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WALKER ENGINEERING, LLC

TECHNICAL DRAINAGE STUDY
for

RETAIL BUILDING
@ NWC OF OLD WOMAN SPRINGS ROAD (SR 18)
& HIGHLAND AVENUE
APN: 0450-292-37
Lucerne Valley, CA
MUP No. P201300122

Prepared for:
DYNAMIC DEVELOPMENT COMPANY, LLC
1725 21st Street
Santa Monica, California 90404
Tel: 310.315.5411
Fax: 310.315.5422

Date Prepared:
April 24, 2013

Meeting Your Land Development Needs

WALKER ENGINEERING, LLC

April 24, 2013
WE Project No. 1253.00

Mr. Anthony Pham
County of San Bernardino
Public Works Land Development
825 E. Third Street
San Bernardino, CA 92415

RE: Technical Drainage Study for the Retail Building at Old Woman Springs Road (Caltrans SR 18) and Highland Avenue in Lucerne Valley, CA
(APN: 0450-292-37)

Dear Mr. Pham:

Attached are two (2) copies of the Technical Drainage Study for the "Retail Building at Old Woman Springs Road & Highland Avenue" for your review. The site will be developed as a retail project located on the northwest corner of Old Woman Springs Road & Highland Avenue in Lucerne Valley, CA.

Please feel free to contact me if you have any questions or need any additional information. Thank you.

Sincerely,
WALKER ENGINEERING, LLC

Debra M. Yamachika, P.E., LEED AP
Project Manager

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INTRODUCTION

This report is a Technical Drainage Study for the ***Retail Building at Old Woman Springs Road (State Route 18) and Highland Avenue,*** a proposed commercial retail project located at the northwest corner (NWC) of Old Woman Springs Road and Highland Avenue in Lucerne Valley, California. Project improvements consist of an approximately 9,026 S.F. building, parking area, onsite drainage conveyance systems, and roadway and driveway improvements for Old Woman Springs Road and an un-named future road, hereafter referred to as the "New Paved Road", located to the west of the site. Old Woman Springs Road is a California Department of Transportation (Caltrans) right of way and therefore an encroachment permit from Caltrans will be required.

The purpose of this study is to present the hydrologic and hydraulic findings for the project site based on the drainage criteria set forth by San Bernardino County and Caltrans. Pre- and post-development site conditions will be analyzed to indicate that the propose development does not adversely impact downstream development and to provide recommendations for flood protection of onsite structures. Per conversation with San Bernardino County Land Development staff, due to the project size and location, **detention/retention for 100 year storm is not required.**

PROJECT DESCRIPTION

The 1.27-acre project site is located on Assessor's Map Book No. 0450, Page 292, and Parcel No. 37 in Lucerne Valley, California. Old Woman Springs Road, an existing paved road, borders the project to the south, an existing dirt road to the west, an existing residential home to the north, and a vacant parcel borders the project to the east.

Proposed improvements in Old Woman Springs Road include completing the half street improvements, including new curb, gutter, sidewalk, and construction of one driveway. For the existing road alignment to the west of the site, half street improvements and a proposed driveway will be constructed.

The *Vicinity Map and Site Description* are included in **Appendix A**. The project site is undeveloped with vegetation growth over the majority of the site. The historical drainage pattern is from south to north across the project site according United States Geologic Service (USGS) topography and our topographical survey performed for the project site. A copy of the USGS map is included in **Appendix A**.

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LAND USE CONDITIONS

The project is currently in the planning process for a Minor Use Permit (No. P201300122).

FLOOD HAZARD DESIGNATION

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) indicates Special Flood Hazard Areas (SFHAs). The project site is located on Community Panel No. **06071C6575H** dated August 28, 2008; however according to FEMA, this map is not printed. Documentation from the FEMA website is included in **Appendix D**; according to FEMA the project is located within **Zone D**, which is not a FEMA designated SFHA.

METHODOLOGY/DESIGN CRITERIA

The hydrologic and hydraulic calculations provided in this report are prepared in accordance with the San Bernardino County Hydrology Manual (SBC Manual), and the Caltrans Highway Design Manual.

Hydrologic Protection Levels

Per the SBC Manual, the 100-year storm event shall be analyzed to determine the required flood protection for all habitable structures and other non-floodproof structures; drainage plans shall demonstrate that this 100-year flood protection criterion is met. Old Woman Springs Road is a designated state road, therefore, per the Caltrans Highway Design Manual, the 25-year storm event shall be analyzed for roadway drainage.

Soil information is obtained from the SBC Manual. According to Figure C-11, Hydrologic Soils Group Map for Southcentral Area, the soil type for the project site is Type A. A Hydrologic Soils Map for the project site is reproduced from Figure C-11 and is included in **Appendix A**. An antecedent moisture condition (AMC) II is assumed. The 25- and 100-year, 1-hour precipitation depths are obtained from NOAA's Atlas 14. Reference information from NOAA Atlas 14 is included in **Appendix D** of this report.

Per conversation with San Bernardino County Land Development staff, the Rational Method shall be used estimate discharges from areas that are less than 640 acres. The Rational Method is defined by the following:

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Rational Method Equation:

Q=CIA

Where:
- Q= Peak Discharge, cfs
- C= Coefficient of Runoff, representing the ratio of runoff depth to rainfall depth
- I = Rainfall Intensity, inches/hour, equal to the time of concentration
- A= Drainage Basin Area, acres

The runoff coefficient and rainfall intensity are based on the runoff surface type and time of concentration of a drainage basin. The runoff coefficient can be estimated based on site reconnaissance and aerial photos, identifying runoff surface type. The rainfall intensity is assumed to be uniformly distributed over the drainage area at a uniform rate over the duration of the storm. These assumptions are reasonable for drainage areas less than 640 acres.

HYDROLOGY

Offsite Drainage Condition

The offsite tributary area to the project site consists of approximately 36.26 acres, south of and adjacent to the project site. Please refer to drainage basins OF-1 through OF-5 on Figure 1, *Offsite Drainage Map* included in **Appendix A**.

As previously mentioned, the general drainage pattern of the area is sheet flow from south to north towards an existing wash that discharges to Rabbit Springs, which is approximately 330 feet east of the project site. Please refer to the USGS map included in **Appendix A** for the location of Rabbit Springs. Rabbit Springs ultimately drains to Lucerne Lake, a dry lake bed approximately 3 miles northwest of the project site. There appears to be a high point in Old Woman Springs Road just east of Highland Avenue; therefore, it is assumed that runoff east of this location will not impact the project site.

The upstream tributary is conservatively assumed developed for the offsite drainage analysis. The assumed land covers for the offsite basins are summarized in Table 2. Note that currently, it appears that much of the drainage tributary is undeveloped with minimal areas of rural residential development.

The existing drainage pattern is sheet flow toward the north. There is a very small area to the east of the project site, basin OF-1 (0.07 acre), which may drain

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onto the project the project site. Basin OF-2 consists of the northern half of Old Woman Springs Road; this area currently drains north across the project site. Runoff from Basin OF-3 consists of the future road area, west of the project site; this area drains north within the existing dirt road towards the existing wash leading to Rabbit Springs. Basins OF-4 and OF-5 extend approximately 0.5 mile south of Old Woman Springs Road. Runoff generated by these basins discharge to Old Woman Springs Road, but remain on the southern half of the street where it is conveyed west via existing roadside ditches.

Upon development of the project site, runoff generated by basin OF-2 will be conveyed west via proposed curb and gutter to the future road located west of the project site. Runoff is then conveyed north, consistent with the existing drainage pattern. The AES Rational Method results are summarized in Table 1 and the calculations are included in **Appendix B**.

TABLE 1
OFFSITE CONDITION FLOWS

BASIN ID*	BASIN AREA (acres)	NODE	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
OF-1	0.07	101	0.29	0.39
OF-2	0.23	201	0.94	1.29
OF-3	0.24	301	0.77	1.06
OF-4	16.23	401	12.26	19.90
OF-5	19.49	501	14.87	24.10
TOTAL	**36.26**	**N/A**	**29.13**	**46.74**

*See **Appendix A** *Offsite Drainage Map* (Figure 1).

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TABLE 2
LAND COVER ASSUMPTIONS

BASIN ID*	BASIN AREA (acres)	NODE	PROPOSED	NOTES
OF-1	0.07	101	Commercial	Assumed future commercial development
OF-2	0.23	201	Commercial	Paved road
OF-3	0.24	301	Commercial	Paved road
OF-4	16.23	401	1 DPA	Assumed rural residential development
OF-5	19.49	501	1 DPA	Assumed rural residential development

* See **Appendix A** *Offsite Drainage Map* (Figure 1).

Existing Onsite Drainage Condition

As previously mentioned the project site is undeveloped with vegetation growth and natural ground cover. It is assumed that the project site consists of 100 percent natural land cover.

In the existing condition, the project site consists of one drainage basin, EXON1. Please refer to Figure 2, *Existing Condition Onsite Basin Map*, included in **Appendix A**. This basin is delineated based on site specific 1-foot contour topography. Runoff generated by basin EXON1 sheet flows across the site to the north (toward the existing residential development). The AES Rational Method results are summarized in Table 3 and the calculations are included in **Appendix B**.

TABLE 3
EXISTING CONDITION FLOWS

BASIN ID*	BASIN AREA (acres)	NODE	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
EXON1	1.27	101	1.97	2.96
TOTAL	**1.27**	**N/A**	**1.97**	**2.96**

*See **Appendix A** for the *Existing Condition Onsite Basin Map* (Figure 2).

Runoff from offsite basins OF-1 and OF-2 is assumed to combine with onsite flows for a total of **3.2 cfs and 4.7 cfs, during the 25- and 100-year storm events**, respectively, at the site's north property line. Runoff from offsite basin OF-3 will not enter the site and will continue north as described in the *Offsite Drainage Condition*.

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Proposed Onsite Drainage Condition

In the proposed condition, a commercial retail building, parking area, and landscaping will be constructed on the project site. The actual proposed percent impervious/pervious is 65/35 percent versus the 90/10 for commercial development, as identified by the SBC Manual. In the proposed condition, condominium land use is chosen for the onsite basin solely to represent the actual land cover onsite.

The developed project site consists of one drainage basin, PRON1. Please refer to Figure 3, *Proposed Condition Onsite Basin Map*, included in **Appendix A**. The project grading plan, included in **Appendix E**, indicates that existing drainage patterns are generally maintained. Onsite runoff is conveyed away from the building, to the adjacent parking or landscape areas. Runoff is then conveyed to the landscaped area along the north property line where it discharges in a manner similar to the existing drainage pattern. The runoff leaving the site in the proposed condition is **3.3 cfs and 4.6 cfs, during the 25- and 100-year storm events**, as summarized in Table 4. The AES Rational Method calculations are included in **Appendix B**.

TABLE 4
PROPOSED CONDITION FLOWS

BASIN ID*	BASIN AREA (acres)	NODE	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
PRON1	1.27	101	3.28	4.61
TOTAL	**1.27**	**N/A**	**3.28**	**4.61**

*See **Appendix A** for the *Proposed Condition Onsite Basin Map* (Figure 3).

Pro-rated drainage sub-basins, PRON1-A, PRON1-B, PRON1-C, and PRON1-D, are further delineated to quantify runoff generated by smaller areas onsite to describe their respective drainage patterns. Table 5 indicates the prorated flow results, the calculations are provided in **Appendix B**.

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TABLE 5
PRORATED FLOW RATES

SUBBASIN ID*	BASIN AREA (acres)	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
PRON1-A	0.32	0.83	1.16
PRON1-B	0.54	1.39	1.96
PRON1-C	0.20	0.52	0.73
PRON1-D	0.21	0.54	0.76
TOTAL	**1.27**	**3.28**	**4.61**

* See **Appendix A** for the *Proposed Condition Onsite Basin Map* (Figure 3).

Majority of Basin PRON1-A consists of the proposed building and the adjacent landscape west of the building. Runoff from the building roof discharges to a vegetated swale within the aforementioned landscape and is conveyed to a drop inlet located further downstream. Runoff entering the inlet is conveyed under the project driveway to the landscape area along the north property line via storm drain pipe. Runoff from the storm drain outlet is then conveyed east within another swale to the proposed runoff discharge point near the northeast corner of the site in the historical location.

Basin PRON1-B, located on the east side of the site consists of parking area. Runoff from this area is conveyed within L-curb along the east property line to the landscaped area along the north property via a curb opening. Runoff entering the landscaped area is conveyed within a swale that meanders through the landscape area until reaching the runoff historical discharge point near the northeast corner of the site in the historical location.

Basin PRON1-C, located at the southwest corner of the site, consists of parking area and proposed landscape. Runoff from the parking area will drain west towards a curb opening that discharges into a 6" storm drain. This runoff will combine with runoff from Basin PRON1-A, then follow the same drainage path to the discharge point at the northeast corner of the site.

Basin PRON1-D consists of primarily of landscape and is located on the north side of the site. Runoff from Basins PRON1-A, PRON1-B, PRON1-C, and PRON1-D combine within the vegetated swale located in the landscape area prior to leaving the site.

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The proposed onsite swales will be vegetated for the purpose of meeting water quality requirements. The swale along the north property line is intentionally meandered to provide adequate contact time for water quality storm runoff.

Runoff from offsite basins OF-1 will not enter the site in the proposed condition as the project grading indicates that the site development is above existing grade at the southeast corner of the site, where OF-1 is located. Instead, runoff from OF-1 will continue to drain north to the existing wash that discharges to Rabbit Springs. Similarly, runoff from OF-2 will also not enter the site in the proposed condition; this runoff is conveyed west to the "New Paved Road" on the west side of the site; then conveyed north to the existing wash that discharges to Rabbit Springs.

HYDRAULIC CALCULATIONS

Hydraulic calculations are provided for the various drainage conveyance systems both offsite and onsite, which include Old Woman Springs Road, the partially improved "New Paved Road" located west of the site, the swales located on the west side of the building and within the landscaped area along the north property line. These calculations validate the onsite design with regard to protection from offsite and onsite storm flows.

The 25-year storm flow depth and velocity is analyzed for conveyance of flows to and within adjacent streets, however the 100-year storm flow depth is also checked for flood protection for the proposed building from offsite flows. The 100-year storm flow depth and velocity is analyzed for conveyance of onsite flows for flood protection for the proposed building. The flow rates used were presented in the previous **Hydrology Section** of this report. The resulting street flow depths and velocities are summarized in Table 6; the calculations are provided in **Appendix C**.

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TABLE 6
HYDRAULIC CALCULATIONS

SECTION*	Q25 (cfs)	Flow Depth (ft)	V25 (fps)	V*D	Q100 (cfs)	Flow Depth (ft)	V100 (fps)	V*D
PS-1 (Existing Old Woman Springs Road south half)	27.13	0.70	1.52	1.06	44	0.84	1.72	1.44
PS-2 (Old Woman Springs Road north half)	0.94	0.28	1.36	0.38	1.29	0.31	1.46	0.45
PS-3 ("New Paved Road")	1.71	0.28	2.23	0.62	2.35	0.29	2.40	0.70
PS-4 (Vegetated Swale west of building)	N/A	N/A	N/A	N/A	1.89	0.9	0.45	N/A
PS-5 (Landscape swale north of building)	N/A	N/A	N/A	N/A	1.96	0.54	2.22	N/A
PS-6 (Vegetated Swale along north PL)	N/A	N/A	N/A	N/A	4.61	1.30	0.51	N/A
PS-7 (U-Gutter along east PL)	N/A	N/A	N/A	N/A	1.96	0.25	3.91	N/A

*See **Appendix A** for *Proposed Condition Onsite Basin Map* (Figure 3).

Currently, the depth of flow in the south half of Old Woman Springs Road is approximately 0.70 feet and 0.85 feet during the 25- and 100-year storm events, respectively (See Section PS-1 on Figure 3). The associated runoff for the south half of Old Woman Springs Road is approximately 27/44 cfs (Basin OF-4 and OF-5) during the 25- and 100-year storm events, respectively, and is **contained**

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within the south half street. Runoff south of Old Woman Springs Road will not adversely affect the project site.

The 25-year storm depth of flow in the north half of Old Woman Springs Road is 0.28 feet (See Section PS-2 on Figure 3). The associated runoff for the north half of Old Woman Springs Road is approximately 0.9 cfs and is below the top of curb. The 25-year storm depth of flow, approximately 0.28 feet (See Section PS-3 on Figure 3), in the "New Paved Road" is also below the top of curb and the associated runoff is approximately 1.7 cfs (Basins OF-2 and OF-3). An 8-inch asphalt dike, located just west of the street crown is proposed in the "New Paved Road", which ensures that runoff with the street remains in the east half of the road. The project driveways and finished floor are adequately set above the depth of flow in Old Woman Springs Road and the "New Paved Road".

As previously mentioned, vegetated swales are proposed onsite to convey flows as well as provide water quality treatment. The vegetated swale located west of the building is 2-feet wide, 1-foot deep with 3:1 horizontal to vertical (H:V) side slopes; the 100-year storm flow (approximately 0.90 feet deep) is contained within the swale (See Section PS-4 on Figure 3). A 2-foot by 2-foot drop inlet will intercept the 100-year storm runoff (approximately 2 cfs) that is conveyed in the vegetated swale and discharge it to the meandering swale near the north property line via a 12-inch storm drain pipe. The ponding depth over the inlet is approximately 0.3 feet. The proposed building elevation is 2937.10', which is over 1 foot higher than the highest water surface elevation in the swale; therefore is adequately protected from storm flows at this location. Also note that there is a 6-inch storm drain pipe that conveys runoff into this vegetated swale. Please refer to the drop inlet and storm drain calculations included in **Appendix C**.

The meandering swale within the landscaped area along the north property line is vegetated downstream of the 12 inch storm drain outlet. An additional landscape swale located upstream of the vegetated swale consists of a v-ditch with 3:1 H:V side slopes. The 100-year storm flow (approximately 0.51 feet deep) is contained in the landscape swale (See Section PS-5 on Figure 3). The vegetated (downstream) swale is 3-feet wide, 1-foot deep with 3:1 H:V side slopes. The 100-year storm flow (approximately 1.30 feet deep) is contained within the swale (See Section PS-6 on Figure 3). Runoff with this swale discharges to a riprap pad at existing grade prior to leaving the project site to allow further reduction in flow velocity and the spreading out of flows to existing drainage patterns. Please note that the velocity within the swale (0.52 feet per second) is not erosive. A riprap size of d50=3 inches and pad thickness of 6 inches is recommended although the calculated size is smaller. Please refer to

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the riprap calculation provided in **Appendix C**. The project site does not adversely impact the existing downstream residential development.

A calculation for the proposed u-gutter along the east property line is also provided to indicate that onsite runoff is conveyed adequately behind the trash enclosure. The 100-year storm flow (approximately 0.25 feet deep) is contained in the proposed gutter (See Section PS-7 on Figure 3).

The project site is located adjacent (north) of the Caltrans right of way, Old Woman Springs Road; **runoff generated by the site does not increase the existing flow to the Caltrans right of way**.

CONCLUSIONS AND RECOMMENDATIONS

1. This project is in compliance with the San Bernardino County Hydrology Manual and the Caltrans Highway Design Manual.

2. This project is within FEMA Zone "**D**", which is not a FEMA designated SFHA.

3. Vegetated swales are proposed onsite for the purpose of meeting water quality requirements and ensuring no adverse impact to downstream improvements and development.

4. Peak runoff rates generated by the project site are 3.42 cfs and 4.80 cfs during the 25-, and 100-year storm events, respectively.

5. The finished floor elevation for the proposed building, 2937.10 feet is adequately protected from onsite and offsite storm runoff.

6. Runoff is adequately conveyed in the adjacent street and is consistent with the existing drainage pattern. Erosion protection is provided for the adjacent landscape in Bradford Road along the with an asphalt dike.

REFERENCES

1. San Bernardino County Hydrology Manual, August 1986.

2. Caltrans Highway Design Manual, Chapter 810, dated August 2011.

3. Caltrans Highway Design Manual, Chapter 830, dated May 2012.

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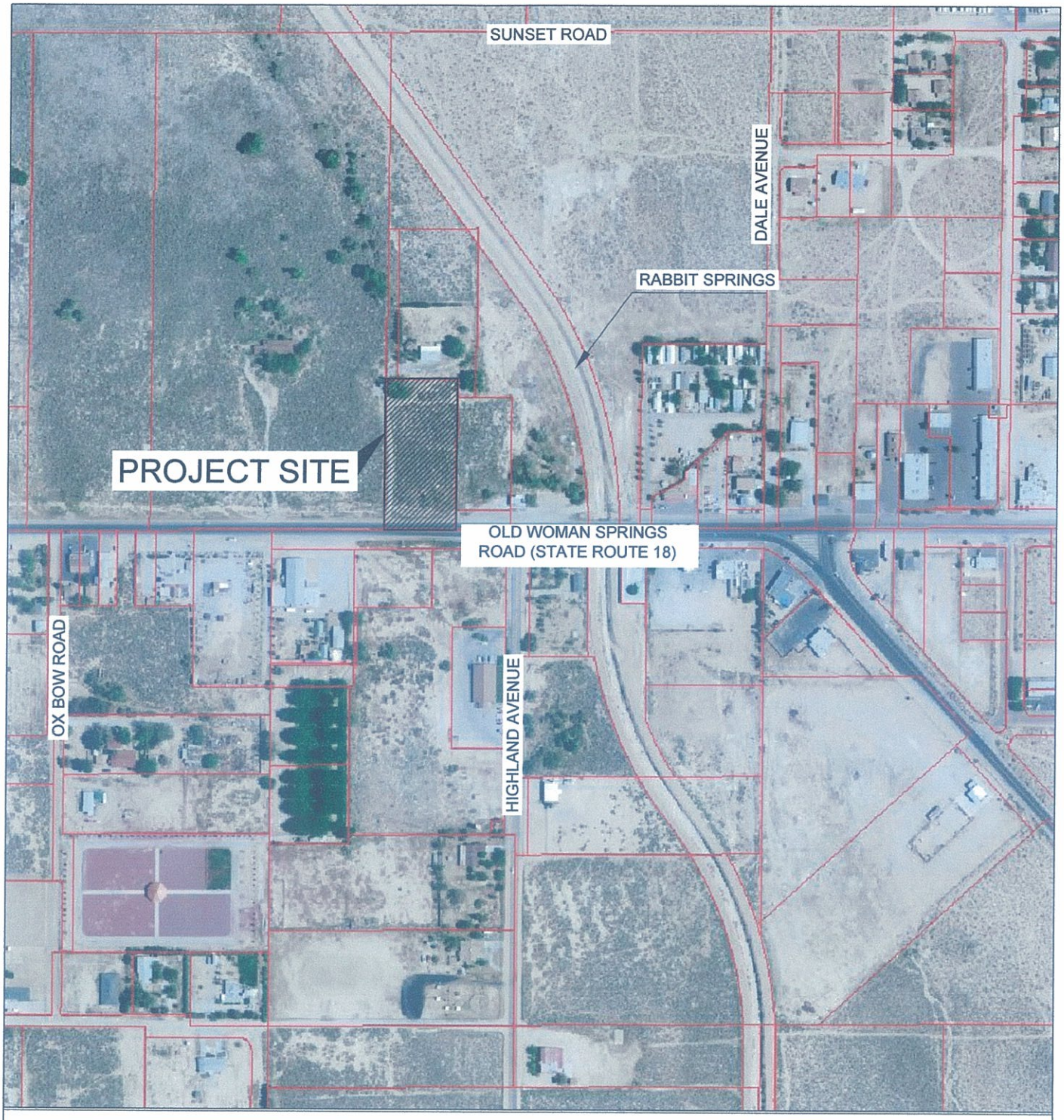
LIST OF APPENDICES

APPENDIX A – FIGURES

- VICINITY MAP
- SITE DESCRIPTION
- USGS MAP
- HYDROLOGIC SOILS MAP
- FIGURE 1 – OFFSITE DRAINAGE BASIN MAP
- FIGURE 2 – EXISTING CONDITION ONSITE DRAINAGE MAP
- FIGURE 3 – PROPOSED CONDITION ONSITE DRAINAGE MAP



