APPENDIX F

PRELIMINARY HYDROLOGY REPORT

PRELIMINARY HYDROLOGY REPORT

AutoZone Oak Hills

APN: 0357-421-15-0-000, 0357-421-16-0-000

September 2020

PREPARED FOR:

AutoZone Parts, Inc.
123 S. Front Street, 3rd Floor
Memphis, TN 38103
(901) 495-8714

PREPARED BY:

Kimley»Horn

765 the City Drive South, Suite 200
Orange, CA 92868
(714) 705-1374

KHA Project #

Certification by Engineer or Authorized Qualified Designee

I certify under penalty of law that this document and all attachments were prepared under my jurisdiction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathered the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Jacob Glaze, PE Date

Contents

References

Hydrology Manual. San Bernardino County, August 1986.

Section 100

100.0 Introduction

Kimley-Horn and Associates has been retained to prepare a Preliminary Drainage Study for the proposed commercial retail building in Oak Hills, California. The 1.06-acre (46,203 Sq. Ft.) site is located southeast of the intersection of Ranchero Road and Escondido Avenue. The APNs for the project site are 0357-421-15-0-000 and 0357-421-16-0-000. **Appendix A** contains an aerial photograph that depicts the project location. The intention of this report is to comply with the requirements of the San Bernardino County Hydrology Manual to assist in the development of the existing vacant site.

The purpose of this report is to provide information regarding the Storm Water Management System (SWMS) design for the proposed development. This investigation was conducted to evaluate the hydrologic conditions in the existing and proposed conditions of the site. Hydraulic calculations to determine the sizing requirements for the proposed on-site drainage system will be included in the Final Drainage Study.

Due to the nature of the project, this report will be accompanied by a Water Quality Management Plan (WQMP). The project proposes to install an infiltration basin system for the proposed development, following the current NPDES General Permit. Since the proposed site proposes onsite retention, the proposed development is not expected to generate additional run-off downstream. Under the proposed condition, there will be no offsite drainage conveyed through the site. Therefore, a hydrology analysis for offsite drainage was not completed.

100.1 Project Description

The proposed project consists of a proposed commercial retail building with associated commercial landscaping, concrete hardscape and asphalt paving parking. The existing site is approximately 0% impervious. Once developed, the site will be approximately 85% impervious.

100.2 Location

The site is located southeast of the intersection of Ranchero Road and Escondido Avenue in Oak Hills, San Bernardino County. The project is bounded by the partially improved Ranchero Road to the north and vacant lots to the west, east and south.

For reference, see **Appendix A**, *Location and Vicinity Maps*.

100.3 Methodology

This Hydrology Report is intended to comply with the requirements of the San Bernardino County Hydrology Manual to assist in the proposed development of the existing site into the proposed AutoZone. The report includes existing and proposed condition hydrologic analysis to determine if the proposed development's run-off will have any impact on downstream properties.

A rational method analysis for the 10-year and 100-year events in accordance with the San Bernardino Hydrology Manual (SBC, 1986) and the 2010 Addendum was completed to calculate the peak discharges for the existing and proposed project conditions. Results from the rational method analysis were used for the synthetic unit hydrograph analysis.

Per the 2010 San Bernardino County Hydrology Manual Addendum, arid regions within San Bernardino County should use NOAA Atlas 14 rainfall atlas and the associated data base (NOAA, 2006) or other local rainfall gauge data for hydrology studies. After review of available data, the NOAA Atlas 14 rainfall data was used for this study. NOAA Atlas 14 also provides information for the various peak durations required to complete the hydrology analysis for the current study.

According to NOAA Atlas 14, the following are the precipitation values that have been utilized for this study:

10-year storm 1-hour intensity (inch/hour)	=	0.809
100-year storm 1-hour intensity (inch/hour)	=	1.33
100-year storm 5-minute point rainfall (inches)	=	0.356
100-year storm 30-minute point rainfall (inches)	=	0.924
100-year storm 1-hour point rainfall (inches)	=	1.33
100-year storm 3-hour point rainfall (inches)	=	2.23
100-year storm 6-hour point rainfall (inches)	=	3.17
100-year storm 24-hour point rainfall (inches)	=	6.50

Appendix F contains the site-specific tabular output from NOAA Atlas 14.

The type of soil and soil conditions are major factors affecting infiltration/detention and resultant storm water runoff. The Natural Resources Conservation Service (NRCS) has classified soil into one general hydrologic soil groups for comparing infiltration and runoff rates. Each group is based on properties that influence runoff, such as water infiltration rate, texture, natural discharge and moisture condition. The runoff potential is based on the amount of runoff at the end of a long duration storm that occurs after wetting and swelling of the soil not protected by vegetation. Using the soil map included in Figure C-11 of the San Bernardino County Hydrology Manual and the Stormwater Facility Mapping online tool for Riverside County, it was determined the hydrologic soil group classification is B. Soil group B is defined as soils having moderate infiltration rates (moderate runoff potential). These soils have a moderate rate of water transmission. See **Appendix F** for the soil reference material and **Appendix E** for the Geotechnical Reports. Infiltration testing will be completed for the Final Drainage Study.

In addition, antecedent moisture condition (AMC) II was used to calculate the 10-year and AMC III for the 100-year peak flows based on the 2010 San Bernardino County Hydrology Manual Addendum. The land use for the existing drainage areas was selected as barren, based on the existing conditions. The land use for the proposed drainage areas were selected based on the proposed impervious percent of the site. The proposed development is estimated to be 85% impervious. The combination of the soil and coverage type was used as the basis for selecting the appropriate curve numbers used to calculate the soil loss rates. See **Appendix F** Figure C-4 for curve numbers based on hydrologic soil conditions for pervious areas.

Using the data specific to the project site, as discussed above, Advanced Engineering Software (AES) Hydrosoft package was used to complete the rational method and the synthetic unit hydrograph analyses. The results of the analyses are included in **Appendix C and D**.

100.4 Drainage Characteristics

The site is in Flood Zone D per the Federal Emergency Management August 28, 2008. Flood Zone D is defined by FEMA as areas where there are possible but undetermined flood hazards, as no analysis of flood hazards has been conducted.

For reference, see **Appendix B**, *FIRMette Map.*

100.4.1 Pre-development Condition

Under the existing condition, there is minor offsite drainage conveyed through the site. A portion of the stormwater flows from the vacant property west of the project site flow are conveyed through the site, which then continue flowing northeast.

The existing condition of the project site is vacant and generally drains in a northeast direction. In the existing condition, there are two (2) drainage areas (DA). A portion of the site drains northeast toward Ranchero Road. Stormwater then continues east along Ranchero Road until reaching a nearby curb opening, where flows are routed south for short distance and then east of the project site. The other portion of the site drains into an existing drainage path southeast of the project site. The existing drainage path drains northeast where flows confluence with the flows from the curb opening on Ranchero Road. After which, stormwater flows are conveyed north across Ranchero Road through seven (7) existing culverts northeast of the project site. Drainage continues flowing northeast until reaching the California Aqueduct, which then discharges into Silverwood Lake. See **Appendix C**, for *Existing Drainage Map*.

Table 1 shows a summary of the pre-development flows for 10 and 100-year storm events.

Table 1: Existing Hydrology Results

Sub-basin	Drainage Area (AC)	Q_{10} (cfs)	T_{C10} (min)	Q_{100} (cfs)	T_{C100} (min)
DA-1	0.35	0.76	10.79	1.36	10.79
DA-2	0.71	1.58	10.44	2.82	10.44
Confluence	1.06	2.34	10.44	4.17	10.44

See **Appendix C**, *Existing Drainage Map and Calculations*.

100.4.2 Post-development Condition

Under the proposed condition, there will be no offsite drainage conveyed through the site. There is a proposed gas station that will be constructed west of the project site. The proposed development will be utilizing the proposed gas station for site access. Therefore, the gas station will need to be constructed prior to the proposed development. The gas station will be discharging stormwater flows to Ranchero Road and will not be discharging any flows to the site anymore. Consequently, a hydrology analysis for off-site drainage was not completed under the proposed condition.

The proposed development includes the construction of a commercial retail building located southeast of the intersection of Ranchero Road and Escondido Avenue. Storm water in the proposed condition will be routed into an infiltration basin system for storm water mitigation. The proposed infiltration basin system is located north of the project area.

The post-development project site is comprised of three (3) drainage areas. Drainage from DA-1 will sheet flow northeast through the site making its way into a curb cut. The drainage will then go into a proposed infiltration basin that is connected to a second infiltration basin for detention and treatment. The connected basin areas are considered DA-2. Stormwater flows routed to the infiltration basin system will infiltrate and any flows exceeding their design capacity will overflow to Ranchero Road through a proposed parkway drain. Similar to the flows from DA-1 in the existing drainage map, the basin overflows will continue east along Ranchero Road until reaching a nearby curb opening, where flows are routed south for short distance and then east of the project site. There is a third drainage area (DA-3) southeast of the site, which includes landscaping that drains southeast due to the proposed site grading daylighting to existing ground within this area. Stormwater flows from DA-3 flow into the existing drainage path southeast of the site, similar to DA-2 in the existing drainage map. The existing drainage path drains northeast where flows confluence with the flows from the curb opening on Ranchero Road.

Table 2 shows a summary of the post-development flows for 10 and 100-year storm events. There is an increase in peak flows under the proposed condition compared to the existing condition. Using the proposed infiltration basin system, the peak flows will be attenuated under the proposed condition so that peak flows exiting the site are less than or equal to the existing flows exiting the project site for any storm event smaller than the 100-year event.

Small area unit hydrographs were analyzed to determine the storm water volume difference between the proposed and existing conditions for the 100-year storm. The required design capture volume (DCV) per the WQMP is 2,456 c.f. The volume required to be detained due to the increase between the pre-development and post-development volumes under the 100-year storm is approximately 436 c.f. Therefore, the basin system was designed to retain the governing DCV. The proposed basin system has a total retention volume of 2,519 c.f. which satisfies the volume requirements for both water quality and storm water mitigation.

Table 2 shows a summary of the post-development flows for 10 and 100-year storm events.

Table 2: Proposed Hydrology Results

Sub-basin	Drainage Area (AC)	Q_{10} (cfs)	T_{C10} (min)	Q_{100} (cfs)	T_{C100} (min)
DA-1, DA-2	**0.90**	**2.44**	**8.61**	**4.13**	**8.60**
DA-3	**0.16**	**0.62**	**5.00**	**1.08**	**5.00**
Confluence	**1.06**	**2.85**	**8.61**	**4.86**	**8.60**

See **Appendix D**, *Proposed Drainage Map and Calculations*.

100.5 Storm Water Mitigation

The proposed development is proposing an infiltration basin system for storm water mitigation. The proposed infiltration basin system was sized to treat the design capture the volume (DCV), as outlined in the WQMP, and to retain the storm water volume required to not create any adverse impacts downstream. Once the infiltration basin system exceeds its capacity, the flows will spill over the emergency over-flow and continue flowing east on Ranchero Road until it reaches the existing curb opening that ultimately routes all the drainage into the seven (7) culverts northeast of the site. The required DCV is 2,456 c.f. The volume required to be detained based on the difference between the pre-development and post-development volumes is approximately 436 c.f. The proposed infiltration basin system has a total retention volume of 2,519 c.f. which satisfies the volume requirements for both water quality and storm water mitigation. The proposed development will not increase peak discharges currently exiting the site under the 100-year storm event.

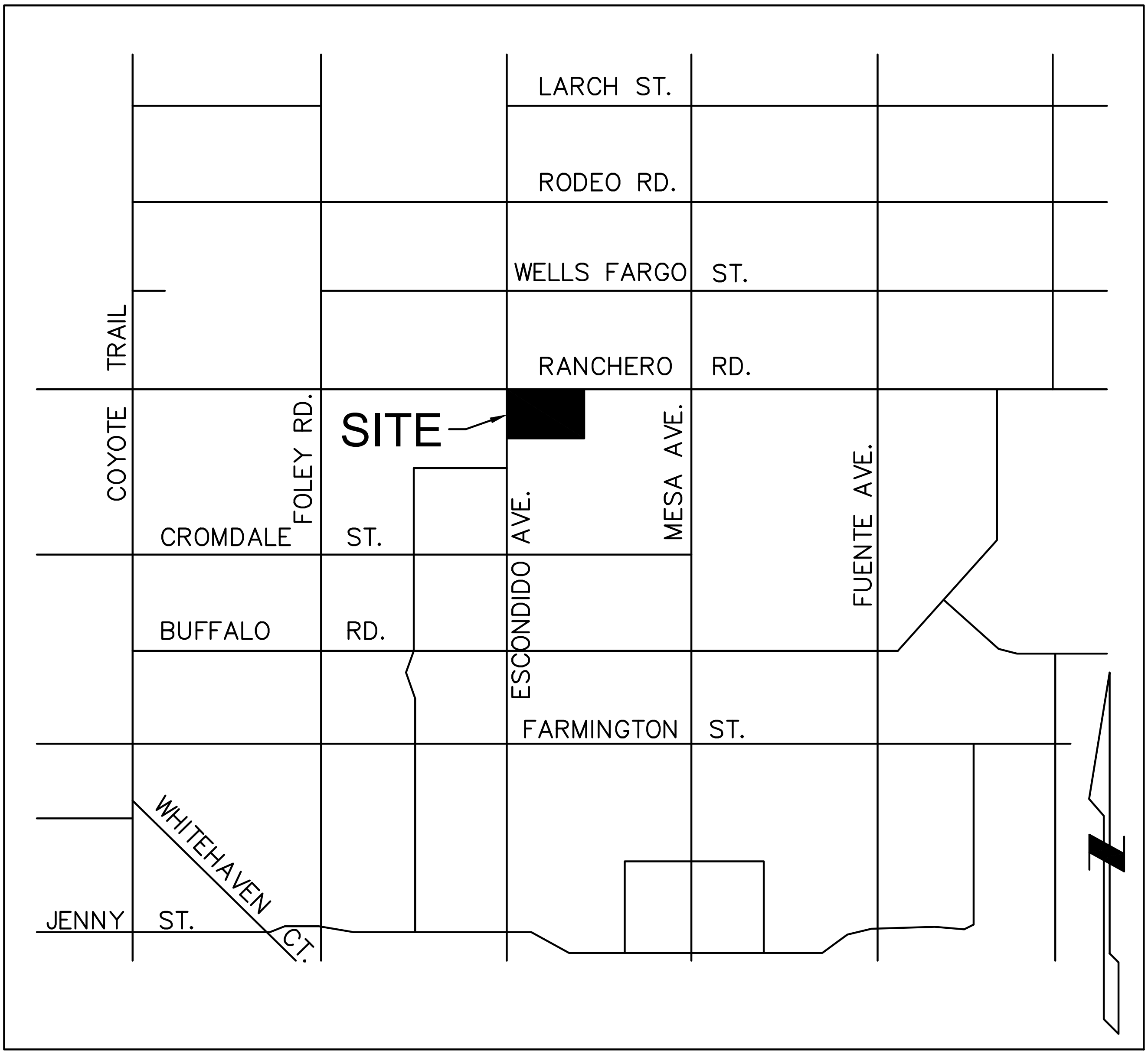
100.6 Conclusion

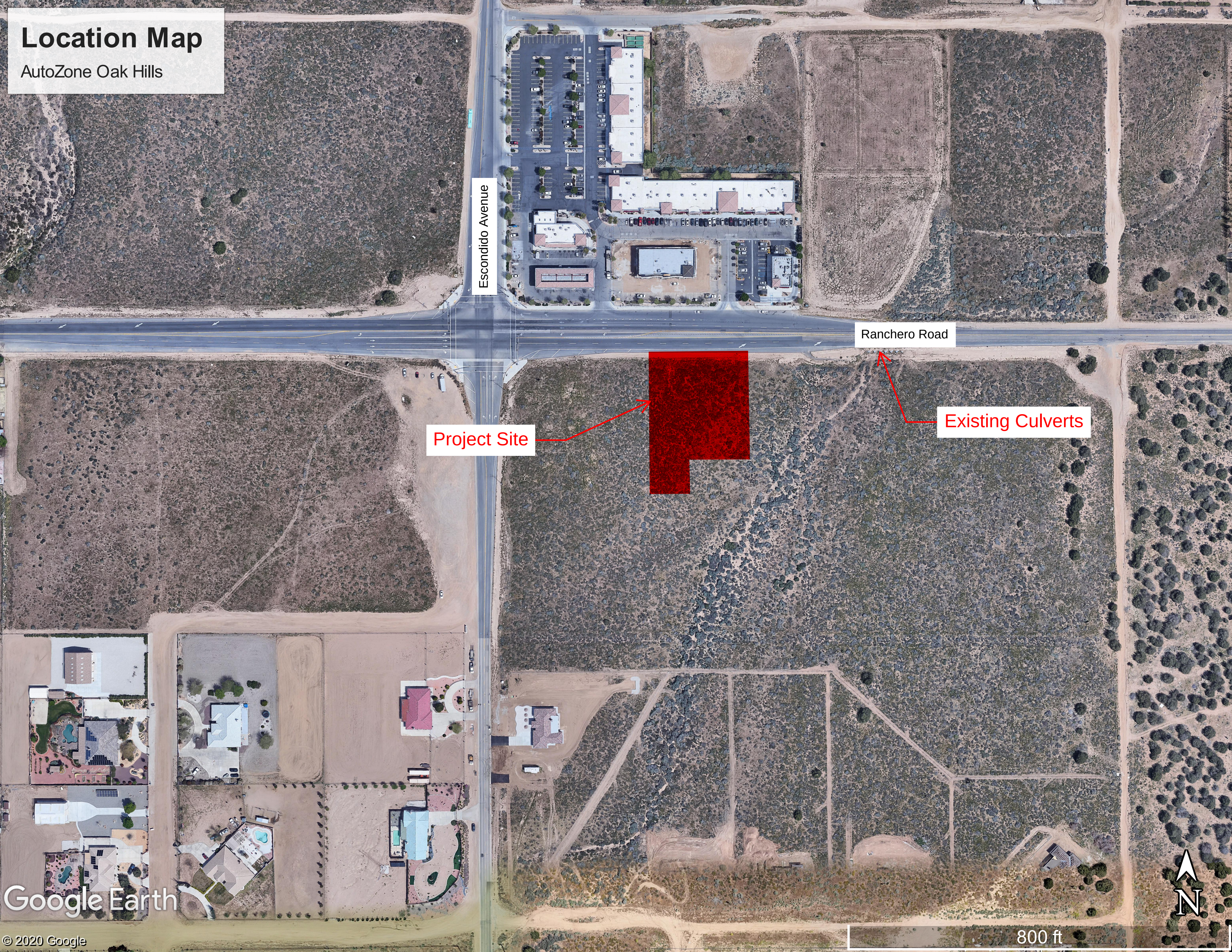
The development of the existing vacant site into the proposed commercial retail building will not create any adverse impacts downstream by not increasing the storm water peak flow rates and volumes discharging from the site under existing conditions. Under the proposed development, the storm water will be routed to the proposed infiltration basin system to attenuate peak flows, detain storm water volumes, and provide water quality treatment.

Appendix A

Location and Vicinity Maps

VICINITY MAP (NOT TO SCALE)




Location Map
AutoZone Oak Hills
Escondido Avenue
Ranchero Road
Project Site
Existing Culverts
Google Earth
© 2020 Google
800 ft
N

Appendix B

FIRMette Map

National Flood Hazard Layer FIRMette

FEMA

117°22'33"W 34°23'15"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

117°21'55"W 34°22'46"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/2/2020 at 11:32 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

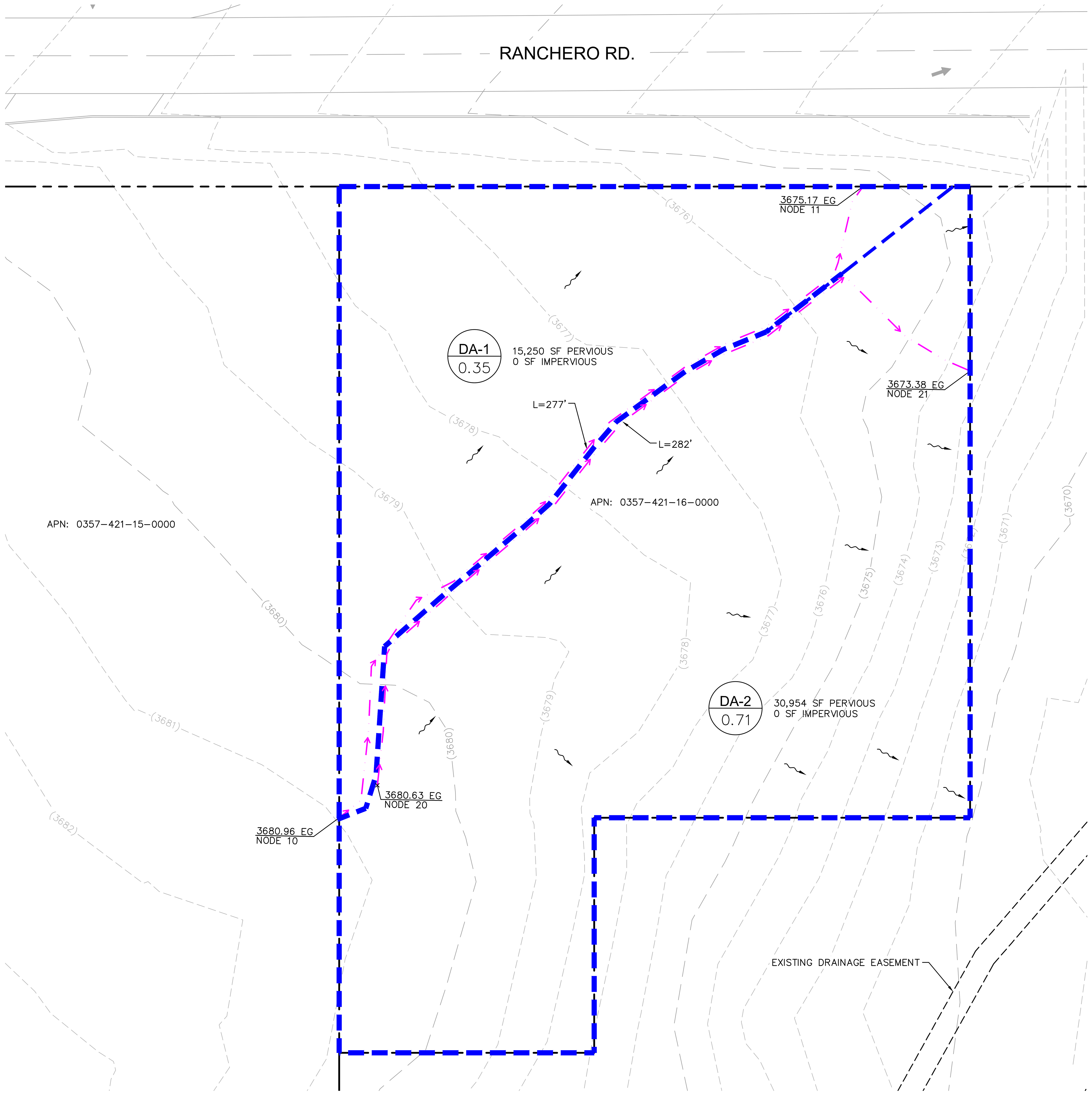
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C

Existing Drainage Map and Calculations

LEGEND

1695	PROPOSED CONTOUR
(1695)	EXISTING CONTOUR
	PROPERTY LINE
	DA BOUNDARY
	PROPOSED STORM DRAIN
	FLOW PATH
	FLOW ARROW
NODE 10 50.00 FS	NODE ID AND ELEVATION
X XX	DA NAME DA AREA (IN ACRES)
	RIGHT OF WAY



NORTH

GRAPHIC SCALE IN FEET
0 10 20 40

SCALE: 1" = 20'
WHEN PRINTED AT FULL
SIZE 24"X36"

CUP NO. XX-XX

Kimley»Horn

EXISTING DRAINAGE MAP
AUTOZONE OAK HILLS
9/11/2020

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
          (c) Copyright 1983-2011 Advanced Engineering Software (aes)
              Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                            Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* AUTOZONE OAK HILLS                                                       *
* 10-YR EXISTING                                                           *
* XO 9/4/20                                                                *
 **************************************************************************

  FILE NAME: AZOH10E.DAT
  TIME/DATE OF STUDY: 07:35 09/04/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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) = 0.8090

  *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     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   277.00
  ELEVATION DATA: UPSTREAM(FEET) =     81.00  DOWNSTREAM(FEET) =     75.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.789
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.689
  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
  "BARREN"                   B        0.35      0.27     1.000    86   10.79
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.76
  TOTAL AREA(ACRES) =      0.35   PEAK FLOW RATE(CFS) =      0.76

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.79
  RAINFALL INTENSITY(INCH/HR) =   2.69
  AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.35
  TOTAL STREAM AREA(ACRES) =       0.35
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.76

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  ELEVATION DATA: UPSTREAM(FEET) =     80.60  DOWNSTREAM(FEET) =     73.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.443
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.751
  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
  "BARREN"                   B        0.71      0.27     1.000    86   10.44
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.58
  TOTAL AREA(ACRES) =      0.71   PEAK FLOW RATE(CFS) =      1.58

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.44
  RAINFALL INTENSITY(INCH/HR) =   2.75
  AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.71
  TOTAL STREAM AREA(ACRES) =       0.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.58

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.76   10.79    2.689  0.27( 0.27) 1.00       0.3      10.00
      2        1.58   10.44    2.751  0.27( 0.27) 1.00       0.7      20.00
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.34   10.44    2.751  0.27( 0.27) 1.00       1.0      20.00
      2        2.31   10.79    2.689  0.27( 0.27) 1.00       1.1      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.34    Tc(MIN.) =    10.44
  EFFECTIVE AREA(ACRES) =       1.05   AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        1.1
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     21.00 =     282.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.1  TC(MIN.) =     10.44
  EFFECTIVE AREA(ACRES) =      1.05  AREA-AVERAGED Fm(INCH/HR)=  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       2.34

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.34   10.44    2.751  0.27( 0.27) 1.00       1.0      20.00
      2        2.31   10.79    2.689  0.27( 0.27) 1.00       1.1      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* AUTOZONE OAK HILLS                                                       *
* 100-YR EXISTING                                                          *
* XO 9/4/20                                                                *
 **************************************************************************

  FILE NAME: AZOH100E.DAT
  TIME/DATE OF STUDY: 07:29 09/04/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                  --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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) = 1.3300

  *ANTECEDENT MOISTURE CONDITION (AMC) III 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     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   277.00
  ELEVATION DATA: UPSTREAM(FEET) =     81.00  DOWNSTREAM(FEET) =     75.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.789
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.421
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 NATURAL POOR COVER
 "BARREN"                  B        0.35      0.11     1.000    97   10.79
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.11
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      1.36
 TOTAL AREA(ACRES) =      0.35   PEAK FLOW RATE(CFS) =      1.36

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.79
 RAINFALL INTENSITY(INCH/HR) =   4.42
 AREA-AVERAGED Fm(INCH/HR) =  0.11
 AREA-AVERAGED Fp(INCH/HR) =  0.11
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       0.35
 TOTAL STREAM AREA(ACRES) =       0.35
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.36

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
 ELEVATION DATA: UPSTREAM(FEET) =     80.60  DOWNSTREAM(FEET) =     73.40

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.443
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.522
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "BARREN"                  B        0.71      0.11     1.000    97   10.44
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.11
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      2.82
 TOTAL AREA(ACRES) =      0.71   PEAK FLOW RATE(CFS) =      2.82

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.44
 RAINFALL INTENSITY(INCH/HR) =   4.52
 AREA-AVERAGED Fm(INCH/HR) =  0.11
 AREA-AVERAGED Fp(INCH/HR) =  0.11
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       0.71
 TOTAL STREAM AREA(ACRES) =       0.71
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.82

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        1.36   10.79    4.421  0.11( 0.11) 1.00       0.3      10.00
     2        2.82   10.44    4.522  0.11( 0.11) 1.00       0.7      20.00
```

```
 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        4.17   10.44    4.522  0.11( 0.11) 1.00       1.0      20.00
     2        4.12   10.79    4.421  0.11( 0.11) 1.00       1.1      10.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       4.17    Tc(MIN.) =    10.44
 EFFECTIVE AREA(ACRES) =       1.05   AREA-AVERAGED Fm(INCH/HR) =  0.11
 AREA-AVERAGED Fp(INCH/HR) =  0.11  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       1.1
 LONGEST FLOWPATH FROM NODE     20.00 TO NODE     21.00 =     282.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.1  TC(MIN.) =     10.44
 EFFECTIVE AREA(ACRES) =      1.05  AREA-AVERAGED Fm(INCH/HR)=  0.11
 AREA-AVERAGED Fp(INCH/HR) =  0.11  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)   =       4.17

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        4.17   10.44    4.522  0.11( 0.11) 1.00       1.0      20.00
     2        4.12   10.79    4.421  0.11( 0.11) 1.00       1.1      10.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     6.50 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
        1          1.06      100.00       86.(AMC II)     0.106      0.945

    TOTAL AREA (Acres) =      1.06
                              _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.106
                                    _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.055
============================================================================
```

RATIONAL METHOD CALIBRATION COEFFICIENT = 1.35
TOTAL CATCHMENT AREA(ACRES) = 1.06
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.106
LOW LOSS FRACTION = 0.055
TIME OF CONCENTRATION(MIN.) = 10.44
SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 100
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.36
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.92
1-HOUR POINT RAINFALL VALUE(INCHES) = 1.33
3-HOUR POINT RAINFALL VALUE(INCHES) = 2.23
6-HOUR POINT RAINFALL VALUE(INCHES) = 3.17
24-HOUR POINT RAINFALL VALUE(INCHES) = 6.50

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.73
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = -0.15

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.17	0.0013	0.19	Q	.	.	.	.
0.34	0.0040	0.19	Q	.	.	.	.
0.51	0.0068	0.19	Q	.	.	.	.
0.69	0.0095	0.19	Q	.	.	.	.
0.86	0.0123	0.19	Q	.	.	.	.
1.04	0.0151	0.19	Q	.	.	.	.
1.21	0.0179	0.20	Q	.	.	.	.
1.38	0.0207	0.20	Q	.	.	.	.
1.56	0.0235	0.20	Q	.	.	.	.
1.73	0.0264	0.20	Q	.	.	.	.
1.91	0.0293	0.20	Q	.	.	.	.
2.08	0.0321	0.20	Q	.	.	.	.
2.25	0.0350	0.20	Q	.	.	.	.
2.43	0.0380	0.20	Q	.	.	.	.
2.60	0.0409	0.21	Q	.	.	.	.
2.78	0.0438	0.21	Q	.	.	.	.
2.95	0.0468	0.21	Q	.	.	.	.
3.12	0.0498	0.21	Q	.	.	.	.
3.30	0.0528	0.21	Q	.	.	.	.
3.47	0.0559	0.21	Q	.	.	.	.
3.65	0.0589	0.21	Q	.	.	.	.
3.82	0.0620	0.21	Q	.	.	.	.
3.99	0.0651	0.22	Q	.	.	.	.
4.17	0.0682	0.22	Q	.	.	.	.
4.34	0.0713	0.22	Q	.	.	.	.
4.52	0.0745	0.22	Q	.	.	.	.
4.69	0.0777	0.22	Q	.	.	.	.
4.86	0.0809	0.22	Q	.	.	.	.
5.04	0.0841	0.23	Q	.	.	.	.
5.21	0.0873	0.23	Q	.	.	.	.
5.39	0.0906	0.23	Q	.	.	.	.
5.56	0.0939	0.23	Q	.	.	.	.
5.73	0.0973	0.23	Q	.	.	.	.
5.91	0.1006	0.23	Q	.	.	.	.
6.08	0.1040	0.24	Q	.	.	.	.
6.26	0.1074	0.24	Q	.	.	.	.
6.43	0.1109	0.24	Q	.	.	.	.
6.60	0.1143	0.24	Q	.	.	.	.
6.78	0.1178	0.25	Q	.	.	.	.
6.95	0.1214	0.25	Q	.	.	.	.

```
 7.13      0.1249      0.25  Q         .         .         .         .
 7.30      0.1285      0.25  .Q        .         .         .         .
 7.47      0.1322      0.25  .Q        .         .         .         .
 7.65      0.1358      0.26  .Q        .         .         .         .
 7.82      0.1395      0.26  .Q        .         .         .         .
 8.00      0.1433      0.26  .Q        .         .         .         .
 8.17      0.1471      0.26  .Q        .         .         .         .
 8.34      0.1509      0.27  .Q        .         .         .         .
 8.52      0.1548      0.27  .Q        .         .         .         .
 8.69      0.1587      0.27  .Q        .         .         .         .
 8.87      0.1626      0.28  .Q        .         .         .         .
 9.04      0.1666      0.28  .Q        .         .         .         .
 9.21      0.1706      0.28  .Q        .         .         .         .
 9.39      0.1747      0.29  .Q        .         .         .         .
 9.56      0.1789      0.29  .Q        .         .         .         .
 9.74      0.1831      0.29  .Q        .         .         .         .
 9.91      0.1873      0.30  .Q        .         .         .         .
10.08      0.1916      0.30  .Q        .         .         .         .
10.26      0.1960      0.31  .Q        .         .         .         .
10.43      0.2004      0.31  .Q        .         .         .         .
10.61      0.2049      0.32  .Q        .         .         .         .
10.78      0.2095      0.32  .Q        .         .         .         .
10.95      0.2142      0.33  .Q        .         .         .         .
11.13      0.2189      0.33  .Q        .         .         .         .
11.30      0.2237      0.34  .Q        .         .         .         .
11.48      0.2285      0.34  .Q        .         .         .         .
11.65      0.2335      0.35  .Q        .         .         .         .
11.82      0.2386      0.35  .Q        .         .         .         .
12.00      0.2437      0.36  .Q        .         .         .         .
12.17      0.2490      0.37  .Q        .         .         .         .
12.35      0.2543      0.37  .Q        .         .         .         .
12.52      0.2597      0.38  .Q        .         .         .         .
12.69      0.2652      0.39  .Q        .         .         .         .
12.87      0.2708      0.40  .Q        .         .         .         .
13.04      0.2766      0.41  .Q        .         .         .         .
13.22      0.2826      0.42  .Q        .         .         .         .
13.39      0.2888      0.44  .Q        .         .         .         .
13.56      0.2951      0.45  .Q        .         .         .         .
13.74      0.3017      0.47  .Q        .         .         .         .
13.91      0.3085      0.48  .Q        .         .         .         .
14.09      0.3155      0.50  .Q        .         .         .         .
14.26      0.3225      0.48  .Q        .         .         .         .
14.43      0.3297      0.52  . Q       .         .         .         .
14.61      0.3372      0.54  . Q       .         .         .         .
14.78      0.3453      0.58  . Q       .         .         .         .
14.96      0.3539      0.61  . Q       .         .         .         .
15.13      0.3632      0.69  . Q       .         .         .         .
15.30      0.3734      0.73  . Q       .         .         .         .
15.48      0.3854      0.94  .  Q      .         .         .         .
15.65      0.3998      1.06  .   Q     .         .         .         .
15.83      0.4176      1.42  .    Q    .         .         .         .
16.00      0.4409      1.82  .      Q  .         .         .         .
16.17      0.4839      4.17  .         .     Q   .         .         .
16.35      0.5225      1.19  .   Q     .         .         .         .
16.52      0.5367      0.79  .  Q      .         .         .         .
16.70      0.5471      0.65  . Q       .         .         .         .
16.87      0.5557      0.56  . Q       .         .         .         .
17.04      0.5633      0.50  .Q        .         .         .         .
17.22      0.5705      0.49  .Q        .         .         .         .
17.39      0.5773      0.46  .Q        .         .         .         .
17.57      0.5836      0.43  .Q        .         .         .         .
17.74      0.5896      0.40  .Q        .         .         .         .
17.91      0.5953      0.38  .Q        .         .         .         .
18.09      0.6006      0.37  .Q        .         .         .         .
18.26      0.6059      0.36  .Q        .         .         .         .
18.44      0.6109      0.35  .Q        .         .         .         .
18.61      0.6158      0.33  .Q        .         .         .         .
```

```
 18.78      0.6205      0.32  .Q        .         .         .         .
 18.96      0.6251      0.31  .Q        .         .         .         .
 19.13      0.6295      0.30  .Q        .         .         .         .
 19.31      0.6338      0.30  .Q        .         .         .         .
 19.48      0.6380      0.29  .Q        .         .         .         .
 19.65      0.6421      0.28  .Q        .         .         .         .
 19.83      0.6461      0.27  .Q        .         .         .         .
 20.00      0.6500      0.27  .Q        .         .         .         .
 20.18      0.6539      0.26  .Q        .         .         .         .
 20.35      0.6576      0.26  .Q        .         .         .         .
 20.52      0.6613      0.25  .Q        .         .         .         .
 20.70      0.6649      0.25  Q         .         .         .         .
 20.87      0.6684      0.24  Q         .         .         .         .
 21.05      0.6719      0.24  Q         .         .         .         .
 21.22      0.6753      0.24  Q         .         .         .         .
 21.39      0.6786      0.23  Q         .         .         .         .
 21.57      0.6819      0.23  Q         .         .         .         .
 21.74      0.6852      0.22  Q         .         .         .         .
 21.92      0.6884      0.22  Q         .         .         .         .
 22.09      0.6916      0.22  Q         .         .         .         .
 22.26      0.6947      0.22  Q         .         .         .         .
 22.44      0.6978      0.21  Q         .         .         .         .
 22.61      0.7008      0.21  Q         .         .         .         .
 22.79      0.7038      0.21  Q         .         .         .         .
 22.96      0.7067      0.20  Q         .         .         .         .
 23.13      0.7096      0.20  Q         .         .         .         .
 23.31      0.7125      0.20  Q         .         .         .         .
 23.48      0.7154      0.20  Q         .         .         .         .
 23.66      0.7182      0.19  Q         .         .         .         .
 23.83      0.7210      0.19  Q         .         .         .         .
 24.00      0.7237      0.19  Q         .         .         .         .
 24.18      0.7251      0.00  Q         .         .         .         .
----------------------------------------------------------------------------
-------------------------------------------------------------------------------
```

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

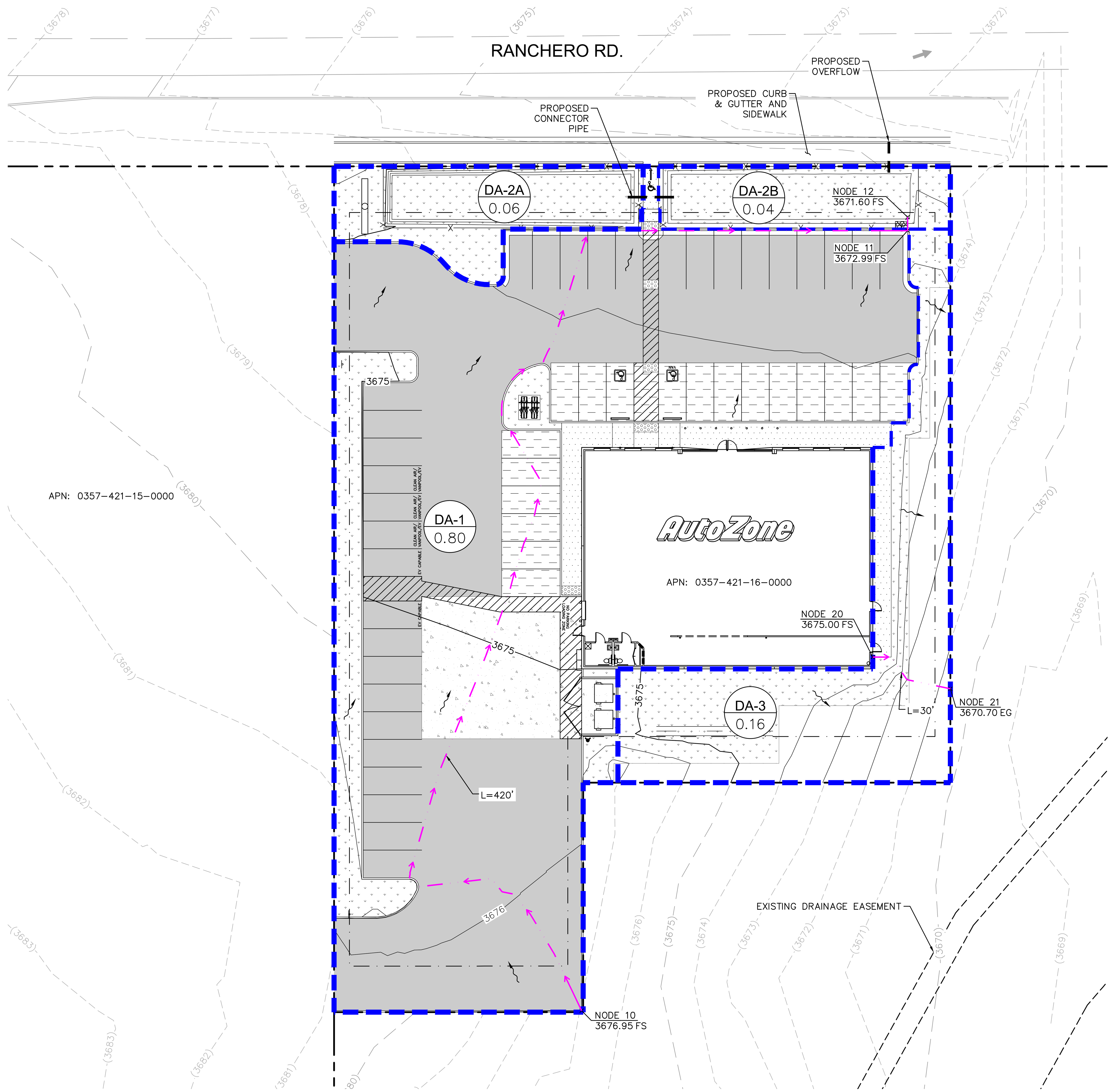
Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1440.7
10%	271.4
20%	62.6
30%	31.3
40%	20.9
50%	10.4
60%	10.4
70%	10.4
80%	10.4
90%	10.4

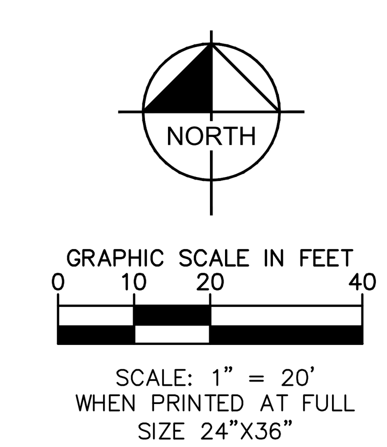
Appendix D

Proposed Drainage Map and Calculations

LEGEND

1695	PROPOSED CONTOUR
(1695)	EXISTING CONTOUR
	PROPERTY LINE
	DA BOUNDARY
	PROPOSED STORM DRAIN
	FLOW PATH
	FLOW ARROW
NODE 10 50.00 FS	NODE ID AND ELEVATION
X XX	DA NAME DA AREA (IN ACRES)
	RIGHT OF WAY
	ASPHALT PAVING
	LANDSCAPING SEE CONCEPTUAL LANDSCAPE PLAN
	HEAVY DUTY CONCRETE PAVING
	LIGHT DUTY CONCRETE PAVING
	CONCRETE SIDEWALK





CUP NO. XX-XX

Kimley»Horn

PROPOSED DRAINAGE MAP
AUTOZONE OAK HILLS
9/11/2020

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2011 Advanced Engineering Software (aes)
             Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                           Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* AUTOZONE OAK HILLS                                                       *
* 10-YR PROPOSED                                                           *
* XO 9/11/20                                                               *
 **************************************************************************

  FILE NAME: AZOH10P.DAT
  TIME/DATE OF STUDY: 14:09 09/11/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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) = 0.8090

  *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     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   415.00
  ELEVATION DATA: UPSTREAM(FEET) =     77.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.576
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.158
  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                 B        0.80      0.75     0.100    56    8.58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.22
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      2.22

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  56
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.00  DOWNSTREAM(FEET) =     71.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =     5.00   CHANNEL SLOPE =  0.2800
  GIVEN CHANNEL BASE(FEET) =    1.00   CHANNEL FREEBOARD(FEET) =  0.0
  "Z" FACTOR =  99.990   MANNING'S FACTOR = 0.035
  *ESTIMATED CHANNEL HEIGHT(FEET) =   0.09
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.150
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         B        0.10      0.75     0.900    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.75
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.33
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.78
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   0.03
  Tc(MIN.) =    8.61
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.22
  EFFECTIVE AREA(ACRES) =      0.90     AREA-AVERAGED Fm(INCH/HR) =   0.14
  AREA-AVERAGED Fp(INCH/HR) =   0.75  AREA-AVERAGED Ap =   0.19
  TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       2.44
  GIVEN CHANNEL BASE(FEET) =    1.00   CHANNEL FREEBOARD(FEET) =  0.0
  "Z" FACTOR =  99.990   MANNING'S FACTOR = 0.035
  *ESTIMATED CHANNEL HEIGHT(FEET) =   0.09

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.09   FLOW VELOCITY(FEET/SEC.) =   2.90
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.61
  RAINFALL INTENSITY(INCH/HR) =   3.15
  AREA-AVERAGED Fm(INCH/HR) =  0.14
  AREA-AVERAGED Fp(INCH/HR) =  0.75
  AREA-AVERAGED Ap =  0.19
  EFFECTIVE STREAM AREA(ACRES) =       0.90
  TOTAL STREAM AREA(ACRES) =       0.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.44

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    33.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     70.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
```

```
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.607
  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
  "BARREN"                   B        0.16      0.27     1.000    86    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      0.62
  TOTAL AREA(ACRES) =      0.16   PEAK FLOW RATE(CFS) =      0.62

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   4.61
  AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.16
  TOTAL STREAM AREA(ACRES) =       0.16
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.62

  ** CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.44    8.61    3.150  0.75( 0.14) 0.19       0.9      10.00
      2        0.62    5.00    4.607  0.27( 0.27) 1.00       0.2      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.73    5.00    4.607  0.45( 0.17) 0.38       0.7      20.00
      2        2.85    8.61    3.150  0.52( 0.16) 0.31       1.1      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.85    Tc(MIN.) =     8.61
  EFFECTIVE AREA(ACRES) =       1.06   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.52  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =       1.1
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     21.00 =     420.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.1  TC(MIN.) =      8.61
  EFFECTIVE AREA(ACRES) =      1.06  AREA-AVERAGED Fm(INCH/HR)=  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.52  AREA-AVERAGED Ap = 0.311
  PEAK FLOW RATE(CFS)   =       2.85

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.73    5.00    4.607  0.45( 0.17) 0.38       0.7      20.00
      2        2.85    8.61    3.150  0.52( 0.16) 0.31       1.1      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY **************************
* AUTOZONE OAK HILLS                                                       *
* 100-YR PROPOSED                                                          *
* XO 9/11/20                                                               *
 **************************************************************************

  FILE NAME: AZOH100P.DAT
  TIME/DATE OF STUDY: 07:11 09/11/2020
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                  --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *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) = 1.3300

  *ANTECEDENT MOISTURE CONDITION (AMC) III 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     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   415.00
  ELEVATION DATA: UPSTREAM(FEET) =     77.00  DOWNSTREAM(FEET) =     73.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.576
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.191
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                 B        0.80      0.42     0.100    76    8.58
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.71
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      3.71

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  56
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     73.00  DOWNSTREAM(FEET) =     71.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =     5.00   CHANNEL SLOPE =  0.4000
  GIVEN CHANNEL BASE(FEET) =    1.00   CHANNEL FREEBOARD(FEET) =  0.0
  "Z" FACTOR =  99.990   MANNING'S FACTOR = 0.035
  *ESTIMATED CHANNEL HEIGHT(FEET) =   0.10
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.182
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         B        0.10      0.42     0.900    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.83
  AVERAGE FLOW DEPTH(FEET) =   0.10   TRAVEL TIME(MIN.) =   0.02
  Tc(MIN.) =    8.60
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.43
  EFFECTIVE AREA(ACRES) =      0.90     AREA-AVERAGED Fm(INCH/HR) =   0.08
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.19
  TOTAL AREA(ACRES) =       0.9         PEAK FLOW RATE(CFS) =       4.13
  GIVEN CHANNEL BASE(FEET) =    1.00   CHANNEL FREEBOARD(FEET) =  0.0
  "Z" FACTOR =  99.990   MANNING'S FACTOR = 0.035
  *ESTIMATED CHANNEL HEIGHT(FEET) =   0.10

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   3.61
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =     420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.60
  RAINFALL INTENSITY(INCH/HR) =   5.18
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.19
  EFFECTIVE STREAM AREA(ACRES) =       0.90
  TOTAL STREAM AREA(ACRES) =       0.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.13

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    33.00
  ELEVATION DATA: UPSTREAM(FEET) =     75.00  DOWNSTREAM(FEET) =     70.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
```

```
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  7.573
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL POOR COVER
  "BARREN"                   B        0.16      0.11     1.000    97    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.11
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      1.08
  TOTAL AREA(ACRES) =      0.16   PEAK FLOW RATE(CFS) =      1.08

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     21.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   7.57
  AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.11
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       0.16
  TOTAL STREAM AREA(ACRES) =       0.16
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.08

  ** CONFLUENCE DATA **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       4.13    8.60    5.182  0.42( 0.08) 0.19       0.9      10.00
      2       1.08    5.00    7.573  0.11( 0.11) 1.00       0.2      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       4.60    5.00    7.573  0.23( 0.09) 0.38       0.7      20.00
      2       4.86    8.60    5.182  0.27( 0.08) 0.31       1.1      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.86    Tc(MIN.) =     8.60
  EFFECTIVE AREA(ACRES) =       1.06   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =       1.1
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     21.00 =     420.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.1  TC(MIN.) =      8.60
  EFFECTIVE AREA(ACRES) =      1.06  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap = 0.311
  PEAK FLOW RATE(CFS)   =       4.86

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       4.60    5.00    7.573  0.23( 0.09) 0.38       0.7      20.00
      2       4.86    8.60    5.182  0.27( 0.08) 0.31       1.1      10.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     6.50 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         1.06       15.00      56.(AMC II)     0.423      0.907

    TOTAL AREA (Acres) =      1.06
                             _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.063
                                     _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.093
==============================================================================
```

```
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.41
    TOTAL CATCHMENT AREA(ACRES) =    1.06
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.063
    LOW LOSS FRACTION = 0.093
    TIME OF CONCENTRATION(MIN.) =  8.60
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.36
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.92
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.33
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.23
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.17
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  6.50

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.74
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =    -0.16

****************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.09      0.0007      0.19  Q         .         .         .         .
  0.23      0.0030      0.19  Q         .         .         .         .
  0.38      0.0052      0.19  Q         .         .         .         .
  0.52      0.0075      0.19  Q         .         .         .         .
  0.66      0.0098      0.19  Q         .         .         .         .
  0.81      0.0121      0.19  Q         .         .         .         .
  0.95      0.0144      0.20  Q         .         .         .         .
  1.09      0.0167      0.20  Q         .         .         .         .
  1.24      0.0190      0.20  Q         .         .         .         .
  1.38      0.0214      0.20  Q         .         .         .         .
  1.52      0.0237      0.20  Q         .         .         .         .
  1.67      0.0261      0.20  Q         .         .         .         .
  1.81      0.0285      0.20  Q         .         .         .         .
  1.95      0.0308      0.20  Q         .         .         .         .
  2.10      0.0332      0.20  Q         .         .         .         .
  2.24      0.0356      0.20  Q         .         .         .         .
  2.38      0.0381      0.20  Q         .         .         .         .
  2.53      0.0405      0.21  Q         .         .         .         .
  2.67      0.0429      0.21  Q         .         .         .         .
  2.81      0.0454      0.21  Q         .         .         .         .
  2.96      0.0479      0.21  Q         .         .         .         .
  3.10      0.0503      0.21  Q         .         .         .         .
  3.24      0.0528      0.21  Q         .         .         .         .
  3.39      0.0553      0.21  Q         .         .         .         .
  3.53      0.0579      0.21  Q         .         .         .         .
  3.67      0.0604      0.21  Q         .         .         .         .
  3.82      0.0629      0.22  Q         .         .         .         .
  3.96      0.0655      0.22  Q         .         .         .         .
  4.10      0.0681      0.22  Q         .         .         .         .
  4.25      0.0707      0.22  Q         .         .         .         .
  4.39      0.0733      0.22  Q         .         .         .         .
  4.53      0.0759      0.22  Q         .         .         .         .
  4.68      0.0786      0.22  Q         .         .         .         .
  4.82      0.0812      0.22  Q         .         .         .         .
  4.96      0.0839      0.23  Q         .         .         .         .
  5.11      0.0866      0.23  Q         .         .         .         .
  5.25      0.0893      0.23  Q         .         .         .         .
  5.39      0.0920      0.23  Q         .         .         .         .
  5.54      0.0947      0.23  Q         .         .         .         .
  5.68      0.0975      0.23  Q         .         .         .         .
```

```
  5.82      0.1003      0.24  Q         .         .         .         .
  5.97      0.1031      0.24  Q         .         .         .         .
  6.11      0.1059      0.24  Q         .         .         .         .
  6.25      0.1087      0.24  Q         .         .         .         .
  6.40      0.1116      0.24  Q         .         .         .         .
  6.54      0.1145      0.24  Q         .         .         .         .
  6.68      0.1173      0.25  Q         .         .         .         .
  6.83      0.1203      0.25  Q         .         .         .         .
  6.97      0.1232      0.25  Q         .         .         .         .
  7.11      0.1262      0.25  .Q        .         .         .         .
  7.26      0.1291      0.25  .Q        .         .         .         .
  7.40      0.1322      0.25  .Q        .         .         .         .
  7.54      0.1352      0.26  .Q        .         .         .         .
  7.69      0.1382      0.26  .Q        .         .         .         .
  7.83      0.1413      0.26  .Q        .         .         .         .
  7.97      0.1444      0.26  .Q        .         .         .         .
  8.12      0.1476      0.27  .Q        .         .         .         .
  8.26      0.1507      0.27  .Q        .         .         .         .
  8.40      0.1539      0.27  .Q        .         .         .         .
  8.55      0.1571      0.27  .Q        .         .         .         .
  8.69      0.1604      0.28  .Q        .         .         .         .
  8.83      0.1636      0.28  .Q        .         .         .         .
  8.98      0.1669      0.28  .Q        .         .         .         .
  9.12      0.1703      0.28  .Q        .         .         .         .
  9.26      0.1737      0.29  .Q        .         .         .         .
  9.41      0.1771      0.29  .Q        .         .         .         .
  9.55      0.1805      0.29  .Q        .         .         .         .
  9.69      0.1840      0.29  .Q        .         .         .         .
  9.84      0.1875      0.30  .Q        .         .         .         .
  9.98      0.1911      0.30  .Q        .         .         .         .
 10.12      0.1947      0.31  .Q        .         .         .         .
 10.27      0.1983      0.31  .Q        .         .         .         .
 10.41      0.2020      0.31  .Q        .         .         .         .
 10.55      0.2057      0.32  .Q        .         .         .         .
 10.70      0.2095      0.32  .Q        .         .         .         .
 10.84      0.2133      0.32  .Q        .         .         .         .
 10.98      0.2172      0.33  .Q        .         .         .         .
 11.13      0.2211      0.33  .Q        .         .         .         .
 11.27      0.2251      0.34  .Q        .         .         .         .
 11.41      0.2291      0.34  .Q        .         .         .         .
 11.56      0.2332      0.35  .Q        .         .         .         .
 11.70      0.2373      0.35  .Q        .         .         .         .
 11.84      0.2416      0.36  .Q        .         .         .         .
 11.99      0.2459      0.36  .Q        .         .         .         .
 12.13      0.2502      0.37  .Q        .         .         .         .
 12.27      0.2545      0.37  .Q        .         .         .         .
 12.42      0.2590      0.38  .Q        .         .         .         .
 12.56      0.2635      0.38  .Q        .         .         .         .
 12.70      0.2681      0.39  .Q        .         .         .         .
 12.85      0.2728      0.40  .Q        .         .         .         .
 12.99      0.2776      0.41  .Q        .         .         .         .
 13.13      0.2825      0.42  .Q        .         .         .         .
 13.28      0.2875      0.43  .Q        .         .         .         .
 13.42      0.2927      0.44  .Q        .         .         .         .
 13.56      0.2980      0.46  .Q        .         .         .         .
 13.71      0.3034      0.46  .Q        .         .         .         .
 13.85      0.3091      0.48  .Q        .         .         .         .
 13.99      0.3148      0.49  .Q        .         .         .         .
 14.14      0.3206      0.48  .Q        .         .         .         .
 14.28      0.3264      0.49  .Q        .         .         .         .
 14.42      0.3324      0.52  . Q       .         .         .         .
 14.57      0.3387      0.54  . Q       .         .         .         .
 14.71      0.3453      0.58  . Q       .         .         .         .
 14.85      0.3522      0.60  . Q       .         .         .         .
 15.00      0.3596      0.65  . Q       .         .         .         .
 15.14      0.3675      0.68  . Q       .         .         .         .
 15.28      0.3761      0.76  .  Q      .         .         .         .
```

```
 15.43      0.3854      0.82  .  Q      .         .         .         .
 15.57      0.3967      1.08  .   Q     .         .         .         .
 15.71      0.4101      1.19  .   Q     .         .         .         .
 15.86      0.4268      1.63  .     Q   .         .         .         .
 16.00      0.4490      2.12  .       Q .         .         .         .
 16.14      0.4904      4.86  .         .        Q.         .         .
 16.29      0.5273      1.37  .    Q    .         .         .         .
 16.43      0.5412      0.98  .  Q      .         .         .         .
 16.57      0.5513      0.72  . Q       .         .         .         .
 16.72      0.5592      0.62  . Q       .         .         .         .
 16.86      0.5662      0.56  . Q       .         .         .         .
 17.00      0.5725      0.51  . Q       .         .         .         .
 17.15      0.5785      0.50  . Q       .         .         .         .
 17.29      0.5843      0.47  .Q        .         .         .         .
 17.43      0.5897      0.45  .Q        .         .         .         .
 17.58      0.5949      0.42  .Q        .         .         .         .
 17.72      0.5998      0.41  .Q        .         .         .         .
 17.86      0.6045      0.39  .Q        .         .         .         .
 18.01      0.6090      0.37  .Q        .         .         .         .
 18.15      0.6134      0.37  .Q        .         .         .         .
 18.29      0.6177      0.36  .Q        .         .         .         .
 18.44      0.6219      0.35  .Q        .         .         .         .
 18.58      0.6259      0.34  .Q        .         .         .         .
 18.72      0.6299      0.33  .Q        .         .         .         .
 18.87      0.6337      0.32  .Q        .         .         .         .
 19.01      0.6374      0.31  .Q        .         .         .         .
 19.15      0.6410      0.30  .Q        .         .         .         .
 19.30      0.6446      0.30  .Q        .         .         .         .
 19.44      0.6481      0.29  .Q        .         .         .         .
 19.58      0.6515      0.28  .Q        .         .         .         .
 19.73      0.6548      0.28  .Q        .         .         .         .
 19.87      0.6581      0.27  .Q        .         .         .         .
 20.01      0.6613      0.27  .Q        .         .         .         .
 20.16      0.6645      0.26  .Q        .         .         .         .
 20.30      0.6676      0.26  .Q        .         .         .         .
 20.44      0.6706      0.26  .Q        .         .         .         .
 20.59      0.6736      0.25  .Q        .         .         .         .
 20.73      0.6766      0.25  Q         .         .         .         .
 20.87      0.6795      0.24  Q         .         .         .         .
 21.02      0.6824      0.24  Q         .         .         .         .
 21.16      0.6852      0.24  Q         .         .         .         .
 21.30      0.6880      0.23  Q         .         .         .         .
 21.45      0.6908      0.23  Q         .         .         .         .
 21.59      0.6935      0.23  Q         .         .         .         .
 21.73      0.6962      0.23  Q         .         .         .         .
 21.88      0.6988      0.22  Q         .         .         .         .
 22.02      0.7015      0.22  Q         .         .         .         .
 22.16      0.7041      0.22  Q         .         .         .         .
 22.31      0.7066      0.22  Q         .         .         .         .
 22.45      0.7092      0.21  Q         .         .         .         .
 22.59      0.7117      0.21  Q         .         .         .         .
 22.74      0.7142      0.21  Q         .         .         .         .
 22.88      0.7166      0.21  Q         .         .         .         .
 23.02      0.7190      0.20  Q         .         .         .         .
 23.17      0.7214      0.20  Q         .         .         .         .
 23.31      0.7238      0.20  Q         .         .         .         .
 23.45      0.7262      0.20  Q         .         .         .         .
 23.60      0.7285      0.20  Q         .         .         .         .
 23.74      0.7308      0.19  Q         .         .         .         .
 23.88      0.7331      0.19  Q         .         .         .         .
 24.03      0.7354      0.19  Q         .         .         .         .
 24.17      0.7365      0.00  Q         .         .         .         .
----------------------------------------------------------------------------
-------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)
```

