|---|---|---|---|
| Critical Depth | | 0.55 | ft |
| Critical Slope | | 0.02019 | ft/ft |
| Velocity | | 4.17 | ft/s |
| Velocity Head | | 0.27 | ft |
| Specific Energy | | 0.73 | ft |
| Froude Number | | 1.53 | |
| Flow Type | Supercritical | | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.46 | ft |
| Critical Depth | 0.55 | ft |
| Channel Slope | 0.05000 | ft/ft |
| Critical Slope | 0.02019 | ft/ft |

# Cross Section for Proposed B - 2

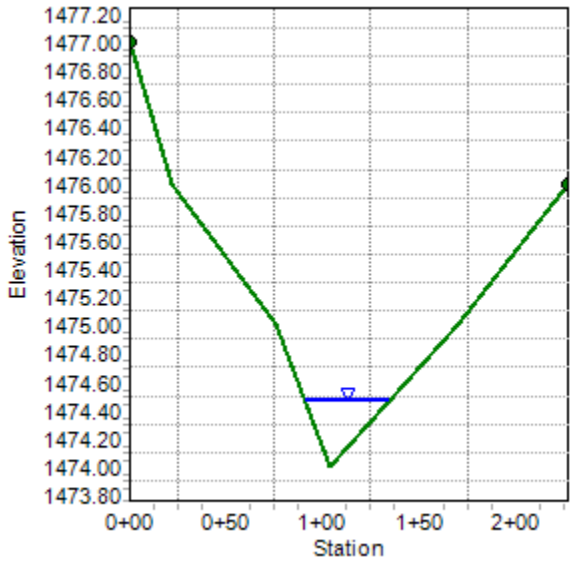
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.05000 | ft/ft |
| Normal Depth | 0.46 | ft |
| Discharge | 42.00 | ft³/s |

## Cross Section Image



NLP Valley Center Solar
Universal Soil Loss
RBF JN: 135828

**Universal Soil Loss Equation**

From San Diego County Hydrology Manual, page 5-7

$$A_S = R * K * Ls * C * P$$

Where:

| | | |
|---|---|---|
| R = | 80 | rainfall erosion index for the given storm period |
| K = | 0.3 | soil erodibility factor |
| Ls = | 1.8 | slope length factor |
| C = | 0.038 | cropping management (vegetation ) factor |
| P = | 1 | erosion control practice factor |
| **As =** | 1.64 | soil loss in tons (dry weight) |

**R**

See Figure 5-2 from SDCHM, included herein

| | | |
|---|---|---|
| P(2)6 = | 1.7 | in |
| I = | 1.75 | in/hr (2-year, 6-hour intensity) |
| R = | 80 | |

**K**

SDCHM

| Soil | K | Percent |
|---|---|---|
| PeC | 0.32 | 60 |
| FaD2 | 0.28 | 30 |
| BlC2 | 0.2 | 10 |