NORTH

NTS

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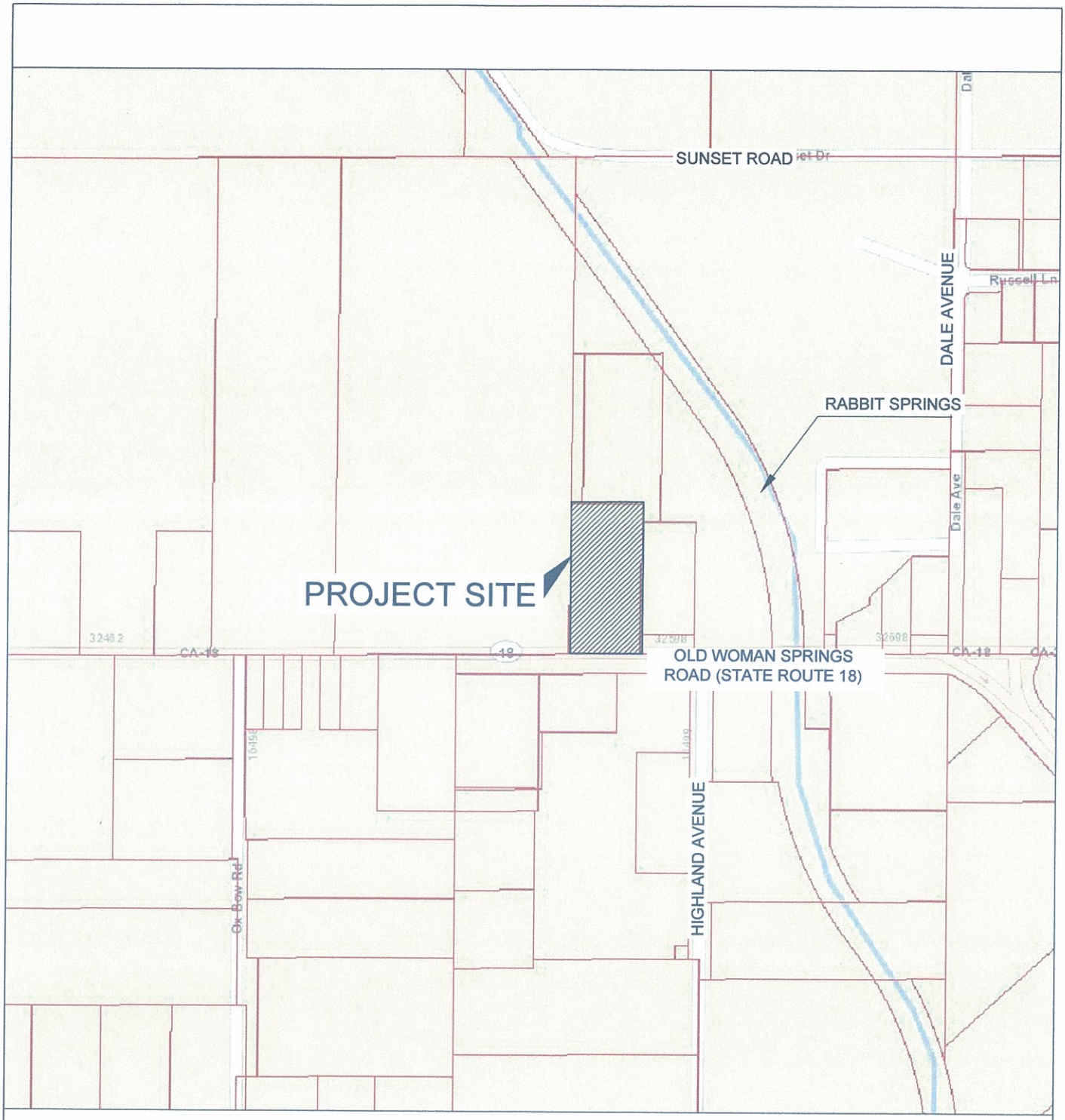
SITE DESCRIPTION

APRIL 24, 2013



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VICINITY MAP

APRIL 24, 2013

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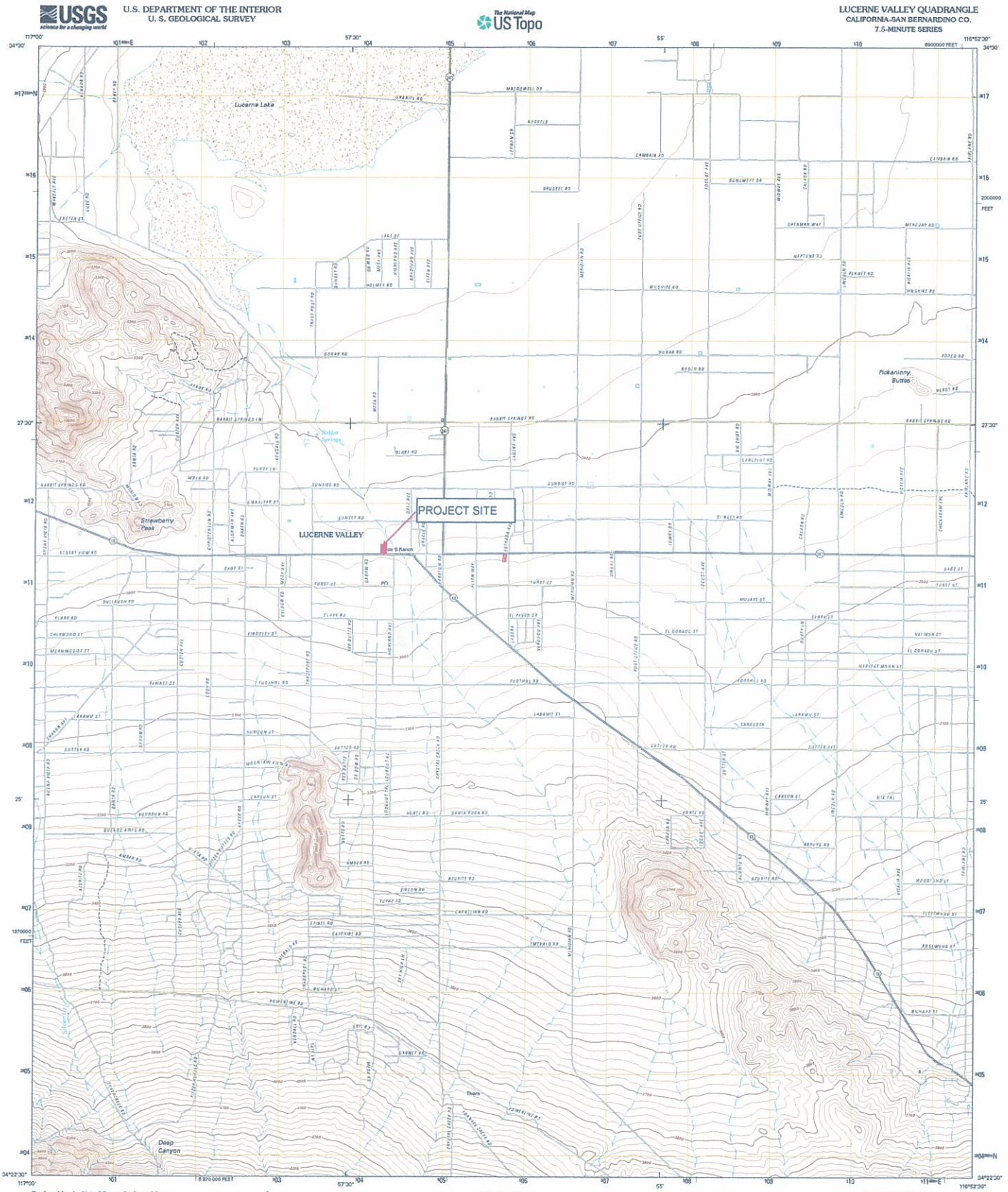


U.S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

USGS science for a changing world

The National Map US Topo

LUCERNE VALLEY QUADRANGLE
CALIFORNIA-SAN BERNARDINO CO.
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 11S
10 000-foot ticks: California Coordinate System of 1983
(zone 5)

Imagery.....NAIP, April 2010
Roads.....©2006-2011 TomTom
Names.....GNIS, 2011
Hydrography.....National Hydrography Dataset, 2010
Contours.....National Elevation Dataset, 2006
Boundaries.....Census, BSWC, IBC, USGS, 1972 - 2010

UTM GRID AND 2012 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
NU
Grid Zone Designation
11S

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.1

CALIFORNIA
QUADRANGLE LOCATION

Rainbow Valley	White Horse Mountain	Grand View Mine
Pilsenseville Valley	Lucerne Valley	Coogle Buttes
Butler Peak	Fernclen	Big Bear City

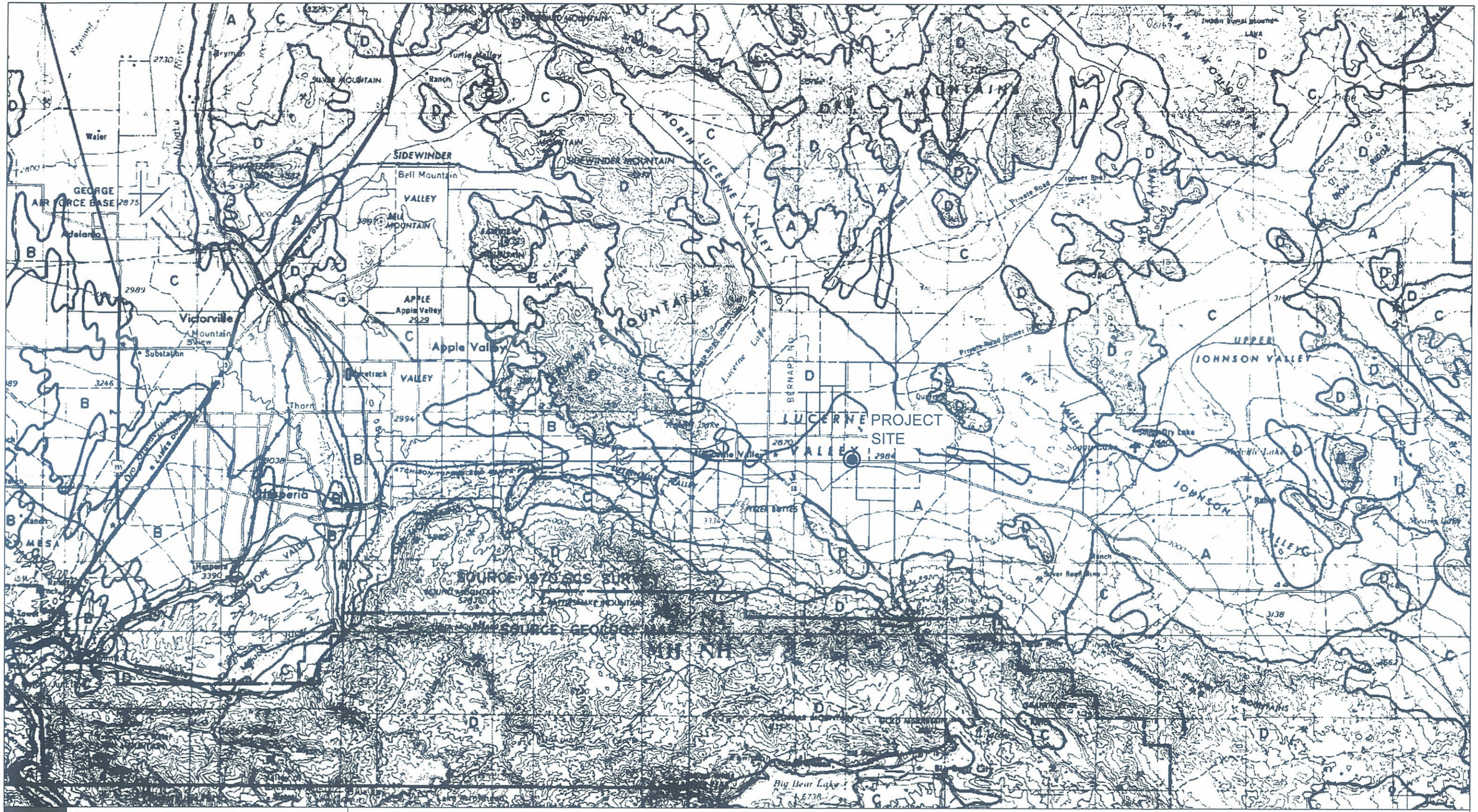
ADJOINING 7.5' QUADRANGLES

ROAD CLASSIFICATION

Interstate Route	State Route
US Route	Local Road
Ramp	4WD

Interstate Route · US Route · State Route

LUCERNE VALLEY, CA
2012



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4/25/13

HYDROLOGIC SOILS MAP

FIGURE C-11 HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA
OF THE SAN BERNARDINO COUNTY HYDROLOGY MANUAL

APPENDIX B

APPENDIX B – HYDROLOGIC CALCULATIONS (RATIONAL METHOD)

- OFFSITE CONDITION ANALYSIS – 25 AND 100- YEAR STORMS
    - OF25YR
    - OF100YR
- EXISTING CONDITION ANALYSIS – 25 AND 100- YEAR STORMS
    - EX25YR
    - EX100YR
- PROPOSED CONDITION ANALYSIS – 25 AND 100- YEAR STORMS
    - PR25YR
    - PR100YR
- PRORATED FLOWS FOR PRON1

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**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                        Analysis prepared by:

                      Walker Engineering, LLC
                  5765 South Rainbow Boulevard Suite 101
                        Las Vegas, NV 89118
                    Meeting Your Development Needs


 ************************* DESCRIPTION OF STUDY *************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                     *
* LUCERNE VALLEY, CA          WE No. 1253.00                             *
* OFFSITE 25 YEAR ANALYSIS                                               *
 ************************************************************************

  FILE NAME: OF25YR.DAT
  TIME/DATE OF STUDY: 12:24 04/19/2013
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.8140

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   157.00
  ELEVATION DATA: UPSTREAM(FEET) =     38.30  DOWNSTREAM(FEET) =     35.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
```

```
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.635
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.07      0.98      0.100    32    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.29
 TOTAL AREA(ACRES) =      0.07   PEAK FLOW RATE(CFS) =      0.29

****************************************************************************
 FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    51.36
 ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     36.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.635
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.23      0.98      0.100    32    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.94
 TOTAL AREA(ACRES) =      0.23   PEAK FLOW RATE(CFS) =      0.94

****************************************************************************
 FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   348.00
 ELEVATION DATA: UPSTREAM(FEET) =     35.90  DOWNSTREAM(FEET) =     29.50

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.024
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.654
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.24      0.98      0.100    32    7.02
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.77
 TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.77

****************************************************************************
 FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  2710.00
 ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     38.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   26.586
```

```
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  1.439
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL(ARID)
 "1 DWELLING/ACRE"           A       16.23      0.75      0.800  32/62  26.59
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
 SUBAREA RUNOFF(CFS) =     12.26
 TOTAL AREA(ACRES) =     16.23   PEAK FLOW RATE(CFS) =     12.26

****************************************************************************
 FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  2814.00
 ELEVATION DATA: UPSTREAM(FEET) =     78.00  DOWNSTREAM(FEET) =     38.30

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   26.364
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  1.448
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL(ARID)
 "1 DWELLING/ACRE"           A       19.49      0.75      0.800  32/62  26.36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
 SUBAREA RUNOFF(CFS) =     14.87
 TOTAL AREA(ACRES) =     19.49   PEAK FLOW RATE(CFS) =     14.87
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       19.5  TC(MIN.) =     26.36
 EFFECTIVE AREA(ACRES) =     19.49  AREA-AVERAGED Fm(INCH/HR)=  0.60
 AREA-AVERAGED Fp(INCH/HR) =  0.75  AREA-AVERAGED Ap = 0.800
 PEAK FLOW RATE(CFS)   =      14.87
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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         Ver. 19.0  Release Date: 06/01/2012  License ID 1645

                        Analysis prepared by:

                        Walker Engineering, LLC
                    5765 South Rainbow Boulevard Suite 101
                           Las Vegas, NV 89118
                      Meeting Your Development Needs


 ************************* DESCRIPTION OF STUDY *************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                     *
* LUCERNE VALLEY, CA          WE No. 1253.00                             *
* OFFSITE 100 YEAR ANALYSIS                                              *
 ************************************************************************

  FILE NAME: OF100YR.DAT
  TIME/DATE OF STUDY: 12:26 04/19/2013
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.1100

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   157.00
  ELEVATION DATA: UPSTREAM(FEET) =     38.30  DOWNSTREAM(FEET) =     35.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
```

```
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.320
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.07      0.98      0.100    32    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.39
 TOTAL AREA(ACRES) =      0.07   PEAK FLOW RATE(CFS) =      0.39

****************************************************************************
 FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    51.36
 ELEVATION DATA: UPSTREAM(FEET) =     38.00  DOWNSTREAM(FEET) =     36.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.320
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.23      0.98      0.100    32    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.29
 TOTAL AREA(ACRES) =      0.23   PEAK FLOW RATE(CFS) =      1.29

****************************************************************************
 FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   348.00
 ELEVATION DATA: UPSTREAM(FEET) =     35.90  DOWNSTREAM(FEET) =     29.50

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.024
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.982
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 A        0.24      0.98      0.100    32    7.02
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.06
 TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      1.06

****************************************************************************
 FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  2710.00
 ELEVATION DATA: UPSTREAM(FEET) =     72.00  DOWNSTREAM(FEET) =     38.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   26.586
```

```
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.962
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL(ARID)
 "1 DWELLING/ACRE"           A       16.23      0.75      0.800  32/62  26.59
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
 SUBAREA RUNOFF(CFS) =     19.90
 TOTAL AREA(ACRES) =     16.23   PEAK FLOW RATE(CFS) =     19.90

****************************************************************************
 FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =  2814.00
 ELEVATION DATA: UPSTREAM(FEET) =     78.00  DOWNSTREAM(FEET) =     38.30

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   26.364
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.974
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL(ARID)
 "1 DWELLING/ACRE"           A       19.49      0.75      0.800  32/62  26.36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
 SUBAREA RUNOFF(CFS) =     24.10
 TOTAL AREA(ACRES) =     19.49   PEAK FLOW RATE(CFS) =     24.10
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       19.5  TC(MIN.) =     26.36
 EFFECTIVE AREA(ACRES) =     19.49  AREA-AVERAGED Fm(INCH/HR)=  0.60
 AREA-AVERAGED Fp(INCH/HR) =  0.75  AREA-AVERAGED Ap = 0.800
 PEAK FLOW RATE(CFS)   =      24.10
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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          Ver. 19.0  Release Date: 06/01/2012  License ID 1645

                          Analysis prepared by:

                          Walker Engineering, LLC
                      5765 South Rainbow Boulevard Suite 101
                              Las Vegas, NV 89118
                          Meeting Your Development Needs


 ************************* DESCRIPTION OF STUDY *************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                     *
* LUCERNE VALLEY, CA         WE No. 1253.00                              *
* EXISTING UNDEVELOPED 25 YEAR ANALYSIS                                  *
 ************************************************************************

  FILE NAME: EX25YR.DAT
  TIME/DATE OF STUDY: 09:55 04/02/2013
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.8140

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   350.08
  ELEVATION DATA: UPSTREAM(FEET) =     36.00  DOWNSTREAM(FEET) =     31.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.842
```

```
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.395
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "OPEN BRUSH"                A        1.27      0.67      1.000     62   12.84
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.67
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      1.97
 TOTAL AREA(ACRES) =      1.27   PEAK FLOW RATE(CFS) =      1.97
================================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        1.3  TC(MIN.) =     12.84
 EFFECTIVE AREA(ACRES) =      1.27  AREA-AVERAGED Fm(INCH/HR)=  0.67
 AREA-AVERAGED Fp(INCH/HR) =  0.67  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)    =       1.97
================================================================================
================================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
       (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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         Ver. 19.0  Release Date: 06/01/2012  License ID 1645

                        Analysis prepared by:

                          Walker Engineering, LLC
                    5765 South Rainbow Boulevard Suite 101
                             Las Vegas, NV 89118
                        Meeting Your Development Needs


 ************************* DESCRIPTION OF STUDY *************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                     *
* LUCERNE VALLEY, CA          WE No. 1253.00                             *
* EXISTING UNDEVELOPED 100 YEAR ANALYSIS                                 *
 ************************************************************************

  FILE NAME: EX100YR.DAT
  TIME/DATE OF STUDY: 09:28 04/02/2013
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.1100

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   350.08
  ELEVATION DATA: UPSTREAM(FEET) =     36.00  DOWNSTREAM(FEET) =     31.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.842
```

```
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.266
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "OPEN BRUSH"                 A        1.27      0.67      1.000    62   12.84
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.67
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      2.96
 TOTAL AREA(ACRES) =      1.27   PEAK FLOW RATE(CFS) =      2.96
================================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        1.3  TC(MIN.) =     12.84
 EFFECTIVE AREA(ACRES) =      1.27  AREA-AVERAGED Fm(INCH/HR)=  0.67
 AREA-AVERAGED Fp(INCH/HR) =  0.67  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)    =       2.96
================================================================================
================================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
       (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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         Ver. 19.0  Release Date: 06/01/2012  License ID 1645

                        Analysis prepared by:

                          Walker Engineering, LLC
                      5765 South Rainbow Boulevard Suite 101
                              Las Vegas, NV 89118
                          Meeting Your Development Needs


 ************************** DESCRIPTION OF STUDY **************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                      *
* LUCERNE VALLEY, CA         WE No. 1253.00                               *
* PROPOSED DEVELOPED 25 YEAR ANALYSIS                                     *
 **************************************************************************

  FILE NAME: PR25YR.DAT
  TIME/DATE OF STUDY: 13:26 04/19/2013
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.8140

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   373.79
  ELEVATION DATA: UPSTREAM(FEET) =     38.54  DOWNSTREAM(FEET) =     31.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.448
```

```
*  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.211
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
CONDOMINIUMS              A        1.27      0.98      0.350    32    8.45
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
SUBAREA RUNOFF(CFS) =      3.28
TOTAL AREA(ACRES) =      1.27   PEAK FLOW RATE(CFS) =      3.28
================================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)      =        1.3  TC(MIN.) =      8.45
EFFECTIVE AREA(ACRES) =      1.27  AREA-AVERAGED Fm(INCH/HR)=  0.34
AREA-AVERAGED Fp(INCH/HR) =  0.97  AREA-AVERAGED Ap = 0.350
PEAK FLOW RATE(CFS)    =      3.28
================================================================================
================================================================================
END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
       (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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         Ver. 19.0  Release Date: 06/01/2012  License ID 1645

                        Analysis prepared by:

                          Walker Engineering, LLC
                      5765 South Rainbow Boulevard Suite 101
                              Las Vegas, NV 89118
                          Meeting Your Development Needs


 ************************* DESCRIPTION OF STUDY *************************
* RETAIL BUILDING AT OLD WOMAN SPRINGS ROAD (HWY 18)                     *
* LUCERNE VALLEY, CA WE No. 1253.00                                      *
* PROPOSED DEVELOPED 100 YEAR ANALYSIS                                   *
 ************************************************************************

  FILE NAME: PR100YR.DAT
  TIME/DATE OF STUDY: 13:12 04/19/2013
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.1100

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *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.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   373.79
  ELEVATION DATA: UPSTREAM(FEET) =     38.54  DOWNSTREAM(FEET) =     31.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.448
```