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1444.8
10%	189.2
20%	60.2
30%	25.8
40%	17.2
50%	8.6
60%	8.6
70%	8.6
80%	8.6
90%	8.6

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 2,456 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA 1 BMP Type Infiltration Basin	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	0.6		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.0		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	1.2		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	1.2		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	1,976		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	2,519		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0		

16 Total Retention Volume from LID Infiltration BMPs: 2,519 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

Appendix E

Geotechnical Investigation

TERRADYNE
Engineers, Geologists & Environmental Scientists

Subsurface Explorations & Geotechnical Investigation

Proposed AutoZone Store #3658
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

AutoZone, Inc.
123 S. Front Street
Memphis, TN 38103

Mr. Robert DeGraaf
Sweetgum Environmental
Plant City, Florida

Terradyne Project No: L201011 **March 10, 2020**

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F, Tustin, CA 92780
Office: 657-212-5800 • Website: www.terradyne.com

TERRADYNE
Engineers, Geologists & Environmental Scientists

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F
Tustin, CA 92780
Office: 657-212-5800
www.terradyne.com

March 10, 2020

Mr. Rob DeGraaf, LEP, PWS
Sweetgum Environmental
Plant City, Florida
Phone: 813-365-2411
Email: robdegraaf@verizon.com
www.sweetgum.com

Re: **Subsurface Explorations & Geotechnical Investigation Report**
Proposed AutoZone Store #3658 at:
Near Ranchero Road and Escondido Ave,
Oak Hills, San Bernardino County, CA 92344
Terradyne Project No.: L201011

Dear Mr. DeGraaf,

In accordance with your request, Terradyne, Inc., Inc. has performed a geotechnical investigation at the subject site. The purpose of our investigation was to evaluate the geotechnical conditions at the site in the areas of proposed construction and to provide geotechnical parameters for design and construction.

Based on our investigation, it is our opinion that the proposed construction is feasible from the geotechnical standpoint provided the recommendations contained herein are incorporated into the project plans and specifications. This report should be reviewed in detail prior to proceeding further with the planned development.

We appreciate and wish to thank you for the opportunity to serve you on this project. Please do not hesitate to contact us if we can be of additional assistance during the Construction Materials Testing and Quality Control phases of construction.

Respectfully Submitted,
Terradyne Engineering, Inc.

Yuting Su

REGISTERED PROFESSIONAL ENGINEER
YU-TING SU
No. 76714
EXP. 12/31/20
CIVIL
STATE OF CALIFORNIA

Yu-Ting Su, Ph.D., P.E.
Senior Project Engineer/ RCE C-76714
Registration Exp. Date: 12/31/2020

PROFESSIONAL GEOLOGIST
HECTOR G. ESTRELLA
No. 2656
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Hector G. Estrella, PG, CEG
Certified Engineering Geologist / CEG 2656
Registration Exp. Date: 5/31/2021

TABLE OF CONTENTS

Page

Appendix A
Figure A - Vicinity Map
Figure B - Approximate Boring Locations Map
Figure C - Regional Geologic Map and Legends
Figure D - Regional Topographic Map
Figure E - CGS Seismic Hazard Information
Figure F - Groundwater Information Map

Appendix B
Boring Logs: B-1 to B-8
Key to Classification Terms and Symbols

Appendix C
Laboratory Tests

Appendix D
ASCE 7-16 Hazard Report

Appendix E
Pavement Design

EXECUTIVE SUMMARY

The soil conditions at the site of the proposed Auto Zone Store #3658 located at Ranchero Road and Escondido Avenue, San Bernardino County, California were explored by drilling eight (8) borings up to the maximum depth of 16.5-ft below existing grade. Laboratory tests were performed on selected samples to evaluate the engineering characteristics of various soil strata encountered in our borings.

This report presents a description of subsurface conditions encountered at the site, recommended foundation systems, and design and construction criteria influenced by the subsurface conditions. It is based on data obtained from field investigations, laboratory test results and our previous experience with similar sites.

- Based on our California Geological Survey (CGS) research, the seismic hazard information (Plate F, Appendix A) pertaining to the subject site as follows:

1) This parcel (APN: 0357-42-103) is not within an Earthquake Fault Zone
2) This parcel (APN: 0357-42-103) has not been evaluated by CGS for seismic landslide hazards
3) This parcel (APN: 0357-42-103) has not been evaluated by CGS for liquefaction hazards

- Our review of the available references indicate that the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude M_W6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site. The San Bernardino Valley section of the San Jacinto Fault Zone located at approximately 10.2 miles to the southwest of the site at the closest point. As noted above the subject property is not within a State of California Fault Zone (CGS, 2018).

- Foundation support for the new AutoZone store building could be derived by utilizing a rigid shallow conventional continuous or spread foundation system embedded within the newly placed fill compacted to 95%. For the design of the structure, modulus of subgrade reaction (k_1) of 100 psi/in is recommended. An allowable bearing capacity of 2000 psf may be used for foundation bearing on in-situ soil. The upper five (5) feet of subgrade within the building should be over excavated and recompacted to 95%. The excavation should also be extended five (5) feet outside the building footprint.

- From a geotechnical standpoint, we are of the opinion that the proposed construction/site grading is not expected to have an adverse impact on adjacent properties and vice versa.

- Ground water was not encountered in our borings during field exploration on February 25, 2020.

Detailed descriptions of subsurface conditions, engineering analysis, and design recommendations are included in this report.

1.0 INTRODUCTION

Terradyne Engineering Inc., conducted an onsite field exploration on February 25, 2020 that included drilling, logging and sampling of eight (8) hollow stem auger geotechnical borings to a maximum depth of 16.5 feet below existing elevations for the proposed Auto Zone Store #3658 development located at approximately 300 feet east of the intersection of Ranchero Road and Escondido Avenue along the south side of Ranchero Road in the City of Hesperia, San Bernardino County, California.

This report describes: the evaluation performed; the results and opinions of the findings; and Terradyne Engineering Inc., geotechnical recommendations for design and construction of the proposed structures.

This project was authorized by Mr. Robert DeGraaf of Sweetgum Environmental.

2.0 PROPOSED CONSTRUCTION

The project will involve the construction of a one-story AutoZone retail Store and associated appurtenant structures, walkways and pavement areas. For this project, Auto Zone created a parcel of approximately +/- 40,000 sf (approximately 200 feet x 200 feet) from a larger parcel with APN 0357-42-103. The planned construction will require minor cuts/fills to achieve the proposed subgrades. The estimated maximum column load for the new one-story retail store building is 75 kips, and the line load is about 3 kips per lineal feet.

3.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical investigation was based upon the planning information provided to us by the client, and consisted of field, laboratory and engineering evaluation of the site's subsurface soil and groundwater conditions and provide geotechnical engineering recommendations for the design and construction of the proposed building and associated improvements. Our scope of services includes the following:

1) Review of readily available documents pertinent to the subject site (Appendix A).

2) The excavation and sampling of eight (8) exploratory engineering borings to a maximum depth of 16.5-ft below existing ground elevations. The borings were excavated in the vicinity of the proposed building structure and parking areas. The soils encountered in the excavations were logged by our field Geologist and relatively

undisturbed and bulk samples were collected at selected intervals in the various soil types to the maximum depth of the exploration.

3) Laboratory analysis of the collected samples.

4) Observation of the groundwater conditions during drilling operations.

5) Geotechnical analysis of the data and information obtained according to the project requirements; and

6) Preparation of this report presenting our findings, conclusions and recommendations, pertinent to the proposed building and paving sections for drive and parking areas.

The Scope of Services does not include percolation/infiltration assessment nor environmental assessment of the presence or absence of wetlands and/or hazardous or toxic materials in the soil, surface water, groundwater, or air, in the proximity of this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

4.0 SITE DESCRIPTION

Based on review of the property details provided, the parcel under investigation consists of an undeveloped partition of land located to the southeast of the intersection of Ranchero Road and Escondido Avenue in the City of Hesperia, San Bernardino County California (APN Number 0357-42-103). It is composed of a roughly square shaped lot which is currently undeveloped with native flora covering the majority of the lot. Site Topography grades gently to the northeast with site elevations ranging from approximately +3675 to +3681 feet above mean sea level. It is our understanding that the proposed structures are to be constructed at elevations similar to those currently existing at the subject site.

Review of the USGS Hesperia, California 7.5-minute topographic quadrangle (Plate D, Appendix A) and the Google Earth Pro® database indicates the subject property is located on a distal alluvial fan emanating from the San Gabriel Mountains to the south and southwest. The subject property is approximately situated at 34.38279° north latitude and 117.37162° west longitude (Google Earth Pro®, 2018).

5.0 GEOTECHNICAL INVESTIGATION

The field exploration by Terradyne Engineering Inc., was completed on February 25, 2020. Eight (8) hollow-stem auger borings were advanced to a maximum depth of 16.5 feet below ground surface. The locations of these exploratory borings (referenced as Boring-1 through Boring-8) are shown on the Approximate Boring Locations Map (Figure B, Appendix A).

The exploratory boring excavations were advanced using a truck mounted drill rig with an 8-inch diameter hollow-stem auger. Drive samples recovered from all borings, were obtained using a Modified California Drive Sampler (2.5-inches inside diameter and 3-inches outside diameter) with thin brass liners, and a Standard Penetrometer (2-inches outside diameter and 1-3/8-inches inside diameter). The samplers were driven 12 to 18 inches into the soil by a 140-pound hammer free-falling for a distance of 30-inches.

Representative bulk and relatively undisturbed samples were taken of earth materials encountered in this field investigation. Recovered samples were placed in transport containers and returned to our laboratory for further classification and testing. The soils classifications listed in the excavation logs are a result of visual classification of soil with field moisture content. The classifications were assigned in accordance with ASTM D-2488: "Description of Soils (Visual-Manual Method)" and all applicable field soil-identification procedures described therein. These may or may not correspond precisely to those indicated by subsequent laboratory methods. Classifications, made in the field from auger cuttings and drive samples, were verified in the laboratory after further examination and testing of samples.

All eight borings were backfilled with native soil on February 25, 2020. Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands (see Figure C, Appendix A).

The following samples, presented in Table 1, were collected as a part of our field exploration procedure:

Table 1

Type of Sample	Number Collected
Undisturbed Ring Samples	16
Bulk Sample	5

5.1 Regional Groundwater

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site. The nearest recorded wells by order of distance are:

Table 2

Well No.	Ground Elev. (ft. amsl)	Highest GW Depth.	Date	Latest GW Depth.	Date	Distance from Subject Site (mi.)
343958N1173757W001	+3616.8	750.0	01/01/1917	NA	NA	0.91 N
343836N1173490W001	+3560.9	735.0	04/25/1984	748.8	02/03/1996	1.2 E
343808N1173475W001	+3566	743.1	04/01/2010	745.6	05/01/2010	1.38 E

**NOTES: Lowest subject site elevation approximately +3675 msl (Google Earth 2019).
ft. amsl: feet above mean sea level. All measurements and distances are approximate

Groundwater seepage was not observed during drilling operations. Groundwater levels will fluctuate with seasonal climatic variations and changes in the land use. Soils with low permeability may require several days for groundwater to enter and stabilize in the boreholes. It is not unusual to encounter shallow groundwater during or after periods of rainfall. Surface water tends to percolate through the surface until it encounters a relatively imperious layer.

It should be noted that variations in subsurface water (including perched water zones and seepage) may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.

5.2 Field Log

The field logs were prepared for the borings. These logs include information concerning the boring method, samples attempted and recovered, and the presence of various soil materials (such as silt, clay, gravel or sand) and groundwater observations. It also includes an interpretation of the subsurface conditions between samples. Therefore, these logs include both factual and interpretive information.

5.3 Presentation of the Data

The boring logs represent our interpretation of the field and laboratory soil classification of the samples obtained, it should be noted that conditions between borings locations may vary considerably and it should be expected that site conditions may or may not be precisely represented by any one of the borings. Soil deposition processes and topographic forming processes are such that soil and rock types and conditions may change in small vertical intervals and short horizontal distances. The boring log descriptions represent approximate changes in soil and rock composition, moisture, color and relative density. The final boring logs and key to classification terms and symbols are included in Appendix B.

5.4 General Subsurface Conditions

The soils underlying the site may be grouped into one generalized stratum with similar physical and engineering properties. The lines on the logs designating the interface between soil strata represent approximate boundaries. The transition between materials may be gradual. The soil stratigraphy at the boring locations is presented in the Boring Logs. The engineering characteristics of the underlying soils, based on our field and laboratory test results, are summarized and presented in Table 3.

Table 3

Stratum	Depth Range (feet)	Remarks
0'-16.5' Older ALLUVIUM (Qoa) Silty SAND, light brown to brown, loose to dense, slightly moist	0-16.5	No groundwater encountered

The above description generally highlights the major soil stratification features and soil characteristics. The boring logs should be consulted for specific information at the boring locations.

5.5 Laboratory Testing Program

In addition to field exploration, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials that are necessary to evaluate the soil parameters. These tests include:

1) Moisture Content & Density (ASTM D2216 & ASTM D2937)
2) Grain Size Distribution (ASTM D422)
3) Expansion Index (ASTM D4829)
4) One-Dimensional Consolidation (ASTM D2435)
5) Corrosion Potential (CT-417, CT-422, CT-532(643))
6) Direct Shear Test (ASTM D3080)

5.6 Soil Corrosion Potential

A near surface sample was tested to measure pH, soluble sulfate, soluble chloride and resistivity of the soil. The results are presented on Table 4.

Table 4

Sample Location/ Depth, (ft)	pH	Soluble Sulfate (PPM)	Soluble Chloride (PPM)	Soil Resistivity (Ohm-cm)
B-5/ 0-5.0	7.40	37	33	8,400

Sulfate Content

A representative near-surface soil sample was tested during our investigation for soluble sulfate content. The result of this test indicates a soluble sulfate content of (0.0037) percent by weight or negligible sulfate exposure. As such, the soils exposed are not expected to pose a significant potential for sulfate reaction with concrete. Per ACI 318-14 Table 19.3.1.1 the requirement of Exposure Category (S) and Class (S1) is applicable.

Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's pH level, electrical resistivity, and chloride content. In general, soil having a minimum resistivity less than 2,000 ohm-cm is considered corrosive. Soil with a chloride content of 500 ppm or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, a representative soil sample was tested during our investigation to determine soil resistivity, chloride content, and pH level. The soil resistivity measurement of the sample was over (8,400) ohm-cm, chloride content of approximately (33) ppm, and the pH level of approximately (7.40). The results indicate that the near surface soil at the site is considered mildly corrosive to ferrous metals and negligible degree of corrosivity to metals for Chloride Content. However, considering the site history, we recommend a standard level of corrosion protection measure to be considered in the design phase of the project.

Concrete

Laboratory test indicated that the subject site contains soil sulfate content in the negligible range (i.e., less than 150 part per million). However, it is recommended that concrete for all construction at the site utilize a widely available, Type-II Portland cement with a maximum 0.50 water/cement ratio and should comply with all the requirements of governing agencies and current applicable Code. The minimum compressive strength of concrete shall be 4000 psi at 28 days and maximum slump during placement shall be five inches. The minimum concrete cover should be 1.5-inches. Final selection of the appropriate concrete design should be made by the project structural engineer based on the local laws and ordinances, and desired level of conservatism.

6.0 FAULTING AND SEISMICITY

The principal seismic considerations for improvements at the subject site are surface rupture of fault traces, damage caused by ground shaking during a seismic event, and seismically-induced ground settlement. The potential for any or all of these hazards depends upon the recency of fault activity and the proximity of nearby faults to the subject site. The possibility of damage due to ground rupture is considered unlikely since no active faults are known to cross the site and no evidence of active faulting was noted during our investigation. Our review of the proper literature (CGS 2018) indicates that the subject site lies outside the present Earthquake Fault Zones, which are described in the Alquist-Priolo Earthquake Fault Zoning Act as being placed along active faults Based on the review of the available references (USGS), the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude MW6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site and the San Bernardino Valley section of the San Jacinto Fault Zone, located at approximately 10.2 miles to the southwest of the site at the closest point.

Based on a review of a liquefaction study by the San Bernardino Valley Municipal Water District (GSS, 2011) the subject property is not located within an area of potential liquefaction. Due to the relatively flat topography the site is not susceptible earthquake induced landslides.

6.1 Seismic Design Parameters

The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in California. Design of the proposed improvements in accordance with current CBC requirements is intended to reduce the impact of seismic shaking on the proposed improvements. Recommended seismic design acceleration parameters in accordance with the new 2020 California Building Code (CBC) and ASCE 7-16 are presented in Table 5 below (no accurate address for this project, applying the address of 7151 Escondido Avenue, Oak Hills, CA 92344).

Table 5

CBC DESIGN RESPONSE SPECTRUM PARAMETERS	
Latitude	34.380496 degrees north
Longitude	-117.372579 degrees west
Site Class	D – Stiff Soil
Seismic Design Category (SDC)	N/A
MCE_R Ground Motion, Ss (period=0.2s)	1.5 g
MCE_R Ground Motion, S_1(period=1.0s)	0.6 g
Site-modified Spectral Acceleration Value, S_{MS}	1.5 g
Site-modified Spectral Acceleration Value, S_{M1}	N/A
Numeric Seismic Design Value at 0.2s SA, S_{DS}	1.0 g
Numeric Seismic Design Value at 1.0s SA, S_{D1}	N/A
Site Amplification Factor at 0.2s, F_a	1.0
Site Amplification Factor at 1.0s, F_v	N/A
Site Modification Peak Ground Acceleration, PGA_M	0.611 g

Note: Ground motion hazard analysis may be required, see ASCE/SEI 7-16 Section 11.4.8
ASCE 7 Hazards Report is attached in Appendix D. Final selection of the appropriate seismic design coefficients should be made by the structural consultant based on the local laws and ordinances, expected building response, and desired level of conservatism.

7.0 FOUNDATION RECOMMENDATIONS

7.1 Foundation on Expansive Soils

The clayey sections of the artificial fill and natural soils, though generally less expensive than the overlying soils. Expansive soils can be subject to repeated swelling upon wetting and contraction upon drying which can damage concrete slabs or foundations bearing on such soils. Mitigation for foundations in expansive soils generally involves deepening the footing to a depth below that which will be subject to repeated swelling and contraction (shrinking from drying out).

Expansive soils change in volume with change in moisture content. Shrinking and swelling of the clays can cause heaving and cracking on slab-on-grade and structures founded on shallow foundations. The results of our exploration, laboratory testing and engineering evaluation indicate the soils underlying this site have Very Low Expansion (Non-Expansion) Potential characteristics (Expansion Index, EI =

2) per ASTM D4829. As such, special measures per 2016 California Building Code (CBC) Section 1803.5.3 are required to mitigate expansive soil.

Table 6

Expansion Index, (EI)	0 – 20	21 – 50	51 – 90	91 – 130	>130
Expansion Potential	Very low	Low	Medium	High	Very high
2013 CBC Expansion Classification	Non-Expansive	Expansive			

7.2 Settlement

Provided our report recommendations are followed, we estimate the total and differential settlements on the order of one (1) inch and one-half (½) inch, respectively over the span of 30-ft.

7.3 Foundation System

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation. Greater embedment may be necessary to resist lateral loads due to wind and seismic forces of the requirements of 2016 CBC. A coefficient of friction of 0.25 of dead load may be used. We recommend all footings should be reinforced with two #4 bars at the top and 2 #4 bars at the bottom. A minimum allowable bearing capacity of 2000 psf may be used for a continuous or spread foundation system bearing on newly compacted select fill. The allowable bearing value may be increased by 250 pounds per square foot per foot increase in depth or width to a maximum of 2500 psf. The upper **5-ft** of the soil within the building pad area should be over excavated and re-compacted to minimum 95% of maximum dry density as determined by laboratory ASTM D1557 modified proctor test. The over excavation should be extended horizontally a minimum of 5-ft outside from the building footprint measured from the lowest adjacent existing or proposed grade, whichever is more.

Table 7

Earth Material and Foundation Design Parameters		
Earth Material Parameters	Foundation Bearing Material	Competent Native Soil (Older Alluvium) Certified Fill/Approved Soil
	Foundation Bearing Pressures [3]	2,000 psf
	Coefficient of Friction [1]	0.25
	Passive Earth Pressure (EFP) [3]	200 pcf
	Maximum Passive Earth Pressure	2,500 psf
Continuous Footing Design	Minimum Width	24 inches
	Min. Embedment Depth into Bearing Material [2]	18 inches
	Minimum Reinforcement	2 No.4 Rebars at Top and Bottom
Independent Pad Design	Minimum Foundation Dimensions	24" x 24" square
	Min. Embedment Depth into Bearing Material [2]	18 inches

Notes:

[1] When combining frictional resistance and passive pressure, the passive pressure component should be reduced by one-third.
[2] Foundation depths subject to increase per the project structural engineer's design.
[3] One-third increases on the bearing and passive pressures for wind and seismic loads are allowed.

7.4 Slab on Grade

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc., should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation." A vapor barrier over the crushed rock should be considered in the areas where the migration of moisture through the floor slab would be detrimental. To protect the vapor barrier (Visqueen) from punctures during placement, it is recommended that the Visqueen be placed over two-inch thick, clean san layer. The vapor barrier should be at least 10-mil plastic (STEGO or Equivalent) and should be sealed at all splices, around plumbing, and at the parameter of slab areas. Every effort should be made to provide a continuous barrier and care should be taken no to puncture the membrane. Some contractors exercising special care use heavier membranes or double layers of 10-mil plastic with splices staggered and sealed. Slab design should be in compliance with the 2016 Cal Green Code where applicable.

7.5 Lateral Earth Pressures

7.5.1 Passive Earth Pressure

Lateral loads may be resisted by friction provided by the soil on the base of the foundation and by passive earth pressure. A coefficient of friction of 0.25 of dead load may be used. An allowable passive earth pressure of 200 psf per foot of depth may be used for footings poured on compacted in-situ soil. The maximum value of passive earth pressure should be limited to 2,500 psf. Frictional resistance and passive pressure resistance may be used in combination if friction coefficient is reduced by one-third. A one-third increase in passive pressure may be used for resistance against seismic and wind loading.

7.5.2 Active Earth Pressure

Active earth pressures behind walls depend on wall movement, back fill slope, surcharge loads and back fill material.

Table 8

Equivalent Fluid Pressure, EFP (pcf)	
Active Condition	40
At-rest Condition	65

These equivalent fluid pressure (EFP) does not include the effect of seepage pressures, surcharge loads such as construction equipment, vehicular loads or future storage near the walls. If the basement wall or cantilever retaining wall can tilt forward to generate "active earth pressure" condition, the values under active condition should be used. For rigid non-yielding walls which are part of the building, the values" at rest condition" should be used. The compactive effort should be controlled during backfill operations. Over compaction can produce lateral earth pressures in excess of at rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained at minimum 95 percent of Modified Proctor (ASTM D1557) maximum dry density.

The backfill behind the wall should be drained properly. The simplest drainage system consists of a drain located near the bottom of the wall. The drain collects the water that enters the backfill and this may be disposed of through outlets along the base of the wall. To ensure that the drains are not clogged by fine particles, they should be surrounded by a granular filter wrapped in a geofabric such as Mirafi 140N or equivalent. Despite a well-constructed toe drain, substantial water pressure may develop behind the wall if the backfill consists of clays or silts. A more satisfactory drainage system, consisting of a back drain of 12 inches to 24 inches width gravel may be provided behind the wall to facilitate to drainage.

7.6 Retaining Wall Design

Recommendations below may be applied to typical masonry or concrete vertical retaining walls to a maximum height of 6 feet. Additional review and recommendations should be requested for higher walls.

Recommendations were developed assuming that wall backfill placed within a 1:1 (horizontal: vertical) gradient (45-degree angle) projection behind any wall is comprised of the onsite granular non-expansive soils which are placed as certified compacted fill. Use of other materials might necessitate revision to the parameters provided and modification of wall designs. The following criteria may be applied to retaining wall design below.

Foundations for vertical masonry and poured concrete retaining walls may be designed and constructed using recommendations in the "Foundations" discussion presented above.

Cantilevered Walls

Cantilevered retaining walls are free to rotate and not restrained with minor deflections. Active earth pressures may be used in the designing of cantilevered walls. An equivalent fluid pressure (EFP) may be used to calculate the horizontal pressure against the walls, as tabulated below for retaining walls less than 6 feet in height.

Table 9

RETAINING WALL DESIGN, 6 FEET OR LESS (NON-EXPANSIVE SOIL)	
Surface Slope of Retained Material (H: V)	Equivalent Fluid Pressure (pcf)
Level	30
5:1	32
4:1	35
3:1	38
2:1	43
1½:1	55

These equivalent fluid pressures do not include other superimposed loading conditions such as expansive soil, vehicular traffic, structures, seismic conditions or adverse geologic conditions.

Retaining walls supporting sloping ground should be provided with a minimum freeboard height of 12 inches. Any slough, debris or trash accumulating behind the freeboard (in the catchment area) should be removed immediately to ensure the freeboard performs as intended.

Restrained Walls

The retaining walls are called non-yielding walls because the walls cannot move lately at the top and should be designed for an equivalent fluid pressure (EFP) of 45 pcf for level backfills.

7.7 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, estimated traffic indices for various pavement-loading conditions, and on a design R-value of 73.3 from the MTGL, Inc. The design R-value was chosen based on laboratory testing of a representative sample and considering the sandy soil conditions at near the surface. The preliminary flexible pavement sections may consist of the following for the Traffic Indices (TI) indicated and the calculations are in the Appendix E. The Asphalt Cement (AC) and Class II Aggregate Base (AB) thickness are presented below for different Traffic Indices. Final pavement design where needed should be based on the Traffic Index determined by the project civil engineer.

<u>Table 10</u>

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78

The final pavement design also should be verified during actual site grading and the above sections may be revised accordingly per actual representative R-value. The minimum required compaction of aggregate base is 95% of maximum dry density.

In areas where rigid concrete pavement is planned, at a minimum, concrete should be 4000 psi with fiber mesh, 5 inches thick in parking areas (light duty) and 6 inches thick (heavy duty) in loading areas. Concrete paving to be placed over a minimum 4-inch thick granular base on prepared subgrade soil. Reinforcement should be specified by the structural engineer but should be a minimum of #3 rebar at 18 inches on center each way. The PCC pavement sections should be provided with crack-control joints spaced no more than 14 feet on center each way. If saw cuts are used, they should have a minimum depth of ¼ of the slab thickness and made within 24 hours of concrete placement. We recommend that sections be as nearly square as possible.

8.0 CONSTRUCTION GUIDELINES

8.1 Construction Monitoring

As Geotechnical Engineer of Record for this project, Terradyne Engineering Inc., should be involved in monitoring the foundation installation and earthwork activities by the special inspections requirements and tests of existing site soil conditions: fill placement and load-bearing requirements shall be performed in accordance with this **section of 1705.6** and **Table 1705.6**. The performance of any foundation system is not only dependent on the foundation design but is strongly influenced by the quality of construction. Prior to construction, please contact our office so that a Foundation and Earthwork Monitoring Plan can be incorporated into the Project Quality Control Program.

TABLE 1705.6

REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	—	X
2. Verify excavations are extended to proper depth and have reached proper material.	—	X
3. Perform classification and testing of compacted fill materials.	—	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	X	—
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	—	X

8.2 Site Preparation

Grading should conform to the guidelines presented in the 2019 California Building Code (CBC, 2019), as well as the requirements of the City of Hesperia and County of San Bernardino.

Prior to earthwork or construction operations, the site should be cleared of surface and subsurface obstructions and stripped of any vegetation in the areas proposed for development. Removed vegetation and debris should then be properly disposed of off-site. Holes resulting from removal of buried obstructions which extend below finish site grades should be backfilled with suitable fill soils compacted to a **minimum 95** percent relative compaction (based on ASTM Test Method D1557).

8.3 Removal of Unsuitable Soils

The existing upper soils alluvial deposits soils are considered to be potentially compressible and maybe collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of 5 feet outside the building footprint. Following removal of the upper soils, the bottom of the excavation(s) should be observed and approved by a representative of this office to verify that these potentially compressible materials have been properly removed.

Prior to fill placement, all areas to receive fill and/or other surface improvements, shall be scarified to a minimum depth of **10 inches** below removal grade elevations, be moisture conditioned to **3 percent over optimum** moisture content and compacted to minimum **95** percent relative compaction, based on ASTM Test Method D1557. After this procedure is completed, backfill of the removal excavation should take place by moisture conditioning the removed soils prior to placement to at least optimum to 3 percent over optimum moisture content and recompaction of these soils to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). These operations should be performed under the observation and testing of a representative of this office. It should be understood that based on the observations of our field representative, localized deeper or shallower removals may be recommended. Any removed soils shall be moisture conditioned as necessary to achieve a moisture content of at least optimum to 3 percent over optimum moisture content and be recompacted to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). This earthwork should extend a minimum of 5 feet beyond the proposed footing limits.

Any proposed subgrade for support of appurtenance slabs on grade and miscellaneous improvements should be scarified minimum (18"), moisture conditioned up to three (3) percent over optimum moisture content and compacted. The subgrades should be compacted to minimum 95 percent of maximum dry density as determined by laboratory ASTM D1557 modified proctor test.

When excavations deeper than five feet are made, temporary construction slopes should be no steeper than 1.5:1 (horizontal to vertical). Sheeting and bracing should be provided by the contractor, as necessary, to protect workers in the excavation. Where excavations undermine existing improvements, such as the existing walls, etc., temporary structural support should be provided to reduce the risk of damage resulting from undercutting. Permanent cut and fill slopes (if proposed), should not be constructed steeper than 2:1 (horizontal to vertical) and should be considered subject to review by the geotechnical consultant at the time of grading. These slopes should possess sufficient compacted fines to limit erosion risk. If upon construction, relatively clean, cohesionless sands are encountered, reconstruction by blending in fines to compacted fill and/or flattering of slopes will be advised.

8.4 Fill Placement and Compaction

If necessary, the on-site soils are suitable for reuse as compacted fill, provided they are free of organic materials and debris and material larger than 6 inches in diameter. Should import soils be utilized for near-surface fills, these soils should be predominately granular, possess a low or very low expansion potential (see Section 8.4 below), and be approved by the geotechnical engineer prior to their transportation to the site. Lift thicknesses will be dependent upon the size and type of equipment used. In general, fill should be placed in uniform lifts not exceeding 8 to 10 inches. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. All earthwork should be conducted in accordance with the applicable codes, agency requirements, the recommendations, and the standard grading guidelines. The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

8.5 Temporary Excavations and Backfill

Underground trenches are anticipated to be excavated with moderate effort using conventional construction equipment in good operating condition. Deep trenches may require the use of heavier equipment operations. The encountered soils at the site consisted of loose to medium dense, poorly consolidated sands. As such these soils may be subject to collapse and or cave-ins. To satisfy OSHA requirements and for workmen's safety, it will be necessary to shore excavations deeper than 5 feet. The proposed trenches deeper than 5 feet may also be laid back in a 1:1 horizontal to vertical (45 degrees). During wet weather, runoff water should be prevented from entering the excavation. The contractor is responsible for the safety of the workers and should observe the federal and local regulations including CALOSHA excavation and trench safety guidelines.

The on-site soils may be used as trench backfill provided, they are screened of rock sizes over 6 inches in maximum dimension and organic matter. Trench backfill should be compacted in uniform lifts (not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (based on ASTM D1557).

8.6 Shoring

Based on the anticipated depth of excavation (5 feet) below existing grade for the construction of the building, it appears that there may be insufficient space for sloped excavations. If so, shoring should be used to support the excavations. Cantilever, or braced shoring may be considered at this site. Cantilevered shoring can be utilized where some deflection is acceptable. However, where shoring will support adjacent properties and excessive deflection can lead to settlement, braced shoring should be utilized. The magnitude of shoring movements and resulting settlements are difficult to estimate because they depend on many factors, including the method and the specialty shoring contractor's skill in the installation. We estimate a properly installed system will limit settlements to adjacent improvements to less than one inch. Settlement of structures or facilities founded adjacent to the shoring will occur in proportion to both the distance between the shoring and the facilities, and the amount of horizontal deflection of the shoring system. The vertical settlement will be a maximum at the shoring face and decrease as the horizontal distance from the shoring increases. Beyond a distance from the shoring equal to the height of the shoring, the settlement is expected to be negligible. The maximum vertical settlement is expected to be about 75 percent of the horizontal deflection of the shoring system.

We judge the most appropriate temporary shoring system for this project is a typical soldier-pile-and-lagging system. For this type of system, soldier piles are placed in predrilled holes which will be backfilled with concrete. Wood or concrete lagging will be placed between the soldier piles as the excavation proceeds. Geotechnical parameters for the design of lagging & soldier pile (such as active & passive soil pressures, skin friction, pile fixity, allowable deflection at top of pile, etc.) are provided below:

- Skin friction along the back of the soldier piles using an allowable skin friction of 250 psf for walls above the excavation level.
- An allowable skin friction of 300 psf may be used on the perimeter of the piles below the bottom of the excavation.
- Cantilever soldier-pile-and-lagging walls should be designed to resist an active earth pressure corresponding to an equivalent fluid weigh of 35 pounds per cubic foot (pcf). This lateral force may be resisted by passive earth pressures against the embedded vertical

faces of the piers. We recommend passive resistance be calculated using an equivalent fluid weight of 250 pcf (Max. 3000 pcf) in the underlying native soil. The calculated passive pressure may be applied over three pier diameters.

- The Point of Fixity is defined as a percentage of the embedment depth 'D' which varies from 0 to 0.75D. For unrestrained shoring systems in most stiff to medium dense soils, a value of 0.25D may be assumed. A greater value may be used for loose sand or soft clay.
- Surcharge coefficient 0.5 may be used with uniform vertical surcharges for cantilever, and braced shoring lateral earth pressures.

It is difficult to accurately predict the amount of deflection of a shored embankment. It should be realized that some deflection will occur. It is recommended that the deflection be minimized to prevent damage to existing structures and adjacent improvements. Where public rights-of-way are present or adjacent offsite structures do not surcharge the shoring excavation, the shoring deflection should be limited to less than 1 inch at the top of the shored embankment. Where offsite structures are within the shoring surcharge area it is recommended that the beam deflection be limited to less than ½ inch at the elevation of the adjacent offsite foundation, and no deflection at all if deflections will damage existing structures. The allowable deflection is dependent on many factors, such as the presence of structures and utilities near the top of the embankment, and will be assessed and designed by the project shoring engineer.

The selection, design, construction, and performance of the shoring system should be the responsibility of the contractor. The shoring system should be designed by a licensed structural engineer experienced in the design of retaining systems, and installed by an experienced shoring specialty contractor. The shoring engineer should be responsible for the design of temporary shoring in accordance with applicable regulatory requirements. We should review the final shoring plans to check that they are consistent with the recommendations presented in this report. Excavations and shoring should be observed by personnel of our firm so that any necessary modifications based on variations in the soil conditions encountered can be made. All applicable safety requirements, including Cal-OSHA requirements, should be met. It is the responsibility of the contractor to maintain safe and stable slopes during construction. Heavy construction equipment, building materials, excavated soil, and vehicle traffic should not be allowed within ten feet of the top of excavations. During wet weather, runoff should be prevented from running across slopes and from entering excavations.

Prior to excavation, it is recommended that walls, structures, or portions of structures within a horizontal distance of 1.5 times the depth of the excavation be inspected to determine their present condition. For documentation purposes, photographs should be taken of preconstruction distress conditions and level surveys of adjacent grade and pavement should be performed. During construction, deflection of the shoring system should be monitored initially on a frequent (weekly) basis until it can be demonstrated that no movement is occurring. At that time, less frequent monitoring can be performed. In addition, the structures should be periodically inspected for signs of distress. Adjacent grade and pavement should be monitored to determine the amount of movement resulting from the construction activities. If distress, or settlement is noted, an investigation should be performed, and correction measures taken so that continued or worsened distress or settlement is mitigated.

8.7 Temporary Drainage Measures

Temporary drainage provisions should be established to minimize water runoff into construction areas. If standing water does accumulate, it should be removed by pumping as soon as possible. Adequate protection against sloughing of soils should be provided for workers and inspectors entering the excavations. This protection should meet CALOSHA and other applicable building codes.

8.8 Selection of Structural Fill

Any select structural fill used at the site should have a Liquid Limit less than 35 and a Plasticity Index between 5 and 15. The fill should contain no particles greater than one (1) inch in diameter. The percent passing U.S. Standard Sieve No. 4 should be between 40 and 80 percent and passing Sieve No. 40 between 10 and 50 percent. The percent passing Sieve No. 200 should be less than 20 percent.

Pit-run gravels (with some clay binders) and crushed limestone (with sufficient fines to bind the aggregate together) are examples of suitable select structural fill materials. The fill materials should be placed in loose lifts not to exceed 8 inches thick and compacted to 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content up to two percentage points above optimum.

8.9 Groundwater

In areas where significant cuts (2-feet or more) are made to establish final grades for building pads, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Subsurface drains may be required to intercept seasonal groundwater seepage. The need for these, or other dewatering devices, on building pads should be carefully addressed during construction. Our office could be contacted to visually inspect final pads to evaluate the need for such drains.

Groundwater seepage may occur several years after construction if the rainfall rate or drainage changes in the vicinity of the project site. If seepage runoff occurs towards the building, an engineer should be called on to evaluate its' effect and determine whether French drains are required at the location.

8.10 Control Testing and Field Observation

Subgrade preparation and structural fill placement should be monitored by the project geotechnical engineer or his representative. Field-tests for moisture content and relative compaction of the fill soils shall be performed by Terradyne Engineering, Inc. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction. Any areas do not meet the required relative compaction should be re-compacted and retested until compliance is met the required of relative compaction.

9.0 SITE DRAINAGE AND MAINTENANCE

Final drainage is important for the performance of the proposed construction. Landscaping, plumbing, and downspout drainage is also important. It is vital that all roof drainage be transported away from the building so that water does not pond around it, which can result in a soil volume change underneath the building. Plumbing leaks (if any) should be repaired as soon as possible in order to minimize the magnitude of a moisture change under the slab. Large trees and shrubs should not be planted in the immediate vicinity of the structures, since root systems can cause a substantial reduction in soil volume in the vicinity of the trees during dry periods.

Adequate drainage should be provided to reduce seasonal variations in moisture content of foundation soils. All pavement and sidewalks within 10-feet of the structures should be sloped away from the structures to prevent ponding of water around the foundations. Final grades within 10-feet of the structure should be adjusted to slope away from structures preferably at a minimum slope of 2 percent. Maintaining positive surface drainage throughout the life of the structure is essential.

In areas with pavement or sidewalks adjacent to the new structure, a positive seal must be provided and maintained between the structures and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. Post-construction movement of pavement and flat-work is not uncommon. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post construction movement of flatwork, particularly if such movement would be critical. Normal maintenance should include inspection of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.

Trench backfill for utilities should be properly placed and compacted, as outlined in this report, and in accordance with the requirements of local City, County and/or State Standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should be prevented from becoming a conduit and allowing an access for surface or subsurface water to travel toward the new structures. Concrete cut-off collars or clay plugs should be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.

10.0 REVIEW and SERVICES

All soil, geologic, and structural aspects of the proposed Project are subject to the review and approval of the governing agency(s). It should be recognized that the governing agency(s) can dictate the manner in which the project proceeds. They could approve or deny any aspect of the proposed improvements and/or could dictate which foundation and grading options are acceptable.

10.1 Plan Review

Upon completion, we should review the project plans and specifications to check that they conform to the intent of our recommendations.

10.2 Additional Geotechnical Services

Additional geotechnical services will be required subsequent to the investigation report. Additional fees will accrue for the additional services. The additional fees will depend on the scope of the additional work. A separate proposal and agreement will be prepared for the additional services. The following services are considered additional services.

- Response to questions from the reviewing agencies.
- Once plans for the proposed development are completed, the geotechnical consultant will need to review and approve the drawings.
- During construction, the geotechnical consultant will need to observe and test earthwork and observe foundation excavations for the proposed development.

11.0 LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from eight (8) borings drilled at the site and the design details furnished by Mr. Robert DeGraaf of Sweetgum Environmental.

This report may not reflect the exact variations of the soil conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. If variations appear evident, it will be necessary to re-evaluate our recommendations after performing on-site observations and tests to establish the engineering significance of these variations. The project geotechnical engineer should review the final plans for the proposed structures so that he may determine if changes in the foundation recommendations are required. The project geotechnical engineer declares that the findings, recommendations or professional advice contained herein have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechnical engineering and engineering geology. No other warranties are implied or expressed.

This report is valid until site conditions change due to disturbance (cut and fill grading) or changes to nearby drainage conditions or two (2) years from the date of this report, whichever occurs first. Beyond this expiration date, Terradyne shall not accept any liability associated with the engineering recommendations in the report, particularly if the site conditions have changed. If this report is desired for use for design purposes beyond this expiration date, we highly recommend an update of this report with the possibility of drilling additional borings so that we can verify the subsurface conditions and validate the recommendations in this report.

This report has been prepared for the exclusive use of the owner, owner's representative and the design team for the specific application to the proposed Auto Zone Store #3658 located at near Ranchero Road and Escondido Avenue, Oak Hills, San Bernardino County, California.

REFERENCES

California Building Code (CBC), 2019, California Code of Regulations, Title 24, Part 2, Volume 2 of 2,

Google Earth Pro®, 2019, Version 7.3.2.5776.

American Society for Testing and Materials (ASTM), 2011, Annual Book of ASTM Standards, Volume 04.08, Construction: Soil and Rock (I), Standards D 420 - D 5876.

California Building Code, 2016, California Code of Regulations Title 24, Part 2, Volume 2 of 2.

American Society of Civil Engineers (ASCE), Minimum Design Loads for Buildings and other Structures, Standard 7-16

NAVFAC DM 7.1 Soil Mechanics, U.S. Department of the Navy 1982 Edition, May 1982

NAVFAC DM 7.2, Foundation and Earth Structures, U.S. Department of the Navy 1984

California State Water Resources Control Board, Website, GeoTracker database, http://geotracker.waterboards.ca.gov/gama/, accessed January 2019.