Weighted K Factor = 0.30

**Ls**

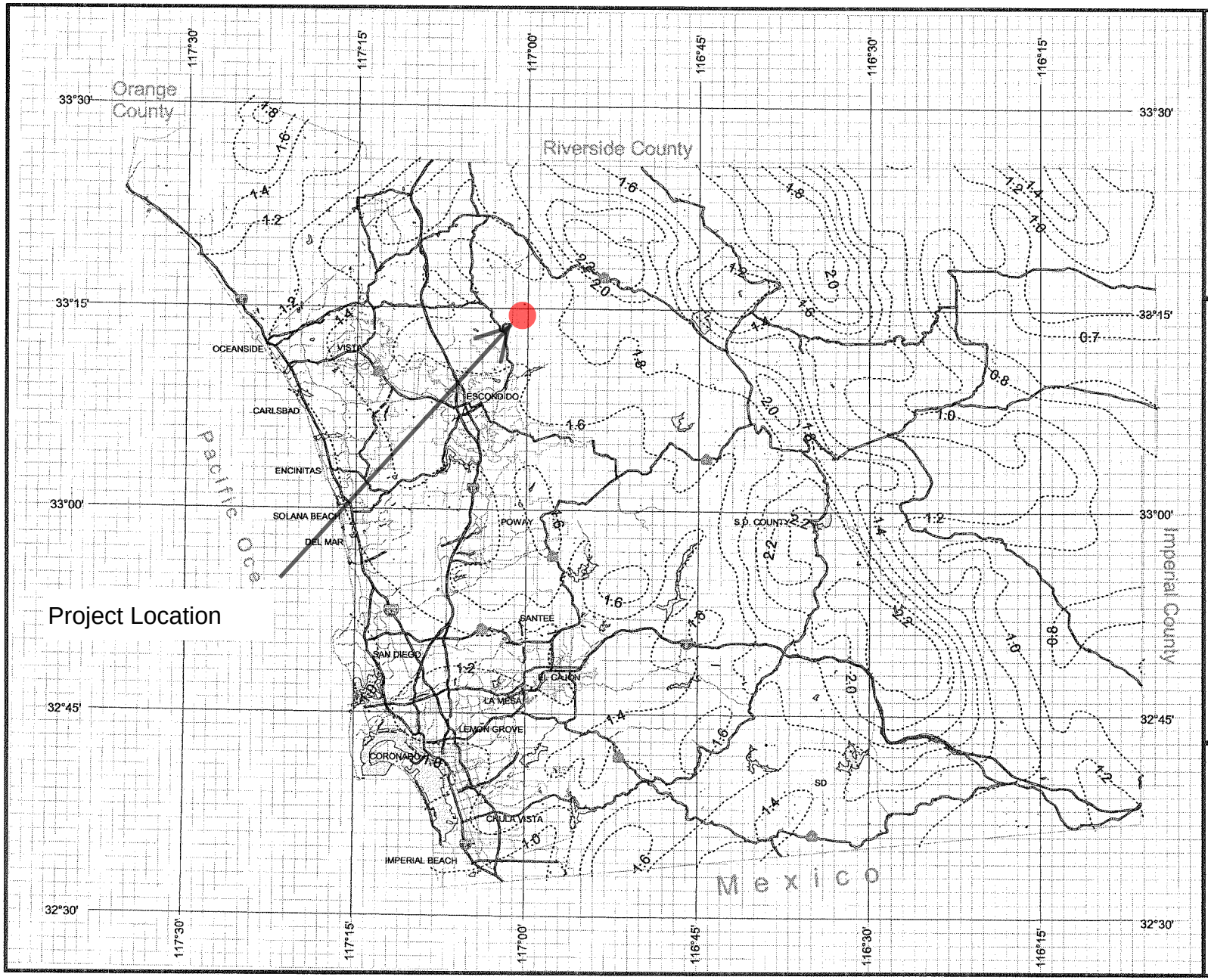
See Figure 5-5 from SDCHM, included herein
Ls = 1.8

**C**

See Table 5-3 from SDCHM, included herein
Canopy of Tall Weeds or Short Brush
25% Canopy Cover
60% ground cover
C = 0.038

**P**

See Table 5-6 from SDCHM, included herein
Soil Sealant
P = 1




# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**2 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