```
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.378
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 CONDOMINIUMS              A        1.27      0.98      0.350    32    8.45
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA RUNOFF(CFS) =      4.61
 TOTAL AREA(ACRES) =      1.27   PEAK FLOW RATE(CFS) =      4.61
================================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        1.3  TC(MIN.) =      8.45
 EFFECTIVE AREA(ACRES) =      1.27  AREA-AVERAGED Fm(INCH/HR)=  0.34
 AREA-AVERAGED Fp(INCH/HR) =  0.97  AREA-AVERAGED Ap = 0.350
 PEAK FLOW RATE(CFS)    =       4.61
================================================================================
================================================================================
 END OF RATIONAL METHOD ANALYSIS
```

PRORATED FLOW CALCULATIONS

25 YEAR STORM

BASIN ID*	ACRES	Q25	CFS/AC	NOTES
PRON1	1.27	3.28	2.58	
PRON1-A	0.32	0.83		Drains to veg. swale along west of building
PRON1-B	0.54	1.39		Drains to l/s swale north of building
PRON1-C	0.20	0.52		Drains to 6" pipe
PRON1-D	0.21	0.54		Drains to veg. swale along north prop. Line
TOTAL	**1.27**	**3.28**		

100YEAR STORM

BASIN ID*	ACRES	Q100	CFS/AC	NOTES
PRON1	1.27	4.61	3.63	
PRON1-A	0.32	1.16		Drains to veg. swale along west of building
PRON1-B	0.54	1.96		Drains to l/s swale north of building
PRON1-C	0.20	0.73		Drains to 6" pipe
PRON1-D	0.21	0.76		Drains to veg. swale along north prop. Line
TOTAL	**1.27**	**4.61**		

*SEE PROPOSED CONDITION DRAINAGE MAP (FIGURE 3)

APPENDIX C- HYDRAULICS

- SECTION PS-1 (OLD WOMAN SPRINGS ROAD EX. SOUTH HALF) – Q25, Q100
- SECTION PS-2 (OLD WOMAN SPRINGS ROAD FUTURE NORTH HALF) – Q25, Q100
- SECTION PS-3 ("NEW PAVED ROAD" HALF STREET) – Q25, Q100
- SECTION PS-4 (VEG SWALE ALONG WEST SIDE OF BUILDING) – Q100
- SECTION PS-5 (LANDSCAPED SWALE NORTH SIDE) – Q100
- SECTION PS-6 (VEG SWALE ALONG NORTH PROPERTY LINE) – Q100
- SECTION PS-7 (U-GUTTER PRON1-B) - Q100
- 6-INCH OUTLET PIPE CALCULATION (AT VEG SWALE ALONG WEST SIDE OF BUILDING) – Q100
- 12-INCH OUTLET PIPE (AT CATCH BASIN) – Q100
- GRATE INLET CALCULATIONS – Q100
- 12-INCH INLET PIPE FOR CATCH BASIN CALCULATION – Q100
- RIP RAP CALCULATIONS (VEG SWALE ALONG NORTH PROPERTY LINE) – Q100

Cross Section for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q25

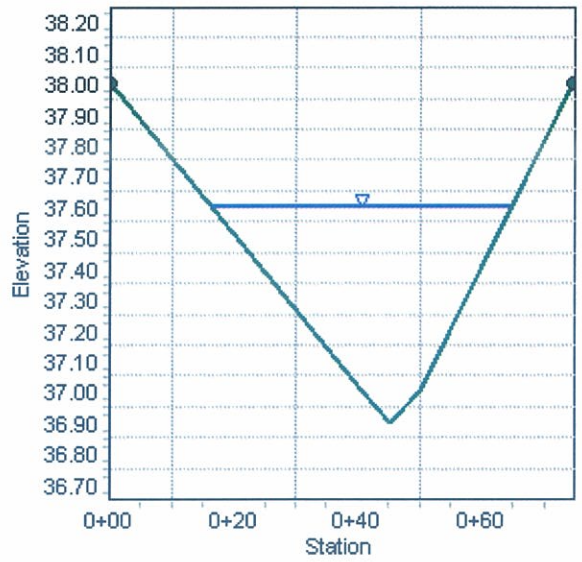
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00250	ft/ft
Normal Depth	0.70	ft
Discharge	27.13	ft³/s

Cross Section Image



Worksheet for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00250	ft/ft
Discharge	27.13	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	38.00
0+40.50	37.00
0+45.20	36.90
0+49.90	37.00
0+74.70	38.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 38.00)	(0+74.70, 38.00)	0.025

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	0.70	ft
Elevation Range	36.90 to 38.00 ft	
Flow Area	17.81	ft²
Wetted Perimeter	48.53	ft
Hydraulic Radius	0.37	ft
Top Width	48.51	ft
Normal Depth	0.70	ft
Critical Depth	0.50	ft

Worksheet for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q25

Results

Critical Slope		0.01421	ft/ft
Velocity		1.52	ft/s
Velocity Head		0.04	ft
Specific Energy		0.73	ft
Froude Number		0.44	
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	0.70	ft
Critical Depth	0.50	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.01421	ft/ft

Cross Section for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q100

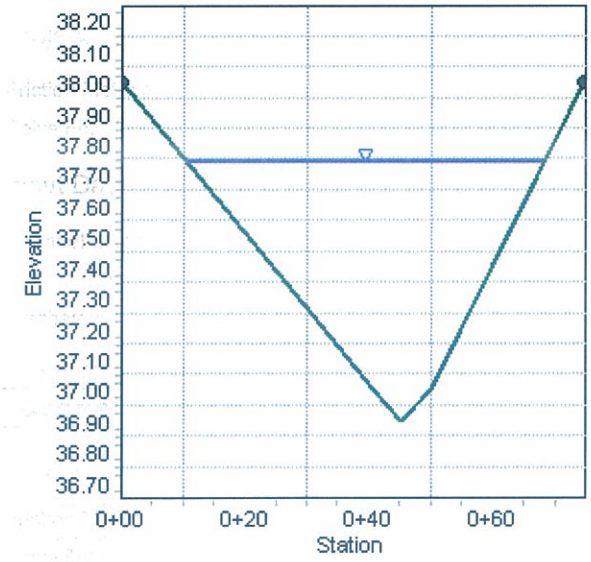
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00250	ft/ft
Normal Depth	0.84	ft
Discharge	44.00	ft³/s

Cross Section Image



Worksheet for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00250	ft/ft
Discharge	44.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	38.00
0+40.50	37.00
0+45.20	36.90
0+49.90	37.00
0+74.70	38.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 38.00)	(0+74.70, 38.00)	0.025

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	0.84	ft
Elevation Range	36.90 to 38.00 ft	
Flow Area	25.57	ft²
Wetted Perimeter	58.05	ft
Hydraulic Radius	0.44	ft
Top Width	58.02	ft
Normal Depth	0.84	ft
Critical Depth	0.61	ft

Worksheet for PS-1 EX S. 1/2 STREET OLD WOMAN SPRINGS- Q100

Results

Critical Slope		0.01330	ft/ft
Velocity		1.72	ft/s
Velocity Head		0.05	ft
Specific Energy		0.89	ft
Froude Number		0.46	
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	0.84	ft
Critical Depth	0.61	ft
Channel Slope	0.00250	ft/ft
Critical Slope	0.01330	ft/ft

Cross Section for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q25

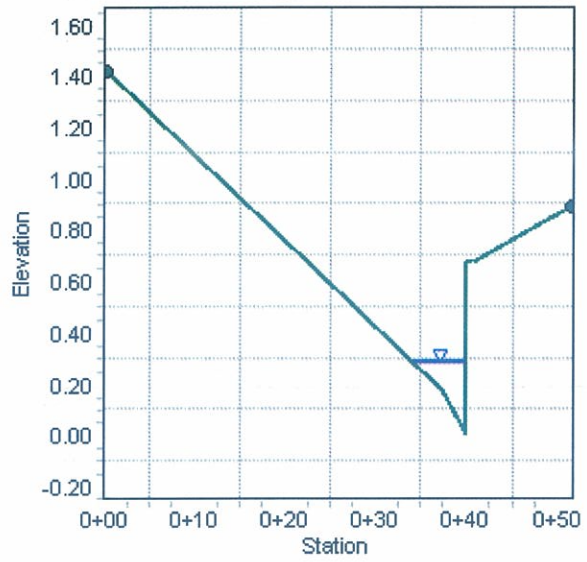
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Normal Depth	0.28	ft
Discharge	0.94	ft^3/s

Cross Section Image



Worksheet for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Discharge	0.94	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.42
0+37.33	0.17
0+40.00	0.00
0+40.00	0.67
0+40.50	0.67
0+47.50	0.81
0+51.50	0.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.42)	(0+51.50, 0.89)	0.016

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	0.28	ft
Elevation Range	0.00 to 1.42 ft	
Flow Area	0.69	ft²
Wetted Perimeter	6.18	ft
Hydraulic Radius	0.11	ft
Top Width	5.90	ft

Worksheet for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q25

Results

Normal Depth		0.28	ft
Critical Depth		0.25	ft
Critical Slope		0.00847	ft/ft
Velocity		1.36	ft/s
Velocity Head		0.03	ft
Specific Energy		0.31	ft
Froude Number		0.70	
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	0.28	ft
Critical Depth	0.25	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00847	ft/ft

Cross Section for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q100

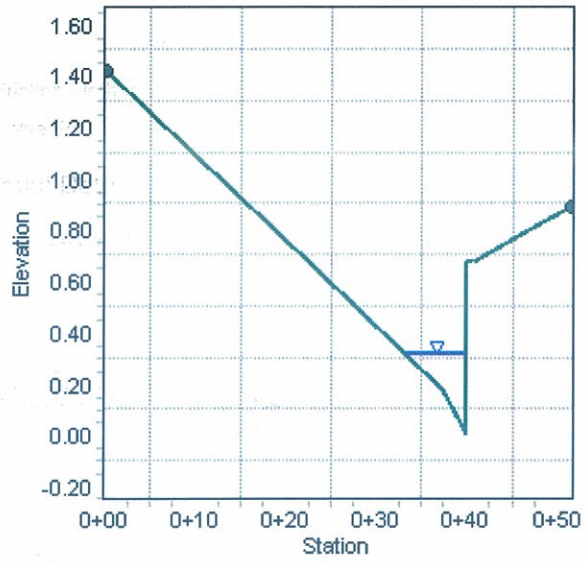
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Normal Depth	0.31	ft
Discharge	1.29	ft³/s

Cross Section Image



Worksheet for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00400	ft/ft
Discharge	1.29	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.42
0+37.33	0.17
0+40.00	0.00
0+40.00	0.67
0+40.50	0.67
0+47.50	0.81
0+51.50	0.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.42)	(0+51.50, 0.89)	0.016

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	0.31	ft
Elevation Range	0.00 to 1.42 ft	
Flow Area	0.88	ft²
Wetted Perimeter	7.12	ft
Hydraulic Radius	0.12	ft
Top Width	6.81	ft

Worksheet for PS-2 PR N. 1/2 STREET OLD WOMAN SPRINGS - Q100

Results

Normal Depth		0.31	ft
Critical Depth		0.27	ft
Critical Slope		0.00816	ft/ft
Velocity		1.46	ft/s
Velocity Head		0.03	ft
Specific Energy		0.34	ft
Froude Number		0.72	
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	0.31	ft
Critical Depth	0.27	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.00816	ft/ft

Cross Section for PS-3 PR. E 1/2 STREET NEW PAVED ROAD - Q25

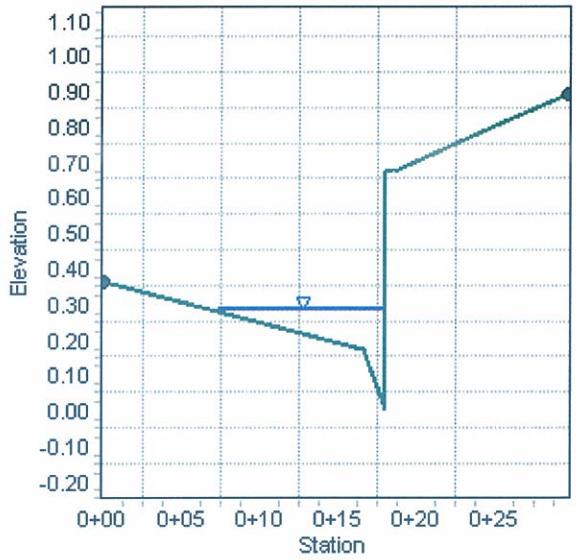
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Normal Depth	0.28	ft
Discharge	1.71	ft³/s

Cross Section Image



Worksheet for PS-3 PR. E 1/2 STREET NEW PAVED ROAD - Q25

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	1.71	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.36
0+16.50	0.17
0+18.00	0.00
0+18.00	0.67
0+18.50	0.67
0+25.50	0.81
0+29.50	0.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.36)	(0+29.50, 0.89)	0.016

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	0.28	ft
Elevation Range	0.00 to 0.89 ft	
Flow Area	0.77	ft²
Wetted Perimeter	10.92	ft
Hydraulic Radius	0.07	ft
Top Width	10.64	ft

Worksheet for PS-3 PR. E 1/2 STREET NEW PAVED ROAD - Q25

Results

Normal Depth		0.28	ft
Critical Depth		0.30	ft
Critical Slope		0.00885	ft/ft
Velocity		2.23	ft/s
Velocity Head		0.08	ft
Specific Energy		0.35	ft
Froude Number		1.47	
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	0.28	ft
Critical Depth	0.30	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.00885	ft/ft

Cross Section for PS-3 PR. E 1/2 STREET NEW PAVED ROAD - Q100

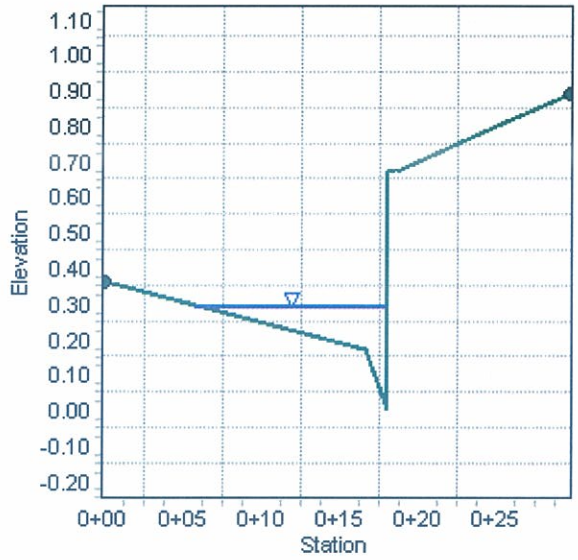
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Normal Depth	0.29	ft
Discharge	2.35	ft³/s

Cross Section Image



Worksheet for PS-3 PR. E 1/2 STREET NEW PAVED ROAD - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02000	ft/ft
Discharge	2.35	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.36
0+16.50	0.17
0+18.00	0.00
0+18.00	0.67
0+18.50	0.67
0+25.50	0.81
0+29.50	0.89

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.36)	(0+29.50, 0.89)	0.016

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	0.29	ft
Elevation Range	0.00 to 0.89 ft	
Flow Area	0.98	ft²
Wetted Perimeter	12.57	ft
Hydraulic Radius	0.08	ft
Top Width	12.27	ft

Cross Section for PS-4 VEG SWALE ALONG WEST SIDE OF BLDG- Q100

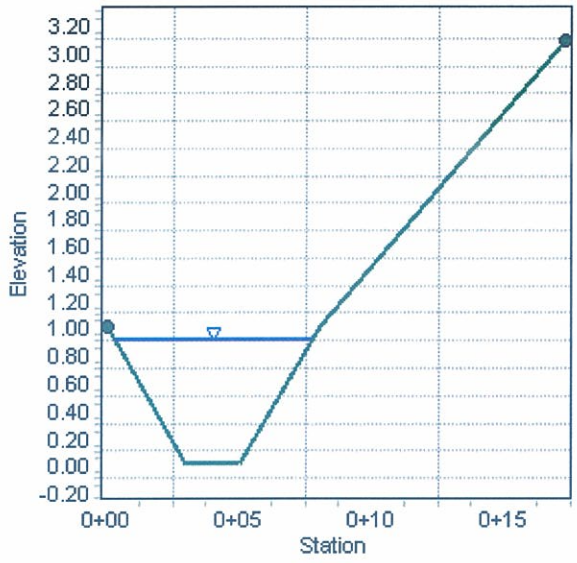
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01250	ft/ft
Normal Depth	0.90	ft
Discharge	1.89	ft³/s

Cross Section Image



Worksheet for PS-4 VEG SWALE ALONG WEST SIDE OF BLDG- Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01250	ft/ft
Discharge	1.89	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.00
0+03.00	0.00
0+05.00	0.00
0+08.00	1.00
0+17.28	3.09

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.00)	(0+17.28, 3.09)	0.250

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	0.90	ft
Elevation Range	0.00 to 3.09 ft	
Flow Area	4.24	ft²
Wetted Perimeter	7.70	ft
Hydraulic Radius	0.55	ft
Top Width	7.40	ft
Normal Depth	0.90	ft
Critical Depth	0.26	ft

Worksheet for PS-4 VEG SWALE ALONG WEST SIDE OF BLDG- Q100

Results

Critical Slope		1.59290	ft/ft
Velocity		0.45	ft/s
Velocity Head		0.00	ft
Specific Energy		0.90	ft
Froude Number		0.10	
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	0.90	ft
Critical Depth	0.26	ft
Channel Slope	0.01250	ft/ft
Critical Slope	1.59290	ft/ft

Cross Section for PS-5 Landscape SWALE North P/L Q100

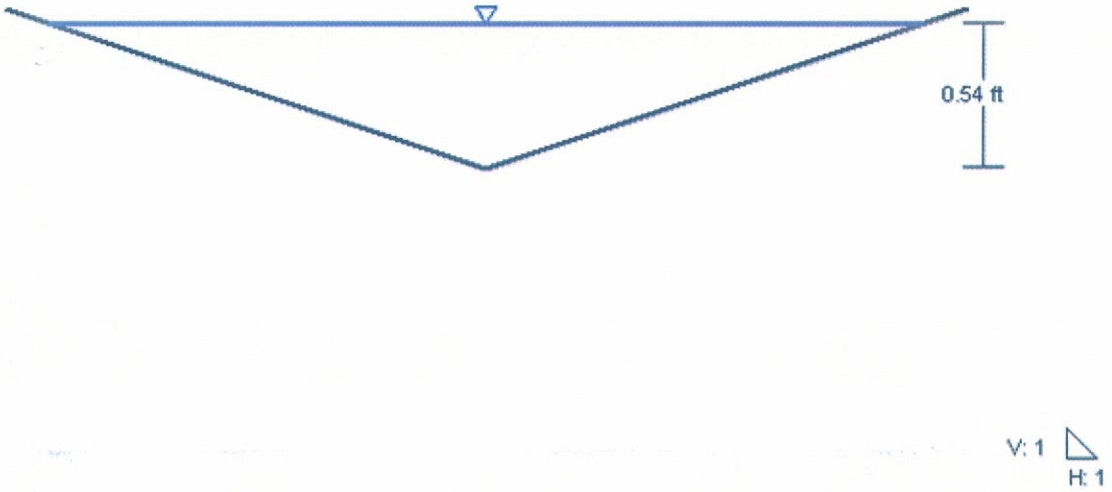
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00850	ft/ft
Normal Depth	0.54	ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.96	ft³/s

Cross Section Image



Worksheet for PS-5 Landscape SWALE North P/L Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.025	
Channel Slope	0.00850	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.96	ft^3/s

Results

Normal Depth	0.54	ft
Flow Area	0.88	ft^2
Wetted Perimeter	3.43	ft
Hydraulic Radius	0.26	ft
Top Width	3.26	ft
Critical Depth	0.48	ft
Critical Slope	0.01568	ft/ft
Velocity	2.22	ft/s
Velocity Head	0.08	ft
Specific Energy	0.62	ft
Froude Number	0.75	
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	0.54	ft
Critical Depth	0.48	ft
Channel Slope	0.00850	ft/ft
Critical Slope	0.01568	ft/ft

Cross Section for PS-6 VEG SWALE ALONG NORTH P/L Q100

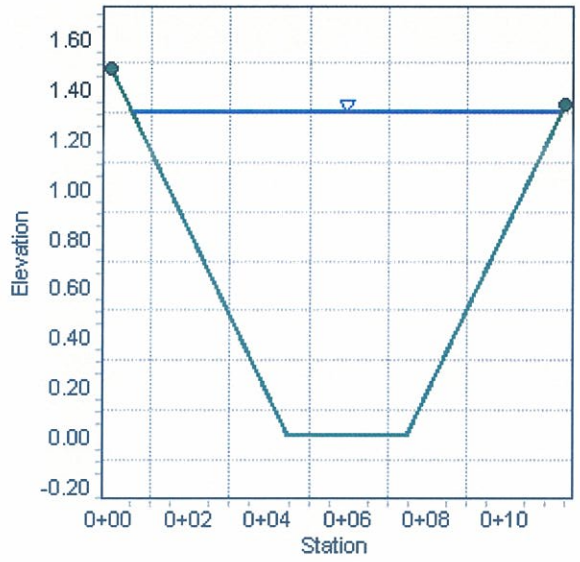
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	1.30	ft
Discharge	4.61	ft³/s

Cross Section Image



Worksheet for PS-6 VEG SWALE ALONG NORTH P/L Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	4.61	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	1.48
0+04.44	0.00
0+07.44	0.00
0+11.44	1.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 1.48)	(0+11.44, 1.33)	0.250

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	1.30	ft
Elevation Range	0.00 to 1.48 ft	
Flow Area	9.00	ft²
Wetted Perimeter	11.24	ft
Hydraulic Radius	0.80	ft
Top Width	10.82	ft
Normal Depth	1.30	ft
Critical Depth	0.37	ft
Critical Slope	1.41841	ft/ft

Worksheet for PS-6 VEG SWALE ALONG NORTH P/L Q100

Results

Velocity		0.51	ft/s
Velocity Head		0.00	ft
Specific Energy		1.31	ft
Froude Number		0.10	
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	1.30	ft
Critical Depth	0.37	ft
Channel Slope	0.01000	ft/ft
Critical Slope	1.41841	ft/ft

Cross Section for PS-7 U-GUTTER PRON1-B Q100

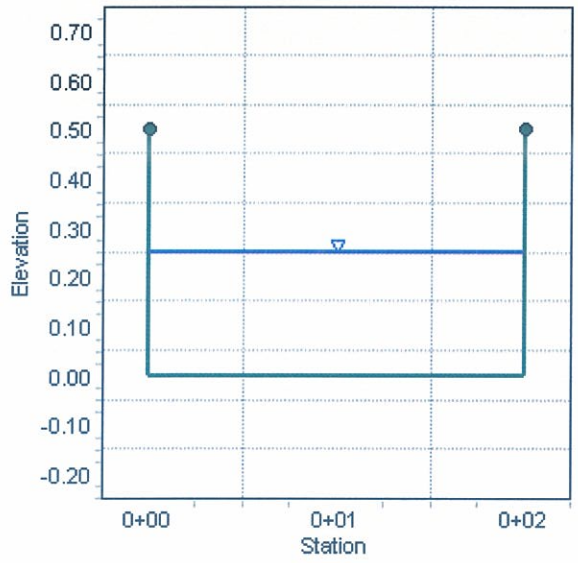
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.25	ft
Discharge	1.96	ft³/s

Cross Section Image



Worksheet for PS-7 U-GUTTER PRON1-B Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	1.96	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.50
0+00.00	0.00
0+02.00	0.00
0+02.00	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.50)	(0+02.00, 0.50)	0.013

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	0.25	ft
Elevation Range	0.00 to 0.50 ft	
Flow Area	0.50	ft²
Wetted Perimeter	2.50	ft
Hydraulic Radius	0.20	ft
Top Width	2.00	ft
Normal Depth	0.25	ft
Critical Depth	0.31	ft