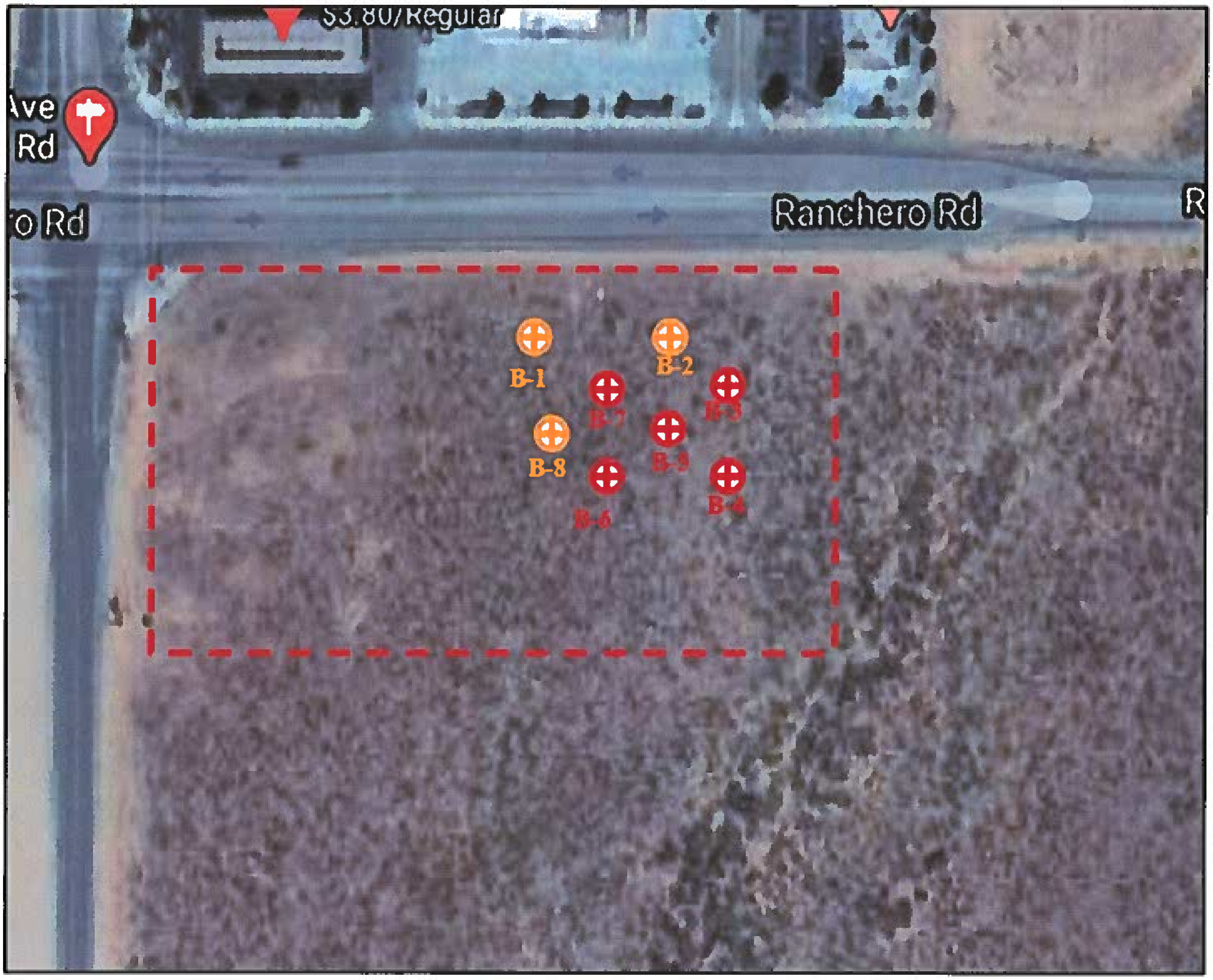
Dibblee, T.W., 1964, Geologic map of the Lucerne Valley quadrangle, San Bernardino County, California: U.S. Geological Survey, Miscellaneous Geologic Investigations Map I-426, scale 1:62,500

United States Geological Survey (USGS), 2015 edition, 7.5' Minute Topographic Map of the Fawnskin Quadrangle, San Bernardino County, California, Scale 1:24,000

ASCE Hazard Tool https://asce7hazardtool.online/

APPENDIX A

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Vicinity Map	
	Terradyne Project No.: L201011	Figure: A

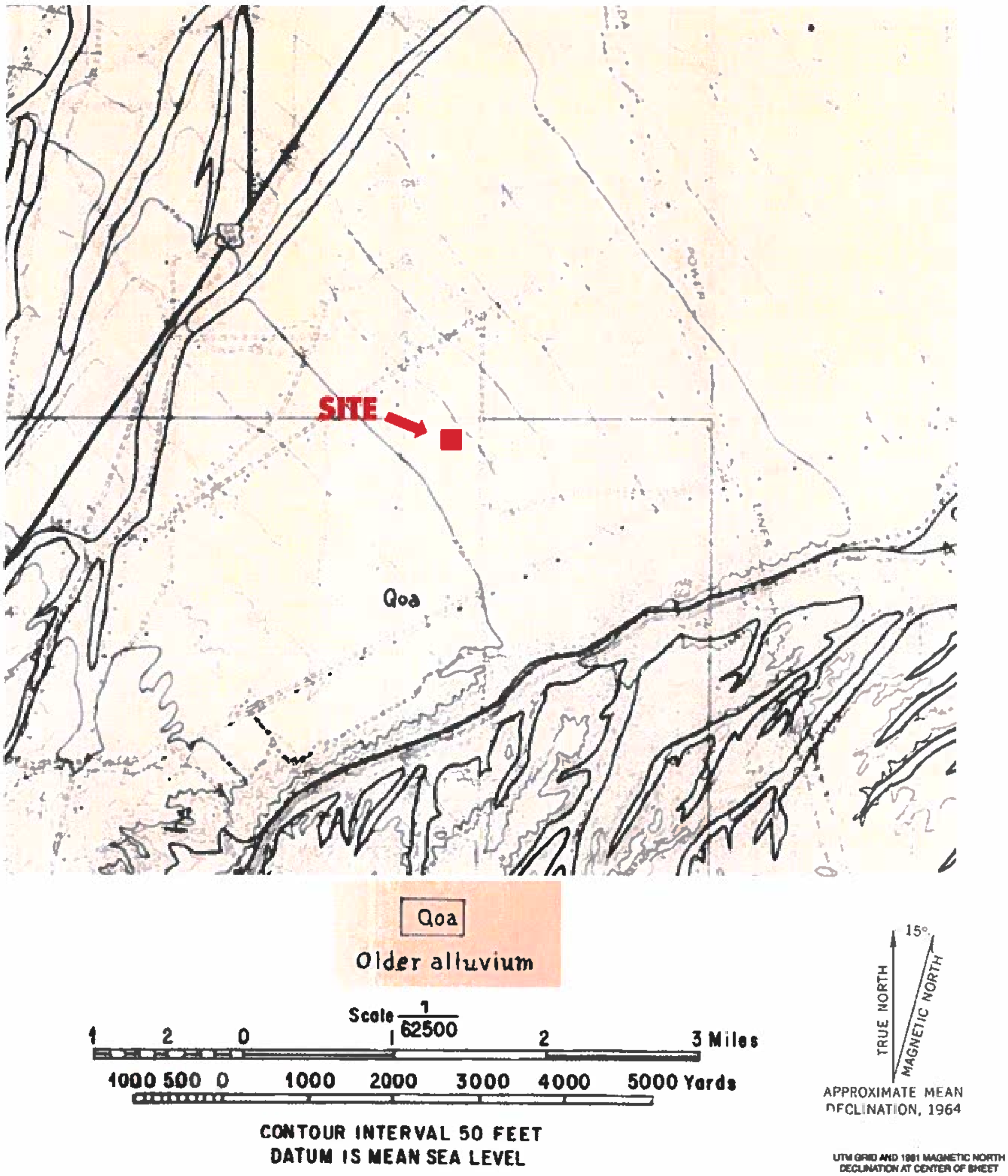


Approximate Boring Locations 15 feet depth

Approximate Boring Locations 10 feet depth

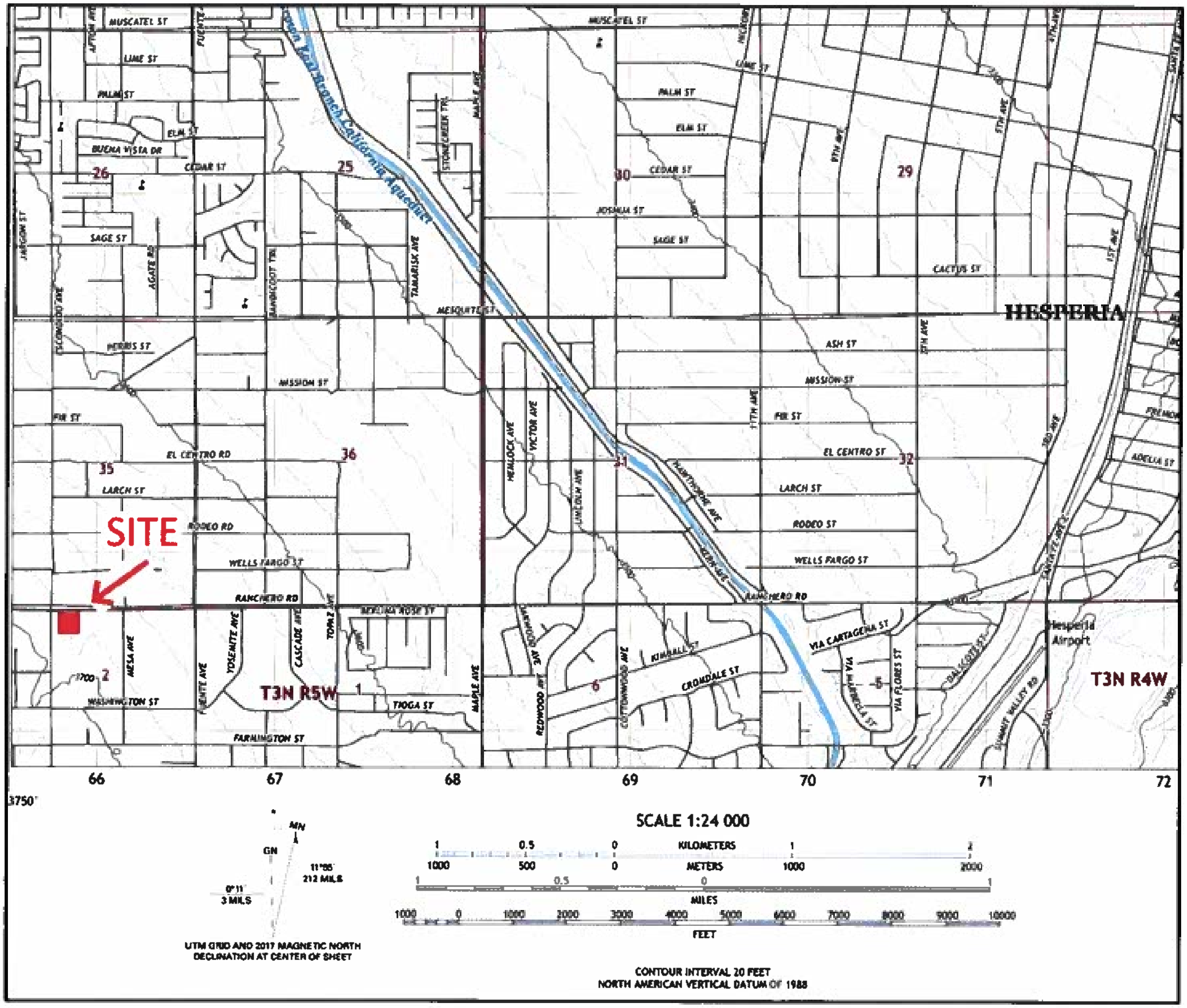
Approximate Subject Lot Boundary

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Approximate Boring Location Map	
	Terradyne Project No.: L201011	Figure: B



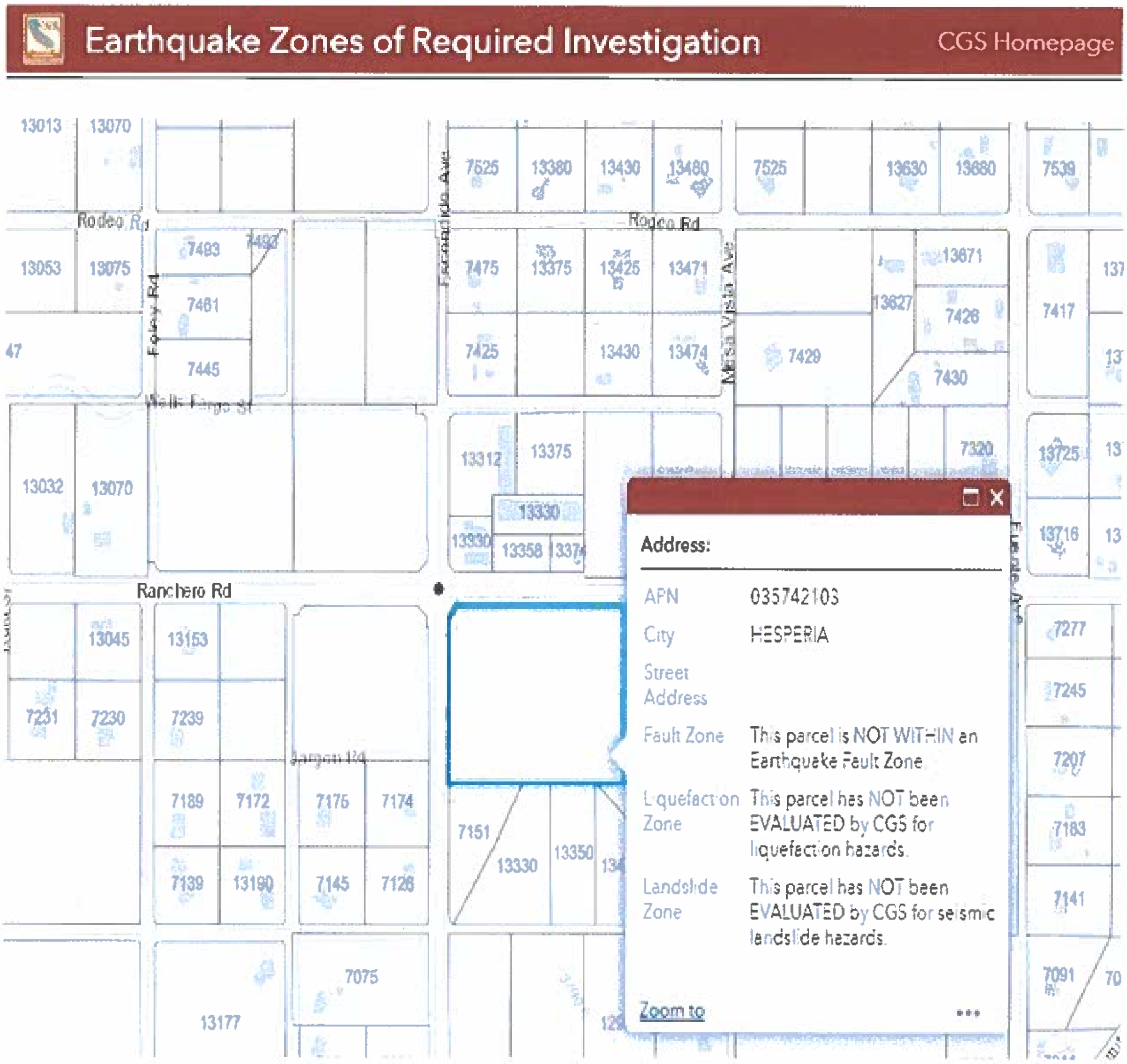
Map Reference: Dibblee, T.W., 1965, Geologic map of the 15-minute Hesperia quadrangle, San Bernardino County, California: U.S. Geological Survey, Open-File Report OF-65-43, scale 1:62,500

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County; CA 92344	**Terradyne Engineering, Inc.** Regional Geologic Map and Legends Terradyne Project No.: L201011 — Figure: C



Map Reference: : United States Geological Survey (USGS), 2012 edition, 7.5' Minute Topographic Map of the Hesperia Quadrangle, San Bernardino County, California, Scale 1:24,000

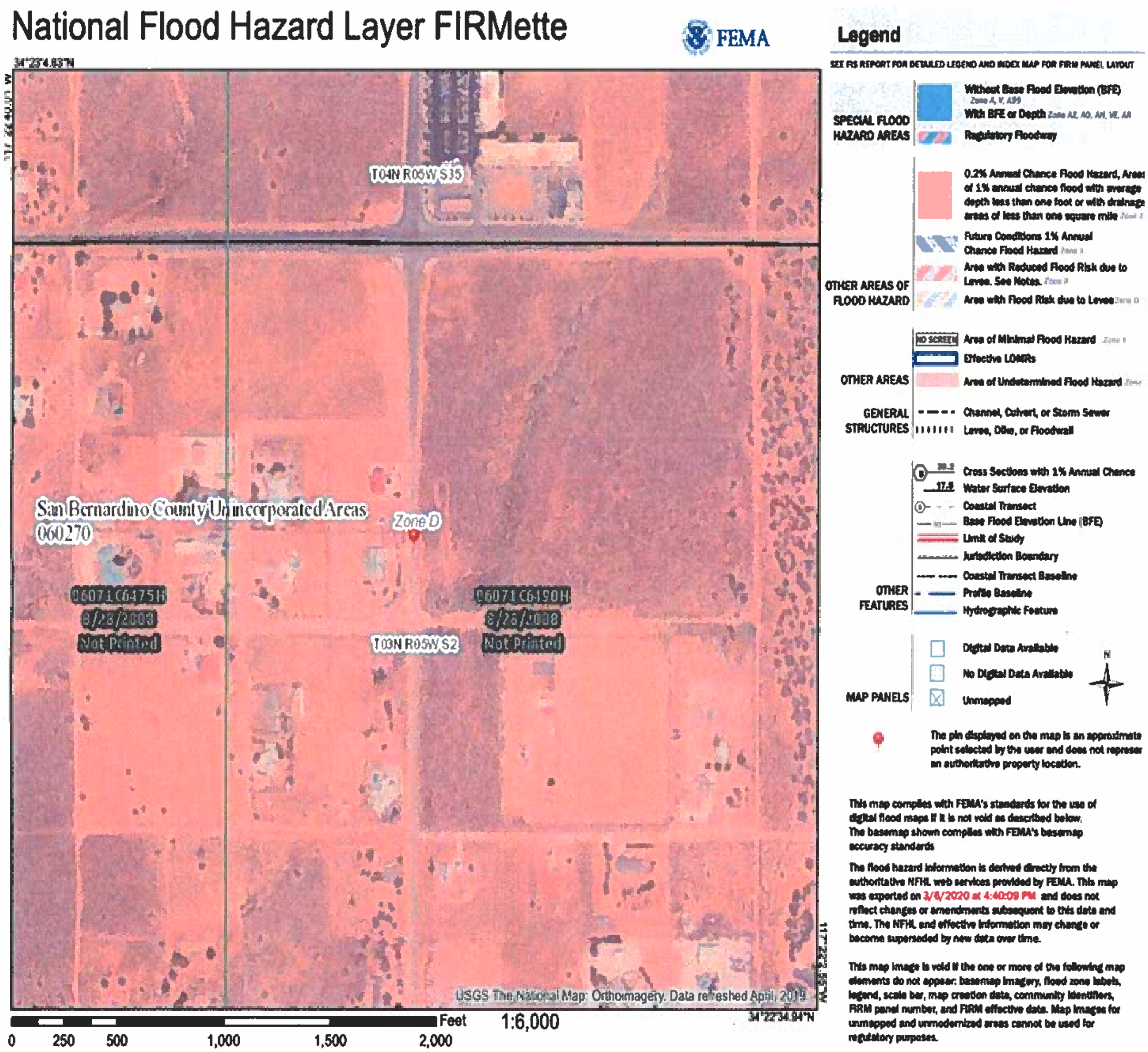
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Regional Topographic Map Terradyne Project No.: L201011 — Figure: D



California Geological Survey (CGS)

Ref: https://maps.conservation.ca.gov/cgs/EQZApp/app

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** CGS Seismic Hazard Information Terradyne Project No.: L201011 — Figure: E



Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Groundwater Information Map Terradyne Project No.: L201011 — Figure: F

APPENDIX B

Boring Logs

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Escolndido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 1** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 In**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-1 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, medium dense, moist	5.21				
			B-1 @ 2.5'-4'	6/9/14	SM		Silty SAND, light brown, medium dense, slightly moist					
	5		B-1 @ 4.5'-5.0'	6/4/5	SM		Silty SAND, light brown, loose, slightly moist	5.26	115.93			
			B-1 @ 7.5'-9'	8/13/13	SM		Consistency changed to medium dense					
	10		B-1 @ 10'-10.5	25/38/28	SM		Silty SAND, light brown with reddish mixed, dense, slightly moist	2.54	114.73			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

C:\Users\jgliang\Desktop\Project\L201011\Boring log\L201011.bg4[master 4 tab].tpl

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	# Log of Boring 2 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-2 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, loose, moist	5.21				
			B-2 @ 2.5'-4'	4/6/7	SM		Silty SAND, brown, medium dense, slightly moist					
	5		B-2 @ 4.5'-5.0'	4/4/5	SM		Silty SAND, light brown, loose, slightly moist	6.11	113.40	15.7		
			B-2 @ 7.5'-9'	11/17/18	SM		Consistency changed to dense					
	10		B-2 @ 10'-10.5'	31/50 for 6"	SM		Silty SAND, brown, very dense, slightly moist	6.46	112.89			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bgs[master 4 lab].tpl

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	# Log of Boring 3 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-3 @ 2.5'-4'	3/4/6	SM							
	5				SM		Silty SAND, light brown, medium dense, slightly moist					
			B-3 @ 7.0'-7.5'	5/10/16	SM		Consistency changed to very dense	4.68	117.21	21.1		
	10		B-3 @ 10'-11.5'	14/15/21	SM		Consistency changed to dense					
			B-3 @ 12.5'-14	6/16/18	SM							
	15		B-3 @	15/50 for 6"	SM		Silty SAND, light brown, very dense, slightly moist, with some gravel	3.88	110.05	16.4		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 4** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-4 @ 2.5'-4'	4/7/6	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, brown, medium dense, slightly moist					
			B-4 @ 7.0'-7.5'	11/16/19	SM		Silty SAND, light brown, very dense, slightly moist, with reddish brown sandstone	3.92	115.55	17.7		
			B-4 @ 8.5'-10'	19/41/50 for 6"								
	10				SM		Consistency changed to dense					
			B-4 @ 11'-12.5'	10/16/24								
					SM		Silty SAND, brown, very dense, slightly moist, with sandstone and some gravel					
	15		B-4 @	50 for 6"	SM			6.59	104.30			
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	# Log of Boring 5 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-5 @ 0'-5'		SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist	3.45				
			B-5 @ 2.5'-4'	3/4/7	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, lightt brown, medium dense, slightly moist, with some gravel					
			B-5 @ 7.0'-7.5'	6/11/18	SM		Silty SAND, light brown, very dense, slightly moist, with sandstone	4.13	103.68	20.5		
			B-5 @ 8.5'-10'	27/50 for 5"								
	10				SM		Silty SAND, light brown, dense, slightly moist, with some sandstone and some gravel					
			B-5 @ 12.5'-14	13/18/25	SM		Silty SAND, light brown, dense, slightly moist, with some gravel					
	15		B-5 @ 15'-15.5	50 for 6"	SM		Consistency changed to very dense, with sandstone and no gravel	4.84	100.65	29.3		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	# Log of Boring 6 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-6 @2.5'-4	2/4/6	SM							
	5				SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
			B-6 @ 7.0'-7.5'	6/9/8	SM		Consistency changed to dense	5.93	114.58	22.2		
			B-6 @ 8.5'-10'	16/21/23								
	10				SM		Silty SAND, light brown, medium dense, slightly moist					
			B-6 @ 12.5'-14	10/12/12	SM		Some sandstone present					
	15		B-6 @ 15'-15.5	21/26/38	SM		Silty SAND, brown, dense, slightly moist, with sandstone	5.98	118.04	13.3		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bg4[master 4 lab].tpl

Project: New Auto Zone Store #3658 Project Location: Near Ranchero Dr. & Esocindido Ave. Oak Hill CA Project Number: L201011	Log of Boring 7 Sheet 1 of 1

Date(s) Drilled: 2/25/2020	Logged By: ZJ	Checked By: HE
Drilling Method: Standard Penetration Test Hollow-Stem Auger	Drill Bit Size/Type: 8 in	Total Depth of Borehole: 16.5 feet bgs
Drill Rig Type: CME-75	Drilling Contractor:	Approximate Surface Elevation:
Groundwater Level and Date Measured: Not Encountered Groundwater	Sampling Method(s): Bulk, Modified California, SPT	Hammer Data: 140lbs 30" drop
Borehole Backfill: Native Soil	Location: See Boring Location Map	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-7 @ 0'-5'		SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist	3.97				
			B-7 @ 2.5'-4'	4/5/5	SM							
	5				SM		Silty SAND, lightt brown, loose, slightly moist, with some sandstone					
			B-7 @ 7.0'-7.5'	6/7/7	SM		Changed to very dense	4.42	111.89			
			B-7 @ 8.5'-10'	31/50 for6"								
	10				SM		Silty SAND, light brown, very dense, slightly moist, with some sandstone and some gravel					
			B-7 @ 12.5'-14	19/26/20	SM		Consistency changed to dense					
	15		B-7 @ 15'-15.5	26/50 for 5"	SM		Consistency changed to very dense	4.84	108.32			
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

Project: **New Auto Zone Store #3658**	**Log of Boring 8**
Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA**	**Sheet 1 of 1**
Project Number: **L201011**	

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

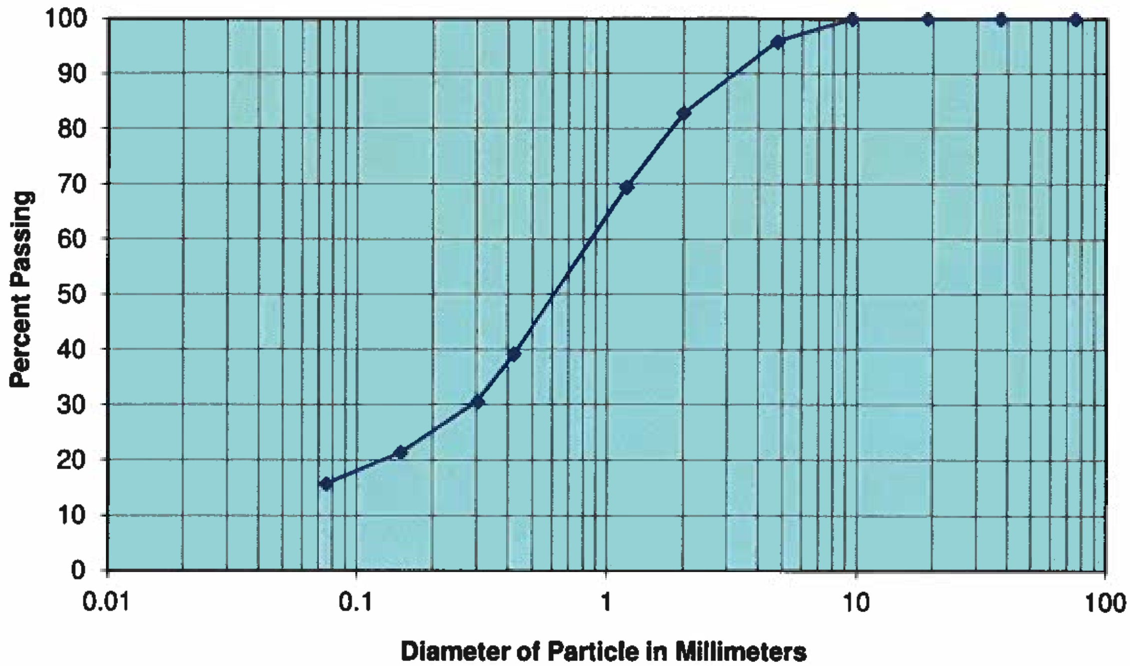
Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, medium dense, moist					
					SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
	5		B-8 @ 4.5'-5.0'	4/6/13	SM		Silty SAND, light brown, medium dense, slightly moist, with sandstone and gravel	6.00	116.27	19.1		
			B-8 @ 7.5'-9'	8/14/19	SM							
	10		B-8 @ 10'-10.5	7/9/10	SM			4.21	101.65			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bgs[master 4 lab).tpl]

APPENDIX C

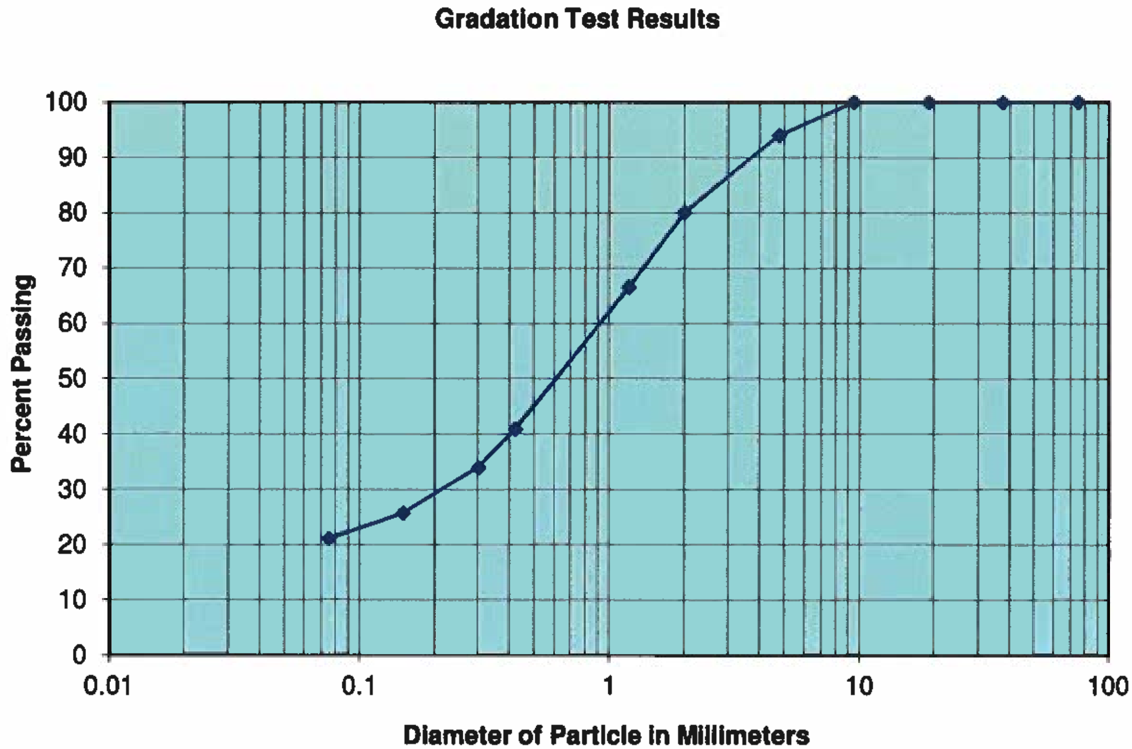
Laboratory Tests

Gradation Test Results



B-1 @ 4.5'-5.0'

Gravel	Sand	Fines
4.2 %	80.0 %	15.7 %



B-3 @ 7.0'- 7.5'

Gravel	Sand	Fines
6.0 %	73.0 %	21.0 %

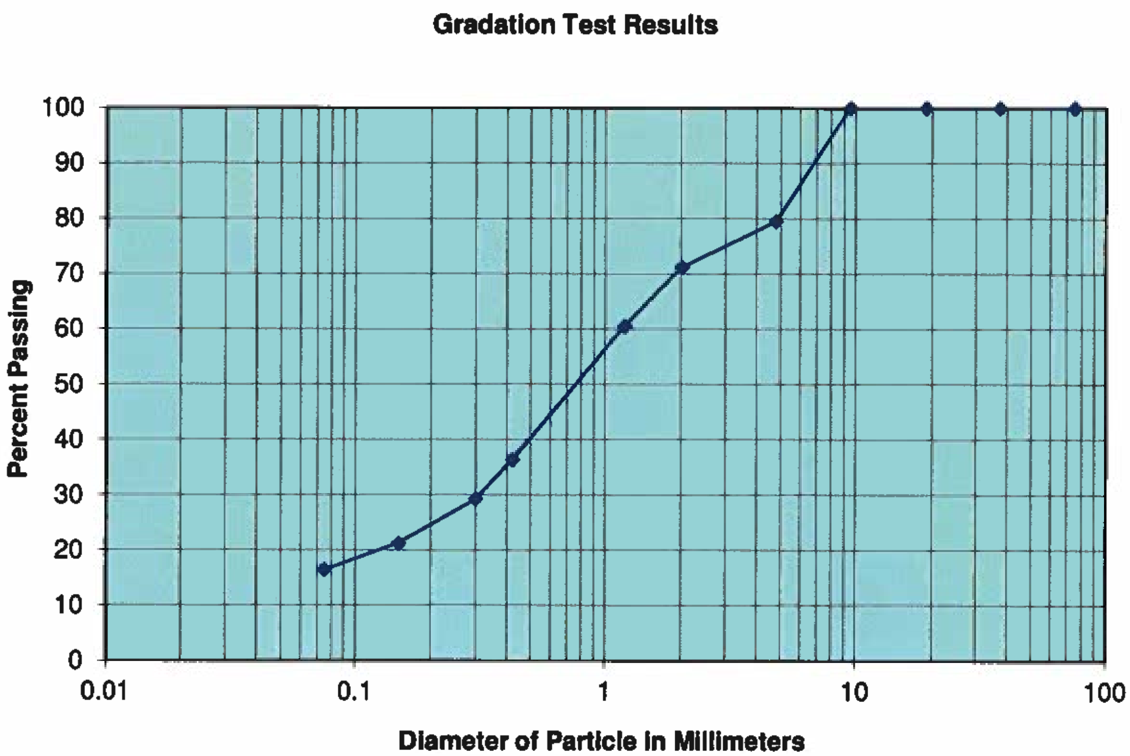
Subsurface Explorations/Geotechnical Investigation

Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Grain Size Distribution

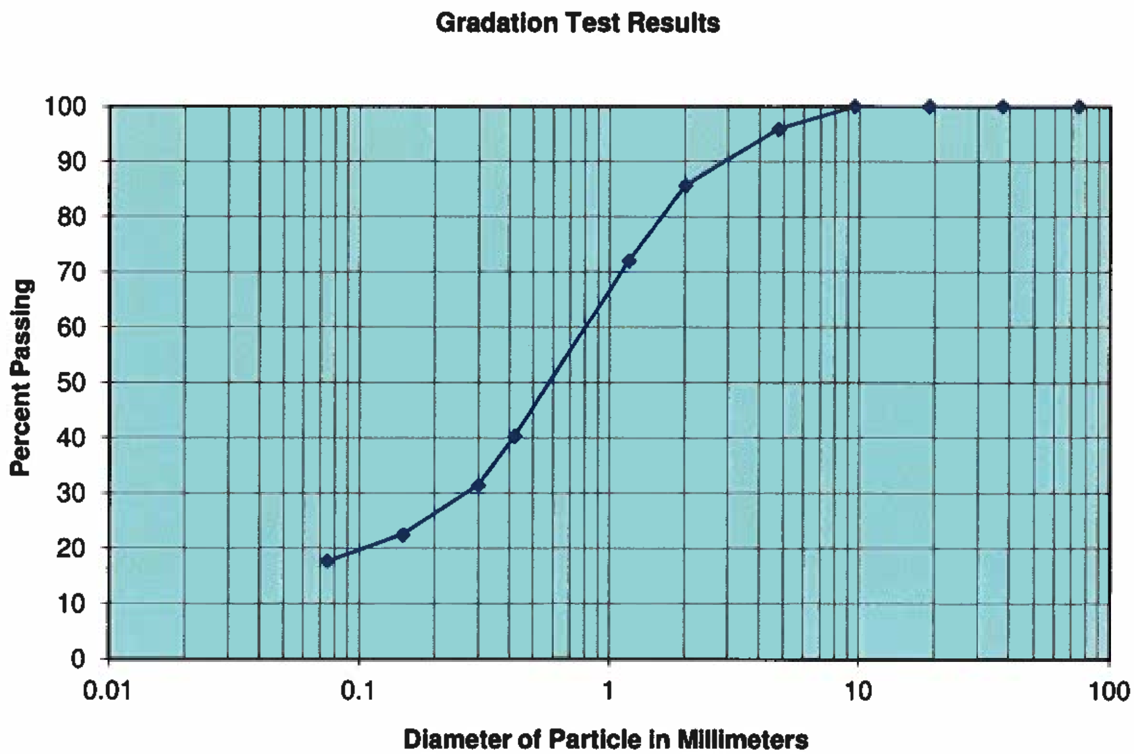
Terradyne Project No.: L201011 | Plate: H



B-3 @ 15.0'- 15.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: I

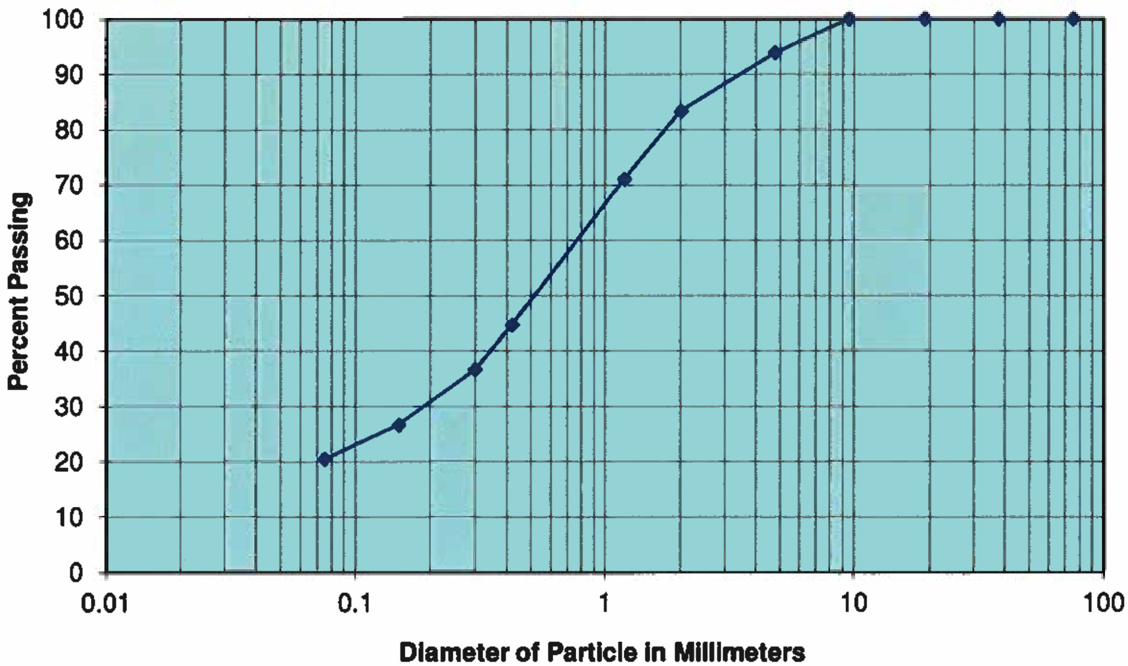


B-4 @ 7.0'- 7.5'

Gravel	Sand	Fines
4.1 %	78.2 %	17.7 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: J

Gradation Test Results

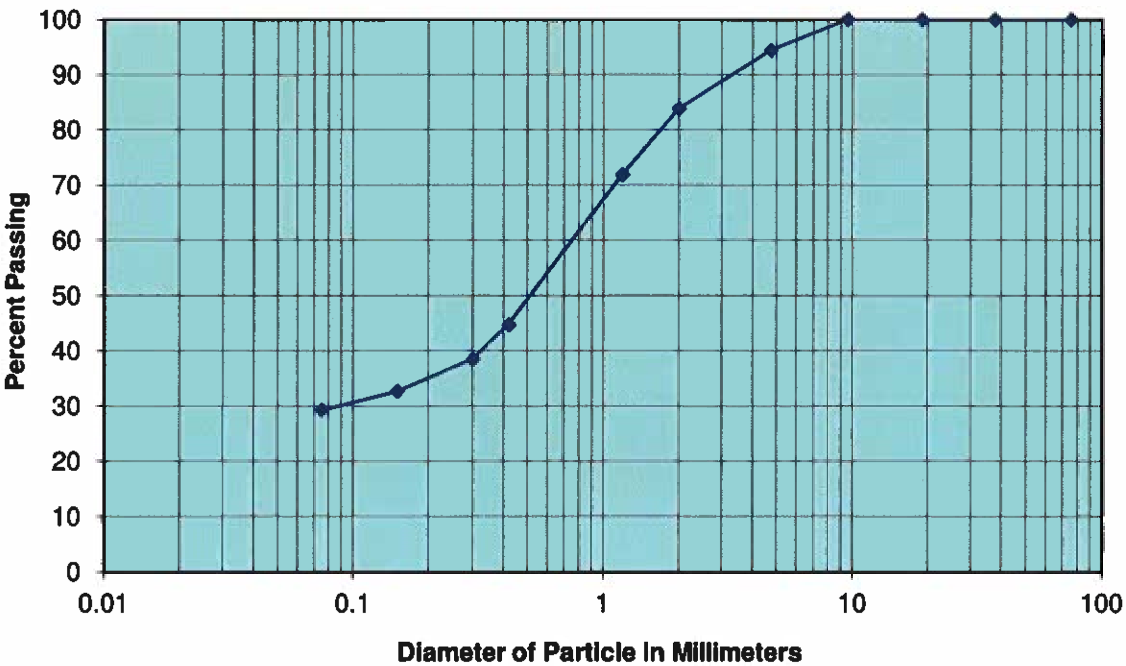


B-5 @ 7.0'- 7.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: K

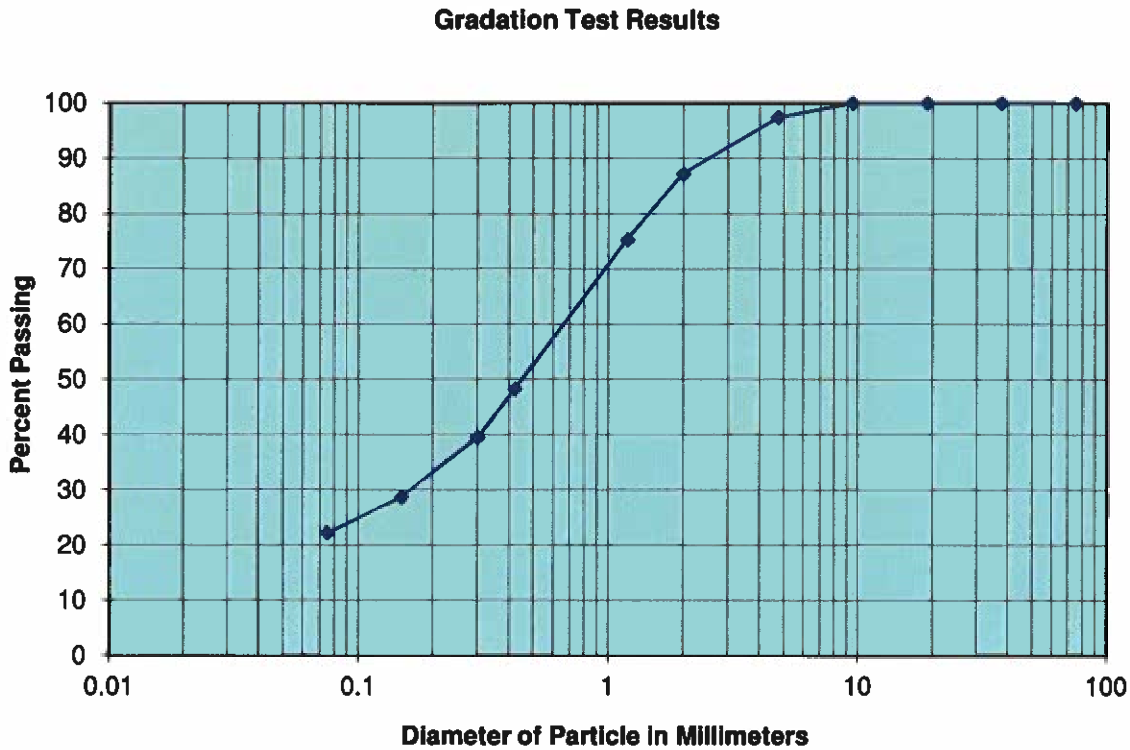
Gradation Test Results



B-5 @ 15.0'- 15.5'

Gravel	Sand	Fines
5.6 %	65.1 %	29.3 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: L

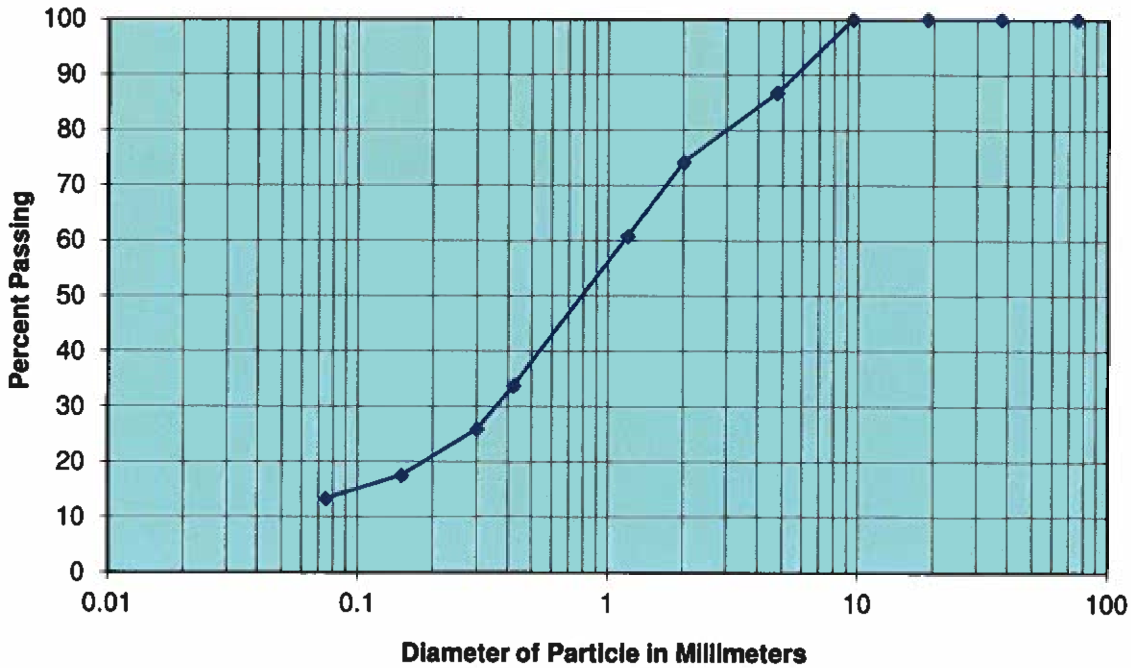


B-6 @ 7.0'- 7.5'

Gravel	Sand	Fines
2.6 %	75.2 %	22.2 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: M

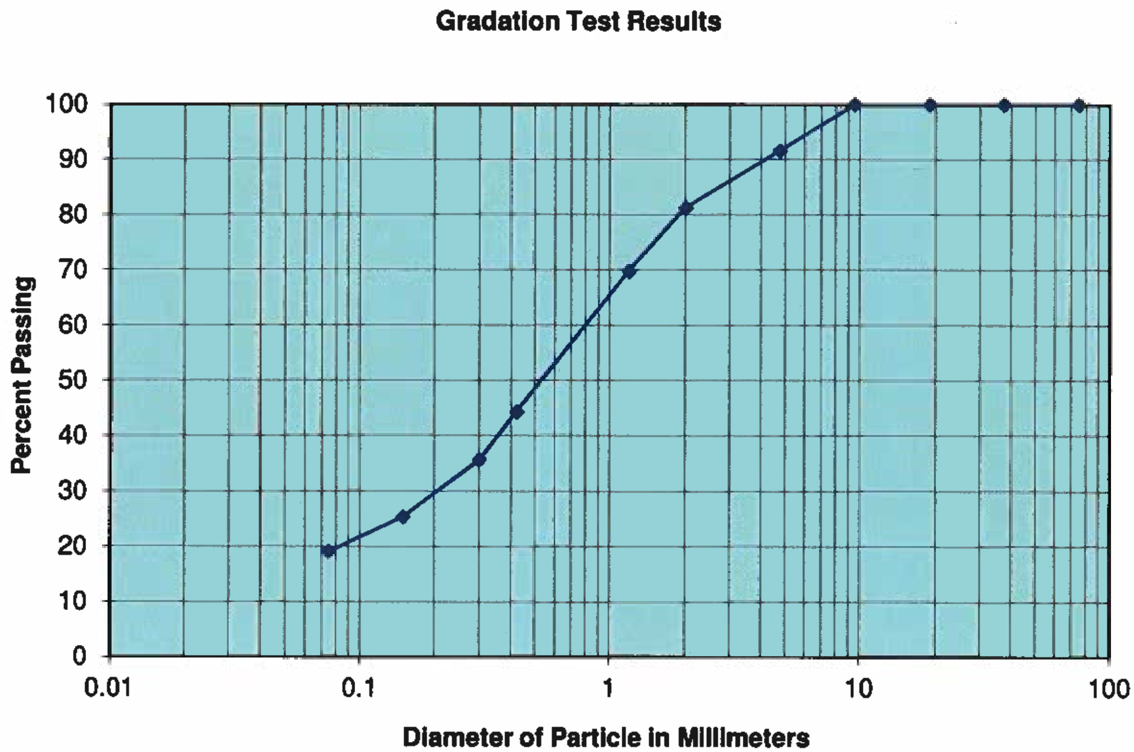
Gradation Test Results



B-6 @ 15.0'- 15.5'

Gravel	Sand	Fines
13.3 %	73.4 %	13.3 %

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution Terradyne Project No.: L201011 — Plate: N



B-8 @ 7.0'- 7.5'

Gravel	Sand	Fines
8.4 %	72.5 %	19.1 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: O

Expansion Index Test (ASTM D 4829)

Project Name: Auto Zone, Store# 3658, Near Ranchero Dr & Esocondid	Sample By:	CR	Date: 2/7/20
Project No. : L201010	Tested By:	WS	Date: 2/27/20
Boring No.: B8	Depth (ft): 1 - 5'		
Sample No. :			
Soil Identification:			

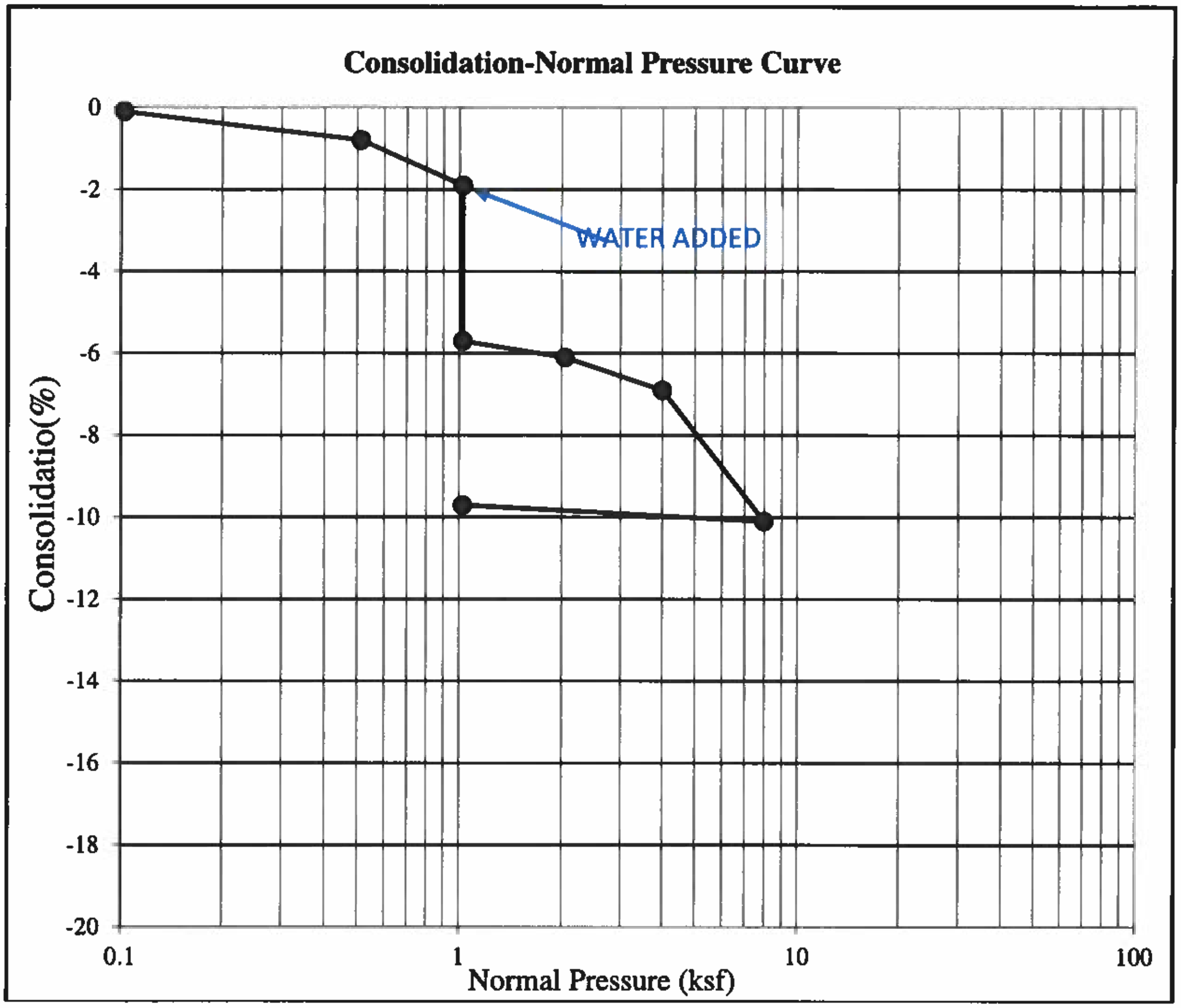
Dry Wt. of Soil + Cont. (g)	
Wt. of Container No. (g)	
Dry Wt. of Soil (g)	0.0
Weight Soil Retained on #4	
Sieve Percent Passing # 4	