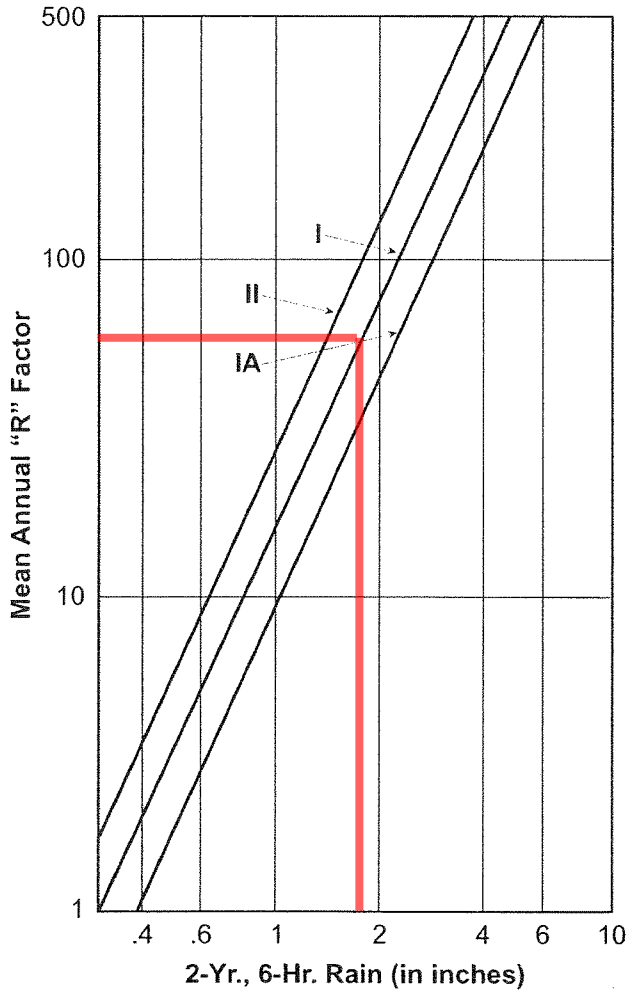
P(2)6 = 1.7 in

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

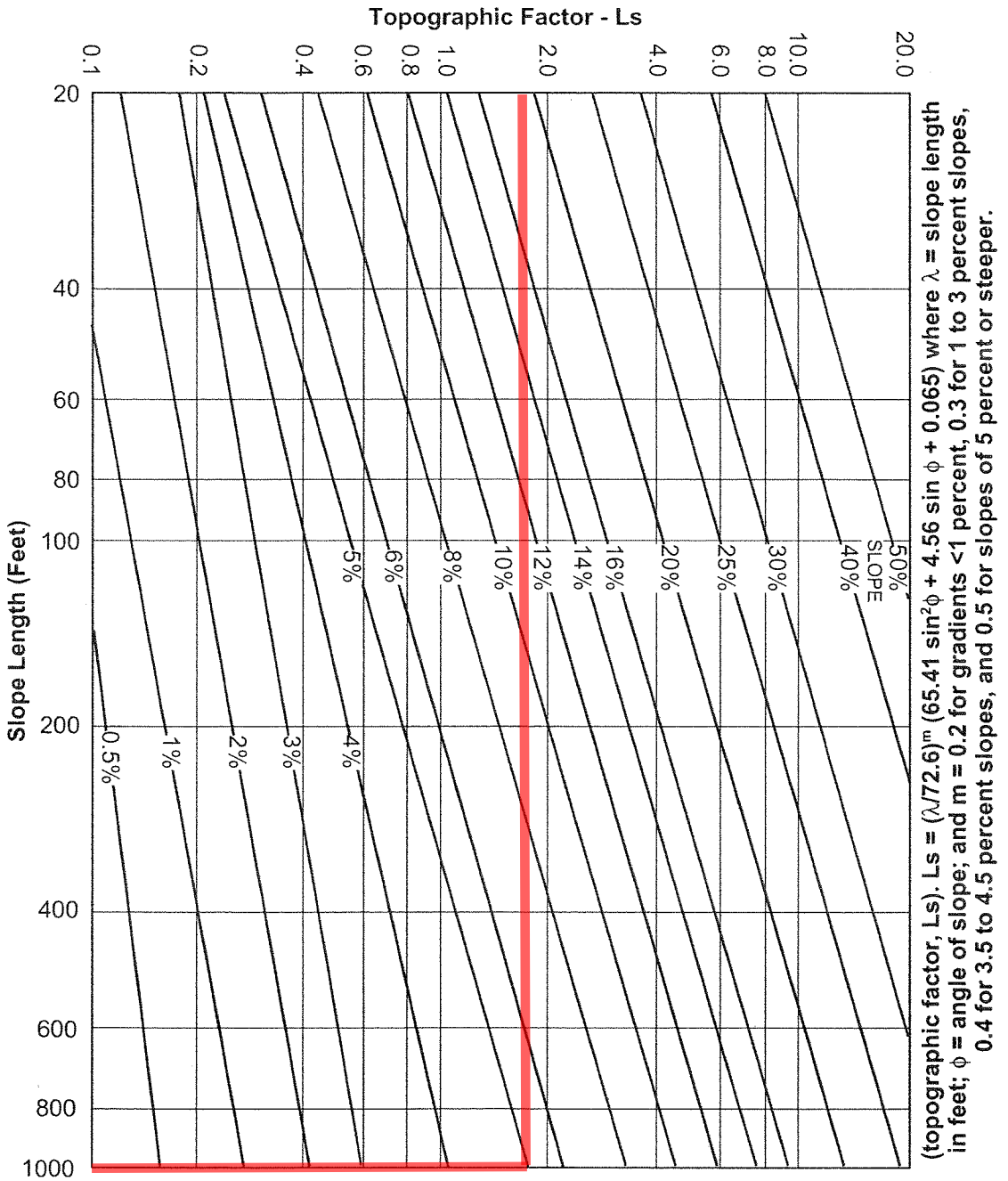



SOURCE: Wischmeier, 1977

FIGURE

**R Factors based on 2-Year, 6-Hour Storm Event (Intensity)**

**5-2**




SOURCE: SEA, USDA, Agricultural Handbook Number 537, December 1978

FIGURE

**Chart for determining Topographic Factors (L,s)**

**5-5**

## Table 5-3

## C FACTORS FOR PASTURE, RANGELAND, AND IDLE GROUND[1]

| Vegetal Canopy | | | Cover That Contacts the Surface | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type and Height of Raised Canopy[2] | Canopy Cover[3] % | Type[4] | Percent Ground Cover | | | | | |
| | | | 0 | 20 | 40 | 60 | 80 | 95-100 |
| Column No.: | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| No appreciable canopy | | G | .45 | .20 | .10 | .042 | .013 | .003 |
| | | W | .45 | .24 | .15 | .090 | .043 | .011 |
| Canopy of tall weeds or short brush (0.5 m fall ht.) | 25 | G | .36 | .17 | .09 | .038 | .012 | .003 |
| | | W | .36 | .20 | .13 | .082 | .041 | .011 |
| | 50 | G | .26 | .13 | .07 | .035 | .012 | .003 |
| | | W | .26 | .16 | .11 | .075 | .039 | .011 |
| | 75 | G | .17 | .10 | .06 | .031 | .011 | .003 |
| | | W | .17 | .12 | .09 | .067 | .038 | .011 |
| Appreciable brush or brushes (2 m fall ht.) | 25 | G | .40 | .18 | .09 | .040 | .013 | .003 |
| | | W | .40 | .22 | .14 | .085 | .042 | .011 |
| | 50 | G | .34 | .16 | .085 | .038 | .012 | .003 |
| | | W | .34 | .19 | .13 | .081 | .041 | .011 |
| | 75 | G | .28 | .14 | .08 | .036 | .012 | .003 |
| | | W | .28 | .17 | .12 | .077 | .041 | .011 |
| Trees but no appreciable low brush (4 m fall ht.) | 25 | G | .42 | .19 | .10 | .041 | .013 | .003 |
| | | W | .42 | .23 | .14 | .087 | .042 | .011 |
| | 50 | G | .39 | .18 | .09 | .040 | .013 | .003 |
| | | W | .39 | .21 | .14 | .085 | .042 | .011 |
| | 75 | G | .36 | .17 | .09 | .039 | .012 | .003 |
| | | W | .36 | .20 | .13 | .083 | .041 | .011 |

Source: Gray and Leiser 1982.