Critical Slope	0.00522	ft/ft

Worksheet for PS-7 U-GUTTER PRON1-B Q100

Results

Velocity		3.91	ft/s
Velocity Head		0.24	ft
Specific Energy		0.49	ft
Froude Number		1.38	
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	0.25	ft
Critical Depth	0.31	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00522	ft/ft

Cross Section for VEG SWALE (west side of bldg) 6" OUTLET PIPE - Q100

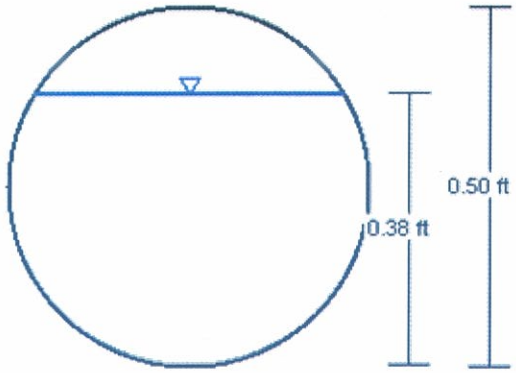
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01990	ft/ft
Normal Depth	0.38	ft
Diameter	0.50	ft
Discharge	0.73	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for VEG SWALE (west side of bldg) 6" OUTLET PIPE - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01990	ft/ft
Diameter	0.50	ft
Discharge	0.73	ft³/s

Results

Normal Depth	0.38	ft
Flow Area	0.16	ft²
Wetted Perimeter	1.06	ft
Hydraulic Radius	0.15	ft
Top Width	0.43	ft
Critical Depth	0.43	ft
Percent Full	75.8	%
Critical Slope	0.01571	ft/ft
Velocity	4.57	ft/s
Velocity Head	0.32	ft
Specific Energy	0.70	ft
Froude Number	1.32	
Maximum Discharge	0.85	ft³/s
Discharge Full	0.79	ft³/s
Slope Full	0.01693	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	75.79	%
Downstream Velocity	Infinity	ft/s

Worksheet for VEG SWALE (west side of bldg) 6" OUTLET PIPE - Q100

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.38	ft
Critical Depth	0.43	ft
Channel Slope	0.01990	ft/ft
Critical Slope	0.01571	ft/ft

Cross Section for CATCH BASIN 12" OUTLET PIPE - Q100

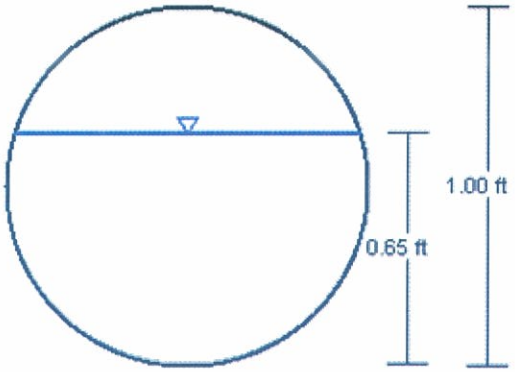
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Normal Depth	0.65	ft
Diameter	1.00	ft
Discharge	1.89	ft³/s

Cross Section Image



V: 1
H: 1

Worksheet for CATCH BASIN 12" OUTLET PIPE - Q100

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	1.00	ft
Discharge	1.89	ft^3/s

Results

Normal Depth	0.65	ft
Flow Area	0.54	ft^2
Wetted Perimeter	1.87	ft
Hydraulic Radius	0.29	ft
Top Width	0.96	ft
Critical Depth	0.59	ft
Percent Full	64.6	%
Critical Slope	0.00671	ft/ft
Velocity	3.52	ft/s
Velocity Head	0.19	ft
Specific Energy	0.84	ft
Froude Number	0.83	
Maximum Discharge	2.71	ft^3/s
Discharge Full	2.52	ft^3/s
Slope Full	0.00281	ft/ft
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
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	64.64	%
Downstream Velocity	Infinity	ft/s

Worksheet for CATCH BASIN 12" OUTLET PIPE - Q100

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.65	ft
Critical Depth	0.59	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00671	ft/ft

Grate Inlet Headwater Depth Calculation

2'X2' GRATE - Catch Basin (PRON1-A)

Known:			
Q =	Flow	2	cfs
W =	Width of Grate	2	ft
L =	Length of Grate	2	ft
D =	Diameter of Circle		in
Cf =	Clogging Factor	50	%

Weir Conditions:

Hw=(Q/(Cw*P))2/3

Cw =	Weir Coefficient	2.70	
P =	Perimeter of Grate	8.00	ft
Pc =	Perimeter (w/clogging)	4.00	ft
Hw =	Headwater Depth	0.32	ft

Orifice Conditions:

Hw=(Q/(Co*Ac))2/2*g

Co =	Orifice Coefficient	0.67	
A =	Grate Area	4.00	ft^2
Gf =	Grate Opening Factor	0.67	
Ac =	Grate Open Area (w/clogging)	1.34	ft^2
Hw =	Headwater Depth	0.08	ft

Worst Case Scenario Occurs Under Weir Conditions

Headwater Depth = **0.32 ft** with Rectangular Grate

PIPE CULVERT

Inlet control and outlet control.

INLET PIPE FOR CATCH BASIN FROM VEG. SWALE WEST OF BLDG

INPUT VARIABLES:	
Pipe diameter	12.00 in
Slope	2.00 %
Number of pipes	1
Manning's 'n'	0.013
Culvert length	77.02 ft
Discharge	2.00 cfs (Q100)
Ent. Coef. (Ke)	0.35

OUTPUT VARIABLES:	
INLET CONTROL HWo:	
Tapered throat	0.87 ft
45 degree bevels	0.89 ft
Sq. edge headwall	0.93 ft
Thin edge projecting	1.00 ft
OUTLET CONTROL HWo:	
HWo depth	-0.36 ft
Velocity	2.55 fps
Critical depth	0.60 ft

Note: 1. Outlet control assumes full pipe flow.
2. Critical depth can not exceed the pipe diameter.

Date 04/15/13 Project Retail Bldg @ Lucerne Valley

Calced by JO
Checked by DY

Riprap Lining Calculation
North PL Vegetated Swale

Velocity = 0.52

S = 0.01

S_S = 2.5

d_{50} = 0.003

$d_{50} = (3v * (S^{0.17}/S_s-1))^2$

APPENDIX D – REFERENCE MATERIALS

- FIRM MAP
- NOAA ATLAS 14 POINT PRECIPITATION VALUES
- SOILS EXHIBIT
- EXCERPTS FORM CALTRANS HIGHWAY DESIGN MANUAL
- EXCERPTS FROM SBC MANUAL

Approximate Map Scale 1:24,000 (1" = 2,000')

1,000 0 1,000 2,000 4,000 FEET

250 0 250 500 1,000 METERS

(Distance is exaggerated along the horizontal axis.)

National Flood Hazard Layer

Point Location Map

Latitude: 34.44388
Longitude: -116.95295

Community Information

Name: San Bernardino County Unincorporated Areas

NFIP Community Identification Number: 060270

County:

State:

MAP NUMBER
06071C6575H
COUNTYWIDE, NOT PRINTED

EFFECTIVE DATE
August 28, 2008

Federal Emergency Management Agency

Equirectangular Projection
North American Datum of 1983
Vertical datums are identified in the legend.

This map shows official flood hazard information from the National Flood Hazard Layer. It includes most revisions up to today, except those identified by property description. Base map information is for orientation purposes and should not be used for measurement. FEMA's policy on use of digital flood hazard data can be found at http://www.fema.gov/library/viewRecord.do?id=3235. Additional map information is available from http://msc.fema.gov.

Floodways and flood hazard zones (minimum percent annual chance flood)
- Floodway
- VE (1 percent)
- V (1 percent)
- AE (1 percent)
- A (1 percent)
- AH (1 percent)
- AO (1 percent)
- AR (1 percent)
- A99 (1 percent)
- 0.2 percent or 1 percent shallow flood, small-area flood, or protected by levee
- D (not assessed)
- Not included
- X (less than 0.2 percent) or open water

Flood hazard limits
- Floodway limit
- 1 percent limit
- 0.2 percent limit
- Study limit
- Zone break

CBRS or OPA unit
- CBRS/OPA unit

Base Flood Elevation (BFE) and Profiles
- BFE - NAVD 88
- BFE - NGVD 29
- BFE - Other
- Cross section
- Transects

Reference points
- Bench mark
- River distance

Boundaries
- International
- State
- County
- Community
- Special district
- Park, forest, etc

Surface water
- Streams
- Water bodies

Structures
- Bridge
- Channel, culvert
- Dam, lock
- Levee, dike
- Other

Transportation
- Major roads
- Minor roads
- Railroads

Approximate Map Scale 1:24,000 (1" = 2,000')

1,000 0 1,000 2,000 4,000 FEET

250 0 250 500 1,000 METERS

(Distance is exaggerated along the horizontal axis.)

National Flood Hazard Layer

Point Location Map

Latitude: 34.44388
Longitude: -116.95295

Community Information

Name: San Bernardino County Unincorporated Areas

NFIP Community Identification Number: 060270

County:

State:

MAP NUMBER
06071C6575H
COUNTYWIDE, NOT PRINTED

EFFECTIVE DATE
August 28, 2008

Federal Emergency Management Agency

Equirectangular Projection
North American Datum of 1983

Boundaries

Jurisdiction

- International boundary
- State boundary
- County boundary
- Community boundary
- Special district (levee, utility, etc) boundary
- Park, forest, and other public land boundary

Flood Insurance Rate Map (FIRM)

- FIRM boundary

Letter of Map Revision (LOMR)

- LOMR boundary

This map shows official flood hazard information from the National Flood Hazard Layer. It includes most revisions up to today, except those identified by property description. Base map information is for orientation purposes and should not be used for measurement. FEMA's policy on use of digital flood hazard data can be found at http://www.fema.gov/library/viewRecord.do?id=3235. Additional map information is available from http://msc.fema.gov.

National Flood Hazard Layer Point Location Report

FEMA

Point Location

Latitude: 34.44388 Longitude: -116.95295 (North American Datum of 1983)

Community

Community Name:	San Bernardino County Unincorporated Areas
NFIP Community Identification Number:	060270
County:	
State:	

Flood Hazard Zone

For more information about flood hazard zones see http://www.fema.gov/plan/prevent/fhm/fq_gen13.shtm.

Zone:	D
Is this Zone a Special Flood Hazard Area (SFHA)?	No
Is this Location a Floodway?	No

Coastal Barrier Resources System (CBRS) or Otherwise Protected Area (OPA) Unit

No CBRS or OPA unit at this location.

For more information about CBRS and OPA units see http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/cbrs.shtm.

National Flood Insurance Program (NFIP) Map

Map Panel Number:	06071C6575H
Effective or Revised Date:	August 28, 2008
Panel Type:	COUNTYWIDE, NOT PRINTED
Reason Panel Not Printed:	AREA ALL IN ZONE D
Initial FIRM Date:	September 29, 1978
Date of FIRM Index Map:	August 28, 2008

To view the flood hazard map or order the map or flood hazard data please visit FEMA's Map Service Center at http://msc.fema.gov.

Letter(s) of Map Revision (LOMRs)

No LOMRs at this location.

Remarks

This report provides information found in the National Flood Hazard Layer for the point location on which you clicked.

If you clicked on a boundary, the system decides the side of the boundary on which to report. If the location in which you are interested is very close to a boundary, use extra care to click on the exact location.

The elevation of your property relative to the Base Flood Elevation (BFE) is the main factor in determining a flood hazard. To validate that a location is outside of a base flood, determine if the elevation of the location is higher than those of nearby Base Flood Elevations.

Flood hazards change gradually with the distance from potential sources of flooding, elevation, and other factors. You always should be aware of nearby areas that have a flood hazard and do not rely solely on flood hazard information for a single location.

For detailed information about Base Flood Elevations and other data, supplement the information on this report by reviewing the National Flood Hazard Layer data or National Flood Insurance Program map, the Flood Insurance Study (FIS) report, and nearby Letters of Map Change (LOMCs) that provide changes to the map and report. These items are available through FEMA's Map Service Center at http://msc.fema.gov.

For more information about the National Flood Insurance Program please visit the web site http://www.fema.gov/business/nfip/.

WALKER ENGINEERING, LLC
5765 S. RAINBOW BLVD.
SUITE 101
LAS VEGAS, NV 89118
TEL: 702.873.5197
FAX: 702.873.5346

meeting your land development needs

4/5/13

HYDROLOGIC SOILS MAP

FIGURE C-11 HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA
OF THE SAN BERNARDINO COUNTY HYDROLOGY MANUAL

NOAA Atlas 14, Volume 6, Version 2
Location name: Lucerne Valley, California, US*
Coordinates: 34.4442, -116.9530
Elevation: 2931 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.088** (0.073-0.108)	**0.118** (0.097-0.145)	**0.161** (0.132-0.198)	**0.198** (0.161-0.245)	**0.252** (0.199-0.323)	**0.297** (0.229-0.388)	**0.344** (0.260-0.461)	**0.395** (0.290-0.544)	**0.467** (0.329-0.670)	**0.526** (0.358-0.781)
10-min	**0.126** (0.104-0.154)	**0.169** (0.139-0.207)	**0.231** (0.190-0.284)	**0.284** (0.231-0.352)	**0.362** (0.285-0.463)	**0.425** (0.329-0.556)	**0.493** (0.372-0.661)	**0.566** (0.416-0.779)	**0.670** (0.472-0.961)	**0.754** (0.514-1.12)
15-min	**0.152** (0.126-0.186)	**0.205** (0.169-0.251)	**0.279** (0.230-0.343)	**0.343** (0.280-0.425)	**0.437** (0.345-0.560)	**0.514** (0.397-0.672)	**0.597** (0.450-0.799)	**0.685** (0.503-0.943)	**0.810** (0.571-1.16)	**0.912** (0.621-1.35)
30-min	**0.215** (0.177-0.263)	**0.289** (0.238-0.354)	**0.394** (0.324-0.484)	**0.484** (0.395-0.600)	**0.617** (0.487-0.789)	**0.725** (0.560-0.947)	**0.841** (0.635-1.13)	**0.966** (0.709-1.33)	**1.14** (0.805-1.64)	**1.29** (0.876-1.91)
60-min	**0.283** (0.234-0.347)	**0.381** (0.314-0.467)	**0.520** (0.427-0.638)	**0.639** (0.521-0.791)	**0.814** (0.642-1.04)	**0.956** (0.739-1.25)	**1.11** (0.838-1.49)	**1.27** (0.935-1.75)	**1.51** (1.06-2.16)	**1.70** (1.16-2.52)
2-hr	**0.381** (0.315-0.467)	**0.502** (0.414-0.616)	**0.673** (0.553-0.827)	**0.819** (0.668-1.01)	**1.03** (0.813-1.32)	**1.20** (0.929-1.57)	**1.38** (1.04-1.85)	**1.57** (1.15-2.16)	**1.83** (1.29-2.63)	**2.04** (1.39-3.02)
3-hr	**0.453** (0.374-0.554)	**0.594** (0.489-0.728)	**0.789** (0.649-0.970)	**0.958** (0.781-1.19)	**1.20** (0.947-1.54)	**1.40** (1.08-1.82)	**1.60** (1.21-2.14)	**1.82** (1.33-2.50)	**2.11** (1.49-3.03)	**2.34** (1.59-3.46)