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4	4
Specimen Height (in.)	1.00	1.00
Wt. Comp. Soil + Mold (g)	785.7	815.8
Wt. of Mold (g)	367.0	367.0
Specific Gravity (Assumed)	2.65	2.65
Ring Factor	0.301	0.301
Wet Wt. of Soil + Cont. (g)	204.5	203.1
Dry Wt. of Soil + Cont. (g)	198.9	192.4
Wt. of Container (g)	124.0	100.8
Moisture Content (%)	7.5	11.7
Wet Density (pcf)	126.0	135.1
Dry Density (pcf)	117.3	121.0
Degree of Saturation (%) [S_{meas}]	48.3	84.3

SPECIMENT INUNDATION in distilled water for the period of 24h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Reading (in.)
2/27/2020	3:40 PM	1		41
2/28/2020	3:50 PM	1		43

Expansion Index (EI)=(Final rdg-InitialRdg)/Initial Thick)x1000	2	**Plate: P**



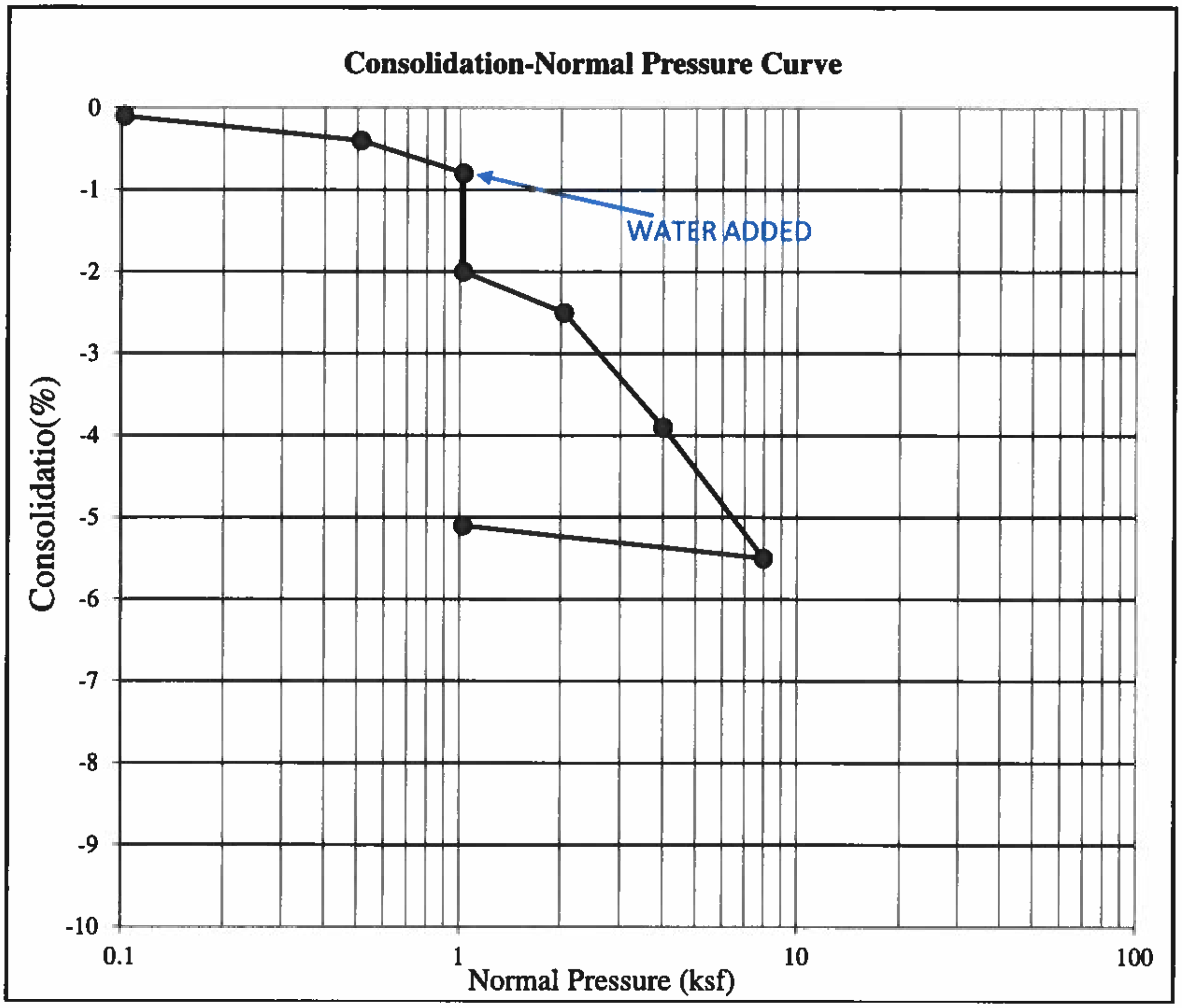
Boring Info		Before Test		After Test		Record	
Boring No.	B-4	Moisture (%)	3.92	Moisture (%)	16.03	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	179.8	Total Weight (g)	193.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	41.8	Ring Weight (g)	41.8	Start Date	3/6/2020
		Wet Density (pcf)	114.7	Wet Density (pcf)	126.1	End Date	3/9/2020

Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr &
Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

Terradyne Project No: L201011 | Plate: Q



Boring Info		Before Test		After Test		Record	
Boring No.	B-7	Moisture (%)	4.42	Moisture (%)	16.50	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	185.8	Total Weight (g)	201.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	46.3	Ring Weight (g)	46.3	Start Date	3/6/2020
		Wet Density (pcf)	115.9	Wet Density (pcf)	129.0	End Date	3/9/2020

Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr & Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

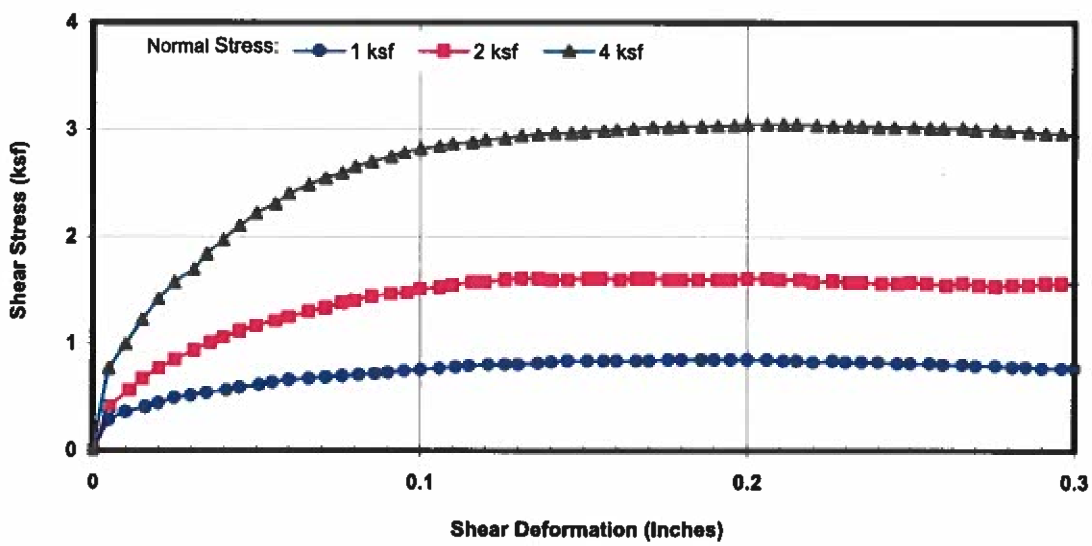
Terradyne Project No: L201011 | Plate: R

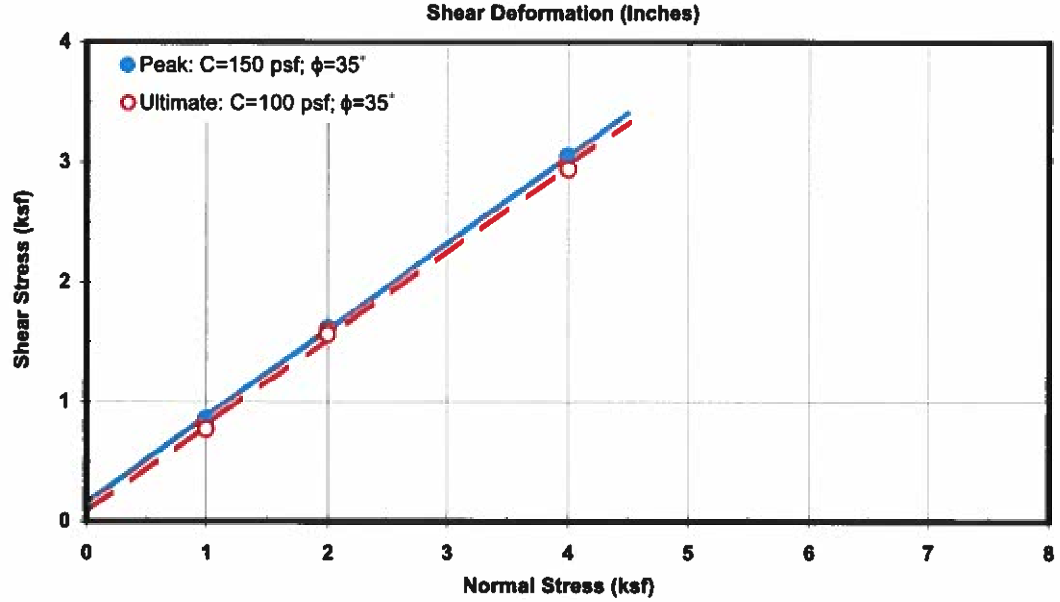
AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Client:	Terradyne Engineering Inc.	**Tested By:** LS	**Date:** 02/28/20
Project Name:	AutoZone #3658, Oak Hills, CA	**Computed By:** NR	**Date:** 03/03/20
Project No.:	L201011	**Checked by:** AP	**Date:** 03/04/20
Boring No.:	B-5		
Sample No.:	- **Depth (ft):** 7-7.5		
Sample Type:	Mod. Cal.		
Soil Description:	Silty Sand w/gravel		
Test Condition:	Inundated **Shear Type:** Regular		

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
111.0	107.8	2.9	18.9	14	91	1	0.852	0.768
						2	1.608	1.560
						4	3.050	2.940





APPENDIX D

ASCE 7-16 Hazards Report

![ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS]

ASCE 7 Hazards Report

Address:
7151 Escondido Ave
Hesperia, California
92344

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 3697.07 ft (NAVD 88)
Latitude: 34.380496
Longitude: -117.372579

AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.6	T_L :	12
F_a :	1	PGA :	0.555
F_v :	N/A	PGA_M :	0.611
S_{MS} :	1.5	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Sun Mar 08 2020

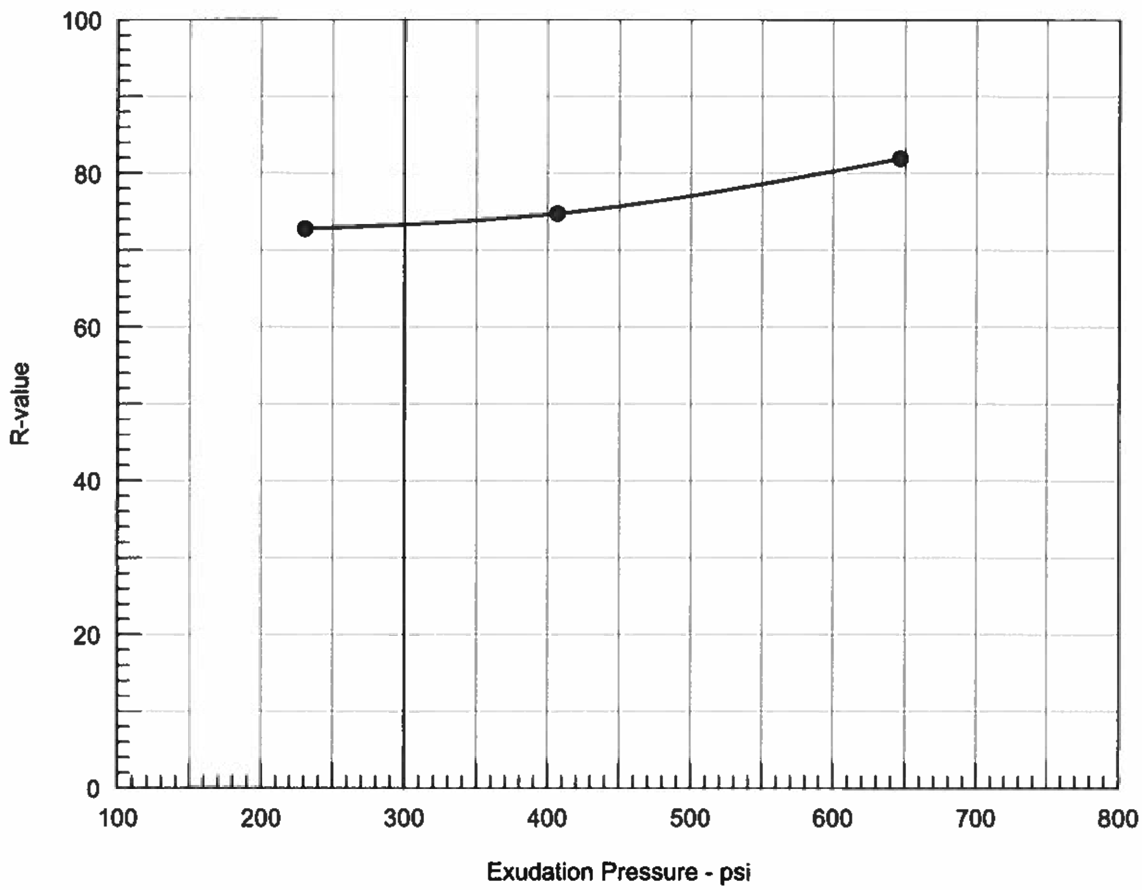
Date Source: USGS Seismic Design Maps

AMERICAN SOCIETY OF CIVIL ENGINEERS

APPENDIX E

Pavement Design

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	132.8	7.5	0.00	22	2.43	231	74.0	72.8
2	350	131.8	6.8	0.00	15	2.45	646	81.9	81.9
3	350	134.1	7.1	0.00	20	2.40	407	76.4	74.7

Test Results	Material Description
R-value at 300 psi exudation pressure = 73.3	MD REDDISH BRN SILTY SAND W TRACE GRAVEL

Project No.: 3842A01
Project: TERRADYNE
Location: B2 @ 0-5'
Sample Number: 192
Date: 3/2/2020

Tested by: RS
Checked by: CF
Remarks:
SAMPLED BY: CLIENT

R-VALUE TEST REPORT

MTGL, Inc.

Figure ______

Design of Pavement Section by Caltrans Method Using Traffic Index and R-Value

Lowest TI	5	
R-Value of Subgrade	73.3	
R-Value of Aggregate Base	78	(usually 78)
R-Value of Aggregate Subbase	50	(usually 50)
Gravel factor for AB from Table 663.3	1.1	(usually 1.1)
Gravel factor for AS from Table 663.3	1	(usually 1.0)

Project Name: **AutoZone Store#3658**
Project No.: **L201011**
Date: **3/10/2020**

Summary of Results, mm

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
hickness of dense-graded asphalt concrete (mm)	60	75	75	90	105	105	120	135	135	150	150	165	165
Thickness of Class 2 aggregate base(mm)	135	135	165	165	165	195	195	195	225	225	255	255	285
Thickness of aggregate subbase(mm)	105	105	105	105	105	105	105	105	105	105	105	105	105

Summary of Results, inches

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
Thickness of dense-graded asphalt concrete(in.)	2.5	3	3	3.5	4	4	4.5	5.5	5.5	6	6	6.5	6.5
Thickness of Class 2 aggregate base (in.)	5.5	5.5	6.5	6.5	6.5	7.5	7.5	7.5	8.5	8.5	10	10	11.5
Thickness of aggregate subbase (in.)	4	4	4	4	4	4	4	4	4	4	4	4	4

GEOTECHNICAL SUMMARY

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F
Tustin, CA 92780
Office: 657-212-5800
www.terradyne.com

SOILS

Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands

0'-16.5' Older ALLUVIUM (Qoa)
Silty SAND, light brown to brown, loose to dense, slightly moist (No groundwater encountered)

GROUNDWATER

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site.

SITE PREPARATIONS

The existing upper soils alluvial deposits soils are considered to be potentially compressible and collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of 5 feet outside the building footprint

COMPACTIONS REQUIREMENTS

The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

SLAB PREPARATION

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc, should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation."

FOUNDATIONS

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation.

PAVEMENT DESIGN

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78

Appendix F
Reference Material

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Wednesday, September 02, 2020

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	035742103
Project Site Acreage:	11.681
HCOC Exempt Area:	No
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - See Note **Facility Name** - See Note **Owner** - See Note
Closest channel segment's susceptibility to Hydromodification:	See Note
Highest downstream hydromodification susceptibility:	See Note
Is this drainage segment subject to TMDLs?	See Note
Are there downstream drainage segments subject to TMDLs?	See Note
Is this drainage segment a 303d listed stream?	See Note
Are there 303d listed streams downstream?	See Note
Are there unlined downstream waterbodies?	See Note
Project Site Onsite Soil Group(s):	B
Environmentally Sensitive Areas within 200':	None
Groundwater Depth (FT):	No data available
Parcels with potential septic tanks within 1000':	Yes
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	

Note: No drainage facilities located within 2 miles of site.

NOAA Atlas 14, Volume 6, Version 2
Location name: Hesperia, California, USA*
Latitude: 34.3826°, Longitude: -117.3714°
Elevation: 3684.07 ft**
* source: ESRI Maps
** source: USGS

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	0.095 (0.079-0.116)	0.131 (0.108-0.160)	0.178 (0.147-0.218)	0.217 (0.178-0.268)	0.271 (0.214-0.346)	0.313 (0.242-0.408)	0.356 (0.269-0.476)	0.400 (0.294-0.550)	0.461 (0.325-0.661)	0.508 (0.346-0.754)
10-min	0.136 (0.113-0.166)	0.187 (0.155-0.229)	0.256 (0.211-0.313)	0.311 (0.255-0.384)	0.388 (0.307-0.496)	0.448 (0.347-0.585)	0.510 (0.385-0.682)	0.574 (0.422-0.789)	0.661 (0.466-0.947)	0.728 (0.496-1.08)
15-min	0.165 (0.136-0.201)	0.227 (0.188-0.277)	0.309 (0.255-0.378)	0.376 (0.308-0.465)	0.470 (0.372-0.600)	0.542 (0.420-0.707)	0.617 (0.466-0.824)	0.694 (0.510-0.954)	0.799 (0.563-1.15)	0.881 (0.599-1.31)
30-min	0.247 (0.204-0.301)	0.340 (0.281-0.415)	0.463 (0.382-0.567)	0.564 (0.461-0.696)	0.704 (0.557-0.898)	0.812 (0.629-1.06)	0.924 (0.698-1.24)	1.04 (0.764-1.43)	1.20 (0.844-1.72)	1.32 (0.898-1.96)
60-min	0.354 (0.293-0.432)	0.487 (0.403-0.595)	0.664 (0.548-0.813)	0.809 (0.662-0.999)	1.01 (0.798-1.29)	1.17 (0.902-1.52)	1.33 (1.00-1.77)	1.49 (1.10-2.05)	1.72 (1.21-2.46)	1.89 (1.29-2.81)
2-hr	0.524 (0.434-0.639)	0.698 (0.578-0.853)	0.931 (0.768-1.14)	1.13 (0.920-1.39)	1.39 (1.10-1.78)	1.60 (1.24-2.09)	1.82 (1.38-2.43)	2.05 (1.50-2.82)	2.36 (1.66-3.38)	2.60 (1.77-3.86)
3-hr	0.659 (0.546-0.804)	0.869 (0.718-1.06)	1.15 (0.948-1.41)	1.38 (1.13-1.71)	1.71 (1.35-2.18)	1.97 (1.52-2.56)	2.23 (1.69-2.98)	2.51 (1.85-3.45)	2.90 (2.04-4.15)	3.20 (2.18-4.75)
6-hr	0.947 (0.784-1.16)	1.24 (1.03-1.51)	1.63 (1.35-2.00)	1.96 (1.61-2.42)	2.42 (1.92-3.10)	2.79 (2.16-3.64)	3.17 (2.40-4.24)	3.57 (2.62-4.91)	4.13 (2.91-5.93)	4.58 (3.12-6.80)
12-hr	1.25 (1.03-1.52)	1.67 (1.39-2.05)	2.25 (1.85-2.75)	2.72 (2.23-3.36)	3.38 (2.68-4.32)	3.91 (3.03-5.10)	4.46 (3.37-5.96)	5.03 (3.70-6.92)	5.84 (4.11-8.36)	6.48 (4.41-9.61)
24-hr	1.68 (1.49-1.93)	2.32 (2.05-2.67)	3.18 (2.80-3.67)	3.89 (3.41-4.53)	4.89 (4.14-5.89)	5.68 (4.71-6.98)	6.50 (5.27-8.19)	7.37 (5.81-9.54)	8.58 (6.49-11.6)	9.55 (6.98-13.3)
2-day	1.97 (1.75-2.27)	2.75 (2.43-3.17)	3.81 (3.37-4.41)	4.71 (4.13-5.49)	5.99 (5.08-7.22)	7.02 (5.83-8.63)	8.11 (6.57-10.2)	9.28 (7.31-12.0)	10.9 (8.27-14.8)	12.3 (8.97-17.1)
3-day	2.10 (1.86-2.42)	2.95 (2.61-3.40)	4.13 (3.64-4.77)	5.13 (4.49-5.98)	6.57 (5.57-7.92)	7.75 (6.43-9.53)	9.00 (7.29-11.3)	10.4 (8.16-13.4)	12.3 (9.31-16.6)	13.9 (10.2-19.4)
4-day	2.26 (2.00-2.60)	3.18 (2.82-3.67)	4.47 (3.94-5.16)	5.57 (4.88-6.49)	7.17 (6.07-8.63)	8.47 (7.03-10.4)	9.86 (7.99-12.4)	11.4 (8.96-14.7)	13.6 (10.3-18.3)	15.4 (11.2-21.5)
7-day	2.53 (2.24-2.91)	3.57 (3.16-4.12)	5.03 (4.44-5.81)	6.28 (5.50-7.32)	8.09 (6.85-9.74)	9.56 (7.94-11.8)	11.1 (9.03-14.0)	12.9 (10.1-16.7)	15.3 (11.6-20.7)	17.4 (12.7-24.3)
10-day	2.70 (2.39-3.11)	3.81 (3.38-4.40)	5.38 (4.75-6.21)	6.72 (5.89-7.83)	8.67 (7.34-10.4)	10.3 (8.51-12.6)	12.0 (9.69-15.1)	13.8 (10.9-17.9)	16.5 (12.4-22.2)	18.7 (13.6-26.1)
20-day	3.20 (2.83-3.68)	4.55 (4.03-5.25)	6.46 (5.70-7.47)	8.11 (7.10-9.45)	10.5 (8.91-12.7)	12.5 (10.4-15.3)	14.6 (11.8-18.4)	16.9 (13.3-21.9)	20.2 (15.3-27.2)	22.9 (16.7-32.0)
30-day	3.75 (3.32-4.32)	5.34 (4.72-6.15)	7.58 (6.69-8.76)	9.53 (8.34-11.1)	12.4 (10.5-14.9)	14.7 (12.2-18.1)	17.2 (13.9-21.7)	20.0 (15.7-25.8)	23.9 (18.1-32.3)	27.2 (19.8-37.9)
45-day	4.47 (3.96-5.14)	6.30 (5.58-7.26)	8.91 (7.86-10.3)	11.2 (9.79-13.0)	14.5 (12.3-17.5)	17.3 (14.3-21.2)	20.3 (16.4-25.5)	23.5 (18.5-30.4)	28.2 (21.3-38.1)	32.1 (23.4-44.8)
60-day	5.11 (4.53-5.88)	7.11 (6.29-8.20)	9.97 (8.80-11.5)	12.5 (10.9-14.5)	16.2 (13.7-19.5)	19.2 (15.9-23.6)	22.5 (18.2-28.4)	26.1 (20.6-33.9)	31.4 (23.7-42.4)	35.8 (26.2-50.0)

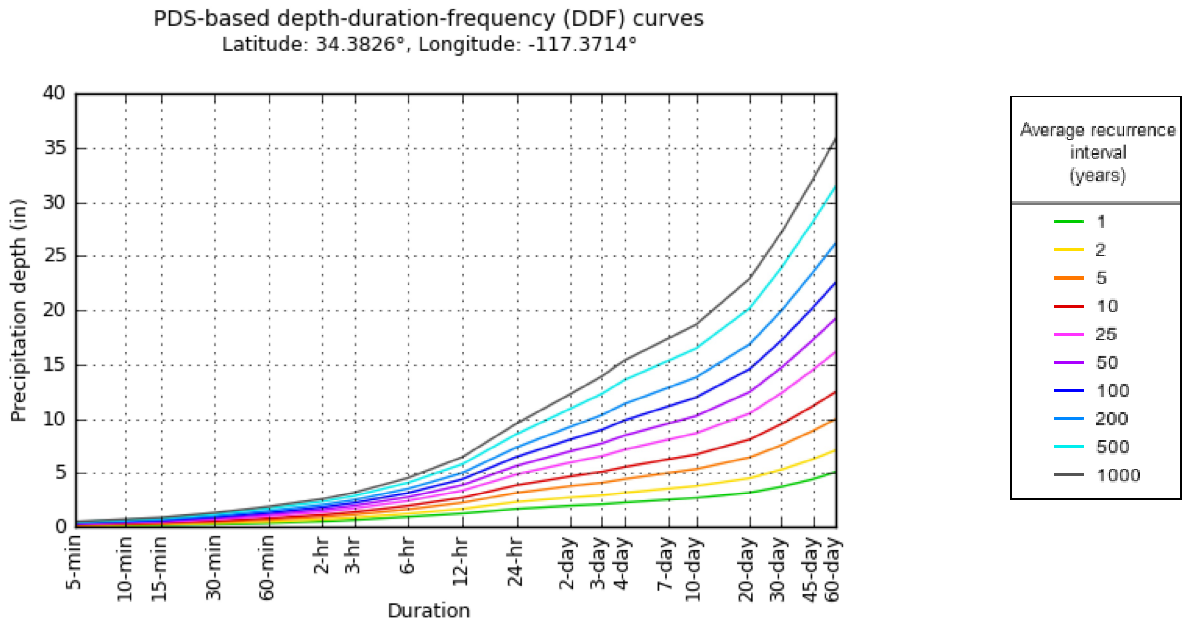
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

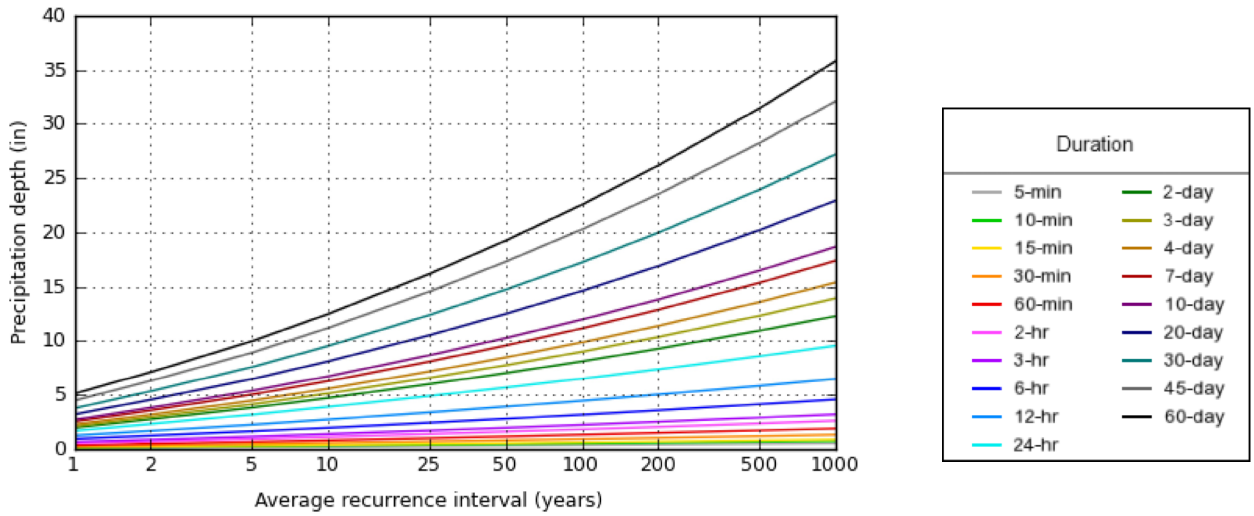
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical





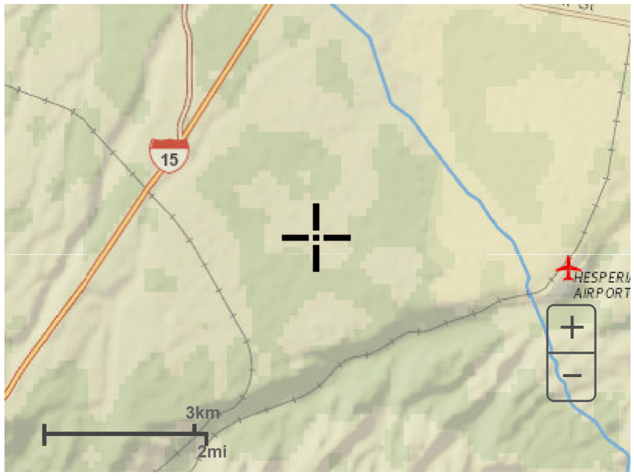
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Sep 2 14:59:37 2020

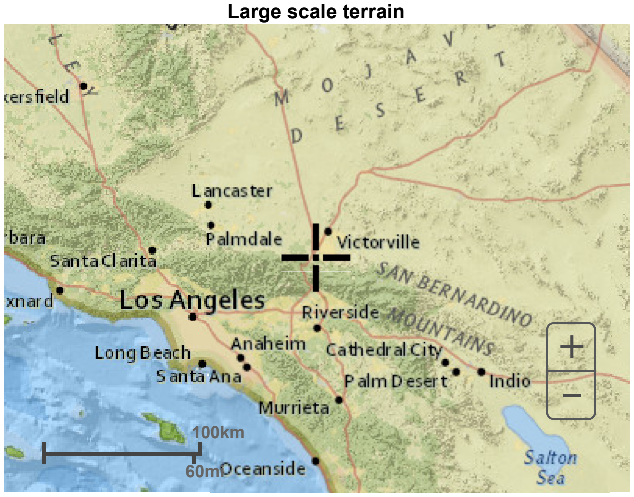
Back to Top

Maps & aerials

Small scale terrain

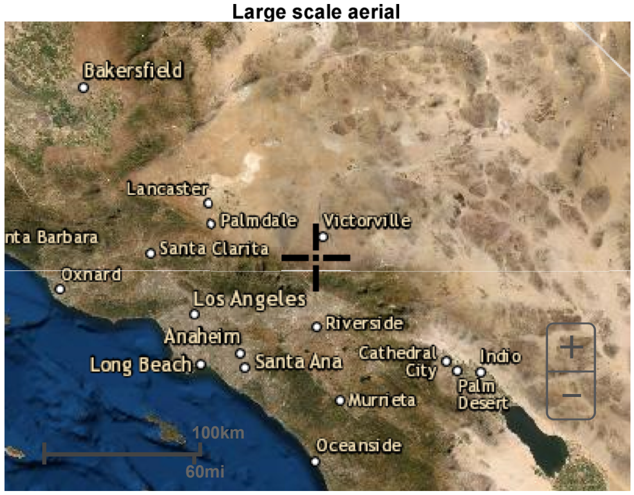


Large scale terrain



Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

NOAA Atlas 14, Volume 6, Version 2
Location name: Hesperia, California, USA*
Latitude: 34.3826°, Longitude: -117.3714°
Elevation: 3684.07 ft**
* source: ESRI Maps
** source: USGS

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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.14** (0.948-1.39)	**1.57** (1.30-1.92)	**2.14** (1.76-2.62)	**2.60** (2.14-3.22)	**3.25** (2.57-4.15)	**3.76** (2.90-4.90)	**4.27** (3.23-5.71)	**4.80** (3.53-6.60)	**5.53** (3.90-7.93)	**6.10** (4.15-9.05)
10-min	**0.816** (0.678-0.996)	**1.12** (0.930-1.37)	**1.54** (1.27-1.88)	**1.87** (1.53-2.30)	**2.33** (1.84-2.98)	**2.69** (2.08-3.51)	**3.06** (2.31-4.09)	**3.44** (2.53-4.73)	**3.97** (2.80-5.68)	**4.37** (2.98-6.49)
15-min	**0.660** (0.544-0.804)	**0.908** (0.752-1.11)	**1.24** (1.02-1.51)	**1.50** (1.23-1.86)	**1.88** (1.49-2.40)	**2.17** (1.68-2.83)	**2.47** (1.86-3.30)	**2.78** (2.04-3.82)	**3.20** (2.25-4.58)	**3.52** (2.40-5.23)
30-min	**0.494** (0.408-0.602)	**0.680** (0.562-0.830)	**0.926** (0.764-1.13)	**1.13** (0.922-1.39)	**1.41** (1.11-1.80)	**1.62** (1.26-2.12)	**1.85** (1.40-2.47)	**2.08** (1.53-2.86)	**2.39** (1.69-3.43)	**2.64** (1.80-3.92)
60-min	**0.354** (0.293-0.432)	**0.487** (0.403-0.595)	**0.664** (0.548-0.813)	**0.809** (0.662-0.999)	**1.01** (0.798-1.29)	**1.17** (0.902-1.52)	**1.33** (1.00-1.77)	**1.49** (1.10-2.05)	**1.72** (1.21-2.46)	**1.89** (1.29-2.81)
2-hr	**0.262** (0.217-0.320)	**0.349** (0.289-0.426)	**0.466** (0.384-0.570)	**0.562** (0.460-0.694)	**0.696** (0.551-0.890)	**0.802** (0.621-1.05)	**0.910** (0.688-1.22)	**1.02** (0.752-1.41)	**1.18** (0.831-1.69)	**1.30** (0.886-1.93)
3-hr	**0.219** (0.182-0.268)	**0.289** (0.239-0.353)	**0.383** (0.316-0.469)	**0.461** (0.377-0.569)	**0.569** (0.450-0.727)	**0.655** (0.507-0.854)	**0.743** (0.562-0.994)	**0.836** (0.615-1.15)	**0.965** (0.680-1.38)	**1.07** (0.725-1.58)
6-hr	**0.158** (0.131-0.193)	**0.207** (0.171-0.253)	**0.273** (0.225-0.334)	**0.328** (0.268-0.405)	**0.405** (0.320-0.517)	**0.466** (0.361-0.607)	**0.529** (0.400-0.707)	**0.597** (0.438-0.820)	**0.690** (0.486-0.990)	**0.765** (0.521-1.14)
12-hr	**0.104** (0.086-0.126)	**0.139** (0.115-0.170)	**0.186** (0.154-0.228)	**0.226** (0.185-0.279)	**0.281** (0.222-0.359)	**0.324** (0.251-0.423)	**0.370** (0.279-0.494)	**0.418** (0.307-0.574)	**0.484** (0.341-0.694)	**0.538** (0.366-0.798)
24-hr	**0.070** (0.062-0.080)	**0.097** (0.085-0.111)	**0.132** (0.117-0.153)	**0.162** (0.142-0.189)	**0.204** (0.173-0.245)	**0.237** (0.196-0.291)	**0.271** (0.219-0.341)	**0.307** (0.242-0.398)	**0.358** (0.270-0.483)	**0.398** (0.291-0.556)
2-day	**0.041** (0.036-0.047)	**0.057** (0.051-0.066)	**0.079** (0.070-0.092)	**0.098** (0.086-0.114)	**0.125** (0.106-0.150)	**0.146** (0.121-0.180)	**0.169** (0.137-0.213)	**0.193** (0.152-0.250)	**0.228** (0.172-0.307)	**0.256** (0.187-0.357)
3-day	**0.029** (0.026-0.034)	**0.041** (0.036-0.047)	**0.057** (0.051-0.066)	**0.071** (0.062-0.083)	**0.091** (0.077-0.110)	**0.108** (0.089-0.132)	**0.125** (0.101-0.157)	**0.144** (0.113-0.186)	**0.171** (0.129-0.231)	**0.193** (0.141-0.270)
4-day	**0.024** (0.021-0.027)	**0.033** (0.029-0.038)	**0.047** (0.041-0.054)	**0.058** (0.051-0.068)	**0.075** (0.063-0.090)	**0.088** (0.073-0.108)	**0.103** (0.083-0.129)	**0.119** (0.093-0.153)	**0.141** (0.107-0.191)	**0.160** (0.117-0.224)
7-day	**0.015** (0.013-0.017)	**0.021** (0.019-0.024)	**0.030** (0.026-0.035)	**0.037** (0.033-0.044)	**0.048** (0.041-0.058)	**0.057** (0.047-0.070)	**0.066** (0.054-0.084)	**0.077** (0.060-0.099)	**0.091** (0.069-0.123)	**0.103** (0.076-0.144)
10-day	**0.011** (0.010-0.013)	**0.016** (0.014-0.018)	**0.022** (0.020-0.026)	**0.028** (0.025-0.033)	**0.036** (0.031-0.043)	**0.043** (0.035-0.053)	**0.050** (0.040-0.063)	**0.058** (0.045-0.074)	**0.069** (0.052-0.093)	**0.078** (0.057-0.109)
20-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.011)	**0.013** (0.012-0.016)	**0.017** (0.015-0.020)	**0.022** (0.019-0.026)	**0.026** (0.022-0.032)	**0.030** (0.025-0.038)	**0.035** (0.028-0.046)	**0.042** (0.032-0.057)	**0.048** (0.035-0.067)
30-day	**0.005** (0.005-0.006)	**0.007** (0.007-0.009)	**0.011** (0.009-0.012)	**0.013** (0.012-0.015)	**0.017** (0.015-0.021)	**0.020** (0.017-0.025)	**0.024** (0.019-0.030)	**0.028** (0.022-0.036)	**0.033** (0.025-0.045)	**0.038** (0.028-0.053)
45-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.007)	**0.008** (0.007-0.010)	**0.010** (0.009-0.012)	**0.013** (0.011-0.016)	**0.016** (0.013-0.020)	**0.019** (0.015-0.024)	**0.022** (0.017-0.028)	**0.026** (0.020-0.035)	**0.030** (0.022-0.041)
60-day	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.011** (0.010-0.014)	**0.013** (0.011-0.016)	**0.016** (0.013-0.020)	**0.018** (0.014-0.024)	**0.022** (0.016-0.029)	**0.025** (0.018-0.035)

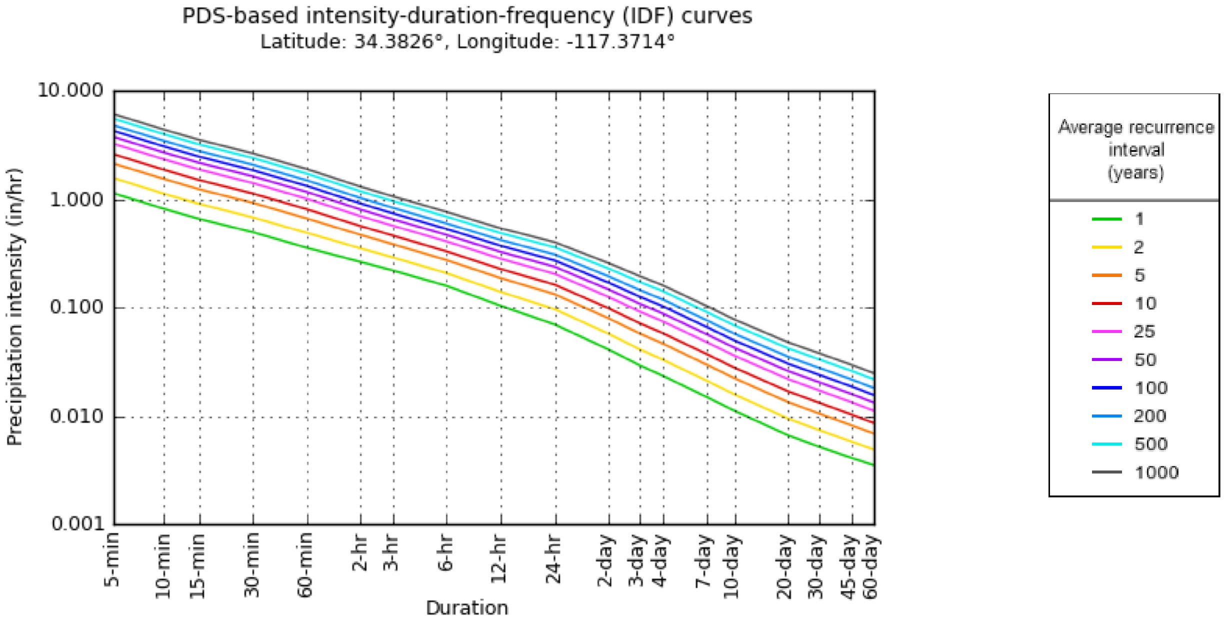
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

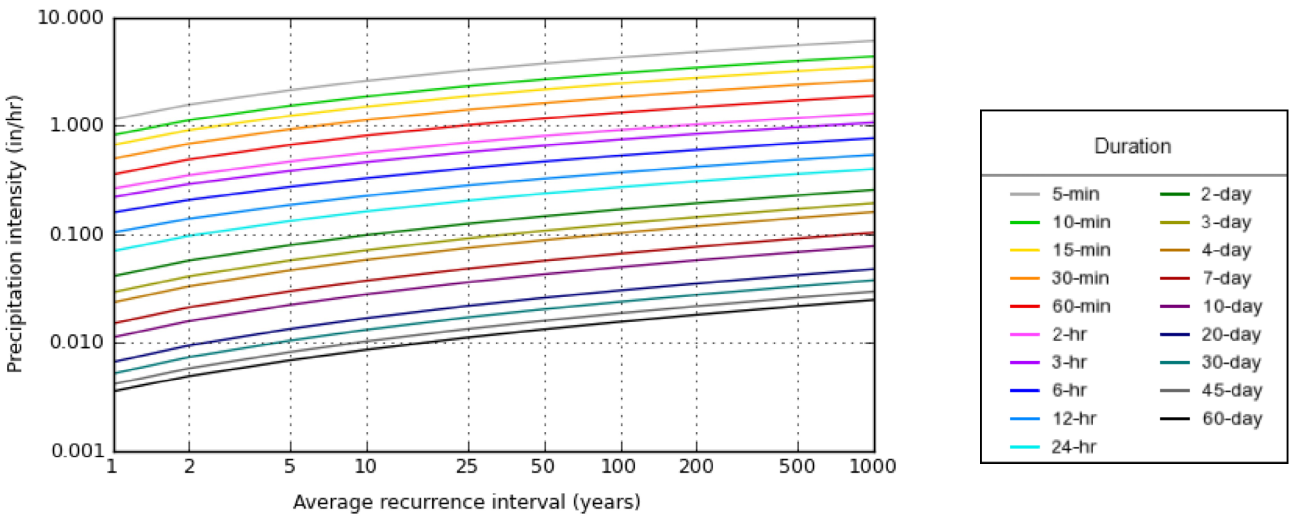
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical



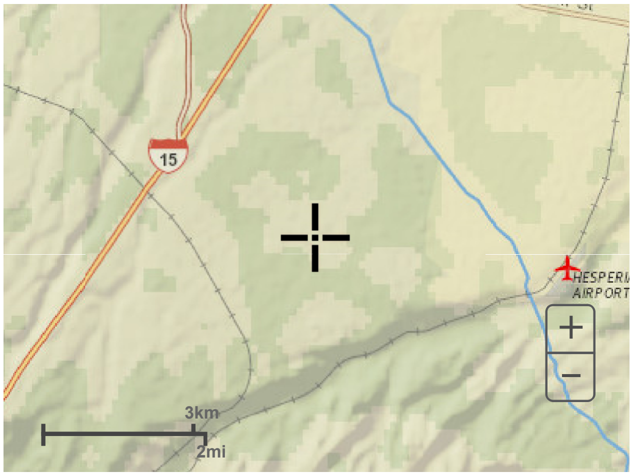


NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Wed Sep 2 15:03:16 2020

Back to Top

Maps & aerials

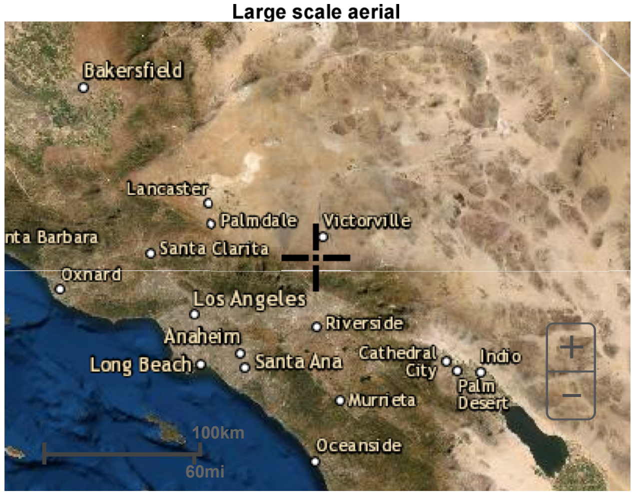
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



[Back to Top](#)

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Residential Landscaping (Lawn, Shrubs, etc.) - The pervious portions of commercial establishments, single and multiple family dwellings, trailer parks and schools where the predominant land cover is lawn, shrubbery and trees.

Row Crops - Lettuce, tomatoes, beets, tulips or any field crop planted in rows far enough apart that most of the soil surface is exposed to rainfall impact throughout the growing season. At plowing, planting and harvest times it is equivalent to fallow.

Small Grain - Wheat, oats, barley, flax, etc. planted in rows close enough that the soil surface is not exposed except during planting and shortly thereafter.

Legumes - Alfalfa, sweetclover, timothy, etc. and combinations are either planted in close rows or broadcast.

Fallow - Fallow land is land plowed but not yet seeded or tilled.

Woodland - grass - Areas with an open cover of broadleaf or coniferous trees usually live oak and pines, with the intervening ground space occupied by annual grasses or weeds. The trees may occur singly or in small clumps. Canopy density, the amount of ground surface shaded at high noon, is from 20 to 50 percent.

Woodland - Areas on which coniferous or broadleaf trees predominate. The canopy density is at least 50 percent. Open areas may have a cover of annual or perennial grasses or of brush. Herbaceous plant cover under the trees is usually sparse because of leaf or needle litter accumulation.

Chaparral - Land on which the principal vegetation consists of evergreen shrubs with broad, hard, stiff leaves such as manzonita, ceanothus and scrub oak. The brush cover is usually dense or moderately dense. Diffusely branched evergreen shrubs with fine needle-like leaves, such as chamise and redchank, with dense high growth are also included in this soil cover.

Annual Grass - Land on which the principal vegetation consists of annual grasses and weeds such as annual bromes, wild barley, soft chess, ryegrass and filaree.

Irrigated Pasture - Irrigated land planted to perennial grasses and legumes for production of forage and which is cultivated only to establish or renew the stand of plants. Dry land pasture is considered as annual grass.

Meadow - Land areas with seasonally high water table, locally called cienegas. Principal vegetation consists of sod-forming grasses interspersed with other plants.

Orchard (Deciduous) - Land planted to such deciduous trees as apples, apricots, pears, walnuts, and almonds.

Orchard (Evergreen) - Land planted to evergreen trees which include citrus and avocados and coniferous plantings.

Turf - Golf courses, parks and similar lands where the predominant cover is irrigated mowed close-grown turf grass. Parks in which trees are dense may be classified as woodland.

SCS
COVER TYPE
DESCRIPTIONS

Figure C-2

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
NATURAL COVERS - Ex Condition					
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
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
Prop Condition					
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)

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

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

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.

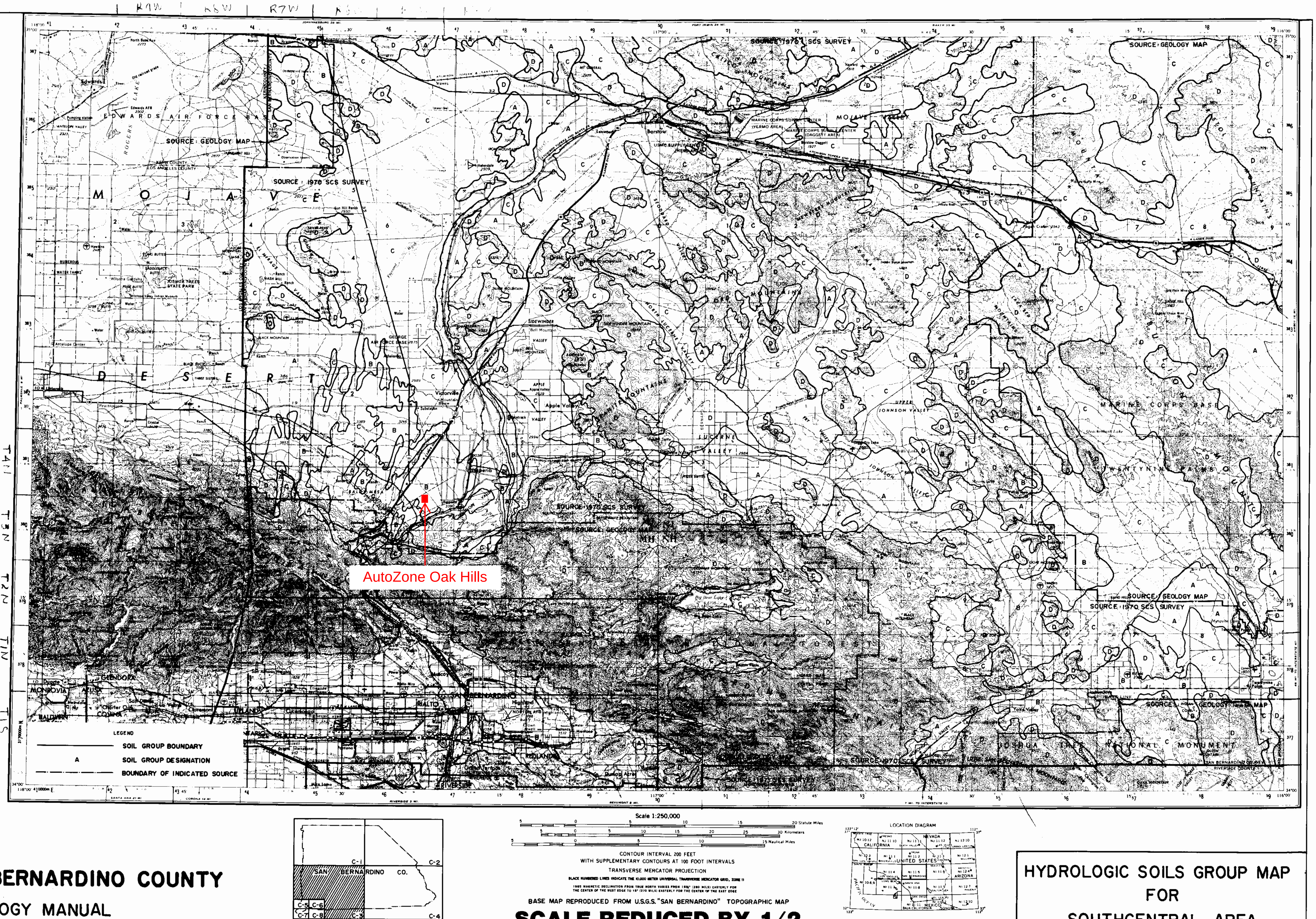
2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some 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



SCALE REDUCED BY 1/2

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA

FIGURE C-11

MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

AutoZone Oak Hills

APN 0357-421-15-0-000 AND APN 0357-421-16-0-000

PRELIMINARY

Prepared for:

AutoZone Parts, Inc.