[1] All values shown assume (1) random distribution or mulch or vegetation, and (2) mulch of appreciable depth where it exists.
[2] Average fall height of waterdrops from canopy to soil surface: m = meters.
[3] Portion of total-area surfaee that would be hidden from view by canopy in a vertical projection (a bird's-eye view).
[4] G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep.
W: Cover at surface is mostly broadleaf herbaceous plants (as weeds) with little lateral-root network near the surface, and/or undecayed residue.

**Table 5-6 (Page 1 of 2)**

**C FACTOR AND P FACTOR VALUES FOR RAINFALL EROSION CONTROL MEASURES**

| Treatment | C Factor | P Factor |
|---|---|---|
| BARE SOIL | | |
| Packed and Smooth | 1.00 | 1.00 |
| Freshly Disked | 1.00 | 0.90 |
| Rough Irregular Surface | 1.00 | 0.90 |
| SEDIMENT BASIN/TRAP | 1.00 | 0.50[A] |
| STRAW BALE BARRIER, GRAVEL FILTER, SAND BAGS | 1.00 | 0.80 |
| SILT FENCE BARRIER | 1.00 | 0.50 |
| ASPHALT/CONCRETE PAVEMENT | 1.00 | 1.00 |
| GRAVEL (¼" to 1½") @ 135 TONS/ACRE | 0.05 | 1.00 |
| SOD GRASS | 0.01 | 1.00 |
| TEMPORARY VEGETATION/COVER CROP | 0.45[B] | 1.00 |
| HYDRAULIC MULCH @ 2 TONS/ACRE | 0.10[C] | 1.00 |
| SOIL SEALANT | 0.01 - 0.60[D] | 1.00 |
| EROSION CONTROL MATS/BLANKETS | 0.10 | 1.00 |
| HAY OR STRAW DRY MULCH @ 2 TONS/ACRE & ANCHORED | | |
| Assumes planting of grass seed has occurred prior to application, otherwise C Factor = 1.00. | | |
| Slope (%) | | |
| 1 to 10 | 0.06 | 1.00 |
| 11 to 15 | 0.07 | 1.00 |
| 16 to 20 | 0.11 | 1.00 |
| 21 to 25 | 0.14 | 1.00 |
| 25 to 33 | 0.17 | 1.00 |
| > 33 | 0.20 | 1.00 |

# Appendix E: Declaration of Responsible Charge

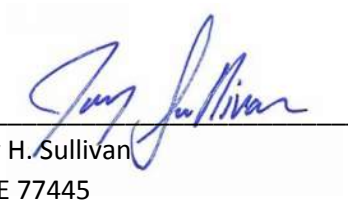
Michael Baker
INTERNATIONAL

Michael Baker
INTERNATIONAL

**Declaration of Responsible Charge**

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of project drawings and specification by County of San Diego is confined to a review only and does not relieve me, as engineer of work, or my responsibilities for project design.



Jay H. Sullivan
RCE 77445
Exp. 6-30-17

8-7-15
Date