6-hr	**0.591** (0.488-0.724)	**0.772** (0.637-0.947)	**1.02** (0.841-1.26)	**1.24** (1.01-1.53)	**1.54** (1.22-1.98)	**1.79** (1.38-2.34)	**2.04** (1.54-2.74)	**2.31** (1.70-3.18)	**2.68** (1.89-3.84)	**2.96** (2.02-4.39)
12-hr	**0.715** (0.590-0.875)	**0.965** (0.795-1.18)	**1.31** (1.08-1.61)	**1.60** (1.31-1.99)	**2.02** (1.59-2.59)	**2.35** (1.82-3.07)	**2.70** (2.04-3.61)	**3.06** (2.24-4.21)	**3.55** (2.50-5.09)	**3.93** (2.68-5.83)
24-hr	**0.888** (0.787-1.02)	**1.25** (1.11-1.44)	**1.75** (1.54-2.02)	**2.17** (1.90-2.52)	**2.76** (2.34-3.32)	**3.23** (2.68-3.97)	**3.73** (3.02-4.69)	**4.25** (3.35-5.50)	**4.99** (3.77-6.73)	**5.57** (4.08-7.78)
2-day	**1.03** (0.916-1.19)	**1.48** (1.31-1.71)	**2.10** (1.86-2.43)	**2.62** (2.30-3.06)	**3.35** (2.84-4.04)	**3.94** (3.27-4.84)	**4.55** (3.69-5.73)	**5.20** (4.10-6.73)	**6.11** (4.62-8.25)	**6.84** (5.00-9.54)
3-day	**1.11** (0.982-1.27)	**1.60** (1.42-1.84)	**2.30** (2.03-2.65)	**2.88** (2.52-3.35)	**3.69** (3.13-4.44)	**4.33** (3.60-5.33)	**5.01** (4.06-6.31)	**5.74** (4.52-7.42)	**6.76** (5.11-9.12)	**7.59** (5.55-10.6)
4-day	**1.16** (1.03-1.33)	**1.68** (1.49-1.94)	**2.44** (2.15-2.82)	**3.07** (2.69-3.57)	**3.94** (3.34-4.75)	**4.64** (3.85-5.71)	**5.38** (4.36-6.78)	**6.17** (4.86-7.99)	**7.29** (5.51-9.83)	**8.18** (5.98-11.4)
7-day	**1.22** (1.08-1.41)	**1.81** (1.60-2.08)	**2.67** (2.35-3.08)	**3.39** (2.97-3.95)	**4.43** (3.75-5.33)	**5.25** (4.36-6.45)	**6.10** (4.94-7.68)	**7.01** (5.52-9.07)	**8.28** (6.27-11.2)	**9.29** (6.79-13.0)
10-day	**1.26** (1.12-1.45)	**1.90** (1.68-2.18)	**2.83** (2.50-3.27)	**3.63** (3.18-4.23)	**4.79** (4.06-5.77)	**5.71** (4.74-7.02)	**6.67** (5.41-8.40)	**7.68** (6.05-9.95)	**9.12** (6.90-12.3)	**10.2** (7.49-14.3)
20-day	**1.37** (1.21-1.57)	**2.14** (1.90-2.46)	**3.31** (2.92-3.82)	**4.33** (3.79-5.04)	**5.85** (4.96-7.04)	**7.08** (5.87-8.70)	**8.37** (6.78-10.5)	**9.72** (7.66-12.6)	**11.6** (8.75-15.6)	**13.0** (9.51-18.2)
30-day	**1.50** (1.33-1.73)	**2.38** (2.11-2.75)	**3.75** (3.31-4.33)	**4.97** (4.36-5.79)	**6.81** (5.77-8.20)	**8.30** (6.89-10.2)	**9.85** (7.98-12.4)	**11.5** (9.04-14.8)	**13.7** (10.3-18.5)	**15.3** (11.2-21.4)
45-day	**1.70** (1.51-1.96)	**2.74** (2.43-3.16)	**4.37** (3.86-5.05)	**5.85** (5.12-6.81)	**8.11** (6.87-9.76)	**9.98** (8.29-12.3)	**11.9** (9.66-15.0)	**13.9** (11.0-18.0)	**16.6** (12.6-22.5)	**18.7** (13.7-26.1)
60-day	**1.83** (1.63-2.11)	**2.98** (2.64-3.43)	**4.81** (4.25-5.56)	**6.49** (5.69-7.57)	**9.05** (7.67-10.9)	**11.2** (9.29-13.8)	**13.5** (10.9-16.9)	**15.7** (12.4-20.4)	**18.8** (14.2-25.4)	**21.1** (15.4-29.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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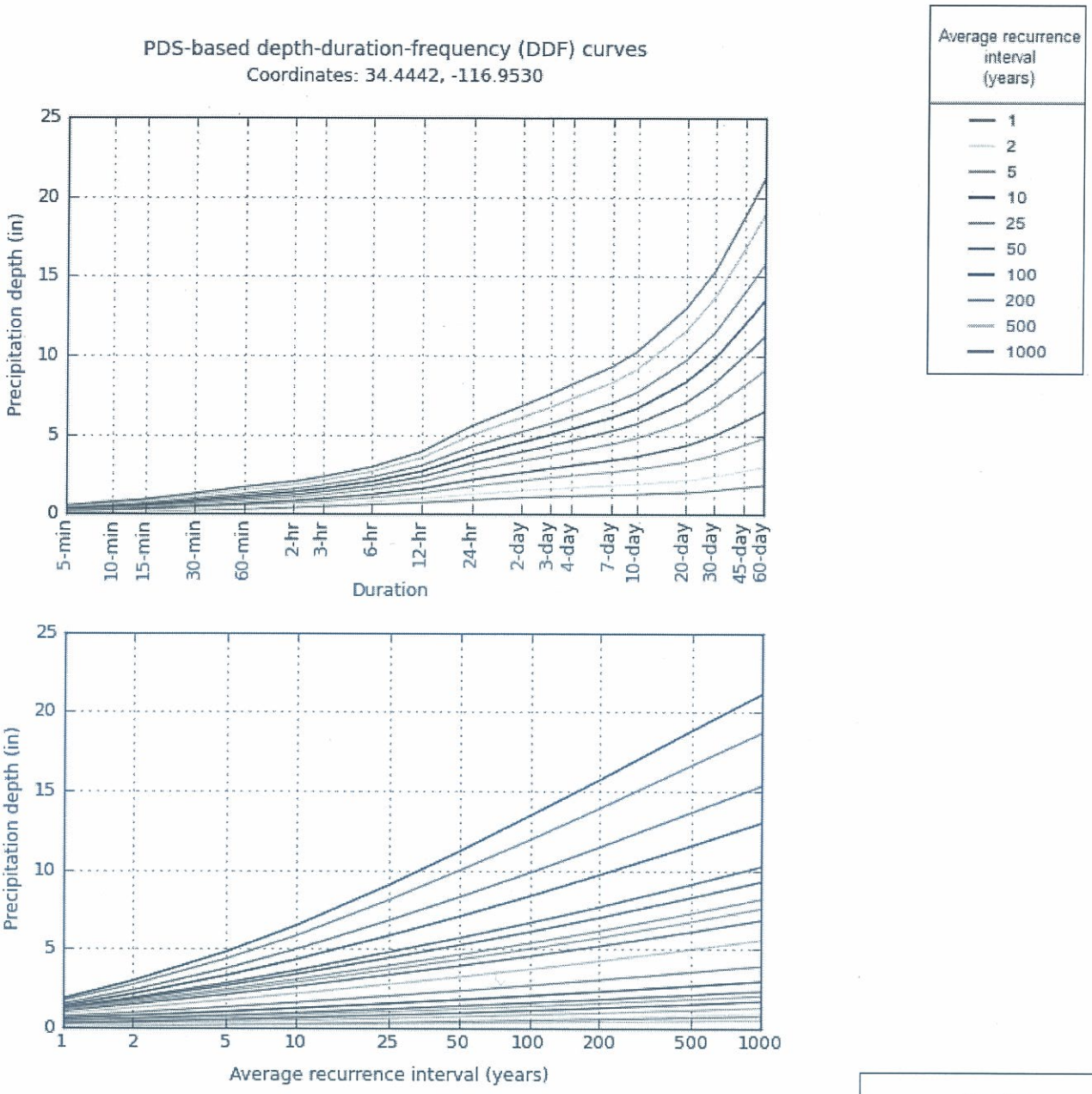
PF graphical



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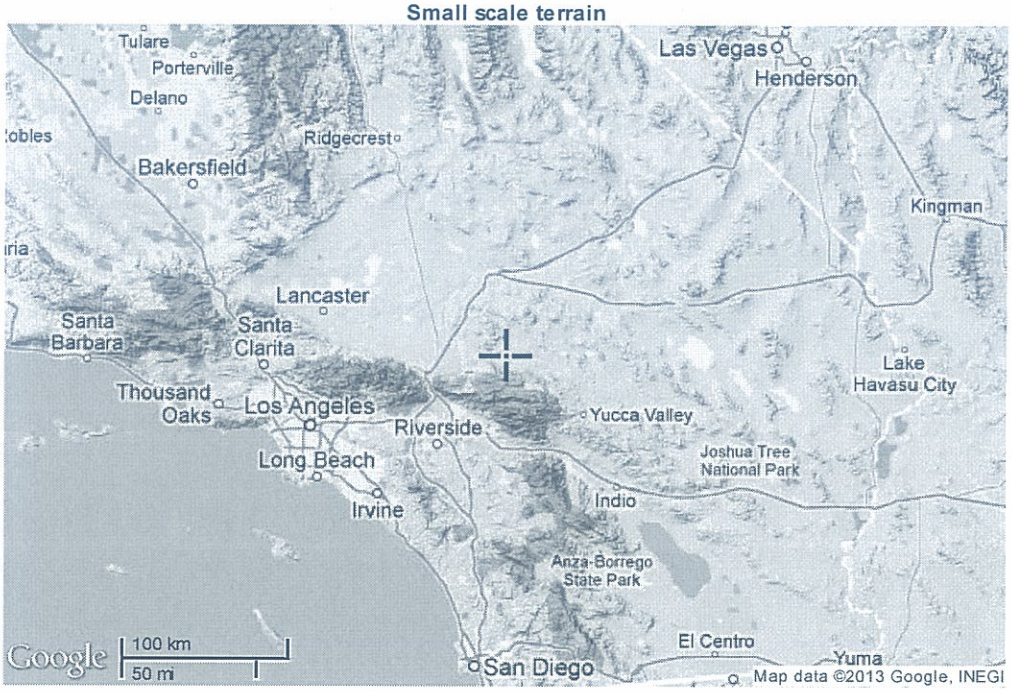
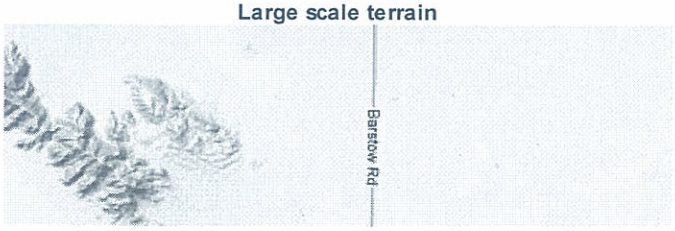
Maps & aerials

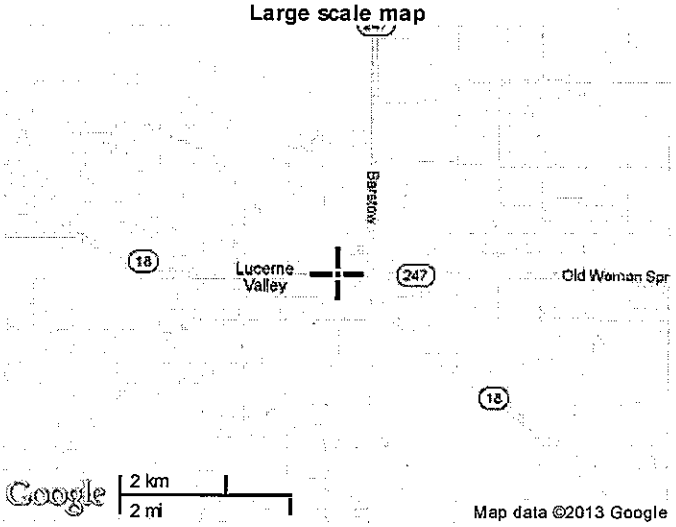
Small scale terrain



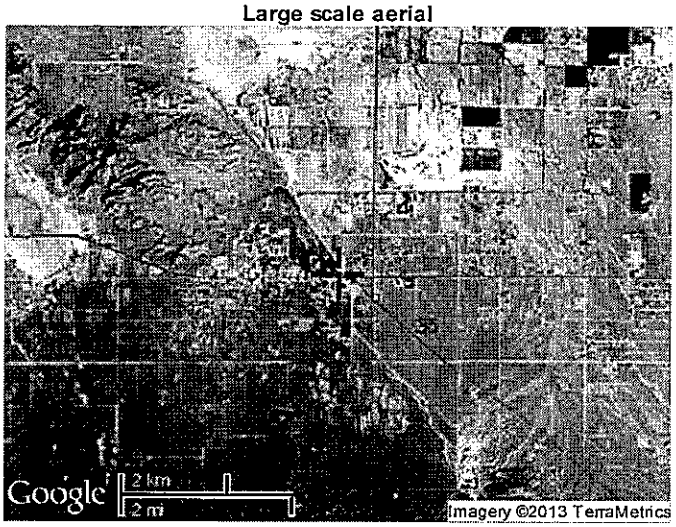
Large scale terrain



Large scale map



Large scale aerial



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Disclaimer

highway, over the watershed divide, or through structure(s) provided for emergency relief". The "overtopping flood" is of particular interest to highway drainage engineers because it may be the threshold where the relatively low profile of the highway acts as a flood relief mechanism for the purpose of minimizing upstream backwater damages.

(3) *Design Flood.* "The peak discharge (when appropriate, the volume, stage, or wave crest elevation) of the flood associated with the probability of exceedance selected for the design of a highway encroachment". Except for the rare situation where the risks associated with a low water crossing are acceptable, the highway will not be inundated by the "design flood".

(4) *Maximum Historical Flood.* "The maximum flood that has been recorded or experienced at any particular highway location". This information is very desirable and where available is an indication that the flood of this magnitude may be repeated at the project site. Hydrologic analysis may suggest that the probability for recurrence of the "maximum historical flood" is very small, less than 1 percent. Nevertheless consideration should be given to sizing drainage structures to convey the "maximum historical flood".

(5) *Probable Maximum Flood.* "The flood discharge that may be expected from the most severe combination of critical meteorological and hydrological conditions that are reasonably possible in the region". The "probable maximum flood" is generally not applicable to highway projects. The possibility of a flood of such rare magnitude, as used by the Corps of Engineers, is applicable to projects such as major dams, when consideration is to be given to virtually complete security from potential floods.

818.2 Establishing Design Flood Frequency

There are two recognized alternatives to establishing an appropriate highway drainage design frequency. That is, by policy or by economic analysis. Both alternatives have merit and may be applied exclusively or jointly depending upon general conditions or specific constraints.

Application of traditional predetermined design flood frequencies implies that an acceptable level of risk was considered in establishing the design standard. Modern design concepts, on the other hand, recommend that a range of peak flows be considered and that the design flood be established which best satisfies the specific site conditions and associated risks. A preliminary evaluation of the inherent flood-related risks to upstream and downstream properties, the highway facility, and to the traveling public should be made. This evaluation will indicate whether a predetermined design flood frequency is applicable or additional study is warranted.

Highway classification is one of the most important factors, but not the sole factor, in establishing an appropriate design flood frequency. Due consideration should be given to all the other factors listed under Index 801.5. If the analysis is correct, the highway drainage system will occasionally be overtaxed. The alternative of accommodating the worst possible event that could happen is usually so costly that it may not be justified.

Highway engineers should understand that the option to select a predetermined design flood frequency is generally only applicable to new highway locations. Because of existing constraints, the freedom to select a prescribed design flood frequency may not exist for projects involving replacement of existing facilities. Caltrans policy relative to up-grading of existing drainage facilities may be found in Index 803.3.

Although the procedures and methodology presented in HEC 17, Design of Encroachments on Flood Plains Using Risk Analysis, are not fully endorsed by Caltrans, the circular is an available source of information on the theory of "least total expected cost (LTEC) design". Highway engineers are cautioned about applying LTEC methodology and procedures to ordinary drainage design problems. The Headquarters Hydraulics Engineer in the Division of Design should be consulted before committing to design by the LTEC method since its use can only be justified and recommended under extra-ordinary circumstances.

General Winter Storm - In the Antelope Valley and Northern Basin and Range regions, the dominant storm type is the general winter storm. These storms are characterized by their long duration, 6 hours to 12 hours or more, and possibly intermittently for 3 days to 5 days over a relatively large area. General winter storms produce the majority of large peaks in the northern desert areas; the majority of the largest peaks discharge greater than or equal to 20 cfs/mi^2 occurred during the winter and fall months in the Owens Valley/Mono Lake and Northern Basin and Range regions. At elevations above 6,000 ft, much of the winter precipitation falls as snow; however, snowfall doesn't play a significant role in flood-producing runoff in the southern desert regions (Colorado Desert, Sonoran Desert, Antelope Valley and Mojave Desert). In the northern desert regions (Owens Valley/Mono Lake and Northern Basin and Range), more floods from snowmelt occur at lower elevations; more than 50 percent of runoff events occurred in spring, most likely snowmelt, but did not produce large floods.

(b) Regional Regression

Newly developed equations for California's Desert regions are shown on Table 819.7A.

While the regression equations for the Northern Basin and Range region provide more accurate results than previous USGS developed equations, there is some uncertainty associated with them. Therefore, the development of a rainfall-runoff model may be preferable for ungaged watersheds in this region.

(c) Rational Method

The recommended upper limit for California's desert regions is 160 acres (0.25 mi^2).

Table 819.7B lists common runoff coefficients for Desert Areas. These coefficients are applicable for storms with 2-year to 10-year return intervals, and must be adjusted for larger, less frequent storms by multiplying the coefficient by an appropriate frequency factor, C(f), as stated in Index 819.2(1) of this manual. The frequency factors, C(f), for 25-year, 50-year and 100-year storms are 1.1, 1.2 and 1.25, respectively. Under no circumstances should the product of C(f) times the runoff coefficient exceed 1.0. If a value of 1.0 is reached, it is recommended to use the value of 0.95.

(d) Rainfall-Runoff Simulation

A rainfall-runoff simulation approach uses a numerical model to simulate the rainfall-runoff process and generate discharge hydrographs. It has four main components: rainfall; rainfall losses; transformation of effective rainfall; and channel routing.

(1) Rainfall

a. Design Rainfall Criteria

The selection of an appropriate storm duration depends on a number of factors, including the size of the watershed, the type of rainfall-runoff approach and hydrologic characteristics of the study watershed. Watershed sizes are analyzed below and are applied to California's Desert regions in Table 819.7C.

Drainage Areas $\leq$ 20 mi^2 – Drainage areas less than 20 mi^2 are primarily representative of summer convective storms, and usually occur in the southern desert regions (Colorado Desert, Sonoran Desert, Antelope Valley and Mojave Desert regions). Since these storms usually result in intense rainfall, over a small drainage area and are generally less than 6 hours, it is recommended that a 6-hour local design storm be utilized.

Drainage Areas > 20 mi^2 & $\leq$ 100 mi^2 – For drainage areas between 20 mi^2 and 100 mi^2, the critical storm can be a summer convective storm or a general

type of flow can be analyzed as a Newtonian fluid and standard hydraulic methods can be used. The upper limit of sediment concentration by volume for normal stream flow is 20 percent and bulking factors are applied cautiously because of the low concentration. (See Table 819.7I) The small amount of sediment is conveyed by conventional suspended load and bed-load.

2. Hyperconcentrated Flow

Hyperconcentrated flow is more commonly known as mud flow. Because of potential for large volumes of sand in the water column, fluid properties and transport characteristics change and the mixture does not behave as a Newtonian fluid. However, basic hydraulic methods and models are still generally accepted and used for up to 40 percent sediment concentration by volume. For hyperconcentrated flow, bulking factors vary between 1.43 and 1.67 as shown in Table 819.7I.

3. Debris Flow

In debris flow state, behavior is primarily controlled by the composition of the sediment and debris mixture, where the volume of clay can have a strong influence in the yield strength of the mixture.

During debris flow, which has an upper limit of 50 percent sediment concentration by volume, the sediment/debris/water mixture no longer acts as a Newtonian fluid and basic hydraulic equations do not apply. If detailed hydraulic analysis or modeling of a stream operating under debris flow is needed, FLO2DH is the recommended software choice given its specific debris flow capabilities. HEC-RAS is appropriate for normal stream flow and hyperconcentrated flow, but cannot be applied to debris flow.