123 S. Front Street, 3rd Floor

Memphis, TN 38103

(901)495-8714

Prepared by:

Kimley-Horn and Associates

765 the City Drive South, Suite 200

Orange, CA 92868

(714) 705-1374

Submittal Date: 9/14/2020

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Final Approval Date:______________________

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for AutoZone Parts, Inc by Kimley-Horn and Associates. The WQMP is intended to comply with the requirements of the San Bernardino County and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 0357-421-15-0-000 AND APN 0357-421-16-0-000

Owner's Signature			
Owner Name: AutoZone Parts, Inc. - Mitch Bramlitt			
Title	Developer/Owner		
Company	AutoZone Parts, Inc.		
Address	123 S. Front Street, 3rd Floor		
Email	mitch.bramlitt@autozone.com		
Telephone #	(901) 495-8714		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	N/A	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 0357-421-15-0-000 AND APN 0357-421-16-0-000

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Jacob Glaze, P.E.		PE Stamp Below
Title	Civil Engineer	
Company	Kimley-Horn and Associates, Inc.	
Address	765 The City Drive South Suite 200 Orange, CA 92868	
Email	jacob.glaze@kimley-horn.com	
Telephone #	(714) 705-1374	
Signature		
Date		

Table of Contents

Forms

Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

<table>
<tr><th colspan="6">Form 1-1 Project Information</th></tr>
<tr><td colspan="2">Project Name</td><td colspan="4">AutoZone Oak Hills</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">AutoZone Parts, Inc. - Mitch Bramlitt</td></tr>
<tr><td>Mailing Address:</td><td>123 S. Front Street, 3rd Floor, Memphis, TN 38103</td><td>E-mail Address:</td><td>mitch.bramlitt@autozone.com</td><td>Telephone:</td><td>(901) 495-8714</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td>N/A</td><td>Tract/Parcel Map Number(s):</td><td colspan="2">APN 0357-421-15-0-000 AND APN 0357-421-16-0-000</td></tr>
<tr><td colspan="2">Additional Information/ Comments:</td><td colspan="4">N/A</td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">This project is for the proposed construction of a 6,797 square foot commercial retail shop on 46,203 square feet of vacant property, of which only 42,980 square feet will be disturbed. In addition to the proposed commercial retail shop the project includes the construction of new asphalt, concrete pavement, concrete sidewalks, landscaping, and a trash enclsoure. The site is located southeast of Ranchero Road and Escondido Avenue in Oak Hills, San Bernardino County. The project is bounded by Ranchero Road to the north and vacant lots to the west, east, and south. Since the project area (area of disturbance) is less than 1-acre, hydromodification analysis is not necessary.

The majority of the stormwater runoff within the project area sheet flows northeast toward two infiltration basins located south of Ranchero Road. The two infiltration basins will be connected and once they exceed their capacity, the overflows will be conveyed to Ranchero Road through an undersidewalk culvert. A small portion of the site flows offsite due the proposed grading joining existing ground and is therefore a de-minimis landscape area that flows southeast into an existing drainage path.

The existing condition of the project site is vacant and generally drains in a northeast direction. In the existing condition, there are two (2) drainage areas (DA). A portion of the site drains northeast toward Ranchero Road. Stormwater then continues east along Ranchero Road until reaching a nearby curb opening, where flows are routed south for short distance and then east of the project site. The other portion of the site drains into an existing drainage path southeast of the project site. The existing drainage path drains northeast where flows confluence with the flows from the curb opening on Ranchero Road. After which, stormwater flows are conveyed north across Ranchero Road through seven (7) existing culverts northeast of the project site. Drainage continues flowing northeast until reaching the California Aqueduct, which then discharges into the Mojave River.</td></tr>
</table>

Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	A WQMP shall be completed, approved, and inspected. The property owner is required to provide continous maintence of BMPs.

Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

<table>
<tr><th colspan="6">Form 2.1-1 Description of Proposed Project</th></tr>
<tr><td colspan="6">1 Regulated Development Project Category (Select all that apply):</td></tr>
<tr><td colspan="2">☒ #1 New development involving the creation of 5,000 ft² or more of impervious surface collectively over entire site</td><td colspan="2">☐ #2 Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site</td><td>☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface</td><td>☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface</td></tr>
<tr><td colspan="6">☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) Will require source control Site Design Measures. Use the “PCMP” Template. Do not use this WQMP Template.</td></tr>
<tr><td>2 Project Area (ft2):</td><td>42,980</td><td>3 Number of Dwelling Units:</td><td>1</td><td>4 SIC Code:</td><td>1542, 5531 - Auto and Home Supply stores</td></tr>
<tr><td colspan="6">5 Is Project going to be phased? Yes ☐ No ☒ If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</td></tr>
</table>

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management
Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:
The property owner (Owner), AutoZone Parts, Inc, will be responsible for the long-term operations and maintenance of all WQMP stormwater facilities within the project site. The point of contact of the Owner is AutoZone Parts, Inc., with full contact information located under Section 1 of this WQMP. The Owner will also be responsible for the implementation, long-term operations and maintenance, and funding of the WQMP stormwater facilities described hereon, and will amend this WQMP as needed to reflect any changes to the hydrologic conditions of the property. In addition, the Owner accepts full responsibility for the interim operation and maintenance of the WQMP stormwater facilities. This WQMP will be reviewed with the facility operator, facility supervisors, employees, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. No onsite public facilities will be installed for this development but connection to existing public utilities will require the following publicly maintained offsite facilities: Water Sanitary Sewer Storm Drain

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Pavement Runoff (Pollutant of Concern)
Nutrients - Phosphorous	E ☒	N ☐	Primary sources of nutrients are fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Pirmary sources of nutrients are fertilizers and eroded soils (Pollutant of Concern)
Noxious Aquatic Plants	E ☒	N ☐	Source: Commercial Landscaping
Sediment	E ☒	N ☐	Source: Construction and grading at landscaped areas.
Metals	E ☒	N ☐	Source: Brake pad dust and tire tread wear from vehicle traffic. (Pollutant of Concern)
Oil and Grease	E ☒	N ☐	Source: Vehicular traffic
Trash/Debris	E ☒	N ☐	Public waste, and general waste products on landscape.
Pesticides / Herbicides	E ☒	N ☐	At landscaped areas only
Organic Compounds	E ☒	N ☐	At landscaped areas only
Other: Oxygen Demanding Compound	E ☒	N ☐	At landscaped areas only
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.382618°	Longitude -117.371428°	Thomas Bros Map page

1 San Bernardino County climatic region: ☒ Desert

2 Does the site have more than one drainage area (DA): Yes☐ No☒ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	Runoff from the parking lot and proposed Autozone building will surface flow into the northeast infiltration basin connected to a second infiltration basin, where flow will be treated.
DA1 DMA B to Outlet 1	
DA2 to Outlet 2	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	15,250	30,954		
2 Existing site impervious area (ft^2)	0	0		
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2	2		
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	B	B		
5 Longest flowpath length (ft)	277	282		
6 Longest flowpath slope (ft/ft)	0.021	0.021		
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren	Barren		
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Poor	Poor		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*				
4 Hydrologic soil group *County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*				

Form 3-3 Watershed Description for Drainage Area	
Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	California Aqueduct, Mojave River (West Fork), Silverwood Lake
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Silverwood Lake - Mercury, Polychlorinated Biphenyls
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Silverwood Lake - Mercury, Polychlorinated Biphenyls
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	The Project is not within an ESA
Hydromodification Assessment	☐ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	The developer will provide educational pamphlets published by California State Regional Water Quality Control Boards – Lahontan Region, or other appropriate sources.
N2	Activity Restrictions	☒	☐	The types of activities allowed within the Project will be limited to those allowed by the County of San Bernardino codes, regulations, and zoning ordinances.
N3	Landscape Management BMPs	☒	☐	Landscape plans will be consistent with the County of San Bernardino requirements for water conservation vegetation. Utilizing programmable irrigation systems, and/or rain shut off sensors.
N4	BMP Maintenance	☒	☐	Per Owner’s Certification and Maintenance Agreement
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	Project to comply with Title 22 CCR
N6	Local Water Quality Ordinances	☒	☐	Owners to abide by the State, County and Local Water Ordinances, provide with the Educational material and pamphlets
N7	Spill Contingency Plan	☒	☐	Spill Contingency Plan included within Section 6 of report herein.
N8	Underground Storage Tank Compliance	☐	☐	No storage tanks to be allowed for this project
N9	Hazardous Materials Disclosure Compliance	☒	☐	Hazardous Waste Procedures Manual included within Section 6 of report herein.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N10	Uniform Fire Code Implementation	☒	☐	As required per San Bernardino County Fire Department.
N11	Litter/Debris Control Program	☒	☐	Private parking lot will be maintained by the Owner/Tenants. Public streets will be maintained by the City of Oak Hills.
N12	Employee Training	☒	☐	Provide an ongoing education material
N13	Housekeeping of Loading Docks	☐	☒	Project does not feature any loading docks
N14	Catch Basin Inspection Program	☐	☒	No catch basins proposed
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Only parking lot once a month per maintenance schedule
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	N/A
N17	Comply with all other applicable NPDES permits	☐	☒	N/A

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, If not applicable, state reason
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☐	☒	No catch basins proposed.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage allowed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Provided Trash enclosure location per site plan.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Landscaping to be designed per state guidelines.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Per the Landscape Plans.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Per Grading and Drainage Plan
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not feature any dock areas.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not featured per this project.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not featured per this project.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, If not applicable, state reason
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not featured per this project.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not featured per this project.
S14	Wash water control for food preparation areas	☐	☒	Not featured per this project.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: This is addressed in the project site plan through the optimized design of proposed hardscape, which will allow for a maximum area of proposed landscaping within the property boundary.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: Proposed landscaped areas and infiltration basins maximize natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Some alterations were made to site drainage patterns and time of concentration but general path still follows existing pattern.
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☒ No ☐ Explanation: This is addressed in the project grading and drainage plan by routing flows to the infiltration basins.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: The site does not use porous pavement.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The site does not have sensitive areas.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Proposed planters are to be landscaped
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Infiltration basin areas will be staked during construction to minimize compaction.

Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐ Explanation: Vegetated swales used where possible.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation: Site spacing is too limited at landscape areas to stake off.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: Site does not have a on-site water collection system.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: Stream setback not applicable to site.

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft^2): 39,468	2 Imperviousness after applying preventative site design practices (Imp%): 83	3 Runoff Coefficient (Rc): _0.631 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.487 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.60 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 2,456 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 N/A *Form 4.2-3 Item 12*	2 N/A *Form 4.2-4 Item 13*	3 N/A *Form 4.2-5 Item 10*
Post-developed	4 N/A *Form 4.2-3 Item 13*	5 N/A *Form 4.2-4 Item 14*	6 N/A *Form 4.2-5 Item 14*
Difference	7 *N/A* *Item 4 – Item 1*	8 *N/A* *Item 2 – Item 5*	9 *N/A* *Item 6 – Item 3*
Difference (as % of pre-developed)	10 *N/A%* *Item 7 / Item 1*	11 *N/A%* *Item 8 / Item 2*	12 *N/A%* *Item 9 / Item 3*

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3):
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), *S_o = Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) *V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) *T_t = Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) *T_c = Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet hydromodification requirement (min): *$T_{C\text{-}Hydro}$ = (Item 13 * 0.95) – Item 14*								

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p\text{-}hydro}$ = *(Item 14 * 0.95) – Item 10*		

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis: (attach)
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than ten feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is “Yes”: Yes ☐ No ☒ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.* *If no, then proceed to Item 8 below.* [8] Any answer from Item 4 through Item 6 is “Yes”: Yes ☐ No ☒ *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP.* *If no, then proceed to Item 9, below.* [9] All answers to Item 1 through Item 6 are “No”: *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.* *Proceed to Form 4.3-2, Site Design BMPs.*

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☐ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): 0 $V_{retention}$ *=Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☐ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): 0 $V_{retention}$ *=Sum of Item 12 for all BMPs*			

Form 4.3-2 cont. Site Design BMPs (DA 1)

14 Implementation of Street Trees: Yes ☐ No ☐ *If yes, complete Items 14-18. If no, proceed to Item 19*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches*			
18 Runoff volume retention from street tree BMPs (ft^3): 0 *$V_{retention}$ = Sum of Item 17 for all BMPs*			
19 Total Retention Volume from Site Design BMPs: 0 *Sum of Items 5, 13 and 18*			

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 2,456 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA 1-4 BMP Type Infiltration Basin	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	0.6		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.0		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	1.2		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	1.2		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	1,976		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	2,519		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0		

16 Total Retention Volume from LID Infiltration BMPs: 2,519 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1)		
1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume* ☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow* ☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-5 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) *$V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-6 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA 1 DMA BMP Type N/A		DA 1 DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*		N/A		
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) *A_{bottom} = Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ *=(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V *=Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) *Q_{BMP} = (Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) *$V_{biotreated}$ = (Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-7 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item $2^{\wedge 1.67}$ * Item $3^{\wedge 0.5}$)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item $2^{\wedge 2}$)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 2,456 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 0 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 2,519 *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-4*

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  *Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 1)	
1 Volume reduction needed for hydromodification performance criteria (ft³): N/A *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design and infiltration, BMP (ft³): *Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft³): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site BMPs (ft³):
5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☐ • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐	
6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☐	

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Litter/Debris Control Program	Owner	Litter shall be picked up, trash enclosure areas shall be swept and cleaned, dumpsters shall be emptied.	Ongoing standard maintenance as needed
Parking Lot Sweeping	Owner	Parking lots must be swept	Monthly
Landscape Management	Owner	Gardening and lawn care practices to prevent landscape waste to exit project site per SC-73	Weekly
Efficient Irrigation Systems	Owner	Irrigation systems must be inspected to ensure proper operation.	Weekly
Trash Storage Areas	Owner	Trash storage areas must be inspected to ensure integrity of structural elements.	Weekly
Infiltration Basin	Owner	See TC-11 Infiltration Basin O&M information. See Appendix D	See TC-11 Infiltration Basin O&M information.

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

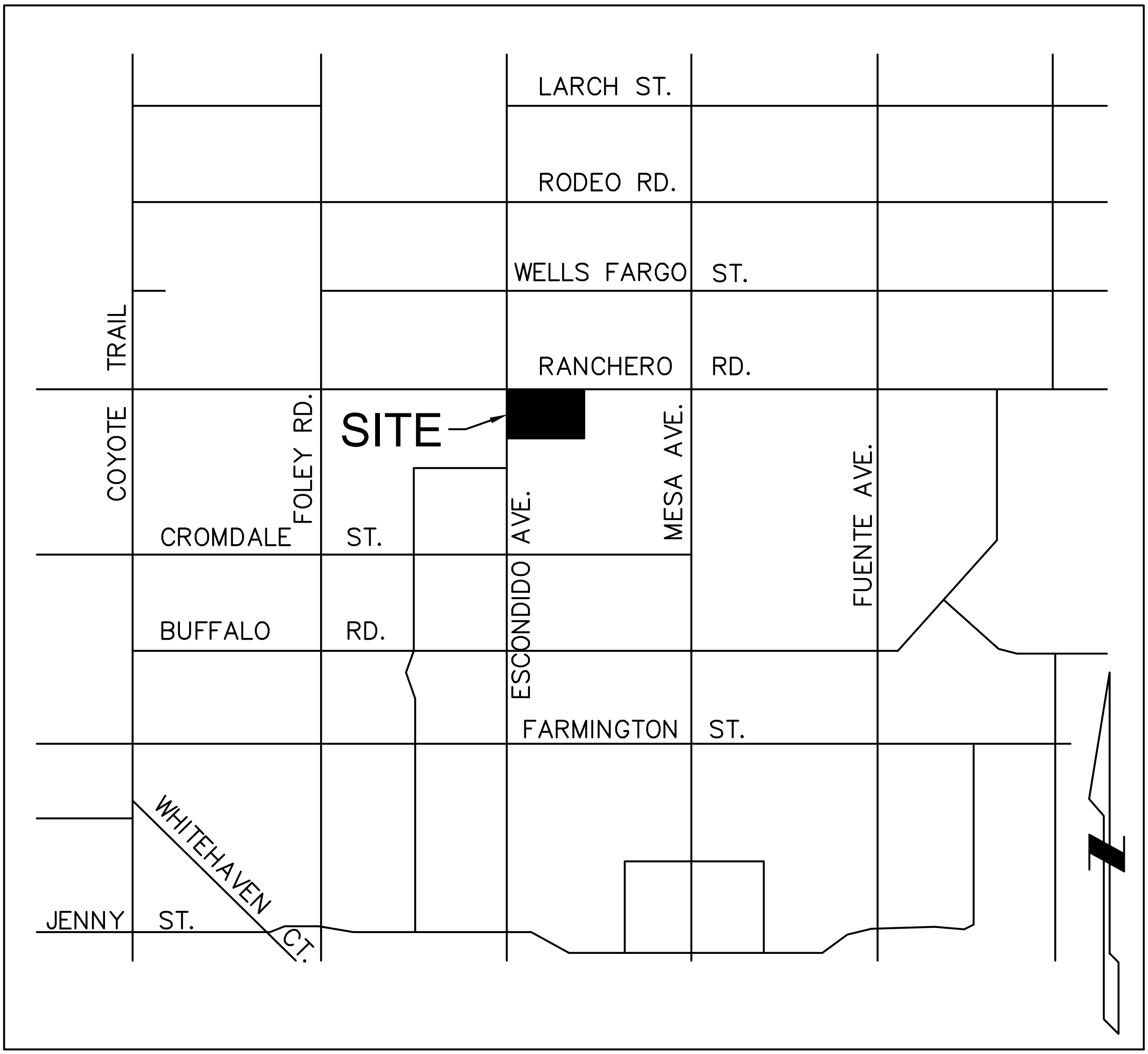
- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

APPENDICES

APPENDIX A

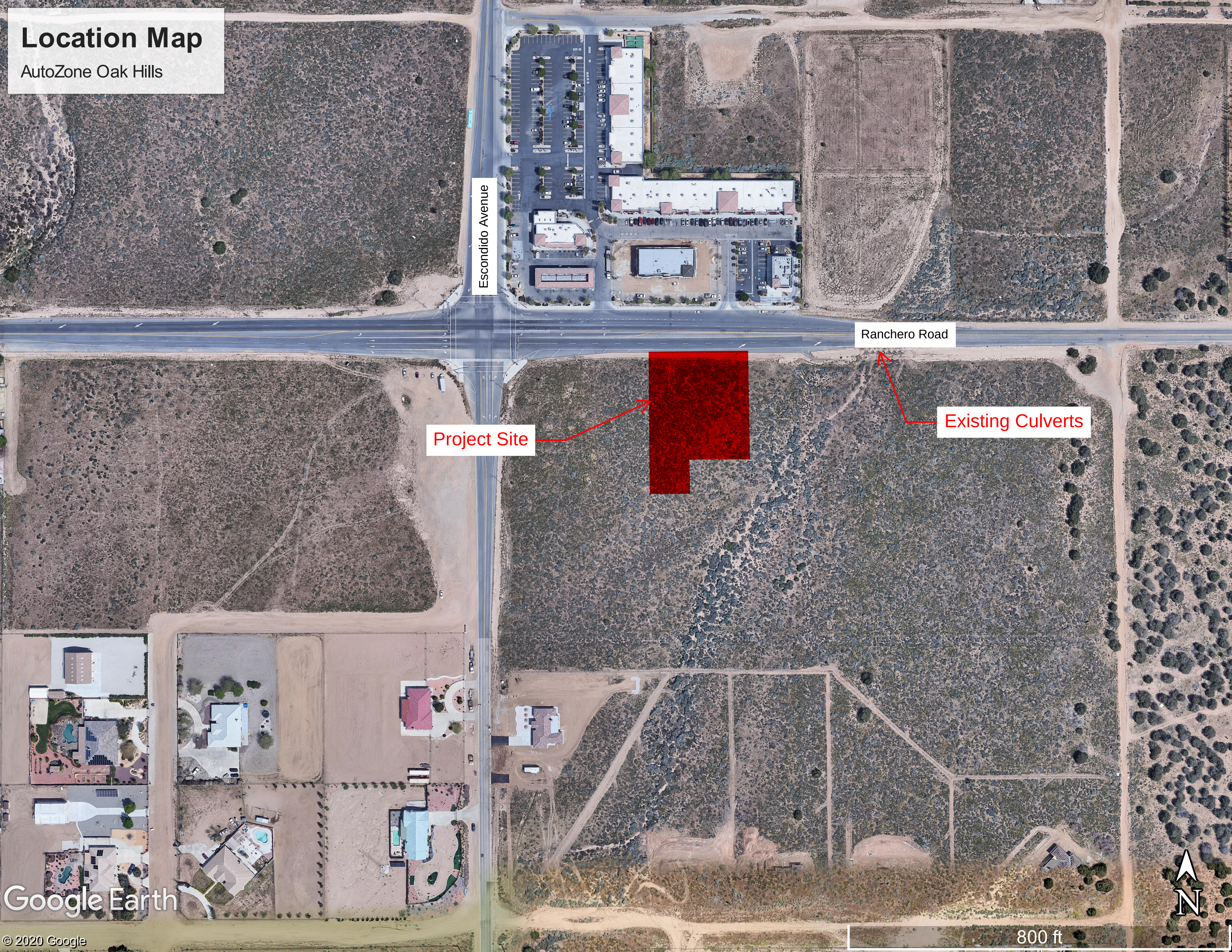
VICINITY AND LOCATION MAP

VICINITY MAP (NOT TO SCALE)



Location Map

AutoZone Oak Hills



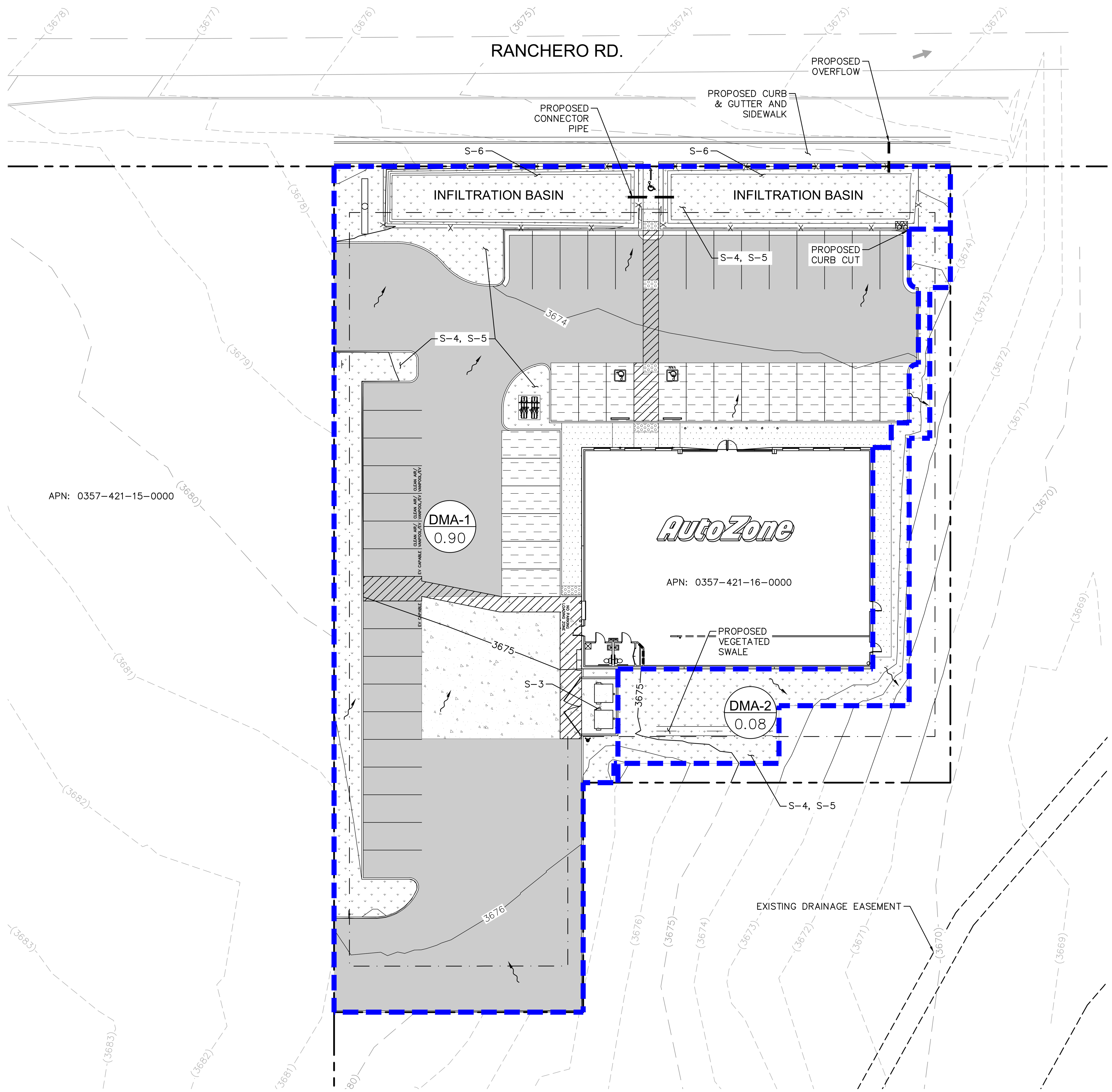
APPENDIX B

WQMP SITE PLAN

LEGEND

1695	PROPOSED CONTOUR
(1695)	EXISTING CONTOUR
	PROPERTY LINE
	DA BOUNDARY
	PROPOSED STORM DRAIN
	FLOW ARROW
X / XX	DMA NAME DMA AREA (IN ACRES)
	RIGHT OF WAY
	ASPHALT PAVING
	LANDSCAPING SEE CONCEPTUAL LANDSCAPE PLAN
	HEAVY DUTY CONCRETE PAVING
	LIGHT DUTY CONCRETE PAVING
	CONCRETE SIDEWALK

STRUCTURAL SOURCE CONTROL BMPS	
BMP ID	BMP DESCRIPTION
S-3	REFUSE / TRASH COLLECTION AREAS
S-4	LANDSCAPE IRRIGATION AND DESIGN
S-5	FINISH GRADE OF LANDSCAPE AREAS
S-6	PROTECT SLOPES AND PROVIDE ENERGY DISSIPATION (LANDSCAPE SLOPES)

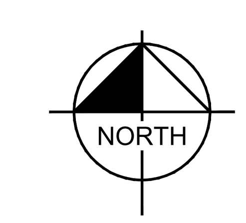


LANDSCAPE NOTE:

FINISH GRADE OF LANDSCAPE AREAS IS TO BE DEPRESSED 1-2 INCHES (MIN.) BELOW TOP OF CURB, SIDEWALK OR PAVEMENT.

BMP MAINTENANCE:

INFILTRATION BASIN
TRASH, DEBRIS AND SEDIMENT MUST BE REMOVED FROM BASIN CURB CUT LOCATIONS, ALONG GUTTERS, AND WITHIN THE BASINS AND DISPOSED OF PER LOCAL JURISDICTION REQUIREMENTS. INSPECTION AND MAINTENANCE REQUIRED AFTER EVERY RAIN EVENT GREATER THAN 0.5". INSPECTIONS SHOULD OCCUR ON A MONTHLY BASIS TO ENSURE OPTIMUM PERFORMANCE. THE OWNER IS RESPONSIBLE FOR ALL BMP MAINTENANCE OPERATIONS.



GRAPHIC SCALE IN FEET
0 10 20 40

SCALE: 1" = 20'
WHEN PRINTED AT FULL
SIZE 24"X36"

CUP NO. XX-XX

Kimley»Horn

WQMP SITE PLAN
AUTOZONE OAK HILLS
9/13/2020

APPENDIX C

CALCULATIONS

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.5
B	Design	Tributary area size	0.25	1	0.25
		Level of pretreatment/ expected sediment loads	0.25	1	0.25
		Redundancy	0.25	2	0.5
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			1.25
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				1.875	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				0.6	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$				0.3	
Supporting Data					
Briefly describe infiltration test and provide reference to test forms: Using the soil map included in Figure C-11 of the San Bernardino County Hydrology Manual and the Stormwater Facility Mapping online tool for Riverside County, it was determined the hydrologic soil group classification is B. Soil group B is defined as soils having moderate infiltration rates (moderate runoff potential). For conservative purposes, the design infiltration rate used was the minimum allowed for infiltration (0.3in/hr), accounting for a factor of safety of 2.					

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

NOAA Atlas 14, Volume 6, Version 2
Location name: Hesperia, California, USA*
Latitude: 34.3826°, Longitude: -117.3714°
Elevation: 3684.07 ft**
* source: ESRI Maps
** source: USGS

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	0.095 (0.079-0.116)	0.131 (0.108-0.160)	0.178 (0.147-0.218)	0.217 (0.178-0.268)	0.271 (0.214-0.346)	0.313 (0.242-0.408)	0.356 (0.269-0.476)	0.400 (0.294-0.550)	0.461 (0.325-0.661)	0.508 (0.346-0.754)
10-min	0.136 (0.113-0.166)	0.187 (0.155-0.229)	0.256 (0.211-0.313)	0.311 (0.255-0.384)	0.388 (0.307-0.496)	0.448 (0.347-0.585)	0.510 (0.385-0.682)	0.574 (0.422-0.789)	0.661 (0.466-0.947)	0.728 (0.496-1.08)
15-min	0.165 (0.136-0.201)	0.227 (0.188-0.277)	0.309 (0.255-0.378)	0.376 (0.308-0.465)	0.470 (0.372-0.600)	0.542 (0.420-0.707)	0.617 (0.466-0.824)	0.694 (0.510-0.954)	0.799 (0.563-1.15)	0.881 (0.599-1.31)
30-min	0.247 (0.204-0.301)	0.340 (0.281-0.415)	0.463 (0.382-0.567)	0.564 (0.461-0.696)	0.704 (0.557-0.898)	0.812 (0.629-1.06)	0.924 (0.698-1.24)	1.04 (0.764-1.43)	1.20 (0.844-1.72)	1.32 (0.898-1.96)
60-min	0.354 (0.293-0.432)	0.487 (0.403-0.595)	0.664 (0.548-0.813)	0.809 (0.662-0.999)	1.01 (0.798-1.29)	1.17 (0.902-1.52)	1.33 (1.00-1.77)	1.49 (1.10-2.05)	1.72 (1.21-2.46)	1.89 (1.29-2.81)
2-hr	0.524 (0.434-0.639)	0.698 (0.578-0.853)	0.931 (0.768-1.14)	1.13 (0.920-1.39)	1.39 (1.10-1.78)	1.60 (1.24-2.09)	1.82 (1.38-2.43)	2.05 (1.50-2.82)	2.36 (1.66-3.38)	2.60 (1.77-3.86)
3-hr	0.659 (0.546-0.804)	0.869 (0.718-1.06)	1.15 (0.948-1.41)	1.38 (1.13-1.71)	1.71 (1.35-2.18)	1.97 (1.52-2.56)	2.23 (1.69-2.98)	2.51 (1.85-3.45)	2.90 (2.04-4.15)	3.20 (2.18-4.75)
6-hr	0.947 (0.784-1.16)	1.24 (1.03-1.51)	1.63 (1.35-2.00)	1.96 (1.61-2.42)	2.42 (1.92-3.10)	2.79 (2.16-3.64)	3.17 (2.40-4.24)	3.57 (2.62-4.91)	4.13 (2.91-5.93)	4.58 (3.12-6.80)
12-hr	1.25 (1.03-1.52)	1.67 (1.39-2.05)	2.25 (1.85-2.75)	2.72 (2.23-3.36)	3.38 (2.68-4.32)	3.91 (3.03-5.10)	4.46 (3.37-5.96)	5.03 (3.70-6.92)	5.84 (4.11-8.36)	6.48 (4.41-9.61)
24-hr	1.68 (1.49-1.93)	2.32 (2.05-2.67)	3.18 (2.80-3.67)	3.89 (3.41-4.53)	4.89 (4.14-5.89)	5.68 (4.71-6.98)	6.50 (5.27-8.19)	7.37 (5.81-9.54)	8.58 (6.49-11.6)	9.55 (6.98-13.3)
2-day	1.97 (1.75-2.27)	2.75 (2.43-3.17)	3.81 (3.37-4.41)	4.71 (4.13-5.49)	5.99 (5.08-7.22)	7.02 (5.83-8.63)	8.11 (6.57-10.2)	9.28 (7.31-12.0)	10.9 (8.27-14.8)	12.3 (8.97-17.1)
3-day	2.10 (1.86-2.42)	2.95 (2.61-3.40)	4.13 (3.64-4.77)	5.13 (4.49-5.98)	6.57 (5.57-7.92)	7.75 (6.43-9.53)	9.00 (7.29-11.3)	10.4 (8.16-13.4)	12.3 (9.31-16.6)	13.9 (10.2-19.4)
4-day	2.26 (2.00-2.60)	3.18 (2.82-3.67)	4.47 (3.94-5.16)	5.57 (4.88-6.49)	7.17 (6.07-8.63)	8.47 (7.03-10.4)	9.86 (7.99-12.4)	11.4 (8.96-14.7)	13.6 (10.3-18.3)	15.4 (11.2-21.5)
7-day	2.53 (2.24-2.91)	3.57 (3.16-4.12)	5.03 (4.44-5.81)	6.28 (5.50-7.32)	8.09 (6.85-9.74)	9.56 (7.94-11.8)	11.1 (9.03-14.0)	12.9 (10.1-16.7)	15.3 (11.6-20.7)	17.4 (12.7-24.3)
10-day	2.70 (2.39-3.11)	3.81 (3.38-4.40)	5.38 (4.75-6.21)	6.72 (5.89-7.83)	8.67 (7.34-10.4)	10.3 (8.51-12.6)	12.0 (9.69-15.1)	13.8 (10.9-17.9)	16.5 (12.4-22.2)	18.7 (13.6-26.1)
20-day	3.20 (2.83-3.68)	4.55 (4.03-5.25)	6.46 (5.70-7.47)	8.11 (7.10-9.45)	10.5 (8.91-12.7)	12.5 (10.4-15.3)	14.6 (11.8-18.4)	16.9 (13.3-21.9)	20.2 (15.3-27.2)	22.9 (16.7-32.0)
30-day	3.75 (3.32-4.32)	5.34 (4.72-6.15)	7.58 (6.69-8.76)	9.53 (8.34-11.1)	12.4 (10.5-14.9)	14.7 (12.2-18.1)	17.2 (13.9-21.7)	20.0 (15.7-25.8)	23.9 (18.1-32.3)	27.2 (19.8-37.9)
45-day	4.47 (3.96-5.14)	6.30 (5.58-7.26)	8.91 (7.86-10.3)	11.2 (9.79-13.0)	14.5 (12.3-17.5)	17.3 (14.3-21.2)	20.3 (16.4-25.5)	23.5 (18.5-30.4)	28.2 (21.3-38.1)	32.1 (23.4-44.8)
60-day	5.11 (4.53-5.88)	7.11 (6.29-8.20)	9.97 (8.80-11.5)	12.5 (10.9-14.5)	16.2 (13.7-19.5)	19.2 (15.9-23.6)	22.5 (18.2-28.4)	26.1 (20.6-33.9)	31.4 (23.7-42.4)	35.8 (26.2-50.0)

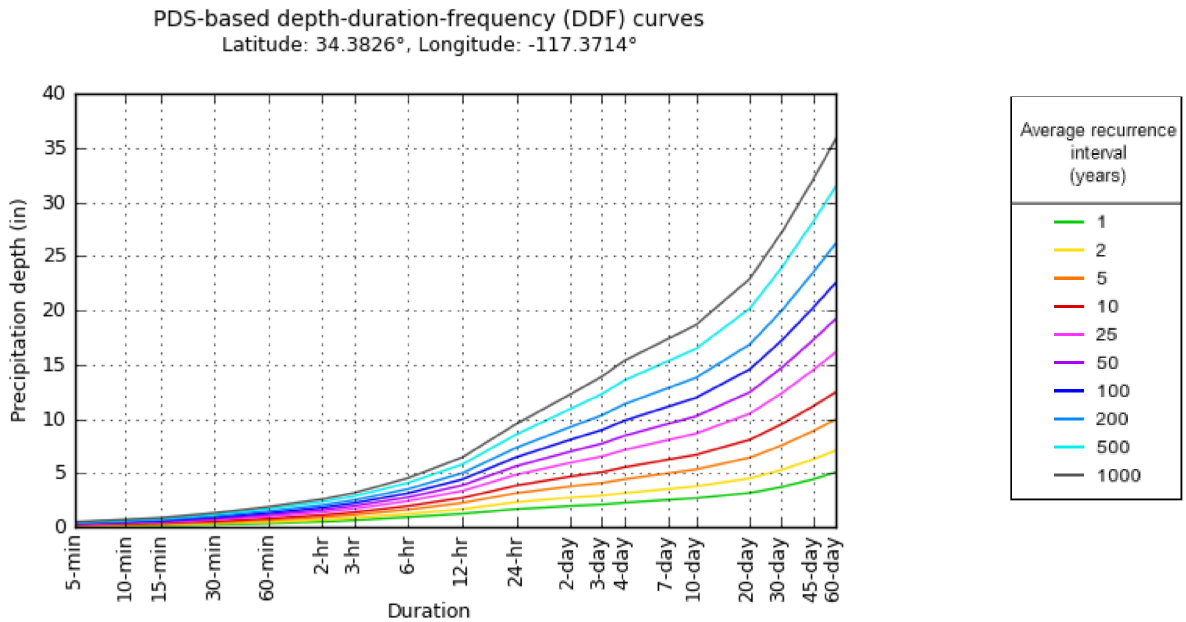
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

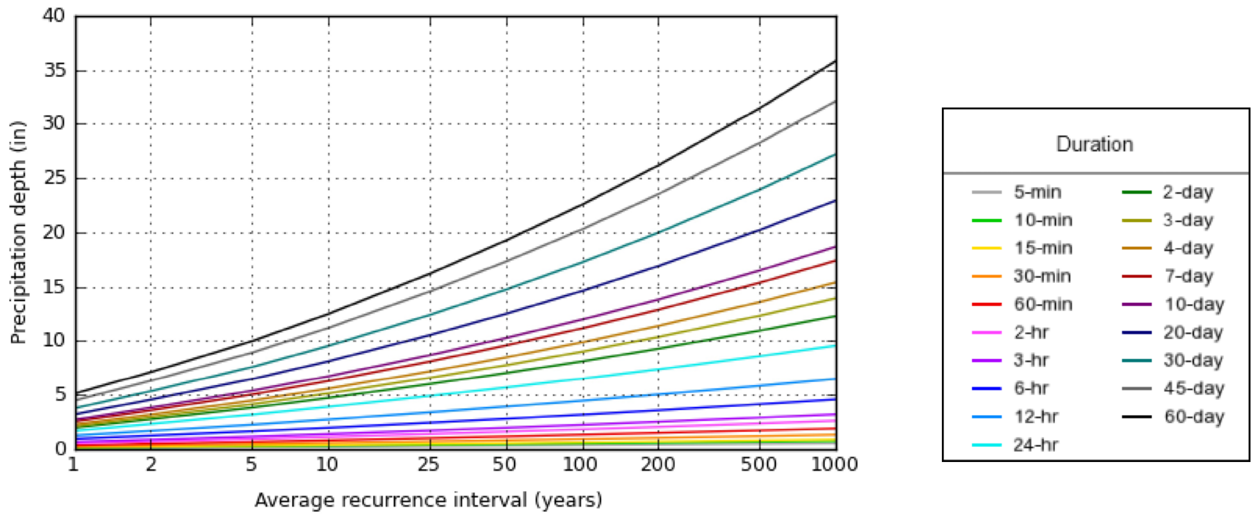
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical





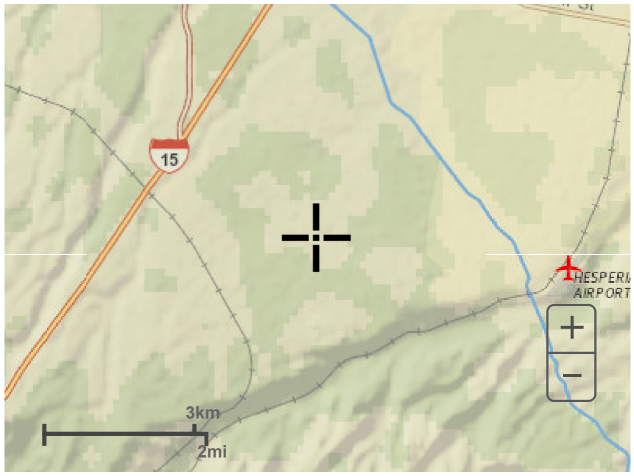
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Sep 2 14:59:37 2020

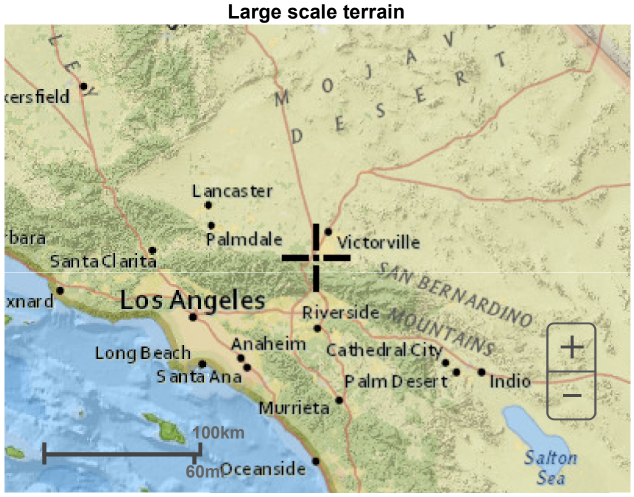
Back to Top

Maps & aerials

Small scale terrain

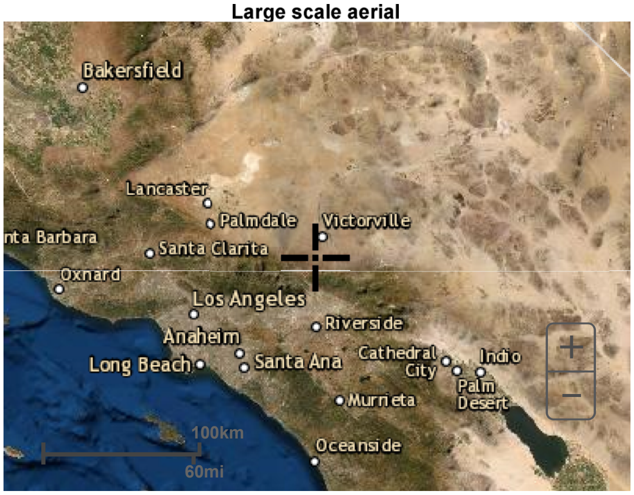


Large scale terrain



Large scale map

Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX D

BMP INFORMATION

Maintenance Concerns, Objectives, and Goals

- Vector Control
- Clogged soil or outlet structures
- Vegetation/Landscape Maintenance
- Groundwater contamination
- Accumulation of metals
- Aesthetics

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

General Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually infiltrates into the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

Inspection/Maintenance Considerations

Infiltration basins perform better in well-drained permeable soils. Infiltration basins in areas of low permeability can clog within a couple years, and require more frequent inspections and maintenance. The use and regular maintenance of pretreatment BMPs will significantly minimize maintenance requirements for the basin. Spill response procedures and controls should be implemented to prevent spills from reaching the infiltration system.

Scarification or other disturbance should only be performed when there are actual signs of clogging or significant loss of infiltrative capacity, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a light tractor. This BMP may require groundwater monitoring. Basins cannot be put into operation until the upstream tributary area is stabilized.

CASQA
California Stormwater Quality Association

Clogged infiltration basins with surface standing water can become a breeding area for mosquitoes and midges. Maintenance efforts associated with infiltration basins should include frequent inspections to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.

Inspection Activities	**Suggested Frequency**
■ Observe drain time for a storm after completion or modification of the facility to confirm that the desired drain time has been obtained. ■ Newly established vegetation should be inspected several times to determine if any landscape maintenance (reseeding, irrigation, etc.) is necessary.	Post construction
■ Inspect for the following issues: differential accumulation of sediment, signs of wetness or damage to structures, erosion of the basin floor, dead or dying grass on the bottom, condition of riprap, drain time, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, pretreatment device condition	Semi-annual and after extreme events
Maintenance Activities	**Suggested Frequency**
■ Factors responsible for clogging should be repaired immediately. ■ Weed once monthly during the first two growing seasons.	Post construction
■ Stabilize eroded banks. ■ Repair undercut and eroded areas at inflow and outflow structures. ■ Maintain access to the basin for regular maintenance activities. ■ Mow as appropriate for vegetative cover species. ■ Monitor health of vegetation and replace as necessary. ■ Control mosquitoes as necessary. ■ Remove litter and debris from infiltration basin area as required.	Standard maintenance (as needed)
■ Mow and remove grass clippings, litter, and debris. ■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons. ■ Replant eroded or barren spots to prevent erosion and accumulation of sediment.	Semi-annual
■ Scrape bottom and remove sediment when accumulated sediment reduces original infiltration rate by 25-50%. Restore original cross-section and infiltration rate. Properly dispose of sediment. ■ Seed or sod to restore ground cover. ■ Disc or otherwise aerate bottom. ■ Dethatch basin bottom.	3-5 year maintenance

Additional Information

In most cases, sediment from an infiltration basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children. Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

Light equipment, which will not compact the underlying soil, should be used to remove the top layer of sediment. The remaining soil should be tilled and revegetated as soon as possible.

Sediment removal within the basin should be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor. This also prevents smearing of the basin floor.

References

King County, Stormwater Pollution Control Manual – Best Management Practices for Businesses. July, 1995 Available at: ftp://dnr metrokc.gov/wlr/dss/spcm/SPCM.HTM

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

APPENDIX E

GEOTECHNICAL REPORT

Subsurface Explorations & Geotechnical Investigation

Proposed AutoZone Store #3658
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

AutoZone, Inc.
123 S. Front Street
Memphis, TN 38103

Mr. Robert DeGraaf
Sweetgum Environmental
Plant City, Florida

Terradyne Project No: L201011 **March 10, 2020**

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F, Tustin, CA 92780
Office: 657-212-5800 • Website: www.terradyne.com

TERRADYNE
Engineers, Geologists & Environmental Scientists

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F
Tustin, CA 92780
Office: 657-212-5800
www.terradyne.com

March 10, 2020

Mr. Rob DeGraaf, LEP, PWS
Sweetgum Environmental
Plant City, Florida
Phone: 813-365-2411
Email: robdegraaf@verizon.com
www.sweetgum.com

Re: **Subsurface Explorations & Geotechnical Investigation Report**
Proposed AutoZone Store #3658 at:
Near Ranchero Road and Escondido Ave,
Oak Hills, San Bernardino County, CA 92344
Terradyne Project No.: L201011

Dear Mr. DeGraaf,

In accordance with your request, Terradyne, Inc., Inc. has performed a geotechnical investigation at the subject site. The purpose of our investigation was to evaluate the geotechnical conditions at the site in the areas of proposed construction and to provide geotechnical parameters for design and construction.

Based on our investigation, it is our opinion that the proposed construction is feasible from the geotechnical standpoint provided the recommendations contained herein are incorporated into the project plans and specifications. This report should be reviewed in detail prior to proceeding further with the planned development.

We appreciate and wish to thank you for the opportunity to serve you on this project. Please do not hesitate to contact us if we can be of additional assistance during the Construction Materials Testing and Quality Control phases of construction.

Respectfully Submitted,
Terradyne Engineering, Inc.

Yuting Su

REGISTERED PROFESSIONAL ENGINEER
YU-TING SU
No. 76714
EXP. 12/31/20
CIVIL
STATE OF CALIFORNIA

Yu-Ting Su, Ph.D., P.E.
Senior Project Engineer/ RCE C-76714
Registration Exp. Date: 12/31/2020

PROFESSIONAL GEOLOGIST
HECTOR G. ESTRELLA
No. 2656
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Hector G. Estrella, PG, CEG
Certified Engineering Geologist / CEG 2656
Registration Exp. Date: 5/31/2021

TABLE OF CONTENTS

Appendix A
Figure A - Vicinity Map
Figure B - Approximate Boring Locations Map
Figure C - Regional Geologic Map and Legends
Figure D - Regional Topographic Map
Figure E - CGS Seismic Hazard Information
Figure F - Groundwater Information Map

Appendix B
Boring Logs: B-1 to B-8
Key to Classification Terms and Symbols

Appendix C
Laboratory Tests

Appendix D
ASCE 7-16 Hazard Report

Appendix E
Pavement Design

EXECUTIVE SUMMARY

The soil conditions at the site of the proposed Auto Zone Store #3658 located at Ranchero Road and Escondido Avenue, San Bernardino County, California were explored by drilling eight (8) borings up to the maximum depth of 16.5-ft below existing grade. Laboratory tests were performed on selected samples to evaluate the engineering characteristics of various soil strata encountered in our borings.

This report presents a description of subsurface conditions encountered at the site, recommended foundation systems, and design and construction criteria influenced by the subsurface conditions. It is based on data obtained from field investigations, laboratory test results and our previous experience with similar sites.

- Based on our California Geological Survey (CGS) research, the seismic hazard information (Plate F, Appendix A) pertaining to the subject site as follows:

1) This parcel (APN: 0357-42-103) is not within an Earthquake Fault Zone
2) This parcel (APN: 0357-42-103) has not been evaluated by CGS for seismic landslide hazards
3) This parcel (APN: 0357-42-103) has not been evaluated by CGS for liquefaction hazards

- Our review of the available references indicate that the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude M_W6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site. The San Bernardino Valley section of the San Jacinto Fault Zone located at approximately 10.2 miles to the southwest of the site at the closest point. As noted above the subject property is not within a State of California Fault Zone (CGS, 2018).

- Foundation support for the new AutoZone store building could be derived by utilizing a rigid shallow conventional continuous or spread foundation system embedded within the newly placed fill compacted to 95%. For the design of the structure, modulus of subgrade reaction (k_1) of 100 psi/in is recommended. An allowable bearing capacity of 2000 psf may be used for foundation bearing on in-situ soil. The upper five (5) feet of subgrade within the building should be over excavated and recompacted to 95%. The excavation should also be extended five (5) feet outside the building footprint.

- From a geotechnical standpoint, we are of the opinion that the proposed construction/site grading is not expected to have an adverse impact on adjacent properties and vice versa.

- Ground water was not encountered in our borings during field exploration on February 25, 2020.

Detailed descriptions of subsurface conditions, engineering analysis, and design recommendations are included in this report.

1.0 INTRODUCTION

Terradyne Engineering Inc., conducted an onsite field exploration on February 25, 2020 that included drilling, logging and sampling of eight (8) hollow stem auger geotechnical borings to a maximum depth of 16.5 feet below existing elevations for the proposed Auto Zone Store #3658 development located at approximately 300 feet east of the intersection of Ranchero Road and Escondido Avenue along the south side of Ranchero Road in the City of Hesperia, San Bernardino County, California.

This report describes: the evaluation performed; the results and opinions of the findings; and Terradyne Engineering Inc., geotechnical recommendations for design and construction of the proposed structures.

This project was authorized by Mr. Robert DeGraaf of Sweetgum Environmental.