For a typical debris flow event, clear-water flow occurs first, followed by a frontal wave of mud and debris. Low frequency events, such as the 100-year flood, most likely contain too much water to produce a debris flow event. Normally, smaller higher frequency events such as 10-year or 25-year floods actually have a greater probability of yielding a debris flow event requiring a higher bulking factor.

As outlined in Table 819.7I, bulking factors for debris flow vary between 1.67 and 2.00.

(c) Sediment/Debris Flow Potential

1. Debris Hazard Areas

Mass movement of rock, debris, and soil is the main source of bulked flows. This can occur in the form of falls, slides, or flows. The volume of sediment and debris from mass movement can enter streams depending upon hydrologic and geologic conditions.

The location of these debris-flow hazards include:

(1) At or near the toe of slope 2:1 or steeper

(2) At or near the intersection of ravines and canyons

(3) Near or within alluvial fans

(4) Soil Slips

Soil slips commonly occur at toes of slope between 2:1 and 3:1. Flowing mud and rocks will accelerate down a slope until the flow path flattens. Once energy loss occurs, rock, mud, and vegetation will be deposited. Debris flow triggered by soil slips can become channelized and travel distances of a mile or more. Figure 819.7E shows the potential of soil slip versus slope angle. As seen in this Figure, the flatter the slope angle, the less effect on flow speed and acceleration.

most important, and often the most difficult phase of this task is the selection of an appropriate design storm frequency for the specific project, location or site under consideration. In order for a design frequency to be meaningful criteria for roadway drainage design, it must be tied to an acceptable tolerance of flooding. Design water spread, encroachment upon the roadbed or adjacent property, is the tolerance of flooding directly related to roadway drainage design. Allowing too little spread is uneconomical in design and too much spread may result in unsafe driving conditions.

To optimize economy in roadway drainage, the allowable water spread should vary, depending on the type of project being designed. Because of the effect of splash and spray on motorist visibility and vehicle control, high volume roads with high speed traffic cannot tolerate as much water spread as urban streets. Likewise, the allowable water spread should be minimized on urban streets where a large number of pedestrians use adjacent sidewalks and pedestrian crosswalks. Consideration should be given to the element of motorist surprise when encountering intermittent puddles rather than a continuous encroachment of water on the driving lane. Eccentric forces are exerted on a vehicle when one side encounters water in the lane and the other side does not.

The probability of exceedance of the design storm and the acceptable tolerance to flooding depends on the importance of the highway and risks involved. Selection of the design storm and water spread parameters on rehabilitation and reconstruction are generally controlled by existing constraints.

In addition to the major roadway drainage considerations previously listed, the following more specific factors are to be considered in establishing the project design storm:

- Highway type
- Traffic volume
- Design speed
- Local standards

The following geometric and design features of the highway directly affect establishment of the project design water spread:

- Cross slope
- Longitudinal slope
- Number of lanes
- Width of shoulders
- Height of curb and dike
- Parking lanes
- Bus/Transit pullouts and loading areas

Desirable limits for water spread with respect to design storm probability of exceedance are given in Table 831.3. The parameters shown are considered minimum roadway drainage design standards for new freeway construction and for all State highways with depressed sections which require pumping. Local conditions may justify less stringent criteria than the table parameters for conventional highways. Exceptions should be documented by memo to the project file.

It is often advantageous, to both the State and the local agency, for highway drainage and street drainage to be compatible. This is particularly true in urban areas and rapidly developing suburban areas where a conventional highway is, or will become, part of the street network. Street drainage criteria adopted by a local agency are generally based on the hydrologic events peculiar to a geographical area. Local drainage standards that satisfy the needs of the community, usually provide reasonable traffic safety and flood risk considerations commensurate with those normally expected for conventional highways in urban areas.

831.4 Other Considerations

(1) Sheet Flow. Concentrations of sheet flow across roadways are to be avoided. As a general rule, no more than 0.10 cubic feet per second should be allowed to concentrate and flow across a roadway. Particular attention should be given to reversal points of superelevation where shoulder and gutter slopes may direct flows across the roadway and gore areas.

Table 831.3

Desirable Roadway Drainage Guidelines

HIGHWAY Type/Category/Feature	DESIGN STORM 4% (25 yrs)	DESIGN STORM 10% (10 yrs)	DESIGN WATER SPREAD Shldr or Parking Lane	DESIGN WATER SPREAD 1/2 Outer Lane	DESIGN WATER SPREAD Local Standard
FREEWAYS					
Through traffic lanes, branch connections, and other major ramp connections.	X	--	X	--	--
Minor ramps.	--	X	X	--	--
Frontage roads.	--	X	--	--	X
CONVENTIONAL HIGHWAYS					
High volume, multilane Speeds over 45 mph.	X	--	X	--	--
High volume, multilane Speeds 45 mph and under.	--	X	--	X	--
Low volume, rural Speeds over 45 mph.	X	--	X	--	--
Urban Speeds 45 mph and under.	--	X	--	--	X
ALL STATE HIGHWAYS					
Depressed Sections That Require Pumping:					

Use a 2% (50 yrs) design storm for freeways and conventional State highways. Design water spread at depressed sections should not exceed that of adjacent roadway sections. A 4% (25 yr) design storm may be used on local streets or road undercrossings that require pumping.

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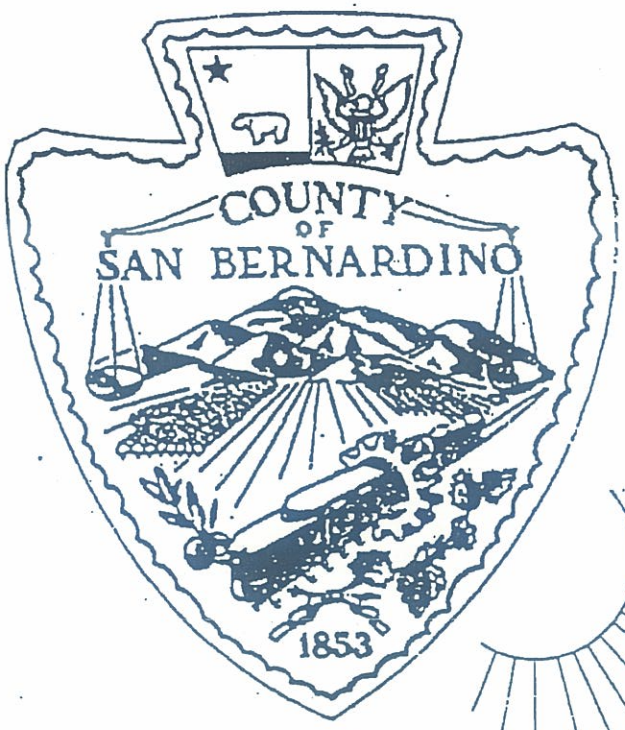
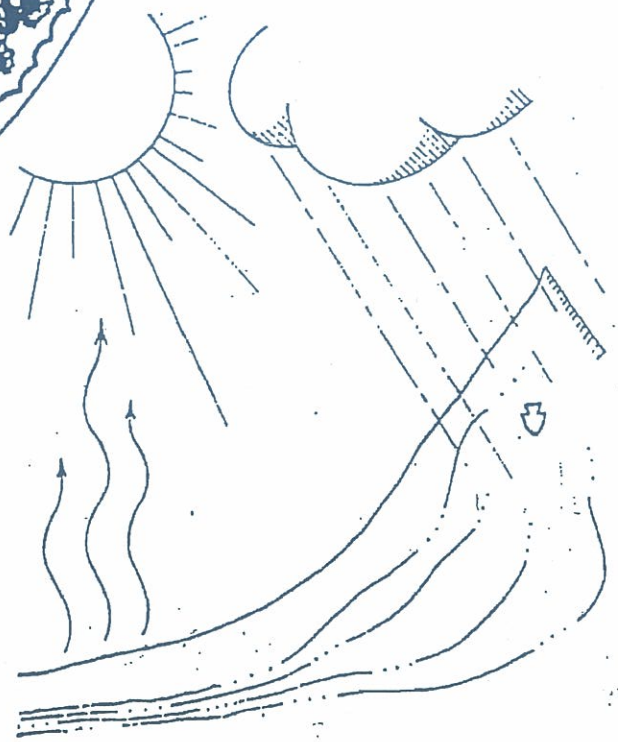




SECTION C

LOSSES

C.1. WATERSHED LOSSES

Watershed outflow is a function of precipitation, watershed losses, and routing processes. Watershed routing processes are presented in Sections D and E where the rational and unit hydrograph methods are presented in detail. Precipitation estimation procedures and data are presented in Section B. This section will present watershed loss computation methods and data.

Watershed losses are considered to be depression storage, vegetation interception and transpiration, minor amounts of evaporation, and infiltration. Infiltration is the process of water entering the soil surface and percolating downward into the soil where it is stored during a precipitation event. Subsequently, the stored soil water may be consumptively used by vegetation, percolate further downward to groundwater storage, or exit the soil surface as seeps or springs. Seepage from stream bank storage is the primary source of baseflow which is derived from prior precipitation events. For modeling purposes, watershed losses are grouped into two components: namely, (i) infiltration, and (ii) initial abstraction which includes all the losses except infiltration.

C.2. HYDROLOGIC SOIL GROUPS

The major factor affecting loss rates is the nature of the soil itself. The soil surface characteristics, its ability to transmit water to subsurface layers, and total storage capacity, are all major factors in controlling the infiltration rate and initial abstraction parameter values of a particular soil. Soils are classified into four hydrologic soil groups as follows (refs. 2,3):

GROUP A: Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well-drained sands or gravels. These soils have a high rate of water transmission.

SOIL TYPE FOR ENTIRE SITE

USED FOR EXISTING UNDEVELOPED CONDITIONS FOR RATIONAL METHOD ANALYSIS

POOR: Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

FAIR: Moderate cover with 50 percent to 75 percent of the ground surface protected by vegetation.

GOOD: Heavy or dense cover with more than 75 percent of the ground surface protected by vegetation.

In most cases, watershed existing conditions cover type and quality can be readily determined by a field review of a watershed. In ultimate planned open spaces, the soil cover condition shall be considered as "good." Figure C-3 provides the CN values for various types and quality of ground cover. Impervious areas shall be assigned a CN of 98. It is noted that for ultimately developed conditions, the CN for urban landscaping (turf) is provided in Figure C-3.

C.4. WATERSHED DEVELOPMENT CONDITIONS

Ultimate development of the watershed should normally be assumed since watershed urbanization is reasonably likely within the expected life of most hydraulic facilities. Long range master plans for the County and incorporated cities should be reviewed to insure that reasonable land use assumptions are made for the ultimate development of the watershed. A field review shall also be made to confirm existing use and drainage patterns. Particular attention shall be paid to existing and proposed landscape practices, as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. Appropriate actual impervious percentages can then be selected from Figure C-4. It should be noted that the recommended values from these figures are for average conditions and, therefore, some adjustment for particular applications may be required.

Compare to p. 133 of LACFCD Computational Hydrology Manual

Curve (I) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
EXISTING UNDEVELOPED CONDITION Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)

26

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (Continued)					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87

Notes:

1. All curve numbers are for Antecedent Moisture Condition (AMC) II.
2. Quality of cover definitions:

   Poor-Heavily grazed, regularly burned areas, or areas of high burn potential. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.

   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.
3. See Figure C-2 for definition of cover types.

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (2 of 2)

3.7

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

PROPOSED DEVELOPED CONDITIONS ~65% IMPERVIOUS ~35% PERVIOUS

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

C.5. ANTECEDENT MOISTURE CONDITION (AMC)

The definitions for the AMC classifications are:

AMC I: Lowest runoff potential. The watershed soils are dry enough to allow satisfactory grading or cultivation to take place.

AMC II: Moderate runoff potential; an average study condition.

AMC III: Highest runoff potential. The watershed is practically saturated from antecedent rains. Heavy rainfall or light rainfall and low temperatures have occurred within the last five days.

For runoff hydrograph studies based on this manual it is assumed that a low AMC index (high loss rates) will be used in developing short return period storms, and a moderate to high AMC index (low loss rates) will be used in developing longer return period storms (e.g., 100 year). For the purposes of design hydrology, AMC I will be used for the 2- and 5-year return frequency storms. For the case of 10-, 25-, 50-year return frequency design storms, AMC II will be used. For 100-year storm analysis, AMC III shall be used. In detention basin design studies, AMC III conditions shall be considered in order to identify any downstream flooding potential.

C.5.1. Adjustment of Curve Numbers (CN) for AMC

The CN values selected for a particular soil cover type and quality also depend upon the AMC condition assumed. The CN values listed in Figure C-3 correspond to AMC II and require adjustment in order to represent either AMC I or AMC III. Table C.1 provides the necessary CN adjustments to account for AMC changes for hydrologic studies in San Bernardino County.

C.6.1. Estimation of Initial Abstraction (Ia)