2.0 PROPOSED CONSTRUCTION

The project will involve the construction of a one-story AutoZone retail Store and associated appurtenant structures, walkways and pavement areas. For this project, Auto Zone created a parcel of approximately +/- 40,000 sf (approximately 200 feet x 200 feet) from a larger parcel with APN 0357-42-103. The planned construction will require minor cuts/fills to achieve the proposed subgrades. The estimated maximum column load for the new one-story retail store building is 75 kips, and the line load is about 3 kips per lineal feet.

3.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical investigation was based upon the planning information provided to us by the client, and consisted of field, laboratory and engineering evaluation of the site's subsurface soil and groundwater conditions and provide geotechnical engineering recommendations for the design and construction of the proposed building and associated improvements. Our scope of services includes the following:

1) Review of readily available documents pertinent to the subject site (Appendix A).

2) The excavation and sampling of eight (8) exploratory engineering borings to a maximum depth of 16.5-ft below existing ground elevations. The borings were excavated in the vicinity of the proposed building structure and parking areas. The soils encountered in the excavations were logged by our field Geologist and relatively

undisturbed and bulk samples were collected at selected intervals in the various soil types to the maximum depth of the exploration.

3) Laboratory analysis of the collected samples.

4) Observation of the groundwater conditions during drilling operations.

5) Geotechnical analysis of the data and information obtained according to the project requirements; and

6) Preparation of this report presenting our findings, conclusions and recommendations, pertinent to the proposed building and paving sections for drive and parking areas.

The Scope of Services does not include percolation/infiltration assessment nor environmental assessment of the presence or absence of wetlands and/or hazardous or toxic materials in the soil, surface water, groundwater, or air, in the proximity of this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

4.0 SITE DESCRIPTION

Based on review of the property details provided, the parcel under investigation consists of an undeveloped partition of land located to the southeast of the intersection of Ranchero Road and Escondido Avenue in the City of Hesperia, San Bernardino County California (APN Number 0357-42-103). It is composed of a roughly square shaped lot which is currently undeveloped with native flora covering the majority of the lot. Site Topography grades gently to the northeast with site elevations ranging from approximately +3675 to +3681 feet above mean sea level. It is our understanding that the proposed structures are to be constructed at elevations similar to those currently existing at the subject site.

Review of the USGS Hesperia, California 7.5-minute topographic quadrangle (Plate D, Appendix A) and the Google Earth Pro® database indicates the subject property is located on a distal alluvial fan emanating from the San Gabriel Mountains to the south and southwest. The subject property is approximately situated at 34.38279° north latitude and 117.37162° west longitude (Google Earth Pro®, 2018).

5.0 GEOTECHNICAL INVESTIGATION

The field exploration by Terradyne Engineering Inc., was completed on February 25, 2020. Eight (8) hollow-stem auger borings were advanced to a maximum depth of 16.5 feet below ground surface. The locations of these exploratory borings (referenced as Boring-1 through Boring-8) are shown on the Approximate Boring Locations Map (Figure B, Appendix A).

The exploratory boring excavations were advanced using a truck mounted drill rig with an 8-inch diameter hollow-stem auger. Drive samples recovered from all borings, were obtained using a Modified California Drive Sampler (2.5-inches inside diameter and 3-inches outside diameter) with thin brass liners, and a Standard Penetrometer (2-inches outside diameter and 1-3/8-inches inside diameter). The samplers were driven 12 to 18 inches into the soil by a 140-pound hammer free-falling for a distance of 30-inches.

Representative bulk and relatively undisturbed samples were taken of earth materials encountered in this field investigation. Recovered samples were placed in transport containers and returned to our laboratory for further classification and testing. The soils classifications listed in the excavation logs are a result of visual classification of soil with field moisture content. The classifications were assigned in accordance with ASTM D-2488: "Description of Soils (Visual-Manual Method)" and all applicable field soil-identification procedures described therein. These may or may not correspond precisely to those indicated by subsequent laboratory methods. Classifications, made in the field from auger cuttings and drive samples, were verified in the laboratory after further examination and testing of samples.

All eight borings were backfilled with native soil on February 25, 2020. Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands (see Figure C, Appendix A).

The following samples, presented in Table 1, were collected as a part of our field exploration procedure:

Table 1

Type of Sample	Number Collected
Undisturbed Ring Samples	16
Bulk Sample	5

5.1 Regional Groundwater

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site. The nearest recorded wells by order of distance are:

Table 2

Well No.	Ground Elev. (ft. amsl)	Highest GW Depth.	Date	Latest GW Depth.	Date	Distance from Subject Site (mi.)
343958N1173757W001	+3616.8	750.0	01/01/1917	NA	NA	0.91 N
343836N1173490W001	+3560.9	735.0	04/25/1984	748.8	02/03/1996	1.2 E
343808N1173475W001	+3566	743.1	04/01/2010	745.6	05/01/2010	1.38 E

**NOTES: Lowest subject site elevation approximately +3675 msl (Google Earth 2019).
ft. amsl: feet above mean sea level. All measurements and distances are approximate

Groundwater seepage was not observed during drilling operations. Groundwater levels will fluctuate with seasonal climatic variations and changes in the land use. Soils with low permeability may require several days for groundwater to enter and stabilize in the boreholes. It is not unusual to encounter shallow groundwater during or after periods of rainfall. Surface water tends to percolate through the surface until it encounters a relatively imperious layer.

It should be noted that variations in subsurface water (including perched water zones and seepage) may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.

5.2 Field Log

The field logs were prepared for the borings. These logs include information concerning the boring method, samples attempted and recovered, and the presence of various soil materials (such as silt, clay, gravel or sand) and groundwater observations. It also includes an interpretation of the subsurface conditions between samples. Therefore, these logs include both factual and interpretive information.

5.3 Presentation of the Data

The boring logs represent our interpretation of the field and laboratory soil classification of the samples obtained, it should be noted that conditions between borings locations may vary considerably and it should be expected that site conditions may or may not be precisely represented by any one of the borings. Soil deposition processes and topographic forming processes are such that soil and rock types and conditions may change in small vertical intervals and short horizontal distances. The boring log descriptions represent approximate changes in soil and rock composition, moisture, color and relative density. The final boring logs and key to classification terms and symbols are included in Appendix B.

5.4 General Subsurface Conditions

The soils underlying the site may be grouped into one generalized stratum with similar physical and engineering properties. The lines on the logs designating the interface between soil strata represent approximate boundaries. The transition between materials may be gradual. The soil stratigraphy at the boring locations is presented in the Boring Logs. The engineering characteristics of the underlying soils, based on our field and laboratory test results, are summarized and presented in Table 3.

Table 3

Stratum	Depth Range (feet)	Remarks
0'-16.5' Older ALLUVIUM (Qoa) Silty SAND, light brown to brown, loose to dense, slightly moist	0-16.5	No groundwater encountered

The above description generally highlights the major soil stratification features and soil characteristics. The boring logs should be consulted for specific information at the boring locations.

5.5 Laboratory Testing Program

In addition to field exploration, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials that are necessary to evaluate the soil parameters. These tests include:

1) Moisture Content & Density (ASTM D2216 & ASTM D2937)
2) Grain Size Distribution (ASTM D422)
3) Expansion Index (ASTM D4829)
4) One-Dimensional Consolidation (ASTM D2435)
5) Corrosion Potential (CT-417, CT-422, CT-532(643))
6) Direct Shear Test (ASTM D3080)

5.6 Soil Corrosion Potential

A near surface sample was tested to measure pH, soluble sulfate, soluble chloride and resistivity of the soil. The results are presented on Table 4.

Table 4

Sample Location/ Depth, (ft)	pH	Soluble Sulfate (PPM)	Soluble Chloride (PPM)	Soil Resistivity (Ohm-cm)
B-5/ 0-5.0	7.40	37	33	8,400

Sulfate Content

A representative near-surface soil sample was tested during our investigation for soluble sulfate content. The result of this test indicates a soluble sulfate content of (0.0037) percent by weight or negligible sulfate exposure. As such, the soils exposed are not expected to pose a significant potential for sulfate reaction with concrete. Per ACI 318-14 Table 19.3.1.1 the requirement of Exposure Category (S) and Class (S1) is applicable.

Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's pH level, electrical resistivity, and chloride content. In general, soil having a minimum resistivity less than 2,000 ohm-cm is considered corrosive. Soil with a chloride content of 500 ppm or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, a representative soil sample was tested during our investigation to determine soil resistivity, chloride content, and pH level. The soil resistivity measurement of the sample was over (8,400) ohm-cm, chloride content of approximately (33) ppm, and the pH level of approximately (7.40). The results indicate that the near surface soil at the site is considered mildly corrosive to ferrous metals and negligible degree of corrosivity to metals for Chloride Content. However, considering the site history, we recommend a standard level of corrosion protection measure to be considered in the design phase of the project.

Concrete

Laboratory test indicated that the subject site contains soil sulfate content in the negligible range (i.e., less than 150 part per million). However, it is recommended that concrete for all construction at the site utilize a widely available, Type-II Portland cement with a maximum 0.50 water/cement ratio and should comply with all the requirements of governing agencies and current applicable Code. The minimum compressive strength of concrete shall be 4000 psi at 28 days and maximum slump during placement shall be five inches. The minimum concrete cover should be 1.5-inches. Final selection of the appropriate concrete design should be made by the project structural engineer based on the local laws and ordinances, and desired level of conservatism.

6.0 FAULTING AND SEISMICITY

The principal seismic considerations for improvements at the subject site are surface rupture of fault traces, damage caused by ground shaking during a seismic event, and seismically-induced ground settlement. The potential for any or all of these hazards depends upon the recency of fault activity and the proximity of nearby faults to the subject site. The possibility of damage due to ground rupture is considered unlikely since no active faults are known to cross the site and no evidence of active faulting was noted during our investigation. Our review of the proper literature (CGS 2018) indicates that the subject site lies outside the present Earthquake Fault Zones, which are described in the Alquist-Priolo Earthquake Fault Zoning Act as being placed along active faults Based on the review of the available references (USGS), the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude MW6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site and the San Bernardino Valley section of the San Jacinto Fault Zone, located at approximately 10.2 miles to the southwest of the site at the closest point.

Based on a review of a liquefaction study by the San Bernardino Valley Municipal Water District (GSS, 2011) the subject property is not located within an area of potential liquefaction. Due to the relatively flat topography the site is not susceptible earthquake induced landslides.

6.1 Seismic Design Parameters

The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in California. Design of the proposed improvements in accordance with current CBC requirements is intended to reduce the impact of seismic shaking on the proposed improvements. Recommended seismic design acceleration parameters in accordance with the new 2020 California Building Code (CBC) and ASCE 7-16 are presented in Table 5 below (no accurate address for this project, applying the address of 7151 Escondido Avenue, Oak Hills, CA 92344).

Table 5

CBC DESIGN RESPONSE SPECTRUM PARAMETERS	
Latitude	34.380496 degrees north
Longitude	-117.372579 degrees west
Site Class	D – Stiff Soil
Seismic Design Category (SDC)	N/A
MCE_R Ground Motion, Ss (period=0.2s)	1.5 g
MCE_R Ground Motion, S_1(period=1.0s)	0.6 g
Site-modified Spectral Acceleration Value, S_{MS}	1.5 g
Site-modified Spectral Acceleration Value, S_{M1}	N/A
Numeric Seismic Design Value at 0.2s SA, S_{DS}	1.0 g
Numeric Seismic Design Value at 1.0s SA, S_{D1}	N/A
Site Amplification Factor at 0.2s, F_a	1.0
Site Amplification Factor at 1.0s, F_v	N/A
Site Modification Peak Ground Acceleration, PGA_M	0.611 g

Note: Ground motion hazard analysis may be required, see ASCE/SEI 7-16 Section 11.4.8
ASCE 7 Hazards Report is attached in Appendix D. Final selection of the appropriate seismic design coefficients should be made by the structural consultant based on the local laws and ordinances, expected building response, and desired level of conservatism.

7.0 FOUNDATION RECOMMENDATIONS

7.1 Foundation on Expansive Soils

The clayey sections of the artificial fill and natural soils, though generally less expensive than the overlying soils. Expansive soils can be subject to repeated swelling upon wetting and contraction upon drying which can damage concrete slabs or foundations bearing on such soils. Mitigation for foundations in expansive soils generally involves deepening the footing to a depth below that which will be subject to repeated swelling and contraction (shrinking from drying out).

Expansive soils change in volume with change in moisture content. Shrinking and swelling of the clays can cause heaving and cracking on slab-on-grade and structures founded on shallow foundations. The results of our exploration, laboratory testing and engineering evaluation indicate the soils underlying this site have Very Low Expansion (Non-Expansion) Potential characteristics (Expansion Index, EI =

2) per ASTM D4829. As such, special measures per 2016 California Building Code (CBC) Section 1803.5.3 are required to mitigate expansive soil.

Table 6

Expansion Index, (EI)	0 – 20	21 – 50	51 – 90	91 – 130	>130
Expansion Potential	Very low	Low	Medium	High	Very high
2013 CBC Expansion Classification	Non-Expansive	Expansive			

7.2 Settlement

Provided our report recommendations are followed, we estimate the total and differential settlements on the order of one (1) inch and one-half (½) inch, respectively over the span of 30-ft.

7.3 Foundation System

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation. Greater embedment may be necessary to resist lateral loads due to wind and seismic forces of the requirements of 2016 CBC. A coefficient of friction of 0.25 of dead load may be used. We recommend all footings should be reinforced with two #4 bars at the top and 2 #4 bars at the bottom. A minimum allowable bearing capacity of 2000 psf may be used for a continuous or spread foundation system bearing on newly compacted select fill. The allowable bearing value may be increased by 250 pounds per square foot per foot increase in depth or width to a maximum of 2500 psf. The upper **5-ft** of the soil within the building pad area should be over excavated and re-compacted to minimum 95% of maximum dry density as determined by laboratory ASTM D1557 modified proctor test. The over excavation should be extended horizontally a minimum of 5-ft outside from the building footprint measured from the lowest adjacent existing or proposed grade, whichever is more.

Table 7

Earth Material and Foundation Design Parameters		
Earth Material Parameters	Foundation Bearing Material	Competent Native Soil (Older Alluvium) Certified Fill/Approved Soil
	Foundation Bearing Pressures [3]	2,000 psf
	Coefficient of Friction [1]	0.25
	Passive Earth Pressure (EFP) [3]	200 pcf
	Maximum Passive Earth Pressure	2,500 psf
Continuous Footing Design	Minimum Width	24 inches
	Min. Embedment Depth into Bearing Material [2]	18 inches
	Minimum Reinforcement	2 No.4 Rebars at Top and Bottom
Independent Pad Design	Minimum Foundation Dimensions	24" x 24" square
	Min. Embedment Depth into Bearing Material [2]	18 inches

Notes:

[1] When combining frictional resistance and passive pressure, the passive pressure component should be reduced by one-third.
[2] Foundation depths subject to increase per the project structural engineer's design.
[3] One-third increases on the bearing and passive pressures for wind and seismic loads are allowed.

7.4 Slab on Grade

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc., should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation." A vapor barrier over the crushed rock should be considered in the areas where the migration of moisture through the floor slab would be detrimental. To protect the vapor barrier (Visqueen) from punctures during placement, it is recommended that the Visqueen be placed over two-inch thick, clean san layer. The vapor barrier should be at least 10-mil plastic (STEGO or Equivalent) and should be sealed at all splices, around plumbing, and at the parameter of slab areas. Every effort should be made to provide a continuous barrier and care should be taken no to puncture the membrane. Some contractors exercising special care use heavier membranes or double layers of 10-mil plastic with splices staggered and sealed. Slab design should be in compliance with the 2016 Cal Green Code where applicable.

7.5 Lateral Earth Pressures

7.5.1 Passive Earth Pressure

Lateral loads may be resisted by friction provided by the soil on the base of the foundation and by passive earth pressure. A coefficient of friction of 0.25 of dead load may be used. An allowable passive earth pressure of 200 psf per foot of depth may be used for footings poured on compacted in-situ soil. The maximum value of passive earth pressure should be limited to 2,500 psf. Frictional resistance and passive pressure resistance may be used in combination if friction coefficient is reduced by one-third. A one-third increase in passive pressure may be used for resistance against seismic and wind loading.

7.5.2 Active Earth Pressure

Active earth pressures behind walls depend on wall movement, back fill slope, surcharge loads and back fill material.

Table 8

Equivalent Fluid Pressure, EFP (pcf)	
Active Condition	40
At-rest Condition	65

These equivalent fluid pressure (EFP) does not include the effect of seepage pressures, surcharge loads such as construction equipment, vehicular loads or future storage near the walls. If the basement wall or cantilever retaining wall can tilt forward to generate "active earth pressure" condition, the values under active condition should be used. For rigid non-yielding walls which are part of the building, the values" at rest condition" should be used. The compactive effort should be controlled during backfill operations. Over compaction can produce lateral earth pressures in excess of at rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained at minimum 95 percent of Modified Proctor (ASTM D1557) maximum dry density.

The backfill behind the wall should be drained properly. The simplest drainage system consists of a drain located near the bottom of the wall. The drain collects the water that enters the backfill and this may be disposed of through outlets along the base of the wall. To ensure that the drains are not clogged by fine particles, they should be surrounded by a granular filter wrapped in a geofabric such as Mirafi 140N or equivalent. Despite a well-constructed toe drain, substantial water pressure may develop behind the wall if the backfill consists of clays or silts. A more satisfactory drainage system, consisting of a back drain of 12 inches to 24 inches width gravel may be provided behind the wall to facilitate to drainage.

7.6 Retaining Wall Design

Recommendations below may be applied to typical masonry or concrete vertical retaining walls to a maximum height of 6 feet. Additional review and recommendations should be requested for higher walls.

Recommendations were developed assuming that wall backfill placed within a 1:1 (horizontal: vertical) gradient (45-degree angle) projection behind any wall is comprised of the onsite granular non-expansive soils which are placed as certified compacted fill. Use of other materials might necessitate revision to the parameters provided and modification of wall designs. The following criteria may be applied to retaining wall design below.

Foundations for vertical masonry and poured concrete retaining walls may be designed and constructed using recommendations in the "Foundations" discussion presented above.

Cantilevered Walls

Cantilevered retaining walls are free to rotate and not restrained with minor deflections. Active earth pressures may be used in the designing of cantilevered walls. An equivalent fluid pressure (EFP) may be used to calculate the horizontal pressure against the walls, as tabulated below for retaining walls less than 6 feet in height.

Table 9

RETAINING WALL DESIGN, 6 FEET OR LESS (NON-EXPANSIVE SOIL)	
Surface Slope of Retained Material (H: V)	Equivalent Fluid Pressure (pcf)
Level	30
5:1	32
4:1	35
3:1	38
2:1	43
1½:1	55

These equivalent fluid pressures do not include other superimposed loading conditions such as expansive soil, vehicular traffic, structures, seismic conditions or adverse geologic conditions.

Retaining walls supporting sloping ground should be provided with a minimum freeboard height of 12 inches. Any slough, debris or trash accumulating behind the freeboard (in the catchment area) should be removed immediately to ensure the freeboard performs as intended.

Restrained Walls

The retaining walls are called non-yielding walls because the walls cannot move lately at the top and should be designed for an equivalent fluid pressure (EFP) of 45 pcf for level backfills.

7.7 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, estimated traffic indices for various pavement-loading conditions, and on a design R-value of 73.3 from the MTGL, Inc. The design R-value was chosen based on laboratory testing of a representative sample and considering the sandy soil conditions at near the surface. The preliminary flexible pavement sections may consist of the following for the Traffic Indices (TI) indicated and the calculations are in the Appendix E. The Asphalt Cement (AC) and Class II Aggregate Base (AB) thickness are presented below for different Traffic Indices. Final pavement design where needed should be based on the Traffic Index determined by the project civil engineer.

Table 10

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78

The final pavement design also should be verified during actual site grading and the above sections may be revised accordingly per actual representative R-value. The minimum required compaction of aggregate base is 95% of maximum dry density.

In areas where rigid concrete pavement is planned, at a minimum, concrete should be 4000 psi with fiber mesh, 5 inches thick in parking areas (light duty) and 6 inches thick (heavy duty) in loading areas. Concrete paving to be placed over a minimum 4-inch thick granular base on prepared subgrade soil. Reinforcement should be specified by the structural engineer but should be a minimum of #3 rebar at 18 inches on center each way. The PCC pavement sections should be provided with crack-control joints spaced no more than 14 feet on center each way. If saw cuts are used, they should have a minimum depth of ¼ of the slab thickness and made within 24 hours of concrete placement. We recommend that sections be as nearly square as possible.

8.0 CONSTRUCTION GUIDELINES

8.1 Construction Monitoring

As Geotechnical Engineer of Record for this project, Terradyne Engineering Inc., should be involved in monitoring the foundation installation and earthwork activities by the special inspections requirements and tests of existing site soil conditions: fill placement and load-bearing requirements shall be performed in accordance with this **section of 1705.6** and **Table 1705.6**. The performance of any foundation system is not only dependent on the foundation design but is strongly influenced by the quality of construction. Prior to construction, please contact our office so that a Foundation and Earthwork Monitoring Plan can be incorporated into the Project Quality Control Program.

TABLE 1705.6

REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	—	X
2. Verify excavations are extended to proper depth and have reached proper material.	—	X
3. Perform classification and testing of compacted fill materials.	—	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	X	—
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	—	X

8.2 Site Preparation

Grading should conform to the guidelines presented in the 2019 California Building Code (CBC, 2019), as well as the requirements of the City of Hesperia and County of San Bernardino.

Prior to earthwork or construction operations, the site should be cleared of surface and subsurface obstructions and stripped of any vegetation in the areas proposed for development. Removed vegetation and debris should then be properly disposed of off-site. Holes resulting from removal of buried obstructions which extend below finish site grades should be backfilled with suitable fill soils compacted to a **minimum 95** percent relative compaction (based on ASTM Test Method D1557).

8.3 Removal of Unsuitable Soils

The existing upper soils alluvial deposits soils are considered to be potentially compressible and maybe collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of <u>5 feet outside the building footprint</u>. Following removal of the upper soils, the bottom of the excavation(s) should be observed and approved by a representative of this office to verify that these potentially compressible materials have been properly removed.

Prior to fill placement, all areas to receive fill and/or other surface improvements, shall be scarified to a minimum depth of **<u>10 inches</u>** below removal grade elevations, be moisture conditioned to **3 percent over optimum** moisture content and compacted to minimum **95** percent relative compaction, based on ASTM Test Method D1557. After this procedure is completed, backfill of the removal excavation should take place by moisture conditioning the removed soils prior to placement to <u>at least optimum to 3 percent over optimum moisture</u> content and recompaction of these soils to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). These operations should be performed under the observation and testing of a representative of this office. <u>It should be understood that based on the observations of our field representative, localized deeper or shallower removals may be recommended.</u> Any removed soils shall be moisture conditioned as necessary to achieve a moisture content of at least optimum to 3 percent over optimum moisture content and be recompacted to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). This earthwork should extend a minimum of 5 feet beyond the proposed footing limits.

Any proposed subgrade for support of appurtenance slabs on grade and miscellaneous improvements should be scarified minimum (18"), moisture conditioned up to three (3) percent over optimum moisture content and compacted. The subgrades should be compacted to minimum 95 percent of maximum dry density as determined by laboratory ASTM D1557 modified proctor test.

When excavations deeper than five feet are made, temporary construction slopes should be no steeper than 1.5:1 (horizontal to vertical). Sheeting and bracing should be provided by the contractor, as necessary, to protect workers in the excavation. Where excavations undermine existing improvements, such as the existing walls, etc., temporary structural support should be provided to reduce the risk of damage resulting from undercutting. Permanent cut and fill slopes (if proposed), should not be constructed steeper than 2:1 (horizontal to vertical) and should be considered subject to review by the geotechnical consultant at the time of grading. These slopes should possess sufficient compacted fines to limit erosion risk. If upon construction, relatively clean, cohesionless sands are encountered, reconstruction by blending in fines to compacted fill and/or flattering of slopes will be advised.

8.4 Fill Placement and Compaction

If necessary, the on-site soils are suitable for reuse as compacted fill, provided they are free of organic materials and debris and material larger than 6 inches in diameter. Should import soils be utilized for near-surface fills, these soils should be predominately granular, possess a low or very low expansion potential (see Section 8.4 below), and be approved by the geotechnical engineer prior to their transportation to the site. Lift thicknesses will be dependent upon the size and type of equipment used. <u>In general, fill should be placed in uniform lifts not exceeding 8 to 10 inches</u>. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. All earthwork should be conducted in accordance with the applicable codes, agency requirements, the recommendations, and the standard grading guidelines. The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

8.5 Temporary Excavations and Backfill

Underground trenches are anticipated to be excavated with moderate effort using conventional construction equipment in good operating condition. Deep trenches may require the use of heavier equipment operations. The encountered soils at the site consisted of loose to medium dense, poorly consolidated sands. As such these soils may be subject to collapse and or cave-ins. To satisfy OSHA requirements and for workmen's safety, it will be necessary to shore excavations deeper than 5 feet. The proposed trenches deeper than 5 feet may also be laid back in a 1:1 horizontal to vertical (45 degrees). During wet weather, runoff water should be prevented from entering the excavation. The contractor is responsible for the safety of the workers and should observe the federal and local regulations including CALOSHA excavation and trench safety guidelines.

The on-site soils may be used as trench backfill provided, they are screened of rock sizes over 6 inches in maximum dimension and organic matter. Trench backfill should be compacted in uniform lifts (not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (based on ASTM D1557).

8.6 Shoring

Based on the anticipated depth of excavation (5 feet) below existing grade for the construction of the building, it appears that there may be insufficient space for sloped excavations. If so, shoring should be used to support the excavations. Cantilever, or braced shoring may be considered at this site. Cantilevered shoring can be utilized where some deflection is acceptable. However, where shoring will support adjacent properties and excessive deflection can lead to settlement, braced shoring should be utilized. The magnitude of shoring movements and resulting settlements are difficult to estimate because they depend on many factors, including the method and the specialty shoring contractor's skill in the installation. We estimate a properly installed system will limit settlements to adjacent improvements to less than one inch. Settlement of structures or facilities founded adjacent to the shoring will occur in proportion to both the distance between the shoring and the facilities, and the amount of horizontal deflection of the shoring system. The vertical settlement will be a maximum at the shoring face and decrease as the horizontal distance from the shoring increases. Beyond a distance from the shoring equal to the height of the shoring, the settlement is expected to be negligible. The maximum vertical settlement is expected to be about 75 percent of the horizontal deflection of the shoring system.

We judge the most appropriate temporary shoring system for this project is a typical soldier-pile-and-lagging system. For this type of system, soldier piles are placed in predrilled holes which will be backfilled with concrete. Wood or concrete lagging will be placed between the soldier piles as the excavation proceeds. Geotechnical parameters for the design of lagging & soldier pile (such as active & passive soil pressures, skin friction, pile fixity, allowable deflection at top of pile, etc.) are provided below:

- Skin friction along the back of the soldier piles using an allowable skin friction of 250 psf for walls above the excavation level.
- An allowable skin friction of 300 psf may be used on the perimeter of the piles below the bottom of the excavation.
- Cantilever soldier-pile-and-lagging walls should be designed to resist an active earth pressure corresponding to an equivalent fluid weigh of 35 pounds per cubic foot (pcf). This lateral force may be resisted by passive earth pressures against the embedded vertical

faces of the piers. We recommend passive resistance be calculated using an equivalent fluid weight of 250 pcf (Max. 3000 pcf) in the underlying native soil. The calculated passive pressure may be applied over three pier diameters.

- The Point of Fixity is defined as a percentage of the embedment depth 'D' which varies from 0 to 0.75D. For unrestrained shoring systems in most stiff to medium dense soils, a value of 0.25D may be assumed. A greater value may be used for loose sand or soft clay.
- Surcharge coefficient 0.5 may be used with uniform vertical surcharges for cantilever, and braced shoring lateral earth pressures.

It is difficult to accurately predict the amount of deflection of a shored embankment. It should be realized that some deflection will occur. It is recommended that the deflection be minimized to prevent damage to existing structures and adjacent improvements. Where public rights-of-way are present or adjacent offsite structures do not surcharge the shoring excavation, the shoring deflection should be limited to less than 1 inch at the top of the shored embankment. Where offsite structures are within the shoring surcharge area it is recommended that the beam deflection be limited to less than ½ inch at the elevation of the adjacent offsite foundation, and no deflection at all if deflections will damage existing structures. The allowable deflection is dependent on many factors, such as the presence of structures and utilities near the top of the embankment, and will be assessed and designed by the project shoring engineer.

The selection, design, construction, and performance of the shoring system should be the responsibility of the contractor. The shoring system should be designed by a licensed structural engineer experienced in the design of retaining systems, and installed by an experienced shoring specialty contractor. The shoring engineer should be responsible for the design of temporary shoring in accordance with applicable regulatory requirements. We should review the final shoring plans to check that they are consistent with the recommendations presented in this report. Excavations and shoring should be observed by personnel of our firm so that any necessary modifications based on variations in the soil conditions encountered can be made. All applicable safety requirements, including Cal-OSHA requirements, should be met. It is the responsibility of the contractor to maintain safe and stable slopes during construction. Heavy construction equipment, building materials, excavated soil, and vehicle traffic should not be allowed within ten feet of the top of excavations. During wet weather, runoff should be prevented from running across slopes and from entering excavations.

Prior to excavation, it is recommended that walls, structures, or portions of structures within a horizontal distance of 1.5 times the depth of the excavation be inspected to determine their present condition. For documentation purposes, photographs should be taken of preconstruction distress conditions and level surveys of adjacent grade and pavement should be performed. During construction, deflection of the shoring system should be monitored initially on a frequent (weekly) basis until it can be demonstrated that no movement is occurring. At that time, less frequent monitoring can be performed. In addition, the structures should be periodically inspected for signs of distress. Adjacent grade and pavement should be monitored to determine the amount of movement resulting from the construction activities. If distress, or settlement is noted, an investigation should be performed, and correction measures taken so that continued or worsened distress or settlement is mitigated.

8.7 Temporary Drainage Measures

Temporary drainage provisions should be established to minimize water runoff into construction areas. If standing water does accumulate, it should be removed by pumping as soon as possible. Adequate protection against sloughing of soils should be provided for workers and inspectors entering the excavations. This protection should meet CALOSHA and other applicable building codes.

8.8 Selection of Structural Fill

Any select structural fill used at the site should have a Liquid Limit less than 35 and a Plasticity Index between 5 and 15. The fill should contain no particles greater than one (1) inch in diameter. The percent passing U.S. Standard Sieve No. 4 should be between 40 and 80 percent and passing Sieve No. 40 between 10 and 50 percent. The percent passing Sieve No. 200 should be less than 20 percent.

Pit-run gravels (with some clay binders) and crushed limestone (with sufficient fines to bind the aggregate together) are examples of suitable select structural fill materials. The fill materials should be placed in loose lifts not to exceed 8 inches thick and compacted to 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content up to two percentage points above optimum.

8.9 Groundwater

In areas where significant cuts (2-feet or more) are made to establish final grades for building pads, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Subsurface drains may be required to intercept seasonal groundwater seepage. The need for these, or other dewatering devices, on building pads should be carefully addressed during construction. Our office could be contacted to visually inspect final pads to evaluate the need for such drains.

Groundwater seepage may occur several years after construction if the rainfall rate or drainage changes in the vicinity of the project site. If seepage runoff occurs towards the building, an engineer should be called on to evaluate its' effect and determine whether French drains are required at the location.

8.10 Control Testing and Field Observation

Subgrade preparation and structural fill placement should be monitored by the project geotechnical engineer or his representative. Field-tests for moisture content and relative compaction of the fill soils shall be performed by Terradyne Engineering, Inc. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction. Any areas do not meet the required relative compaction should be re-compacted and retested until compliance is met the required of relative compaction.

9.0 SITE DRAINAGE AND MAINTENANCE

Final drainage is important for the performance of the proposed construction. Landscaping, plumbing, and downspout drainage is also important. It is vital that all roof drainage be transported away from the building so that water does not pond around it, which can result in a soil volume change underneath the building. Plumbing leaks (if any) should be repaired as soon as possible in order to minimize the magnitude of a moisture change under the slab. Large trees and shrubs should not be planted in the immediate vicinity of the structures, since root systems can cause a substantial reduction in soil volume in the vicinity of the trees during dry periods.

Adequate drainage should be provided to reduce seasonal variations in moisture content of foundation soils. All pavement and sidewalks within 10-feet of the structures should be sloped away from the structures to prevent ponding of water around the foundations. Final grades within 10-feet of the structure should be adjusted to slope away from structures preferably at a minimum slope of 2 percent. Maintaining positive surface drainage throughout the life of the structure is essential.

In areas with pavement or sidewalks adjacent to the new structure, a positive seal must be provided and maintained between the structures and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. Post-construction movement of pavement and flat-work is not uncommon. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post construction movement of flatwork, particularly if such movement would be critical. Normal maintenance should include inspection of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.

Trench backfill for utilities should be properly placed and compacted, as outlined in this report, and in accordance with the requirements of local City, County and/or State Standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should be prevented from becoming a conduit and allowing an access for surface or subsurface water to travel toward the new structures. Concrete cut-off collars or clay plugs should be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.

10.0 REVIEW and SERVICES

All soil, geologic, and structural aspects of the proposed Project are subject to the review and approval of the governing agency(s). It should be recognized that the governing agency(s) can dictate the manner in which the project proceeds. They could approve or deny any aspect of the proposed improvements and/or could dictate which foundation and grading options are acceptable.

10.1 Plan Review

Upon completion, we should review the project plans and specifications to check that they conform to the intent of our recommendations.

10.2 Additional Geotechnical Services

Additional geotechnical services will be required subsequent to the investigation report. Additional fees will accrue for the additional services. The additional fees will depend on the scope of the additional work. A separate proposal and agreement will be prepared for the additional services. The following services are considered additional services.

- Response to questions from the reviewing agencies.
- Once plans for the proposed development are completed, the geotechnical consultant will need to review and approve the drawings.
- During construction, the geotechnical consultant will need to observe and test earthwork and observe foundation excavations for the proposed development.

11.0 LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from eight (8) borings drilled at the site and the design details furnished by Mr. Robert DeGraaf of Sweetgum Environmental.

This report may not reflect the exact variations of the soil conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. If variations appear evident, it will be necessary to re-evaluate our recommendations after performing on-site observations and tests to establish the engineering significance of these variations. The project geotechnical engineer should review the final plans for the proposed structures so that he may determine if changes in the foundation recommendations are required. The project geotechnical engineer declares that the findings, recommendations or professional advice contained herein have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechnical engineering and engineering geology. No other warranties are implied or expressed.

This report is valid until site conditions change due to disturbance (cut and fill grading) or changes to nearby drainage conditions or two (2) years from the date of this report, whichever occurs first. Beyond this expiration date, Terradyne shall not accept any liability associated with the engineering recommendations in the report, particularly if the site conditions have changed. If this report is desired for use for design purposes beyond this expiration date, we highly recommend an update of this report with the possibility of drilling additional borings so that we can verify the subsurface conditions and validate the recommendations in this report.

This report has been prepared for the exclusive use of the owner, owner's representative and the design team for the specific application to the proposed Auto Zone Store #3658 located at near Ranchero Road and Escondido Avenue, Oak Hills, San Bernardino County, California.

REFERENCES

California Building Code (CBC), 2019, California Code of Regulations, Title 24, Part 2, Volume 2 of 2,

Google Earth Pro®, 2019, Version 7.3.2.5776.

American Society for Testing and Materials (ASTM), 2011, Annual Book of ASTM Standards, Volume 04.08, Construction: Soil and Rock (I), Standards D 420 - D 5876.

California Building Code, 2016, California Code of Regulations Title 24, Part 2, Volume 2 of 2.

American Society of Civil Engineers (ASCE), Minimum Design Loads for Buildings and other Structures, Standard 7-16

NAVFAC DM 7.1 Soil Mechanics, U.S. Department of the Navy 1982 Edition, May 1982

NAVFAC DM 7.2, Foundation and Earth Structures, U.S. Department of the Navy 1984

California State Water Resources Control Board, Website, GeoTracker database, http://geotracker.waterboards.ca.gov/gama/, accessed January 2019.

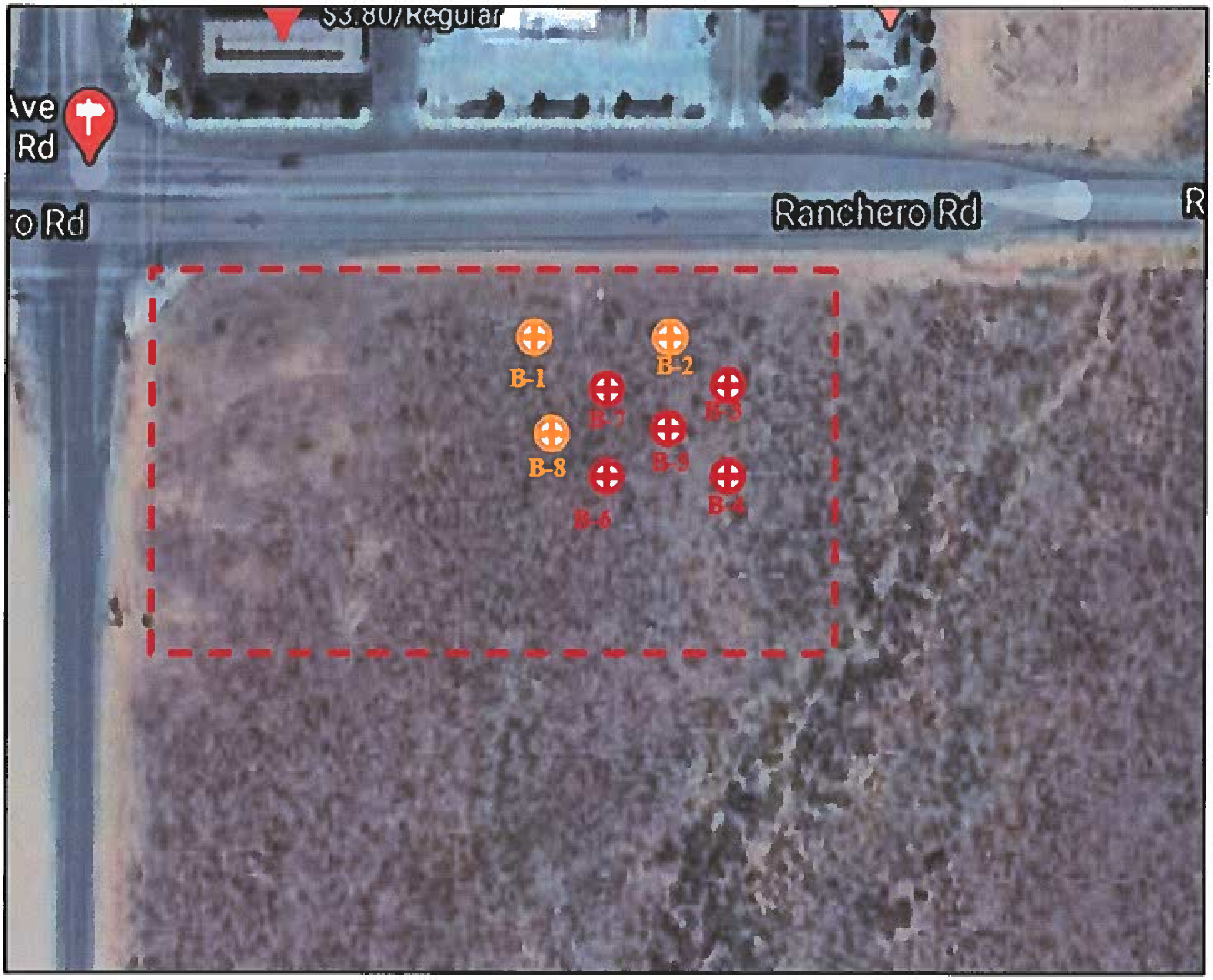
Dibblee, T.W., 1964, Geologic map of the Lucerne Valley quadrangle, San Bernardino County, California: U.S. Geological Survey, Miscellaneous Geologic Investigations Map I-426, scale 1:62,500

United States Geological Survey (USGS), 2015 edition, 7.5' Minute Topographic Map of the Fawnskin Quadrangle, San Bernardino County, California, Scale 1:24,000

ASCE Hazard Tool https://asce7hazardtool.online/

APPENDIX A

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Vicinity Map	
	Terradyne Project No.: L201011	Figure: A



Approximate Boring Locations 15 feet depth

Approximate Boring Locations 10 feet depth

Approximate Subject Lot Boundary

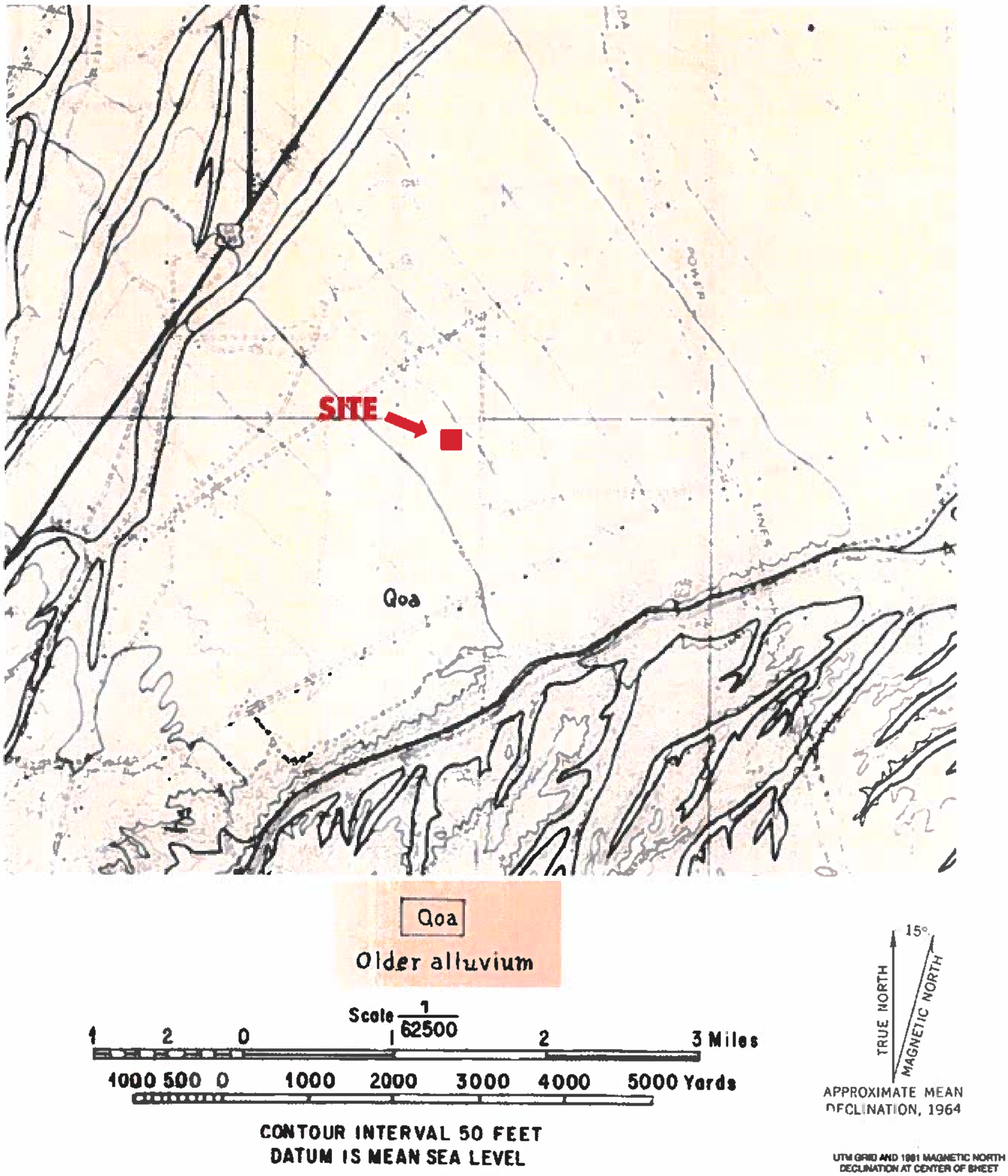
Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Approximate Boring Location Map

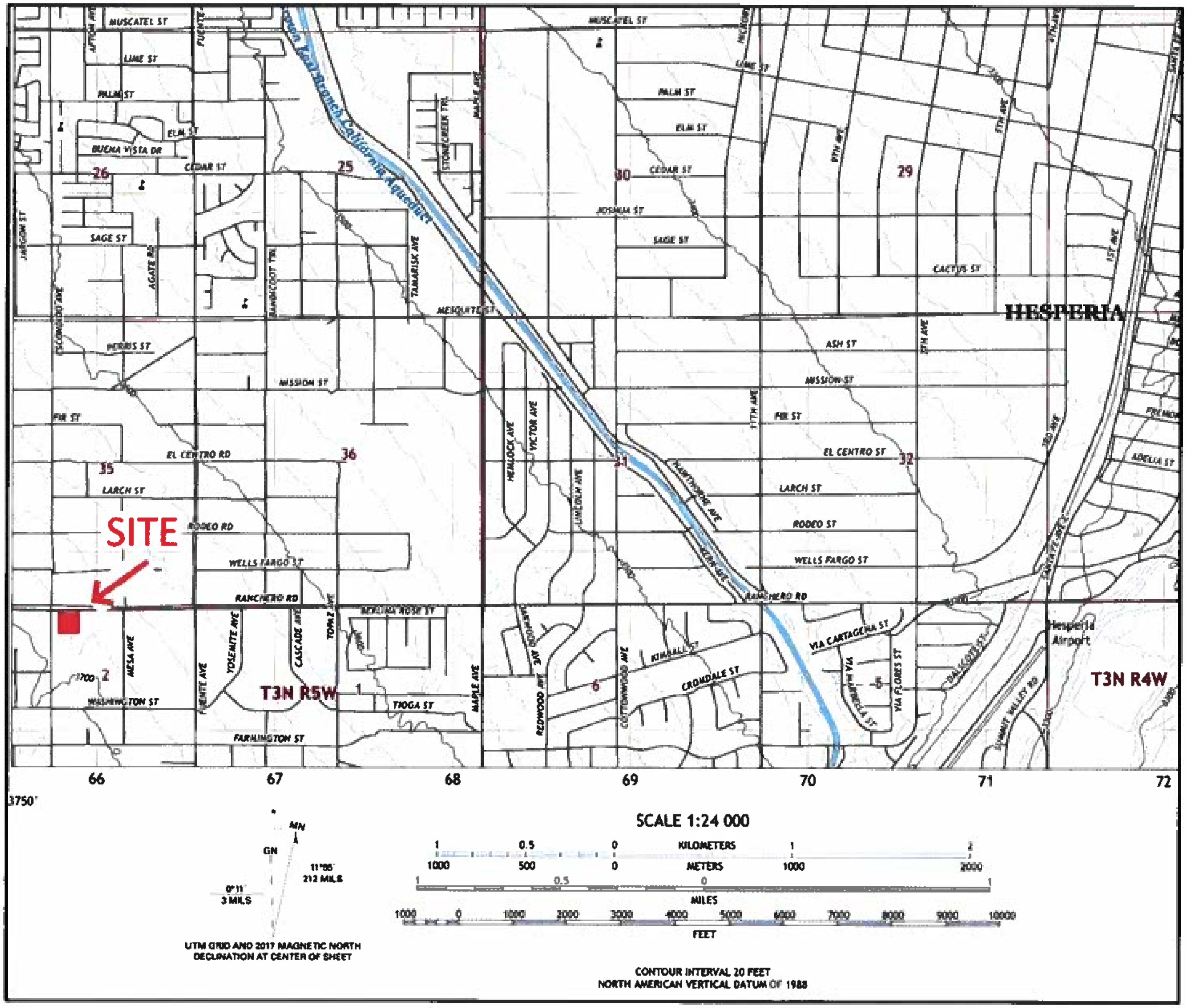
Terradyne Project No.: L201011

Figure: B



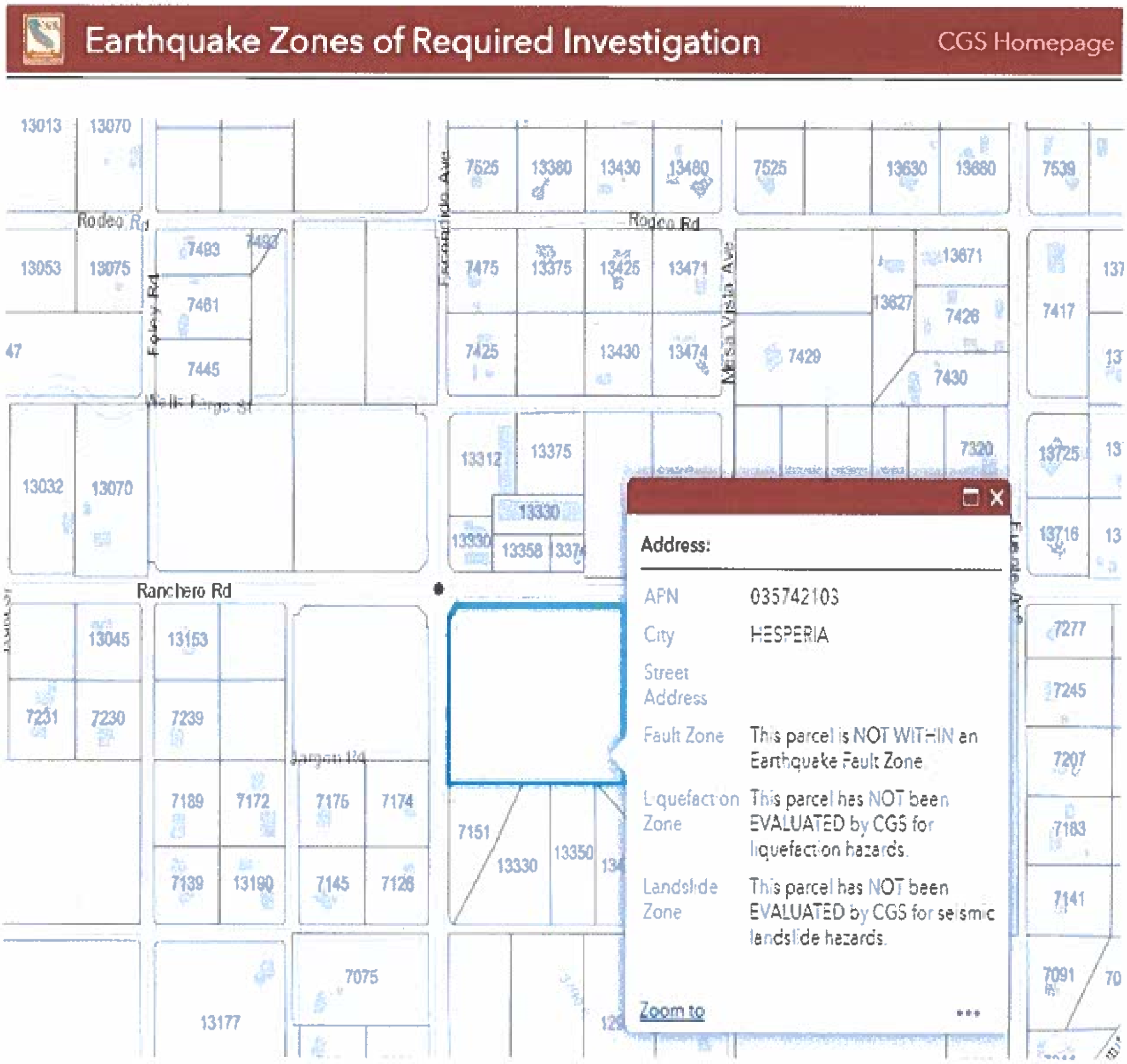
Map Reference: Dibblee, T.W., 1965, Geologic map of the 15-minute Hesperia quadrangle, San Bernardino County, California: U.S. Geological Survey, Open-File Report OF-65-43, scale 1:62,500

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County; CA 92344	**Terradyne Engineering, Inc.** Regional Geologic Map and Legends Terradyne Project No.: L201011 — Figure: C



Map Reference: : United States Geological Survey (USGS), 2012 edition, 7.5' Minute Topographic Map of the Hesperia Quadrangle, San Bernardino County, California, Scale 1:24,000