The initial abstraction (Ia) for an area is a function of land use, treatment, and condition; interception; infiltration; depression storage; and antecedent soil moisture. An estimate for Ia is given by the SCS as

$$Ia = 0.2S \tag{C.1}$$

where S is an estimate of total soil capacity given by

$$S = \frac{1000}{CN} - 10 \tag{C.2}$$

where CN is the area curve number.

C.6.2. Estimation of Storm Runoff Yield

Given the CN for a subarea A_j, the corresponding 24-hour storm runoff yield fraction, Y_j, is estimated by

$$Y_j = \frac{(P_{24} - Ia)^2}{(P_{24} - Ia + S)P_{24}} \tag{C.3}$$

where

Y_j = 24-hour storm runoff yield fraction for subarea A_j

P_{24} = 24-hour storm rainfall

Ia = initial abstraction from (C.1)

S = see (C.2)

It is noted that should Ia be greater than P_{24} in (C.3), then Y_j is defined to be zero. In this manual, the notation Y and Y_j will represent the runoff yield fraction, rather than the volume of runoff.

If the area under study contains several (say m) CN designations, then the yield, Y, for the total area must represent the net effect of the several curve

When sufficient stream gauge information is available, infiltration rates for unit hydrograph hydrology can be estimated from a study of rainfall-runoff relationships of major storms. Where such data is not available, infiltration rates for pervious areas as a function of CN can be estimated using Figures C-3 and C-6. Loss rates for pervious areas estimated from the Figure C-6 curves are generally consistent with values developed from rainfall-runoff reconstitution studies in San Bernardino County watersheds.

C.6.5. Estimation of Catchment Maximum Loss Rates, F_m

The infiltration rate selected from Figure C-6 applies to the pervious area fraction of the watershed. The infiltration rate assumed for an impervious surface is 0.0 inch/hour. The maximum loss rate, F_m, for a catchment is therefore given by

$$F_m = a_p F_p \qquad (C.7)$$

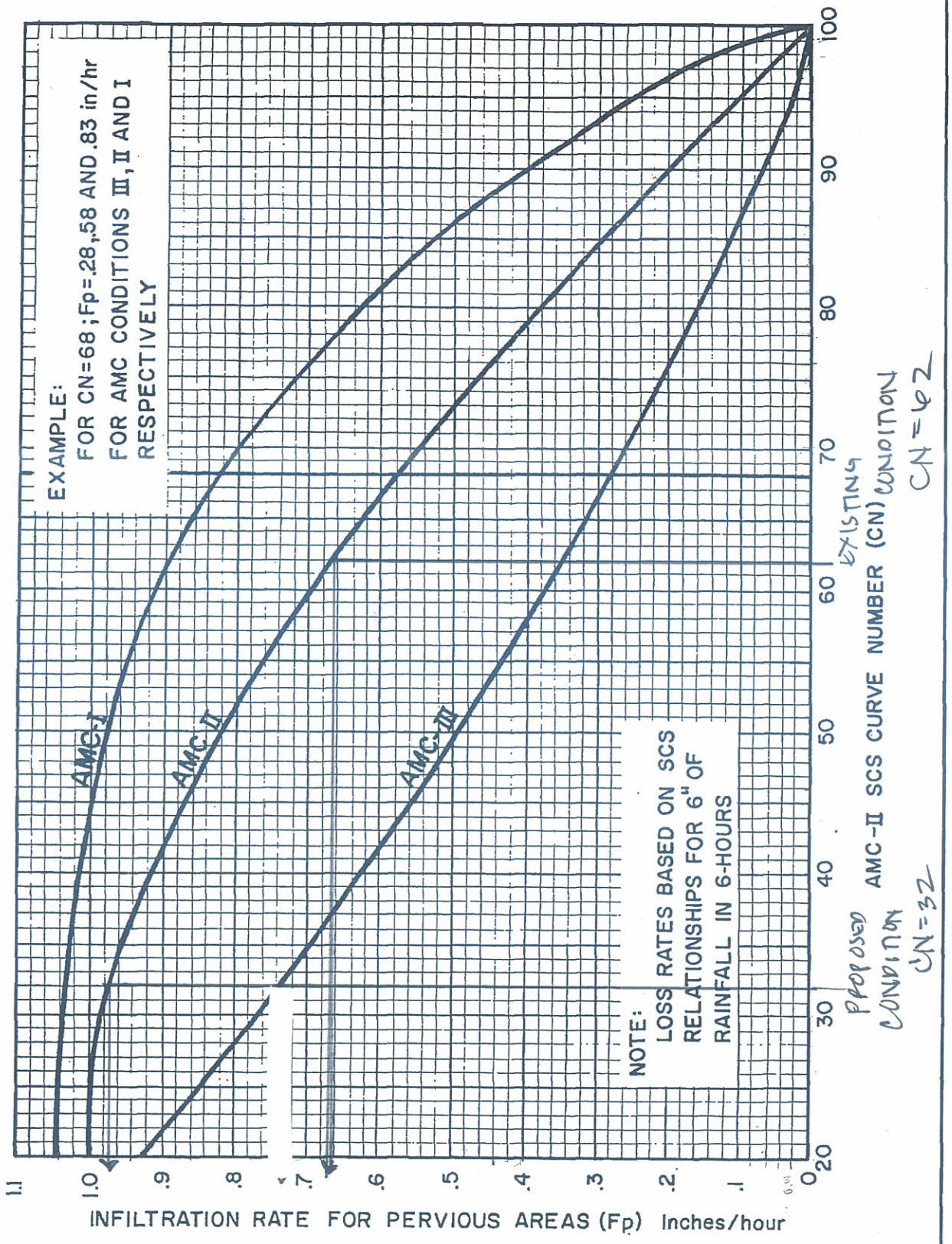
where a_p is the pervious area fraction, and F_p is the infiltration rate for the pervious area.

Should a catchment contain several F_p values, the composite F_m value is determined as a simple area average of the several F_m values. Table C.2 provides Fm values for a wide range of cover types and soil groups.

C.6.6. Design Storm Loss Rates

In design storm runoff hydrograph studies, a 24-hour duration storm pattern is used to develop the time distribution of effective rainfall over the watershed. The effective rainfall quantities are determined by subtracting the watershed losses from the design storm rainfall.

The loss rate used for a particular catchment is a combination of the maximum loss rate F_m and the low loss rate F*. F* is used as the loss rate unless F* exceeds F_m, in which case F_m is used as the loss rate. That is, F_m serves as the maximum loss rate. Typically in 100-year storm studies, F* serves as the loss rate for the entire storm pattern except for the most



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

TABLE C.2. Fm (in/hr) VALUES
FOR TYPICAL COVER TYPES

COVER TYPE	A_p(1)	SOIL GROUP A	B	C	D
NATURAL:					
Barren	1.0	0.41	0.27	0.18	0.14
Row Crops (good)	1.0	0.59	0.41	0.29	0.22
Grass (fair)	1.0	0.82	0.56	0.40	0.31
Orchards (fair)	1.0	0.88	0.62	0.43	0.34
Woodland (fair)	1.0	0.95	0.69	0.50	0.40
URBAN:					
Residential (1 DU/AC)	0.80	0.78	0.60	0.45	0.37
Residential (2 DU/AC)	0.70	0.68	0.53	0.39	0.32
Residential (4 DU/AC)	0.60	0.58	0.45	0.34	0.28
Residential (10 DU/AC)	0.40	0.39	0.30	0.22	0.18
Condominium	0.35	0.34	0.26	0.20	0.16
Mobile Home Park	0.25	0.24	0.19	0.14	0.12
Apartments	0.20	0.19	0.15	0.11	0.09
Commercial/Industrial	0.10	0.10	0.08	0.06	0.05

NOTES:

(1) Recommended a_p values from Figure C-4

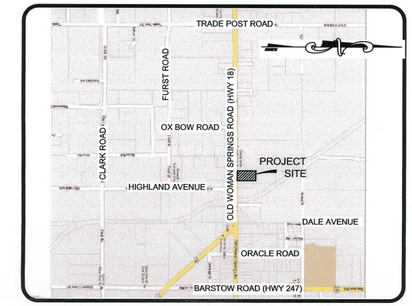
(2) AMC II assumed for all Fm values

(3) CN values obtained from Figure C-3

(4) DU/AC=dwelling unit per acre

APPENDIX E – IMPROVEMENT PLANS

- DETAIL SHEETS
- GRADING PLAN
- PLAN AND PROFILE – "NEW PAVED ROAD"
- PLAN AND PROFILES – OLD WOMAN SPRINGS ROAD



VICINITY MAP
N.T.S.

LEGEND

OF-1 / 0.16	BASIN ID / BASIN AREA (ACRES)
	BASIN BOUNDARY
	FLOW PATH
	FLOW ARROW
NODE 101	NODE NUMBER
ELEV: 1028	NODE ELEVATION

FLOW SUMMARY

GENERAL NOTE

PER INFORMATION OBTAINED FROM THE SAN BERNARDINO HYDROLOGY MANUAL (1986), FIGURE C-11 "HYDROLOGIC SOILS GROUP MAP FOR THE SOUTHCENTRAL AREA, " THE SOIL TYPE FOR THE PROJECT SITE IS A.

GRAPHIC SCALE

500 0 250 500 1000 2000

(IN FEET)
1 inch = 500 feet

FIGURE 1

APN: 0450-292-37

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BENCHMARK

"B 1308"; PID EV3537, A BENCHMARK DISK, SET IN THE TOP OF A GALVANIZED STEEL ROD W/O SLEEVE, STAMPED " B 1308 1978", AT THE SOUTHEAST CORNER OF THE JUNCTION OF BARSTOW ROAD, 124 FEET SOUTH OF THE CENTER LINE OF OLD WOMAN SPRINGS ROAD, 27 FEET EAST OF THE CENTER LINE OF BARSTOW ROAD, 6 FEET SOUTH OF JUNCTION POWERLINE POLE 1738672 E WITH A TRANSFORMER AND TWO GUY WIRES. THE DISTK PROJECTS 1 INCH ABOVE THE SURFACE OF THE GROUND, ACCESS TO WHICH IS HAD THROUGH A 4 INCH PLASTIC SCREW PLUG. 899.268m = 2950.35sft (NAVD 1988).

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MOHAMMAD QURESHI, TRAFFIC DIVISION CHIEF — DATE

RECOMMENDED BY:
APPROVED BY:
GIA KIM, CHIEF, LAND DEVELOPMENT DIVISION — DATE

OFFSITE DRAINAGE MAP

RETAIL BUILDING AT LUCERNE
LUCERNE VALLEY

DRAWING NO. OFF-1
ROAD NO. #
FILE NO. TBD
SHEET 1 OF 3

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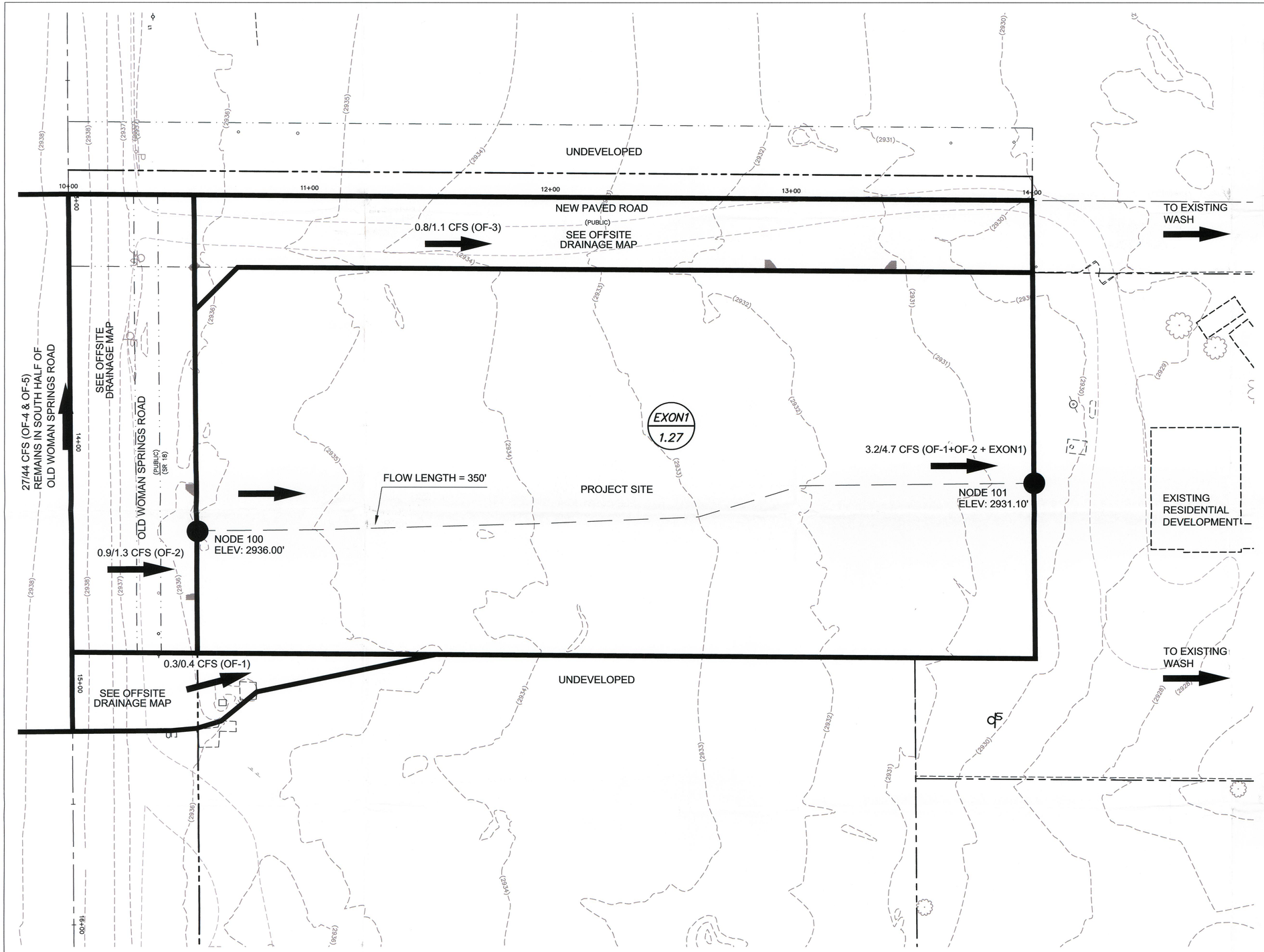

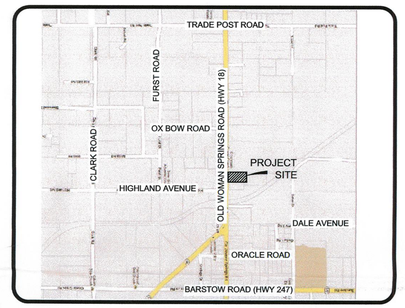

VICINITY MAP
N.T.S.

NORTH

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

LEGEND

EXON1 / 0.16	BASIN ID / BASIN AREA (ACRES)
	BASIN BOUNDARY
	FLOW PATH
	FLOW ARROW
NODE 101	NODE NUMBER
ELEV: 1028	NODE ELEVATION
34/51 CFS	25 YR / 100 YR FLOWRATE (CFS)

FLOW SUMMARY

BASIN ID*	BASIN AREA (acres)	NODE	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
EXON1	1.27	101	1.97	2.96
TOTAL	1.27	N/A	**1.97**	**2.96**

GENERAL NOTE

PER INFORMATION OBTAINED FROM THE SAN BERNARDINO HYDROLOGY MANUAL (1986), FIGURE C-11 "HYDROLOGIC SOILS GROUP MAP FOR THE SOUTHCENTRAL AREA, " THE SOIL TYPE FOR THE PROJECT SITE IS A.

FIGURE 2

APN: 0450-292-37

DRAWING NO.
EON-1

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APPROVED BY:

MOHAMMAD QURESHI TRAFFIC DIVISION CHIEF — DATE

GIA KIM CHIEF, LAND DEVELOPMENT DIVISION — DATE

EXISTING CONDITION ONSITE BASIN MAP

RETAIL BUILDING AT LUCERNE
LUCERNE VALLEY

ROAD NO.
#

FILE NO.
TBD

SHEET 2 OF 3

SUBMITTAL NO. TDS

WE PROJECT NO. 1253.00

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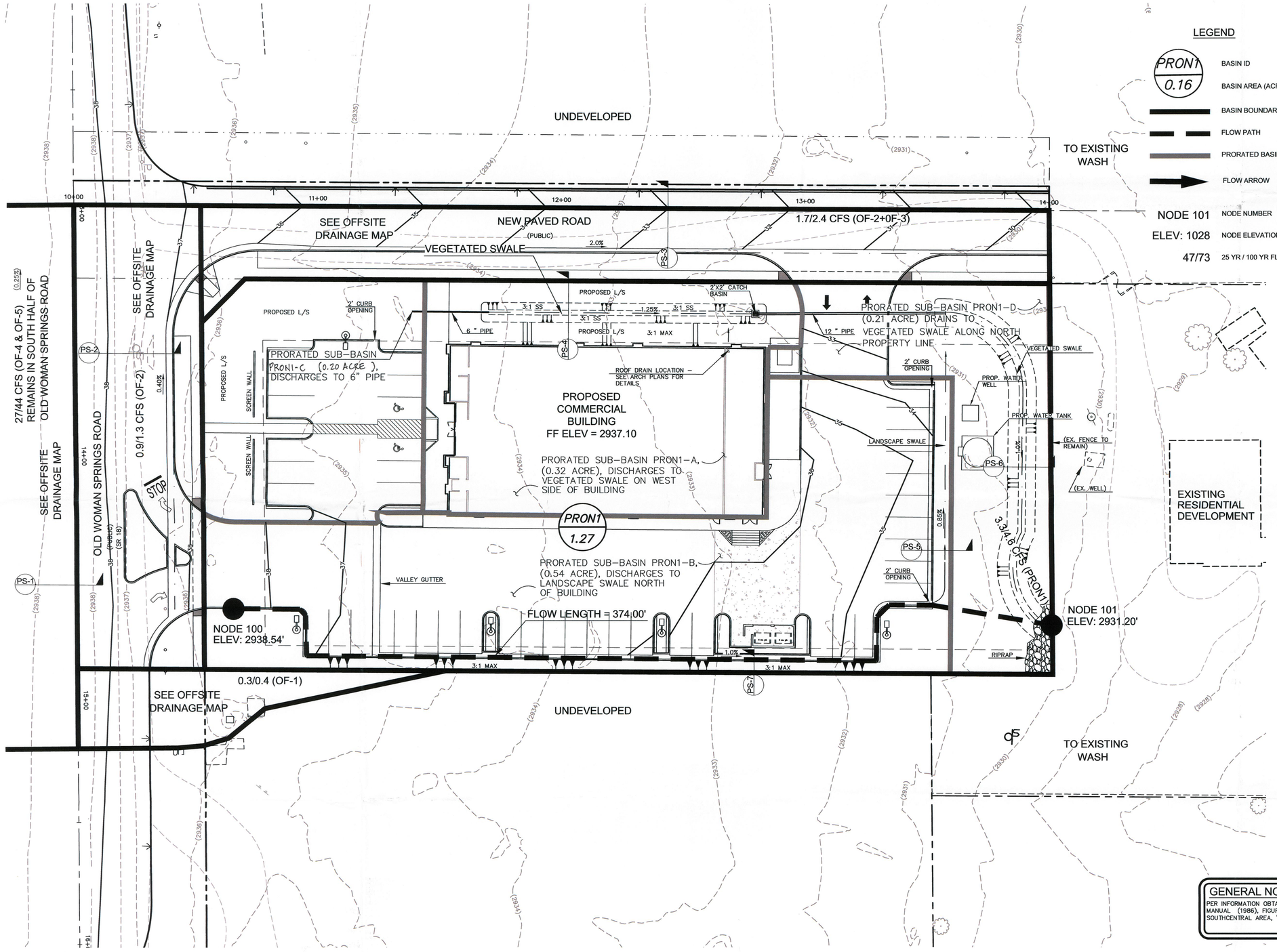
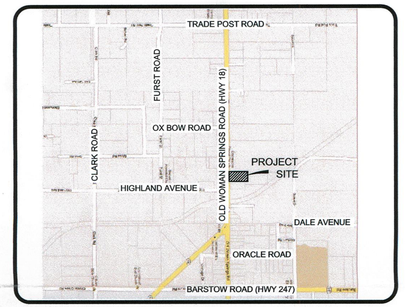


LEGEND

PRON1 / 0.16	BASIN ID / BASIN AREA (ACRES)
	BASIN BOUNDARY
	FLOW PATH
	PRORATED BASIN BOUNDARY
	FLOW ARROW
NODE 101	NODE NUMBER
ELEV: 1028	NODE ELEVATION
47/73	25 YR / 100 YR FLOWRATE (CFS)



VICINITY MAP
N.T.S.

NORTH

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

FLOW SUMMARY

BASIN ID*	BASIN AREA (acres)	NODE	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
PRON1	1.27	101	3.28	4.61
TOTAL	1.27	N/A	**3.28**	**4.61**

PRORATED FLOW RATES

SUBBASIN ID*	BASIN AREA (acres)	25-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
PRON1-A	0.32	0.83	1.16
PRON1-B	0.54	1.39	1.96
PRON1-C	0.2	0.52	0.73
PRON1-D	0.21	0.54	0.76
TOTAL	1.27	**3.24**	**4.61**

HYDRAULIC SUMMARY

SECTION*	Q25 (cfs)	Flow Depth (ft)	V25 (fps)	V*D	Q100 (cfs)	Flow Depth (ft)	V100 (fps)	V*D
PS-1 (Old Woman Springs Road south half)	27.13	0.70	1.52	1.06	44.00	0.84	1.72	1.44
PS-2 (Old Woman Springs Road north half)	0.94	0.28	1.36	0.38	1.29	0.31	1.46	0.45
PS-3 ("New Paved Road")	1.71	0.28	2.23	0.62	2.35	0.29	2.40	0.70
PS-4 (Vegetated Swale west of building)	N/A	N/A	N/A	N/A	1.89	0.90	0.45	N/A
PS-5 (Landscape swale north of building)	N/A	N/A	N/A	N/A	1.96	0.54	2.22	N/A
PS-6 (Vegetated Swale along north PL)	N/A	N/A	N/A	N/A	4.61	1.30	0.51	N/A
PS-7 (U-Gutter along east PL)	N/A	N/A	N/A	N/A	1.96	0.25	3.91	N/A

APN: 0450-292-37
FIGURE 3

GENERAL NOTE
PER INFORMATION OBTAINED FROM THE SAN BERNARDINO HYDROLOGY MANUAL (1986), FIGURE C-11 "HYDROLOGIC SOILS GROUP MAP FOR THE SOUTHCENTRAL AREA, " THE SOIL TYPE FOR THE PROJECT SITE IS TYPE A.

DRAWING NO.
PON-1

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BENCHMARK
"B 1308"; PID EV3537, A BENCHMARK DISK, SET IN THE TOP OF A GALVANIZED STEEL ROD W/O SLEEVE, STAMPED " B 1308 1978", AT THE SOUTHEAST CORNER OF THE JUNCTION OF BARSTOW ROAD, 124 FEET SOUTH OF THE CENTER LINE OF OLD WOMAN SPRINGS ROAD, 27 FEET EAST OF THE CENTER LINE OF BARSTOW ROAD, 6 FEET SOUTH OF JUNCTION POWERLINE POLE 17/38672 E WITH A TRANSFORMER AND TWO GUY WIRES. THE DISTK PROJECTS 1 INCH ABOVE THE SURFACE OF THE GROUND, ACCESS TO WHICH IS HAD THROUGH A 4 INCH PLASTIC SCREW PLUG. 899.268m = 2950.35eft (NAVD 1988).

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MOHAMMAD QURESHI — DATE
TRAFFIC DIVISION CHIEF

RECOMMENDED BY:

APPROVED BY:

GIA KIM — DATE
CHIEF, LAND DEVELOPMENT DIVISION

PROPOSED CONDITION ONSITE BASIN MAP

RETAIL BUILDING AT LUCERNE
LUCERNE VALLEY

ROAD NO.
#

FILE NO.
TBD

SHEET 3 OF 3

SUBMITTAL NO. TDS
WF PROJECT NO. 1253.00

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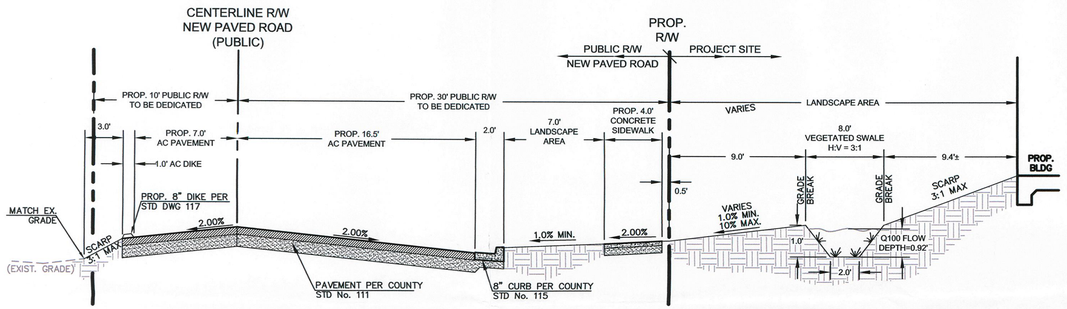
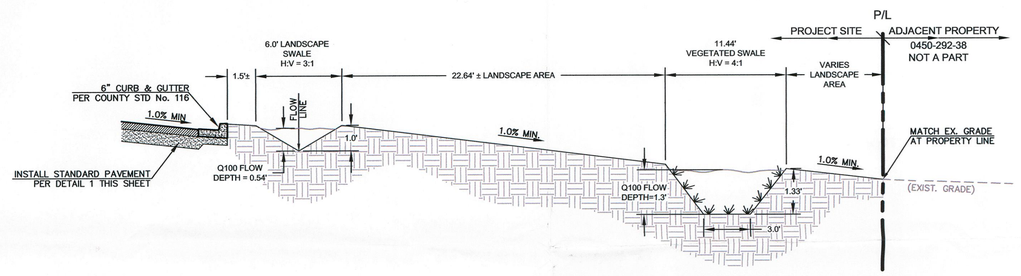
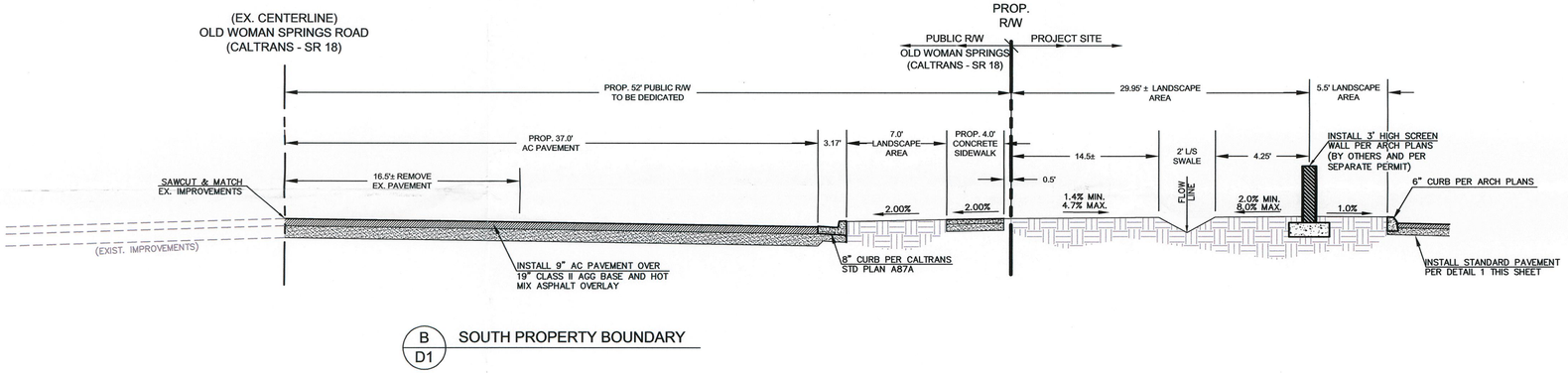


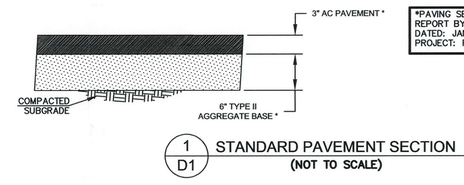
A / D1 WEST PROPERTY BOUNDARY
(NOT TO SCALE)



D / D1 NORTH PROPERTY BOUNDARY
(NOT TO SCALE)



B / D1 SOUTH PROPERTY BOUNDARY

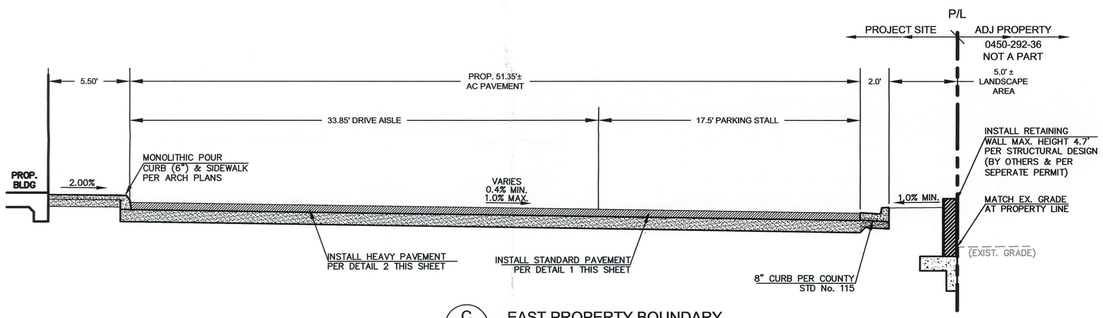


*PAVING SECTION SHOWN IS PER SOILS
REPORT BY: PSI INC.
DATED: JANUARY 22,, 2013
PROJECT: PSI-0559869

1 / D1 STANDARD PAVEMENT SECTION
(NOT TO SCALE)

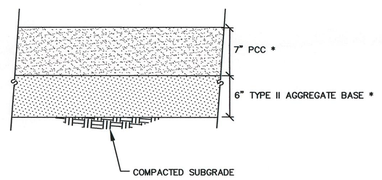
*PAVING SECTION SHOWN IS PER SOILS
REPORT BY: PSI INC.
DATED: JANUARY 22, 2013
PROJECT: PSI-0559869

2 / D1 HEAVY PAVEMENT SECTION
(NOT TO SCALE)



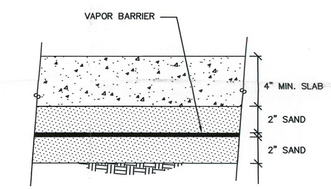
C / D1 EAST PROPERTY BOUNDARY
(NOT TO SCALE)

*PAVING SECTION SHOWN IS PER SOILS
REPORT BY: PSI INC.
DATED: JANUARY 22, 2013
PROJECT: PSI-0559869



3 / D1 PCC SECTION
(NOT TO SCALE)

** PAD SECTION SHOWN IS PER SOILS
REPORT BY: PSI INC.
DATED: JANUARY 22, 2013
PROJECT: PSI-0559869
SECTION TO BE VERIFIED WITH STRUCTURAL
ENGINEER PRIOR TO CONSTRUCTION.



8 / D1 PAD SECTION**
(NOT TO SCALE)

Underground Service Alert
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Call: TOLL FREE
1-800-227-2600
TWO WORKING DAYS BEFORE YOU DIG

BENCHMARK
B 1308"; PID EV3537,
A BENCHMARK DISK, SET IN THE TOP OF A GALVANIZED STEEL ROD W/O SLEEVE, STAMPED " B 1308 1978", AT THE SOUTHEAST CORNER OF THE JUNCTION OF BARSTOW ROAD, 124 FEET SOUTH OF THE CENTER LINE OF OLD WOMAN SPRINGS ROAD, 27 FEET EAST OF THE CENTER LINE OF BARSTOW ROAD, 6 FEET SOUTH OF JUNCTION POWERLINE POLE 1738672 E WITH A TRANSFORMER AND TWO GUY WIRES. THE DISK PROJECTS 1 INCH ABOVE THE SURFACE OF THE GROUND, ACCESS TO WHICH IS HAD THROUGH A 4 INCH PLASTIC SCREW PLUG.
899.268m = 2950.35sft (NAVD 1988).

DEVELOPER
DYNAMIC DEVELOPMENT CO
1725 21ST STREET
SANTA MONICA, CA 90404
TEL: 310.315.5411
CONTACT: JON TANURY
Dynamic DEVELOP DESIGN BUILD

PREPARED BY:
WALKER
ENGINEERING, LLC
5765 S. RAINBOW BLVD, STE. 101
LAS VEGAS, NV 89118
T: 702.873.5197 F: 702.873.5346
WE
meeting your land development needs

REGISTERED PROFESSIONAL ENGINEER
DEBRA M. YAMACHIKA
64488
Exp. 6-30-13
CIVIL
STATE OF CALIFORNIA
7/25/13

MARK	REVISIONS	APPR	DATE

COUNTY OF SAN BERNARDINO
DEPARTMENT OF PUBLIC WORKS

MOHAMMAD SIDDIQUI — DATE
ENGINEER, TRAFFIC DIVISION

MOHAMMAD QURESHI — DATE
TRAFFIC DIVISION CHIEF

RECOMMENDED BY: — DATE

APPROVED BY: — DATE
GIA KIM
CHIEF, LAND DEVELOPMENT DIVISION

DETAIL SHEET

RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

DRAWING NO.
D1

ROAD NO.
#

FILE NO.
TBD

SHEET 3 OF 8

SUBMITTAL NO. TDS
WE PROJECT NO. 1253.00

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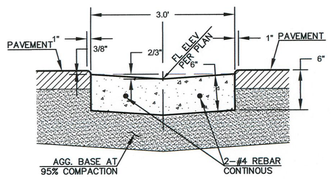
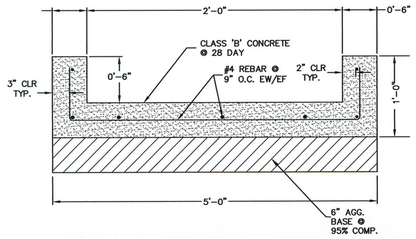
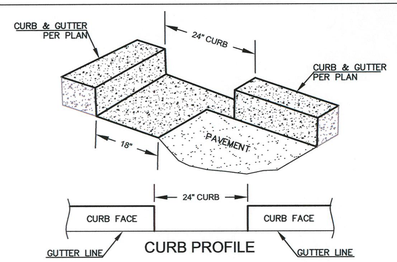


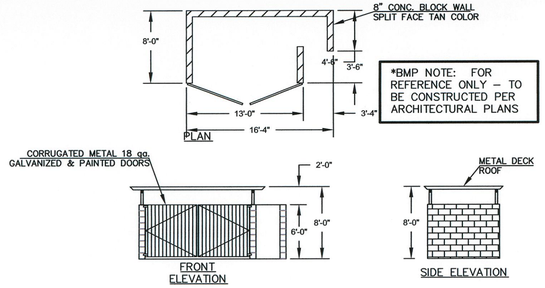
1 / D2 3' VALLEY GUTTER (NOT TO SCALE)



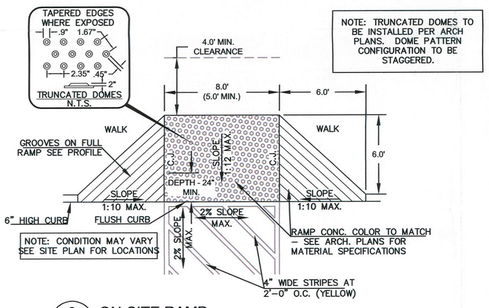
5 / D2 2' WIDE CONCRETE U-GUTTER (NOT TO SCALE)



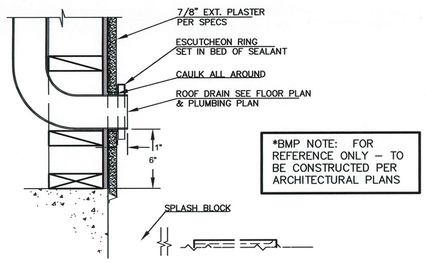