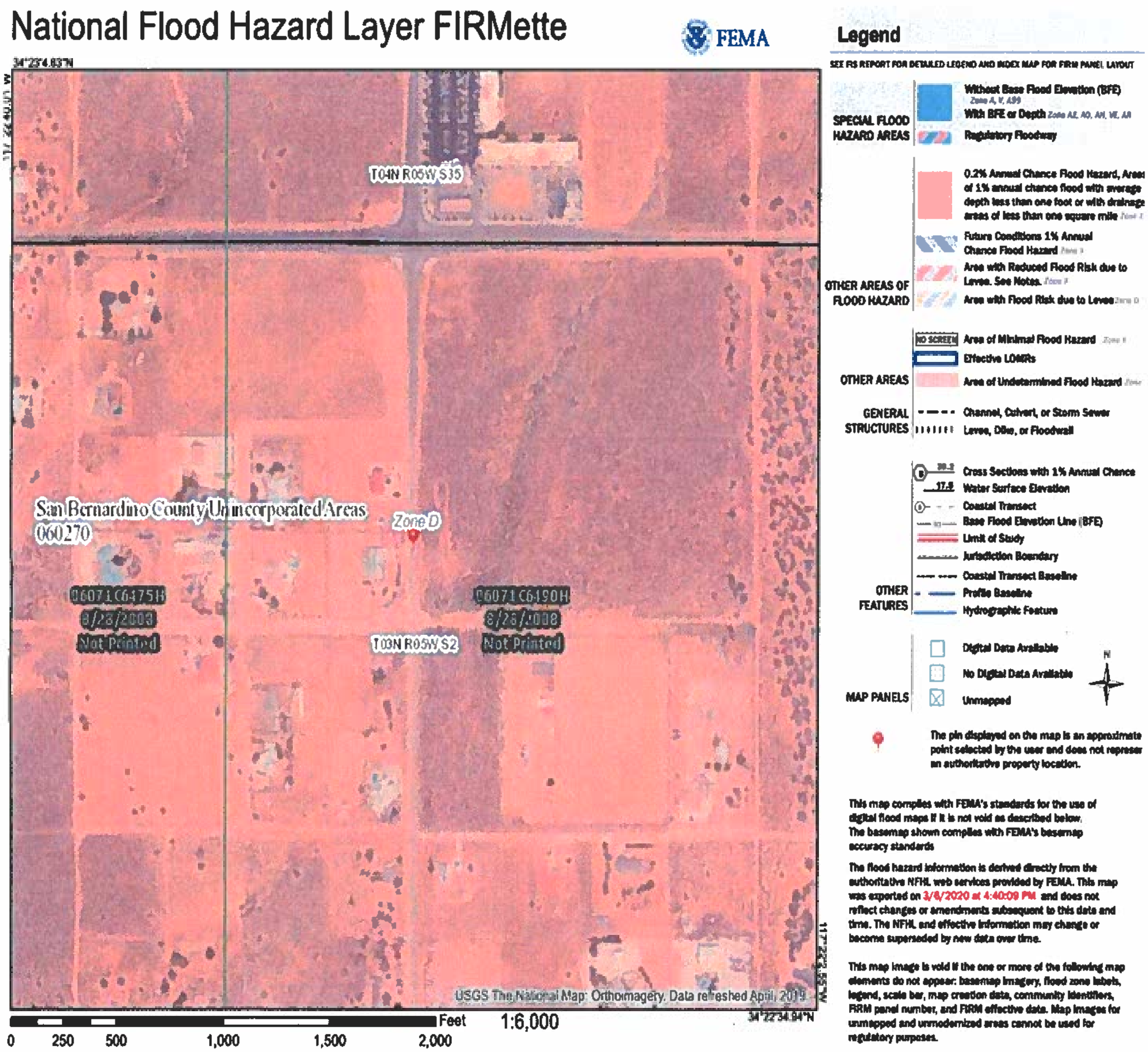
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Regional Topographic Map Terradyne Project No.: L201011 — Figure: D



California Geological Survey (CGS)

Ref: https://maps.conservation.ca.gov/cgs/EQZApp/app

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** CGS Seismic Hazard Information Terradyne Project No.: L201011 — Figure: E



Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Groundwater Information Map	
	Terradyne Project No.: L201011	Figure: F

APPENDIX B

Boring Logs

Log of Boring 1

Sheet 1 of 1

Project: **New Auto Zone Store #3658**
Project Location: **Near Ranchero Dr. & Escondido Ave. Oak Hill CA**
Project Number: **L201011**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-1 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, medium dense, moist	5.21				
			B-1 @ 2.5'-4'	6/9/14	SM		Silty SAND, light brown, medium dense, slightly moist					
	5		B-1 @ 4.5"-5.0'	6/4/5	SM		Silty SAND, light brown, loose, slightly moist	5.26	115.93			
			B-1 @ 7.5'-9'	8/13/13	SM		Consistency changed to medium dense					
	10		B-1 @ 10'-10.5'	25/38/28	SM		Silty SAND, light brown with reddish mixed, dense, slightly moist	2.54	114.73			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

C:\Users\...\Desktop\Project\L201011\Boring log\L201011.bg4[master 4 tab).tpl]

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 2** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-2 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, loose, moist	5.21				
			B-2 @ 2.5'-4'	4/6/7	SM		Silty SAND, brown, medium dense, slightly moist					
	5		B-2 @ 4.5"-5.0'	4/4/5	SM		Silty SAND, light brown, loose, slightly moist	6.11	113.40	15.7		
			B-2 @ 7.5'-9'	11/17/18	SM		Consistency changed to dense					
	10		B-2 @ 10'-10.5'	31/50 for 6"	SM		Silty SAND, brown, very dense, slightly moist	6.46	112.89			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	# Log of Boring 3 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-3 @ 2.5'-4'	3/4/6	SM							
	5				SM		Silty SAND, light brown, medium dense, slightly moist					
			B-3 @ 7.0'-7.5'	5/10/16	SM		Consistency changed to very dense	4.68	117.21	21.1		
	10		B-3 @ 10'-11.5'	14/15/21	SM		Consistency changed to dense					
			B-3 @ 12.5'-14	6/16/18	SM							
	15		B-3 @	15/50 for 6"	SM		Silty SAND, light brown, very dense, slightly moist, with some gravel	3.88	110.05	16.4		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bg4[master 4 lab].tpl

Project: **New Auto Zone Store #3658**	**Log of Boring 4**
Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA**	**Sheet 1 of 1**
Project Number: **L201011**	

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-4 @ 2.5'-4'	4/7/6	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, brown, medium dense, slightly moist					
			B-4 @ 7.0'-7.5'	11/16/19	SM		Silty SAND, light brown, very dense, slightly moist, with reddish brown sandstone	3.92	115.55	17.7		
			B-4 @ 8.5'-10'	19/41/50 for 6"								
	10				SM		Consistency changed to dense					
			B-4 @ 11'-12.5	10/16/24								
					SM		Silty SAND, brown, very dense, slightly moist, with sandstone and some gravel					
	15		B-4 @	50 for 6"	SM			6.59	104.30			
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bgd/[master 4 tab].tpl

Project: **New Auto Zone Store #3658**	Log of Boring 5
Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA**	**Sheet 1 of 1**
Project Number: **L201011**	

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-5 @ 0'-5'		SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist	3.45				
			B-5 @ 2.5'-4'	3/4/7	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, lightt brown, medium dense, slightly moist, with some gravel					
			B-5 @ 7.0'-7.5'	6/11/18	SM		Silty SAND, light brown, very dense, slightly moist, with sandstone	4.13	103.68	20.5		
			B-5 @ 8.5'-10'	27/50 for 5"								
	10				SM		Silty SAND, light brown, dense, slightly moist, with some sandstone and some gravel					
			B-5 @ 12.5'-14	13/18/25	SM		Silty SAND, light brown, dense, slightly moist, with some gravel					
	15		B-5 @ 15'-15.5	50 for 6"	SM		Consistency changed to very dense, with sandstone and no gravel	4.84	100.65	29.3		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

C:\Users\jiang\Desktop\Project\L201011\Boring log\L201011.bgd[(master 4 lab).tpl]

Project: **New Auto Zone Store #3658**	**Log of Boring 6**
Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA**	**Sheet 1 of 1**
Project Number: **L201011**	

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-6 @2.5'-4	2/4/6	SM							
	5				SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
			B-6 @ 7.0'-7.5'	6/9/8	SM		Consistency changed to dense	5.93	114.58	22.2		
			B-6 @ 8.5'-10'	16/21/23								
	10				SM		Silty SAND, light brown, medium dense, slightly moist					
			B-6 @ 12.5'-14	10/12/12	SM		Some sandstone present					
	15		B-6 @ 15'-15.5	21/26/38	SM		Silty SAND, brown, dense, slightly moist, with sandstone	5.98	118.04	13.3		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 7** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-7 @ 0'-5'		SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist	3.97				
			B-7 @ 2.5'-4'	4/5/5	SM							
	5				SM		Silty SAND, lightt brown, loose, slightly moist, with some sandstone					
			B-7 @ 7.0'-7.5'	6/7/7	SM		Changed to very dense	4.42	111.89			
			B-7 @ 8.5'-10'	31/50 for6"								
	10				SM		Silty SAND, light brown, very dense, slightly moist, with some sandstone and some gravel					
			B-7 @ 12.5'-14	19/26/20	SM		Consistency changed to dense					
	15		B-7 @ 15'-15.5	26/50 for 5"	SM		Consistency changed to very dense	4.84	108.32			
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

C:\Users\zjiang\Desktop\Project\L201011\Boring log\L201011.bgs[master 4 tab).tpl]

Project: **New Auto Zone Store #3658**
Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA**
Project Number: **L201011**

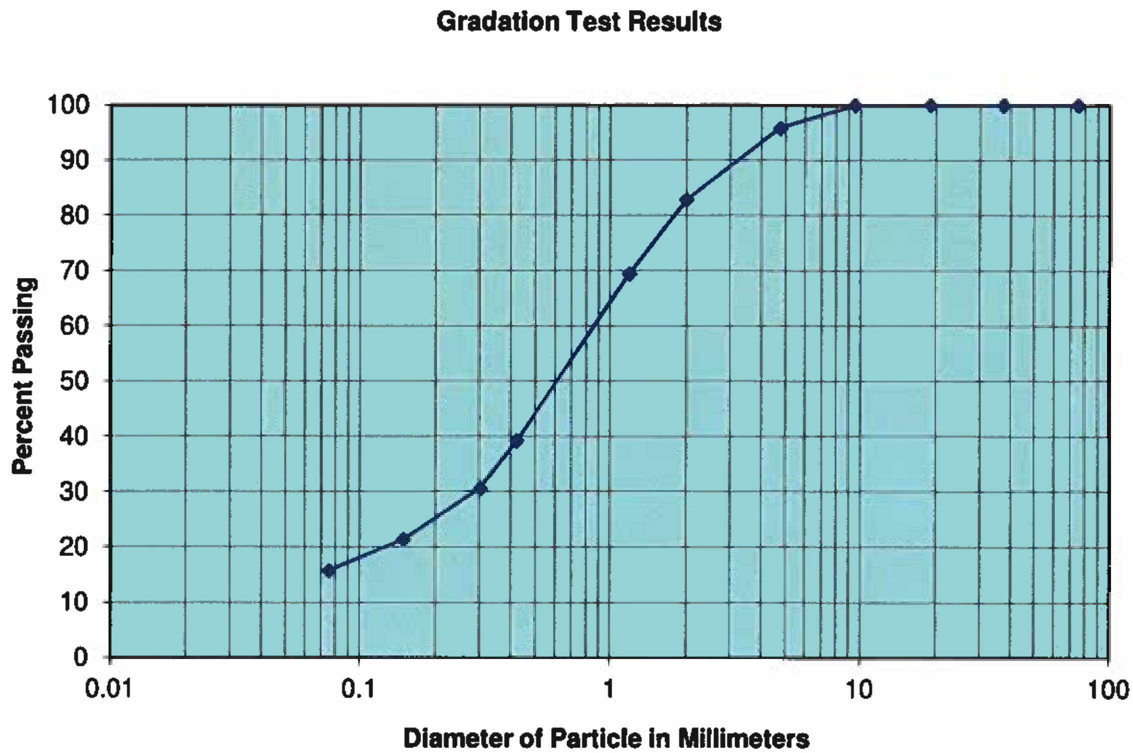
Log of Boring 8
Sheet 1 of 1

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, medium dense, moist					
					SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
	5		B-8 @ 4.5'-5.0'	4/6/13	SM		Silty SAND, light brown, medium dense, slightly moist, with sandstone and gravel	6.00	116.27	19.1		
			B-8 @ 7.5'-9'	8/14/19	SM							
	10		B-8 @ 10'-10.5	7/9/10	SM			4.21	101.65			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

APPENDIX C

Laboratory Tests



B-1 @ 4.5'-5.0'

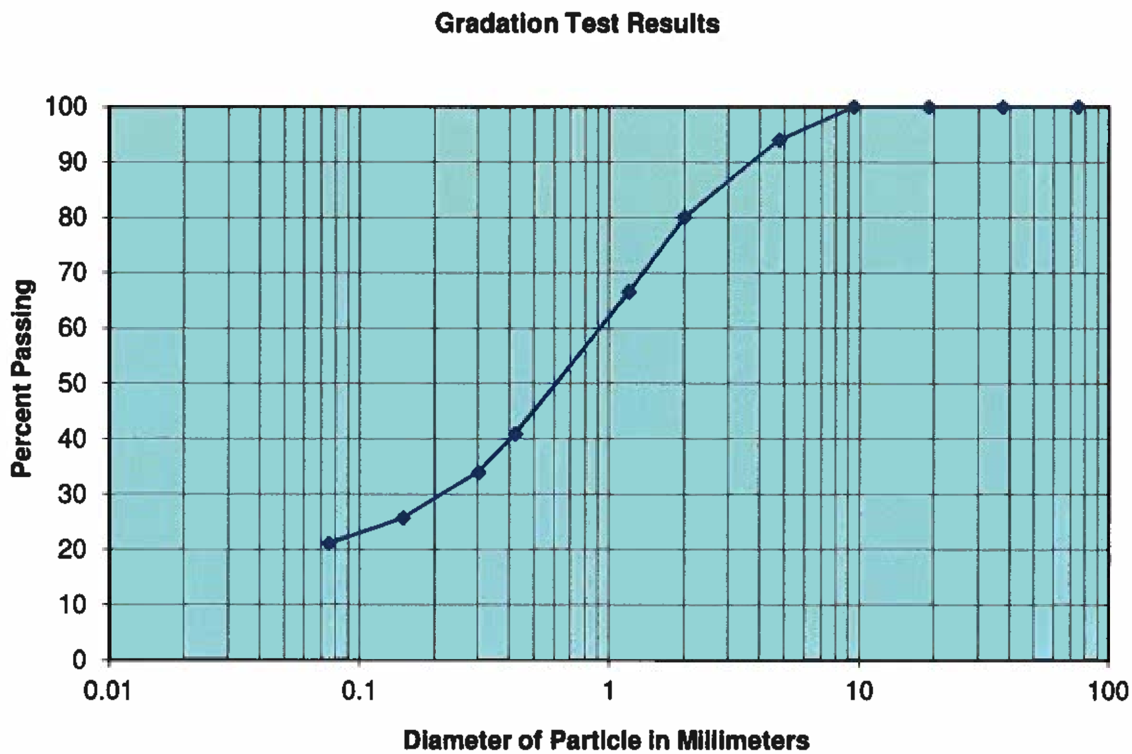
Gravel	Sand	Fines
4.2 %	80.0 %	15.7 %

Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Grain Size Distribution

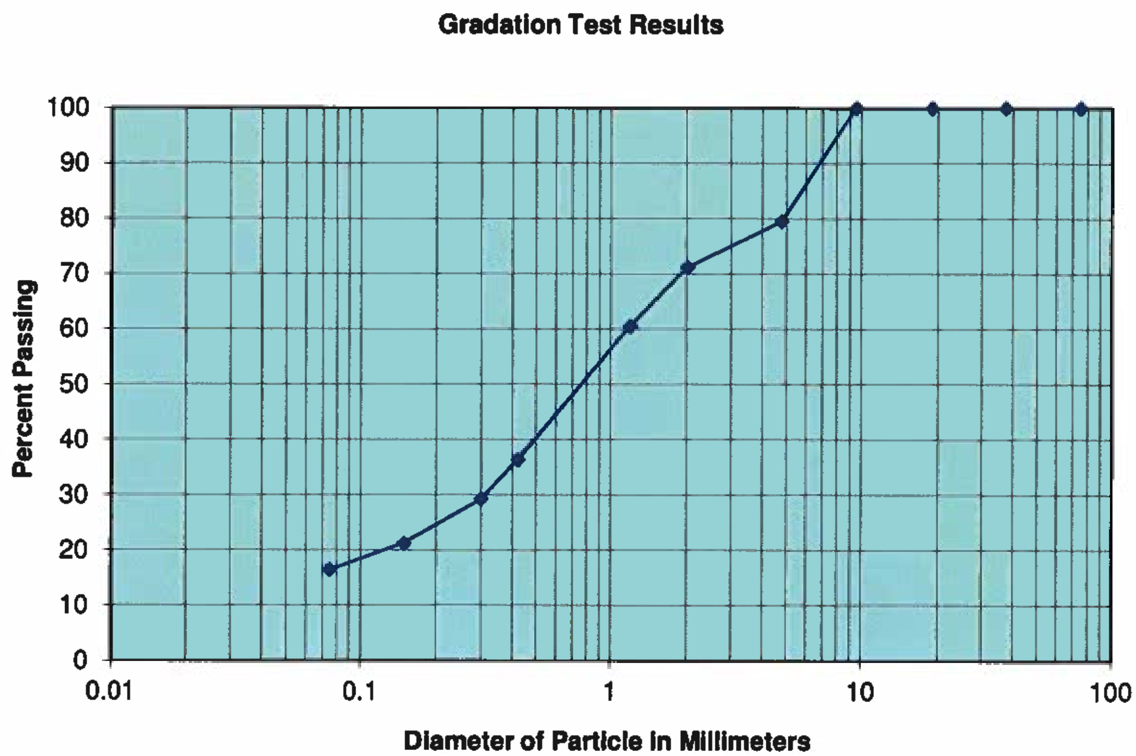
Terradyne Project No.: L201011 | Plate: G



B-3 @ 7.0'- 7.5'

Gravel	Sand	Fines
6.0 %	73.0 %	21.0 %

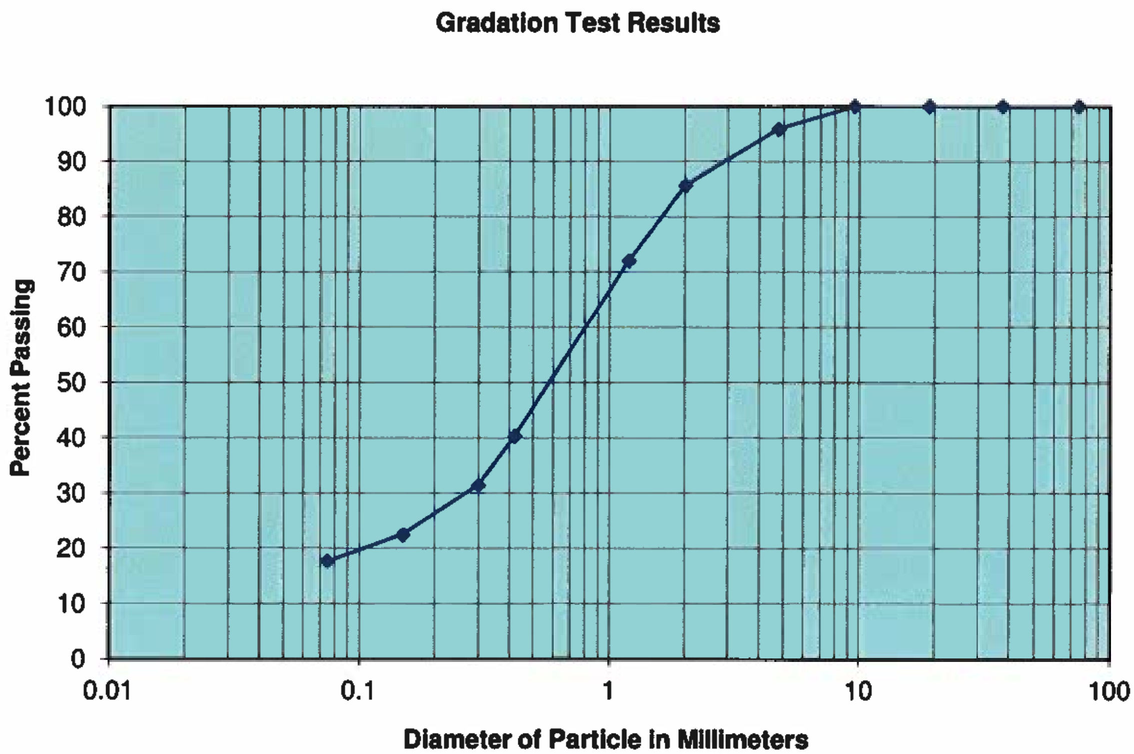
Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: H



B-3 @ 15.0'- 15.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

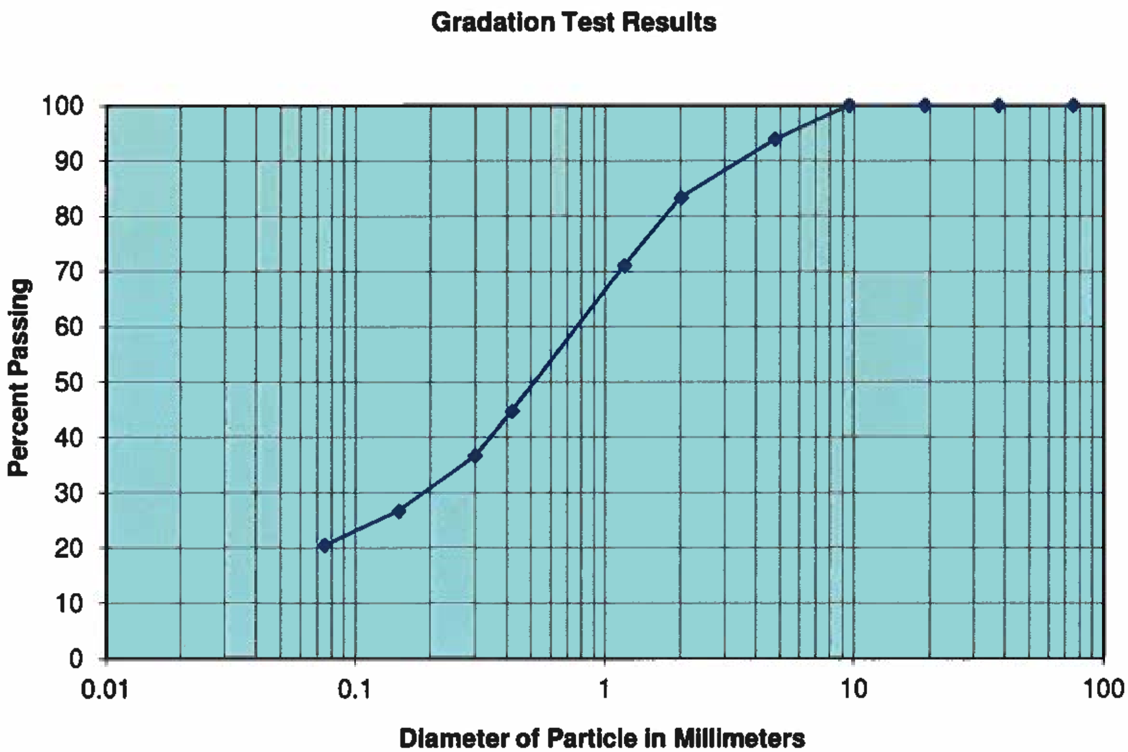
Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: I



B-4 @ 7.0'- 7.5'

Gravel	Sand	Fines
4.1 %	78.2 %	17.7 %

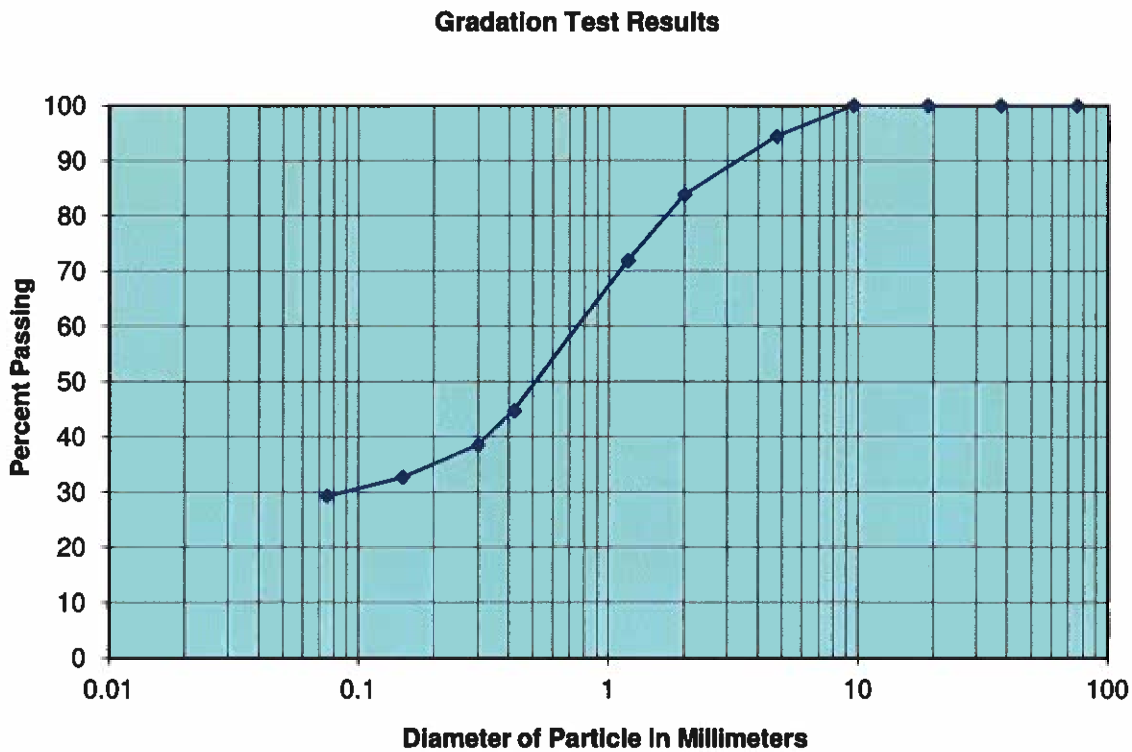
Subsurface Explorations/Geotechnical Investigation	Terradyne Engineering, Inc.	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: J



B-5 @ 7.0'- 7.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution Terradyne Project No.: L201011 — Plate: K

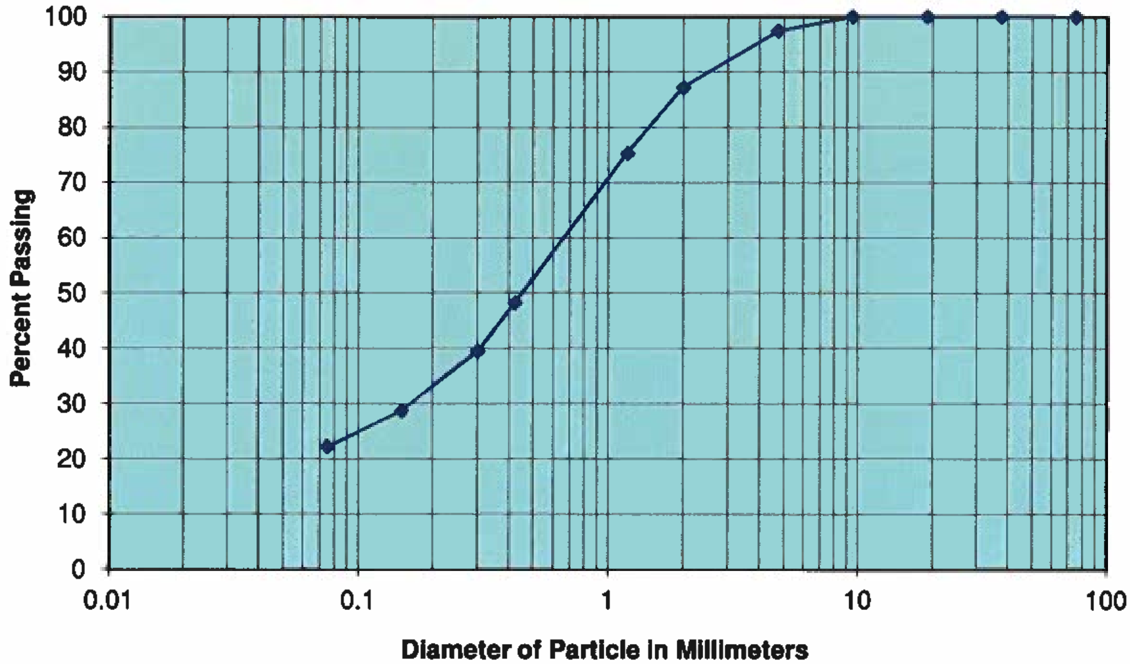


B-5 @ 15.0'- 15.5'

Gravel	Sand	Fines
5.6 %	65.1 %	29.3 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: L

Gradation Test Results

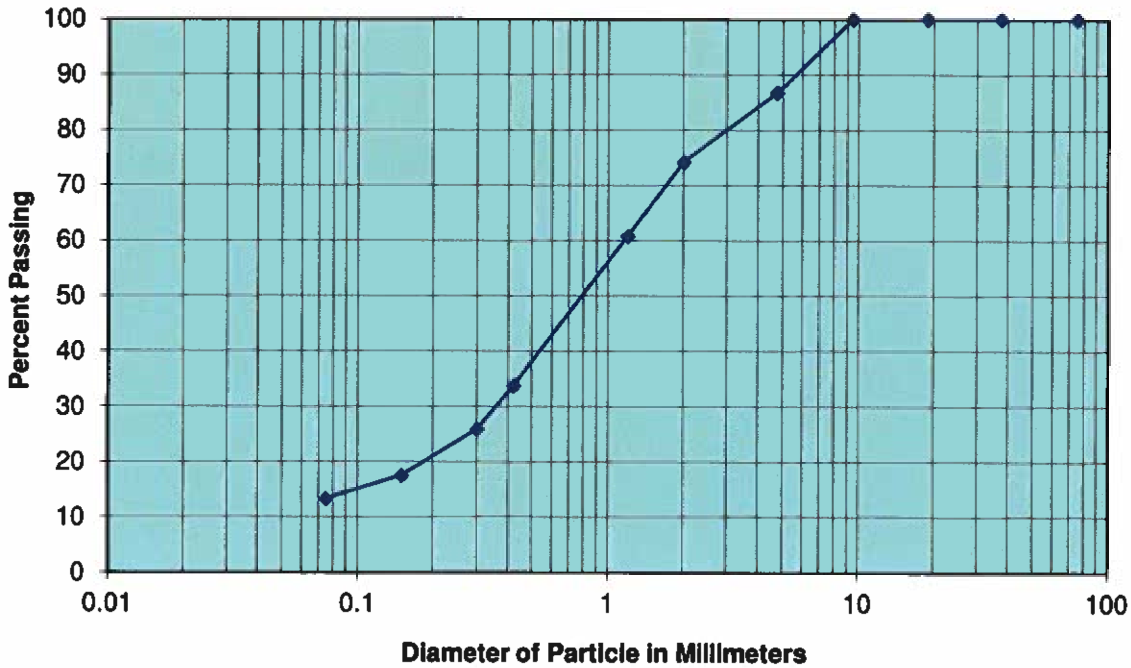


B-6 @ 7.0'- 7.5'

Gravel	Sand	Fines
2.6 %	75.2 %	22.2 %

Subsurface Explorations/Geotechnical Investigation	Terradyne Engineering, Inc.	
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: M

Gradation Test Results

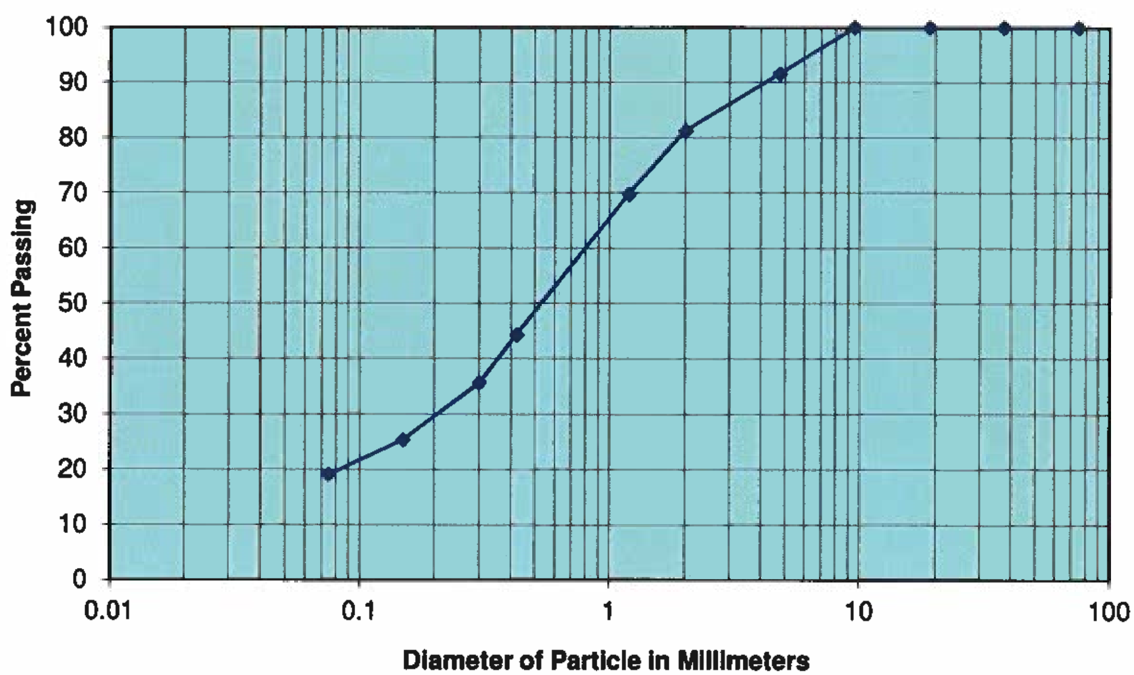


B-6 @ 15.0'- 15.5'

Gravel	Sand	Fines
13.3 %	73.4 %	13.3 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution
	Terradyne Project No.: L201011 — Plate: N

Gradation Test Results



B-8 @ 7.0'- 7.5'

Gravel	Sand	Fines
8.4 %	72.5 %	19.1 %

Subsurface Explorations/Geotechnical Investigation	**Terradyne Engineering, Inc.**
Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	Grain Size Distribution
	Terradyne Project No.: L201011 — Plate: O

Expansion Index Test (ASTM D 4829)

Project Name: Auto Zone, Store# 3658, Near Ranchero Dr & Esocondid	Sample By:	CR	Date: 2/7/20
Project No. : L201010	Tested By:	WS	Date: 2/27/20
Boring No.: B8	Depth (ft): 1 - 5'		
Sample No. :			
Soil Identification:			

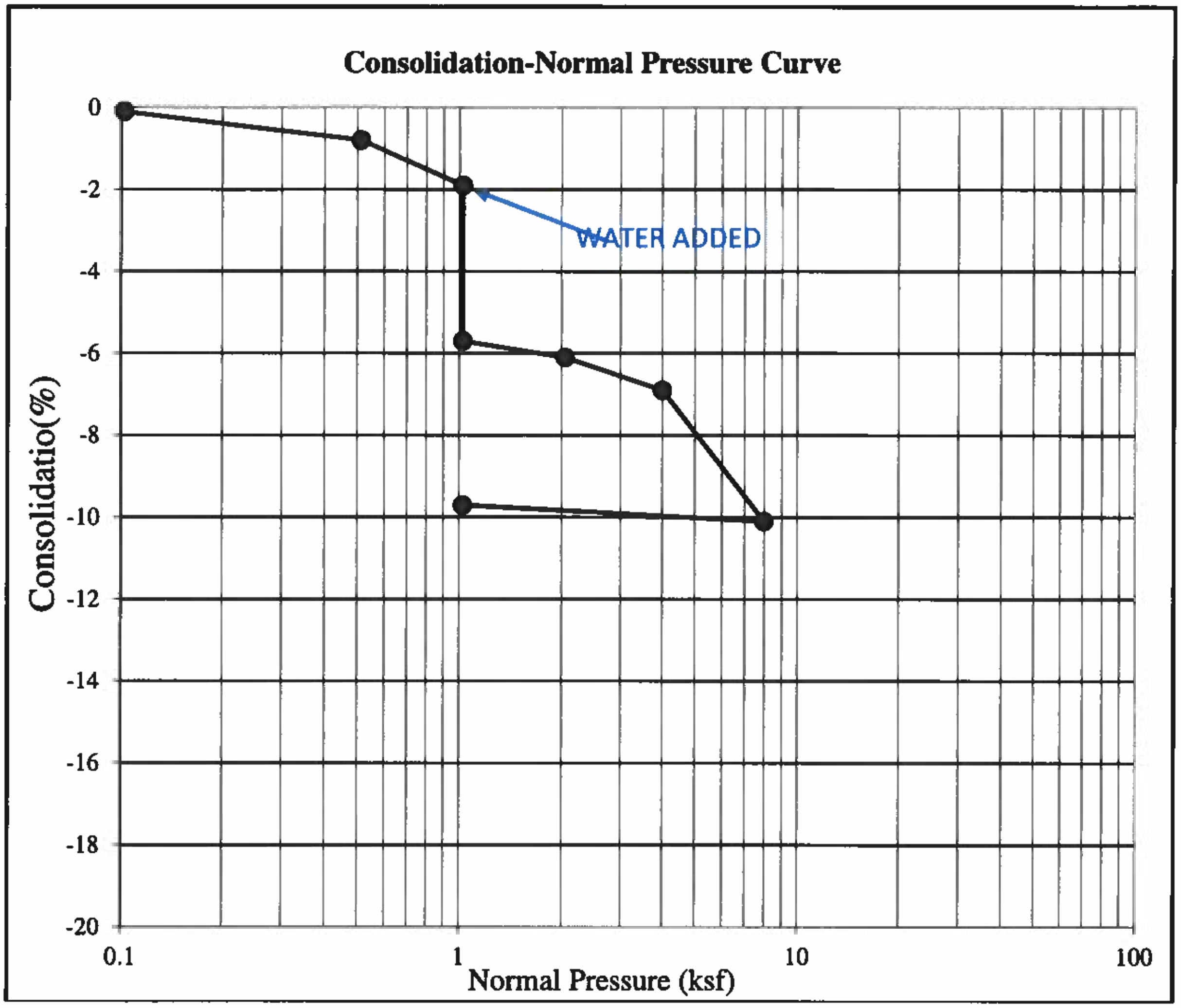
Dry Wt. of Soil + Cont. (g)	
Wt. of Container No. (g)	
Dry Wt. of Soil (g)	0.0
Weight Soil Retained on #4	
Sieve Percent Passing # 4	

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4	4
Specimen Height (in.)	1.00	1.00
Wt. Comp. Soil + Mold (g)	785.7	815.8
Wt. of Mold (g)	367.0	367.0
Specific Gravity (Assumed)	2.65	2.65
Ring Factor	0.301	0.301
Wet Wt. of Soil + Cont. (g)	204.5	203.1
Dry Wt. of Soil + Cont. (g)	198.9	192.4
Wt. of Container (g)	124.0	100.8
Moisture Content (%)	7.5	11.7
Wet Density (pcf)	126.0	135.1
Dry Density (pcf)	117.3	121.0
Degree of Saturation (%) [S_{meas}]	48.3	84.3

SPECIMENT INUNDATION in distilled water for the period of 24h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Reading (in.)
2/27/2020	3:40 PM	1		41
2/28/2020	3:50 PM	1		43

Expansion Index (EI)=(Final rdg-InitialRdg)/Initial Thick)x1000	2	**Plate: P**



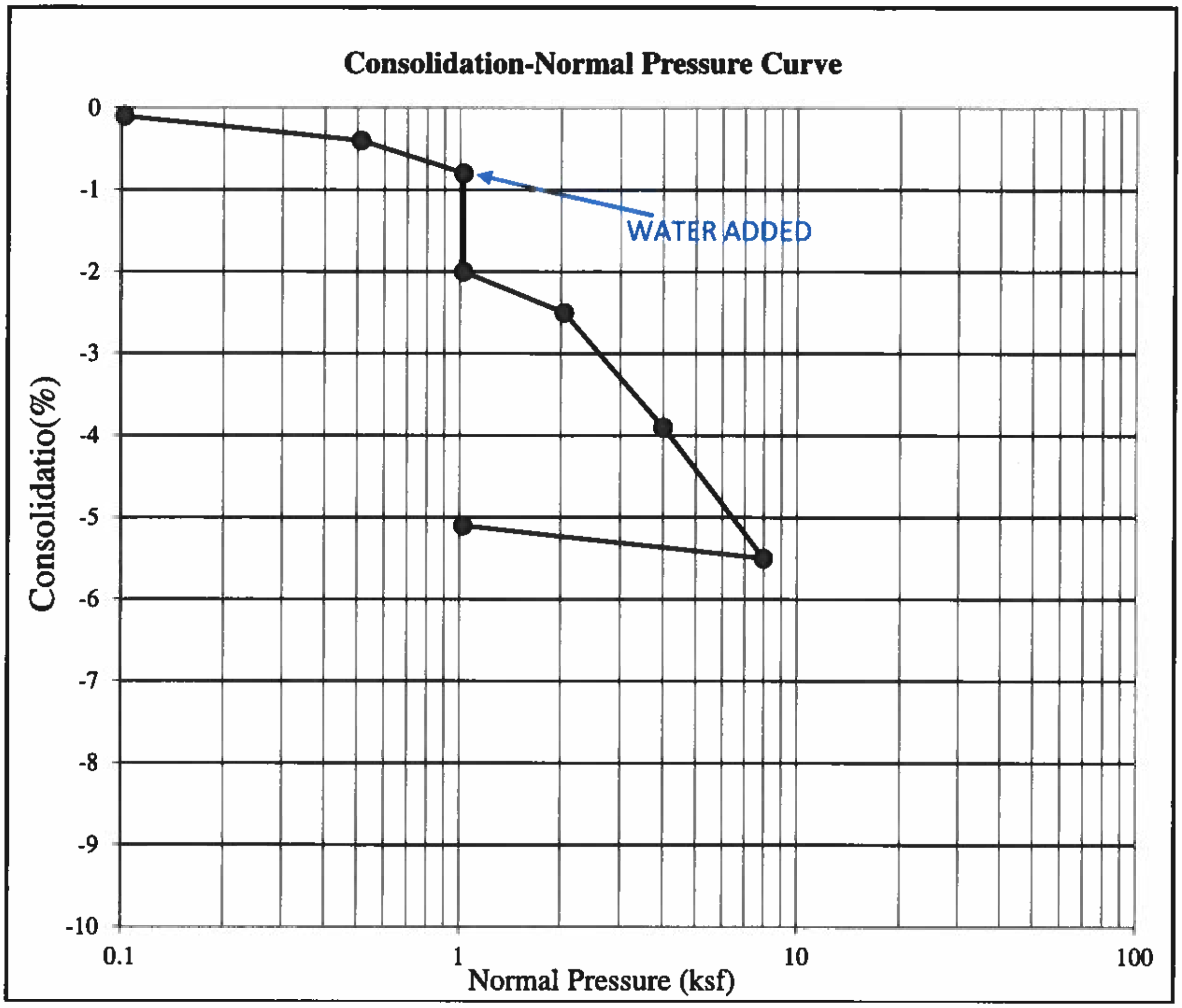
Boring Info		Before Test		After Test		Record	
Boring No.	B-4	Moisture (%)	3.92	Moisture (%)	16.03	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	179.8	Total Weight (g)	193.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	41.8	Ring Weight (g)	41.8	Start Date	3/6/2020
		Wet Density (pcf)	114.7	Wet Density (pcf)	126.1	End Date	3/9/2020

Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr & Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

Terradyne Project No: L201011 | Plate: Q



Boring Info		Before Test		After Test		Record	
Boring No.	B-7	Moisture (%)	4.42	Moisture (%)	16.50	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	185.8	Total Weight (g)	201.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	46.3	Ring Weight (g)	46.3	Start Date	3/6/2020
		Wet Density (pcf)	115.9	Wet Density (pcf)	129.0	End Date	3/9/2020

Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr &
Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

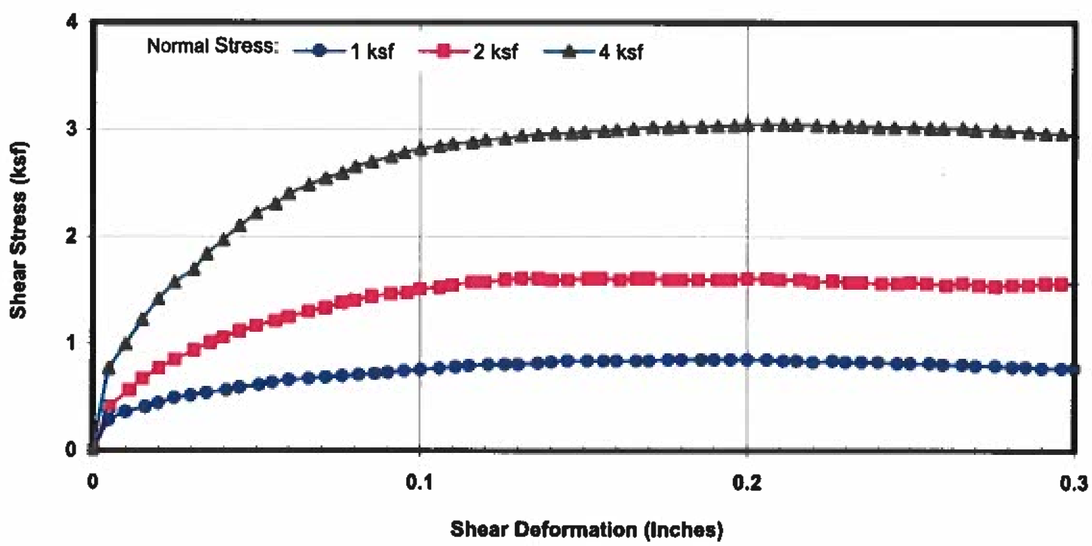
Terradyne Project No: L201011 | Plate: R

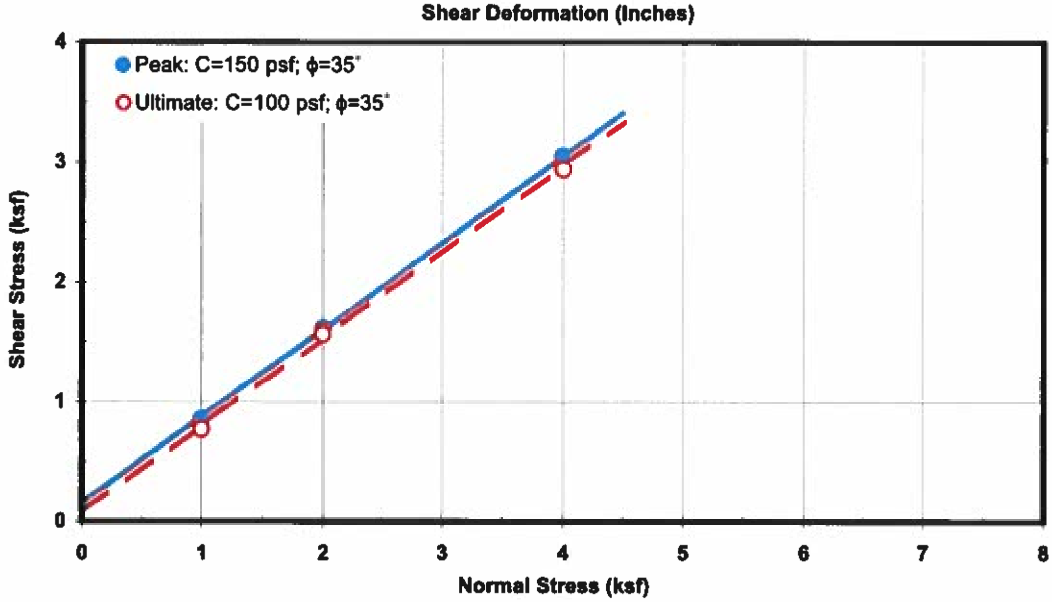
AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Client: Terradyne Engineering Inc. **Tested By:** LS **Date:** 02/28/20
Project Name: AutoZone #3658, Oak Hills, CA **Computed By:** NR **Date:** 03/03/20
Project No.: L201011 **Checked by:** AP **Date:** 03/04/20
Boring No.: B-5
Sample No.: - **Depth (ft):** 7-7.5
Sample Type: Mod. Cal.
Soil Description: Silty Sand w/gravel
Test Condition: Inundated **Shear Type:** Regular

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
111.0	107.8	2.9	18.9	14	91	1	0.852	0.768
						2	1.608	1.560
						4	3.050	2.940





APPENDIX D

ASCE 7-16 Hazards Report

ASCE 7 Hazards Report

Address:
7151 Escondido Ave
Hesperia, California
92344

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 3697.07 ft (NAVD 88)
Latitude: 34.380496
Longitude: -117.372579

AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.6	T_L :	12
F_a :	1	PGA :	0.555
F_v :	N/A	PGA_M :	0.611
S_{MS} :	1.5	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Sun Mar 08 2020

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

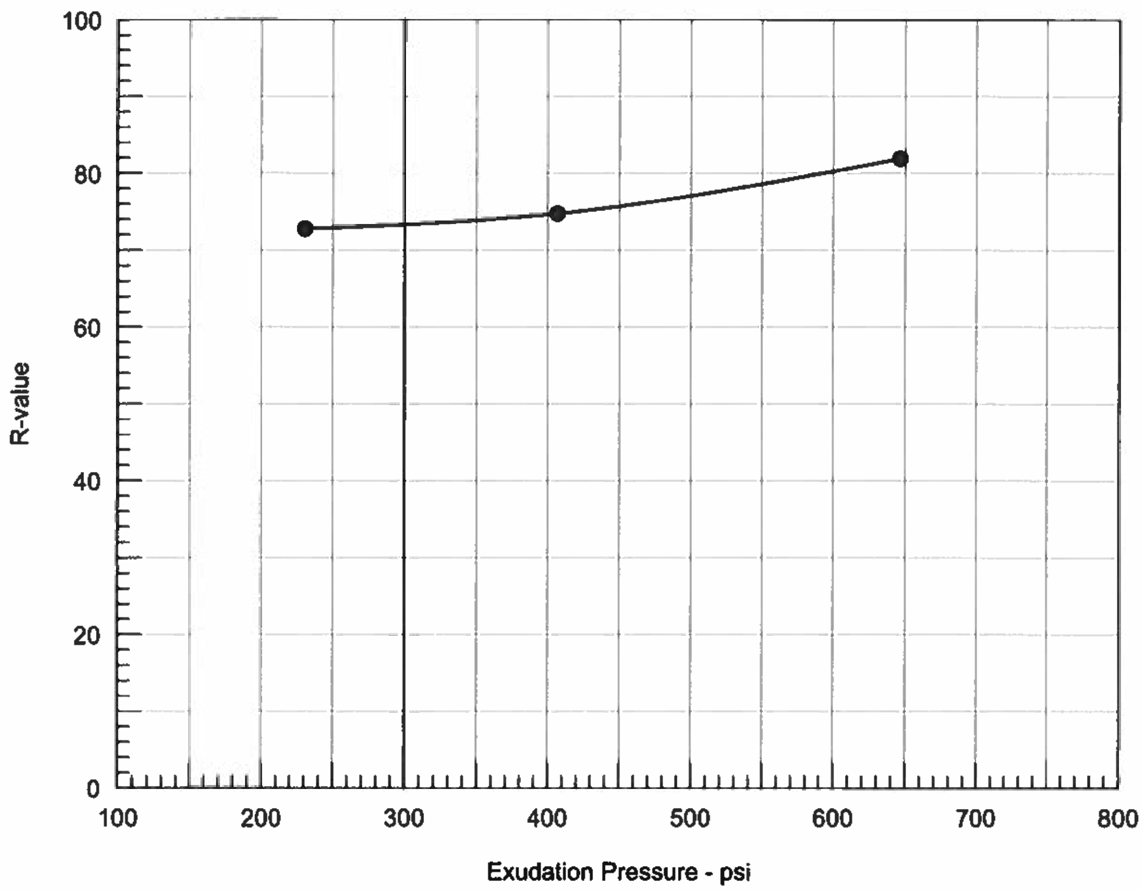
ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

APPENDIX E

Pavement Design

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	132.8	7.5	0.00	22	2.43	231	74.0	72.8
2	350	131.8	6.8	0.00	15	2.45	646	81.9	81.9
3	350	134.1	7.1	0.00	20	2.40	407	76.4	74.7

Test Results	Material Description
R-value at 300 psi exudation pressure = 73.3	MD REDDISH BRN SILTY SAND W TRACE GRAVEL

Project No.: 3842A01
Project: TERRADYNE
Location: B2 @ 0-5'
Sample Number: 192
Date: 3/2/2020

Tested by: RS
Checked by: CF
Remarks:
SAMPLED BY: CLIENT

R-VALUE TEST REPORT

MTGL, Inc.