2 / D2 2' CURB OPENING (NOT TO SCALE)



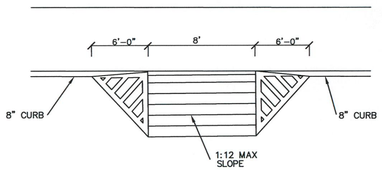
6 / D2 COVERED TRASH ENCLOSURE PER SEPARATE PERMIT (NOT TO SCALE)



3 / D2 ON-SITE RAMP (NOT TO SCALE)



7 / D2 ROOF DRAIN OUTLET PER PER SEPARATE PERMIT (NOT TO SCALE)



4 / D2 ON-SITE RAMP (NOT TO SCALE)

SUBMITTAL NO. TDS

WE PROJECT NO. 1253.00

DRAWING NO. D2

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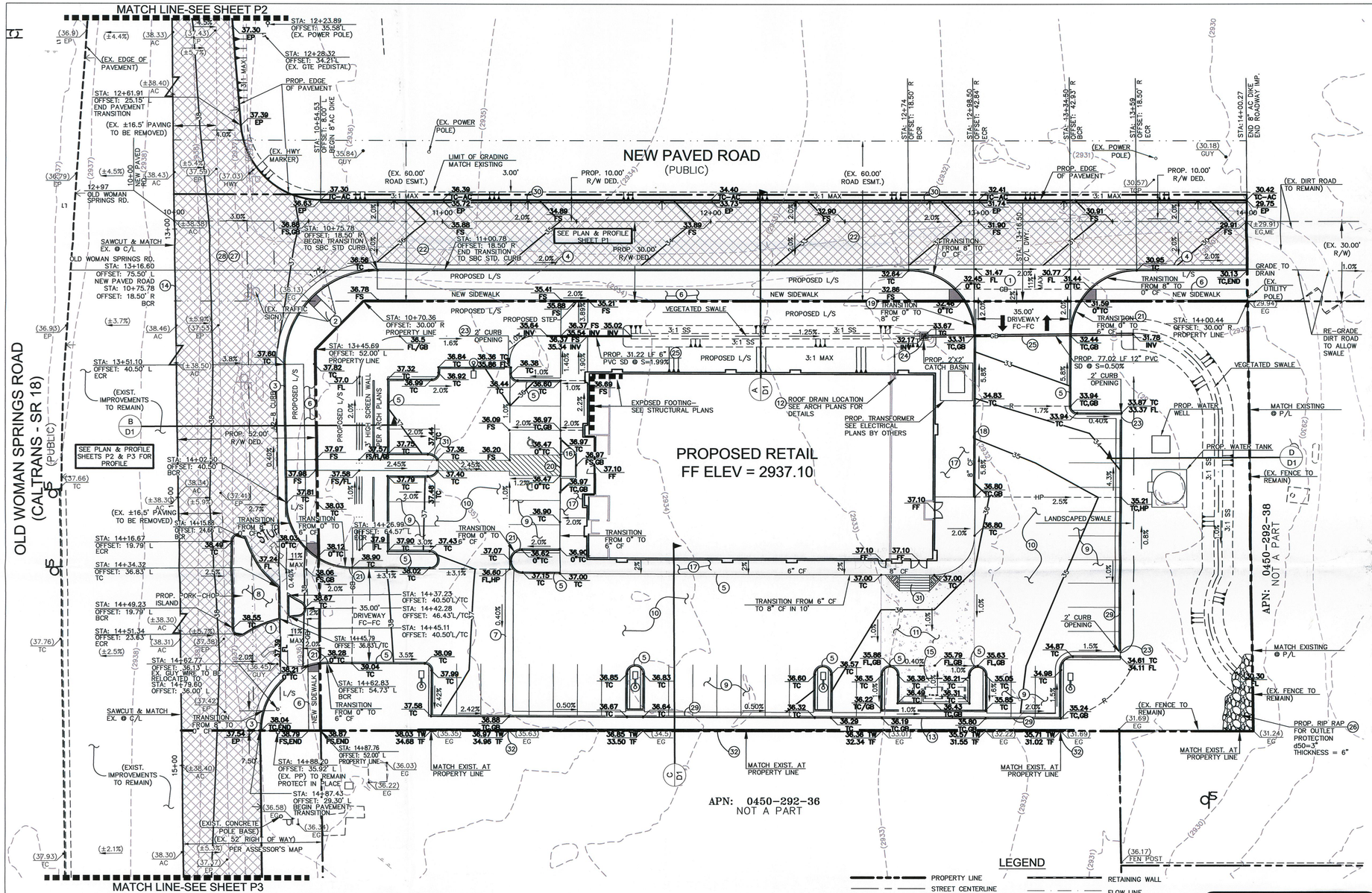
CHIEF, LAND DEVELOPMENT DIVISION

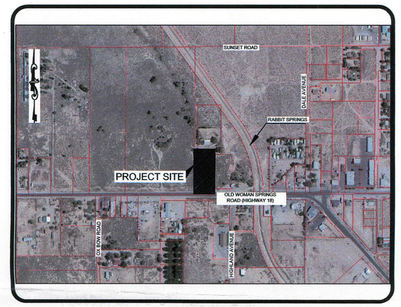
DETAIL SHEET

RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

ROAD NO. #
FILE NO. TBD
SHEET 4 OF 8

E:\1253_DYNAMIC\DWG\LMPRDWGS\04-1253D1.dwg, 4/25/2013 3:16:09 PM, rcabrera, DJ 1050c.pc3





VICINITY MAP
N.T.S.

NORTH

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

NO	CONSTRUCTION NOTES ITEM
1	CONSTRUCT COMMERCIAL DRIVEWAY PER COUNTY STD No. 129B
2	CONSTRUCT CURB RAMP PER CALTRANS STD PLAN A88A, CASE A
3	CONSTRUCT 8" CURB AND GUTTER PER CALTRANS STD PLAN A87A
4	CONSTRUCT 8" CURB AND GUTTER PER COUNTY STD No. 115
5	CONSTRUCT 6" ONSITE CURB PER ARCHITECTURAL PLANS
6	CONSTRUCT SIDEWALK (TYPE "B") PER COUNTY STD No. 109
7	CONSTRUCT 3' WIDE VALLEY GUTTER PER DETAIL 1 ON SHEET D2
8	CONSTRUCT RAISED PASSAGEWAY (TYPE "B") PER CALTRANS STD PLAN A88B
9	CONSTRUCT 3" MIN AC OVER 4" TYPE II AGG. BASE PER SOILS REPORT BY PSI. SEE DETAIL 2 ON SHEET D1
10	CONSTRUCT 4" MIN AC OVER 6" TYPE II AGG. BASE PER SOILS REPORT BY PSI. SEE DETAIL 3 ON SHEET D1
11	CONSTRUCT 6" MIN PCC OVER 4" TYPE II AGG. BASE PER SOILS REPORT BY PSI. SEE DETAIL 4 ON SHEET D1.
12	CONSTRUCT 8" PVC ROOF DRAIN PER ARCHITECTURAL PLANS
13	CONSTRUCT 2' WIDE U-GUTTER PER DETAIL 5 ON SHEET D2
14	SAWCUT AND JOIN EXISTING A/C PAVEMENT
15	CONSTRUCT TRASH ENCLOSURE PER ARCHITECTURAL PLANS
16	CONSTRUCT ON-SITE RAMP PER DETAIL 3 ON SHEET D2
17	CONSTRUCT MONOLITHIC POUR OF CURB & SIDEWALK ADJACENT TO BUILDING. SEE ARCH. PLANS FOR DETAILS.
18	CONSTRUCT 8" ONSITE CURB PER ARCHITECTURAL PLANS
19	TRANSITION FROM 0" CURB TO 8" CURB IN 10' OR AS SHOWN ON PLANS
20	CONSTRUCT 0" CURB
21	TRANSITION FROM 0" CURB TO 6" CURB IN 10' OR AS SHOWN ON PLANS
22	CONSTRUCT HALF WIDTH LOCAL STREET PER COUNTY STD No. 111
23	CONSTRUCT 2' CURB OPENING PER DETAIL 2 ON SHEET D2
24	CONSTRUCT 2'X2' JENSEN DROP INLET (PEDESTRIAN RATED GRATE) OR SIMILAR
25	CONSTRUCT PVC STORM DRAIN PIPE (SIZE PER PLAN)
26	CONSTRUCT RIPRAP (SIZE PER PLAN)
27	CONSTRUCT 9" A.C. OVER 19" CLASS II AGGREGATE BASE AND HOT MIX ASPHALT OVERLAY
28	COLD PLAN (GRIND) EXISTING PAVEMENT TO ACHIEVE 0.25' MINIMUM OF OVERLAY THICKNESS.
29	CONSTRUCT 6" CURB AND GUTTER PER COUNTY STD No. 116
30	CONSTRUCT 8" AC DIKE PER COUNTY STD No. 117
31	CONSTRUCT ON-SITE RAMP PER DETAIL 4 ON SHEET D2
32	CONSTRUCT RETAINING WALL PER STRUCTURAL DESIGN BY OTHERS, SEPARATE PERMIT MAX H=4.7'

LEGAL DESCRIPTION

PARCEL 1:

THAT PORTION OF THE SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE GOVERNMENT SURVEY, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT 297 FEET EAST OF THE SOUTHWEST CORNER OF THE SOUTHWEST ¼ OF THE SOUTHEAST ¼, SAID POINT BEING THE SOUTHEAST CORNER OF THE WEST 9 ACRES OF THE SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SAID SECTION;
THENCE EAST 190 FEET;
THENCE NORTH 400 FEET;
THENCE WEST 190 FEET TO THE EAST LINE OF THE WEST 9 ACRES OF SAID SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SAID SECTION;
THENCE SOUTH ALONG THE EAST LINE THEREOF; 600 FEET TO THE TRUE POINT OF BEGINNING.

PARCEL 2:

AN EASEMENT FOR INGRESS AND EGRESS AND PUBLIC UTILITY PURPOSES OVER A 60 FOOT STRIP OF LAND LYING 30 FEET ON EACH SIDE OF THE FOLLOWING DESCRIBED LINE;

BEGINNING AT A POINT 291 FEET EAST OF THE SOUTHWEST CORNER OF THE SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA ACCORDING TO GOVERNMENT SURVEY, SAID POINT BEING THE SOUTHEAST CORNER OF THE WEST 9 ACRES OF SAID SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SAID SECTION, SAID POINT ALSO BEING THE TRUE POINT OF BEGINNING; THENCE NORTH 400 FEET.

BASIS OF BEARINGS

SOUTH 89°31'53" WEST, BEING THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW ¼) OF THE SOUTHEAST QUARTER (SE ¼) OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST, S.B.M., LUCERNE VALLEY, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

LEGEND

- PROPERTY LINE
- STREET CENTERLINE
- EXISTING WALL
- PROPOSED BUILDING
- (2930) EXISTING CONTOUR
- 30 PROPOSED CONTOUR
- PROPOSED CURB & GUTTER
- PROPOSED CURB
- EXISTING CURB & GUTTER
- EXISTING CURB
- EXISTING BUILDING
- (10) CONSTRUCTION NOTE
- CUT FILL TRANSITION
- SAWCUT LIMITS
- 3:1 SCARP
- RETAINING WALL
- FLOW LINE
- EASEMENT LINE
- HANDICAP PARKING
- FS FINISHED SURFACE
- TC CURB BACK
- EP EDGE OF PAVEMENT
- FG FINISHED GRADE
- FL FLOW LINE
- FF FINISHED FLOOR
- TW TOP OF WALL
- TF TOP OF FOOTING
- 30.50 TC (32.27) AC PROPOSED GRADE
- EXISTING GRADE
- 0.40% SLOPE
- NEW PAVEMENT

EARTHWORK QUANTITIES

*NOTE: THESE QUANTITIES ARE APPROXIMATE AND ARE RAW VOLUMES ONLY. OVEREXCAVATION SUBSIDENCE, SHRINKAGE, & BULKING FACTORS ARE NOT TAKEN INTO ACCOUNT.

CUT = TBD CY
FILL = TBD CY

GEOTECHNICAL NOTE

PER THE GEOTECHNICAL ENGINEERING SERVICES REPORT PERFORMED BY PROFESSIONAL SERVICES INDUSTRIES, REPORT NO. 0559869, DATED JANUARY 22, 2013:

1. THE SITE IS LOCATED WITHIN THE HELENDALE FAULT ZONE, A CURRENTLY DESIGNATED EARTHQUAKE FAULT ZONE PER THE ALQUIST-PRIOLO SPECIAL STUDIES ZONE MAP.

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ENGINEER, TRAFFIC DIVISION

MOHAMMAD QURESHI — DATE
TRAFFIC DIVISION CHIEF

RECOMMENDED BY:

APPROVED BY:
GIA KIM — DATE
CHIEF, LAND DEVELOPMENT DIVISION

PRECISE GRADING PLAN
RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

DRAWING NO. G1
ROAD NO. TBD
FILE NO. TBD
SHEET 5 OF 8

SUBMITTAL NO. TDS
WE PROJECT NO. 1253.00

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DJ 1050c.pc3

FLOODZONE:

THE PARCEL DESCRIBED HEREON LIES WITHIN THE FLOOD HAZARD ZONE HAVING A ZONE DESIGNATION OF "D" (AREAS WITH POSSIBLE BUT UNDETERMINED FLOOD HAZARDS) PER FIRM PANEL NO. 06071C6575H, AN UNPUBLISHED FIRM PANEL.

CURVE & LINE DATA:

SEE SHEET H1 FOR OFF-SITE BACK OF CURB CURVE & LINE DATA.

CALTRANS PERMIT REQUIRED

NO WORK SHALL COMMENCE WITHIN THE CALTRANS RIGHT OF WAY (OLD WOMAN SPRINGS ROAD SR 247) WITHOUT THE APPROVED CALTRANS PERMIT.

CALTRANS NOTICE TO CONTRACTOR:

WHERE DAMAGE IS CAUSED BY THE CONTRACTOR'S OPERATION, THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, REPAIR OR REPLACE DAMAGE FACILITIES PROMPTLY IN ACCORDANCE WITH STATE SPECIFICATIONS AND/OR AS DIRECTED BY THE DEPARTMENT REPRESENTATIVE.

BASIS OF BEARINGS

SOUTH 89°31'53" WEST, BEING THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW ¼) OF THE SOUTHEAST QUARTER (SE ¼) OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST, S.B.M., LUCERNE VALLEY, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

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THENCE WEST 190 FEET TO THE EAST LINE OF THE WEST 9 ACRES OF SAID SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SAID SECTION;
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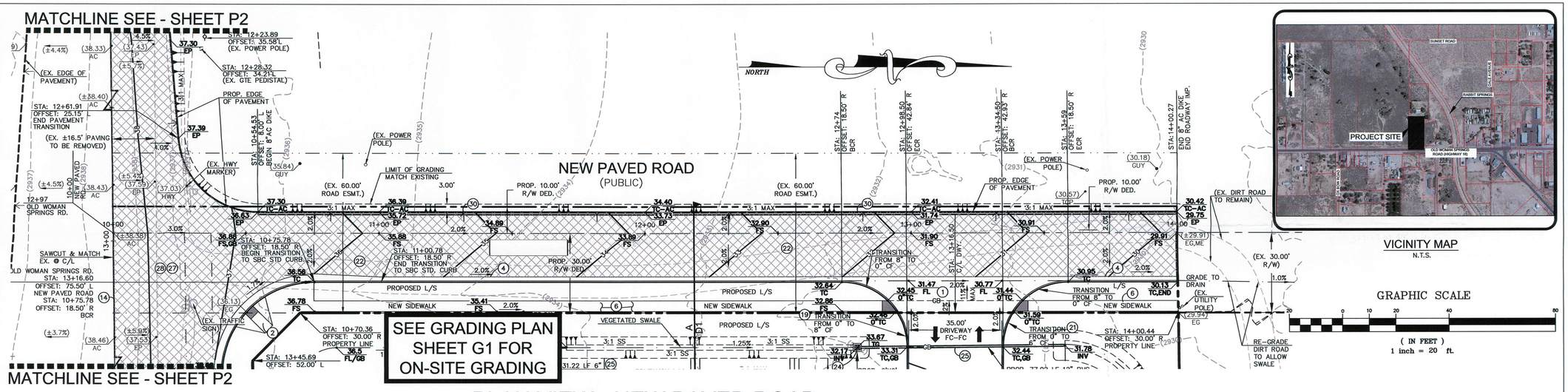
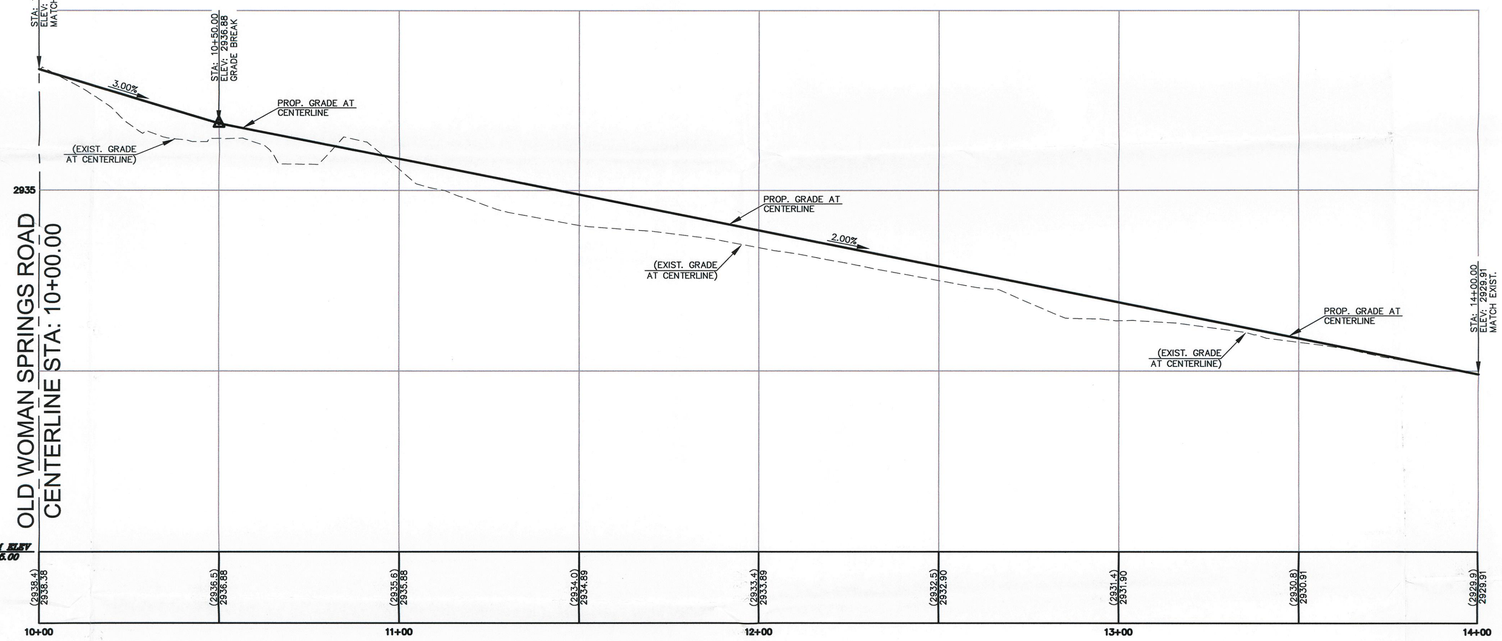


PLAN VIEW - NEW PAVED ROAD

STA: 10+00.00 TO STA: 14+00.00



PROFILE

HORIZ. SCALE: 1"=20'
VERT. SCALE: 1"=2'

LEGEND

PROPERTY LINE	RETAINING WALL
STREET CENTERLINE	FLOW LINE
EXISTING WALL	EASEMENT LINE
PROPOSED BUILDING	HANDICAP PARKING
(2930) EXISTING CONTOUR	FS FINISHED SURFACE
30 PROPOSED CONTOUR	TC CURB BACK
PROPOSED CURB & GUTTER	EP EDGE OF PAVEMENT
PROPOSED CURB	FG FINISHED GRADE
EXISTING CURB & GUTTER	FL FLOW LINE
EXISTING CURB	FF FINISHED FLOOR
EXISTING BUILDING	TW TOP OF WALL
(10) CONSTRUCTION NOTE	TF TOP OF FOOTING
CUT FILL TRANSITION	30.50 TC PROPOSED GRADE
SAWCUT LIMITS	(32.27) AC EXISTING GRADE
3:1 SCARP	0.40% SLOPE
	NEW PAVEMENT

	CONSTRUCTION NOTES
NO	ITEM
1	CONSTRUCT COMMERCIAL DRIVEWAY PER COUNTY STD No. 129B
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A BENCHMARK DISK, SET IN THE TOP OF A GALVANIZED STEEL ROD W/O SLEEVE, STAMPED " B 1308 1978", AT THE SOUTHEAST CORNER OF THE JUNCTION OF BARSTOW ROAD, 124 FEET SOUTH OF THE CENTER LINE OF OLD WOMAN SPRINGS ROAD, 27 FEET EAST OF THE CENTER LINE OF BARSTOW ROAD, 6 FEET SOUTH OF JUNCTION POWERLINE POLE 1738672 E WITH A TRANSFORMER AND TWO GUY WIRES. THE DISK PROJECTS 1 INCH ABOVE THE SURFACE OF THE GROUND, ACCESS TO WHICH IS HAD THROUGH A 4 INCH PLASTIC SCREW PLUG.
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COUNTY OF SAN BERNARDINO
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MOHAMMAD SIDDIQUI, ENGINEER, TRAFFIC DIVISION — DATE
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PLAN & PROFILE-NEW PAVED ROAD

RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

DRAWING NO. P1
ROAD NO. TBD
FILE NO. TBD
SHEET 6 OF 8

SUBMITTAL NO. TDS
WE PROJECT NO. 1253.00

E:\1253_DYNAMIC\DWG\MPRDWGS\08-1253P1.dwg, 4/25/2013 2:21:21 PM, rcabrera, DJ 1050c.pc3

FLOODZONE:

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CURVE & LINE DATA:

SEE SHEET H1 FOR OFF-SITE BACK OF CURB CURVE & LINE DATA.

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BASIS OF BEARINGS

SOUTH 89°31'53" WEST, BEING THE SOUTH LINE OF THE SOUTHWEST QUARTER (SW ¼) OF THE SOUTHEAST QUARTER (SE ¼) OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST, S.B.M., LUCERNE VALLEY, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.

LEGAL DESCRIPTION

PARCEL 1:

THAT PORTION OF THE SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SECTION 11, TOWNSHIP 4 NORTH, RANGE 1 WEST SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE GOVERNMENT SURVEY, DESCRIBED AS FOLLOWS:

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THENCE EAST 190 FEET;
THENCE NORTH 400 FEET;
THENCE WEST 190 FEET TO THE EAST LINE OF THE WEST 9 ACRES OF SAID SOUTHWEST ¼ OF THE SOUTHEAST ¼ OF SAID SECTION;
THENCE SOUTH ALONG THE EAST LINE THEREOF; 600 FEET TO THE TRUE POINT OF BEGINNING.

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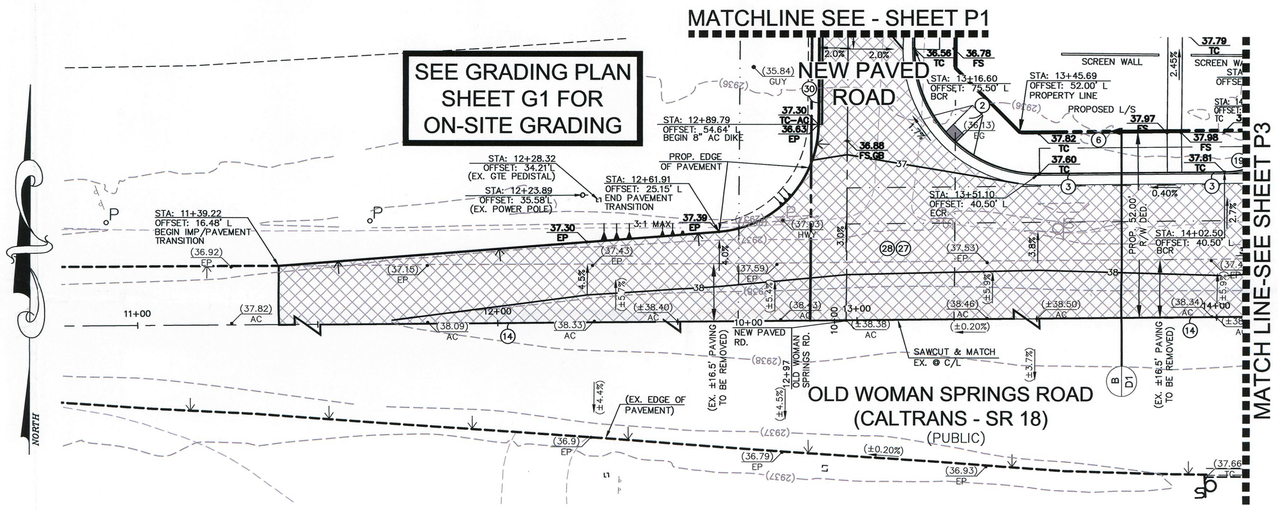
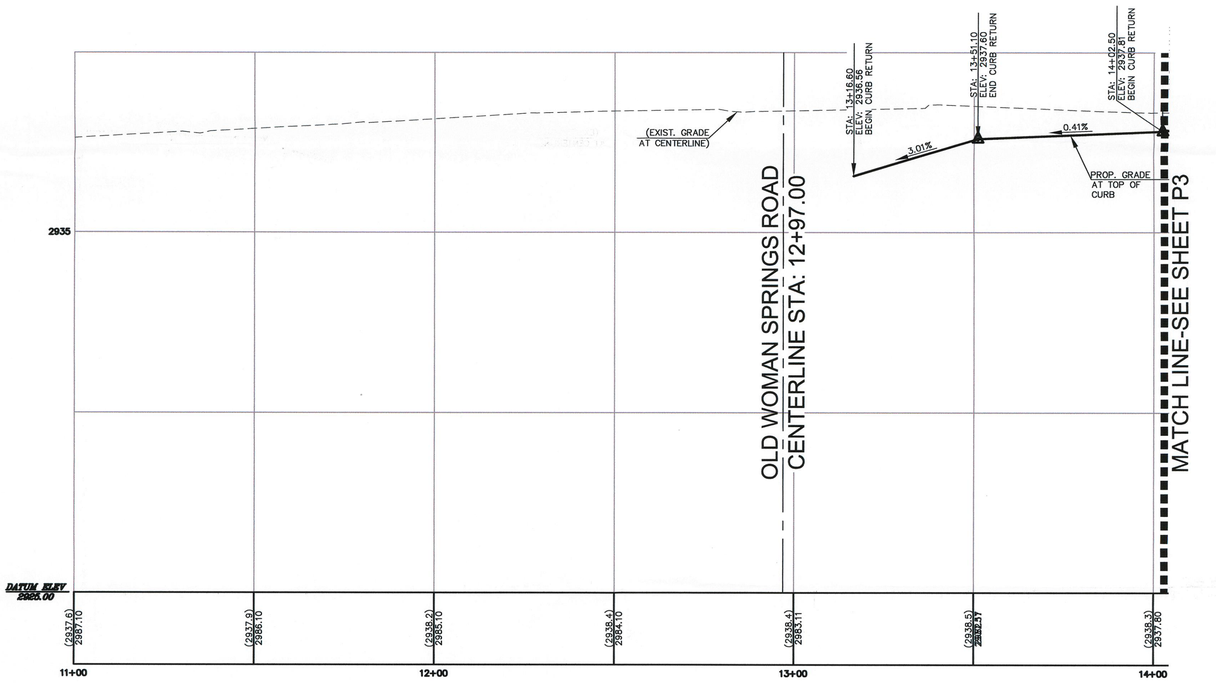


PLAN VIEW - OLD WOMAN SPRINGS

STA: 10+00.00 TO STA: 14+00.00



PROFILE

HORIZ. SCALE: 1"=20'
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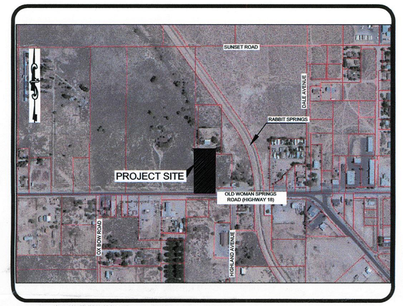

VICINITY MAP
N.T.S.

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

	CONSTRUCTION NOTES
NO	ITEM
1	CONSTRUCT COMMERCIAL DRIVEWAY PER COUNTY STD No. 129B
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3	CONSTRUCT 8" CURB AND GUTTER PER CALTRANS STD PLAN A87A
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LEGEND

	PROPERTY LINE		RETAINING WALL
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	EXISTING WALL		EASEMENT LINE
	PROPOSED BUILDING		HANDICAP PARKING
(2930)	EXISTING CONTOUR	FS	FINISHED SURFACE
30	PROPOSED CONTOUR	TC	CURB BACK
	PROPOSED CURB & GUTTER	EP	EDGE OF PAVEMENT
	PROPOSED CURB	FG	FINISHED GRADE
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	EXISTING CURB	FF	FINISHED FLOOR
	EXISTING BUILDING	TW	TOP OF WALL
10	CONSTRUCTION NOTE	TF	TOP OF FOOTING
	CUT FILL TRANSITION	30.50 TC	PROPOSED GRADE
	SAWCUT LIMITS	(32.27) AC	EXISTING GRADE
3:1	SCARP	0.40%	SLOPE
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APPROVED BY:
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PLAN & PROFILE-OLD WOMAN SPRINGS
RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

ROAD NO. TBD
FILE NO. TBD
SHEET 7 OF 8

DRAWING NO. P2

SUBMITTAL NO. TDS
PROJECT NO. 1253.00

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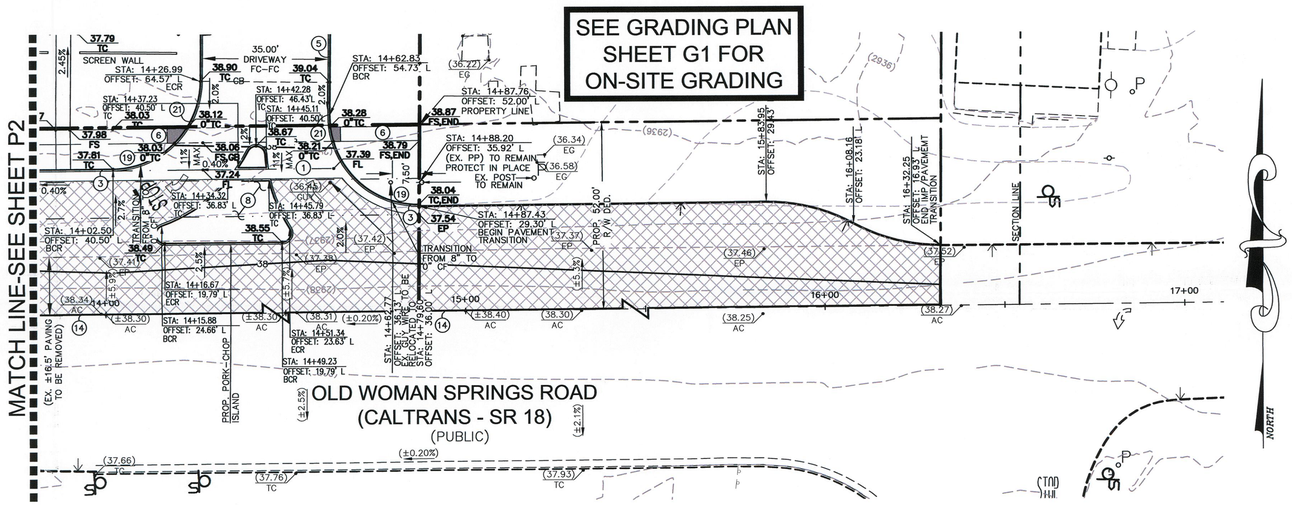
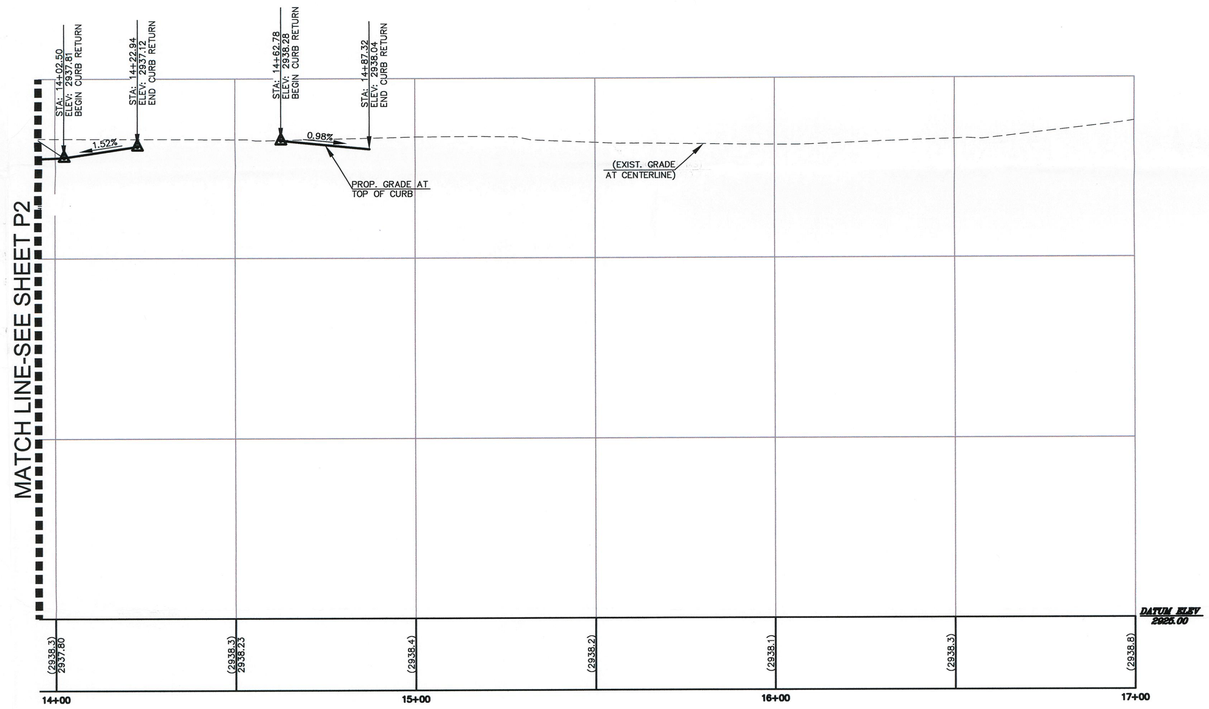


PLAN VIEW - OLD WOMAN SPRINGS

STA: 14+00.00 TO STA: 17+00.00



PROFILE

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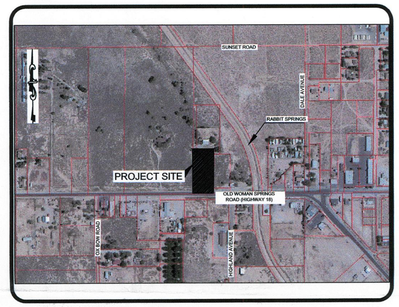

VICINITY MAP
N.T.S.

GRAPHIC SCALE

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(IN FEET)
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LEGEND

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PLAN & PROFILE-OLD WOMAN SPRINGS

RETAIL BUILDING AT
OLD WOMAN SPRINGS & HIGHLAND

DRAWING NO. P3
ROAD NO. TBD
FILE NO. TBD
SHEET 8 OF 8

SUBMITTAL NO. TDS
WF PROJECT NO. 1253.00

E:\1253_DYNAMIC\DWG\IMPRDWGS\09-1253P2.dwg, 4/25/2013 1:24:29 PM, rcabrera, DJ 1050c.pc3