Figure ______

Design of Pavement Section by Caltrans Method Using Traffic Index and R-Value

Lowest TI **5**
R-Value of Subgrade **73.3**
R-Value of Aggregate Base **78** (usually 78)
R-Value of Aggregate Subbase **50** (usually 50)
Gravel factor for AB from Table 663.3 **1.1** (usually 1.1)
Gravel factor for AS from Table 663.3 **1** (usually 1.0)

Project Name: **AutoZone Store#3658**
Project No.: **L201011**
Date: **3/10/2020**

Summary of Results, mm

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
hickness of dense-graded asphalt concrete (mm)	60	75	75	90	105	105	120	135	135	150	150	165	165
Thickness of Class 2 aggregate base(mm)	135	135	165	165	165	195	195	195	225	225	255	255	285
Thickness of aggregate subbase(mm)	105	105	105	105	105	105	105	105	105	105	105	105	105

Summary of Results, inches

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
Thickness of dense-graded asphalt concrete(in.)	2.5	3	3	3.5	4	4	4.5	5.5	5.5	6	6	6.5	6.5
Thickness of Class 2 aggregate base (in.)	5.5	5.5	6.5	6.5	6.5	7.5	7.5	7.5	8.5	8.5	10	10	11.5
Thickness of aggregate subbase (in.)	4	4	4	4	4	4	4	4	4	4	4	4	4

TERRADYNE
Engineers, Geologists & Environmental Scientists

Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F
Tustin, CA 92780
Office: 657-212-5800
www.terradyne.com

GEOTECHNICAL SUMMARY

SOILS

Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands

0'-16.5' Older ALLUVIUM (Qoa)
Silty SAND, light brown to brown, loose to dense, slightly moist (No groundwater encountered)

GROUNDWATER

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site.

SITE PREPARATIONS

The existing upper soils alluvial deposits soils are considered to be potentially compressible and collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of 5 feet outside the building footprint

COMPACTIONS REQUIREMENTS

The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

SLAB PREPARATION

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc, should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation."

FOUNDATIONS

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation.

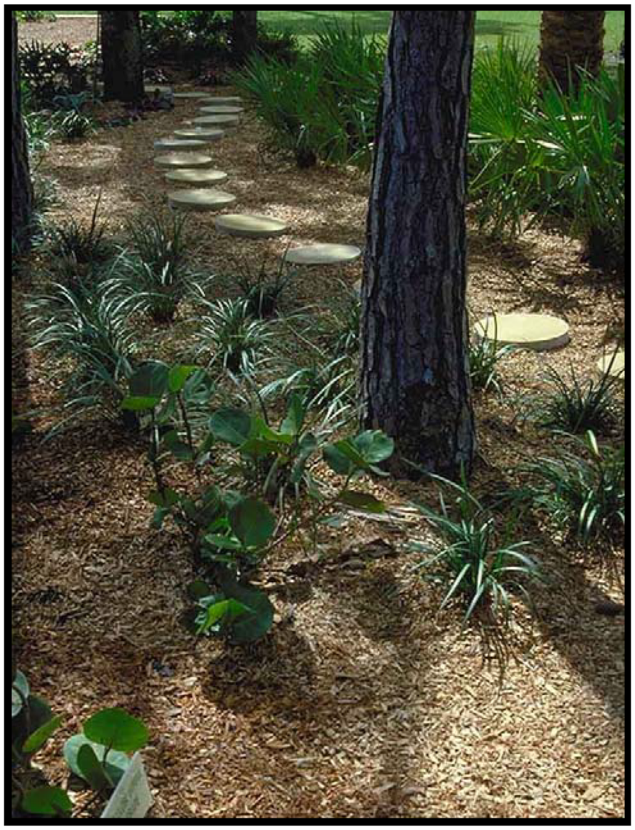
PAVEMENT DESIGN

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78

APPENDIX F

EDUCATIONAL MATERIALS



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.

- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:

  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff

  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect

  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible

  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth

- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Fueling Areas SD-30

Photo Credit: Geoff Brosseau

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

Description

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the stormwater conveyance system. Spills at vehicle and equipment fueling areas can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by stormwater treatment devices.

Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

Designing New Installations

Covering

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system. Note - If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent stormwater run-on and runoff. Grade to direct stormwater to a dead-end sump.

Surfacing

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

Grading/Contouring

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff. (Slope is required to be 2 to 4% in some jurisdictions' stormwater management and mitigation plans.)

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

- In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the stormwater conveyance system.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

☑ Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

Description
Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach
In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications
Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations
Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations
Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.

- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Vehicle Washing Areas — SD-33

Photo Credit: Geoff Brosseau

Design Objectives

- ☑ Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

Description

Vehicle washing, equipment washing, and steam cleaning may contribute high concentrations of metals, oil and grease, solvents, phosphates, and suspended solids to wash waters that drain to stormwater conveyance systems.

Approach

Project plans should include appropriately designed area(s) for washing-steam cleaning of vehicles and equipment. Depending on the size and other parameters of the wastewater facility, wash water may be conveyed to a sewer, an infiltration system, recycling system or other alternative. Pretreatment may be required for conveyance to a sanitary sewer.

Suitable Applications

Appropriate applications include commercial developments, restaurants, retail gasoline outlets, automotive repair shops and others.

Design Considerations

Design requirements for vehicle maintenance are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. Design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Areas for washing/steam cleaning should incorporate one of the following features:

- Be self-contained and/or covered with a roof or overhang
- Be equipped with a clarifier or other pretreatment facility
- Have a proper connection to a sanitary sewer

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Include other features which are comparable and equally effective

CAR WASH AREAS - Some jurisdictions' stormwater management plans include vehicle-cleaning area source control design requirements for community car wash racks in complexes with a large number of dwelling units. In these cases, wash water from the areas may be directed to the sanitary sewer, to an engineered infiltration system, or to an equally effective alternative. Pre-treatment may also be required.

Depending on the jurisdiction, developers may be directed to divert surface water runoff away from the exposed area around the wash pad (parking lot, storage areas), and wash pad itself to alternatives other than the sanitary sewer. Roofing may be required for exposed wash pads.

It is generally advisable to cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area. Sumps or drain lines can be installed to collect wash water, which may be treated for reuse or recycling, or for discharge to the sanitary sewer. Jurisdictions may require some form of pretreatment, such as a trap, for these areas.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment.

Additional Information

Maintenance Considerations

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Outdoor Material Storage Areas SD-34

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutant
- Collect and Convey

Description

Proper design of outdoor storage areas for materials reduces opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the stormwater conveyance system. Materials may be in the form of raw products, by-products, finished products, and waste products. The type of pollutants associated with the materials will vary depending on the type of commercial or industrial activity.

Approach

Outdoor storage areas require a drainage approach different from the typical infiltration/detention strategy. In outdoor storage areas, infiltration is discouraged. Containment is encouraged. Preventative measures include enclosures, secondary containment structures and impervious surfaces.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Some materials are more of a concern than others. Toxic and hazardous materials must be prevented from coming in contact with stormwater. Non-toxic or non-hazardous materials do not have to be prevented from stormwater contact. However, these materials may have toxic effects on receiving waters if allowed to be discharged with stormwater in significant quantities. Accumulated material on an impervious surface could result in significant impact on the rivers or streams that receive the runoff.

Material may be stored in a variety of ways, including bulk piles, containers, shelving, stacking, and tanks. Stormwater contamination may be prevented by eliminating the possibility of stormwater contact with the material storage areas either through diversion, cover, or capture of the stormwater. Control measures may also include minimizing the storage area. Design

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

requirements for material storage areas are governed by Building and Fire Codes, and by current City or County ordinances and zoning requirements. Control measures are site specific, and must meet local agency requirements.

Designing New Installations

Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the stormwater conveyance system, the following structural or treatment BMPS should be considered:

- Materials with the potential to contaminate stormwater should be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system, or (2) protected by secondary containment structures such as berms, dikes, or curbs.

- The storage area should be paved and sufficiently impervious to contain leaks and spills.

- The storage area should slope towards a dead-end sump to contain spills and direct runoff from downspouts/roofs should be directed away from storage areas.

- The storage area should have a roof or awning that extends beyond the storage area to minimize collection of stormwater within the secondary containment area. A manufactured storage shed may be used for small containers.

Note that the location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permits.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

STORMWATER Pollution Prevention

CONSTRUCTION

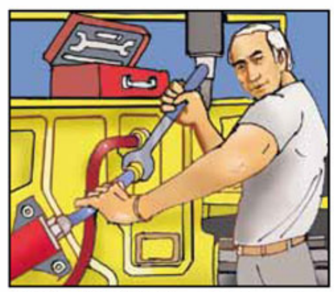
Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Store Materials Safely
Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Ordering Materials & Recycling Waste
Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.

Preventing Erosion
Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydromulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Channels can be lined with grass or roughened pavement to reduce runoff velocity.

Cleaning & Preventing Spills
Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.



Maintaining Vehicles & Equipment
Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids.

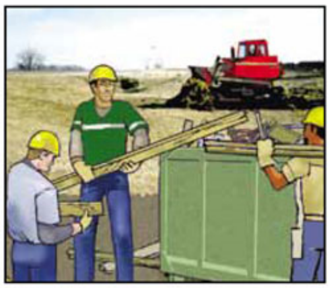
To report illegal dumping call
(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

STORMWATER
Pollution Prevention

EXCAVATION AND GRADING

Sediment, cement wash, asphalt and vehicle fluids from soil excavation and grading often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Recycling Waste

Recycle broken asphalt, concrete, wood, and cleared vegetation whenever possible. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.

Maintaining Vehicles & Equipment

Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutters and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks. Use gravel approaches where truck traffic is heavy to reduce soil compaction and limit the tracking of sediment into the street.

Cleaning & Preventing Spills

Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids. To report serious spills, call 911.

Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Preventing Erosion

Avoid excavation or grading during wet weather. Plant temporary vegetation on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff. Channels can be lined with grass or roughened pavement to reduce runoff velocity.

To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

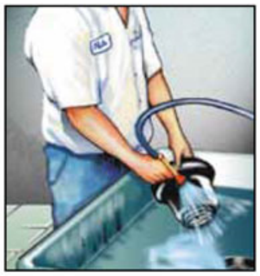
San Bernardino County STORMWATER PROGRAM

STORMWATER

Pollution Prevention

AUTO MAINTENANCE

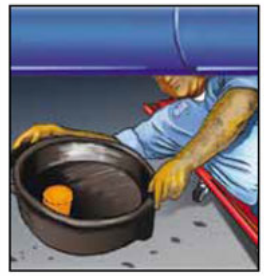
Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Cleaning Auto Parts
Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a shop sink, parking lot, driveway or street.

Storing Hazardous Waste
Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Metal Grinding and Polishing
Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation. Store metal filings in a covered container or indoors.



Preventing Leaks and Spills
Place drip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.

Cleaning Spills
Use dry methods for spill cleanup (sweeping, absorbent materials). Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase. To report serious toxic spills, call 911.

Proper Disposal of Hazardous Waste
Recycle used motor oil and oil filters, anti-freeze and other hazardous automotive fluids, batteries, tires and metal filings collected from grinding or polishing auto parts. Contact a licensed hazardous waste hauler. For more recycling information, call (909) 386-8401.

To report illegal dumping call
(877) WASTE18
sbcountystormwater.org

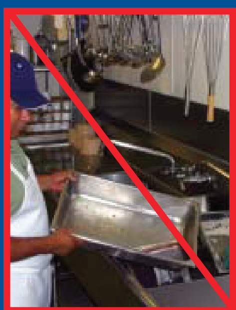
San Bernardino County STORMWATER PROGRAM

Managing FATS, OIL and GREASE

"It's Easier than YOU Think!"

THE WRONG WAY

La Forma Incorrecta



1

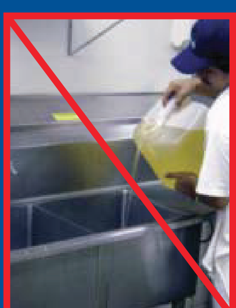
Do not pour cooking residue directly into the drain.

No vierta residuos de cocinar directamente en el desague.

2

Do not dispose of food waste into the garbage disposal.

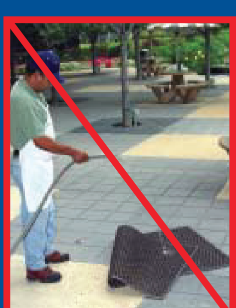
No ponga desperdicios de comida en el triturador de comida.



3

Do not pour waste oil directly into the drain.

No ponga desperdicio de aceite directamente en el desague.



4

Do not wash floor mats where water will run off directly into the storm drain.

No lave tapetes de piso en un lugar donde el agua corra hacia el desague.

THE RIGHT WAY

La Forma Correcta

1

Wipe pots, pans, and work areas prior to washing.

Limpie con una toallita las ollas, cazuelas, y areas de trabajo antes de lavarlos.

2

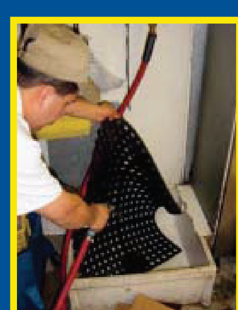
Dispose of food waste directly into the trash.

Deseche los desperdicios de comida en el bote de basura.

3

Collect waste oil and store for recycling.

Junte el desperdicio de aceite y guardelo para que sea reciclado.



4

Clean mats inside over a utility sink.

Limpie los tapetes de piso detro de un lavabo o fregador.

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

  For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- Periodically inspect, fix leaks and realign sprinkler heads.
- Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

IT'S A STORMWATER POLLUTION REVOLUTION!

Keeping your grass green and the Mojave River Watershed clean!

Excess fertilizer use is a major contributor to toxins entering the Mojave River - harming our natural wildlife and eventually making its way back to our faucets, hoses, drinking water and other waterways in the High Desert.

We need your help! Follow these simple steps when applying fertilizer to prevent stormwater pollution and protect our community from toxins:

- Read the label and use only as directed
- Avoid applying near driveways and gutters
- Never apply 24 hours before rain
- Store in a covered area in sealed, waterproof containers
- Buy non-toxic! They're just as effective and better for our watershed.

Fertilizer Chemistry 101

Fertilizers serve different purposes depending on what your lawn needs. Each bag has three percentages (N-P-K) of ingredients to meet your needs. Buy smart and apply safely to save money!

- **N** Nitrogen makes for greener grass
- **P** Phosphorus helps establish a new lawn or tree
- **K** Potassium protects plants from temperature extremes, insects, and disease

To report illegal dumping or for more information on stormwater pollution prevention call 1 (800) 78 CRIME or visit our website at www.mojaveriver.org, Facebook at MojaveWatershed, Twitter @MojaveRiver, or Pinterest at Mojave Watershed.

Disposal Centers

Apple Valley
13450 Nomwaket Road

Hesperia Fire Station
17443 Lemon Street

Victorville Fire Department
East of Desert Knoll Drive
on Loves Lane

Barstow Corporation Yard
900 South Avenue H

San Bernardino County
2824 East W Street
San Bernardino, CA

Don't Get Turned Away!

For hours of operation, quantity limitations and other rules and regulations, call (800) 645-9228 or visit the MRWG website at www.mojaveriver.org before dropping off materials.

COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

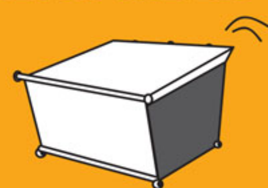
Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE

Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT

- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ **SWEEP FREQUENTLY**
Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ **FIX LEAKS**
Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ **CONSTRUCT ROOF**
Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

San Bernardino County STORMWATER PROGRAM

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

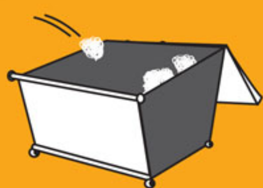
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

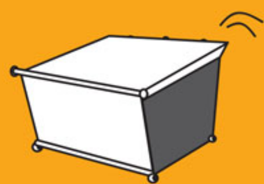
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT

- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ **SWEEP FREQUENTLY**
Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ **FIX LEAKS**
Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ **CONSTRUCT ROOF**
Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

San Bernardino County STORMWATER PROGRAM

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

STORMWATER

Pollution Prevention

ROADWORK AND PAVING

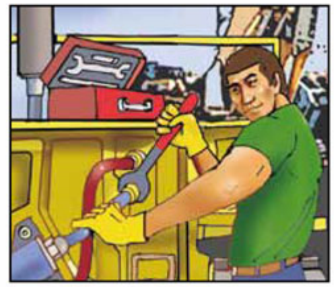
Asphalt, saw-cut slurry and excavated materials from road paving, surfacing and pavement removal often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Preventing Erosion

Schedule excavation and grading work during dry weather. Develop and implement erosion and sediment control plans for excavated embankments. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

During Construction

Cover catch basins and maintenance holes when applying seal coat, slurry seal or fog seal. Use check dams, ditches or berms around excavations, and avoid over applying water for dust control. Never wash excess materials from exposed aggregate or concrete into the street, gutter or a storm drain.



Maintaining Vehicles & Equipment

Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids.

Asphalt & Concrete Removal

Barricade storm drain openings during saw-cutting, and recycle broken up pavement at a crushing company. For recycling information, call (909) 386-8401.

Cleaning & Preventing Spills

Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Sweep up dry spills, instead of hosing. Prevent spills from paver machines by using drip pans, or by placing absorbent materials like cloths or rags under the machines when not in use. To report serious spills, call 911.

To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER MEETS COMMUNITY

Automotive Services

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Storing Hazardous Waste:** Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials undercover with spill containment or inside to prevent contamination of rainwater runoff.
- **Proper Disposal of Hazardous Waste:** Recycle used motor oil and oil filters, anti-freeze and other hazardous automotive fluids, batteries, tires and metal filings collected from grinding polishing auto parts. Contact a licensed hazardous waste hauler. For more recycling information, call (909) 382-5401.
- **Cleaning Auto Parts:** Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the sink or the fluid holding tank. Do not wash parts or equipment in a parking lot, driveway or street.
- **Preventing Leaks and Spills:** Place chip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.
- **Metal Grinding & Polishing:** Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation. Store metal filings in a covered container or indoors.
- **Cleaning Spills:** Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase of the plan. Use dry methods for spill cleanup (sweeping, absorbent materials, etc.). To report serious spills, call 911.
- **Washing Vehicles:** Wash vehicles where the wash water can soak into grass, gravel or be diverted to nearby landscaping, away from the street and storm drains. Wash vehicles at a designated wash rack that is connected to the sanitary sewer or take vehicles to a professional car wash. Use soaps, cleaners and detergents that are labeled phosphate free or biodegradable. The safest products for the environment are vegetable-based or citrus-based soaps.

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Commercial landscape maintenance:

Yard waste, sediments and toxic lawn and garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at www.ciwmb.ca.gov/Organics.
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.
- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.
- **Store Materials Safely:** Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials should be covered with plastic sheeting to protect from rain, wind and runoff.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

STORMWATER Pollution Prevention

FRESH CONCRETE & MORTAR APPLICATION

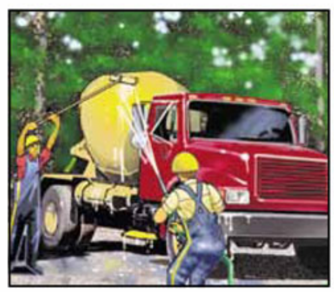
Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Storing Materials
Keep construction materials and debris away from the street, gutter and storm drains. Secure open bags of cement and cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.

Ordering Materials & Recycling Waste
Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. When breaking up paving, recycle the pieces at a crushing company. You can also recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. Call (909) 386-8401 for recycling and disposal information.

During Construction
Schedule excavation and grading during dry weather. Prevent mortar and cement from entering the street and storm drains by placing erosion controls. Setup small mixers on tarps or drop cloths, for easy cleanup of debris. Never bury waste material. Recycle or dispose of it as hazardous waste.

Cleaning Up
Wash concrete dust onto designated dirt areas, not down driveways or into the street or storm drains. Wash out concrete mixers and equipment in specified washout areas, where water can flow into a containment pond. Cement washwater can be recycled by pumping it back into cement mixers for reuse. Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.



To report illegal dumping call
(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Construction & development:

Soil, cement wash, asphalt, oil and other hazardous debris from construction sites often make their way into the San Bernardino County storm drain system, and flow untreated into local waterways. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.

- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

APPENDIX G

303D LIST

Final California 2014 and 2016 Integrated Report (303(d) List/305(b) Report)

Supporting Information

Regional Board 6 - Lahontan Region

Water Body Name:	**Silverwood Reservoir**
Water Body ID:	**CAL6282000020000220163918**
Water Body Type:	**Lake & Reservoir**

DECISION ID 38114 Region 6

Silverwood Reservoir

Pollutant:	**Aldrin**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One linesof evidence is available in the administrative record to assess this pollutant. Zero exceed the water quality objective.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of one samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 38114, Aldrin **Region 6**

Silverwood Reservoir

LOE ID:	45686
Pollutant:	Aldrin

LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Cold Freshwater Habitat
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Aldrin. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum Aldrin concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **38485** **Region 6**

Silverwood Reservoir

Pollutant: **Chlordane**
Final Listing Decision: **Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision: Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status Original
Impairment from Pollutant or Pollution: Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

Two lines of evidence are available in the administrative record to assess this pollutant. One sample was collected and used to evaluate compliance with COLD and COMM beneficial uses. The sample concentration did not exceed the water quality objective/guidelines established for the protection of bioaccumulation in the organism and for consumption of fish.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. The single sample did not exceed the criteria and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 38485, Chlordane **Region 6**

Silverwood Reservoir

LOE ID: 45684

Pollutant: Chlordane
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Cold Freshwater Habitat

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis

Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Chlordane, Total. Two sample composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total chlordane was calculated as the sum of the following chlordane isomers: cis- and trans-chlordane, cis- and trans-nonachlor, and oxychlordane.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum total Chlordane concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 38485, Chlordane **Region 6**

Silverwood Reservoir

LOE ID:	45689
Pollutant:	Chlordane
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue

Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Chlordane, Total. Two sample composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total chlordane was calculated as the sum of the following chlordane isomers: cis- and trans-chlordane, cis- and trans-nonachlor, and oxychlordane.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Water Quality Control Plan, Lahontan Region: Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life.
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for total chlordane in fish tissue is 3.9 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	

Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **38404** **Region 6**

Silverwood Reservoir

Pollutant:	**Dieldrin**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

Two lines of evidence are available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective. For the benficial use of COMM, thsi line of evidence was not used since the fish did not meet the size requirements for proepr evaluation.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of one (COLD)/zero (COMM) samples exceeded the criteria and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 38404, Dieldrin **Region 6**

Silverwood Reservoir

LOE ID:	45698
Pollutant:	Dieldrin
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	0

Number of Exceedances: 0

Data and Information Type: Fish tissue analysis

Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 0 samples exceed the criterion for Dieldrin. Two composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). The composites were not used in the assessment because the laboratory data reporting limit(s) was above the objective and therefore the results could not be quantified with the level of certainty required by the Listing Policy.

Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion: Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)

Objective/Criterion Reference: Water Quality Control Plan for the Lahontan Region (as amended)

Evaluation Guideline: The modified OEHHA Fish Contaminant Goal for dieldrin in fish tissue is 0.32 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.

Guideline Reference: Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene

Spatial Representation: Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).

Temporal Representation: Data was collected on a single day 8/20/2007.

Environmental Conditions: Staff is not aware of any special conditions that might affect interpretation of the data.

QAPP Information: Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).

QAPP Information Reference(s): Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 38404, Dieldrin **Region 6**

Silverwood Reservoir

LOE ID:	45697
Pollutant:	Dieldrin
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Cold Freshwater Habitat
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Dieldrin. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum Dieldrin concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.

QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **42929** **Region 6**

Silverwood Reservoir

Pollutant:	**Endrin**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence is available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective for the benficial uses of COMM/COLD.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of 1samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 42929, Endrin **Region 6**

Silverwood Reservoir

LOE ID:	45676
Pollutant:	Endrin
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis

Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Endrin. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).

Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion: Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)

Objective/Criterion Reference: Water Quality Control Plan for the Lahontan Region (as amended)

Evaluation Guideline: The modified OEHHA Fish Contaminant Goal for endrin in fish tissue is 660 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day. A cooking reduction factor of 1 is applied for skin-off fillets.

Guideline Reference: Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene
Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories Volume 1: Fish Sampling and Analysis

Spatial Representation: Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).

Temporal Representation: Data was collected on a single day 8/20/2007.

Environmental Conditions: Staff is not aware of any special conditions that might affect interpretation of the data.

QAPP Information: Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).

QAPP Information Reference(s): Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 42929, Endrin **Region 6**

Silverwood Reservoir

LOE ID:	45675
Pollutant:	Endrin
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Cold Freshwater Habitat
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Endrin. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum Endrin concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	

	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **42440** **Region 6**

Silverwood Reservoir

Pollutant:	**Heptachlor**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence is available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of one samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 42440, Heptachlor **Region 6**

Silverwood Reservoir

LOE ID:	45688
Pollutant:	Heptachlor
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet

Beneficial Use:	Cold Freshwater Habitat
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Heptachlor. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum Heptachlor concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Silverwood Reservoir

Pollutant:	**Heptachlor epoxide**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence is available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective. For the COMM beneficial use, the laboratory reporting limits were above the objective and so the the data was not used.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of zero (COMM)/one (COLD) samples exceeded the guidelines and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 42894, Heptachlor epoxide **Region 6**

Silverwood Reservoir

LOE ID:	45694
Pollutant:	Heptachlor epoxide
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	0
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 0 samples exceed the criterion for Heptachlor epoxide. Two composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish

	from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). The composites were not used in the assessment because the laboratory data reporting limit(s) was above the objective and therefore the results could not be quantified with the level of certainty required by the Listing Policy.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for heptachlor epoxide in fish tissue is 0.93 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene Public Health Goal for Heptachlor and Heptachlor Epoxide in Drinking Water
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 42894, Heptachlor epoxide **Region 6**

Silverwood Reservoir

LOE ID:	45693
Pollutant:	Heptachlor epoxide
LOE Subgroup:	Pollutant-Tissue

Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Cold Freshwater Habitat

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Heptachlor epoxide. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion: Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference: Water Quality Control Plan for the Lahontan Region (as amended)

Evaluation Guideline: National Academy of Science guidelines (NAS 1972) establish a maximum Heptachlor Epoxide concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference: National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency

Spatial Representation: Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation: Data was collected on a single day 8/20/2007.
Environmental Conditions: Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information: Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s): Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **42441** **Region 6**

Silverwood Reservoir

Pollutant:	**Hexachlorobenzene/ HCB**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence ais available in the administrative record to assess this pollutant.Zero of the samples exceed the water quality objective.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of 1 samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 42441, Hexachlorobenzene/ HCB **Region 6**

Silverwood Reservoir

LOE ID:	45681
Pollutant:	Hexachlorobenzene/ HCB
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Hexachlorobenzene. The 1 sample for largemouth bass consisted

	of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for hexachlorobenzene in fish tissue is 2.8 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene Air Toxics Hotspots Program Risk Assessment Guidelines. Part II Technical Support Document for Describing Available Cancer Potency Values.
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **46586** **Region 6**

Silverwood Reservoir

Pollutant: **Lindane/gamma Hexachlorocyclohexane (gamma-HCH)**
Final Listing Decision: **Do Not List on 303(d) list (TMDL required list)**

Last Listing Cycle's Final Listing Decision: Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status Original
Impairment from Pollutant or Pollution: Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

Two lines of evidence are available in the administrative record to assess this pollutant. One sample was collected to evaluate protection of the COLD and COMM beneficial use. The single sample did not exceed the water quality objective/guidelines for protection of bioaccumulation in fish and consumption of contaminated fish tissue.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of one sample exceeded the guideline for protection of the organism from bioaccumulation and for consumption of fish and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 46586, Lindane/gamma Hexachlorocyclohexane (gamma-HCH) **Region 6**

Silverwood Reservoir

LOE ID: 45682

Pollutant: Lindane/gamma Hexachlorocyclohexane (gamma-HCH)
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Cold Freshwater Habitat

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for HCH, gamma. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs:

	Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum Lindane concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 46586, Lindane/gamma Hexachlorocyclohexane (gamma-HCH) **Region 6**

Silverwood Reservoir

LOE ID:	45687
Pollutant:	Lindane/gamma Hexachlorocyclohexane (gamma-HCH)
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1

Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for HCH, gamma. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for lindane in fish tissue is 4.6 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene Air Toxics Hotspots Program Risk Assessment Guidelines. Part II Technical Support Document for Describing Available Cancer Potency Values.
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID	**37786**	**Region 6**
Silverwood Reservoir		

Pollutant: **Mirex**
Final Listing Decision: **Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision: Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status Original
Impairment from Pollutant or Pollution: Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

Zero lines of evidence are available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of zero samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 37786, Mirex **Region 6**

Silverwood Reservoir

LOE ID: 45700

Pollutant: Mirex
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Commercial or recreational collection of fish, shellfish, or organisms

Number of Samples: 0
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 0 samples exceed the criterion for Mirex. Two composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found

	in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). The composites were not used in the assessment because the laboratory data reporting limit(s) was above the objective and therefore the results could not be quantified with the level of certainty required by the Listing Policy.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for mirex in fish tissue is 0.28 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene Expedited Cancer Potency Values and Proposed Regulatory Levels for Certain Proposition 65 Carcinogens.
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **37787** **Region 6**

Silverwood Reservoir

Pollutant: **Selenium**
Final Listing Decision: **Do Not List on 303(d) list (TMDL required list)**

Last Listing Cycle's Final Listing Decision: Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status Original
Impairment from Pollutant or Pollution: Pollutant

Regional Board Conclusion: This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence is available in the administrative record to assess this pollutant. Zero of the samples exceed the water quality objective.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero of one samples exceeded the guideline and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 37787, Selenium **Region 6**

Silverwood Reservoir

LOE ID: 45683

Pollutant: Selenium
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Commercial or recreational collection of fish, shellfish, or organisms

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Selenium. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water

	Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Water Quality Control Plan, Lahontan Region: All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The OEHHA Fish Contaminant Goal for selenium in fish tissue is 7.4 ppm. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day. A background dietary consumption rate of 0.114 mg/day is applied for this micronutrient.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. One sample was collected from 1 location. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **43563** **Region 6**

Silverwood Reservoir

Pollutant:	**Total DDT (sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD)**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant
Regional Board Conclusion:	This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status. One line of evidence is available in the administrative record for both COMM and COLD to assess this pollutant. Zero of the samples exceed the water quality objective for either

benficial use.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero (COMM)/zero (COLD) of 1 samples exceeded the guideline/criteria and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 43563, Total DDT (sum of 4,4'- and 2,4'-isomers of DDT, DDE, and DDD) **Region 6**

Silverwood Reservoir

LOE ID: 45691

Pollutant: Total DDT (sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD)
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Cold Freshwater Habitat

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for DDT, Total. Two sample composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total DDT was calculated as the sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD.
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum total DDT concentration of 1000 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 43563, Total DDT (sum of 4,4'- and 2,4'-isomers of DDT, DDE, and DDD) **Region 6**

Silverwood Reservoir

LOE ID:	45692
Pollutant:	Total DDT (sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD)
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for DDT, Total. Two sample composites (5 fish per composite) were generated from one species: largemouth bass. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total DDT was calculated as the sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA

	Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Water Quality Control Plan, Lahontan Region: Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life.
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for total DDT in fish tissue is 15 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **37663** **Region 6**

Silverwood Reservoir

Pollutant:	**alpha-Endosulfan (Endosulfan 1)**
Final Listing Decision:	**Do Not List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	Do Not List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Impairment from Pollutant or Pollution:	Pollutant
Regional Board Conclusion:	This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status. One line of evidence is available in the administrative record for COLD and COMM beneficial uses to assess this pollutant. Zero of the samples exceed the water quality

objective for either beneficial use.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification against placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category.

This conclusion is based on the staff findings that:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. Zero (COMM)/Zero (COLD) of 1 samples exceeded the guideline/criteria and this does not exceed the allowable frequency listed in Table 3.1 of the Listing Policy.
4. Pursuant to section 3.11 of the Listing Policy, no additional data and information are available indicating that standards are not met.

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 37663, alpha-Endosulfan (Endosulfan 1) **Region 6**

Silverwood Reservoir

LOE ID: 45703

Pollutant: alpha-Endosulfan (Endosulfan 1)
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Cold Freshwater Habitat

Number of Samples: 1
Number of Exceedances: 0

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Endosulfan I. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum total Endosulfan concentration of 100 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 37663, alpha-Endosulfan (Endosulfan 1) **Region 6**

Silverwood Reservoir

LOE ID:	45704
Pollutant:	alpha-Endosulfan (Endosulfan 1)
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for Endosulfan I. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA

	Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Pesticide concentrations, individually or collectively, shall not exceed the lowest detectable levels, using the most recent detection procedures available. There shall not be an increase in pesticide concentrations found in bottom sediments. There shall be no detectable increase in bioaccumulation of pesticides in aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The modified OEHHA Fish Contaminant Goal for endosulfan (I and II) in fish tissue is 13,000 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories Volume 1: Fish Sampling and Analysis
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **40708** **Region 6**

Silverwood Reservoir

Pollutant:	**Mercury**
Final Listing Decision:	**List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Sources:	Source Unknown
Expected TMDL Completion Date:	2025
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.11 of the Listing Policy. Under this section when all other listing factors do not result in the listing of a water segment but information indicates non-attainment of standards, a water segment shall be evaluated to determine whether the weight of evidence demonstrates the water quality standard is not attained. If the weight of evidence indicates non-attainment, the water segment shall be placed on the section 303(d) list.

Two lines of evidence, are available in the administrative record to assess mercury concentrations in fish fillets. LOE # 45699 average fish tissue samples collected at a single site on the same day according to section 6.1.5 of the Listing Policy. One exceedance of one sample is not sufficient to support a listing based upon Section 3.1 of the Listing Policy.

Though the samples were collected from a single location on a single day, fish move throughout a lake and accumulate mercury in tissue over time. Therefore, spatial and temporal independence does not apply. A second line of evidence (LOE # 47544) presents total wet-weight mercury concentrations from fifteen individual largemouth bass. Assessing these data according to Table 3.1 would be sufficient to support a listing.

Based on the readily available data and information, the weight of evidence indicates there is sufficient justification for placing this water segment-pollutant combination on the Section 303(d) list.

This conclusion is based on the following:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. There is fifteen exceedances of fifteen sample associated with LOE 47544 and additional data used to support the health advisory, and this exceeds the allowable frequency listed in Table 3.1 of the Listing Policy.
4. The Office of Environmental Health Hazard Assessment (OEHHA) has issued a health advisory and guidelines for eating fish from Silverwood Lake due to high levels of mercury and PCBs. Refer to fish tissue info and resources for the Lahontan Region at: http://www.waterboards.ca.gov/lahontan/water_issues/programs/swamp/index.shtml for a summary of the advisory and the background information (including associated sample results) and a description of how the guidelines were developed. Pursuant to section 3.4 of the Listing Policy, "a water segment shall be placed on the section 303(d) list if a health advisory against the consumption of edible resident organisms, has been issued by OEHHA or DHS."

5. The process is scientifically defensible and reproducible.

Regional Board Decision Recommendation:

This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation:

After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 40708, Mercury **Region 6**

Silverwood Reservoir

LOE ID: 47544

Pollutant: Mercury
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Commercial or recreational collection of fish, shellfish, or organisms

Number of Samples: 15
Number of Exceedances: 15

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 15 of 15 samples exceed the criterion for Mercury. Sixteen composites (1 fish per composite) were generated from one species (largemouth bass). One composite sample could not be used in the assessment due to a total fish length that did not fall within lengths noted in the guideline. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion: Water Quality Control Plan, Lahontan Region: All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Objective/Criterion Reference: Water Quality Control Plan for the Lahontan Region (as amended)

Evaluation Guideline: The USEPA 304(a) recommended water quality criterion for concentrations of methylmercury in fish tissue of trophic level 4 fish (150 - 500 mm; fillet wet weight) is 0.2 mg/kg. Total mercury is usually analyzed for most fish studies and assumed to be 100 percent methylmercury for the purposes of risk assessment (Klasing & Brodberg 2008). The fish consumption rate of 32 g/day is considered more protective of human health since recommendations are now to eat one meal per week of fish to obtain necessary Omega-3 nutrition. The fish consumption rate of 32 g/day is also protective of wildlife, as it protects 6 out of 7 endangered species.
Guideline Reference: Water Quality Criterion for the Protection of Human Health: Methylmercury. Final. United States Environmental Protection Agency Office of Science and Technology Office of Water. EPA-823-R-01-001. January 2001

Spatial Representation: Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 1 location. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation: Data was collected on a single day 8/20/2007.
Environmental Conditions: Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information: Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):

	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 40708, Mercury **Region 6**

Silverwood Reservoir

LOE ID:	45699
Pollutant:	Mercury
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Commercial or recreational collection of fish, shellfish, or organisms
Number of Samples:	1
Number of Exceedances:	1
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 1 of 1 samples exceed the criterion for Mercury. Sixteen composites (1 fish per composite) were generated from one species (largemouth bass) and were averaged. One composite sample could not be used in the assessment due to a total fish length that did not fall within lengths noted in the guideline. The results of the composites collected on the same day were averaged, per USEPA 2001, resulting in a total of one sample and one exceedance. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009).
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP
Water Quality Objective/Criterion:	Water Quality Control Plan, Lahontan Region: All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	The USEPA 304(a) recommended water quality criterion for concentrations of methylmercury in fish tissue of trophic level 4 fish (150 - 500 mm; fillet wet weight) is 0.20 mg/kg. Total mercury is usually analyzed for most fish studies and assumed to be 100 percent methylmercury for the purposes of risk assessment (Klasing & Brodberg 2008).
Guideline Reference:	Water Quality Criterion for the Protection of Human Health: Methylmercury. Final. United States Environmental Protection Agency Office of Science and Technology Office of Water. EPA-823-R-01-001. January 2001
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Samples were collected from 1 location. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per

	waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

DECISION ID **42987** **Region 6**

Silverwood Reservoir

Pollutant:	**PCBs (Polychlorinated biphenyls)**
Final Listing Decision:	**List on 303(d) list (TMDL required list)**
Last Listing Cycle's Final Listing Decision:	List on 303(d) list (TMDL required list)(2012)
Revision Status	Original
Sources:	Source Unknown
Expected TMDL Completion Date:	2025
Impairment from Pollutant or Pollution:	Pollutant

Regional Board Conclusion:

This pollutant is being considered for placement on the section 303(d) list under section 3.1 of the Listing Policy. Under section 3.1 a single line of evidence is necessary to assess listing status.

One line of evidence is available in the administrative record to assess this pollutant. One sample exceeds the water quality objective. This line of evidence is from data collected as part of the SWAMP Bioaccumulation Oversight Group study. The information in this study prompted an additional study, specific to Silverwood Lake in 2011. The information in the subsequent study provided the information to submit to the Office of Environmental Health Hazard Assessment to issue a fish consumption advisory in August of 2013 for Silverwood Lake based on elevated levels of mercury and PCBs.

Based on the readily available data and information, the weight of evidence indicates that there is sufficient justification in favor of placing this water segment-pollutant combination on the section 303(d) list in the Water Quality Limited Segments category. With OEHHA releasing a fish consumption advisory, listing is based on Secion 3.4 of the Listing Policy.

This conclusion is based on the following:
1. The data used satisfies the data quality requirements of section 6.1.4 of the Policy.
2. The data used satisfies the data quantity requirements of section 6.1.5 of the Policy.
3. There is one exceedance of one sample associated with LOE 45678 for COMM beneficial use and the additional data used to support the health advisory, and this exceeds the allowable frequency listed in Table 3.1 of the Listing Policy.
4. The Office of Environmental Health Hazard Assessment (OEHHA) has issued a health advisory and guidelines for eating fish from Silverwood Lake due to high levels of mercury and PCBs. Refer to fish tissue info and resources for the Lahontan Region at: http://www.waterboards.ca.gov/lahontan/water_issues/programs/swamp/index.shtml for a summary of the advisory and the background information (including associated sample results) and a description of how the guidelines were developed. Pursuant to section 3.4 of the Listing Policy, "a water segment shall be placed on the section 303(d) list if a health advisory against the consumption of edible resident organisms, has been issued by OEHHA or DHS."

Regional Board Decision Recommendation: This region was not assessed this cycle. All decisions have been carried over from the previous cycle and remain the same.

State Board Review of Regional Board Conclusion and Recommendation:

State Board Decision Recommendation: After review of this Regional Board decision, SWRCB staff recommend the decision be approved by the State Board.

Line of Evidence (LOE) for Decision ID 42987, PCBs (Polychlorinated biphenyls) **Region 6**

Silverwood Reservoir

LOE ID: 45678

Pollutant: PCBs (Polychlorinated biphenyls)
LOE Subgroup: Pollutant-Tissue
Matrix: Tissue
Fraction: Fish fillet

Beneficial Use: Commercial or recreational collection of fish, shellfish, or organisms

Number of Samples: 1
Number of Exceedances: 1

Data and Information Type: Fish tissue analysis
Data Used to Assess Water Quality: Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 1 of 1 samples exceed the criterion for PCB, Total. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total PCB was assessed for as follows: PCB aroclors and congeners were summed separately and the sum that yielded the highest value was used for the assessment.
Data Reference: Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA
Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008
Statewide Lakes Sportfish Contamination Study 2007 2008
Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey

SWAMP Data: SWAMP

Water Quality Objective/Criterion: Water Quality Control Plan, Lahontan Region: All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Objective/Criterion Reference: Water Quality Control Plan for the Lahontan Region (as amended)

Evaluation Guideline: The modified OEHHA Fish Contaminant Goal for polychlorinated biphenyls in fish tissue is 2.6 ppb. This screening level assumes an average body weight of 70 kg and a consumption rate of 32 g/day for a 30 year exposure over a 70-year lifetime. This constituent is a carcinogen therefore the risk level is set to one in a million. A cooking reduction factor of 1 is applied for skin-off fillets.
Guideline Reference:

	Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

Line of Evidence (LOE) for Decision ID 42987, PCBs (Polychlorinated biphenyls) **Region 6**

Silverwood Reservoir

LOE ID:	45677
Pollutant:	PCBs (Polychlorinated biphenyls)
LOE Subgroup:	Pollutant-Tissue
Matrix:	Tissue
Fraction:	Fish fillet
Beneficial Use:	Cold Freshwater Habitat
Number of Samples:	1
Number of Exceedances:	0
Data and Information Type:	Fish tissue analysis
Data Used to Assess Water Quality:	Water Board staff assessed SWAMP data for Silverwood Lake to determine beneficial use support and results are as follows: 0 of 1 samples exceed the criterion for PCB, Total. The 1 sample for largemouth bass consisted of 2 composites (5 fish per composite) that were not independent and so were averaged. Details of the compositing protocol can be found in the March 2009 report entitled: "Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Study" (SWAMP, 2009). Total PCB was assessed for as follows: PCB aroclors and congeners were summed separately and the sum that yielded the highest value was used for the assessment.
Data Reference:	Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008 Statewide Lakes Sportfish Contamination Study 2007 2008 Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey
SWAMP Data:	SWAMP

Water Quality Objective/Criterion:	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. (Water Quality Control Plan, Lahontan Region)
Objective/Criterion Reference:	Water Quality Control Plan for the Lahontan Region (as amended)
Evaluation Guideline:	National Academy of Science guidelines (NAS 1972) establish a maximum total PCB concentration of 500 ug/Kg (wet weight) in tissue samples for protection of aquatic life from bioaccumulation of toxic substances.
Guideline Reference:	National Academy of Sciences. Water Quality Criteria 1972. EPA-R3-73-033. Washington, D.C.: U.S. Environmental Protection Agency
Spatial Representation:	Data for this line of evidence for Silverwood Lake was collected at 1 monitoring site [Silverwood Lake - 628PSW035]. Two samples were collected from 2 locations. Individual sample locations consisted of an area within a given waterbody from which fish tissue samples were collected. The number of sample locations per waterbody was based on the overall size of the waterbody (SWAMP, 2010). Specifics of individual sampling locations can be found in the supplemental report entitled "Cruise Report for the Surface Waters Ambient Monitoring Program (SWAMP) Bioaccumulation Screening Study in California Lakes and Reservoirs, Sampling Dates: June 2007- March 2008" (SWAMP, 2008).
Temporal Representation:	Data was collected on a single day 8/20/2007.
Environmental Conditions:	Staff is not aware of any special conditions that might affect interpretation of the data.
QAPP Information:	Samples were collected, processed, and analyzed in accordance with the methods described in Quality Assurance Project Plan "Screening Study of Bioaccumulation in California Lakes and Reservoirs." (SWAMP, 2008).
QAPP Information Reference(s):	Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments

APPENDIX H

O&M PLAN

RECORDING REQUESTED BY:
County of San Bernardino
Department of Public Works

AND WHEN RECORDED MAIL TO:
County of San Bernardino
Department of Public Works
825 E. Third Street, Room 117
San Bernardino, CA 92415-0835

SPACE ABOVE THIS LINE FOR RECORDER'S USE

COVENANT AND AGREEMENT REGARDING WATER QUALITY MANAGEMENT PLAN AND STORMWATER BEST MANAGEMENT PRACTICES TRANSFER, ACCESS AND MAINTENANCE

THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING INFORMATION

Covenant and Agreement Regarding Water Quality Management Plan and Stormwater Best Management Practices Transfer, Access and Maintenance

OWNER NAME: ____

PROPERTY ADDRESS: ____

____

APN: ____

THIS AGREEMENT is made and entered into in

______________________________________ ,California, this _________ day of

______________________________________ , by and between

____ , hereinafter

referred to as Owner, and the COUNTY OF SAN BERNARDINO, a political subdivision of the State of California, hereinafter referred to as “the County”;

WHEREAS, the Owner owns real property (“Property”) in the County of San Bernardino, State of California, more specifically described in Exhibit “A” and depicted in Exhibit “B”, each of which exhibits is attached hereto and incorporated herein by this reference; and

WHEREAS, at the time of initial approval of development project known as

____ within the Property described herein, the County required the project to employ Best Management Practices, hereinafter referred to as “BMPs,” to minimize pollutants in urban runoff; and

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, dated ______________________, on file with the County and incorporated herein by this reference, hereinafter referred to as “WQMP”, to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the County; and

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs.

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner shall comply with the WQMP.

2. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.

3. Owner hereby provides the County's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the County Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the BMPs, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 5 below. The County shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a breach of this Agreement and may also be a violation of the County's Pollutant Discharge Elimination System regulations, which on the effective date of this Agreement are found in County Code Sections 35.0101 et seq. If there is reasonable cause to believe that an illicit discharge or breach of this Agreement is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions. Owner recognizes that the County may perform routine and regular inspections, as well as emergency inspections, of the BMPs. Owner or Owner's successors or assigns shall pay County for all costs incurred by County in the inspection, sampling, testing of the BMPs within thirty (30) calendar days of County invoice.

4. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the County, the Owner shall provide the County with documentation identifying the material(s) removed, the quantity, and disposal destination), testing construction or reconstruction.

5. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) business days of being given written notice by the County , the County is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the Property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the County Code from the date of the notice of expense until paid in full. Owner or Owner's successors or assigns shall pay County within thirty (30) calendar days of County invoice.

6. The County may require the owner to post security in form and for a time period satisfactory to the County to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the County may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the surety(ies) to perform the obligations of this Agreement.

7. The County agrees, from time to time, within ten (10) business days after request of Owner, to execute and deliver to Owner, or Owner's designee, an estoppel certificate requested by Owner, stating that this Agreement is in full force and effect, and that Owner is not in default hereunder with regard to any maintenance or payment obligations (or specifying in detail the nature of Owner's default). Owner shall pay all costs and expenses incurred by the County in its investigation of whether to issue an estoppel certificate within thirty (30) calendar days after receipt of a County invoice and prior to the County's issuance of such certificate. Where the County cannot issue an estoppel certificate, Owner shall pay the County within thirty (30) calendar days of receipt of a County invoice.

8. Owner shall not change any BMPs identified in the WQMP without an amendment to this Agreement approved by authorized representatives of both the County and the Owner.

9. County and Owner shall comply with all applicable laws, ordinances, rules, regulations, court orders and government agency orders now or hereinafter in effect in carrying out the terms of this Agreement. If a provision of this Agreement is terminated or held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall remain in full effect.

10. In addition to any remedy available to County under this Agreement, if Owner violates any term of this Agreement and does not cure the violation within the time already provided in this Agreement, or, if not provided, within thirty (30) calendar days, or within such time authorized by the County if said cure reasonably requires more than the subject time, the County may bring an action at law or in equity in a court of competent jurisdiction to enforce compliance by the Owner with the terms of this Agreement. In such action, the County may recover any damages to which the County may be entitled for the violation, enjoin the violation by temporary or permanent injunction without the necessity of proving actual damages or the inadequacy of otherwise available legal remedies, or obtain other equitable relief, including, but not limited to, the restoration of the Property and/or the BMPs identified in the WQMP to the condition in which it/they existed prior to any such violation or injury.

11. This Agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the County, including interest as herein above set forth, subject to foreclosure in event of default in payment.

12. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the County harmless and pay all costs incurred by the County in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

13. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

14. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an

interest in all or part of the Property. Owner shall provide a copy of such notice to the County at the same time such notice is provided to the successor.

15. Time is of the essence in the performance of this Agreement.

16. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

17. Owner agrees to indemnify, defend (with counsel reasonably approved by the County) and hold harmless the County and its authorized officers, employees, agents and volunteers from any and all claims, actions, losses, damages, and/or liability arising out of this Agreement from any cause whatsoever, including the acts, errors or omissions of any person and for any costs or expenses incurred by the County on account of any claim except where such indemnification is prohibited by law. This indemnification provision shall apply regardless of the existence or degree of fault of indemnitees. The Owner's indemnification obligation applies to the County's "active" as well as "passive" negligence but does not apply to the County's "sole negligence" or "willful misconduct" within the meaning of Civil Code Section 2782, or to any claims, actions, losses, damages, and/or liabilities, to the extent caused by the acts or omissions of any third party contractors undertaking any work (other than field inspections) or other maintenance on the Property on behalf of the County under this Agreement..

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

IF TO COUNTY :

Director of Public Works

825 E. Third Street, Room 117

San Bernardino, CA 92415-0835

IF TO OWNER:

____

____

____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Company/Trust:__________________________

Signature: ______________________________

Name: ________________________________

Title: ________________________________

Date: ________________________________

OWNER:

Company/Trust:__________________________

Signature: ______________________________

Name: ________________________________

Title: ________________________________

Date: ________________________________

FOR: Maintenance Agreement, dated __________________________, for the project known as ____________________________________ ____________________________________

(APN)______________________________,

As described in the WQMP dated __________________________________.

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation.

ACCEPTED BY:

____

KEVIN BLAKESLEE, P.E., Director of Public Works

Date: __________________________________

Attachment: Notary Acknowledgement

ATTACHMENT 1
Notary Acknowledgement)

EXHIBIT A

(Legal Description)

EXHIBIT B

(Map/illustration)